BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
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December 3, 2015

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State of Hawaii
Department of Health

and

Mr. Bob Pallarino
United States Environmental Protection Agency
Region IX

and

Mr. Jimmy Miyamoto
Deputy Operations Officer
NAVFAC Hawaii

Subject: Board of Water Supply Recommendations to Consider in the Development of the Red Hill Administrative Order on Consent (AOC) Work Plans

Thank you for your invitation to meet with us on December 3, 2015. As discussed, BWS is pleased to offer the following recommendations for consideration by EPA, DOH, Navy and DLA, herein referred to as the "Parties", in your development of the work plans for each of the AOC Statement of Work (SOW) tasks. The list describes the basic elements we feel the work plans need to safeguard our precious drinking water supplies and environment into the future. Our list is not intended to be comprehensive, but provides a starting point for discussions on how to ensure the SOW tasks produce defensible scientific and engineering outcomes. The BWS looks forward to working with the Parties if they elect to incorporate the suggestions, proposed procedures, and action items herein into the applicable Work Plans.

Section 2 – Tank Inspection, Repair, and Maintenance (TIRM)

Tank Inspection and Record of Maintenance intervals table from the Navy Audit Service (NAS) report needs to be updated immediately and provided to BWS in order to understand current status and plans for each of the underground storage tanks (NAS, 2010). The reliability of the currently used non-destructive evaluation (NDE) techniques needs to be evaluated and characterized. For instance, BWS subject matter experts (SMEs) need to know the probability of detection of inside and outside diameter defects.

Section 3 – Tank Upgrade Alternatives (TUA)

The BWS believes that the Tank Upgrade Alternatives (TUA) cannot be appropriately evaluated until the risk assessment of the tanks (Section 8) is completed by the Parties. The BWS believes that the "tank within a tank" non-grout option should be re-visited by the Parties. BWS is interested to learn how the Parties derived the 22-year period (with an allowable extension of up to 5 additional years) over which to deploy best available practicable technology (BAPT) or cease tank use. We are very much interested to reviewing the data and technical analyses that shows continued operation of the tanks will not lead to future fuel releases to the sub-surface during that period. The SOW implies that the future release rate from the tanks will be acceptable, even though the risk of future releases will increase as the tanks continue to deteriorate.

Section 4 – Release Detection/Tank Tightness Testing

The BWS is interested in reviewing any information with regard to statistical defensible probability of leak detection for the tanks. We recommend blind testing of the system where controlled releases (not to the environment) are made where an operator does not know a test is occurring and determine if the system in place can statistically and reliably detect leaks at a given rate. Soil vapor monitoring wells are too few in number for detection of past and future leaks and are presently restricted to screened intervals below the concrete plug for each tank bottom to be reliably used for leak detection. The monitoring network and its complementary soil vapor monitoring network must be designed to ensure adequate and defensible release detection for all tanks during the time period that the AOC/SOW is implemented. Results of release detection/tank tightness testing should be incorporated into the risk assessment (Section 8).

Section 5 – Corrosion and Metal Fatigue Practices

The BWS strongly recommend the Parties immediately plan and perform additional non-destructive examination (NDE) and destructive testing (DT) analysis on Tanks #1 and #19. It is our understanding that Tanks #1 and #19 have been permanently taken out of service and are available for quantification of the current size distribution of corrosion depth (inner and outer surfaces) as well as the distribution of weld defects. This effort should include complete NDE of these tanks followed by DT of selected locations. This will require developing a statistically valid sampling plan that will determine the nature and scope of NDE and DT required to achieve a predetermined confidence that the corrosion is properly characterized. Furthermore these tanks can also be used to evaluate the nature and extent of weld defects and whether weld defects can be reliably detected using NDE for all tanks at the facility.

The SOW does not address the critical need for NDE of tank-related piping, which includes lines up to 32-inches in diameter. There appears no indication that the tank-related piping has been systematically inspected, despite indications of hydrostatic failures, weld cracks, and metal loss locations as recent as 2008. The details of repairs reportedly performed in response to these inspection initiatives have not been made available to the BWS. In the approximately ten years since the initial inspections and repairs were reportedly performed, BWS could find no evidence that additional inspections and/or repairs have been carried out to address wall loss locations that have continued to thin (corrode) and/or locations where the coating has subsequently been compromised. BWS requests that all tank-related piping inspection information be provided.

Section 6 – Investigation and Remediation of Releases

The BWS believes more emphasis is needed by the Navy/DLA on fate and transport of light non-aqueous phase liquid (LNAPL) in the vadose zone. There have been numerous identified significant releases, but no accounting as to the disposition of the hydrocarbon mass in the vadose zone or the identification of pathways for contaminants to reach groundwater. An understanding the geologic and hydrogeologic framework at a site-specific scale to accurately assess the movement of contaminants in the vadose zone, contaminants in the saturated zone, and contaminants in potential perched groundwater zones are needed. Site-specific coring studies are needed for the areas around the tanks to determine the basalt characteristics and assess which depth intervals are likely to retain and/or provide preferential pathways for leaked fuel.

A comprehensive understanding of the nature and extent and fate and transport of contamination in the subsurface (vadose zone and saturated zone) is imperative to conducting a dependable evaluation of remedial technologies.

The DOH Office of Hazard Evaluation and Emergency Response (HEER) technical guidance manual (TGM) describes a three-stage site assessment process (Site Investigation, Environmental Hazard Evaluation, and Response Action) to determine whether further action is necessary for a site. The BWS requests that the Parties adopt the process described in the TGM for their Task 6 work plan. The Task 6 work plan should include the following features of the TGM:

1. Providing a detailed plan (including schedule) of stakeholder involvement relative to the site investigation process.
2. Development/update of a site-specific conceptual site model (CSM) that assists in identifying data needs (data gaps), guiding data collection, and evaluating risk to human health and the environment such as is defined in the HEER TGM.
3. The CSM should be updated in an iterative process as additional data are collected.
4. Development of a plan and schedule for how the CSM will be updated as new site data are generated.
5. Please share all CSM versions with the BWS team.
6. Adoption of Tier 1 environmental action levels (EALs) for Drinking Water Toxicity, unless more stringent US EPA maximum contaminant limits (MCLs) exist, and development of a site-specific action risk assessment with BWS inputs for exposure scenarios as part of determining other action levels. This evaluation should needs to address unregulated substances.
7. An emergency response action should be taken to identify where the LNAPL is and begin removal to abate the risk of additional contaminants reaching groundwater.

The BWS requests interim progress reports be provided related to the development of the Investigation and Remediation of Release Report. Waiting for two years for the development of the document without regulatory or stakeholder input is undesirable. Additionally, characterization work on complex sites such as Red Hill requires an iterative approach. The course of the investigation will likely need revision based on the data that are being generated during the characterization process.

The BWS does not believe that the vadose zone or groundwater contaminant plumes have been adequately characterized. The Navy/DLA must be required to delineate the impacts to groundwater in all directions of the Red Hill tanks.

TEC (2010) established that there are significant errors in the elevation measurements for the tops of casings (TOC) for the Red Hill wells. Provisional data from Oki (2015a) indicate the possibility of continuing errors in TOC elevations or in the choices of TOC measuring points. These errors identified by TEC (2010) are large enough to create significant errors in groundwater heads and determining flow directions. Given the past surveying errors and the provisional differences identified by the USGS, the TOCs of all wells should be accurately determined. Furthermore, the data set of historical groundwater measurements must be reviewed and adjusted to remove errors from surveys and differences in choice of TOC locations so that groundwater heads and groundwater flow directions can be established with the necessary accuracy.

There are too few groundwater wells to adequately establish groundwater flow and direction and define the source area. These data gaps must be remedied by installing additional monitoring wells on and off the Facility.

The recent BWS-USGS aquifer test data confirm that groundwater heads are dynamic and influenced by all pumping rates, especially those at the Red Hill and Halawa shafts and Moanalua wells. Understanding head distributions across the aquifer area around the Red Hill Facility requires knowing how heads change in time as pumping rates change in time. Therefore, we recommend that the Parties install pressure transducers with data loggers and present all heads with regard to pumping rates at the major withdrawal points.

The BWS has elected to develop and maintain an independent CSM for the Red Hill facility. A plan for data sharing during the investigation planning process is requested.

The subsurface characterization work activities lack a standalone Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP). The SAP and QAPP must be developed according to the appropriate state and federal regulations, approved, and strictly followed during all data acquisition activities at Red Hill. The BWS requests that the SAP be developed or revised in compliance with State and Federal regulations.

The BWS requests confirmation that the list of analytes for groundwater monitoring and sampling include inorganic compounds that are important indicators of petroleum hydrocarbon degradation, particularly nitrate, iron, manganese, and sulfate, which have regulatory limits.

Section 7 – Groundwater Protection and Evaluation

The BWS believes that the existing groundwater flow model has been developed on too large a scale and may not accurately assess the contaminant fate and transport on a site-specific scale. Inclusion of newly derived data is necessary as additional site characterization tasks are completed.

The scale of the updated and calibrated groundwater flow model is not appropriate for the contaminant fate and transport model because there are presently insufficient data to adequately represent the preferential transport pathways in the a'a and pahoehoe flows. Appropriately representing the features governing plume and LNAPL migration will require much more field characterization and spatial refinement in both the flow and transport models. Fuel LNAPL and dissolved-phase plumes may be limited to a small volume within a few preferential pathways that will likely be essentially invisible to the coarser-scale groundwater flow model. The groundwater model will need to be refined spatially to match the scale of the basalt preferential transport pathways before undertaking transport modeling. Therefore, the field characterization program must be designed to provide data at the required spatial resolution.

The Rotzoll and El-Kadi (2006) groundwater model is not adequate for developing a defensible understanding of groundwater flow direction and rate within the aquifers around the Facility. This model and any descendant models cannot be refined without first remedying critical data gaps. For example, there are no data about the hydrogeologic framework or heads in South and North Halawa valleys between the Red Hill Facility and Halawa shaft. Data from recent USGS aquifer test (Oki, 2015b) indicate that a number of Red Hill wells responded to pumping changes at Halawa shaft, but the nature of these responses cannot be resolved without additional wells to establish the hydrogeologic framework and more aquifer tests.

TEC (2010) established that there are significant errors in the measurements for the TOC elevations for the Red Hill wells used to provide groundwater heads for calibrating the Rotzoll and El-Kadi groundwater flow model. These errors are large enough to create significant errors in groundwater heads used for model calibration, likely leading to model bias and larger than necessary uncertainty. The erroneous elevation for tops of casings must be addressed promptly so that groundwater heads can be recalculated with the necessary accuracy prior to conducting calibration of the updated model.

The location and thickness of valley-fill materials in the Halawa valleys remain an important data gap that must be addressed before any model updates. Rotzoll and El-Kadi (2007) simply assumed there was a barrier to groundwater flow between Red Hill and the Halawa Shaft called valley fill (see Figure 4-1 in TEC, 2007) along the North Halawa valley and cited a USGS groundwater modeling report (Oki, 2005) as justification. The modelers included this barrier even though there is no direct evidence that it exists; this represents a critical data gap. Actual borehole data supporting this conceptual model of a valley fill barrier in North Halawa valley are, however, limited to nonexistent (see page 17 in Oki, 2005). The modelers ignored Oki's findings that predicted groundwater levels in the Red Hill – Halawa area were essentially unchanged whether valley fill was present or absent in the model simulations: "Simulated water levels in the absence of valley-fill barriers generally were lower, by a few tenths of a foot or less, than simulated water levels using the base-case valley-fill barriers..." (page 53 in Oki, 2005). Comparison of the groundwater levels predicted in wells near Red Hill and Halawa Shaft show no apparent differences for simulations with and without the valley-fill barriers in the Oki (2005) simulations. The Oki (2005) groundwater flow model was not sensitive to the presence or absence of a valley-fill barrier in North Halawa valley given the available head data at that time. Nor did Rotzoll and El-Kadi test the sensitivity of their reported findings to the absence of a North Halawa valley-fill unit, which, given the importance of such an assumption, should have been tested thoroughly.

The Parties should require that the work plan ensure that the groundwater model files and draft report will be peer-reviewed by the BWS and at least one independent expert.

Numerous important data gaps must be remedied before beginning the modeling effort. The source areas in the vadose zone and the aquifer have not been defined or characterized. The basalt flows in the vadose zone and saturated zone at the Facility have not been described nor have their hydraulic and transport properties been quantified adequately. Transport modeling will be of little value without first acquiring an adequate and defensible understanding of the nature and extent of the fuel contamination.

The Parties should require that the work plan ensure that the solute transport model files and draft report will be peer-reviewed by the BWS and an independent expert.

Section 8 – Risk/Vulnerability Assessment

The planned quantitative risk assessment scope should include, at a minimum, the following items:

1. Engage independent, respected, established subject matter specialists
    a. Seismic Risk (including geotechnical hazards)
    b. Internal Systems Risk/Reliability Analysis (equipment failures, fires, human error…)
    c. Risk of penetration by ongoing corrosion-fatigue and probability of leak rate
    d. Ability to quantify the reliability of leak detection.
2. Independent peer review by well-respected, experienced experts.
3. The scope of the seismic risk assessment should include:
    a. Site-specific seismic hazard assessment.
    b. Further research damage to the tanks and piping due to 1948 earthquake.
    c. Evaluation of structure, system and component fragilities (conditional damage probabilities).
    d. Calculation of annual probability of damage (or release).
4. Identify and quantify internal risks
    a. Perform formal Failure Modes and Effects Analysis (or equivalent)
    b. Failure modes should include releases due to:

i. Weld defects
ii. Corrosion (combined inner and outside surface corrosion)
iii. Fatigue
iv. Equipment Failure
v. Fire
vi. Human Error or malevolent actions

The risk assessment should be started immediately using best available information, then revised after NDE/DT has been completed on tanks #1 and #19.

Part B – Additional Information Requests

BWS needs additional information regarding the condition of the tanks to determine the risk of future leaks that includes, but is not limited to the following topics. We respectfully request the following information from the Parties:

1. Welding methods used in original construction, filler metal used, plate alloy chemistry and specification
2. Weld inspection reports including any metallography or cross-sectional analysis of weldments, corrosion, or fatigue
3. Corrosion inspection reports
4. Welding method and electrodes used for the last repair welds that leaked in 2013/14 Tank #5 repair
5. Access to any reports regarding lessons learned from these weld repair induced leaks
6. Site specific seismic hazard curves
7. Site geotechnical characterizations (i.e., reports from geotechnical engineering studies)
8. Seismic fragility curves for structures, systems and components
9. Equipment failure records
10. Condition surveys of tanks and tunnels
11. Access to any plates and tell tails and their welds removed from the tanks, if any.
12. All reports and data related to the reasons that Tanks #1 and #19 have been permanently removed from service, and particularly any identified conditions that were unique to these tanks.
13. Updated Tank Inspection and Record of Maintenance intervals table from the Navy Audit Report (NAS, 2010)

14. All tank-related piping inspection information.

Thank you for your kind consideration of the items above. If you have any questions, please feel free to contact me at (808) 748-5061.

Very truly yours,

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

References

Navy Audit Service (NAS). 2010. Audit Report N2010-0049 Department of the Navy Red Hill and Upper Tank Farm Fuel Storage Facilities (NAS FOIA Case Number AUD-2015-0004).

Oki, Delwyn (USGS), 2005. Numerical Simulation of the Effects of Low-Permeability Valley-Fill Barriers and the Redistribution of Ground-Water Withdrawals in the Pearl Harbor Area, Oahu, Hawaii. Scientific Investigations Report 2005-5223.

Oki, Delwyn (USGS), 2015a. Personal communication with E. Kawata, Board of Water Supply,. Provisional top of casing elevations. March, 2015.

Oki, Delwyn (USGS), 2015. Personal communication with E. Kawata, Board of Water Supply,. Provisional head responses from 2015 aquifer test. July, 2015.

Rotzoll, K., and A.I. El-Kadi. 2007. Numerical Ground-Water Flow Simulation for Red Hill Fuel Storage Facilities NAVFAC Pacific, Oahu, Hawaii. Prepared for TEC Inc., August 2007. Honolulu, Hawaii.

TEC. 2007. Final Technical Report, Red Hill Bulk Fuel Storage Facility, Pearl Harbor, Hawaii, Contract Number N62742-02-D-1802, CTO 007, Aug 2007.

———. 2010. Type 1 Letter Report – Re-evaluation of the Tier 3 Risk Assessment/Groundwater Model & Proposed Course of Action Red Hill Bulk Fuels Storage Facility, Pearl Harbor, HI Contract Number N47408-04-D-8514, Task Order 54. May 4.