



[Advice # 23](#) From: Jackson Kinzer

97-WSD-135

Ms. Marilyn B. Reeves, Chair
Hanford Advisory Board
c/o Confluence Northwest
342 Union Station
800 N.W. Sixth Street
Portland, Oregon 97209

Dear Ms. Reeves:

HANFORD ADVISORY BOARD (HAB) ADVICE ON VADOSE ZONE

The U.S. Department of Energy, Richland Operations Office (RL) welcomes the HAB Consensus Advice #67. The advice is timely as RL, with input from stakeholders and Tribal Nations, develops comprehensive approaches to addressing vadose zone contamination beneath the Single-Shell Tank Farms managed by the Tank Waste Remediation System (TWRS). RL is striving to do this work in accordance with the Hanford Federal Facility Agreement and Consent Order and the TWRS Environmental Impact Statement (EIS) Record of Decision (ROD) recommendations regarding "expeditious, safe, and efficient removal, treatment and disposal of tank wastes." Specifically, RL is:

- Developing a Vadose Zone Program Plan that identifies data needs to support TWRS operations, retrieval, closure, and regulatory requirements, and prioritizes the data collecting activities at various funding levels.
- Implementing Expert Panel advice to a) revise contaminant transport models to incorporate the new data and understanding of potential contaminant transport mechanisms, and b) to collect additional field and laboratory data needed to better understand the vertical and horizontal extent and migration properties of vadose zone contaminants.
- Integrating vadose zone characterization issues among TWRS Programs and between TWRS and other Hanford Site programs, including Environmental Restoration.
- Evaluating tank farm activities that could contribute to increased migration of contaminants in the vadose zone, including minimizing infiltration of precipitation into the tank farm vadose zone, and reducing leak loss during tank retrieval.
- Evaluating, in conjunction with State of Washington Department of Ecology, Tank C-106 leak detection issues to protect the environment and demonstrate retrieval technology in support of single-shell tank waste retrieval.
- Continuing effective public information and involvement activities to ensure regulators, Tribal Nations, stakeholders, and the general public are informed in vadose zone issues.
- Implementing the decisions documented in the TWRS EIS ROD to collect data regarding vadose zone contamination and other data gaps identified in the TWRS EIS prior to supplementing the TWRS EIS.

RL recognizes the importance of the vadose zone and has taken actions to address the implications of new data on vadose zone contamination in a manner that supports moving forward with tank waste retrieval, treatment, and disposal. The second iteration of a vadose zone program plan for TWRS is undergoing internal review through September 19, 1997. It will then be available for further development based on discussions with review by, and input from regulators, Tribal Nations, and other stakeholders. Characterization and other work will then be chosen and prioritized to meet vadose zone data needs as identified in the plan.

Additional details on how TWRS is responding to your advice and recommendations is contained in the attachment. If you have questions please contact David Shafer on (509) 376-9255 or Carolyn Haass on (509) 372-273.

Sincerely,

Jackson Kinzer, Assistant Manager
Office of Tank Waste Remediation
System

WSD:DSS
Attachment

cc S. Dahl, Ecology
M. Wilson, Ecology
R. Patt, HAB
R. Belsey, HAB
T. Carpenter, HAB

RESPONSE TO THE HANFORD ADVISORY BOARD CONSENSUS ADVICE #67

BACKGROUND:

Statement: "In February 1996, new data were disclosed that contamination in the form of Cesium-137 has been found deep in the ground beneath tanks in Hanford's SX Tank Farm."

Response:

The U.S. Department of Energy (DOE) initiated the Vadose Zone Program using new monitoring equipment to assess known contamination in tank farm boreholes. Based on gross gamma equipment measurements it had long been known that gamma-emitting contamination was present in boreholes at depths of at least 125 feet (ft) beneath certain tank farms. The new monitoring equipment allows discrimination between the various gamma-emitting isotopes to allow DOE to better understand the contamination resulting from past tank farm operations, including spills and tank waste leaks to the soil.

In the SX Tank Farm summary report, it was observed that contamination of Cesium-137 was present in boreholes at depths greater than previously estimated. Preliminary data from the BX Farm indicates contamination of Cesium-137 at similar depths. The report on SX Farm, however, concluded that

insufficient information was available from the data to determine the extent of contamination or the mechanisms that caused the contamination to be at the depths observed.

Statement: "As of December 1996, two new boreholes had been drilled, using techniques that were less likely to cause borehole contamination. The new data confirm that contamination in the vadose zone formation to a depth of at least 130 feet and this is not a result of borehole effects."

Response:

The Panel recommended that DOE drill between two and three new characterization wells in the SX Farm to determine if the contamination was exclusively the result of contamination migrating through existing boreholes or if contamination was moving through the natural formation. The first well was drilled in October 1996. The Panel reviewed the data from the first well and advised DOE in November 1996 that the results were inconclusive. The second well was drilled in December 1996. Based on the results of the second well, the Panel advised DOE that the data from the second well indicated that "contamination has moved through the formation" and that data from the first borehole demonstrated contamination drag-down by well installation and little else because the well siting could not be established at an appropriate location. However, the Panel cautioned DOE that the data was limited and therefore "whether the second borehole represents a broadly-spread contaminated plume or one narrowly defined by a pathway cannot be determined from the limited available data so far."

Statement: National Research Council (NRC) comments on the TWRS Draft Environmental Impact Statement

Response:

It is important to recognize that the NRC reviewed the Draft TWRS EIS and provided a "broader analysis of the overall approach" taken by DOE and Ecology in remediation of the Hanford tank waste. Comments by the NRC relating to the scope of the EIS were similar in nature to comments submitted by stakeholders and Tribal Nations. Following the issuance of the Draft TWRS EIS for public comment, DOE modified the EIS to address the substance of these comments. Changes to the document that addressed concerns identified by the NRC included:

- Additional analysis of the uncertainties associated with contaminant migration of res waste, leakage of sluicing liquids during retrieval, and past tank waste leaks. (Appendix F)
- Expansion of the analysis of the "the risk associated with waste left in the tanks...in context of overall risks." (Volume One, Section 5.13 and Appendix F)
- Expansion of the long-term risk analysis to address uncertainties associated with cal risk over a 10,000 year period.
- Providing the available data regarding vadose zone contamination and a discussion calculation of the potential migration mechanisms that were being evaluated by the zone characterization program in Appendix K.

This and other analysis included in the Final EIS were not reviewed by the NRC.

NRC comments on the overall approach taken by DOE and Ecology in remediation of the Hanford tank waste were largely related to the scope of the Draft EIS. The NRC concluded that decisions regarding remediation of tank waste should not be made because of the uncertainties associated with technologies, regulations, and characterization (including that of the vadose zone) and should not be made without making interrelated decisions on the disposition of the tanks, residual wastes, and contaminated soils. The NRC recommended a phased decision strategy that would result in construction of a pilot

vitrification plant to treat double-shell tanks and deferring decisions on single-shell tank retrieval and remediation for "as long as 10 years." During this 10-year period, the NRC recommended DOE evaluate:

- "multiple alternatives involving both ex-situ and in-situ disposal" including "in-tank waste stabilization methods" and "selective partial removal of waste from tanks, with subsequent stabilization of residues"
- Technologies and alternatives "unconstrained by current regulatory requirements"
- Grout as a waste form for low-activity waste
- "Removal options of less than 99 percent to examine more thoroughly the tradeoffs between cost and risk reduction in removing the last fraction of the waste residue"
- "A deferred-action option in which tanks containing significant quantities of relatively short-lived radionuclides (90Sr and 137Cs) would be stabilized and contained by temporary physical barriers for perhaps 100 to 150 years to allow them to decay by an order of magnitude before remediation is undertaken."

DOE agreed with the NRC that there are substantial uncertainties associated with the TWRS program. In response to similar comments, DOE revised the EIS to enhance the discussion of uncertainties, including the relevance of uncertainties in the evaluation of alternatives. DOE selected an approach for remediation, Phased Implementation, that provides adequate flexibility to accommodate future changes in the program as additional data on tank waste characterization, vadose zone characterization, operational efficiencies and costs, and new technologies are developed.

DOE believes that tank farm remediation has been studied extensively for a number of years and that the data are sufficient to move forward with the first phase of remediation while, at the same time, evaluating specific technologies that have the potential to appreciably benefit the TWRS program. While it may be advantageous to continue studying various paths for remediation, DOE believes that the previous studies have reduced the uncertainties to a manageable level. The risks of proceeding with remediation are less than the risks of further releases of contaminants from the tanks, the potential for accidents in unremediated tanks, and the high cost of continuing to manage the tank waste in rapidly aging facilities that have exceeded their design life. The new data on vadose zone contamination reinforces the need to retrieve and treat tank waste. Regional stakeholders strongly support DOE's plans to move forward with remediation and do not support further studies of alternate paths or alternatives that are not in conformance with the Tri-Party Agreement.

The TWRS EIS and other analyses conducted by DOE can only be based on the best available data at the time of the analysis and must be completed to support decisions required to meet Tri-Party Agreement and regulatory requirements. The EIS acknowledged this limitation. DOE did not include alternatives for remediation of contaminated soils because, as stated in the TWRS EIS, "there is insufficient information concerning the amount of contamination to be remediated." DOE did commit in the TWRS EIS to "prepare future NEPA analysis ... to address disposition of the tanks and associated equipment, residual waste remaining after retrieval, and contaminated soils; resolution of emerging information concerning contamination of the vadose zone, and the integration of tank farm closure with the remediation of other Central Plateau areas." As recommended by the NRC, in the TWRS Record of Decision, DOE committed to revisiting the TWRS decisions when additional data became available and identified a number of points in time when this would be performed.

RESPONSE TO THE ADVICE:

Statement: "DOE must heed the advice of the Vadose Zone Expert Panel and the

National Academy of Sciences."

Response:

DOE is using the conclusions and recommendations of the Panel in helping craft its current program. DOE is currently developing data quality objectives (DQOs) for the further characterization of the SX Tank Farm that will address the characterization needs identified by the Panel and by the TWRS and ER programs. DOE is proceeding with a long-term Vadose Zone Program based on recommendations of the Panel, the end-use of the characterization data, and information gained by iterative characterization and modeling of the vadose zone. Also, DOE is revising Site vadose zone contaminant transport models to address the new data, conclusions regarding contaminant transport mechanisms identified by the Panel, and long-term vadose zone and TWRS program needs associated with analysis of contaminant transport and assessments of risk.

DOE is also using the advice of the NRC in developing its program. As the NRC acknowledged in their review of the EIS, the EIS identified a number of data and technology uncertainties that would require additional analysis to support retrieval and closure decisions. DOE committed in the Final EIS and in the Record of Decision to collect additional data and conduct additional analysis and to periodically reevaluate the decisions reached in the Record of Decision based on new data. Also, DOE committed to supplement the EIS or conduct other appropriate NEPA analysis regarding closure issues when sufficient data was available to support analysis of closure alternatives.

Statement: "Hanford continues to spend money on modeling tank farm contamination using inaccurate and incomplete data."

Response:

DOE is implementing the Panel's advice to revise vadose zone contaminant transport models. All TWRS vadose zone modeling efforts are incorporating the new data into the conceptual models and collecting additional data needed to address specific concerns of the Panel related to technical issues that could impact vadose zone conceptual models.

The programs that are presently involved in developing or performing vadose zone modeling at the tank farms include the Hanford Tanks Initiative Retrieval Performance Criteria Analysis, the TWRS Low-Activity Waste Performance Assessment, and RCRA assessment modeling for the SX Tank Farm. The HTI and Low-Activity Waste Performance Assessment modeling effort is structured to aid in characterization data development and refinement of the conceptual model to address findings of the Panel and Vadose Zone Program. The model refinement and characterization efforts are complementary parts of an iterative process -- as new data becomes available, models are revised to incorporate new information regarding field conditions. As models are revised, field characterization is conducted to verify the predictive value of the revised model. This iterative process is the basis of a characterization program that is scientifically defensible and cost-effective.

Statement: "DOE is proceeding with existing plans to remediate tanks such as C-106, heedless of the new findings and their implications."

Response:

TWRS is proceeding with SST waste retrieval to allow tank remediation at Hanford using hydraulic sluicing, similar to what was accomplished on 53 SSTs in the past, as the baseline technology. Current planning is to utilize sluicing technology in tanks that are not anticipated to leak during retrieval operations. Initial demonstration of this technology is planned for waste removal from Tank C-106. This

tank contains self boiling waste which requires that cooling water be periodically added to it. Failure to remediate Tank C-106 could result in loss of tank integrity and continuation of water additions to a leaking tank. In addition, excessive temperatures could result in tank structural failure and airborne release of tank contents. Further demonstration of alternative technologies (to sluicing) are planned for removal of the waste heel in Tank C-106 following sluicing. These technologies, if successful, could provide for SST waste retrieval from SST with limited leakage potential. SST remediation beyond the Tank C-106 demonstration is planned for completion in accordance with Tri-Party Agreement requirements, which also include provisions for establishing leak detection, monitoring, and mitigation measures.

Statement: "Finally, it appears that the efforts to characterize the vadose zone is underfunded, understaffed, and a low priority."

Response:

DOE considers the vadose zone characterization an important priority. However, the need for additional vadose zone data must be weighed against other needs, and the activities to gather the data sequenced to provide vadose zone data when needed for decision making, but not necessarily before. Characterization data is needed to support decisions associated with tank farm operations, waste retrieval, eventual closure of the tank farms. Since the inception of the Vadose Zone Program in FY 1995, DOE has expanded its funding. Funding in FY 1995 was \$2.8 million and the current funding level in FY 1997 is \$3.4 million. DOE is in the process of prioritizing vadose zone activities at various levels of funding for FY 1998 and subsequent years to support the overall TWRS mission, but with a base case funding of \$4.0M.

Recommendation: "1. Provide adequate resources necessary to develop a comprehensive plan and investigate and document the extent of the radiological contamination of the vadose zone. This should include continued support to the Expert Panel and a budgetary increase of the vadose zone project in consultation with the Expert Panel and this Board."

Response:

Development of a Comprehensive Plan and Resources for the Vadose Zone Program -- Since the inception of the Vadose Zone Program in FY 1995, DOE has expanded its funding. Funding in FY 1995 was \$2.8 million and the current funding level in FY 1997 is \$3.4 million. DOE is evaluating options for expanding tank farm vadose zone characterization activities using a combination of funding from TWRS and the ER program to address data collection needs identified by the Panel, as well as ER program needs associated with RCRA groundwater assessments and TWRS retrieval program analysis of retrieval performance criteria. Vadose zone characterization is a complex issue and the development of a plan will involve extensive consultation with various Hanford program elements, Ecology, the Panel and stakeholders. As DOE progresses with development of the plan, the Board will be informed regarding this issue.

Continued support for the Vadose Zone Panel -- DOE commends the Panel for its careful evaluation of the existing data concerning the cesium contamination beneath the SX Tank Farm. The Panel has advanced DOE's understanding of this complex issue and the conclusions of the Panel will contribute to an advancement in the Vadose Zone Program. The task of the Panel was to address specific technical issues associated with data collection and interpretation of spectral gamma borehole logging in the SX Tank Farm. DOE funded the Panel, beginning in FY 1996, and allocated additional funding to address data collection recommended by the Panel to support their analysis of specific technical issues. The

Panel issued their final report on April 30, 1997. While the work of this Panel is complete, RL recognizes and values the need for periodic, independent review and evaluation. The membership of such review groups in the future would vary such that the right mix of technical and programmatic expertise is brought to an issue. In addition, as part of vadose zone integration between ER, TWRS, and Waste Management (WM), RL is looking at forming independent panels to provide input on vadose zone issues across program lines consistent with the coordination needed at RL.

Recommendation: "2. Continue to integrate vadose zone characterization issues between programs at Hanford, as recommended by the HAB in Consensus Advice No. 54 (November 8, 1996)."

Response:

TWRS programs potentially affected by the new data are being integrated. Additionally, TWRS, Waste Management, and ER are working to integrate data collection and analysis in response to the new data and Panel advice. Integration efforts are in their formative stages because of the relatively recent nature of the Panel report. However, the development of data quality objectives for further subsurface characterization of the SX Farm has been a joint effort between TWRS and ER. Among the integration efforts between TWRS program elements, including HTI, Retrieval, Vadose Zone, and Operations are the following:

- Informing regulators, Tribal Nations, and stakeholders about the implications of the vadose zone data and Panel advice regarding each of their respective programs and overall TWRS and DOE program decisions.
- Defining data needs and analysis and related schedules that should be addressed by the Vadose Zone Program or by the respective programs.
- Refining vadose zone contaminant transport models, as advised by the Panel, to incorporate new understandings of contaminant transport mechanisms and new data from the Vadose Zone and other programs.
- Revisiting previously proposed vadose zone characterization plans in light of the emerging information and Panel advice to ensure 1) the plans are integrated with the various programs; 2) they adhere to a formal DQO process; and 3) consider input from Ecology, the U.S. Environmental Protection Agency, and stakeholders.

Recommendation: "3. Evaluate any and all activities at the Hanford tank farms that contribute liquid discharges to the ground that could "drive" the existing contamination deeper."

Response:

DOE has evaluated tank farm activities that contribute to liquid discharges to the ground. Discharges from the tank farms to the ground resulted from two types of activities: 1) intentional discharges which ended in 1966; and 2) unintentional discharges resulting from leaking tanks. Discharges of SST liquid to the ground was ceased in 1966 and since then, no waste from SSTs or double-shell tanks (DSTs) has been discharged to the ground intentionally. DOE removed all SSTs from service in 1980 and initiated a program to remove all pumpable liquid and stabilize the tank waste until final disposition. This effort, known as salt well pumping, is currently ongoing. Approximately 30 tanks remain to be interim stabilized and these tanks will be completed by the year 2001. There are 67 confirmed or assumed leaking SSTs and all but five of the SSTs that are assumed leakers have been interim stabilized to minimize potential releases to the environment. Data from the gamma spectral logging program is being reviewed that might indicate two additional tanks are leakers that have not previously been reported as such before.

As part of the interim stabilization effort and to manage waste volume in DSTs, the 242-A Evaporator is used to evaporate the liquid from the tank waste. Recent evaporator campaigns have removed several million gallons of water from the tank waste, minimizing 1) liquids in the tanks available for potential release to the environment in the event of a SST leak; and 2) waste volume in DSTs allowing for improved waste management using existing tank capacity. Liquid recovered from the evaporator is transferred to the Effluent Treatment Facility for treatment and release to the environment in a State-approved land disposal site. This facility is a long distance from the tanks and does not contribute to driving existing contaminants in the vadose zone beneath the tanks and deeper into the environment.

DOE is currently evaluating the potential that resurfacing of tank farms with gravel to improve worker safety could contribute to increased infiltration of natural precipitation into the vadose zone and increasing the rate of contaminant migration in the vadose zone due to past tank leaks. Finally, DOE is evaluating, through the HTI program, the potential for leakage losses during waste retrieval using sluicing to contribute to faster migration of waste in the vadose zone from past tank leaks. This evaluation is being conducted in conjunction with the HTI analysis of retrieval performance evaluation criteria and Tri-Party Agreement Milestones associated with establishment of allowable leakage levels for tank waste retrieval, and development and deployment of leak detection, monitoring and mitigation measures.

Recommendation: "4. Revisit C-106 leak detection issues, with an emphasis on providing a monitoring system to assure maximum leak detection capability and the best possible environmental protection."

Response:

Tank C-106 retrieval will use the best available technology for in-tank level detection and external dry well radiation monitoring techniques to determine leakage losses during retrieval operations. These techniques can determine leakage losses during retrieval on the order of 8,000 gallons or equivalent to a two-inch level drop for a tank-to-tank retrieval process. To date, a review of other techniques which may reduce this leak detection limit have not resulted in improved or available technologies. Retrieval efforts in Tank C-106 are planned to resolve the high-heat "watchlist" safety issue. This tank contains self-boiling waste that concentrates overtime. Consequently, cooling water must be periodically added to it. Failure to remediate Tank C-106 could result in loss of tank integrity and continuation of water additions to a leaking tank. In addition, excessive temperatures could result in tank structural failure and airborne release of tank contents. The analysis of spectral gamma logging data from C Farm has been moved ahead on the schedule so that this data is available sooner to help make decisions regarding retrieval from Tank C-106. DOE is continuing to evaluate leak detection, monitoring, and mitigation (LDMM) technologies. Any technology providing improvements to existing capabilities will be evaluated for incorporation into the baseline.

Recommendation: "5. Develop and implement an effective public involvement plan on the vadose zone issue so that information is readily available to interested parties, and input from a wide variety of sources can be considered."

Response:

DOE is committed to providing timely and ongoing information to our regulators, Tribal Nations and stakeholders, and the general public about the new vadose zone findings. As part of DOE's public information and involvement program, DOE has publicly released all data regarding this issue, issued press releases and conducted interviews with news media when new findings became available, and briefed the Hanford Advisory Board (HAB), stakeholders, Tribal Nations, and regulators as new

information has become available. DOE continues to work closely with HAB to ensure an effective TWRS public involvement plan and with Tribal Nations to maintain an effective government-to-government consultation process. Stakeholder and Tribal Nation involvement for the TWRS program and its Vadose Zone Program are conducted within that framework. Meetings are being scheduled with Tribal Nations to review the first iteration of a TWRS Vadose Zone Project Plan that was developed to support the FY 1998 Integrated Priority List process. The TWRS program is working to ensure effective communication and provide meaningful opportunities to involve our regulators, Tribal Nations, stakeholders and the general public in TWRS decision making.

Recommendation: "6. Revise or supplement the TWRS EIS to assure that reliable and accurate data are used to make future decisions regarding retrieval and closure."

Response:

The Final EIS, which was completed in August 1996, included:

- Information regarding the findings of the vadose zone program,
- Analysis of potential mechanisms that could result in faster transport of contaminants in the vadose zone than previously estimated,
- Analysis of uncertainties associated with vadose zone contaminant transport, and
- Informing the decision makers and public that data gaps regarding vadose zone contamination would need to be addressed before decisions regarding tank farm closure could be analyzed.

The TWRS EIS was not intended to support the analysis of closure alternatives because: "The impacts of closure cannot be meaningfully evaluated at this time. DOE will conduct an appropriate NEPA review, such as an EIS to support tank closure, in the future" (59 FR 4052). In the EIS, DOE recognized remediation of the tank waste, closure of the tank farms, and remediation of areas surrounding the tanks, including contaminated soils, are interrelated issues. Even though inadequate information was available to fully assess all alternatives for closure, DOE used the best available information to assess the relationship of tank waste remediation to closure of the tank farms. Consistent with the requirements of NEPA implementing regulations 10 Code of Federal Regulations (CFR) Part 1500 to 1508, the EIS presents 1) information relative to closure to provide the public and decision makers with information on how decisions made now may affect future decisions on closure; 2) information on which alternatives would preclude clean closure for the tank farms; and 3) information on the cumulative impacts of the entire project.

New data regarding the vadose zone and many other aspects of the TWRS program are constantly becoming available. In the Record of Decision, DOE committed to the development of data needed to address uncertainties, including vadose zone characterization. DOE is funding a number of projects (including vadose zone characterization) that will result in new data in the months and years ahead. In the TWRS EIS and Record of Decision, DOE committed to preparing appropriate NEPA analysis when sufficient data becomes available to support decision making regarding remediation of soils surrounding the tank farms. While the new data regarding vadose zone contamination is important, as the Expert Panel concluded, there is still substantial uncertainty regarding transport mechanisms, the extent of past leaks, and type of contaminants. As the level of uncertainty is diminished by modeling and additional data collection, DOE will revise or supplement the TWRS EIS or conduct other NEPA analysis if the new information demonstrates that this is necessary.

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*For questions or comments, please send [email](mailto:Hanford_Advisory_Board@rl.gov) to Hanford_Advisory_Board@rl.gov
Response to HAB Consensus Advice #67 (April 3-4, 1997)
Subject: HAB Consensus Advice on TWRS Vadose Zone Characterization
Letter from Jackson Kinzer, Department of Energy, dated September 3, 1997
URL: <http://www.hanford.gov/boards/hab/response/023.htm>
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