KD AUCLAIR & ASSOCIATES, LLC

INDEPENDENT REVIEW OF THE DRAFT TANK CLOSURE AND WASTE MANAGEMENT ENVIRONMENTAL IMPACT STATEMENT

Preliminary Assessment

FINAL, Rev 0
6 March, 2010

2010

Undertaken on behalf of the Hanford Advisory Board & Enviroissues

Contract **#046-007-000;** Task Order DE-AT27-06RV14745

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1 EXECUTIVE SUMMARY

1.1 Background

The external Independent Review Team (IRT) was contracted to conduct an independent review of the analyses of the proposed remediation alternatives presented in the draft Tank Closure and Waste Management Environmental Impact Statement (TC&WM EIS). The IRT provided appropriate subject matter expertise to review the draft EIS and its supporting documentation. The IRTs efforts were conducted over the period of 21 January 2010 through 2 March 2010. This report is the documentation of the IRT effort, observations, conclusions and recommendations. The summary of this report will be presented at the 4 March 2010 HAB meeting, scheduled to be conducted in Richland, Wa.

1.1.1 Scope of Work

The IRT effort focused on the three key aspects of concern and the four evaluation criteria established by the HAB. The aspects of concern were 1) Did the EIS analyses adhere to reasonable standards of practice; 2) Did the EIS analyses adhere to the methodologies and practices as defined in the scope of the EIS, inclusive of Risk; and 3) Did the EIS analyses address or incorporate recommendations from the Hanford Advisory Board.

The four evaluation criteria consisted of transparency of analyses; the consistency and evenhandedness with which the results of the technical analyses of contaminant transport in soils and groundwater are applied in the evaluations of the various remediation alternatives considered in the draft EIS; and whether or not the EIS methodology adequately addressed both risk and cumulative risk . The IRT also examined how well the proposed remediation alternatives comply with the guidance provided by the Board in their Decision Analysis Flowcharts for surface, soil, and groundwater remediation, as well as past relevant advice.

1.1.2 Method and Approach

The IRT completed our efforts in a two-phase approach. The first phase was an analysis and assessment of the fundamental reliability of the EIS analytical basis. The basis for this first phase effort is simply stated that if this analysis ‘engine’ or ‘machine’ is not sound, then any results derived from the same are questionable, thereby calling into question the fundamental basis of the EIS itself. To this end, the IRT conducted an assessment which evaluated the following aspects: Analysis of the process used, Analysis of the data used, and Analysis of the data and risk analysis approach. These analysis were conducted in consideration of the above cited four evaluation criteria.

The second phase of our analysis and assessment evaluated each of the primary treatment alternatives, Tank Waste [Tank Farm] Alternatives, Waste Management Alternatives, and FFTF Alternatives as they relate to the four HAB defined evaluation criteria [Transparency, Consistency and Evenhandedness, Use of a Risk Based Approach inclusive of Cumulative Risk, Considerate of the HAB advice].

1.2 Observations and Conclusions

Relative to the key aspects of concern, the following summary level observations and conclusions are offered:

1.2.1 Did the EIS analyses adhere to reasonable standards of practice

The EIS appears to be sufficient for the purposes of an EIS that evaluates the Tank Farms alternatives, Solid Waste alternatives, and FFTF alternatives, **based on industry and regulatory norms**, in the opinion of the Independent Review Team. It does not however, address all elements set forth for itself, it has internal inconsistencies, and it does not address all offered stakeholder alternatives. These frailties are further addressed in the body of the report.

1.2.2 Did the EIS analyses adhere to the methodologies and practices as defined in the scope of the EIS, inclusive of Risk

However, based on the fact that conservative estimates were made for many of the important parameters in the risk calculations, the uncertainties that were described in the various chapters and appendices, and the lack of documented QA/QC activities, as documented elsewhere in this review, it is the conclusion of the reviewers that this EIS, while satisfying the requirements of an [industry norm] EIS, **is not sufficiently precise to be relied upon for any final decision on a**

"preferred alternative."

Although the Draft EIS paid much attention to providing a **cumulative risk analysis**, and although the details of the components of the analyses were adequate for calculations of risks associated with a given overall alternatives combination, the **overall methodology was flawed**. Of specific note is the matter where there are 99 possible combinations of alternatives that need to be evaluated for cumulative risk. With all the variations given for each of these alternatives, the combinations of the variations become several hundred. In spite of this large variation in possible outcomes, the Draft EIS chose only 3 of the possible combinations to evaluate for cumulative effects. And one of these three was the baseline case of no action for all three areas, Tank Waste, FFTF, and Waste Management. This leaves **only 2 of the possible 98 remaining alternatives** that **were evaluated**.

Further, in consideration of how uncertainties and cumulative risk appear to be handled, the IRT is concerned at the lack of transparency and therefore rigor implied by statements like those found 2-142 (Closure) "The *TC & WM EIS* analyses rely on various modeling approaches to predict the consequences of RPP mission activities that DOE may undertake in the future. Some of these models are complex and rely on assumptions that are subject to a large degree of uncertainty, particularly when trying to predict potential impacts out to 10,000 years. One such uncertainty is how waste moves in the vadose zone and groundwater. The *TC & WM EIS* analyses assume that both the groundwater flow field and infiltration rate will remain constant over 10,000 years, and that the location of the river channel will remain the same over the same period"

In Chapters 4 and 6 of the EIS, discussion and evaluation is for <u>short-term</u> consequences only. Also, note that the last sentence in Section 4.4, in summary, states that for final selection, it might be necessary to evaluate different combinations of the various alternatives. In other words, this is not a complete analysis of the cumulative effects for all the alternatives. Section 6.3 describes, "The long-term cumulative impacts were assumed to occur following the active project phase for each TC & WM EIS alternative and were assessed out to approximately 10,000 years in the future." While for the short-term the Draft EIS states, "For this EIS, short-term cumulative impacts were assumed to occur for up to 188 years (2006 to 2193 under Tank Closure Alternative 2A)." **The cumulative analysis is not adequate.**

Although the groundwater influences of various alternatives for Tank Closure, FFTF decommissioning, and Solid Waste Management are considered in this Draft EIS, **the ongoing decisions concerning the groundwater operable units are not evaluated.** This raises the question of how groundwater remediation will affect the various alternatives by altering the groundwater flow patterns. **The vadose zone and groundwater remediation alternatives have not been considered in this EIS.** This is in spite of the fact that the EIS concludes in it's Summary that "Long-term impact analysis indicates that the largest potential impact on human health may be due to past-practice discharges to cribs and trenches (ditches) and past leaks from SSTs."

The Optimization Strategy for Central Plateau Closure, WMP-18061, Rev. 0, Prepared for the U.S. Department of Energy Assistant Secretary for Environmental Management, Richland, WA, September 2003 evaluated the relative risks from contamination from various sources on the Hanford Site. It was concluded that the BC Cribs and Trenches area had the highest impact on the concentrations of Tc-99 in the groundwater, and, therefore, on the health risk assessments for the Hanford Site. Yet, from what the reviewers have been able to determine, this area has not been explicitly mentioned in the EIS. Nor is it clear how the details of discharges from this area have been developed. Since a major part of the contribution to the risk assessment comes from past discharges and leaks, it would seem that the details of how these sites were handled would be important. It is not clear how any of the past practice releases are handled in this Draft EIS except for those associated with the Tank Farms, Solid Waste Disposal, or FFTF.

1.2.3 Did the EIS analyses address or incorporate recommendations from the Hanford Advisory Board

The alternatives evaluated in the Draft EIS appear to mostly reflect HAB advice, however there are several aspects that may require further HAB action to see them addressed in some fashion. Since the Draft EIS did not address alternatives for groundwater remediation, the full extent of the Groundwater Decision Flowsheet found in HAB advice #197 was not used. It appears that no groundwater remediation decisions were presented in the Draft EIS. It's focus was on decisions for the Tank Farms, Solids Waste Management, and FFTF. The transport analysis presented in Appendix O, however, contained the logic of following the contaminant from the source to potential human exposure, the same as in the Flowsheet. The main features of the Flowsheet that were not addressed in the Draft EIS were the issues of necessary further Site characterization and the deliberate development of new technologies to address groundwater issues. Furthermore, it is not clear what the fundamental assumptions were for the remediation of past practice releases to the groundwater for this EIS. This is particularly relevant to Advice #173 Flowchart. The remediation of past practice waste sites have not been evaluated in this Draft EIS.

1.2.4 Conclusions / Findings:

Given the above there are a number of challenges and opportunities for improvement, and therefore areas for the HAB to evaluate and make recommendations upon. These challenges and opportunities are summarized as Findings in the following section, and described in more detail in the body of the report:

1.2.4.1 The EIS appears to be sufficient for the purposes of an EIS that evaluates the Tank Farms alternatives, Solid Waste alternatives, and FFTF alternatives, based on industry and regulatory norms, in the opinion of the Independent Review Team.

1.2.4.2 There are no apparent adequately referenced and/or documented QA/QC procedures or protocols.

1.2.4.3 Uncertainties are not adequately quantified with specific exceptions further discussed in the body of the report.

1.2.4.4 The EIS did not evaluate cumulative risk in a rigorous way and the overall methodology described is flawed. Specifically, only two of ninety-eight combination of alternatives [plus the base case of no action] were evaluated for cumulative risk.

1.2.4.5 The EIS has insufficient precision to make decisions among the combinations of alternatives.

1.2.4.6 In the context of cumulative risk, this Draft EIS fails to deal with all the remediation options of the Site. In particular, it does not present alternatives for the remediation of past-practice discharges, in spite of the EIS Summary statement that "Long-term impact analysis indicates that the largest potential impact on human health may be due to past-practice discharges to cribs and trenches (ditches) and past leaks from SSTs." It is unclear how the alternatives for these discharges might affect the analysis of the alternatives considered in this EIS for the Tank Farms, Solid Waste, and FFTF.

1.2.4.7 The modeling was deterministic and based on judgment as to what to include or exclude. The modeling did not benefit from a rigorous FEPS process for determining the important parameters.

2 EIS REVIEW

2.1 Introduction

The external Independent Review Team (IRT) was contracted to conduct an independent review of the analyses of the proposed remediation alternatives presented in the draft Tank Closure and Waste Management Environmental Impact Statement (TC&WM EIS). It is the IRT's understanding that this effort will support the Hanford Advisory Board's (Board) commitment to review and advise the Department of Energy (DOE) as to the value and appropriateness of the analyses of the proposed remediation alternatives provided in the TC&WM EIS for selecting the DOE's path forward. The IRT provided appropriate subject matter expertise to review the draft EIS and its supporting documentation, document the findings in a report, and present this report to the Board. This report is the documentation of the IRT effort, observations, conclusions and recommendations.

The IRT effort focused on the transparency of those analyses and on the consistency and evenhandedness with which the results of the very technical analyses of contaminant transport in soils and groundwater are applied in the evaluations of the various remediation alternatives considered in the draft EIS. The IRT also examined how well the proposed remediation alternatives comply with the guidance provided by the Board in their Decision Analysis Flowcharts for surface, soil, and groundwater remediation, as well as past relevant advice.

In summary, the IRT effort focused our independent review to identify:

- Did the EIS analyses adhere to reasonable standards of practice
- Did the EIS analyses adhere to the methodologies and practices as defined in the scope of the EIS, inclusive of Risk
- Did the EIS analyses address or incorporate recommendations from the Hanford Advisory Board.

2.2 IRT Method and Approach

The IRT determined that a structured approach which first evaluated the fundamental reliability of the EIS analytical basis was critical. The need for a sound under pinning, hinged on a documented quality program, and documented approach to how data is qualified and used, is necessary for a successful evaluation of any [remediation] alternative. If this analysis 'engine' or 'machine' is not sound, then any results derived from the same are questionable. To this end, the IRT conducted an assessment which evaluated the following aspects:

- Analysis of the process used
- Analysis of the data used
- Analysis of the data and risk analysis approach

The above bulleted analysis can be found in Sections 2.3.1 – 2.3.3, of this report.

In addition, and consistent with the contracted scope of work, the following key elements for evaluation during this effort were also addressed in order to ascertain adherence to the elements cited in Section 2.1 above:

2.2.1 Transparency

The IRT views "transparency" as a simple litmus test: a technically competent reviewer must be able to understand the draft EIS without recourse to the author. With this in mind, the draft EIS was reviewed to assure that all critical elements are clear, transparent and comprehensive. In other words there is no such thing as "yes, no, or n/a" … there is only "yes, no, or n/a BECAUSE". Our review focused on assessing whether or not the draft EIS provided sufficient / documented basis, documented approach and method, and rationale for each major decision and/or recommendation evaluated by the IRT.

2.2.2 Consistency and evenhandedness in applying the results of the technical analyses of contaminant transport in soils and groundwater to the various remediation alternatives considered in the draft EIS

Critical to assessing the transparency will be how the draft EIS addressed a consistent, evenhanded, documented, and rational approach to key drivers that impact all suggested paths forward. Key to these are the aspects of contaminant transport in soils and groundwater. Of particular importance in the evaluation of the technical analysis of the contaminant transport is to check the rigor of the QA/QC methods employed in the use of the data in the model and other calculations. The new data that were generated during the preparation of the EIS needs to be evaluated for relevancy and consistency with previous data. The characteristics of the solubility and distribution coefficients used to evaluate contaminant migration in both the vadose zone and in the aquifers needs to be specified. The incorporation of the appropriate boundary conditions and the handling of the vadose zone contribution to the groundwater model needs to be evaluated. The coupling of the vadose zone with the groundwater is a very important feature of the modeling because the vadose zone serves as a significant contributor to the future potential contamination of the groundwater. The vadose zone calculations need to receive special scrutiny because it has the potential of being a major source of error. The IRT evaluated the basis, approach, methods, controls, assumptions, and [apparent] configuration management associated with the modeling and data sampling and analysis efforts documented in the draft EIS. These were, in turn, assessed against industry norms for similar criteria.

2.2.3 Use of a risk-based approach

Current industry standards and best practice employ a risk based cost-efficient approach to modeling cleanup of contaminated sites. The technique involves linkage of accepted computer models to form a risk-based remediation (RBR) package that analyzes site remediation via iterative fate and transport modeling. Significant savings have been realized through use of this strategy compared with current practices that are not cost-efficient and are tantamount to over-remediation, while meeting risk-based groundwater criteria at downgradient exposure points. The RBR approach also focuses attention on the questionable cost-benefit value associated with marginal increments in risk reduction. The draft EIS was evaluated for evidence of adequacy, efficacy, and rational to implementation of the application of this RBR strategy, or the lack thereof.

The draft EIS was evaluated for the following three main aspects of risk evaluation methodology: 1. Evaluation of the rigor of the use of the industry standard of establishing the appropriate features, events, and processes (FEPs) for the migration of contaminants to appropriate receptors. 2. Evaluation of how these features, events, and process have been used (through modeling) to calculate the transport of the contaminants to the appropriate receptors. 3. Evaluation of the receptors that were used to estimate the risks, the methodology and values used for receptor dose calculations, and the levels of uncertainty associated with the risk calculations.

2.2.4 Evaluation to determine if evidence exists that the EIS provides an adequate analysis of cumulative risk and mass balance

The flowsheets associated with each of the recommended alternatives in the draft EIS were evaluated for compliance to industry standard practice, realistic evaluation of and basis on the Best Basis Inventory, and the cumulative risks that may be introduced by any given path forward.

The issue of cumulative risk needs special scrutiny because of the combined effects of the chemical and radiological hazards to impact both human and ecological health. The elements and compounds in the contamination cannot be taken as just individual contributors. Their cumulative effects must be taken into account and appropriate calculations made. To this end the IRT reviewed how the EIS addressed the number of possible combinations of alternatives, as well as the degree of rigor and quantitative analysis given the selection criterion for those alternative combinations chosen.

Our effort included an analysis of the data used including: sources, QA/QC employed, comparisons and consistency with other data, and the use and/or acknowledgement of guidance provided by the Board in their Decision Analysis Flowcharts for surface, soil, and groundwater remediation, as well as past relevant advice.

2.2.5 How well the proposed remediation alternatives comply with the guidance provided by the Board in their Decision Analysis Flowcharts for surface, soil, and groundwater remediation, as well as past relevant advice

Each of the key and salient recommendations from the HAB were evaluated for their incorporation and/or address in the draft EIS. Particular attention was paid to those that relate to concerns and recommended paths forward relative to surface, soil, and groundwater remediation as they pertain to the draft EIS elements.

2.3 EIS Review - Methodologies, Practices, and Adherence to Reasonable Standards of Practice

The review process by which the EIS was evaluated for this aspect, was established by the IRT. A set of criteria, which included transparency, consistency and even handedness, evaluation of procedures and software, analysis of data used, QA/QC employed, pathways as per FEP procedure, quantification of risk and cumulative risk, and quantification of uncertainties were established.

The IRT also evaluated the logic of the EIS process used, the data used for input into that process, and the conclusions the EIS reached in the context of these evaluation criteria. In addition, the IRT evaluated each of the alternatives for comparison with previous HAB Advice.

2.3.1 Analysis of the process used

A summary of the EIS process used is summarized in Chapter 1 of the EIS, Section 1.7.1 and reads as follows:

"In creating and modifying the alternatives, emphasis was placed on including all reasonable waste storage, retrieval, treatment, disposal, and tank closure components that could be selected. The goal was to give the public and decision makers sufficient information about each candidate component and allow maximum flexibility in selecting the technologies, methods, time periods, and location of the treatment and closure activities. Developing alternatives that could be selected in their entirety was not a primary goal. Therefore, the alternatives described in this section and evaluated in the balance of the EIS are combinations of the treatment and closure decision options under consideration."

2.3.1.1 Transparency

The transparency of the QA/QC procedures is not evident. No entry for "quality" is even given in the Index. It seems odd that this should be omitted since a primary reason for the effort leading to the current version of this EIS was a detected flaw in the immediately preceding attempt at a Solid Waste EIS by Battelle. The word "quality" was not mentioned once in the entire 449 page Appendix Q on Human Health, Dose, and Risk Analysis. In the entire 93 page Appendix M on Release to Vadose zone, there was only one mention of the word "quality," and it was only in the general context of providing a stepwise procedure. It is believed, however, by these reviewers as a result of observing activities during the preparation of this EIS, that SAIC put much effort into the details of their QA/QC procedures. A separate document is supplied, independent of the actual EIS, which contains a review of the QA issues identified in earlier reports as they pertain to the current EIS. The November 2008 report has the title "Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS) Quality Assurance Follow Up." The report states, "However, the review was limited by insufficient documentation in many areas including modeling development, input/output process controls, and modeling uncertainties." This lack of documentation remains a failing of the current EIS. Additional discussion can be found in Section 2.3.2.2, below.

2.3.1.2 Consistency and Evenhandedness

Contaminant transport analysis in soils and groundwater. There is reasonable basis for concern with regard to questions as to whether there is consistency between previous modeling and current EIS efforts for the Hanford Site. Notwithstanding this concern, there seems to be reasonable consistency with the general requirements of a NEPA driven EIS.

The reason for questioning the consistency with previous modeling of the Hanford Site is the use of MODFLOW for this EIS. Previous modeling efforts at Hanford mainly used a version of CFEST at PNNL for the groundwater flow simulations. STOMP (the PNNL multiphase porous media code) was used in combination with CFEST in previous modeling. Thus, with respect to using the same code for simulating the vadose zone transport, this effort is consistent with past efforts. The advantages of CFEST in previous groundwater modeling at Hanford were that it used adaptable meshing, integrated solute transport, and local refinement of the mesh. From certain statements in the EIS it appears that SAIC used some of the data from PNNL in the construction of their MODFLOW model. It is unclear as to what extent SAIC used all the information available from previous modeling at PNNL, specifically Columbia River water elevations and site water table elevation data from "*Data Package for Hanford Assessments, PNNL-14753, Rev. 1*, Pacific Northwest National Laboratory, Richland, Washington, January 2006, Thorne, P.D., M.P. Bergeron, M.D. Williams, and V.L. Freeman".

In addition, the IRT looked for substantive evidence of consideration of Constituent of Potential Concern (COPC), which are directly affected by the migrational aptitudes associated with solubility and sorption of the analyte of concern. Evidence was neither found described in the body of the EIS, well defined in the Appendices, nor found to be referenced.

Appendix L on Groundwater Flow Field Development, Section L.1 *Introduction*, second paragraph, last sentence states: “Thus, this *TC & WM EIS* balances the dual goals of accuracy and comparability against the available information and the need for timely decision-making.” As a result of the “compromising” approach apparent in the EIS, there were details in the analysis that could be questioned. The larger points include the use of a deterministic set of values for the flow and transport parameters derived from an ad hoc calibration approach, the lack of quantification of uncertainties in the analysis, and the lack of documented QA/QC procedures used for the transport analysis. The conclusion would be that, because of the lack of these and other details, the ability of this Draft EIS to significantly contribute to "timely decision-making" has been greatly reduced.

Tank Closure. References Supporting the Basis of the EIS do not appear to be the most recent nor take advantage of the latest information available for several of the EIS evaluated technology alternatives. Lack, for the most part of references that postdated the TWRS and HSW EIS indicated that if used, signs of update of the TC & WM EIS are not transparent to the reader. The IRT reviewers were surprised, for example, that the cutoff date for this EIS data set was somewhere between 2003-2004 for the TC sections of the document. Indeed, Chapter 1 of the EIS acknowledges “deficiencies” in predecessor EIS documents, which were identified by both Federal and peer review, would be corrected in the TC & WM EIS. To do so, in part, would require using information developed within the DOE Complex.

In many parts of the alternative treatment oriented discussions, based on both EIS Chapter 2 and Appendix E content and references, there is no apparent credit taken for significant progress in the DOE Complex that demonstrated the technical viability or weakness of an alternate supplementary treatment technology. This lack of update in the evaluation of alternatives weaken the even-handedness of the document.

2.3.1.3 Evaluation of procedures and software used

The modeling activities for the EIS were carried out using MODFLOW for the groundwater flow simulations and STOMP (a multiphase porous media transport code developed at PNNL) for the vadose zone modeling. The vadose zone modeling was used in only selected places to simulate the release and transport of hazardous materials at specific locations of potential release of contaminants to the groundwater on the Site. In section L.4.1 of Appendix L, Groundwater Flow Field Development, the EIS states that a constant thickness of each layer in the model across the entire model domain was used in the horizontal direction. The model consisted of 31 layers. The 31 layers span 75 meters (165 – 90 meters amsl). They give no justification for the use of constant thicknesses of the layers. Only two units were used to describe the lithology of the Site (above the basalt layer), the Ringold Formation and the Hanford Formation. Two minor formations, Cold Creek and Plio-Pleistocene (PP) units, are represented in several locations between the Hanford and Ringold formations. A total of 14 material types (including the basalt) were used for these layers. The horizontal gridding was 200 X 200 meters. While the thicknesses of the various layers were varied to accommodate the variations of flow and properties in the vertical direction, they provided for no such variation of spacing in the horizontal direction to accommodate the finer scale property and flow variations in the horizontal direction. They concluded that finer discretization in the vicinity of the Gable Mountain Gap was not necessary (Table L-1), but they did not appear to have analyzed the effects elsewhere of heterogeneity. In Section L.4.2 the EIS states "For the *TC & WM EIS* groundwater flow model, the rivers, subsurface influx, basalt "basement," and natural recharges are taken as constant. The only time-varying fluxes of water across the model boundary are anthropogenic areal recharges." This allows for no seasonal or yearly fluctuations of any of the natural processes. It is not clear if runoff from the Gable Mountain area has been included in the model.

To quote from the Scientific Software Group, "MODFLOW sometimes encounters difficulties or fails to converge in drying/re-wetting situations." This known difficulty has been addressed in the modeling for this EIS in Section L.4.2.1 by "Cells above 115 meters (377 feet) amsl that are encoded as basalt are made active, with a hydraulic conductivity 500 times smaller than that of Hanford and Ringold muds (0.001 meters [0.00328 feet] per day). This active status prevents the MODFLOW cells from drying out during fluctuations of the water table which causes model instabilities (see Section L.5.1.1)." No analysis was given as to the magnitude of the error that was introduced by this artificial construct. Kriging was used in the final Top of Basalt (TOB) determination with the default settings of ArcGIS. It is not stated what the default settings were. The main feature of Kriging as a statistically-based interpolation method is that it gives greater weight to nearer data. This means that at places where there is not much data the error of the interpolation is expected to be greater. No analysis was given as to the resulting accuracy of this interpolation, although the EIS states “Uncertainty estimates were assigned to each TOB elevation value.”

Three fourths of the historical data was used in the calibration of the model. The remaining 25% were used for validation. The EIS states in Section L.6.1 that calibration was not undertaken “outside the active model domain.” It is not clear what subset of the model domain is considered “active.” For the calibration process (Section L.7) the EIS states “The model was first preconditioned by simulating the year 1940 (pre-Hanford) by running the model for 500 years in transient mode without any anthropogenic recharge influxes.” But there had to be some pre-calibrated form of the model that was used in these calculations. The resulting model, therefore, is heavily influenced by the initial conditions based on this 500-year simulation without calibration. There is no indication that a sensitivity analysis was conducted on the influence of the initial conditions. An iterative process whereby the initial conditions based on the first 500-year simulation were followed by further iterations of the initial 500 years based on revised calibration values would have generated more confidence in the overall accuracy of the model. It would still be influenced by the first 500-year simulation, but there would be a chance of correcting inaccuracies in that simulation to produce a better initial condition.

The initial calibration was performed by the Parameter Estimation Module (PEST), but the estimated uncertainties with that software were considered too small. They then went to a probabilistic approach using Monte Carlo simulations. With this approach, they varied each of the values for the 13 conducting material types for approximately 400 model runs. They established criteria for a series of “best realizations” was established. The EIS states “For each data set, the best realizations were chosen according to two criteria. The first criterion was that the RMS value for that realization was among the lowest (at least in the lowest 1 percent). The second criterion was that MODPATH (MODFLOW particle-tracking postprocessing package), particle tracks from sources in the 200-East Area showed reasonable qualitative agreement with the observed shape of the tritium plume originating near the Plutonium-Uranium Extraction (PUREX) Plant in the 200-East Area." These runs then determined the range of values for hydraulic conductivity used in the analysis. It is not clear whether the particle tracking criterion used for determining "best realizations" was sufficiently quantified or broad for the results to be applicable to the entire Hanford Site. It is also not clear to what extent the value ranges chosen were validated. The fourth data set was used for validation and only the statement that was made about how well validated the model was is the following in Section L.9: "Results concluded that the hydraulic conductivity values producing the lowest RMS error using validation data set 4 reasonably correlate to the hydraulic conductivity values that produced the lowest RMS error using calibration data sets 1, 2, and 3." Only 26 model runs were attempted to determine if the calibrations met the criteria for acceptance. This small number of runs raises the question of how well the calibration was documented. The path line illustrations for the particle tracking using the resulting parameters was done only for certain specific runs. It remains unclear what the "average" path would be. The EIS concludes, "Based on the results of this analysis, coupled with the qualitative matching of the Alternate Case flow model tritium plume pathline analysis with the Base Case flow model results, run 195 was selected as the Alternate Case flow model. This means that the alternatives analysis is based on only one deterministic model.

2.3.2 Analysis of the data used

The data used in the Draft EIS was analyzed from several points of view. The reviewers focused on the consistency of the data used and the stated reliability of that data. The reviewers did not review the details of the data that were used in the models and follow the results through to the exposure risk assessments. Most of the specifics for such a detailed analysis were not presented, not even in the appendices. The main areas of focus for the review were evaluations of sources, evaluations of the QA/QC methodology used, and evaluations of how the data compared with other data. These were chosen as areas of focus because changes in data for sources can produce large changes in the outcomes of risk assessments. The reliability of the data needs to be verified through a rigorous QA/QC process. Finally, the data used in the Draft EIS should be consistent with the large body of knowledge about the Site that has been developed over the years.

2.3.2.1 Sources

According to Appendix D, Waste Inventories, Section D.1.1, “The primary sources of information related to tank inventories and past releases are summarized in the *Inventory and Source Term Data Package* (DOE 2003a), which was developed for this *TC & WM EIS*.” For the most current information of the contents of the storage tanks the Best-Basis Inventory (BBI), presented in DOE-ORP-2003-02, Rev. 0, *Inventory and Source Term Data Package* (DOE 2003), was used. The EIS, however, points out that “In addition, the 23 SSTs listed in Table D-1 were not sampled or their historical sample data are unusable. They quote a 1999 report by Simpson, DeFigh-Price, and Banning stating “Sampling is not required (from these tanks) for retrieval and disposal planning purposes.” They further note “Due to these limitations on collected samples, a complete tank inventory cannot be determined based on samples only. Further, limited data are available for some of the key tank closure risk drivers.” This raises considerable doubt about the accuracy of the sources assumed in this EIS.

There is also uncertainty about sources relative to vadose zone sources. In section D.1.5 the EIS states “Because many of the cribs and trenches (ditches) are in close proximity to the SST farms, in some cases it is very difficult to clearly identify contamination sources in the vadose zone or groundwater.” This uncertainty about the release mechanisms for some of the contamination could cause difficulties in accurately assessing the consequences of these releases.

The anticipated inventories for FFTF came from another source. According to Section D.2.1, “The primary documentation prepared in support of the inventories presented in this section is *FFTF Radioactive and Hazardous Materials Inventory* (CEES 2006).” The estimates of the amount of waste that need to be accounted for keep changing (Appendix D2.1.3).

It is assumed (Appendix D.3.1.1) that “no additional offsite TRU or mixed TRU waste would be received at Hanford." If this ever changes, then this EIS would not be adequate to evaluate the environmental impacts of such imported TRU to Hanford.

There are, however, other wastes that are anticipated to be imported to Hanford. According to Appendix D, Section D.3.6, "As part of the Settlement Agreement among the DOE, the Washington State Department of Ecology, and the Washington State Attorney General's Office (*State of Washington v. Bodman,* Civil No. 2:03-cv-05018-AAM, January 6, 2006), this *TC & WM EIS* evaluated the transportation of LLW and MLLW from other DOE sites to Hanford for disposal. The volume of this offsite waste is established in existing stipulations that were agreed upon with the State of Washington, entered as orders of the court in the Settlement Agreement, and recorded in the "Record of Decision for the *Solid Waste Program, Hanford Site, Richland, WA:* Storage and Treatment of Low-Level Waste and Mixed Low-Level Waste; Disposal of Low-Level Waste and Mixed Low-Level Waste, and Storage, Processing, and Certification of Transuranic Waste for Shipment to the Waste Isolation Pilot Plant" (69 FR 39449). The volumes are limited to 62,000 cubic meters (81,100 cubic yards) of LLW and 20,000 cubic meters (26,200 cubic yards) of MLLW. These upper limit volumes were used for analysis purposes only in this *TC & WM EIS*." The main source document (Section D.3.6) for estimating the quantities of these imported contaminants was *Analysis of Offsite-Generated Waste Projections, "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site,"* dated July 13, 2006 (DOE 2006). According to that document, "The information needed for the EIS was not readily available, so efforts were undertaken to use existing corporate information, supplemented by information from DOE waste managers." The document further explains, "In addition to uncertainties in waste volume, the newly collected LLW and MLLW waste data did not include radionuclide or hazardous chemical data needed for EIS modeling." A previous document, *Low-Level Waste Capacity Report*, Revision 2, produced in 2000, was used instead for these estimates.

During operations there will be generation of non-CERCLA, non-tank waste related radiological and chemical waste at Hanford. According to Appendix D, Section D.3.5, "Estimates of the radiological and chemical inventories for the above sources were developed from the Hanford

Solid Waste Integrated Forecast Technical (SWIFT) Report, FY2006–FY2035 database (Barcot 2005). From this source, the volume of LLW and MLLW for the period of 2006 through 2035 was estimated to be approximately 5,300 cubic meters (6,930 cubic yards) (SAIC 2008b)." This waste material comes from several sources including the Plutonium Finishing Plant, the T Plant complex, the Waste Encapsulation and Storage Facility, WRAP, the Waste Sampling and Characterization Facility, groundwater sampling activities, PNNL, the Cold Vacuum Drying Facility, the Canister Storage Building and the Liquid Waste Processing Facility (including LERF, ETF, the State-Approved Land Disposal Site, and the Treatment Effluent Disposal Facility).

The difficulty in predicting these quantities contributes to the uncertainties in the calculations; however, the EIS states that it has taken "conservative" numbers for their estimates. The analytical basis for that estimate, i.e. what defines "conservative", were neither documented in the EIS nor referenced. The unknown level of uncertainty in these "conservative" estimates contributes to overall uncertainty in the results of the EIS.

2.3.2.2 QA/QC employed

The QA/QC followed in the EIS was a direct result of the January 2006 "Report of the Review of the Hanford Solid Waste Environmental Impact (EIS) Data Quality, Control, and Management Issues" and the October 2006 "Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS)," which were both prepared by Randolph T. Kay from the Idaho Operations Office. This Solid Waste review criticized the level of QA/QC of the previous Hanford Site Solid Waste Environmental Impact Statement (HSW-EIS), which was prepared by Battelle for the Richland Operations Office. The report concluded that the Price-Anderson Amendments Act's use as a determining factor for the establishment of a quality assurance program does not comply with requirements found in either 10 CFR 830 nor DOE Order 414.1. The Solid Waste review recommended "Perform an evaluation to determine the significance of the data quality errors identified during this review." As far as we know this evaluation was never made. There were significant deficiencies noted in the Review of

TC&WM quality assurance. The report noted that the Document Control Plans did not reflect requirements of DOE Order 414.1C. They found significant organizational deficiencies. The SAIC Quality Management Plan had not been updated since 2003. The records management process did not adequately control access to or protect the Administrative Record. The Hanford Well Information System (HWIS) was found to be inaccurate. No evidence exists within the EIS itself that QA oversight of the TC&WM EIS activities by the ORP QA group has occurred since their review of the original QA Plan.

In searching the index for the entire EIS for “quality,” no such entry was found. The only section found on the subject of Quality Assurance was a 4-sentence paragraph comprising S.3.2 concerning inventory. It is stated that “an independent quality assurance review was conducted,” but no substantiation of that claim is made. SAIC’s QA management plan was not given in the document.

The latest evaluation of the QA/QC procedures comes from the November 2008 “Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS) Quality Assurance Follow Up.” It focused on issues which were still outstanding from the October 2006 *Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS).* Mainly these fell into the categories of software quality control, QA procedures applied to groundwater, transportation, human health and safety analysis, and other recommendations made in the original report. The documents which were reviewed by the QA/QC review team do not appear to be referenced in the EIS. The conclusion of the review team was “SAIC has the required QA program in place and have fully implemented it since the last review conducted in October 2006. Several minor compliance issues were identified and are described in Section 4.0 below.” It is stated that the team reviewed documentation of groundwater modeling uncertainties. They conclude, “However, the review was limited by insufficient documentation in many areas including model development, input/output process control, and modeling uncertainties.” It is the conclusion of this review that the EIS did not adequately quantify their modeling uncertainties. They, also, did not present sufficient information to determine the adequacy of their QA/QC efforts in the other areas mentioned above, i.e., modeling development and input/output process control.

2.3.2.3 Comparisons and consistency with other data

Groundwater: The reason for questioning the consistency with previous modeling of the Hanford Site is the use of MODFLOW for this EIS. Previous modeling efforts at Hanford mainly used a version of CFEST at PNNL for the groundwater flow simulations. STOMP (the PNNL multiphase porous media code) was used in combination with CFEST in previous modeling. Thus, with respect to using the same code for simulating the vadose zone transport, this effort is consistent with past efforts. The advantages of CFEST in previous groundwater modeling at Hanford were that it used adaptable meshing, integrated solute transport, and local refinement of the mesh. From certain statements in the EIS it appears that SAIC used some of the data from PNNL in the construction of their MODFLOW model. It is unclear as to what extent SAIC used all the information available from previous modeling at PNNL. It is unclear as to what extent SAIC used all the information available from previous modeling at PNNL, specifically Columbia River water elevations and site water table elevation data from "*Data Package for Hanford Assessments, PNNL-14753, Rev. 1*, Pacific Northwest National Laboratory, Richland, Washington, January 2006, Thorne, P.D., M.P. Bergeron, M.D. Williams, and V.L. Freeman".

Tank Closure Alternatives: The EIS does not appear to have updated the input data / data sources for several of the alternative treatment technologies discussed and evaluated, save perhaps some of those associated with the BBI and MODFLOW models. Information salient to the alternatives under review do not appear to take into account updates from across the complex [i.e. there is no documented evidence to that effect]. Specifically and notably apparent are updates to the technical viability or weakness of Steam Reforming where work has been done at the Idaho National Laboratory and Savannah River Site, as well as Bulk Vitrification where significant work was completed here at the Hanford Site.

2.3.2.4 Accuracy:

The IRT conducted a simple test to assess the accuracy of the EIS. We conducted a spot-check of 6 pages in the beginning of Chapter 2. Chapter 2 was chosen due to a simple error noted on page 43 during our review. Having noted the error [second bullet below] we checked a few pages in either direction. In the short span of these few pages we found the following errors:

- On page 40, chapter 2, section 2.3.1.1, "from grade level (elevation 158 meters [550 feet])" is not correct. 158 meters is 518 feet.
- On page 43, chapter 2, section 2.3.3.1, "with a radius of about 391 meters (128.5 feet)" is not correct. 391 meters is 1,283 feet.
- On page 43, chapter 2, section 2.3.3.1, "minimum thickness of about 1.7 meters (5.7 feet)" is not correct to the digits given. 1.7 meters is 5.6 feet to the digits given.
- On page 45, chapter, section 2.3.3.2.2, "dimensions of 22 meters by 29 meters (72 feet by 94 feet)" is not correct to the digits given. 29 meters is 95 feet to the digits given.

Such simple errors cast needless doubt on the credibility of the EIS if they are but simple editorial errors and not carried through into the calculations themselves. Should these errors actually carry into the calculations, serious concerns arise as to the fidelity of the work and derived actions. The IRT was surprised to find such a high number of errors of this sort in such a short section of the EIS, and these found in having used such a simple observational test. A test, we might add, that we would assume to have been conducted during the production of the report as a simple matter of QA of the results. This does not instill confidence in the accuracy of the EIS.

2.3.3 Analysis of the data and risk analysis approach

The risk analysis approach was analyzed for its consistency with accepted practice, the pathways by which the contaminants could reach receptors, and the values used for assessing health effects based on concentrations and exposure method. Although the data that was used for the risk analysis were checked for consistency with previously published data, no models similar to those used in the EIS calculations were run by the IRT. It falls to the QA/QC employed by the EIS to assure that the models used the data appropriately. Unfortunately, no documented paper trail nor linkage could for the QA/QC used in the preparation of the EIS could be found within the EIS or its appendices.

2.3.3.1 Pathways as per FEPs procedures

The Organisation for Economic Co-operation and Development (OECD) states in their publication *Features, Events, and Processes (FEPs) for Geologic Disposal of Radioactive Waste (August 2000),* "Safety assessments of disposal sites for radioactive waste involve analyses of potential releases of radionuclides from the disposed waste and subsequent transport to the human environment. An important stage of assessment is the identification and documentation of all the features, events and processes (FEPs) that may be relevant to long-term safety. This activity provides a basis for the selection of the FEPs that should be included in quantitative analyses, and developing the scenarios that should be evaluated." The full Features, Events, and Processes (FEPs) methodology was not employed for this EIS. A peer-reviewed FEPs methodology for the Hanford Site has been published in the Journal *Stochastic Environmental Research and Risk Assessment*. The title is *A Comprehensive and Systematic Approach to Developing and Documenting Conceptual Models of Contaminant Release and Migration at the Hanford Site,* *Volume 18, Number 2 / April, 2004*. The abstract states, "The U. S. Department of Energy's Richland Operations Office has initiated efforts to adapt and implement the features, events, and processes (FEP) methodology used in scenario development for nuclear waste disposal programs to the environmental management and remediation problems facing the Hanford site. These efforts have shown that modification of the FEPs methodology to incorporate the use of process relationship diagrams (PRD) is effective in facilitating the development of conceptual models and selection of potentially relevant factors (i.e., FEPs) to be incorporated into a specific environmental assessment." From what could be determined during our limited review, the IRT concludes that the modeling was found to be deterministic and based on (undocumented) judgment as to what to include or exclude. The modeling did not benefit from a rigorous FEPS process for determining the important parameters.

2.3.3.2 Quantification of risk

The draft EIS was evaluated for documented evidence of the following three main aspects of risk evaluation methodology:

1. Evaluation of the rigor of the use of the/an industry standard for establishing the appropriate features, events, and processes [FEPs] for the migration of contaminants to appropriate
receptors.

2. Evaluation of how these features, events, and process have been used (through modeling) to calculate the transport of the contaminants to the appropriate receptors.

3. Evaluation of the receptors that were used to estimate the risks, the methodology and values used for receptor dose calculations, and the levels of uncertainty associated with the risk calculations.

In addition, the issue of cumulative risk was given special scrutiny because of the *potential* for combined effects of the chemical and radiological hazards to impact both human and environmental health.

The team could not find any concerted and documented attempt to address *the propagation of* uncertainties between the various parts of the EIS important to analyzing long term consequences during our review of: Chapter 2 - Proposed Actions and Alternatives; Chapter 5 Long-Term Environmental Consequences; Chapter 6 Cumulative Impacts; and Chapter 7 Environmental Consequences Discussion. In addition checks of the appendices associated with these EIS chapters (e.g., Chapters 2, 5, 6, Appendix E, etc.) did not change our observations.

It should be noted however, in Appendix D (Tank Waste Inventory) relative to the BBI and other data on source terms, the analysis efforts appeared to met our expectations for risk ‘analysis’, i.e. an effort that went beyond itemizing hazards. Both the use of various statistical methods to evaluate inventory uncertainty and a good discussion of how and why values for release were selected and justified for use in consequence assessments (by scenario alternative) appeared to be well done based on the limited time we had to explore the technical details.

2.3.3.3 Uncertainties

“Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS) Quality Assurance Follow Up” found that the “Groundwater modeling uncertainties are not yet sufficiently documented.” Appendix L Introduction states “This TC & WM EIS acknowledges uncertainty and incompleteness in the data and, where the uncertainty is significant or a major factor in understanding the impacts, explains how the uncertainty affects the analysis.” In Section L.1.1 the EIS states “An evaluation and discussion of the effects of uncertainties and gaps in input data (e.g., spatial distribution of well borings across the study area), modeling assumptions (e.g., conceptualizing the top of basalt as a no-flow boundary), and numerical error (e.g., head and water balance residuals) must be provided.” No apparent evidence could be found by the IRT to validate that this had, in fact, been done.

In Section L.1.2 the EIS states “Similarly, numerous calculations were performed to evaluate the sensitivity of the simulated flow field to uncertainties in input parameters.” This was not done in the general way this statement suggests. This appendix describes the results where the calculations suggested that the groundwater flow field was sensitive to changes in input parameters; other calculations are included in separate project documentation. In Section L.1.2 it states “This appendix describes the results where the calculations suggested that the groundwater flow field was sensitive to changes in input parameters.” Section L.2 is dedicated to some variations in the modeling to reach some conclusions about uncertainty. It seems, though, that only two different flow fields were evaluated to reflect uncertainty in the top of the basalt surface in the Gable Mountain—Gable Butte area (Appendix O). The issue of how the groundwater flows through this Gap has not yet been resolved. In this section (Appendix O) the only attempt that was made in the EIS to illustrate how uncertainties in the parameters used could affect the outcome of the EIS was the comparison of those two general flow fields; specifically the flows through the Gable Mountain Gap. Only one other item was selected for a type of uncertainty analysis, the flux for technetium-99 from the BY and TY Crib Areas. A Monte Carlo simulation was conducted using only 100 runs of only 500 years simulated with random distributions representing + or – 50% of the Base Case flux as alternatives. Even with this relatively small perturbation in Base Case of only one item, they conclude “These results suggest that variations of source strength on the order of 50 percent would result in large variations in large variations in the near field (at the barriers surrounding the sources)." They do not state whether 50% is a reasonable assumption for the amount of variation in the flux histories predicted by STOMP. It should be noted that this analysis did not begin with variations in the transport parameters themselves, but only used the artificially varied fluxes of technetium-99 at these locations. Also, these simulations were not carried out over the longer period of 10,000 years considered in other parts of the EIS; only 500 years as a demonstration. No other quantifications of results of uncertainty in the modeling could be found.

In consideration of the above, the IRT is concerned at the lack of transparency and therefore rigor implied by statements like those found in 2-142 (Closure) "The *TC & WM EIS* analyses rely on various modeling approaches to predict the consequences of RPP mission activities that DOE may undertake in the future. Some of these models are complex and rely on assumptions that are subject to a large degree of uncertainty, particularly when trying to predict potential impacts out to 10,000 years. One such uncertainty is how waste moves in the vadose zone and groundwater. The *TC & WM EIS* analyses assume that both the groundwater flow field and infiltration rate will remain constant over 10,000 years, and that the location of the river channel will remain the same over the same period."

Due to the uncertainties in the source terms, discussed above, there is considerable question of how these uncertainties affect the outcome of the EIS. Relative to the tank volumes Appendix D, Section D.1.1.4 states "Because of the difficulty in determining the extent of phase volumes and in measuring volume, values of RSD (Relative Standard Deviation) values for volume were based on quantitative and *qualitative* information." The italics represent our emphasis.

In summary, while the EIS acknowledges many sources of uncertainties, it fails to quantify the magnitudes of the consequences of these uncertainties across each element of the analysis or cumulative risk.

3 ANALYSIS OF THE EIS ALTERNATIVES

3.1 Overview of Alternatives Selection and Analysis

The Draft EIS states in the Summary, "Ecology understands that the selection of a smaller number of preferred alternatives, or of a specific preferred alternative from that set, will be considered by DOE throughout public review of the Draft TC & WM EIS. When the final EIS is prepared, a preferred alternative will be identified by DOE." It concludes, "Ecology will update this foreword in the Final TC & WM EIS and will express its agreement or disagreement with DOE's preferred alternative for specific decisions in the foreword." Based on the fact that conservative estimates were made for many of the important parameters in the risk calculations, the uncertainties that were described in the various chapters and appendices, and the lack of documented QA/QC activities, as documented elsewhere in this review, it is the conclusion of the reviewers that this EIS, while satisfying the general programmatic requirements of a NEPA based EIS effort, is not sufficiently precise to be relied upon for any final decision on a combination of "preferred alternatives."

Although the Draft EIS paid much attention to providing a cumulative risk analysis, and although the details of the components of the analyses were adequate for calculations of risks associated with a given overall alternatives combination, the overall methodology was flawed. With 11 alternatives for Tank Farm Closure, 3 alternatives for Waste Management, and 3 alternatives for FFTF, there are 99 possible combinations of alternatives that need to be evaluated for cumulative risk. With all the variations given for each of these alternatives, the combinations of the variations become several hundred. In spite of this large variation in possible outcomes, the Draft EIS chose only 3 of the possible combinations to evaluate for cumulative effects. And one of these three was the baseline case of no action for all three areas, Tank Waste, FFTF, and Waste Management. This leaves only two of the possible 98 remaining alternatives that were evaluated.

Chapter 6 on Cumulative Impacts describes in section 6.1 the methodology. It states, "As described in Chapter 4, Section 4.4, several hundred impacts scenarios could result from the potential combinations of the 11 Tank Closure, 3 Fast Flux Test Facility (FFTF) Decommissioning, and 3 Waste Management alternatives when factored with their associated option cases and waste disposal groups. For purposes of cumulative impact analysis, three combinations of alternatives were chosen to represent key points along the range of actions and associated overall impacts that could result from full implementation of the three sets of proposed actions. Alternative Combination 1 represents the potential short-term impacts resulting from minimal DOE action and the greatest long-term impacts with respect to groundwater." As described in Chapter 4, Combination 1 is the combination of no action for all three areas.

Chapter 4 is the chapter describing the evaluation of short-term impacts. In the realization that looking at the impacts of all possible combinations of the alternatives produced a large number of possibilities, the EIS analyzed the various combinations for short-term risk and chose to evaluate only three (one of which was no action) combinations for determining what the short-term cumulative impacts would be. Notice that these combinations were taken to be representative of various ranges of impacts for the <u>short-term</u> analysis, not the long-term. This selection, based on short-term analysis, was carried forward to Chapter 6 for the entire EIS (including long-term) determination of cumulative risk.

Section 4.4 on Combination of Alternatives states, "Several hundred impacts scenarios could result from the potential combinations of the 11 Tank Closure, 3 FFTF Decommissioning, and 3 Waste Management alternatives when factored with their associated option cases and waste disposal groups. For purposes of analysis, the following combinations of alternatives were chosen to represent key points along the range of actions and associated overall impacts that could result from full implementation of the three sets of proposed actions:

- Combination 1: all No Action Alternatives

- Combination 2: Tank Closure Alternative 2B (Expanded WTP Vitrification; Landfill

Closure), FFTF Decommissioning Alternative 2 (Entombment) with the Idaho Option for disposition of RH-SCs and the Hanford Reuse Option for disposition of bulk sodium, and Waste Management Alternative 2 (Disposal in IDF, 200-East Area Only) with Disposal Group 1

• Combination 3: Tank Closure Alternative 6B, Base Case (All Vitrification with Separations; Clean Closure); FFTF Decommissioning Alternative 3 (Removal) with the Idaho Option for disposition of RH-SCs and the Hanford Reuse Option for disposition of bulk sodium, and Waste Management Alternative 2 (Disposal in IDF, 200-East Area Only) with Disposal Group 2.

Alternative Combination 1 represents the potential short-term impacts resulting from minimal DOE action and the greatest long-term impact with respect to groundwater. Alternative Combination 2 is a midrange case representative of DOE’s Preferred Alternative(s), as addressed in Chapter 2, Section 2.12. Alternative Combination 3 reflects the most conservative estimate of impacts for most resource areas in terms of the intensity of the potential impact and therefore represents, on the whole, a combination that would result in maximum potential short-term impacts, but would likely have the lowest long-term impacts on groundwater. For some resource areas, a combination that includes Alternative 6A, Option Case, would result in maximum short-term impacts. Selection of these three alternative combinations for detailed analysis in this EIS is done only to establish overall impact-level reference cases for stakeholders and decisionmakers to consider, and does not preclude the selection and implementation of different combinations of the various alternatives in support of final agency decisions."

Note that the above discussion and evaluation is for <u>short-term</u> consequences only. Also, note that the last sentence states that for final selection, it might be necessary to evaluate different combinations of the various alternatives. In other words, this is not a complete analysis of the cumulative effects for all the alternatives. Section 6.3 describes, "The long-term cumulative impacts were assumed to occur following the active project phase for each TC & WM EIS alternative and were assessed out to approximately 10,000 years in the future." While for the short-term the Draft EIS states, "For this EIS, short-term cumulative impacts were assumed to occur for up to 188 years (2006 to 2193 under Tank Closure Alternative 2A)." In summary, the cumulative analysis is not adequate.

None of the alternatives addresses the issue of future technology development as part of the remediation goals. None of the alternatives focuses on additional characterization for implementation. Finally, none of the alternatives and methods, as described, recognizes nor takes advantage of improvement in technology, nor improvement in sampling and data analysis method, that have occurred on the Site and within the DOE Complex, since the time of the data set used in this EIS. The EIS, however, recognizes some characterization uncertainties, as well as some technology uncertainties. These characterization uncertainties affect the risk calculations, while the technology uncertainties mainly concern the treatment of the Tank Farm wastes. Characterization and technology development are recurring themes in several statements of HAB advice.

Although the groundwater influences of various alternatives for Tank Closure, FFTF decommissioning, and Solid Waste Management are considered in this Draft EIS, the ongoing decisions concerning the groundwater operable units are not evaluated. This raises the question of how groundwater remediation will affect the various alternatives by altering the groundwater flow patterns. The vadose zone and groundwater remediation alternatives have not been considered in this EIS. This is in spite of the fact that the report concludes in the Summary that “Long-term impact analysis indicates that the largest potential impact on human health may be due to past-practice discharges to cribs and trenches (ditches) and past leaks from SSTs.” Alternatives for dealing with these past-practice discharges have not been presented. This would seem not to be in agreement with HAB advice #132, which states “Groundwater remediation must be an integral part of source term remediation.”

3.2 Tank Farm Alternatives

3.2.1 Description Tank Closure Alt 1: No Action

Tank Waste Storage: DOE would continue to store and monitor waste in the SSTs and DSTs for 100 years. Tanks showing signs of deterioration affecting their structural integrity would be filled with grout or gravel as a corrective action or emergency response. The cesium and strontium capsules would remain in storage in the WESF.

Retrieval: Waste from the tanks would not be retrieved. Treatment: No vitrification or treatment capacity would be built after 2008. The existing WTP construction would be terminated, and the WTP site would be isolated pending some future use, if any. No ILAW or IHLW would be produced.

Disposal: The waste in the SST and DST systems would remain in the tank farm indefinitely.

Closure: Tank closure would not be addressed under this alternative. DOE would maintain security and management of the site for a 100-year administrative control period (ending in 2107). During this period, DOE would continue to store and conduct routine monitoring of the waste in the SSTs, DSTs, and miscellaneous underground storage tanks.

3.2.2 Implement the *Tank Waste Remediation System EIS* Record of Decision with Modifications

3.2.2.1 Tank Closure Alternative 2A: Existing WTP Vitrification; No Closure

Tank Waste Storage — Continue current waste management operations using existing tank storage facilities. Replace DSTs in a phased manner through 2054 [Alt 2A] because they will all exceed their 40-year design life during the period of waste retrieval. Under Tank Closure Alternative 2B: DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new WRFs, which are below-grade lag storage and minimal waste treatment facilities, would be constructed.

Tank Waste Retrieval — Using currently available liquid-based waste retrieval and leak detection systems, waste would be retrieved to the TPA minimum goal, i.e., residual waste would not exceed 10.2 cubic meters (360 cubic feet) for 100-series tanks or 0.85 cubic meters (30 cubic feet) for the smaller 200-series tanks, corresponding to 99 percent retrieval

Tank Waste Treatment — Treatment Under Tank Closure Alternative 2A: The existing WTP configuration (two HLW melters and two LAW melters) would operate at a theoretical maximum capacity (TMC) of 6 metric tons of glass IHLW per day and 30 metric tons of glass ILAW per day. Treatment would start in 2018, and both HLW and LAW treatment would end in 2093. All the waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur. For analysis purposes, it was assumed that the WTP would need to be replaced after 60 years. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Treatment Under Tank Closure Alternative 2B: The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of four LAW melters) to provide a vitrification TMC of 6 metric tons of glass IHLW per day and 90 metric tons of glass ILAW per day. Treatment would start in 2018 and end in approximately 2040 (for HLW) and 2043 (for LAW). All the waste streams routed to the WTP would be pretreated, including technetium-99 removal from the LAW stream. No facilities would need to be replaced. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Tank Farm Disposal — LAW immobilized via the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented

This option seems to not support HAB advice #214 in part because the SSTs are not closed and the Tc-99 stays on site. The lack of closure of the SSTs would mean that HAB advice #132 would be less likely to be met because of more institutional controls over longer periods

of time limiting human occupation of the Site.

3.2.2.2 __Tank Closure Alternative 2B:__ Expanded WTP Vitrification; Landfill Closure

Tank Waste Storage — Continue current waste management operations using existing tank storage facilities. Replace DSTs in a phased manner through 2054 [Alt 2A] because they will all exceed their 40-year design life during the period of waste retrieval. Under Tank Closure Alternative 2B: DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new WRFs, which are below-grade lag storage and minimal waste treatment facilities, would be constructed.

Tank Waste Retrieval — Using currently available liquid-based waste retrieval and leak detection systems, waste would be retrieved to the TPA minimum goal, i.e., residual waste would not exceed 10.2 cubic meters (360 cubic feet) for 100-series tanks or 0.85 cubic meters (30 cubic feet) for the smaller 200-series tanks, corresponding to 99 percent retrieval

Tank Waste Treatment — Treatment Under Tank Closure Alternative 2A: The existing WTP configuration (two HLW melters and two LAW melters) would operate at a theoretical maximum capacity (TMC) of 6 metric tons of glass IHLW per day and 30 metric tons of glass ILAW per day. Treatment would start in 2018, and both HLW and LAW treatment would end in 2093. All the waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur. For analysis purposes, it was assumed that the WTP would need to be replaced after 60 years. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Treatment Under Tank Closure Alternative 2B: The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of four LAW melters) to provide a vitrification TMC of 6 metric tons of glass IHLW per day and 90 metric tons of glass ILAW per day. Treatment would start in 2018 and end in approximately 2040 (for HLW) and 2043 (for LAW). All the waste streams routed to the WTP would be pretreated, including technetium-99 removal from the LAW stream. No facilities would need to be replaced. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Tank Farm Disposal — LAW immobilized via the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented

This option seems to support HAB advice #214 better in part because Tc-99 is removed in the pretreatment process to the WTP and incorporated into the glass for shipment off-site. Of the two options under alternative #2, 2B also seems to support HAB advice #197 better because it would have less Tc-99 left on site to eventually contaminate the groundwater.

3.2.2.3 Tank Closure Alt 3A-C : Existing WTP Vitrification with Supplemental Treatment Technology; Landfill Closure:

Tank Waste Storage — DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new WRFs would be constructed.

Tank Waste Retrieval — Using currently available liquid-based waste retrieval and leak detection systems, waste would be retrieved to the TPA minimum goal, i.e., residual waste would not exceed 10.2 cubic meters (360 cubic feet) for 100-series tanks or 0.85 cubic meters (30 cubic feet) for the smaller 200-series tanks, corresponding to 99 percent retrieval.

Tank Waste Treatment — The existing WTP configuration (two HLW melters and two LAW melters) would operate at a TMC of 6 metric tons of glass IHLW per day and 30 metric tons of glass ILAW per day. Treatment would start in 2018, and both HLW and LAW treatment would end in approximately 2040. All waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur as part of WTP pretreatment.

- WTP capacity would be supplemented with **(3A)** bulk vitrification treatment capacity to immobilize a portion of the LAW. Bulk vitrification supplemental treatment of the LAW would occur in both the 200-East and 200-West Areas. In the 200-East Area, the waste feed would be pretreated in the WTP, excluding technetium-99 removal. In the 200-West Area, the waste feed would be pretreated in a new Solid-Liquid Separations Facility.

- WTP capacity would be supplemented with (3B) cast stone treatment capacity to immobilize a portion of the LAW. Cast stone supplemental treatment of the LAW would occur in both the 200-East and 200-West Areas. In the 200-East Area, the waste feed would be pretreated in the WTP, including technetium-99 removal. In the 200-West Area, pretreated in a new Solid-Liquid Separations Facility.
- WTP capacity would be supplemented (3C) with steam reforming treatment capacity to immobilize a portion of the LAW. The steam reforming supplemental treatment for the LAW would occur in both the 200-East and 200-West Areas. In the 200-East Area, the waste feed would be pretreated in the WTP, excluding technetium-99 removal. In the 200-West Area, the waste feed would be pretreated in a new Solid-Liquid Separations Facility.

A separate portion of the tank waste (approximately 11.8 million liters [3.1 million gallons]) for all alternatives would be designated as mixed TRU waste and treated and packaged for disposal at WIPP The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Tank Waste Disposal — LAW immobilized via both the WTP and external to the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented. Mixed TRU waste would be stored on site in a new storage facility pending disposal at WIPP.

Tank Farm Closure — As operations are completed, the SST system at Hanford would be closed as an RCRA hazardous waste landfill unit under WAC 173-303, “Dangerous Waste Regulations,” and DOE Order 435.1, as applicable, or decommissioned under DOE Order 430.1B. The tanks and ancillary equipment would be filled with grout to immobilize the residual waste, prevent future tank subsidence, and discourage intruder access. Soil would be removed down to 4.6 meters (15 feet) for the BX and SX tank farms and replaced with clean soils from onsite sources. The removed contaminated soils and ancillary equipment would be disposed of on site in the RPPDF, a new facility similar to an IDF. The closed tank systems and six sets of adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. Postclosure care would continue for 100 years.

HAB advice on greater homogeneity of glass forms (#214) seems better served by these options. Also, the TRU waste is shipped off site.

Further comments regarding HAB advice support, for each of Alternatives 3A – 3C, are cited below in Sections 3.2.2.4 through 3.2.2.6.

3.2.2.4 Tank Closure Alt 3A : Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure

All storage forms are glass, which would help support HAB advice #197 because of less mobile state of the waste form.

3.2.2.5 Tank Closure Alt 3B : Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure

Cast stone, which stays on Site, might be viewed as less supportive of HAB advice #197 because it is seen as being more leachable than glass.

3.2.2.6 Tank Closure Alt 3C : Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure

Steam reforming instead of vitrification could be viewed as less protective of the groundwater in the long term. This would agree less with HAB advice #197 than the other options.

3.2.3 ***Tank Closure Alt 4:*** Existing WTP Vitrification with Supplemental Treatment

Technologies; Selective Clean Closure/Landfill Closure

Tank Waste Storage — DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new WRFs would be constructed

Tank Waste Retrieval — Using currently available liquid-based retrieval and leak detection systems along with a final chemical wash step, waste would be retrieved to a volume corresponding to 99.9 percent retrieval, equal to residual tank waste of no more than 1 cubic meter (36 cubic feet) for 100-series tanks or 0.08 cubic meters (3 cubic feet) for the smaller 200-series tanks.

Tank Waste Treatment — The existing WTP configuration (two HLW melters and two LAW melters) would operate at a TMC of 6 metric tons of glass IHLW per day and 30 metric tons of glass ILAW per day. Treatment would start in 2018, and both HLW and LAW treatment would end in approximately 2043, include treating the highly contaminated waste stream resulting from clean closure of the BX and SX tank farms. All waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur as part of WTP pretreatment. WTP capacity would be supplemented with additional waste treatment capacity to immobilize a portion of the LAW. Supplemental treatment of the LAW would occur in both the 200-East and 200-West Areas and consist of a combination of cast stone treatment capacity in the 200-East Area and bulk vitrification treatment capacity in the 200-West Area. The waste stream feed for the 200-East Area cast stone supplemental treatment facility would be pretreated in the WTP, excluding technetium-99 removal. In the 200-West Area, the waste feed would be pretreated in a new Solid-Liquid Separations Facility.

A separate portion of the tank waste (approximately 11.8 million liters [3.1 million gallons]) would be designated as mixed TRU waste and packaged for disposal at WIPP. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Tank Waste Disposal — LAW immobilized via both the WTP and external to the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented. Mixed TRU waste would be packaged and stored on site in an existing or new storage facility pending disposal at WIPP.

Tank Farm Closure — As operations are completed, the SST system at Hanford, except the BX and SX tank farms, would be closed as an RCRA hazardous waste landfill unit under WAC 173-303, "Dangerous Waste Regulations," and DOE Order 435.1, as applicable, or decommissioned under DOE Order 430.1B. The tanks and ancillary equipment would be filled with grout to immobilize the residual waste, prevent long-term degradation of the tanks, and discourage intruder access. The closed tank systems, except the BX and SX tank farms, and six sets of adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. Postclosure care would continue for 100 years. The BX and SX tank farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. The removed tanks, ancillary equipment, and soils would be treated, as appropriate, in the Preprocessing Facility (PPF), a new facility, resulting in MLLW and a highly contaminated liquid waste stream. The MLLW would be disposed of on site, and the highly contaminated liquid waste stream would be processed as HLW in the WTP, resulting in additional IHLW. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. Highly contaminated soils from deep soil excavation would be treated in the PPF. This process would generate a contaminated liquid waste stream that would be processed as LAW in the WTP, resulting in additional ILAW. The washed soils would be disposed of in the RPPDF, a new facility similar to an IDF. The BX and SX tank farms would be backfilled with clean soil.

Some of the tanks are clean closed, which better supports HAB advice #132 to encourage greater areas of possible human use of the Site. Also, retrieval of 99.9% of the waste would mean less in place and contribute to better alignment with HAB advice #197 for protection of the groundwater.

3.2.4 ***Tank Closure Alt 5:*** Expanded WTP Vitrification with Supplemental Treatment

Technologies; Landfill Closure

Tank Waste Storage — DOE would continue current waste management operations using existing tank storage facilities. Four new DSTs and four WRFs would be constructed.

Tank Waste Retrieval — Using currently available liquid-based retrieval and leak detection systems, waste would be retrieved to a volume corresponding to 90 percent retrieval, less than the TPA Milestone M-45-00 minimum goal of 99 percent. Retrieval to 90 percent represents a programmatic risk analysis process for the tank farms as defined by Appendix H of the TPA, "Single Shell Tank Waste Retrieval Criteria Procedure." The 90 percent retrieval level would be equal to residual tank waste of no more than 102 cubic meters (3,600 cubic feet) for 100-series tanks or 8.5 cubic meters (300 cubic feet) for the smaller 200-series tanks.

Tank Waste Treatment — The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of one LAW melter) to provide a vitrification TMC of 6 metric tons of glass IHLW per day and 45 metric tons of glass ILAW per day. All waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur as part of WTP pretreatment. Treatment would start in 2018 and end in approximately 2034.

This alternative considers implementation of a sulfate removal technology following WTP pretreatment that would potentially reduce the amount of glass produced in the WTP by increasing the waste loading in the ILAW glass.

WTP capacity would be supplemented with additional waste treatment capacity to immobilize a portion of the LAW. Supplemental treatment of the LAW would occur in both the 200-East and 200-West Areas and consist of a combination of cast stone treatment capacity in the 200-East Area and bulk vitrification treatment capacity in the 200-West Area. The waste stream feed for the 200-East Area cast stone supplemental treatment facility would be pretreated in the WTP, excluding technetium-99 removal. In the 200-West Area, the waste feed would be pretreated in a new Solid-Liquid Separations Facility.

A separate portion of the tank waste (approximately 11.8 million liters [3.1 million gallons]) would be designated as mixed TRU waste and packaged for disposal at WIPP. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Tank Waste Disposal — LAW immobilized both via the WTP and external to the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented. Mixed TRU waste would be packaged and stored on site in a new storage facility pending disposal at WIPP.

Tank Farm Closure — As operations are completed, the SST system would be closed as an RCRA hazardous waste landfill unit under WAC 173-303, "Dangerous Waste Regulations," and DOE Order 435.1, or decommissioned under DOE Order 430.1B. The tanks and ancillary equipment would be filled with grout to immobilize the residual waste, prevent long-term degradation of the tanks, and discourage intruder access. Tank systems (tanks, ancillary equipment, and soils) and the six sets of adjacent cribs and trenches (ditches) would be closed in place and covered with the Hanford barrier (a barrier with performance characteristics that exceed RCRA requirements for disposal of hazardous waste). To support this schedule, SST system ancillary equipment outside the boundaries of the surface barriers would not be removed or decontaminated. Postclosure care would continue for 100 years.

Only retrieves 90% of the waste from the tanks, which goes against all previous HAB advice on amount to retrieve from the tanks.

3.2.5 ***Tank Closure Alt 6A-C:*** All Waste as Vitrified HLW

Tank Waste Storage —Storage Under Tank Closure Alternative 6A: DOE would continue current waste management operations using existing tank storage facilities that would be modified as needed to support SST waste retrieval and treatment. New DSTs would be required after the existing DSTs reach the end of their design life.

Storage Under Tank Closure Alternatives 6B and 6C: DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new WRFs would be constructed.

Tank Waste Retrieval — Retrieval Under Tank Closure Alternatives 6A and 6B**:** Using currently available liquid-based retrieval and leak detection systems along with a final chemical wash step, waste would be retrieved to a volume corresponding to 99.9 percent retrieval, equal to residual tank waste of no more than 1 cubic meter (36 cubic feet) for 100-series tanks or 0.08 cubic meters (3 cubic feet) for the smaller 200-series tanks.

Retrieval Under Tank Closure Alternative 6C**:** Using currently available liquid-based waste retrieval and leak detection systems, waste would be retrieved to the TPA minimum goal, i.e., residual waste would not exceed 10.2 cubic meters (360 cubic feet) for 100-series tanks or 0.85 cubic meters (30 cubic feet) for the smaller 200-series tanks, corresponding to 99 percent retrieval.

Tank Waste Treatment — Treatment Under Tank Closure Alternative 6A: The existing WTP configuration would be modified to process all waste as HLW through expanded HLW vitrification capacity. This new WTP configuration (five HLW melters and no LAW melters) would provide a total vitrification TMC of 15 metric tons of glass IHLW per day. Treatment would start in 2018 and end in approximately 2163, requiring two WTP replacement facilities due to design-life constraints. There would be no pretreatment, LAW treatment, or technetium-99 removal. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Treatment Under Tank Closure Alternatives 6B and 6C: The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of four LAW melters) to provide a vitrification TMC of 6 metric tons of glass IHLW per day and 90 metric tons of glass ILAW per day. Treatment would start in 2018 and end in approximately 2040 (for HLW) and 2043 (for LAW). All waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur as part of WTP pretreatment. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Tank Waste Disposal — Disposal Under Tank Closure Alternative 6A**:** IHLW canisters would be stored on site until disposition decisions are made and implemented. Replacement of the canister storage facilities would be required after a 60-year design life. The HLW debris from clean closure would be managed as HLW and stored on site.

Disposal Under Tank Closure Alternatives 6B and 6C: IHLW canisters would be stored on site until disposition decisions are made and implemented. ILAW glass canisters would be managed as HLW and stored on site. Under Alternative 6B, HLW debris from clean closure would be managed as HLW and stored on site.

Tank Farm Closure — Closure Under Tank Closure Alternatives 6A and 6B**:** These alternatives analyze clean closure of all twelve 200-East and 200-West Area SST farms following deactivation. Clean closure of the tank farms would involve removal of all tanks, associated ancillary equipment, and contaminated soil to a depth of 3 meters (10 feet) directly beneath the tank base. These materials would be packaged as HLW for onsite storage in shielded boxes. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. The new PPF would process the highly contaminated deep soil to render it acceptable for onsite disposal. The liquid waste stream from the PPF soil washing would be thermally treated in the PPF and disposed of on site in an IDF. The washed soils would be disposed of in the RPPDF, a new facility similar to an IDF. Clean closure of the SST system would preclude the need for post-closure care. The six sets of adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier (Base Cases). Optional clean closure of these cribs and trenches (ditches) would occur under the Option Cases.

Closure Under Tank Closure Alternative 6C**:** As operations are completed, the SST system would be closed as an RCRA hazardous waste landfill unit under WAC 173-303, “Dangerous Waste Regulations,” and under DOE Order 435.1, or decommissioned under DOE Order 430.1B. The tanks would be filled with grout to immobilize the residual waste, prevent long-term degradation of the tanks, and discourage intruder access. Soil would be removed down to 4.6 meters (15 feet) for the BX and SX tank farms and replaced with clean soils from onsite sources. The removed contaminated soils and ancillary equipment would be disposed of on site in the RPPDF, a new facility similar to an IDF. The closed tank systems and the six sets of adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. Postclosure care would continue for 100 years.

Further comments regarding HAB advice support, for each of Alternatives 6A – 6C, are cited below in Sections 3.2.5.1 through 3.2.5.3.

3.2.5.1 All Vitrification/No Separations; Clean Closure (Base and Option Cases)

All waste being treated to form IHLW means that there could be less homogeneity in the resulting glass waste forms. This supports HAB advice #214 less than the others, which provide segregation pathways. However, it supports #214 by providing clean closure for the tanks, thus giving a smaller footprint to residual contaminants. It also provides for removal of 99.9% of tank waste.

3.2.5.2 All Vitrification with Separations; Clean Closure (Base and Option Cases)

Segregation of waste types provides for possibly more homogeneous glass forms, in support of HAB advice #214. It also provides for removal of 99.9% of tank waste.

3.2.5.3 All Vitrification with Separations; Landfill Closure

Same as 6B above except 99% of the waste is removed from the tanks.

3.3 Waste Management Alternatives

Waste Management alternatives evaluated in this *TC & WM EIS* address the expansion of waste disposal capacity at Hanford to provide for the disposal of on- and offsite waste, thus to facilitate the cleanup of Hanford and other DOE sites. The major mission components include onsite storage and disposal of Hanford-generated and other sites' LLW and MLLW; onsite storage of Hanford-generated TRU waste; and eventual closure of the waste facilities.

3.3.1 Waste Management Alternative 1: No Action

Storage: LLW and MLLW would be stored at the CWC until processed for disposal in trenches 31 and 34 in low-level radioactive waste burial ground (LLBG) 218-W-5. TRU waste would be stored at the CWC and disposed of in WIPP. Processing of waste prior to disposal would continue to occur at existing facilities at the CWC, Waste Receiving and Processing Facility (WRAP), and T Plant. No offsite LLW, MLLW, or TRU waste would be received.

Disposal: LLW and MLLW would be disposed of in LLBG 218-W-5, trenches 31 and 34, through 2035. TRU waste would be disposed of in WIPP. Further construction at IDF-East would be discontinued in 2008, and the IDF site would be deactivated.

Closure: Administrative control would be implemented for 100 years.

Complies with HAB advice #133, which recommends full cost of imported waste must be recovered, in that there is no importation of waste from other sites.

3.3.2 ***Waste Management Alternative 2:*** Disposal in one IDF, 200-East Area Only

Storage: LLW, MLLW, and TRU waste would be stored at the CWC until processed for disposal. Processing of waste prior to disposal would occur at existing and expanding facilities at the CWC, WRAP, and T Plant. No offsite TRU waste would be received. Offsite LLW and MLLW would be received from other DOE sites. A total volume of 62,000 cubic meters (81,000 cubic yards) of LLW and 20,000 cubic meters (26,000 cubic yards) of MLLW was assumed to be received, as identified in the Settlement Agreement for waste disposal at Hanford.

Disposal: LLBG 218-W-5, trenches 31 and 34, would continue to operate through 2050. Construction, operations, deactivation, closure, and post-closure care would take place at IDF-East. Waste from tank treatment operations, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-East. Waste from tank farm cleanup operations would be disposed of in the RPPDF. TRU waste would be disposed of in WIPP.

Closure: Disposal facilities would be covered with engineered modified RCRA Subtitle C barriers. Post closure care would continue for 100 years.

The cost of imported waste seems to have been somewhat accounted for (HAB advice #133) because the imported waste has to be treated before being imported to the Hanford Site. The previous HSW-EIS did not account these costs.

3.3.3 ***Waste Management Alternative 3:*** Disposal in two IDFs, 200-East and 200-West Areas

Storage: LLW, MLLW, and TRU waste would be stored at the CWC until processed for disposal. Processing of waste prior to disposal would occur at existing and expanding facilities at the CWC, WRAP, and T Plant. No offsite TRU waste would be received. Offsite LLW and MLLW would be received from other DOE sites. A total volume of 62,000 cubic meters (81,000 cubic yards) of LLW and 20,000 cubic meters (26,000 cubic yards) of MLLW was assumed to be received.

Disposal: LLBG 218-W-5, trenches 31 and 34, would continue to operate through 2050. Construction, operations, deactivation, closure, and post closure care would take place at IDF-East and IDF-West. Waste from onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-West. Waste from tank waste treatment operations would be disposed of in IDF-East. Waste from tank farm cleanup operations would be disposed of in the RPPDF. TRU waste would be disposed of in WIPP.

Closure: Disposal facilities would be covered with engineered modified RCRA Subtitle C barriers. Postclosure care would continue for 100 years.

The cost of imported waste seems to have been somewhat accounted for (HAB advice #133) because the imported waste has to be treated before being imported to the Hanford Site. The previous HSW-EIS did not account these costs.

3.4 FFTF Alternatives

The NOI for the "FFTF Decommissioning EIS" (69 FR 50176) identified the three alternatives listed below.

In general, since FFTF is not on the Central Plateau, HAB advice #173 and its accompanying flow chart does not apply.

3.4.1 FFTF Decommissioning Alternative 1: No Action

As stated in the EIS, CEQ NEPA regulations (40 CFR 1500–1508) and DOE NEPA regulations (10 CFR 1021) require analysis of a "no action" alternative. The FFTF Decommissioning No Action Alternative includes completion of actions in accordance with previous DOE NEPA decisions. Final decommissioning of FFTF would not occur.

Specifically, only deactivation activities for the FFTF complex and support buildings, as described in the Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington (DOE 2006b), would be conducted.

Deactivation activities would include removal and packaging of the RH-SCs for storage in the 400 Area, as described in the FONSI dated March 31, 2006. The FFTF Reactor Containment

Building (RCB) (Building 405) and the rest of the buildings within the 400 Area Property Protected Area (PPA) would be maintained through 2107 (for 100 years after the TC & WM EIS ROD is published) under administrative controls such as site security and management. After 2107, administrative controls would cease and the remaining waste is assumed to become available for release to the environment.

With regard to the disposition of the sodium, this option satisfies the HAB advice #214 to keep large amounts of sodium out of WTF. It does not agree with HAB advice #214 with respect to minimizing the area of contamination. It does not agree with advice #197 for remove, treat, and dispose as preferred option.

3.4.2 FFTF Decommissioning Alternative 2: Entombment

Facility Disposition. The Entombment Alternative consists of removing all aboveground structures within the 400 Area PPA and minimal removal of below-grade structures, equipment, and materials as required to comply with regulatory standards. The RCB would be demolished and removed to grade, and auxiliary facilities would be removed to 0.91 meters (3 feet) below grade. Equipment, piping, and components containing hazardous and radioactive materials would be removed from below-grade structures only as needed for treatment to meet regulatory requirements. Any other necessary treatment of equipment or components would occur in place without removal from the facilities. After treatment, some of the components could be returned to below-grade spaces and grouted in place with the remaining structures and equipment to stabilize them and minimize void space. Most other equipment and materials removed from the facilities would be disposed of in the 200 Areas. An RCRA-compliant barrier would be constructed over the remains of the RCB and any other remaining below-grade structures (including the reactor vessel) that contain residual radioactive and treated hazardous materials. Equipment to be removed under this alternative includes the RH-SCs, which contain sufficient quantities of metallic sodium and radionuclides that they could not be treated and entombed in the RCB with the remaining materials.

Disposition of Remote-Handled Special Components. The RH-SCs consist of four large filter assemblies designed to remove radionuclides and other contaminants from the FFTF sodium coolant systems and the inert-cover gas systems. These components would require treatment to drain and stabilize residual metallic sodium prior to disposal, and they would contain sufficient quantities of radionuclides to require remote handling. Removal and storage of the RH-SCs in the 400 Area are covered in the FONSI dated March 31, 2006 (DOE 2006b). It would be necessary to treat these components in a specialized facility that is equipped to handle hazardous reactive materials and components with high radiological dose rates. Such a facility does not currently exist within the DOE waste management complex; however, most other waste generated during facility decommissioning could be managed using existing or proposed capabilities. Therefore, DOE needs to decide on an approach for treating and disposing of the FFTF RH-SCs. The two options discussed below are being considered for managing these components.

Hanford Option. The RH-SCs would be shipped to an onsite treatment facility. The capability to treat these components does not currently exist at Hanford, nor has such a capability been previously proposed, although construction of a facility to treat RH- and oversized MLLW or TRU waste was evaluated in a previous NEPA review (DOE 2004a). Following treatment, the components and residuals would be disposed of with other Hanford waste in the 200 Areas. DOE is considering this option for management of the FFTF RH-SCs in response to scoping comments that recommended minimizing offsite transportation of these components and treatment residuals.

Idaho Option. The RH-SCs would be shipped to the proposed RTP at the MFC at INL. The proposed RTP would treat remote-handled components containing comparable levels of radiological materials, as well as metallic sodium. An EA is being prepared at INL to evaluate this proposed treatment (DOE 2009a). Following treatment at the RTP, the FFTF components and residuals would be disposed of with other INL waste at an offsite facility, or they could be returned to Hanford for disposal. DOE is considering this option for the FFTF RH-SCs to utilize the existing sodium management expertise at the MFC and to consolidate waste management activities within the DOE complex at existing or proposed facilities.

Disposition of Bulk Sodium. The Hanford radioactive bulk sodium inventory consists of approximately 1.1 million liters (300,000 gallons) of metallic sodium, including sodium from the Hallam Reactor and the Sodium Reactor Experiment (SRE), in addition to sodium drained from the FFTF cooling systems during deactivation. Hallam and SRE sodium are currently stored in the Hanford 200-West Area Central Waste Complex (CWC). Sodium from FFTF is stored in the 400 Area within the RCB or adjacent storage facilities. The current DOE plan for this sodium is to convert it to a caustic for product reuse by ORP for the WTP. The two options discussed below are being considered for managing the Hanford radioactive bulk sodium inventory.

- Hanford Reuse Option. The bulk sodium would be stored in its current locations until it is shipped to an onsite facility for processing to a caustic (sodium hydroxide). The capability to process the bulk sodium does not currently exist at Hanford. The treated sodium (caustic) would be transferred to the 200-East Area for product reuse by ORP for the WTP. DOE is considering this option for processing the Hanford bulk sodium inventory in response to scoping comments that recommended minimizing the need for offsite transportation of the bulk sodium and caustic.

Idaho Reuse Option. The bulk sodium would be stored in its current locations until it is shipped to the MFC for processing. The capability to process bulk metallic sodium currently exists at the MFC SPF, which previously has been used to process metallic sodium from the Experimental Breeder Reactor II (EBR-II) and other facilities. Following processing, the caustic would be returned to Hanford for use in the WTP. DOE is considering this option for processing the Hanford bulk sodium inventory to utilize existing sodium management expertise and facilities at the MFC.

This option has several ways of converting sodium, but it ends up in WTF, which does not agree with HAB advice #214. This alternative anticipates an engineered barrier, which does

not agree with HAB advice #174 to use engineered barriers as last resorts.

3.4.3 FFTF Decommissioning Alternative 3: Removal

Facility Disposition. The Removal Alternative consists of removing all above-grade structures within the 400 Area PPA, as well as contaminated below-grade structures, equipment, and materials. The RCB would be demolished and removed to grade, and all auxiliary facilities would be removed to 0.91 meters (3 feet) below grade. Most equipment, piping, and components containing chemically hazardous and radioactive materials, including the reactor vessel, lead shielding, depleted uranium shielding, and asbestos, would be removed from below-grade structures. Most equipment and materials removed from the facilities would be disposed of in the 200 Areas. The remaining structures and equipment, consisting mainly of the external RCB structure and associated components, as well as uncontaminated below-grade portions of auxiliary facilities, would be backfilled or grouted to minimize void space. The PPA would be backfilled to grade, contoured, and revegetated as necessary to stabilize the ground surface or to prepare the site for future industrial use.

Disposition of Remote-Handled Special Components. The two options being considered under FFTF Decommissioning Alternative 2 are the *same* options being considered under FFTF Decommissioning Alternative 3 for disposition of the RH-SCs.

Disposition of Bulk Sodium. The two reuse options being considered under FFTF Decommissioning Alternative 2 are the *same* options being considered under FFTF Decommissioning Alternative 3 for the disposition of the bulk sodium.

This option considers the same ways of converting sodium, but it ends up in WTF, which does not agree with HAB advice #214. HAB advice #132, which recommends encouragement of human presence on the Site, seems to best served by this option.

3.5 SUMMARY OF HAB ADVICE TO DOE – IRT REVIEW AND OBSERVATION / COMMENTS

General Observations and Overview of our analysis: For the most part the HAB recommendations were sufficiently broad and general in nature that they could not be allocated to applying to an individual alternative. In addition, where the HAB advice differs from regulatory requirements, the later dominated the selection of distinct EIS alternatives. We have identified such conflicts between regulation and the HAB recommendations when they were recognized. However, where a piece of advice was applicable to groups or the entire set of EIS alternatives, we have acknowledged that and described how well the advice was reflected in the EIS.

Overall and for the most part, the HAB advice did not appear to be uniquely applicable to many of the *individual* alternatives. As has been noted earlier in this report, the advice rather was more broadly associated with the general scope of remediation decisions than the analysis of given alternatives that faced the authors of the EIS. Indeed a number of items of HAB advice, as identified in the IRT's SOW, were no longer relevant to the draft EIS we reviewed. These pertained to:

- Complying with all regulatory requirements including CERCLA, RCRA, NEPA, DOE Orders, and the Nuclear Waste Policy Act as amended.
- Addressing, where practical, stake holder recommendations,
- Working with that required scope of exposure scenarios as defined in the NEPA process
- Advice on specific remediation alternatives to be evaluated, such as Advice #180 on BC cribs, Focused Feasibility Study, and Proposed Plan.

In addition, the IRT did find that the HAB advice did not appear to clearly distinguish between the more limited scope/purpose of the EIS process (NEPA) and the more specific, and at times more detailed, RCRA/CERCLA permitting and closure process. Indeed, there was no mention in the HAB advices of working with the Performance Assessments published by DOE associated with long terms effects [e.g., ILAW] despite what appeared to be a PA's relevance to HAB concerns.

The narratives below contain analysis to tie the contents of the EIS to the given list of HAB advice. Some advice was no longer relevant to the scope of the EIS, as presented, and was not further assessed [Note: [1]]

The IRT added Advice #185 to our list of items evaluated because it not only served as an excellent compendium of HAB concerns, but also detailed the response of the Washington Department of Ecology (WDOE) to those concerns.

The HAB has expressed concern regarding consistency and evenhandedness on the part of DOE throughout several HAB Advice notices [e.g. 173, 185, 197, 214, etc.]. The IRT comments regarding those aspects are reflected elsewhere in this report.

The IRT, in our similar review of HAB Advice as we conducted on the EIS, is left with the impression of similar bias in a number of their Advice Letters, over time. The connotation left with the IRT, having read the entirety of the HAB Advice, is one in which there is specific inclination for specific treatment alternatives on the part of the HAB.

Footnote [1] Outdated HAB Advice Related Notes:

1. Advice Item #166, U Plant Closure Plan, was out of scope of the EIS.
2. Advice item #180, 200 BC Cribs Focused Feasibility Study and Proposed Plan is implicitly covered as part of Tank closure options. It is NOT treated separately in the TC alternatives.
3. Contains detailed feedback from WDOE, which present an alternative viewpoint on the HAB advice. Feedback is based both on regulatory focus/limitations and State of WA priorities.
4. Advice regarding the Public Comment Period Considerations for the TC & WM EIS was no longer relevant as comment review periods are set by law.

Number / Date / Title

215 / Feb 2009 / Surface Storage of Vitrified High Level Waste (life cycle analysis of various on Site storage options)

Page 76 of Appendix D states "The figures in the following section reflect the assumption that IHLW would be disposed of off site (however, this IHLW would be stored on site until disposition decisions are made and implemented). As indicated in the Administration's fiscal year 2010 budget request, the Administration intends to terminate the Yucca Mountain program while developing nuclear waste disposal alternatives. Notwithstanding the decision to terminate the Yucca Mountain program, DOE remains committed to meeting its obligations to manage and ultimately dispose of HLW and SNF. The Administration intends to convene a blue ribbon commission to evaluate alternative approaches for meeting these objectives. The commission will provide the opportunity for a meaningful dialogue on how best to address this challenging issue and will provide recommendations that will form the basis for working with Congress to revise the statutory framework for managing and disposing of HLW and SNF." This means that the possibility that IHLW will remain on Site for a long period of time has not been evaluated in this Draft EIS.

With the advent of the closure of the Yucca Mountain disposal alternative for HLW, this issue becomes important to assure interim safe storage of such waste. Comparably this holds true for TRU and ILAW waste, which are not specifically addressed in the Advice. In general, there are alternatives proposed in the EIS that deal with alternative HLW onsite storage.

With the advent of the closure of the Yucca Mountain disposal alternative for HLW, this issue becomes important to assure interim safe storage of such was. Comparably this holds true for TRU and ILAW waste, which are not specifically addressed in the Advice.

However, the issue of the closing of the Yucca Mountain disposal alternative is being litigated and rightfully the EIS assumes it will not be a disposal alternative unless judged otherwise. In addition, the President's Blue Ribbon committee to assess long tern options for disposal or other alternative for HLW has just begun. And its recommendations are a year away.

214 / Feb 2009 / System Criteria to Guide Selection of Optimum Paths for Treating Hanford Wastes (tank farm focus on tank farm waste treatment and storage: Advice to focus on Tc-99 and I-129 as major drivers of risk and major issue for isolation, take systems approach to brainstorming on ways to accelerate tank farm waste processing and closure, take an integrated approach to closure to achieve efficiencies, invest in technology development rather than accept current less effective technology, abide by legal requirements; emphasize long term deep geological repository solutions, emphasize alternatives that produce more homogeneous glass logs, apply resources early to reduce risks, shrink the footprint of the Site, and reduce sodium in the waste.)

Overall, this HAB advice provides appropriate and mostly relevant, guidance to EIS development related to aspects of tank waste retrieval, treatment, storage and where relevant to onsite disposal.

The EIS authors have acknowledged the shareholder and legal criteria, to be a part of the analysis to the degree they apply to a NEPA constrained analysis. Some elements of this Advice would more readily apply to permitting and closure associated with a proposed action, then the analysis of alternatives in this EIS.

In its present draft form, the documented EIS alternatives provide a broad span of alternatives, some of which will likely fulfill the letter and perhaps the spirit of the NEPA regulations, State of WA cleanup requirements, and the desires of other stakeholders.

197 / June 2007 / Groundwater Values, and Attachment (Groundwater values: highest beneficial use, reasonable time frame, full funding of groundwater remediation, continued technology development, the public and tribes consulted on alternatives, institutional controls not acceptable for contaminated plumes; remove, treat, and dispose preferred alternative. Flow chart: Further characterize where needed, develop new technologies as part of remediation effort,

The HAB advice is more focused on the RCRA/CERCLA permitting and closure process than the more limited, but general, scope of the (NEPA driven) EIS process.

The issues raised in #197 are broader than just tank farms related items, and are discussed by the IRT in our discussion of the {long-term} cumulative effects

185 / April / 2006 Tank Closure and Waste Management Environmental Impact Statement. This contains a combination of general comments on the scope of the EIS. This is accompanied by a set of detailed and specific comments associated with (1) actions, alternatives and impacts for all Hanford waste sites; (2) infrastructure; (3) compliance with TPA, EPA requirements and State requirements; (4) quality assurance; and (5) all known and reasonably foreseeable impacts to groundwater. This advice also contains very detailed feedback to the HAB by the WDOE, in part agreeing and in part disagreeing with the HAB suggestions. A Combined DOE (ORP and RL) and Washington Department of Ecology response to the general comment was also provided. The combination of the three documents provided the IRT with a broad insight of the affected agencies positions and basis, with respect to the TC & WM EIS.

This advice, although not listed in the IRT's statement of work was deemed important since it deals with the transparency, recording of the QA process, records keeping, and overall data and modeling assessments that underlie the EIS.

It also deals with:

- ***A needed assessment of a wide range of alternatives,***
- ***Need for necessary and sufficient data to achieve the actions listed by an alternative,***
- ***Completeness and transparency of dealing with cumulative impacts, and more.***

We believe that the contents of the EIS, in general, contain and represent a good-faith effort to respond to the HAB and associated WDOE concerns.

However, in other parts of our review documentation, we have identified areas where such explicit analyses was either not transparent, appeared incomplete, or fell short of meeting promises to use risk based analyses. [e.g., Topic One and Topic 4]

Most of the items in advice #185 [e.g., Topic Two, Topic Three] have been assessed during the IRT review, and are discussed, if relevant, elsewhere in this report. [2]

180 / Nov 2005 / 200 BC Cribs Focused Feasibility Study and Proposed Plan (Evaluate Best Available Technologies [BAT], favor removal rather than just cover, analyze worker dose, integrate for long-term stewardship, and analyze better the failure of institutional controls.)

The BC Cribs were not an explicit part of this EIS. Only the cribs, trenches and ditches associated closely with the Tank Farms, Solid Waste Disposal operations, or FFTF were included in the analysis.

[2] The letter report divided the specific HAB feedback sub-criteria in numbered topic areas focused on: (Topic One) Actions, alternatives and impacts for all Hanford Waste sites; (Topic Two) Infrastructure; {Topic Three) Compliance with TPA, EPA requirements and State requirements; (Topic Four) Quality Assurance; (Topic Five) All known and reasonably foreseeable impacts to water.

174 / June 2005 / Considerations for Barrier Applications (engineered barriers as a last resort, engineered barriers not a permanent solution, for short life-time contaminants engineered barriers could be used, provide monitoring to detect contaminant migration early, provide public review process, barrier failure should be planned for, DOE should maintain long-term stewardship of barriers, and close monitoring of performance.)

Barriers are planned to be used extensively for all remediation actions anticipated in this EIS. These are planned to be more than the "temporary" barriers recommended by HAB advice #174. The attributes of barriers over the period analyzed by this EIS are given in Section M.2 of Appendix M. This includes the prescribed values to take for infiltration through these barriers (Table M-2) from the "Technical Guidance Document for Tank Closure Environmental Impact Statement, Vadose Zone and Groundwater Revised Analyses (Technical Guidance Document) (DOE 2005)."

This advice deals with the broader then the EIS scope issues of adequate characterization. It also expresses a HAB preference to clean closure as opposed to the use of engineered barriers.

From an IRT perspective, the characterization aspects of the tank inventory appear adequate to the EIS purpose. Their limitations are for the most part well defined in Appendix D. It is also true, but not acknowledged in either the EIS or this HAB advice, that extensive characterization of retrieved materials will occur before the waste is transferred to the WTP or to supplemental treatment. The weakest link, relative to characterization, remains the analysis (composition, solubility and toxicity…) of the residual heels in a SST; an item that is dealt with by using a volume surrogate for residuals and bulk general solids characteristics for the waste itself.

With respect to clean closure, the alternative is clearly driven by some stakeholder values. However, the purpose of the EIS is to explore all reasonable alternatives. Relative to Tank Farm Closure, the EIS covers the range of possibilities appropriate to Hanford. The down select process described in the EIS and Appendices clearly ruled out those technologies that

seem too immature or others too risky to use as alternatives. In terms of NEPA requirements, in the opinion of the IRT, the EIS has treated barrier related concerns, except where risk methodology and QA are soft, in an appropriate manner.

173 / April 2005 / Central Plateau Values, and Attachment (Path for remove, treat, and dispose, with side options for further technology development, further characterization, and investigation of in situ treatment)

The EIS appears to be generally consistent with CERCLA guidance meeting the HAB's intent. However, a number of aspects of the HAB's flowsheet were not addressed in the EIS. Namely, no clear argument was made to the respond to the question of "whether it was appropriate to invest time and money for in situ treatment, considering the risk".

It is the IRT's observation that, based on the EIS identified DOE screening process, the selection of the most likely candidates for exploration appeared both technically and operationally reasonable. This remains true despite IRT concerns that the alternatives that use supplementary treatment were neither treated "transparently" nor in an "evenhanded" manner. The main issues for the Central Plateau is that the remediation alternatives of past practice waste sites are not covered in this Draft EIS.

166 / Sept 2004 / U Plant Closure Plan (encourages proceeding with U-plant closure as a good learning exercise.)

The closure of U-Plant is not within the scope of the TC & WM EIS.

164 / June 2004 / Tank Closure EIS Alternatives (Alternatives should be in compliance with TPA agreements, in particular meeting the 2028 deadline for retrieving and treating all tank waste.) Note: This TPA agreement has been superceded by a new agreement in August 2009.

This item appears to concentrate on TPA revised milestones. As such it is not specifically applicable to the broader scope of the TC & WM EIS. Overall the EIS acknowledges the TPA, as one factor in meeting its purpose. However since, among other factors, meeting the TPA milestones depends upon funding allocated by Congress, the schedule analyzed by this Draft EIS is one that is taken as a "given".

133 / July 2002 / Hanford Solid Waste Environmental Impact Statement (Finds that the HSW-EIS was inadequate and requests it be withdrawn; that EIS assumed that previous PEIS was acceptable for Hanford to receive off-Site LLW and MLLW waste, which was not accepted by the HAB; integrate all waste management options for cumulative assessment, that HSW-EIS was insufficient to support DOE proposed decisions, 22 specific failures in the analysis were noted, upgrade GW monitoring and establish vadose zone monitoring near burial grounds, and imported waste costs must be recovered.)

A critical driver to the current Draft TW & WM EIS addressing the acknowledged deficiencies in its predecessor, the Hanford Solid Waste [HSW] EIS, as well as addressing the combined shortfalls when also considering the predecessor Tank Waste Retrieval System [TWRS] EIS. The TC & WM EIS acknowledges the existence of these shortfalls. However, in many instances this Draft EIS does not adequately deal with them to the IRTs satisfaction. Specifically, documentation of the QA/QC process is missing. These areas of shortfall are reported in the body of this report.

132 / June 2002 / Exposure Scenarios Task Force on the 200 Area (Continuing long-term human presence in the core zone is desirable, groundwater remediation must be integral part of source term remediation, groundwater must be usable outside the waste management units' points of compliance, focus on planning now for long-term stewardship, risk analysis should include maximum exposure scenarios, need continuing refinement of ability to make accurate risk measurements, and values in previous Site Uses recommendations should be followed.)

The degree to which exposure scenarios' task force recommendations are reflected in the overall EIS is discussed in previous sections of our report.

4 CONCLUSIONS

In closing, the IRT offers the following conclusions for the HAB to consider in its deliberations and formulation of its next round of Advice to the DOE.

1. The general methodology of the EIS was consistent with the regulatory requirements of an EIS and served to evaluate the protectiveness of the various closure alternatives at the Hanford Site. As a further comment about QA/QC, the reports on the evaluations of their QA/QC said they had to meet DOE Order 414.1.C requirements. It is not documented that they did so. So there is a possible deficiency with regard to meeting QA/QC requirements set out by DOE itself.

2. This EIS was a result of less than satisfactory QA/QC carried out in the previous Solid Waste EIS. As such, it would have been expected that the QA/QC efforts of this EIS would have been documented. They were not documented in the EIS. A review team's report of the QA/QC procedures for this EIS appeared in November 2008 and is separate from the EIS, but no final QA/QC report seems to have been produced. {Sections 2.2.2, 2.2.4, 2.3.1.1, 2.3.2.2}

3. The modeling for the EIS seems to have been marginally satisfactory, even in consideration that some inherent limitations of MODFLOW were noted. The vadose zone models were rigorous, but they used the saturated values from the calibration of MODFLOW as a starting point and coupled their independent calculations through source term boundary conditions to MODFLOW. The approach to deciding which features, events, or processes (FEPs) were important in developing the model did not take advantage of the accepted FEPs process for nuclear waste. As noted in the *Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS) Quality Assurance Follow Up*, the QA/QC for the modeling was not sufficiently documented as of November 2008. It should be noted that this perspective is

only for the prima fascia description of the models within the EIS. No analysis of the technical details nor independent model runs were conducted by the IRT during this review due to time constraints. {Sections 2.2.3, 2.3.1.1, 2.3.1.2, mainly 2.3.1.4, 2.3.2.2, 2.3.2.3, 2.3.3.1, 2.3.3.2, 2.3.3.3}

4. The risk calculations performed were of a deterministic nature. This results, as described in Appendix L, from the use of flow parameters in the flow modeling being based on those from only one of the runs. The limitations of the modeling prevented a more rigorous probabilistic risk approach taking into account the uncertainties in the modeling. As a result a conservative approach was taken to the risk evaluations. The risk from the CERCLA sites turned out to be more significant than earlier believed in comparison to the risks from the Tank Farm waste. {Sections 2.2.3, 2.2.4, 2.3.3, 2.3.2.1, 2.4.1.3}

5. Although the EIS purports to attempt to quantify uncertainties, they were not able to do so in a rigorous way. The EIS dealt with only two uncertainties for the groundwater flow, one was providing two alternative flow scenarios through the Gable Mountain Gap, and the other was a demonstration of the effect of uncertainty of the flux for technetium-99 from the BY and TY Crib Areas. These uncertainties were judged to result "in large variations in the near field." The Best Basis Inventory (BBI) contains more rigorous evaluations of uncertainty. The level of uncertainty presented in the BBI is likely sufficient to evaluate tank inventory uncertainties. {Sections 2.2.3, 2.3.1.1, 2.3.1.4, 2.3.2.1, 2.3.2.2, 2.3.3.2, mainly 2.3.3.3 on Uncertainty}

6. Most of the HAB's advice has been covered in the draft EIS. The most outstanding continuing issue is that of [further] characterization. The EIS does not make recommendations about further characterization. Although the EIS could clearly benefit from better characterization, they were tasked with providing the best calculations that could be made with the data available during the time frame of the production of the EIS. Also, as noted above, the EIS produced the evaluation based on technologies currently available or anticipated to be available by the time it was needed. They did not provide a mechanism for deciding where new technologies needed to be developed. {Section 2.4 and 2.5.2}

7. The EIS does not appear to have updated the input data / data sources for, save those associated with the BBI and MODFLOW models. Information salient to the alternatives under review do not appear to [there is no documented evidence that] take into account updates from across the complex [e.g. saltstone, etc.].

8. The analysis of cumulative risk was insufficiently rigorous. Only 2 of 98 alternative combinations [plus the baseline use of "no action"] were evaluated. No quantitative analysis was presented as to the sufficiency of these two isolated combinations. There was no apparent attempt at treating all alternatives in an evenhanded manner in the evaluation of cumulative risk.

9. There is evidence of apparent calculation and unit conversion inaccuracy based on a simple check over a span of 6 pages in Chapter 2 wherein there were errors on every page save one.

5 APPENDICIES

5.1 Power Point Slides from Independent Review Team 17 February 2010 Presentation to the HAB

17 Feb 2010 HAB Presentation

Hanford Tank Closure & Waste Management [TC&WM] EIS

External Independent Review Team Preliminary Assessment Report

AGENDA

- **Introductions**
  - **Overview of KD Auclair & Associates, LLC**
- **Background**
  - **Scope of Work**
  - **Method and Approach**
  - **Current Status – Work Remaining**
- **Preliminary Observations and Conclusions**
- **Recommendations**
- **EIS Review** - Methodologies, Practices, and Adherence to Reasonable Standards of Practice
- Break
- Q&A

Providing Management, Operations, Business Intelligence, Engineering, Sustainable Development, Security, and Technology Integration Solutions

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KD Auclair & Associates, LLC
COMPANY OVERVIEW

- Veteran Owned Small Business concern providing Management, Operations, Business Improvement [MOBIS], Business Intelligence, Security and Technology Improvement and Integration Solutions and support
- Can provide more than 1000 man-years of experience and expertise in direct support of Project, Engineering, Procurement, Construction, Quality, Risk, Process Improvement, and Security Management for a wide range of operations

Exculpatory Language

- Presentation Material and Views Expressed may not reflect the views of DOE, the prime contractors that support them, nor regulatory and standards bodies cited in examples as they have not been reviewed and approved by the same.
- Bottom Line: Personal Views based on past experience and prima facia review of the EIS materials as provided in publicly available documents and electronic resources.

EIR Team Scope of Work

- **What our review and assessment effort is *NOT:***
  - **NOT** a full and independent detailed technical review of the full EIS.
- What our review and assessment effort *IS:*
  - Our review and assessment effort **IS** a limited and targeted review of select aspects and perspectives of the EIS

EIR Team Scope of Work

[cont.]

- The External Independent Review (EIR) Team contracted to conduct an independent review and analyses of the proposed remediation alternatives presented in the draft Tank Closure and Waste Management Environmental Impact Statement (TC&WM EIS)
- Effort is focused on the following select perspectives:

EIR Team Scope of Work

[cont.]

- <u>Transparancy</u>
- <u>Consistency and evenhandedness</u> in applying the results of the technical analyses of contaminant transport in soils and groundwater to the various remediation alternatives considered in the draft EIS
- Use of a <u>risk-based approach</u>

EIR Team Scope of Work

[cont.]

- Evaluation to determine if evidence exists that the EIS provides an adequate analysis of cumulative risk and mass balance
- How well the proposed remediation alternatives comply with the guidance provided by the [Hanford Advisory] Board in their Decision Analysis Flowcharts for surface, soil, and groundwater remediation, as well as past ***relevant*** advice

EIR Team Scope of Work

[cont.]

- In summary, the EIR Team effort focused our independent review to identify:
  - Did the EIS analyses adhere to reasonable standards of practice
  - Did the EIS analyses adhere to the methodologies and practices as defined in the scope of the EIS, inclusive of Risk
  - Did the EIS analyses address or incorporate recommendations from the Hanford Advisory Board

Method & Approach

- First evaluated the fundamental reliability of the EIS analytical basis
- The need for a sound under pinning, hinged on a documented quality program, and documented approach to how data is qualified and used, is necessary for a successful evaluation of any [remediation] alternative.

Method & Approach

[cont.]

- If this analysis ‘engine’ or ‘machine’ is not sound, then any results derived from the same are questionable.

EIR Team Scope of Work

[cont.]

- ➢ EIR Team conducted an assessment which evaluated the following aspects:
  - ❖ Analysis of the process used
  - ❖ Analysis of the data used
  - ❖ Analysis of the data and risk analysis approach

Method & Approach
[cont.]

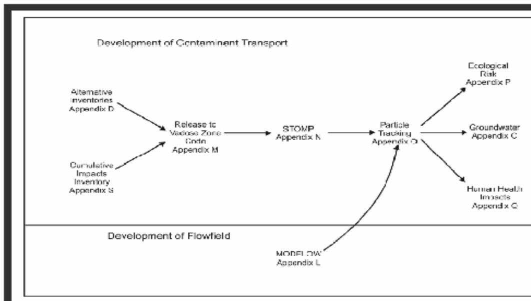

Figure 5-1. Groundwater Modeling Process

EIR Team Scope of Work

[cont.]

- Analysis of the process used; the data used; and the data and risk analysis approach:
  - Transparency
  - Consistency and evenhandedness
  - Risk, cumulative risk and mass balance
  - HAB advice and recommendation considerations

Terms and Definitions

- **Transparency**

The EIR Team views "transparency" as a simple litmus test: a technically competent reviewer must be able to understand the draft EIS without recourse to the author.

Terms and Definitions
[cont.]

- Consistency and evenhandedness :
  - Was there evidence of undue bias against or for a particular alternative
  - Documented and Rational approach
  - Key to these are the aspects of contaminant transport in soils and groundwater
  - Of particular importance is the rigor of the QA/QC methods

Terms and Definitions
[cont.]

- Consistency and evenhandedness [cont.]:
  - The EIR Team evaluated the basis, approach, methods, controls, assumptions, and configuration management associated with the modeling and data sampling and analysis efforts documented in the draft EIS.
  - These were assessed against industry norms for similar criteria.

EIR Team Scope of Work

[cont.]

- Risk, cumulative risk and mass balance
- HAB advice and recommendation considerations

EIR Team Summary of PRELIMINARY Observations and Conclusions

- **The general methodology of the EIS was consistent with the regulatory requirements of an EIS and served to evaluate the protectiveness of the various closure alternatives at the Hanford Site.** {Section 2.3.1.2 }
- As a further comment about QA/QC, the reports on the evaluations of their QA/QC said they had to meet DOE Order 414.1.C requirements. It is not documented that they did so. So there is a possible deficiency with regard to meeting QA/QC requirements set out by DOE itself.

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- **The details of the EIS were sufficient to evaluate the protectiveness of the alternatives presented.** {Sections 2.2.1, 2.3.1.4, 2.3.3.3}
- **This EIS was a result of less than satisfactory QA/QC carried out in the previous Solid Waste EIS.** As such, it would have been expected that the QA/QC efforts of this EIS would have been documented. They were not documented in the EIS. A review team's report of the QA/QC procedures for this EIS appeared in November 2008 and is separate from the EIS, but **no final QA/QC report seems to have been produced.** {Sections 2.2.2, 2.2.4, 2.3.1.1, 2.3.2.2}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- **The modeling for the EIS seems to have been satisfactory**, although some inherent limitations of MODFLOW were noted. The vadose zone models were rigorous, but they used the saturated values from the calibration of MODFLOW as a starting point and coupled their independent calculations through source term boundary conditions to MODFLOW.
- The approach to deciding which features, events, or processes (FEPs) were important in developing the **model did not take advantage of the accepted industry standard FEPs process for nuclear waste**.

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- As noted in the *Report of the Review of the Hanford Tank Closure & Waste Management Environmental Impact Statement (EIS) Quality Assurance Follow Up*, the QA/QC for the modeling was not sufficiently documented as of November 2008 – this still appears to be the case. {Sections 2.2.3, 2.3.1.1, 2.3.1.2, mainly 2.3.1.4, 2.3.2.2, 2.3.2.3, 2.3.3.1, 2.3.3.2, 2.3.3.3}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- **The risk calculations performed were of a deterministic nature.** This results, as described in Appendix L, from the use of flow parameters in the flow modeling being based on those from only one of the runs. The EIS paid particular attention to the details of the cumulative risk calculations. **The limitations of the modeling prevented a more rigorous probabilistic risk approach taking into account the uncertainties in the modeling.** As a result a conservative approach was taken to the risk evaluations. The risk from the CERCLA sites turned out to be more significant than earlier believed in comparison to the risks from the Tank Farm waste. {Sections 2.2.3, 2.2.4, 2.3.3, 2.3.2.1, 2.4.1.3}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- **Although the EIS purports to attempt to quantify uncertainties, they were not able to do so in a rigorous way.** The EIS dealt with only two uncertainties for the groundwater flow, one was providing two alternative flow scenarios through the Gable Mountain Gap, and the other was a demonstration of the effect of uncertainty of the flux for technetium-99 from the BY and TY Crib Areas. These uncertainties were judged to result "in large variations in the near field."
- **The Best Basis Inventory (BBI) contains more rigorous evaluations of uncertainty. The level of uncertainty presented in the BBI is sufficient for evaluating source uncertainties.** {Sections 2.2.3, 2.3.1.1, 2.3.1.4, 2.3.2.1, 2.3.2.2, 2.3.3.2, mainly 2.3.3.3 on Uncertainty}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- **The EIS is largely consistent with the HAB Advisory 197 – Groundwater Values Flowchart.** Five of the six steps in that chart were considered in the groundwater evaluations conducted in the EIS, the exception being the decision (item 6 in the chart) as to whether to launch further technology development. The EIS focuses on the Alternatives that are currently under consideration, which are based on current technologies.
- Where there were questions about how well certain features were <u>characterized</u>, the EIS takes into account the associated uncertainties (see above). {Section 2.4 and 2.5.2}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- **The EIS is consistent with the HAB Advisory 173 – Central Plateau Remedial Action Values Flow Chart.** Where there were questions about how well certain features were characterized, the EIS takes into account the associated uncertainties (see above). Five of the six steps in that chart were considered, but the alternative flow paths involving the development of new technologies were not considered. The EIS focuses on the Alternatives that are currently under consideration, which are based on current technologies. {Section 2.4 and 2.5.2}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- Most of the HAB's advice has been covered in the draft EIS. The most outstanding continuing issue, which is mentioned above in the last two summary points discussing the HAB flow charts, is the issue of characterization. The EIS does not make recommendations about further characterization nor about additional treatment technology. Although the EIS could clearly benefit from better characterization, they were tasked with providing the best calculations that could be made with the data available during the time frame of the production of the EIS. Also, as noted above, the EIS produced the evaluation based on technologies currently available or anticipated to be available by the time it was needed. They did not provide a mechanism for deciding where new technologies needed to be developed. {Section 2.4 and 2.5.2}

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

- The EIS does not appear to have updated the input data / data sources for, save those associated with the BBI and MODFLOW models. Information salient to the alternatives under review do not appear to [there is no documented evidence that] take into account updates from across the complex [e.g. saltstone, etc.].

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

<u>In regard to the individual treatment alternatives</u>

- Approaches are largely conservative
  - Inventories appear to be stated at the upper bounds
  - Releases in the Technical Guidance document are also conservative [upper bounds]
- Transport mechanisms / modeling is deterministic
  - Through Vadose – middle of the road values
  - Through Ground water – middle of the road values
  - Dose / exposure to the populace uses standard numbers but again appear to be conservative

EIR Team
PRELIMINARY
Observations and Conclusions
[cont.]

<u>In regard to the individual treatment alternatives</u>

HOWEVER:

- Between release and contact to receptors:
  - Transport basis for vadose zone and for ground water are NOT conservative
- A number of uncertainties are identified throughout the document
- Statements of conservative approach / values being applied – but no documented evidence of what or how
- Use of conservative approach may diminish the ability to determine which treatment alternative is most effective

17 Feb 2010 HAB Presentation

Hanford Tank Closure & Waste Management [TC&WM] EIS

External Independent Review Team Preliminary Assessment Report

<u>QUESTIONS ?????</u>

KD Auclair & Associates, LLC
COMPANY OVERVIEW

- EXPERTISE in more than 25 fields of discipline, science, and functional operations
- SUPPORT for select R&D programs, Market Research, Infrastructure Needs and Requirements Assessments, and Program and Policy development and definition studies for both Government and Private Sector organizations
- FLEXIBILITY to help your organization make a rapid transition from the abstract elements of planning to practical and fully implemented programs with appropriate performance monitoring metrics in place to help continually monitor performance and profitability

KD Auclair & Associates, LLC
COMPANY OVERVIEW

- EXPERIENCE -- our corporate culture is that of Strategic Teaming Agreements, Collaborative Agreements, Sub-contracts, direct hire / labor agreements, and VAR [value added re-seller] Agreements with Technical Specialists, Subject Matter Experts, Scientists, and Equipment, Technology, and Services Providers to achieve our capability in depth and flexibility to respond and support our client's needs

K.D. Auclair & Associates, LLC
CORE COMPETENCIES

- Project, Engineering, Construction, Risk, and Quality Programs Management
- Business Intelligence and Process Improvement Systems and Practices
- Sustainable Design and Development
- Security and Vulnerability Assessments, and Security Technology Integration & Deployment

K.D. Auclair & Associates, LLC
CORE COMPETENCIES [continued]:

- Project Financing and Investment Initiatives
- Advanced Technology Selection, Development, and Implementation for Extreme Environments
- Technology and Systems Integration Initiatives

5.2 Power Point Slides from Independent Review Team 4 March 2010 Presentation to the HAB

4 March 2010 HAB Presentation

Hanford Tank Closure & Waste Management [TC&WM] EIS

External Independent Review Team Preliminary Assessment Report

AGENDA

- **Introductions**
- **Summary Observations and Conclusions**
- **HAB Advice Review and Observations and Conclusions**
- Q&A

Providing Management, Operations, Business Intelligence, Engineering, Sustainable Development, Security, and Technology Integration Solutions

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Exculpatory Language

- Presentation Material and Views Expressed may not reflect the views of DOE, the prime contractors that support them, nor regulatory and standards bodies cited in examples as they have not been reviewed and approved by the same.
- Bottom Line: Personal Views based on past experience and prima facia review of the EIS materials as provided in publicly available documents and electronic resources.

EIR Team Scope of Work

- **What our review and assessment effort is *NOT:***
  - **NOT** a full and independent detailed technical review of the full EIS.
- What our review and assessment effort *IS:*
  - Our review and assessment effort **IS** a limited and targeted review of select aspects and perspectives of the EIS

Method & Approach

- First evaluated the fundamental reliability of the EIS analytical basis -- we checked the model and the data
- We checked the EIS using the HAB designated criteria
- We used simple tests that one would assume would be conducted by an originating organization to assure reasonable accuracy and fidelity of data

EIR Team Summary of Observations and Conclusions

1.2.1 Did the EIS analyses adhere to reasonable standards of practice

- **The EIS appears to be sufficient for the purposes of an EIS** that evaluates the Tank Farms alternatives, Solid Waste alternatives, and FFTF alternatives, **based on industry and regulatory norms**
- It does not however, address all elements set forth for itself, it has internal inconsistencies, and it does not address all offered stakeholder alternatives.

EIR Team Observations and Conclusions [cont.]

1.2.2 Did the EIS analyses adhere to the methodologies and practices as defined in the scope of the EIS, inclusive of Risk

- The EIS **is not sufficiently precise to be relied upon for any final decision on a "preferred alternative."**
  - conservative estimates were made for many of the important parameters in the risk calculations,
  - the uncertainties that were described in the various chapters and appendices, and
  - the lack of documented QA/QC activities

EIR Team
Observations and Conclusions
[cont.]

- **Cumulative risk analysis overall methodology was flawed**.
  - 99 possible combinations of alternatives that need to be evaluated for cumulative risk
  - With all the variations given for each of these alternatives, the combinations of the variations become several hundred
  - Draft EIS chose only 3 of the possible combinations to evaluate - one of which is the baseline "no action" alternative
  - This leaves only 2 of the possible 98 remaining alternatives that were evaluated

EIR Team
Observations and Conclusions
[cont.]

- **The cumulative analysis is not adequate**
  - Chapters 4 and 6 of the EIS, discussion and evaluation is for <u>short-term</u> consequences only
  - last sentence in Section 4.4, in summary, states that for final selection, it might be necessary to evaluate different combinations of the various alternatives
  - In other words, this is not a complete analysis of the cumulative effects for all the alternatives

EIR Team
Observations and Conclusions
[cont.]

- **The vadose zone and groundwater remediation alternatives have not been considered in this EIS**
  - groundwater influences of various alternatives for Tank Closure, FFTF decommissioning, and Solid Waste Management are considered
  - **ongoing decisions concerning the groundwater operable units are not evaluated**
  - raises the question of how groundwater remediation will affect the various alternatives by altering the groundwater flow patterns
  - This is in spite of the statement in the Summary that “Long-term impact analysis indicates that the largest potential impact on human health may be due to past-practice discharges to cribs and trenches (ditches) and past leaks from SSTs.”

EIR Team
Observations and Conclusions
[cont.]

- The Optimization Strategy for Central Plateau Closure, WMP-18061, Rev. 0, September 2003
  - evaluated the relative risks from contamination from various sources on the Hanford Site
  - It was concluded that the BC Cribs and Trenches area had the highest impact on the concentrations of Tc-99 in the groundwater, and, therefore, on the health risk assessments for the Hanford Site
- Yet, from what the reviewers have been able to determine, this area has not been explicitly mentioned in the EIS
- It is not clear how any of the past practice releases are handled in this Draft EIS except for those associated with the Tank Farms, Solid Waste Disposal, or FFTF

EIR Team Observations and Conclusions [cont.]

1.2.3 Did the EIS analyses address or incorporate recommendations from the Hanford Advisory Board

- The alternatives evaluated in the Draft EIS appear to mostly reflect HAB advice
- However there are several aspects that may require further HAB action to see them addressed in some fashion.
  - Draft EIS did not address alternatives for groundwater remediation, the full extent of the Groundwater Decision Flowsheet found in HAB advice #197 -- this in spite of the Transport Analysis presented in Appendix O which contained the same logic as that of the HAB Flowsheet …. Source to potential human exposure
  - Further Site characterization

EIR Team Observations and Conclusions [cont.]

1.2.3 Did the EIS analyses address or incorporate recommendations from the Hanford Advisory Board [cont.]

- Deliberate development of new technologies to address groundwater issues
- It is not clear what the fundamental assumptions were for the remediation of past practice releases to the groundwater for this EIS - particularly relevant to Advice #173 Flowchart.
- The remediation of past practice waste sites have not been evaluated in this Draft EIS.

EIR Team Observations and Conclusions
[cont.]

1.2.4 Conclusions / Findings

- ***The EIS appears to be sufficient for the purposes of an EIS that evaluates the Tank Farms alternatives, Solid Waste alternatives, and FFTF alternatives, based on industry and regulatory norms, in the opinion of the Independent Review Team – pending further review of the accuracy issue.***
- ***There are no apparent adequately referenced and/or documented QA/QC procedures or protocols.***
- ***Uncertainties are not adequately quantified with specific exceptions further discussed in the body of the report.***

EIR Team Observations and Conclusions
[cont.]

1.2.4 Conclusions / Findings [cont.]

- ***The EIS did not evaluate cumulative risk in a rigorous way and the overall methodology described is flawed. Specifically, only two of ninety-eight combination of alternatives [plus the base case of no action] were evaluated for cumulative risk.***
- ***The EIS has insufficient precision to make decisions among the combinations of alternatives.***

EIR Team Observations and Conclusions [cont.]

1.2.4 Conclusions / Findings [cont.]

- ***In the context of cumulative risk, this Draft EIS fails to deal with all the remediation options of the Site. In particular, it does not present alternatives for the remediation of past-practice discharges, in spite of the EIS Summary statement that "Long-term impact analysis indicates that the largest potential impact on human health may be due to past-practice discharges to cribs and trenches (ditches) and past leaks from SSTs." It is unclear how the alternatives for these discharges might affect the analysis of the alternatives considered in this EIS for the Tank Farms, Solid Waste, and FFTF.***

EIR Team Observations and Conclusions [cont.]

1.2.4 Conclusions / Findings [cont.]

- ***The modeling was deterministic and based on judgment as to what to include or exclude. The modeling did not benefit from a rigorous FEPS process for determining the important parameters.***
- ***There appears to be the potential for serious and fundamental data error based on a simple check of conversion factors in Chapter 2 of the EIS.***

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**
- ***Tank Closure Alternative 2A:*** Existing WTP Vitrification; No Closure
  - ***This option seems to not support HAB advice #214 in part because the SSTs are not closed and the Tc-99 stays on site. The lack of closure of the SSTs would mean that HAB advice #132 would be less likely to be met because of more institutional controls over longer periods of time limiting human occupation of the Site.***
- ***Tank Closure Alternative 2B:*** Expanded WTP Vitrification; Landfill Closure
  - ***This option seems to support HAB advice #214 better in part because Tc-99 is removed in the pretreatment process to the WTP and incorporated into the glass for shipment off-site. Of the two options under alternative #2, 2B also seems to support HAB advice #197 better because it would have less Tc-99 left on site to eventually contaminate the groundwater.***

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**
- ***Tank Closure Alt 3A-C*** **:** Existing WTP Vitrification with Supplemental Treatment Technology; Landfill Closure:
  - ***Tank Closure Alt 3A*** ***: Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure***

    All storage forms are glass, which would help support HAB advice #197 because of less mobile state of the waste form.

  - ***Tank Closure Alt 3B*** ***: Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure***

    Cast stone, which stays on Site, might be viewed as less supportive of HAB advice #197 because it is seen as being more leachable than glass

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**

- ***Tank Closure Alt 3A-C :*** Existing WTP Vitrification with Supplemental Treatment Technology; Landfill Closure:

  - ***Tank Closure Alt 3C : Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure***

  Steam reforming instead of vitrification could be viewed as less protective of the groundwater in the long term. This would agree less with HAB advice #197 than the other options

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**

- ***Tank Closure Alt 4:*** Existing WTP Vitrification with Supplemental Treatment Technologies; Selective Clean Closure/Landfill Closure

  Some of the tanks are clean closed, which better supports HAB advice #132 to encourage greater areas of possible human use of the Site. Also, retrieval of 99.9% of the waste would mean less in place and contribute to better alignment with HAB advice #197 for protection of the groundwater.

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**

- ***Tank Closure Alt 5:*** Expanded WTP Vitrification with Supplemental Treatment Technologies; Landfill Closure .

  Only retrieves 90% of the waste from the tanks, which goes against all previous HAB advice on amount to retrieve from the tanks

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**

- ***Tank Closure Alt 6A-C:*** All Waste as Vitrified HLW **:**

- ***Tank Closure Alternative 6A: All Vitrification/No Separations; Clean Closure (Base and Option Cases)***

  All waste being treated to form IHLW means that there could be less homogeneity in the resulting glass waste forms. This supports HAB advice #214 less than the others, which provide segregation pathways. However, it supports #214 by providing clean closure for the tanks, thus giving a smaller footprint to residual contaminants. It also provides for removal of 99.9% of tank waste

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.2 Tank Farm Alternatives**
- ***Tank Closure Alt 6A-C:*** All Waste as Vitrified HLW **:**
- ***Tank Closure Alternative 6B:*** All Vitrification with Separations; Clean Closure (Base and Option Cases)

Segregation of waste types provides for possibly more homogeneous glass forms, in support of HAB advice #214. It also provides for removal of 99.9% of tank waste

- ***Tank Closure Alternative 6C:*** ***All Vitrification with Separations; Landfill Closure***

Same as 6B above except 99% of the waste is removed from the tanks

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.3 Waste Management Alternatives**
- ***Waste Management Alternative 1:*** No Action **:**

Complies with HAB advice #133, which recommends full cost of imported waste must be recovered, in that there is no importation of waste from other sites)

- ***Waste Management Alternative 2:*** Disposal in one IDF, 200-East Area Only

The cost of imported waste seems to have been somewhat accounted for (HAB advice #133) because the imported waste has to be treated before being imported to the Hanford Site. The previous HSW-EIS did not account these costs.

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.3 Waste Management Alternatives**

- ***Waste Management Alternative 3:*** Disposal in two IDFs, 200-East and 200-West Areas:

  The cost of imported waste seems to have been somewhat accounted for (HAB advice #133) because the imported waste has to be treated before being imported to the Hanford Site. The previous HSW-EIS did not account these costs.

EIR Team
Observations and Conclusions
In regard to the individual treatment alternatives

- **3.4 FFTF Alternatives**

  In general, since FFTF is not on the Central Plateau, HAB advice #173 and its accompanying flow chart does not apply

- ***FFTF Decommissioning Alternative 1:*** No Action **:**

  With regard to the disposition of the sodium, this option satisfies the HAB advice #214 to keep large amounts of sodium out of WTF. It does not agree with HAB advice #214 with respect to minimizing the area of contamination. It does not agree with advice #197 for remove, treat, and dispose as preferred option.

EIR Team
Observations and Conclusions

<u>In regard to the individual treatment alternatives</u>

<u>3.4 FFTF Alternatives</u>

- ***<u>FFTF Decommissioning Alternative 2:</u>*** Entombment **:**

  This option has several ways of converting sodium, but it ends up in WTF, which does not agree with HAB advice #214. This alternative anticipates an engineered barrier, which does not agree with HAB advice #174 to use engineered barriers as last resorts.

- ***<u>FFTF Decommissioning Alternative 3:</u>*** Removal **:**

  This option considers the same ways of converting sodium, but it ends up in WTF, which does not agree with HAB advice #214. HAB advice #132, which recommends encouragement of human presence on the Site, seems to best served by this option.

EIR Team
Observations and Conclusions

<u>In regard to the HAB Advice to DOE</u>

<u>General Observations and Overview of our analysis:</u>

- The HAB advice did not appear to be uniquely applicable to many of the *individual* alternatives
- A number of items of HAB advice were no longer relevant to the draft EIS we reviewed. These pertained to:
  - Complying with all regulatory requirements including CERCLA, RCRA, NEPA, DOE Orders, and the Nuclear Waste Policy Act as amended.
  - Addressing, where practical, stake holder recommendations,
  - Working with that required scope of exposure scenarios as defined in the NEPA process
  - Advice on specific remediation alternatives to be evaluated, such as Advice #180 on BC cribs, Focused Feasibility Study, and Proposed Plan

EIR Team
Observations and Conclusions
In regard to the HAB Advice to DOE

General Observations and Overview of our analysis:

- Specific Outdated HAB Advice Related Notes:
  - 1. Advice Item #166, U Plant Closure Plan, was out of scope of the EIS.
  - 2. Advice item #180, 200 BC Cribs Focused Feasibility Study and
  - Proposed Plan is implicitly covered as part of Tank closure options. It is NOT treated separately in the TC alternatives.
  - 3. Contains detailed feedback from WDOE, which present an alternative viewpoint on the HAB advice. Feedback is based both on regulatory focus/limitations and State of WA priorities.
  - 4. Advice <> the Public Comment Period Considerations for the TC & WM EIS was no longer relevant since the EIS draft had been issued

EIR Team
Observations and Conclusions
In regard to the HAB Advice to DOE

General Observations and Overview of our analysis:

- In addition, the IRT did find that the HAB advice did not appear to clearly distinguish between the more limited scope/purpose of the EIS process (NEPA) and the more specific, and at times more detailed, RCRA/CERCLA permitting and closure process.
  - Indeed, there was no mention in the HAB advices of working with the Performance Assessments published by DOE associated with long terms effects [e.g., ILAW] despite what appeared to be a PA's relevance to HAB concerns

- The IRT added Advice #185 to our list of items evaluated because it not only served as an excellent compendium of HAB concerns, but also detailed the response of the Washington Department of Ecology (WDOE) to those concerns

4 March 2010 HAB Presentation

Hanford Tank Closure & Waste Management
[TC&WM] EIS

External Independent Review Team
Assessment Report

QUESTIONS ?????

5.3 Independent Review Team Biographical Information

Mr. Kim Auclair, The Independent Review Team lead, has more than 36 years of experience in project management, external independent reviews, configuration and requirements management, quantitative and qualitative risk analysis, and technology development and transfer. He is a recognized subject matter expert in automation and robotics in extreme environments, project management, six sigma, risk management, and sustainability. He has extensive experience at the Hanford site with a significant portion of that in support of the Waste Treatment Plant Project. Mr. Auclair provided overall guidance on the effort inclusive of cross cutting support, as well as a specific focus in the areas of risk, transparency, and how well the proposed remediation alternatives comply with the guidance provided by the Board in their Decision Analysis Flowcharts for the surface, soil, and groundwater remediation; as well as those other past relevant advice.

Dr. Thomas Fogwell, P.E. has more than 29 years of experience and is an expert in groundwater transport modeling and analysis, as well as technology development, analysis, and transfer. He has extensive expertise in multi-attribute alternative analysis methodologies. He is additionally familiar with the Hanford Site having previously served as Scientific Director and Manager of Site Integration and Assessment under the previous PHMC contract [2002-2007]. Dr. Fogwell has also been a fellow at Oxford University with an appointment in Physics at Wolfson College. While there he conducted research at the UKAEA Harwell Laboratory, south of Oxford, in multiphase fluid flow. He developed new methods for multiphase fluid flow instrumentation using optical techniques and contributed to the development of the Harwell fluid dynamics simulation code. During this period, Dr. Fogwell was responsible for the areas of Technical Integration, Remediation Decision Support, Database Integration, Environmental Databases, and Technology Management. Dr. Fogwell provided the Independent Review Team cross cutting support with a specific focus in the analysis of the modeling efforts documented in the EIS, as well as in the areas of consistency and evenhandedness in applying the results of the technical analysis of contaminant transport in soils and groundwater to the various remediation alternatives considered in the draft EIS.

Dr. Harry Babad has more than 35 years experience involving troubleshooting and technical integration in the areas of applied chemistry, its associated R&D and R&T needs, identification, experimental planning, implementation, and production scale-up and assessment of the risks associated with storage and disposal alternatives. Further, Dr. Babad is recognized as a national and international expert on nuclear waste treatment and disposal, characterization, safe storage, strategic planning, technical and regulatory issue resolution and closure, and developing and implementing major program technical
strategies. Dr. Babad provided the Independent Review Team cross cutting support as well as a specific focus in the determination as to whether or not the draft EIS provides an adequate analysis of cumulative risk and mass balance for the various remediation alternatives considered, with a focus on the Tank Farms elements of the draft EIS.