BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
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June 19, 2018

Mr. Omer Shalev
EPA Red Hill Project Coordinator
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
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and

Ms. Roxanne Kwan
Solid and Hazardous Waste Branch
State of Hawaii
Department of Health
2827 Waimano Home Road
Pearl City, Hawaii 96782

Dear Mr. Shalev and Ms. Kwan:

Subject: Honolulu Board of Water Supply (BWS) Comments on the Red Hill Alternative Location Study, Red Hill Bulk Fuel Storage Facility (RHBFSF), Administrative Order on Consent (AOC) Statement of Work (SOW) Section 8.f, dated March 6, 2018

The BWS offers the following comments to the subject study.

The alternative location study was presented as a potential tank upgrade alternative (TUA) at the March 14, 2018 Public Meeting even though alternatives for tank relocation are not discussed in the TUA Report (Navy, 2017).

According to the study's site selection criteria, the potential alternative location must provide capability equal to or greater than the current capability at the RHBFSF. However, certain site selection factors, most notably scoring candidate sites on a minimum site ground elevation basis, needlessly disadvantages any site that is not located at the same elevation above sea level as the RHBFSF in favor of the existing RHBFSF site or another site in close proximity to it and over the drinking water aquifer. In our view this approach is flawed and fails to appropriately assess other reasonable alternatives.

The preferred tank relocation site alternative (site G), uphill from the RHBFSF, also increases the cost of relocation compared to the other TUA options. (See the handout provided by the Navy at the public meeting held on March 14, 2018 provided as part of Attachment A). It also extends the time needed for construction beyond the maximum duration specified in the AOC (Attachment A). In short, the study is selecting an alternative site that is costlier in both time and money compared to the TUA options (Attachment A), that effectively produces a decision that eliminates relocation as a likely outcome.

It was BWS' understanding that the study's purpose was to consider alternative sites that would satisfy the Navy's fuel storage needs and not be located over the drinking water supply. BWS believes several of the alternative locations identified in the study (e.g. Site A, C, and L) are viable options for accommodating the Navy's needs for a fueling facility while also greatly reducing the threat to Oahu's drinking water by not having the facility located over the potable water aquifer. The risk to the underlying drinking water aquifer is simply too great to consider building a new facility in the same Red Hill location as it would only prolong the existing problem and defer much-needed tank upgrades far into the future.

General Comments

1. The document describes itself as a "... comparison of risks and benefits between the current facility and alternative fuel storage facilities" associated with Section 8 of the AOC. This is an overstatement, as the report presents no comparative risk analysis regarding the overriding concern, that is, potential contamination of the aquifer. As discussed below, risk to the aquifer is not adequately represented in the Navy's choice and implementation of site selection factors.

2. The Navy is proposing a standard tank design for a nonstandard application of a very large (250 million gallons) fuel storage facility perched just above (approximately 100 feet) a sole-source aquifer. The potential consequences from a fuel leak into the aquifer could be severe, and therefore, the facility should be designed with a probability of failure (leak) that is much lower than that expected from off-the-shelf solutions. The BWS believes that any design of a facility of this magnitude over our drinking water aquifer should incorporate leak prevention features and redundancies that exceed those of a standard design.

Specific Comments – Navy Site Scorecard

The Navy ranks 12 sites on Oahu based on 14 site selection factors (Table 1). The BWS disagrees with the Navy's algorithm and the scoring values that led to its scoring values that led to its conclusion that alternative Site G (Kapūkaki, adjacent to the current RHBFSF) is best suited for relocation of the RHBFSF.

1. Some of the site selection factors used to evaluate the candidate sites are more important than others, and yet no weighting is utilized in the scoring. For instance, three of the fourteen selection factors are nominally related to aquifer contamination risk: Proximity to Drinking Wells, Sustainability and Resiliency, and Other Environmental Concerns. These factors should be more heavily weighted. Also, there is no indication of the uncertainty associated with each site selection factor, as it is typical to weigh uncertain scores lower than others.

   The most important environmental site selection factor for scoring sites for bulk storage of regulated product is whether a release could potentially contaminate a drinking water aquifer. This site selection factor was not scored, and its omission leads to unreliable results that should not serve as input to any reasonable relocation site selection. Instead, the Navy simply used proximity to a drinking water well as a site selection factor, which is not the same as the potential for migration of a release to a drinking water aquifer. Also, it appears some of the wells considered by the Navy are no longer in service.

2. The Navy's selection factor "Proximity to Drinking Water Wells" incorrectly implies that contamination potential scales with distance to a drinking water source by ignoring whether the site is located upgradient or downgradient (relative to the regional groundwater flow direction) of the water supply. Sites that are upgradient of water supplies pose a much larger risk than sites that are downgradient of the water supplies. All but one of the alternative sites considered lie inside the Hawaii Department of Health's Underground Injection Control (UIC) line (see Figure 4), which indicates that all but one have the potential to contaminate O'ahu drinking water. Only Site A is located outside the UIC line shown in Figure 4. Releases at sites proximate to the UIC line have less potential to contaminate the drinking water than those further inland and hydraulically upgradient.

3. Requiring that all tanks be located within a single site unnecessarily restricts relocation alternatives. For instance, Sites C and L could be combined into a single alternative (Site C+L).

4. Scoring sites on a minimum site ground elevation of 300-ft (100-ft cover + 50-ft tall tanks + 150-ft drop for gravity flow) arbitrarily skews the scores of many candidate sites. We believe it would be more defensible and less arbitrary to rank the elevation differential available for gravity flow as a function of distance from the pier (i.e., to maintain a minimum grade), such that closer sites need not

match the current elevation at the more distant RHBFSF. Also, as stated in the report, the 100-ft cover thickness could be reduced using higher strength cover fill (e.g., reinforced concrete).

5. Many cells of the scorecard require considerable local knowledge. Based on some candidate site scores, the BWS is concerned that Austin Brockenbrough & Associates, LLP may not have access to such insight regarding suitability of various sites.

The BWS believes that the flaws inherent to the Navy's site selection methodology materially impacted the ultimate site identified by the Navy as the "best choice" for tank alternative locations. Upon further consideration of the concerns listed above, it becomes clear that other tank alternative location options may be preferable. For example, consider a new alternative location comprising Site C (Makalapa Crater Military Housing Area) and Site L (NAVFAC Hawaii Facilities) together. Most importantly, this composite Site C + L lies close to the UIC line (Figure 4), and thus any spills or leaks at this site would pose little risk to the aquifer compared to Site G (Kapūkaki) located near the RHBFSF. The tanks spaced as described in the relocation alternative report would fit within this composite Site C+L; an example layout is shown in Figure 5.

To demonstrate how the report's alternative site selection conclusion might change if one considers this potential combined Site C+L and then addresses the concerns above, the BWS offers an illustrative modification of the Navy scorecard. While the BWS does not endorse the methodology prescribed by alternative location study for scoring candidate tank relocation sites, the original Navy scorecard has been modified in three ways to provide a comparative score for this combined site. First, a row was added for a new site selection factor - the location of each site relative to the UIC line. Second, a column was added to represent the composite Site C+L. Third, scores for the new row and column were determined by BWS best judgement, based on local knowledge of the area, including the presence/absence of any *operational* drinking water wells. As seen in the attached Table 1, after these simple changes the composite Site C+L scores in the modified scorecard at least as well as Site G (Kapūkaki, just uphill of the existing RHBFSF), the top site in the original Navy scorecard. If the site selection factors related to environmental risk were to be given higher weight than those pertaining to cost or constructability, the composite Site C+L would easily outscore Site G. This exercise demonstrates that, notwithstanding the scores provided in the subject report, other relocation alternative sites may be just as suitable as the Navy's top choice, but even more protective of our drinking water.

Specific Comments - Tank Design

We offer the following comments based on referenced standard drawings (DOD Standard Design AW 78-24-33), referenced design standard (UFC 3-460-01), and photographs of construction similar to what is contemplated in the subject relocation report (Figure 1).

1. To our knowledge the referenced plan set (AW 78-24-33) is dated 2010, which predates latest EPA UST regulations. Has the plan set been modified or shown to meet these updated regulations? If not, the report should be updated with a plan set that do meet EPA UST regulations.

2. Plan Set Sheet S101, Tank Note 1 requires the tanks to be fabricated, erected and tested per API 650 (Figure 2). Also, Sheet S101, General Note 2 requires the tanks to be erected and tested prior to constructing the concrete walls (Figure 2). In past AOC meetings and as stated in EEI 2008, the Navy has shown reluctance to water test the tanks at the RHBFSF. The BWS believes that this testing is critical to demonstrating the structural soundness and leak tightness of large, field-constructed tanks, and we recommend that these tanks be water tested to full depth per API 650 prior to filling with fuel. Furthermore, API 650 x-ray radiographic testing of all tank wall welds should be performed, as well as vacuum testing for tank bottom welds.

3. From our review of the referenced materials, it is unclear whether the geosynthetic drainage mat or the reinforced concrete wall is intended to be the secondary barrier (Figure 3). The drawings require the reinforced concrete be designed per ACI 318-05 (Figure 2), but the intent of those provisions is not waterproof construction, which requires special detailing and reinforcing. In addition, the drawings do not call for a watertight geosynthetic drainage layer membrane, nor are there provisions to protect it during construction (such as erecting a rebar cage immediately adjacent). The tank design should include explicit requirements for a reliable secondary containment barrier design capable of containing leaks into an interstice that allows continuous leak monitoring.

4. The final design of the tanks will likely differ substantially from the standard design of the Plan Set. The proposed volume is half again greater than the largest standard tank in the referenced design (maximum volume in Standard Design AW 78-24-33 is 100,000 barrels (bbl); proposed tank size is 150,000 (bbl), and the overburden load (weight of soil cover) on the tank roof from 100 feet of fill will overwhelm the roof structures of the standard design.

If you have any questions, please feel free to contact Erwin Kawata, Program Administrator of the Water Quality Division at 808-748-5061.

Very truly yours,

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

cc: Mr. Steve Linder
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Attachments

Figures 1 - 5
Table 1
Attachment A: Red Hill Tank Upgrade Alternatives (TUA) Report Summary handout from the public meeting held on March 14, 2018

References

Department of the Navy (Navy). 2018. Administrative Order on Consent Statement of Work Section 8.f, Red Hill Alternative Location Study, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oahu, Hawaii. March 6.

Department of the Navy (Navy). 2017. Administrative Order on Consent Statement of Work Section 3.3 Tank Upgrade Alternatives Report, Red Hill Bulk Fuel Storage Facility (Red Hill), Joint Base Pearl Harbor-Hickam, Oahu, Hawaii. December 8.

E. Y. W. Lau, P.E. (Lau). 2018. Board of Water Supply (BWS) Comments on the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Section 3 Tank Upgrade Alternatives (TUA) Report dated December 8, 2017. Letter to Mr. Omar Shalev, Environmental Protection Agency (EPA) and Ms. Roxanne Kwan, Hawaii Department of Health. February 12.

Figure 1.

Photograph 2.2-11 from Relocation Report showing drainage mat that comprises the inboard formwork for the concrete pour, and therefore no opportunity to coat it per the requirement of Steel Tank Note 8 on Sheet S101

Photograph 2.2-11

Geosynthetic drainage layer (black material with dimples).

Figure 2.

Excerpted requirements from notes on the referenced DoD Standard Design AW 78-24-33, Sheet S101.

STEEL TANK NOTES:

1. EXCEPT AS SHOWN OR MODIFIED HEREIN OR IN THE CONTRACT SPECIFICATIONS, THE TANK SHALL BE FABRICATED, ERECTED AND TESTED IN ACCORDANCE WITH AMERICAN PETROLEUM INSTITUTE STANDARD (API) 650. TENTH EDITION, NOV. 1998 W/ADDENDUMS 1,2 AND 3, WELDED STEEL TANKS FOR OIL STORAGE.
2. STEEL PLATES SHALL CONFORM TO THE REQUIREMENTS OF API 650, SECTION 2, BASED UPON THE DESIGN METAL TEMPERATURE.
3. SHELL PLATES AND ROOF PLATES SHALL HAVE A MINIMUM THICKNESS OF 6. BOTTOM PLATES SHALL HAVE A MINIMUM THICKNESS OF 8. PLATE JOINTS SHALL HAVE 100% PENETRATION WELDS. FILLET WELDED LAP JOINTS ARE NOT ALLOWED.
4. STAINLESS STEEL PLATES SHALL CONFORM TO ASTM A 240, TYPE 304
5. CAPACITY
   A. MAXIMUM CAPACITY = 2021 m^3 (12,700 BBL'S)
   B. NET WORKING CAPACITY = 1591 m^3 (10,000 BBL'S)
6. DESIGN METAL TEMPERATURE = -8.3° C
7. CORROSION ALLOWANCE = 0mm ROOF AND BOTTOM PLATES
   2mm SHELL PLATES
8. INTERIOR AND EXTERIOR SURFACES INCLUDING INTERSTITIAL SPACE OF THE TANK SHELL SHALL BE PROVIDED WITH A PROTECTIVE COATING.

GENERAL NOTES:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK AND THE CONTRACTING OFFICER SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCY.
2. STEEL TANK SHALL BE ERECTED AND WATER FILL TESTED PRIOR TO PLACEMENT OF CONCRETE WALL AND ROOF SLABS.

MATERIAL NOTES

CONCRETE AND REINFORCEMENT: (SHALL CONFORM TO ACI 318-05)

Figure 3.

Cross section of tank wall depicted in Detail A of the referenced DoD Standard Design AW 78-24-33, Sheet 302, also showing concrete cast tight against drainage mat, precluding opportunity to coat the concrete.

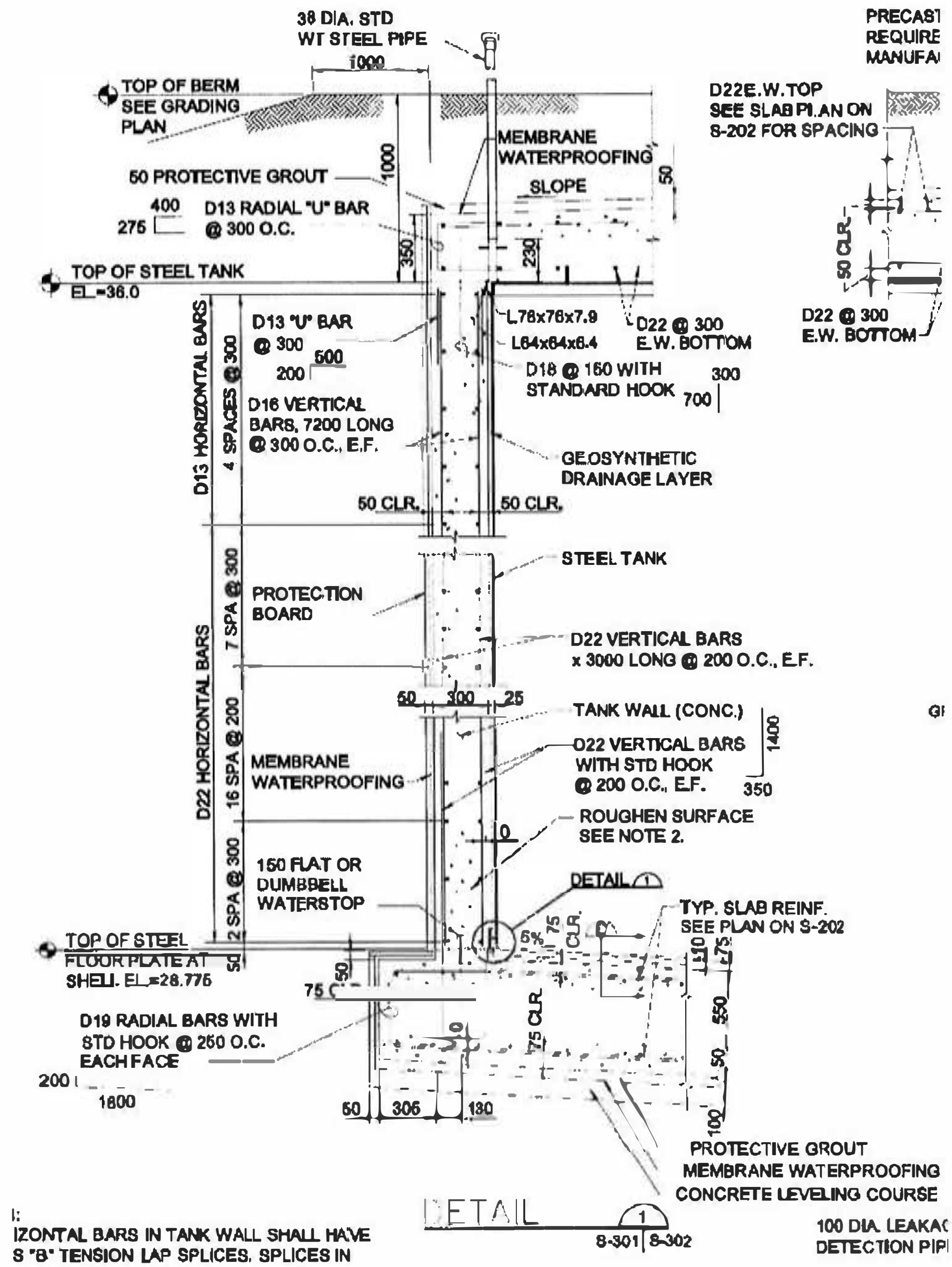

Figure 4.

Locations of alternate sites scored in the Navy relocation report. Cyan line indicates the underground injection control line, which is adapted from DOH webserver (http://histategis.maps.arcgis.com/apps/Viewer/index.html?appid=4261e15895cc46fd82cd5e8e396fdf63) on April 30, 2018.

Site A: Hickam Field
Site B: Navy-Marine Golf Course
Site C: Makalapa Crater Military Housing Area
Site D: Salt Lake District Park
Site E: Aliamanu Military/Coast Guard Reservation
Site F: Quarry
Site G: Kapūkaki
Site H: Adjacent to Tripler Army Medical Center
Site I: Adjacent to Fort Shafter
Site J: Campbell Industrial Park
Site K: Lualualei Naval Magazine
Site L: NAVFAC Hawaii Facilities (between Marshall Road. and Namur Road)

Figure 5.

BWS Composite Site C+L (approximated by blue shading) showing one possible tank layout.

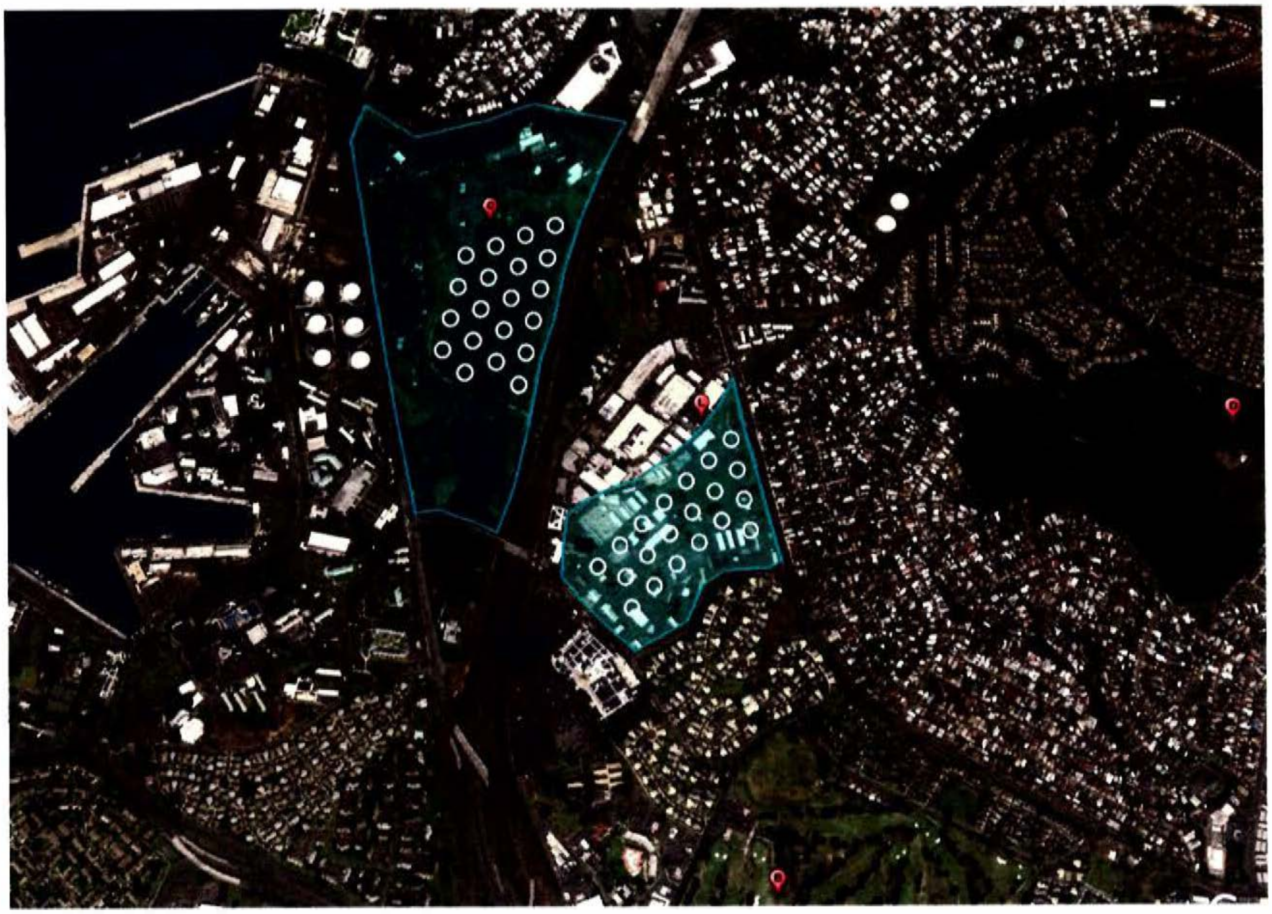

Table 1.

Navy relocation site scorecard modified to include new site (C+L) and new site selection factor (Proximity to UIC Line). Original Navy results are in grey, while the BWS modifications are in black.

SITE SELECTION FACTORS	POTENTIAL SITES Points Scale: 0 (extremely unfavorable) to 10 (extremely favorable)												New Site
	'A'	'B'	'C'	'D'	'E'	'F'	'G'	'H'	'I'	'J'	'K'	'L'	'C+L'
[illegible]	8	8	0	0	0	10	5	10	10	5	10	5	10
[illegible]	7	3	0	5	5	0	8	7	7	10	3	3	7
[illegible]	10	10	10	0	10	0	10	0	0	5	10	10	10
[illegible]	8	0	5	0	5	10	10	5	5	10	7	5	5
[illegible]	0	0	0	5	5	10	10	10	10	0	10	0	0
[illegible]	3	5	5	5	5	5	5	5	5	5	5	5	5
[illegible]	5	0	2	0	0	0	0	5	0	5	5	0	10
[illegible]	5	5	5	5	5	10	2	5	5	10	5	3	4
[illegible]	5	5	10	5	10	7	10	3	0	0	0	7	10
[illegible]	1	1	1	5	5	10	7	7	7	3	5	3	3
[illegible]	0	1	1	1	5	5	8	5	5	0	0	1	1
[illegible]	0	1	4	0	5	3	8	3	3	0	0	1	10
[illegible]	0	0	1	8	8	10	8	7	6	0	0	0	10
[illegible]	10	2	3	3	1	8	10	7	6	1	10	3	6
TOTAL POINTS in original Navy Scorecard	62	41	46	42	72	88	101	77	65	54	68	46	
Proposed BWS Selection Factor: Proximity to Underground Injection Control Line 10 = site is below or near UIC 0 = site is well mauka of UIC	10	10	10	0	0	0	0	0	0	10	0	10	10
TOTAL POINTS including new selection factor and Site C+L	72	51	56	42	72	88	101	77	65	64	68	56	101

Attachment A: Navy's "Red Hill Tank Upgrade Alternatives (TUA) Summary", Public Meeting, March 14

14 March 2018

Red Hill Tank Upgrade Alternatives (TUA) Report Summary

The TUA report, submitted to the Environmental Protection Agency (EPA) and Hawaii Department of Health (DOH) on 8 December 2017, is one of many sources of information to be used in evaluating options for selecting a tank upgrade. The TUA report does not make decisions or recommendations. It provides stakeholders (Navy, Defense Logistics Agency (DLA), EPA, and Hawaii Department of Health (DOH)) with a technical evaluation of six upgrades under consideration, rating each upgrade against 18 attributes. The purpose of the report is to provide sound engineering concepts for consideration by all stakeholders and when combined with the other sources of information derived from the Administrative Order on Consent (AOC) process, stakeholders are provided with the necessary material to select the best TUA for eventual implementation.

The report is the result of a collaborative effort among all stakeholders. This collaboration began with 23 TUAs that were evaluated, most of which were quickly ruled out as not being feasible for this application. Six remaining alternatives were selected as worthy of more in-depth study. This engineering report details these six alternatives: three single-wall and three double-wall alternatives.

- Single wall designs:
  - 1A - Improved repair and restoration of existing tanks
  - 1B - Improved repair and restoration, and add interior coating
  - 1D - Replace tank steel liner and add interior coating
- Double wall designs:
  - 2A - Composite Tank, Carbon Steel, with interior coating
  - 2B - Composite Tank, Stainless Steel
  - 3A - Tank within a Tank, Carbon Steel with interior and exterior coatings

While the report shows that each of the above alternatives is feasible to complete within the time constraints of the AOC, each has its share of pros and cons and inherent risks which need to be further evaluated. For example, while each TUA, 1A through 3A, provides a seemingly greater degree of environmental protection, each of these proposed projects is also progressively more complex and time consuming to complete. Added complexity and duration adds greater risk to the successful completion of the project; that is, the greater the complexity the higher the degree of uncertainty that the upgrade will ultimately perform as expected. These are issues we will be working to resolve in the coming months.

Alternative 1A is the prevailing maintenance practice utilized at Red Hill in which the tanks are taken out of service, cleaned, tested, inspected, repaired and returned to service. The inspection and repair process is an improved process over previous years incorporating many enhancements after completing a thorough review. The best available inspection technology and procedures, with several layers of oversight have been prepared specifically for Red Hill.
Estimated construction costs per tank: $10 to $25 Million.
Pros - Readily inspectable; Lowest project risk
Cons - No secondary containment

Alternative 1B is the same as alternative 1A but 100% of the tank's interior surface is coated with a proven epoxy paint. Under alternative 1A, only the bottom barrel is coated with the epoxy paint.
Estimated construction costs per tank: $25 to $100 Million.
Pros: Additional liner..., Readily inspectable; Low project risk
Cons: No secondary containment

Alternative 1D entails removing the existing steel liner by cutting/grinding the welds joining the plates to each other while leaving the existing back ribs/structural supports in place, inspecting the remaining structure for integrity and suitability for reuse, and installing new 1/4-inch thick carbon steel plates.

14 March 2018

Estimated construction costs per tank: $100 to $250 Million
Pros: Completely new steel liner; Readily inspectable
Cons: No secondary containment; High construction risks

Alternative 2A consists of a new 1/4-inch thick carbon steel liner structurally attached to the existing steel liner creating a double wall assembly with an approximately 3" interstitial space that will be used to monitor for leaks. The new steel liner would serve as the primary tank envelope and the existing steel liner will serve as the secondary containment. For structural reasons, the interstitial space will be filled with concrete or similar product yet permit for leak detection. The interior surface of the new steel liner would be protected with an epoxy paint.
Estimated construction costs per tank: $25 to $100 Million
Pros: Completely new inner liner; Secondary containment
Cons: High project risk; No project of this scale has ever been attempted; Reduced volume

Alternative 2B is constructed the same as 2A except the new interior lining would be made with 3/16" thick stainless steel. Stainless steel (SS) will eliminate the need to coat the new interior tank surface.
Estimated Construction Costs per tank: $100 to $250 Million
Pros: Completely new SS inner liner; Secondary containment
Cons: High project risk; No project of this scale has ever been attempted; Reduced volume

Alternative 3A involves constructing a carbon steel tank inside the existing tank. A 5'-0" wide annular space around the new tank would be provided to allow inspection of the new tank exterior surface and the interior surface of the existing steel liner. The new tank would be designed in accordance with American Petroleum Institute, API 650 and anchored and braced to resist movement caused by seismic ground motion. The existing tank steel liner would serve as the secondary containment barrier.
Estimated Construction Costs per tank: $100 to $250 Million
Pros: Complete new inner liner/tank; Secondary containment; Inner and outer containment inspectable
Cons: High Project Risk; Seismic concerns; No project of this scale has ever been attempted; Most reduced volume

Further details and features of the each one of the alternatives are explained and rated in Part E of the TUA report. Part D defines the 18 attributes developed by all stakeholders which rate each TUA's ability to address the criteria of each attribute from an engineering perspective with considerations for general construction, environmental release detection, testing and commissioning, inspection / repair / maintenance requirements, operations, and construction cost and duration. Part F tabulates the six TUAs and their related attribute ratings within these categories. The remaining parts and appendices of the report provide detailed background and supporting information, concept drawings, and specific construction, execution, and cost considerations for use by the decision makers.

Alternate Location Study evaluated 12 potential locations on Oahu and ranked them on 14 different selection factors. The results of this preliminary study indicate that the existing U.S. Government property northeast of the current Red Hill facility is well suited as an alternate site location. The concept would involve the construction of 40 new "cut and cover" tanks (each tank half the capacity of the existing 20 Red Hill tanks). The report provides a detailed explanation of the site selection factors and evaluation process and also explains cost and construction time estimates. The study is available on the EPA website.
Estimated Construction Costs per tank: $100 to $250 Million
Pros: Completely new tanks meeting all USG and Hawaii regulations, Secondary Containment
Cons: Construction duration exceeds AOC deadlines, Most costly

The complex TUA decision involves gathering various data sourced from multiple engineering, environmental, and social disciplines. Each will be weighed and evaluated by multiple stakeholders with varying priorities.