BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
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August 17, 2015

Mr. Steve Linder
United States Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105

and

Dr. Keith Kawaoka
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Linder and Dr. Kawaoka:

Subject: August 7, 2015 Meeting Between the Board of Water Supply (BWS), United States Environmental Protection Agency (EPA), and Hawaii Department of Health (DOH) to Discuss BWS Comments to the Proposed Administrative Order on Consent (AOC) and Statement of Work (SOW) on the Red Hill Bulk Fuel Storage Facility

Thank you for contacting BWS to request a meeting to discuss our comments to the Red Hill Fuel Facility AOC and SOW. We appreciated the opportunity to meet on August 7, 2015 to discuss your questions and areas needing additional clarification.

As discussed in our email transmittals dated August 5 and 6, 2015, the topics for the meeting were finalized as follows:

- Introductions
- BWS Overall Concerns Related to AOC
- EPA's New Underground Storage Tank (UST) Regulations
- Sole Source Aquifer Concerns
- Characterization of Risk to Water Supply
- Goals for Investigation and Cleanup
- Options and Actions to Increase Transparency
- Funding for Major Upgrades
- DOH and EPA Description of Process Going Forward and Associated Timelines

We reiterate our request that all questions and areas needing clarification be submitted to BWS from EPA and/or DOH in writing so that we can ensure we provide you the most thorough response. In the meantime, we are pleased to offer our formal responses to three topics that were discussed at the meeting; namely the application of the corrosion protection requirements to the Red Hill tanks under the new revised EPA UST regulations, multi-hazard risk assessment, and the potential site characterization approach for Red Hill.

Applicable Corrosion Protection Regulations:

Section IV.C.2 of the preamble to 40 CFR Parts 280 and 281, which addresses deferred field-constructed tanks such as those at Red Hill, states, in part:

> *This final UST regulation requires all airport hydrant systems and field-constructed tanks that routinely contain regulated substances and are in contact with the ground to meet corrosion protection requirements in § 280.252(b)(1). Metal tanks and piping which are encased or surrounded by concrete have no metal in contact with the ground and are not subject to the corrosion protection requirements (EPA, 2015).*

We have discussed this preamble section of the updated regulations at length, and offer the following interpretation. The second sentence of the excerpt above exempts *metal tanks* that are encased or surrounded by concrete. The Red Hill facility tanks are not metal tanks encased in concrete but, rather, reinforced concrete tanks with metal (steel) liners, as they have been described in technical documents, including:

- "Facilities consist of twenty steel lined concrete underground storage vaults; 100 feet in diameter and 250 feet high…" (Bechtel, 1949, p. 147)
- "It is assumed that the existing shell and concrete outside the liner, are in a condition suitable to continue as the primary structural element of the tank." (Enterprise Engineering, Inc., 1998, p. 27)
- "Since the original construction of the Red Hill tanks incorporated a concrete bearing wall (minimum 4 feet thick) behind the ¼ inch steel liner…" (Enterprise Engineering, Inc., 1998, Tab F)
- "The engineering evaluation was performed in accordance with the applicable sections of API Standard 653 Third Edition December 2001, Addendum 3 February 2008. API 653 has only limited application to this highly custom designed concrete tank with a steel liner." (Enterprise Engineering, Inc., 2008, p. 1)
- "In addition, the SI [Site Investigation] concluded that the aging of the Facility will increase the possibility that such a release could occur as a result of leaks breaching both the steel liners and concrete containment of the tanks. While the tank steel liners have been repaired, the concrete containment cannot be maintained." (TEC, 2008, p. ES-1)
- "Tank 6 was built in 1942 (completed 1943). Its nominal capacity is 302,000 barrels. The tank, like the others in Red Hill, is an underground concrete tank with a steel liner." (Weston, 2008, p. iii)

- "Tank 16 [sic] is an underground concrete tank with an internal steel liner." (Weston, 2008, p. 1-2)

The reinforced concrete shell provides the structural support for the thin steel liner. A steel tank without the concrete support would need to be constructed from much thicker steel or otherwise stiffened to prevent it from buckling. An internal steel liner can be much thinner since much of the load is supported by the thick reinforced concrete tank.

Since these are not *metal tanks*, a literal interpretation of this preamble exemption would not apply at Red Hill. Secondly, it appears that the intent of this exemption is to preclude the corrosion protection requirements of § 280.252(b)(1) for metal tanks that are already protected from corrosion by concrete encasement. This is not the case at Red Hill, as the steel tank liners are corroding from the inside (contact with product and impurities including water) as well as from the outside, where the condition of the concrete-to-steel interface is largely unknown.

For example, page 29 of the May 1998 report by Enterprise Engineering, Inc., regarding the condition and potential repair of Tank 19, describes both general and pitting corrosion on the outside surface of the steel liner, clearly indicating the concrete/grout is not protecting the steel liner. This report goes on to suggest a likely mechanism that may explain the non-protective nature of the concrete/grout. This mechanism suggests that beach sand and/or seawater rather than fresh water was used to make the concrete. The presence of chloride in concrete in sufficient quantities will reduce concrete's ability to protect the steel from corrosion. The volumetric expansion of the rust formed on the steel as a result of this corrosion will then act to crack the concrete. The cracks in the concrete allow water ingress to and along the steel concrete interface, further accelerating the corrosion process. Other mechanisms are also possible that allow the concrete to become non-protective to steel such as carbonation (reducing the alkalinity), diffusion of chloride into the concrete from the ground water, the presence of voids at the steel-concrete interface, etc. Nevertheless, whatever the mechanism, the concrete is not protecting the steel liner's exterior surface from corrosion.

Based on historic release information, the total amount of fuel leaked through the liner at Red Hill since construction is likely on the order of hundreds of thousands of gallons. It seems very unlikely that the intent of this exemption would be to exclude field constructed underground fuel tanks that are known to be corroding and have intermittently leaked since their construction, especially given that the UST regulations are intended to protect human health and the environment (Background section, page 41587 in US EPA, 2015) and remove previous deferrals for these tanks.

Furthermore, there is nothing in the wording of the regulations themselves that would exempt Red Hill from the corrosion protection requirements for deferred (in this case, field-constructed) tanks. Section 280.251 of Subpart K states, in part:

> *(c) Except as provided in § 280.252, owners and operators must comply with the requirements of subparts A through H and J of this part.*

The pertinent section in §280.252 that applies to corrosion protection states, in part:

> *(1) Corrosion protection. UST system components in contact with the ground that routinely contain regulated substances must meet one of the following:...*

Thus, the regulations require that deferred tanks comply with all subparts of §280 except for I, unless some relief is provided in §280.252. However, the pertinent section of §280.252 only provides alternate corrosion protection requirements for components *in contact with the ground* and, thus, would not strictly apply to the Red Hill tank liner. However, the situation at Red Hill is functionally similar: the interface between the outside face of the steel liner and the concrete tank wall is a corrosive environment causing significant, ongoing corrosion and associated leaks. Again, it seems very unlikely that the intent of the aforementioned §280.252 would be to exclude corrosion protection requirements for tank liners that are known to be corroding on both the inside and outside faces, causing leaks. Any interpretation of the updated regulations that allows exclusion of such corrosion protection from the Red Hill tanks cannot be protective of human health and the environment at the Red Hill Facility.

In summary, a rational reading of these regulations indicates that the Red Hill tanks represent a previously deferred system that would now be required to meet the same requirements, including corrosion protection and leak detection, as other regulated tanks as specified in Subparts A through H and J. In addition, we request a formal written determination on this point by the EPA's Office of General Counsel (OGC), Washington D.C.

<u>Multi-Hazard Risk Assessment:</u>

The AOC does not effectively address the risk to the drinking supply. Risk is not measured by just the probability of another leak, it is the product of the probability of a leak contaminating the sole source aquifer (hazard) and the consequence (cost). The AOC focuses on reducing the hazard, but does not adequately address the tremendous cost from the hazard occurring. The total cost would likely include the cost for investigating and cleaning up the leaked fuel, the cost for rehabilitating the failed tank, and the cost for potentially developing new water supplies, among others. Given the enormous potential costs of even a relatively small release, the probability of leakage must be very, very small to attain an acceptable risk. For perspective on the risk, consider that each tank has more storage capacity than did the Exxon Valdez; in essence, each tank is a 70+ year-old Exxon Valdez sitting 100 feet above a sole source aquifer. The question is whether the measures outlined in the AOC will be implemented quickly enough, and if such measures will result in a sufficiently low leak probability that the risk to the underlying sole source aquifer is acceptable.

Continued corrosion is not the only site hazard that could potentially cause significant leakage of fuel from the Red Hill tanks. For instance, a moderate earthquake (by today's design standards) in 1948, when the facility was still relatively new, reportedly caused a substantial leak (at least 35,000 gallons). Presumably, the site seismic hazard and associated risk of generating significant fuel leaks remains unmitigated, with perhaps increased risk due to the system fragility introduced by reported corrosion of the tank liners, pipelines and, presumably, connections.

Moreover, Red Hill pipelines could also be at risk due to soil hazards such as slides and differential settlement. Leaks could also be caused by human error or breakdown of engineered systems. Any decisions regarding appropriate mitigation measures to protect the aquifer must be based on a full, multi-hazard risk assessment. This notion is introduced in Section 8 of the SOW, but with little indication of what its nature and scope would be, which (if any) standards would be followed, or how the results of such an assessment would inform the Navy's leak mitigation strategies.

<u>Site Characterization</u>

A proper Red Hill site investigation provides the information needed to locate and clean up past fuel releases and to identify belowground monitoring points that will detect future fuel releases in a timely manner. To do this, the Red Hill site investigation should:

1. define the source area for the belowground contamination,
2. understand the site geology and hydrogeology,
3. determine the vertical and horizontal extent of contamination in the vadose zone (the rocks and soil between ground surface and the water table aquifer) and groundwater, and
4. identify where and how the contamination could travel in the subsurface. Site characterization methodologies (EPA 1997) call this migration pathways and routes of exposure for the contamination to reach potential receptors, such as people, water supply wells, and the aquifer.

Completing a detailed site investigation and developing a conceptual site model (CSM) are critical first steps before making decisions about clean up or carrying out an effective risk assessment (DOH, 2008; EPA, 1997). There are many guidance documents available from state, federal, and independent agencies that describe the steps for conducting site investigations and developing CSMs, for example, ASTM (2006), ASTM (2014), EPA (1997), DOH (2008), and the US EPA web site, including the "Characterization of the Source and Site" page (http://www.epa.gov/oust/lust/characterization.html). How these guidance documents are used at a given site depends on the type and amount of the contamination released and the complexity of the site's hydrogeology, and is up to the discretion of the investigation team and regulators (ASTM, 2006; ASTM, 2014; DOH, 2008; EPA, 1997). The list below summarizes the general steps for conducting site investigations.

- Identify the location of the source(s) and type(s) of fuel leaked (should identify past Red Hill releases and more recent releases), identify the associated chemicals of potential concern (COPCs), compile all existing data, and develop an initial CSM that identifies data gaps (ASTM, 2014; DOH, 2008; EPA, 1997)
- Design and implement a field program that includes conducting soil borings and installing monitoring wells (vapor, groundwater, perched water) that address these data gaps and achieves the site investigation objectives. The purpose of these initial sample locations are to (DOH, 2008; EPA, 1997):

- Evaluate the geology and hydrogeology of the site so that defensible estimates can be made of the rates and directions of groundwater flow;
- Identify preferential migration pathways ("fast paths") within the vadose and saturated zones;
- Determine the vertical and horizontal extents of the fuel in the vadose zone, fuel in the saturated zone, vapor-phase plume, and plume of dissolved contaminants in the groundwater;
- If encountered, collect data about the physical characteristics and chemical composition of the different fuels that are causing, or will cause belowground contamination;
- Collect site-specific data about the properties of the materials in the vadose zone and saturated zone that control the rate of contaminant migration.

- Evaluate the reliability and validity of field and laboratory measurements collected, update the CSM, and evaluate migration pathways, potential receptors, and the potential exposure pathways (ASTM, 2014; DOH, 2008; EPA, 1997). If additional data needs are required, design and implement additional field programs in an iterative process until the site investigation objectives have been met and the conceptual site model is complete (DOH, 2008; EPA, 1997).

The detailed site investigation will be completed once the objectives have been met and the CSM is finalized. Only then should a risk assessment or detailed environmental hazard evaluation can be conducted or corrective (clean-up) actions evaluated (ASTM, 2006; DOH, 2008 EPA, 1997).

All data collection activities must be conducted in accordance with a Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) (DOH, 2008) appropriate to the site and the objectives. Carrying out the site investigation using the QA/QC procedures outlined in the QAPP will improve the reliability and validity of field and laboratory measurements that will be used for decision-making purposes (DOH, 2008).

The application of these guidance documents to the Red Hill Facility will result in an effective site investigation and CSM that can be used for risk-based and corrective action decisions. However, the Red Hill site investigation must be designed to overcome the challenges posed by the thick sequence of a'a and pahoehoe basaltic lava flows that host the vadose zone and the basal aquifer system (Hunt, 1996, 2004). The physical characteristics of these basalt flows, such as scoriaceous breccias, open lava tubes, and collapsed lava tubes (MacDonald, 1972, Hunt, 1996, 2004) create preferential pathways for the transport of fuel and dissolved contamination. These preferential pathways can be locally deflected (deviating from a straight, down-slope direction) by paleo-topographic and/or paleo-environmental conditions encountered during emplacement of individual basalt flows (MacDonald, 1972). Given the relatively small scale of these preferential pathways, site investigation at Red Hill will require a much larger number of bores and monitoring wells to adequately characterize the site than would be needed for characterization of a fuel release in a different geologic environment. Without the proper scale or spatial resolution of site characterization activities, it will not be possible to select and design successful remedial alternatives for the Red Hill site.

At present, there are seven monitoring wells (Battelle and Parsons, 2015) that have been installed in the basal aquifer at Red Hill and 49 active soil vapor monitoring points which are located within the lower access tunnel (Navy, 2014). These wells should only be considered as a good start to the Red Hill site investigation. Many more vadose zone wells are needed to locate fuel that has leaked into the basalt flows surrounding the tanks. Many more groundwater monitoring wells are needed to locate where fuel has entered the groundwater. These vadose zone and groundwater wells will provide a good warning system for future fuel releases.

We reference several guidance documents that we feel are applicable to conducting a site investigation at Red Hill and there are many more that we do not reference that may be applicable. Most of these documents can be found at http://www.epa.gov/oust/lust/characterization.html. The DOH TGM is the most appropriate guidance to reference when planning and implementing a site investigation in Hawaii. The DOH TGM references the EPA guidance document cited above plus many other alternative references for site characterization activities. The DOH TGM can be found at http://www.hawaiidoh.org/tgm.aspx.

We look forward to the follow-up information you will be providing and the opportunity to review a revised draft of the AOC and SOW that will include a clear description of how your need for confidentiality will be addressed while satisfying the essential need for public transparency, access to all information on this facility, and robust public engagement process.

If you have any questions or would like to meet again, please call me at (808) 748-5061.

Very truly yours,

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

cc: Mr. Duane Miyashiro, Chair, Board of Water Supply
Mr. Jared Blumenfeld, EPA R-9 Administrator
Dr. Virginia Pressler, Director, Department of Health

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