Red Hill Administrative Order on Consent, Statement of Work (SOW),

Section 4.3: Current Fuel Release Monitoring Systems Report

In accordance with the Red Hill Administrative Order on Consent, paragraph 9, DOCUMENT CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fines and imprisonment for knowing violation.

Signature: D.T.

CAPT Dean Tufts, CEC, USN
Regional Engineer, Navy Region Hawaii

Date: 4/4/16

RED HILL FACILITY

CURRENT FUEL RELEASE MONITORING SYSTEMS REPORT

ADMINISTRATIVE ORDER OF CONSENT (AOC) STATEMENT OF WORK (SOW), SECTION 4.3

4 APRIL 2016

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CHAPTER 1 - INTRODUCTION

1-1 BACKGROUND

On December 9, 2013, the Navy placed one of the Tanks (Tank No. 5) at the Red Hill Facility back into service after it had undergone routine scheduled maintenance. The maintenance work consisted of cleaning, inspecting, and repairing multiple sites within the tank. Upon placing Tank No. 5 back into service, the Navy commenced filling the tank with petroleum on December 9, 2014. On January 13, 2014, Navy discovered a loss of fuel from Tank No. 5 and immediately notified the State of Hawaii Department of Health (DOH) and the Environmental Protection Agency (EPA).

In response to the fuel release reported by the Navy, an Administrative Order of Consent (AOC) between the Navy, EPA, and the DOH [1] provides for the performance by the Navy and DLA of a release assessment, response(s) to release(s), and actions to minimize the threat of future releases in connection with the field-constructed bulk fuel USTs, surge tanks, pumps, and associated piping at the Red Hill Bulk Fuel Storage Facility located near Pearl Harbor, on the island of Oahu in the State of Hawaii.

Commander, Navy Region Hawaii (CNRH) has reporting authority for tenant commands with oversight of the Red Hill Fuel Facility: NAVSUP Fleet Logistics Center Pearl Harbor (FLCPH) operates the facility, Naval Facilities Command Hawaii (NAVFAC-HI) maintains the facility, and Defense Logistics Agency (DLA) funds the facility. These commands are located at buildings 150, 1757, X-11, and 479, respectively, on Joint Base Pearl Harbor-Hickam (JBPHH).

1-2 PURPOSE AND SCOPE

The purpose of this Current Fuel Release Monitoring Systems Report is to document the current release detection system and tank tightness testing procedures used at the U.S. Navy's Red Hill Fuel Facility and evaluate these procedures, in accordance section four of the Administrative Order on Consent [1]. The report includes an explanation of recordkeeping procedures, re-filling procedures for tank re-commissioning, filling procedures for daily operations, release detection systems and methods, release detection sensitivity, and previous market surveys for applicable leak detection systems.

CHAPTER 2 - RECORDKEEPING PROCEDURES

2-1 INTRODUCTION

This section of the report provides detailed descriptions of FLCPH's recordkeeping practices and procedures in regards to Red Hill Fuel Facility's associated fuel release monitoring systems.

2-2 AUTOMATED FUEL HANDLING EQUIPMENT (AFHE) AND FUEL MANAGER DEFENSE (FMD) RECORDS

Fleet Logistics Center Pearl Harbor (FLCPH) utilizes an integrated distributed control and real-time monitoring system with their fuel handling and storage system which is titled, the Automated Fuel Handling Equipment (AFHE) system. This system is designed to improve the efficiency and safety of fuel operations by providing remote monitoring and control of fuel storage and transfer operations plus improving data management. AFHE's primary function is to accurately track the overall product inventory on site through the System's Inventory Database. The Inventory database is designed to accurately track the inventory in a real-time mode by comparing the Tank Inventory (Gross and Net Volumes) and adding the Pipeline volume (a function of known pipeline capacity in relation to pipeline slack). [11]

The AFHE System can be utilized to create or supply the information necessary for the following Inventory Reports (samples provided in Appendix C):

- Product Inventory – Daily & Summary Report
- Barge/Truck Inventory – Daily & Summary Report
- Tank Inventory by Tank – Daily & Summary Report
- Tank Inventory by Product – Daily & Summary Report
- Evolution Ticket; provides detailed information regarding one fuel transaction. An "evolution" is a term used to describe any intentional movement of fuel.
- Evolution Fuel Transfer – Daily & Summary Report; provides information about Fuel Transactions grouped by product type.
- DD Form 1348-7: Department of Defense's MILSPETS Defense Fuel Supply Point Shipment & Receipt document
- Material Inspection and Receiving Report (DD Form 250); this is the Department of Defense's standard Issue/Receipt statement.

Fuels Manager Defense is FLCPH's primary means of accounting for fuel inventories at Red Hill Fuel Facility. Varec, Inc. is contracted by the U.S. Defense Energy Support Center (DESC), beginning in 1995, to employ the latest technologies to provide an automated information system for all parties involved in the U.S. Department of Defense (DoD) Energy program. This included migrating the Fuels Automated Management System (FAMS) and service related features with the development of the Fuels Automated System (FAS), now known as BSM-Energy. As a fully developed, Commercial-off-the-Shelf (COTS) product, FuelsManager Defense contains numerous additional features, while retaining all the benefits of the currently deployed system. FuelsManager Defense is integrated with the Microsoft® Windows® 2000, XP and 2003 operating systems. The application consists of client/server and web-based applications that employ the latest technologies to improve data integrity and eliminate the data corruption problems experienced with the previous system. [8]

All of FLCPH's transactions are entered into FuelsManager Defense (FMD) to be electronically shared with the Department of Defense's fuel inventory managers, Defense Logistics Agency. All transactions entered into FuelsManager Defense are stored electronically on a server that is located in building 2125 of JBPHH.

2-2.1 Location of records

2-2.1.1 Primary retention location

Physical copies of documents listed in section 2-2 are retained in building 1757 on JBPHH, while the originals are kept in building 2125 on JBPHH. All of DLA's electronic FMD inventory and data records are retained electronically on a local Business Systems Modernization – Energy (BSM-E) server in building 2125 on JBPHH.

2-2.1.2 Secondary retention location

All of DLA's FMD Inventory and data records must be saved to backup media devices, which are stored away from the BSM-E server, in a location with a different physical address. Therefore, they are stored in building 1757 on JBPHH. [6]

2-2.2 Retention periods

FLCPH retains inventory and data records in accordance with DLA Energy-P-3 and/or DLA Energy Contract Clause I119.04, or I119.05 as applicable. [5] Physical copies of FLCPH's inventory and data records are retained for 3 years (current year plus two additional fiscal years). [6]

All BSM-E electronic data including FMD, ADC or APOSD, FuelMaster®, FuelsManager® and LeakManager™ databases shall be backed up upon completion of End-of-Month (EOM) closeout procedures. The monthly backup media are labeled to reflect the Fiscal Year (FY), data calendar month and date the monthly data backup was completed. Upon successful completion of the End of Year (EOY) closeout actions, the twelve monthly backup media are packaged together and retained for 6 years and 3 months as the Fiscal Year Backup. FLCPH currently stores their twelve month backup media devices in building 1757, on JBPHH. [6]

2-3 TANK TIGHTNESS REPORTS

Tank Tightness Testing (TTT) of the U.S. Navy's Bulk Field-Constructed Underground Storage Tanks (BFCUSTs) at Red Hill are conducted annually to meet the Administrative Order on Consent (AOC) between the Commander Navy Region Hawaii, Defense Logistics Agency (DLA) Energy, the State of Hawaii Department of Health, and the United States Environmental Protection Agency Region 9. This is the U.S. Navy and DLA's primary method of determining the tank's ability to retain fuel which is now conducted on an annual basis, in accordance with the AOC/SOW. [1] Prior to the AOC/SOW agreement, DLA Energy agreed to test the Red Hill tanks biennially, so NAVSUP has records of tank tightness tests that were conducted in 2009, 2011, 2013, and 2015. Red Hill tanks nine and fifteen were not included in the 2009 report because they were part of the U.S. Navy's Leak Detection Market Survey in 2008.

2-3.1 Location of records:

2-3.1.1 Physical copies of the TTTs are retained in building 1757 on JBPHH, while electronic copies are retained on NAVSUP-E's server at Ft. Belvoir, VA.

2-3.2 Retention period:

2-3.2.1 Retained indefinitely

2-4 SOIL VAPOR MONITORING RECORDS

2-4.1 Location of records:

2-4.1.1 Physical copies of the TTTs are retained in building 1757 on JBPHH, while electronic copies are retained on NAVSUP-E's server at Ft. Belvoir, VA.

2-4.2 Retention period:

2-4.2.1 Retained indefinitely

2-5 GROUND WATER INTERFACE TESTING RECORDS

2-5.1 Location of records:

2-5.1.1 Physical copies are retained in buildings X-11, 479, and 1757 on JBPHH.

2-5.2 Retention period:

2-5.2.1 Retained indefinitely

2-6 GROUND WATER MONITORING REPORTS

2-6.1 Location of records:

2-6.1.1 Physical copies are retained in buildings X-11, 479, and 1757 on JBPHH.

2-6.2 Retention period:

2-6.2.1 Retained indefinitely

CHAPTER 3 - DYNAMIC RE-FILLING PROCUDURES FOR TANK RE-COMMISSIONING

3-1 INTRODUCTION

FLCPH considers newly returned to service (RTS) tanks as suspect for potential leaks, establishing and following specific operational and facility management controls with the goal of preventing environmental fuel releases. [7]

3-2 PREVIOUS DYNAMIC RE-FILLING PROCEDURES FOR TANK RE-COMMISSIONING

Since 2008, it has been a standard practice within FLCPH to develop and adhere to fill plans whenever returning a tank to service after a prolonged out-of-service period. In May of 2015, NAVSUP Global Logistics Support (GLS) standardized the criteria for planning and executing all return to service procedures throughout the U.S. Navy. Today, all of NAVSUP's commands follow GLS's 10345.1 instruction titled, "FUEL TANK RETURN TO SERVICE."

3-3 LESSONS LEARNED FROM RED HILL TANK 5

At the time, the Navy over-relied on the capabilities of the contractor to inspect and validate the recently overhauled tank's operability, so operators presumed the alarms were falsely activated and did not immediately react. To ensure this does not happen again, the Navy has adopted new control measures to improve its monitoring procedures and response to alarms. The Navy has issued and implemented new Standard Operating Procedures (SOPs), revised its response to Unscheduled Fuel Movements (UFMs), and incorporated oversight in its quality assurance program.

In accordance with Naval Supply Systems Command (NAVSUP) Global Logistics Support instruction 10345.1, FLCPH employs operational and facility management controls when pumping fuel back into empty tanks. For example, FLCPH develops & employs a fill plan that identifies appropriate flow rates, frequency of trend analysis & manual measurements, and fill heights. After reaching predetermined heights, FLCPH ceases pumping for a minimum of 48 hours in order for the fuel to settle and collect accurate inventory measurements. FLCPH also conducts a trend analysis every four hours. Generally, we only conduct fuel pumping during normal working hours when a full staff is on duty. We follow these procedures for each tank returned to service after a major overhaul. The Navy takes this careful and measured approach in order to prevent fuel spills.

3-3.1 Provide 2014 re-commissioning tank fill procedures

The Fill Plan for Tank 5's re-commissioning is located in Appendix [J]

3-4 CURRENT TANK RE-FILLING PROCEDURES FOR TANK RE-COMMISSIONING

3-4.1 NAVSUP Global Logistics Support (GLS) Instruction 10345.1 implementation at FLCPH

FLCPH considers newly returned to service (RTS) tanks as suspect for potential leaks, establishing and following specific operational and facility management controls with the goal of preventing environmental fuel releases. All tanks containing petroleum, oil, or lubricant products under formal inspection programs, such as American Petroleum Institute Stand 653, Steel Tank Institute Standard SP001, Petroleum Equipment Institute Recommended Practice RP900, and Fiberglass Tank and Pipe Institute Recommended Practice 2007-1 must comply with NAVSUP Global Logistics Support's instruction 10345.1

Prior to returning a tank to service, the NAVSUP Fleet Logistics Center (FLC) Regional Fuels Engineers:

- Review any maintenance and repair actions performed on the tank, looking for areas that might pose an environmental risk.
- For tanks previously under the control of another organization (e.g., if the tank was being repaired by an Execution Agent), coordinate and review proper turnover documentation with the Execution Agent. At a minimum, the following is required:
    - A statement signed by an appropriately certified tank inspector indicating the tank is suitable for return to service including any caveats, clarifications, or limitations that would affect tank operations after return to service. The statement includes due dates for the next applicable formal inspections (internal, external, and leak test) and any repairs required prior to these next inspections
    - A completed inspection report compliant with the applicable code including all required calculations and analysis. Preliminary or field reports cannot be substituted for this requirement.
    - List of repairs identified during the inspection, including completed repairs and repairs that are still pending. All pending repairs are annotated with the due date.
    - Third-party certified calibration ("strapping") charts when a tank is first placed in service when certified calibration charts did not previously exist, or when repairs were made that would be reasonably expected to change the tank's calibration.
    - A statement signed by an agent of the Execution Agent and repair contractor that custody of the tank is returned to the activity and the items in paragraph 3.b.(1)(b) have been provided to the NAVSUP FLC. [7]

TANK COMPLETION CHECKLIST

PART I - TO BE COMPLETED BY SUBMITTING ORGANIZATION

1. SITE NAME | 2. TANK IDENTIFIER

3. TANK ACTION TYPE (check all that apply)
- ☐ Internal Inspection ☐ Internal Repair ☐ External Inspection ☐ External Repair
- ☐ Leak Test ☐ Tank Construction ☐ Tank Retirement / Demolition
- ☐ Other (enter details to right)

4. EXECUTION AGENT (EA) INFORMATION

4a. EA NAME | 4b. EA POC NAME | 4c. EA POC E-MAIL / PHONE

5. CONTRACTOR INFORMATION

5a. CONTRACTOR NAME | 5b. CONTRACT NUMBER

5c. CONTRACTOR POC NAME | 5d. CONTRACTOR POC E-MAIL / PHONE

6. SUITABILITY FOR SERVICE STATEMENT

6a. PROVIDED? ☐ Yes ☐ No | 6b. NEXT EXTERNAL REQUIRES UT? ☐ Yes ☐ No

6c. DATES	OOS	Inspect	Repair Start	Repair Complete	Next Due
INTERNAL					
EXTERNAL					
LEAK TEST					

6d. DATES VERIFIED AS MAX ALLOWABLE BY CODE FROM COMPLETE DATE? ☐ Yes ☐ No

6e. NOTES

7. STATEMENT OF CUSTODY TRANSFER BACK TO ACTIVITY

7a. PROVIDED? ☐ Yes ☐ No

7b. NOTES

8. COMPLETED INSPECTION REPORT

8a. PROVIDED? ☐ Yes ☐ No | 8b. REVIEWED BY

8c. NOTES

9. LIST OF COMPLETED AND PENDING REPAIRS

9a. PROVIDED? ☐ Yes ☐ No | 9b. REVIEWED BY

9c. ALL PENDING REPAIRS HAVE DATES? ☐ Yes ☐ No

9d. ANY PENDING REPAIRS REQUIRE REMOVAL FROM SERVICE WITHIN 10 YRS? ☐ Yes ☐ No

9e. NOTES

10. ALL REQUIRED INFORMATION PROVIDED? ☐ Yes ☐ No

11. PREPARER INFORMATION

11a. NAME | 11b. SIGNATURE | 11c. DATE

PART II - TO BE COMPLETED BY NAVSUP ENERGY ENGINEERING DIVISION

12. INSPECTION PROTOCOL | I | E | L | CHANGED? ☐ Yes ☐ No

JUSTIFICATION IF CHANGED

13. CYCLE NUMBERS | I | E | L

14. NOTES

15. VERIFIED BY (NAVSUP ENERGY Engineer)

15a. NAME | 15b. SIGNATURE | 15c. DATE

NAVSUP Energy Form 072-01 (Rev 02/2015)

FIGURE 3-1 NAVSUP ENERGY Form 072-1 (Return to Service Checklist)

Prior to returning a tank to service, the Site Director or designee:

- Review and comply with all facility management return to service requirements in paragraph 3.b, obtaining concurrence for returning the tank to service from the NAVSUP FLC Regional Fuels Engineer.

- Develop local tank filling standard operating procedures (SOPs). Each SOP can encompass multiple tanks of a similar design and service. SOPs are submitted to the NAVSUP Energy Office for technical review at least 90 days prior to the first covered tank being returned to service. Subsequent review is only required when an SOP substantially changes. SOPs are reviewed for completeness and accuracy during scheduled command inspections.

- Develop a tank-specific Operations Order in accordance with local tank filling SOPs. The Operations Order are reviewed and approved by the NAVSUP FLC Commanding Officer and shall include at a minimum:
    - Tank filling procedures with appropriately defined incremental fill levels and hold times;
    - Physical inspection, gauging, and trend analysis as appropriate upon reaching each incremental fill level; and
    - Emergency drain-down plan in the event the tank needs to be emptied, including specific triggers as to when the drain-down plan should be activated. [7]

3-4.2 Provide summary of site-specific procedures

The site-specific Standard Operating Procedures (SOP) for filling a tank are applied to all of FLCPH's tanks that are being returned to service (RTS), but each RTS shall have a tank-specific Operations Order to provide additional detailed tasks to capture valve alignments, personnel roster, issue tanks, etc.

Please refer to Appendix [K] for FLCPH's Return To Service (RTS) Standard Operating Procedures (SOP)

CHAPTER 4 - DYNAMIC FILLING PROCEDURES FOR DAILY OPERATIONS

4-1 INTRODUCTION

4-2 CURRENT DYNAMIC FILLING PROCEDURES FOR DAILY OPERATIONS

4-2.1 Provide summary of FLCPH’s current dynamic tank filling procedures

FLCPH’s Dynamic Tank Filling Procedures are located in Appendix [C]

CHAPTER 5 - STATIC AND DYNAMIC RELEASE DETECTIONS SYSTEMS

5-1 INTRODUCTION

5-2 STATIC RELEASE DETECTION SYSTEMS

Static release detection systems monitor fuel inside a tank in ‘static’ condition, as the name implies, when nothing is changing the physical properties of the tank (level, mass, volume, etc.). Thus, these monitoring systems can only measure the tank’s tightness when fuel is not being added or removed from the tank. A dynamic leak detection system measures the physical properties of the tank at all times, to include when fuel is being added or removed from the tank.

5-2.1 Automated Fuel Handling Equipment (AFHE): Inventory Management System

- Monitored 24/7
- Not a certified release detection system

5-2.2 Procedures implemented to compliment AFHE in order to detect leaks:

5-2.3 Tank Tightness Testing

Tank Tightness Testing is conducted annually in accordance with 40 CFR 280.

The **Mass Technology Corporation (MTC)** ***Mass Technology Precision Mass Measurement System*** **(MTPMMS)** measures the differential pressure between one point at the bottom of the contained fluid and another point in the vapor space immediately above the fluid surface. The test must be done under static conditions (not under fuel transfer) to determine the differential pressure. The pressure at or near the bottom of the tank corresponds to the mass above the measuring point and independent of liquid level changes caused by the thermal expansion and contraction of the product under test. [3] This system measures mass of the fluid above the sensor, as compared to measurement of a liquid level. The SIM-1000 measures and records the pressure generated by the mass of fluid in the tank under test. This pressure measurement is made relative to the atmospheric pressure generated by the atmosphere above the liquids in the tank. The basis of the system is a very old concept, placing a tube into a liquid, forcing a gas (nitrogen) through the tube, and measuring the pressure of the gas, which is a direct measurement of the pressure at the bottom of the tank. A second barometric pressure is taken in the vapor space above the liquid, so that true differential pressure of the liquid is measured. The sensitivity of the bubbler pressure and barometric pressure sensor is the key to the accuracy of the system. Measurements are subject to statistical analysis to determine if a release is occurring during the test. The PMMS is a computer monitored system that can either be executed as a point-in time test (currently executed at Red Hill) or as continuous testing operations.

Mass Technology Corporation MTPMMS has received third party certification for bulk UST leak detection from Ken Wilcox Associates in accordance with U.S. EPA protocols and is listed on the NWGLDE. Since the third party system generally operates on traditional cut/cover USTs, the deeper Red Hill USTs required the system to be upgraded to deal with the higher pressures associated with these deeper than usual tanks. While the theories and technology are identical to their standard third party certified test a newer pressure transducer was required to account for the depth of the Red Hill tanks. The initial Pilot Testing in February 2008 showed that the MTPMMS worked in the field. The test required minimal installation effort, with MTC opening the gauge port on the top of the tank and lowering in the flexible probe system to the bottom of the tank. Retrieval of the probes was also easy. No leaks above the minimum detectable leak rate of 0.5 gal/hr were noted on Tank 9 for a 10 day test or tank 15 for a 5 day test. [3] The test is not dependent on temperature and requires only a short stabilization time, approximately 48 hours. The ease of implementing this test made it the lowest cost option, so was implemented full scale in 2009. [2]

In 2009, MTC began using its newly listed 24-hour SIM-1000 test method at Red Hill. The SIM-1000 test method utilizes the transducer system instead of the bubbler system used in the pilot testing in 2007 because the transducer is even easier to employ than the bubbler system and is a technology upgrade. Practical application of the older system involved lowering a bubbler unit through the gauge hatch to the tank bottom. A differential reference tube was then placed just above the liquid surface. A low pressure inert gas was conveyed to the bubbler unit at a precisely controlled rate, an additional tube was attached which eliminated the friction and subsequent back-pressure effects on the differential pressure transducer as a result of the gas flow. The pressure required to generate a steady stream of gas bubbles at the bottom of the tank corresponded to the differential pressure as a result of the fluid mass. The pressure measured by a micro-sensitive differential pressure transducer, recorded on a real time basis and post processed using data analysis routines to accurately calculate any changes in the mass of fluid contained within the tank to determine if there was a loss. [2]

5-2.4 Soil Vapor Monitoring

Soil vapor samples are collected and analyzed in the field for volatile organic compound (VOC) concentrations using a photo-ionization detector (PID). Soil vapor monitoring points (SVMPs) are given a SV prefix, followed by the associated tank number, and then the location under the tank: “S” for shallow or front of the UST, “M” for mid depth or middle or the UST, and “D” for deep or outer edge of the UST.

A conservative approach to assess the integrity of the associated tank system is to measure if VOC concentrations exceed 280,000 parts per billion by volume (ppbv) in soil vapor monitoring probes beneath tanks containing JP-5 or JP-8, or 14,000 ppbv in soil vapor monitoring probes beneath tanks containing marine diesel fuel (TEC, 2010). These values are 50 percent of the calculated vapor concentration from fuel-saturated water.

5-2.4.1 Frequency:

Soil vapor monitoring is performed monthly at all active and accessible tanks.

5-2.5 Water Interface Testing

Oil/water interface measurements are taken at monitoring wells RHMW01, RHMW02, RHMW03, and RHMW05. The water level at each well is gauged and measured for the presence of light non-aqueous phase liquids (LNAPLs; sometimes called free product) using an interface meter. The interface meter is lowered into the wells to determine the depth of water to the nearest 0.01 foot, and the existence of any immiscible layer (LNAPL).

5-2.5.1 Frequency:

Oil/water interface measurements are taken monthly at monitoring wells RHMW01, RHMW02, RHMW03, and RHMW05.

5-2.6 Ground water Monitoring Testing

Groundwater samples are collected from sampling point RHMW2254-01 and monitoring wells located inside and outside the Red Hill lower access tunnel. All groundwater samples are analyzed for petroleum constituents.

Analytical results are compared to site specific risk based levels (SSRBLs) for total petroleum hydrocarbons as diesel fuel (TPH-d) and benzene (TEC, 2008). Analytical results are also compared to DOH Environmental Action Levels (EALs) for sites where groundwater is a current or potential drinking water source. [12]

5-2.6.1 Frequency:

Groundwater samples are collected quarterly from four groundwater monitoring wells (wells RHMW01, RHMW02, RHMW03, and RHMW05) located within the lower access tunnel, one sampling point (RHMW2254-01) located at Red Hill Shaft, and five groundwater monitoring wells (RHMW04, RHMW06, RHMW07, HDMW2253 03, and OWDFMW01) located outside of the Facility tunnel system.

5-3 DYNAMIC RELEASE DETECTION SYSTEMS

5-3.1 Research into applicable dynamic release detection systems

The United States Navy and Defense Logistics Agency has surveyed the commercial market in search of applicable dynamic release detection systems in 2008 and 2014, as annotated in their market survey of leak detection system for the Red Hill Fuel Storage Facility in 2008 and 2014 Addendum which are located in Chapter 7. In addition, the U.S. Navy and DLA annually monitor the National Work Group on Leak Detection Evaluations' (NWGLDE) latest assessments of the market for applicable technology that can be applied to the bulk fuel storage tanks at Red Hill. It was through their annual review of NWGLDE's assessments that the U.S. Navy and DLA employed Mass Technology Corporation's Mass Technology Precision Mass Measurement System (MTPMMS) in 2009.

CHAPTER 6 - RELEASE DETECTION SENSITIVITY

6-1 INTRODUCTION

A major factor that drives the sensitivity to which a leak can be determined is the accuracy of the "raw" product level measurement. For a majority of the UST industry this is currently not an issue. The surface area of all "shop fabricated" UST systems is relatively small even at their greatest point, so a measurable change in product depth still only equates to a relatively small change in volume. Since most regulations governing "shop built" USTs have a mandatory leak determination rate of 0.2 gallons per hour (gal/hr) the product measuring devices available today are capable of detecting a change of level in the UST that equates to this volumetric change. This is not true however of the larger "field constructed" USTs.

Since field constructed USTs have a surface much larger than the traditional shop fabricated USTs, the same liquid level measuring devices used to detect leaks on the smaller USTs will only detect leaks of much larger volumes. Since most field constructed USTs were previously deferred from specific leak detection regulatory requirements, this has not traditionally been a problem for the industry, and as a result relatively little effort has been directed at solving leak detection issues for large field constructed storage tanks. This factor coupled with the fact that as an industry very few field constructed USTs exist outside the DOD has led to relatively few solutions for this problem.

It should be stated that there is a definite distinction between inventory control and precision leak detection. In many cases level measurements obtained by ATG are only needed to give the operators an indication of product inventory on hand. The level of accuracy needed for routine inventory control is far less than that required for precision leak detection.

6-2 AUTOMATED FUEL HANDLING EQUIPMENT (AFHE)

6-2.1 Unscheduled Fuel Movement Alarms:

6-2.1.1 Tank inventory in static state:

6-2.1.1.1 Warning alarm actuated when 0.5 inch of movement observed

6-2.1.1.2 Critical alarm actuated when 0.75 inch of movement observed

6-2.1.2 Tank inventory in dynamic state:

6-2.1.2.1 Warning alarm actuated when one inch of movement is observed

6-2.1.2.2 Critical alarm actuated when 1.5 inches of movement is observed

6-3 TANK TIGHTNESS TESTING LEAK DETECTION RATE

6-3.1 0.5 gallons per hour

Determination of leakage rate for the MTC - Precision Mass Measurement Systems SIM-1000 / CBU-1000 (24 hour test) leak detection method is based on the criteria established in the Ken Wilcox Associates, Inc. third party evaluation as listed by the NWGLDE. [4] The MTC Precision Mass Measurement System (24 hour test) is certified with a capability to detect leaks on a tank proportional to the product surface area (PSA) with a probability of detection (PD) of 95 percent and probability of a false alarm (PFA) of 5 percent. Due to the height of the Red Hill tanks, a total of 120 hours of testing is performed for each test, consisting of 48 hours for initial stabilization of the tank and product and then five consecutive 24 hour test events (120 hours).

By performing a number of non-overlapping tests in sequence and averaging the resultant leak rates, a modified threshold can be established for declaring a leak. Through standard statistical analysis, the larger the number of tests used in the averaging will result in a lower threshold and, therefore, a smaller size leak can be detected with a 95 percent PD.

24 hour test 50,000 gallons or greater
For tanks with PSA of 1,257 ft^2 or less, leak rate is 0.1 gallons per hour (gph) with PD = 97.9% and PFA = 5%.
For tanks with larger PSA, leak rate equals [(PSA in ft^2 ÷ 1,257 ft^2) x 0.078 gph].
Leak rate may not be scaled below 0.1 gph.

Example:
For a 100 foot diameter tank with PSA = 7850 ft^2; leak rate = [(7850 ft^2 ÷ 1,257 ft^2) x 0.078 gph]
= 0.49 gph.
Using the statistical analysis of five test events: 0.49 gph ÷ Square Root of 0.49 gph = 0.2178 gph.

The 0.7 gph maximum detected leak rate (MDLF) previously quoted for the testing of the Red Hill tanks in 2009, 2011, and 2013 reports was established during the inaugural biennial test event in 2009. Due to the height and unconventional spherical bottom construction of the tanks, MTC established a conservative test MDLR of 0.7 gph. Based on the consistency of the previous biennial test data and the results of a simulated leak evaluation performed by Ken Wilcox Associates Inc. in May 2009, MTC was confident in revising the test MDLR to 0.5 gph for the 2015 tests. [4] The 0.5 gph MDLR is still conservative relative to the test method calculated rate of 0.22 gph.

BULK UNDERGROUND STORAGE TANK LEAK DETECTION METHOD (50,000 gallons or greater)

VENDOR	EQUIPMENT NAME	LEAK RATE/THRESHOLD/ MAX PRODUCT SURFACE AREA
ASTTest Services, Inc.	ASTTest Mass Balance Leak Detection System	[(product surface area in ft^2 ÷ 5,575 ft^2) x 0.88 gph]/[(product surface area in ft^2 ÷ 5,575 ft^2) x 0.44 gph]/13,938 ft^2
Engineering Design Group, Inc.	EDG XLD 2000 Plus (Revision 1.02) Leak Detection System (MTS DDA Magnetostrictive Probe)	[(product surface area in ft^2 ÷ 12,074 ft^2) x 1.92 gph]/[(product surface area in ft^2 ÷ 12,074 ft^2) x 0.96 gph]/12,076 ft^2
Engineering Design Group, Inc.	Ronan X-76 CTM Automatic Tank Gauging System (MTS Level Plus UST Probe)	[(product surface area in ft^2 ÷ 564 ft^2) x 0.2 gph]/[(product surface area in ft^2 ÷ 564 ft^2) x 0.1 gph]/846 ft^2
Leak Detection Technologies International	MDleak Enhanced Leak Detection and Leak Location Method	0.005 gph/A tank should not be declared tight when chemical marker is detected outside of the tank/Not limited by capacity.
Mass Technology Corp.	Precision Mass Measurement Systems SIM-1000 and CBU-1000 (24 hour test)	[(product surface area in ft^2 ÷ 1,257 ft^2) x 0.1 gph]/[(product surface area in ft^2 ÷ 1,257 ft^2) x 0.05 gph]/ 3,143 ft^2
Mass Technology Corp.	Precision Mass Measurement Systems SIM-1000 and CBU-1000 (48 hour test)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 0.294 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x 0.147 gph]/6,082 ft^2
Mass Technology Corp.	Precision Mass Measurement Systems SIM-1000 and CBU-1000 (72 hour test)	[(product surface area in ft^2 ÷ 14,200 ft^2) x 0.638 gph]/[(product surface area in ft^2 ÷ 14,200 ft^2) x 0.319 gph]/ 35,500 ft^2
Praxair Services, Inc. (originally listed as Tracer Research, Corp.)	Tracer ALD 2000 Automated Tank Tightness Test	0.1 gph/A tank system should not be declared tight when tracer chemical or hydrocarbon greater than the background level is detected outside of the tank./Not limited by capacity.
Universal Sensors and Devices, Inc.	LTC-1000 (Mass Buoyancy Probe)	[(product surface area in ft^2 ÷ 14,244 ft^2) x 1.4 gph]/[(product surface area in ft^2 ÷ 14,244 ft^2) x 0.7 gph]/35,610 ft^2
Universal Sensors and Devices, Inc.	LTC-2000 (Differential Pressure Probe)	[(product surface area in ft^2 ÷ 14,244 ft^2) x 3.0 gph]/[(product surface area in ft^2 ÷ 14,244 ft^2) x 1.5 gph]/35,610 ft^2
Varec, Inc. (originally listed as Coggins Systems, Inc. and later as Endress+Hauser Systems and Gauging)	Fuels Manager and Remote Terminal Unit RTU/8130 (MTS Magnetostrictive Probe)	[(product surface area in ft^2 ÷ 616 ft^2) x 0.2 gph]/[(product surface area in ft^2 ÷ 616 ft^2) x 0.1 gph]/924 ft^2
Varec, Inc. (originally listed as Coggins Systems, Inc. and later as Endress+Hauser Systems and Gauging)	Fuels Manager with Barton Series 3500 ATG (48 hour test) (72 hour test)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 2.0 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x 1.0 gph]/15,205 ft^2
Varec, Inc.	FuelsManager with Enraf 854 ATG (Servo Buoyancy Probe)	[(product surface area in ft^2 ÷ 11,786 ft^2) x 3.00 gph]/[(product surface area in ft^2 ÷ 11,786 ft^2) x 1.50 gph]/ 11,786 ft^2
Varec, Inc.	FuelsManager with MTS M-Series ATG (MTS Magnetostrictive Probe)	[(product surface area in ft^2 ÷ 11,786 ft^2) x 4.50 gph]/[(product surface area in ft^2 ÷ 11,786 ft^2) x 2.25 gph]/ 11,786 ft^2
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-24 (V1.0.2, V1.0.3)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 2.0 or 3.0 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x (2.0 or 3.0 gph - 0.223 gph)]/15,205 ft^2
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-48 (V1.0.2, V1.0.3)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 2.0 or 3.0 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x (2.0 or 3.0 gph - 0.188 gph)]/15,205 ft^2

FIGURE 6-1 NWGLDE Leak Detection Methods 2014

Issue Date: August 23, 1999
Revision Date: December 29, 2011

Mass Technology Corp.

Precision Mass Measurement Systems SIM-1000 and CBU-1000 (24 hour test)

BULK UNDERGROUND STORAGE TANK LEAK DETECTION (50,000 gallons or greater)

Certification	Leak rate is proportional to product surface area (PSA). For tanks with PSA of 1,257 ft² or less, leak rate is 0.1 gph with PD = 97.9% and PFA = 2.1%. Calculated minimum detectable leak rate is 0.078 gph with PD = 95% and PFA = 5%. For tanks with larger PSA, leak rate equals [(PSA in ft² ÷ 1,257 ft²) x 0.1 gph]. Example: For a tank with PSA = 2,000 ft²; leak rate = [(2,000 ft² ÷ 1,257 ft²) x 0.1 gph] = 0.16 gph.
Leak Threshold	Leak threshold is proportional to product surface area (PSA). For tanks with PSA of 1,257 ft² or less, leak threshold is 0.05 gph. For tanks with larger PSA, leak threshold equals [(PSA in ft² ÷ 1,257 ft²) x 0.05 gph]. Example: For a tank with PSA = 2,000 ft²; leak threshold = [(2,000 ft² ÷ 1,257 ft²) x 0.05 gph] = 0.08 gph. A tank system should not be declared tight if the test result indicates a loss or gain that equals or exceeds the calculated leak threshold.
Applicability	Gasoline, ethanol blends up through E100, diesel, aviation fuel, fuel oil #4. Other liquids may be tested after consultation with the manufacturer.
Tank Capacity	Use limited to single field-constructed vertical tanks. Performance not sensitive to product level.
Waiting Time	Minimum of 1 hour, 6 minutes after delivery or dispensing. Valve leaks and pump drain-back may mask a leak. Allow sufficient waiting time to minimize these effects. Waiting times during evaluation ranged from 62 minutes to 31 hours.
Test Period	Minimum of 24 hours. There must be no dispensing or delivery during test.
Temperature	Measurement not required by this system.
Water Sensor	None. Water leaks are measured as increase in mass inside tank.
Calibration	Differential pressure sensor must be checked regularly in accordance with manufacturer's instructions.
Comments	Tests only portion of tank containing product. As product level is lowered, leak rate in a leaking tank decreases (due to lower head pressure). Consistent testing at low levels could allow a leak to remain undetected. Evaluated in a nominal 120,000 gallon, vertical underground tank with product surface area (PSA) of 1,257 ft². Averaging of multiple tests may be used to improve the performance of the system.

FIGURE 6-2 Mass Technology Corp. Leak Detection Method

6-4 SOIL VAPOR SENSITIVITY

6-4.1 VOC concentrations are measured to the nearest 1 part per billion, by volume.

6-5 WATER INTERFACE SENSITIVITY

6-5.1 The depth of water and the existence of any immiscible layer are measured to the nearest 0.01 Foot.

6-6 GROUND WATER MONITORING SENSITIVITY

6-6.1 Varies based on testing method

The Limit of Detection (LOD) is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a 99% confidence level. In other words, if a sample has a true concentration at the LOD, there is a minimum probability of 99% of reporting a “detection” (a measured value ≥ the detection limit) and a 1% chance of reporting a non-detect (a false negative). [13]

The LOD varies for each analytical testing method and for each sampling event. For example, the LODs for TPH-d in July 2015 ranged from 20 to 21 (micro)g/L (parts per billion). The LODs for TPH-d in October ranged from 21 to 24 (micro)g/L. The LODs for benzene in July and October 2015 were 0.10 (micro)g/L. The LODs for naphthalene in July 2015 ranged from 0.0050 to 0.0055 (micro)g/L. The LODs for naphthalene in October was 0.0050 (micro)g/L.

CHAPTER 7 - PREVIOUSLY COMPLETED 2008 MARKET SURVEY OF LEAK DETECTION SYSTEMS FOR THE RED HILL FUEL STORAGE FACILITY, FLEET INDUSTRIAL CENTER, PEARL HARBOR, AND THE 2014 ADDENDUM

7-1 INTRODUCTION

Enterprise Engineering Inc. (EEI), under contract to NFESC, was retained to develop concept alternatives and associated planning level cost estimates to repair the 20 underground tanks at FISC Pearl Harbor Red Hill. [9] In September of 2008, EEI provided their final report labeled, “Red Hill Repair Tanks Options Study.” Then, in 2014, the U.S. Navy contracted Michael Baker Jr., Inc. to perform a new internet search of the NWGLE in hopes of finding new technologies that could provide a solution. [10]

7-2 PREVIOUSLY COMPLETED 2008 MARKET SURVEY OF LEAK DETECTION SYSTEMS FOR THE RED HILL STORAGE FACILITY, FLEET INDUSTRIAL CENTER, PEARL HARBOR

Provided in appendix [F]

FIGURE 7-1 2008 Market Survey Abstract

7-3 2014 ADDENDUM 1 TO THE 2008 MARKET SURVEY

Due to the ongoing concern for appropriate leak detection on the Red Hill Bulk Field Constructed USTs (BFCUSTs) Baker was asked to reevaluate the initial Market Survey prepared in 2008 in terms of any new or emergent technologies appropriate to the Red Hill facility. Baker performed a new internet search of the NWGLE in hopes of finding new technologies that could provide a solution.

Conclusions:

No new technologies have been identified since the submittal of the 2008 Market Survey that provides a new or better solution then those researched previously.

FIGURE 7-2 2014 Market Survey Addendum Conclusion

APPENDIX A – REFERENCES

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DEPARTMENT OF THE NAVY
NAVSUP GLOBAL LOGISTICS SUPPORT
937 N HARBOR DRIVE
SAN DIEGO CA 92132-0001

NAVSUPGLSINST 10345.1
070
9 May 15

NAVSUP GLS INSTRUCTION 10345.1

From: Commander, NAVSUP Global Logistics Support

Subj: FUEL TANK RETURN TO SERVICE

Encl: (1) Tank Return to Service Review and Approval Template

1. Purpose. Provide specific procedures and guidance for returning fuel tanks to service, with the goal of preventing environmental fuel releases. Commanding Officers are accountable for the safe and proper return of fuel tanks to service.

2. Applicability. This instruction applies to all Naval Supply Systems Command (NAVSUP) Global Logistics Support fuel activities. At contracted activities, this instruction shall not be interpreted as providing direction in contradiction to existing contract clauses. In those instances, the activity shall determine how to best meet the intent of this instruction using organic and contracted assets. For the longer term, the activity shall work with the Contracting Officer and Contracting Officer Representative to include the appropriate requirements as a contract modification or in subsequent contract Performance Work Statements.

3. Tank Return To Service Requirements. Each activity shall consider newly returned to service tanks as suspect for potential leaks, establishing and following specific operational and facility management controls with the goal of preventing environmental fuel releases.

a. Tanks Covered By This Instruction

(1) All tanks containing petroleum, oil, or lubricant products under formal inspection programs, such as American Petroleum Institute Standard 653, Steel Tank Institute Standard SP001, Petroleum Equipment Institute Recommended Practice RP900, and Fiberglass Tank and Pipe Institute Recommended Practice 2007-1.

(2) Aboveground and underground tanks of any configuration, whether shop-fabricated or field-erected.

(3) Tanks placed in service for the first time after having been installed or erected on site.

(4) Tanks returned to service after having been removed from service for cleaning, inspection, or repair.

b. Facility Management Return To Service Requirements

(1) Prior to returning a tank to service, the NAVSUP Fleet Logistics Center (FLC) Regional Fuels Engineer shall:

(a) Review any maintenance and repair actions performed on the tank, looking for any areas that might pose an environmental risk.

(b) For tanks previously under the control of another organization (e.g., if the tank was being repaired by an Execution Agent), coordinate and review proper turnover documentation with the Execution Agent. At a minimum, the following is required:

1. A statement signed by an appropriately certified tank inspector indicating the tank is suitable for return to service including any caveats, clarifications, or limitations that would affect tank operations after return to service. The statement shall include due dates for the next applicable formal inspections (internal, external, and leak test) and any repairs required prior to those next inspections. Next inspection due dates shall be the maximum allowable by code, calculated from the latest of the inspection or repair completion dates.

2. A completed inspection report compliant with the applicable code including all required calculations and analysis. Preliminary or field reports cannot be substituted for this requirement.

3. A list of repairs identified during the inspection, including completed repairs and repairs that are still pending. All pending repairs shall be annotated with a due date.

4. Third-party certified calibration ("strapping") charts when a tank is first placed in service, when certified calibration charts did not previously exist, or when repairs were made that would be reasonably expected to change the tank's calibration. For shop-fabricated tanks, manufacturer-provided calibration charts require third-party certification before they can be accepted.

5. A statement signed by an agent of the Execution Agent and repair contractor that custody of the tank is returned to the activity and that items in paragraph 3.b.(1)(b) have been provided to the NAVSUP FLC.

(c) Coordinate with the NAVSUP Energy Office Engineering Division to ensure all engineering requirements have been adequately considered and the tank's records are entered into the NAVSUP Energy Office's information repository.

(2) After returning a tank to service, the NAVSUP FLC Regional Fuels Engineer shall:

(a) Work with the Site Director to ensure the Tank Maintenance Record is updated appropriately.

(b) For tanks that were inspected or repaired, work with the performing organization to obtain copies of the final inspection report and completion report. Provide copies of these reports to the NAVSUP Energy Office for inclusion in their information repository.

(c) Work with the Site Director to ensure warranty issues with the tank are tracked and reported back to the Execution Agent. The warranty period will start on the date of the transfer of custody statement from the Execution Agent per paragraph 3.b.(1)(b)5.

c. Operational Return To Service Requirements

(1) Prior to returning a tank to service, the Site Director or designee shall:

(a) Review and comply with all facility management return to service requirements in paragraph 3.b, obtaining concurrence for returning the tank to service from the NAVSUP FLC Regional Fuels Engineer.

(b) Develop local tank filling standard operating procedures (SOPs). Each SOP can encompass multiple tanks of a similar design and service. SOPs shall be submitted to the NAVSUP Energy Office for technical review at least 90 days prior to the first covered tank being returned to service. Subsequent review is only required when an SOP substantially changes. SOPs will be reviewed for completeness and accuracy during scheduled command inspections.

(c) Develop a tank-specific Operations Order in accordance with local tank filling SOPs. The Operations Order shall be reviewed and approved by the NAVSUP FLC Commanding Officer and shall include at a minimum:

1. Tank filling procedures with appropriately defined incremental fill levels and hold times;

2. Physical inspection, gauging, and trend analysis as appropriate upon reaching each incremental fill level; and

3. Emergency drain-down plan in the event the tank needs to be emptied, including specific triggers as to when the drain-down plan should be activated.

(d) Receive NAVSUP FLC Commanding Officer approval, through the NAVSUP FLC Regional Fuels Officer, to execute the Operations Order and return the tank to service.

(2) While returning a tank to service, the Site Director or designee shall not deviate from the approved Operations Order except in the event of an emergency. During tank return to service operations, any abnormal or out-of-tolerance readings shall be immediately communicated to the Site Director and the Commanding Officer.

(3) After returning a tank to service, the Site Director or designee shall:

(a) Notify the NAVSUP FLC Commanding Officer and the NAVSUP Energy Office, through the NAVSUP FLC Regional Fuels Officer, that the tank has been successfully returned to service.

(b) Continue to monitor the tank in accordance with local SOPs to ensure the tank is not releasing product to the environment.

(4) Preparation and execution of the tank return to service process shall be reviewed and approved by the NAVSUP FLC Commanding Officer. A return to service review and approval template with the minimally required information is included as enclosure (1); the NAVSUP FLC may supplement this information as desired. Once Part IV of enclosure (1) is signed by the Commanding Officer, notify the Execution Agent the tank was successfully returned to service.

4. Implementation. Each activity shall be fully compliant with this instruction within 30 days of issuance.

5. Non-compliance. Non-compliance with this instruction shall be considered a finding at the next command inspection.

6. Point of Contact

NAVSUP Energy Office
8725 John J. Kingman Road
Suite 3719
Fort Belvoir, VA 22060
703-767-7333

7. Records Management. Records created as a result of this instruction, regardless of media and format, shall be managed per SECNAV Manual 5210.1 of November 2007.

J. R. MCNEAL

Distribution:
NAVSUP FLCs

TANK RETURN TO SERVICE REVIEW AND APPROVAL

PART I - GENERAL INFORMATION	
1. SITE NAME	2. TANK IDENTIFIER

PART II - OPERATIONS ORDER		
3. OPERATIONS ORDER IDENTIFIER		
4. OPERATIONS ORDER REVIEW AND APPROVAL I concur with the referenced Operations Order for returning this tank to service.		
4a. NAME	4b. CO SIGNATURE	4c. DATE

PART III - TANK FILLING		
5. OPERATIONS ORDER INITIATION DATE		
6. APPROVAL TO BEGIN FILLING TANK I concur that the referenced Operations Order can be initiated for this tank on the indicated date.		
6a. NAME	6b. CO SIGNATURE	6c. DATE

PART IV - TANK RETURN TO SERVICE		
7. OPERATIONS ORDER COMPLETION DATE (RETURN TO SERVICE DATE)		
8. TANK RETURNED TO SERVICE I have been notified that the tank was successfully returned to service.		
8a. NAME	8b. CO SIGNATURE	8c. DATE

DFSP PEARL HARBOR DYNAMIC TANK FILLING STANDARD OPERATING PROCEDURE (SOP)

1. MATERIALS, REPORTS, AND REFERENCES:

SPECIAL MATERIALS	• Gauging equipment • Automatic tank gauging equipment • Hand held radios • Personal protective equipment
FORMS	• Gauging log
REFERENCES	• DoD 4140.25-M, DoD Management of Bulk Petroleum Products, Natural Gas, and Coal • 33 CFR Part 154, Facilities Transferring Oil or Hazardous Materials in Bulk • 29 CFR §1910.38, Occupational Safety and Health Standards • MIL-STD 3004D: Quality Surveillance for Fuels, Lubricants, and Related Products • UFC 3-460-01, Unified Facilities Criteria, Petroleum Fuel Facilities • MO-230, Maintenance and Operation of Petroleum Fuel Facilities

2. SAFETY:

a. The Fuel Distribution System employee must be familiar with the safety data sheet for product to facilitate the safe handling of fuels.
b. During all transfer operations, safety is the primary concern.
c. Inspection of tank interior for readiness by terminal personnel prior to placing tank back in service.
d. Provide firefighting equipment status to the Terminal Supervisor.
e. Verify that safety equipment and communication equipment is working properly and available at the fuel farm.

3. Planning and Review

a. Determine the receipt and issue tanks for the procedure.
b. Validate inventory levels of specified receipt and issue tanks, and calculate the estimated time.
c. Determine the valve lineups to transfer the fuel from the issue tank to the receipt tank.
d. Determine which pump(s) will be used (if applicable)
e. Determine the number of personnel requirement to the evolution.
f. Verify that no other tanks and/or piping routes are open to the specified piping lineup.

4. Procedure:

a. Set up evolution in AFHE system.
b. From a tank other than the issue tank (if possible), fill the pipeline to the skin valve of the receipt tank.
c. Bleed off entrapped air.
d. Inspect the pipeline and valves for leaks.
e. Close system valves.
f. When ready to perform system transfer/receipt, open system valves except throttle valves.
g. Slowly allow fuel to flow by opening the throttle valves and/or by aligning and starting pump/s if tank transfer is not possible.
h. Observe transfer process by verifying the AFHE system, performing visual inspection of the piping, vales, and tanks and checking for consistent pressures and transfer rates. If large fluctuations are observed, shut down the operation until the cause is determined.
i. Monitor issue tank levels to ensure a low-level condition will not occur.

j. Monitor receipt tank levels to prevent it from being overfilled. The AFHE system will give an alarm at the upper control limit, at the high level alarm and at the high-high level alarm/high level switch. The high level switch will also close the tank skin valve, inhibit system pumps and sound an audible alarm.
k. Perform and maintain an accurate trend analysis/running gauge during the entire operation. If the amount removed from the issue tank does not coincide with the amount received in the receipt tank stop the transfer and determine the cause of the variation.
l. Stop the transfer at the predetermined level by closing the throttle valves and/or stopping the pumps.
m. Close system valves.
n. Caution: A minimum waiting time of 30 minutes after completion of fuel receipts, transfers or movements is required before insertion of any objects into storage tanks. This is a safety measure to permit relaxation of electrostatic charges as required by the MIL-STD-3004 (series) para. 5.9.4
o. Manually gauge the issue and receipt tanks. Compare quantity transferred to quantity received. If there is a significant difference, inform chain of command and investigate the cause of the difference. Compare the manual gauge to the AFHE. If the level determined by the manual gauge and the level indicated by AFHE are off by more than 3/16 inch, submit trouble ticket.
p. The tank will not be placed on line until the proper settling time has elapsed, samples have been drawn, tested and the fuel has been found suitable for use.

5. Operation Order:

a. The operation will be detailed in the tank specific operations order and will contain the following basic elements: • Open system valves • Open issue tank valves • Open receipt tank valves • Align and start pump/s if tank to tank transfer is not possible. • Observe the piping and transfer procedure by checking the ATG system, walking the piping path, looking for leaks and by checking for consistent pressures and transfer rates. A large decrease in pressure or rate may relate to pumping problems or line rupture. Large increases may be caused by pipeline blockage or a fail valve. If large fluctuations are observed, shut down the operation until the cause is determined.

- Close receipt tank valves
- Close system valves as required
- Close issue tank valves

Approved by: LCDR Andrew Lovgren
Director

FINAL 2015 ANNUAL LEAK DETECTION TESTING REPORT OF 14 BULK FIELD-CONSTRUCTED UNDERGROUND STORAGE TANKS AT RED HILL UNDERGROUND FUEL STORAGE FACILITY

JOINT BASE PEARL HARBOR-HICKAM, HAWAII

Prepared for:
Defense Logistics Agency Energy
Ft. Belvoir, Virginia

Prepared under:
NAVFAC Atlantic
Contract N62470-10-D-3000-0048

Submitted by:
Michael Baker International
Virginia Beach, VA

Date:
6 JULY 2015

Michael Baker
INTERNATIONAL

Project: 140296
Task: 4.1.89

FINAL 2015 ANNUAL LEAK DETECTION TESTING REPORT
OF 14 BULK FIELD-CONSTRUCTED UNDERGROUND STORAGE TANKS
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6 JULY 2015

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LIST OF ABBREVIATIONS AND ACRONYMS

AOC	Administrative Order on Consent
BFCUST	Bulk field-constructed underground storage tank
BMP	Best Management Practice
CMP	Centrally Managed Program
CNRH	Commander Navy Region Hawaii (CNRH)
DOH	Department of Health
DLA	Defense Logistics Agency
EPA	Environmental Protection Agency
F-76	Marine diesel fuel
FISC	Fleet Industrial Supply Center
Ft^2	Square feet
gph	Gallons per hour
in	Inch
JB	Joint Base
JP-5, 8	Jet Propellant 5, 8
MDLR	Minimum detectable leak rate
Michael Baker	Michael Baker International
MTC	Mass Technology Corporation
NAVFAC	Naval Facilities Engineering Command
NWGLDE	National Work Group on Leak Detection Evaluations
P_D	Probability of detection
P_{FA}	Probability of a false alarm
PSA	Product surface area

PROFESSIONAL ENGINEER CERTIFICATION:

Final 2015 Annual Leak Detection Testing Report
Of 14 Bulk Field-Constructed Underground Storage Tanks
At Red Hill Fuel Storage Complex

Joint Base Pearl Harbor-Hickam, Hawaii

This report has been reviewed by a professional engineer and has been prepared in accordance with good engineering practices. Laboratory results, field notes, and supporting data have been reviewed and referenced correctly.

I hereby certify that I have examined this report and attest that it has been prepared in accordance with good engineering practices.

Engineer: Christopher D. Caputi, P.E.

Registration Number: 032382

State: Virginia

Date: 6 July 2015

EXECUTIVE SUMMARY

The scope of this project was initially to perform biennial leak detection testing of 18 Bulk Field-Constructed Underground Storage Tanks (BFCUST) at JBPHH. However, in 2014 the Commander Navy Region Hawaii, Defense Logistics Agency (DLA) Energy, The State of Hawaii Department of Health and the Environmental Protection Agency Region 9 negotiated an Administrative Order on Consent (AOC) which requires the annual testing of the BFCUST at Red Hill. Although at the time this testing project began, in late 2014, the AOC had not yet been officially signed by all parties, DLA Energy and the Navy instructed Michael Baker to change to the new proposed annual frequency and move up the testing event to begin in October 2014.

Fourteen of the eighteen BFCUSTs (BFCUST 1 – 4, 6 – 13, 15, and 16) were Mass Technology Corporation leak detection tested from 14 October 2014 through 14 May 2015 with no detectable leak above the test method's minimum detectable leak rate of 0.5 gallons per hour resulting in passed tests. The leak detection test of BFCUST 16 was successful, however, it was not conducted at the fill height (~210 feet) due to operational limitations; testing was conducted at ~58 feet. Three BFCUSTs (BFCUST 5, 14 and 17) were out of service during the test event for internal inspection. One BFCUST (BFCUST 18) was out of service for maintenance of piping and therefore not available for testing.

Annual leak detection testing of the 14 BFCUSTs should be initiated on or before the new annual anniversary date of 14 October 2015 under DLA Energy's Leak Detection Centrally Managed Program (CMP) to comply with the AOC requirements. In addition, the DLA Energy Leak Detection CMP should be notified immediately when BFCUST 16 can be filled to its full fill height and the remaining four BFCUSTs (BFCUST 5, 14, 17 and 18) are each placed back in service in order for leak detection testing to be completed to comply with the AOC agreement.

1.0 INTRODUCTION

1.1 Purpose of Project

The Defense Logistics Agency (DLA) Energy contracted Michael Baker International (Michael Baker), through Naval Facilities Engineering Command (NAVFAC) Atlantic Contract N62470-10-D-3000-0048 to perform biennial leak detection testing of 18 Bulk Field-Constructed Underground Storage Tanks (BFCUSTs) at the Red Hill storage complex, Joint Base (JB) Pearl Harbor-Hickam, Hawaii. However, in 2014 the Commander Navy Region Hawaii (CNRH), DLA Energy, The state of Hawaii Department of Health (DOH) and the Environmental Protection Agency (EPA) Region 9 negotiated an Administrative Order on Consent (AOC) which requires the annual testing of the BFCUST at Red Hill. Although at the time this testing project began, in late 2014, the AOC had not yet been officially signed by all parties, DLA Energy and the Navy instructed Michael Baker to change to the new proposed annual frequency and move up the testing event to begin in October 2014. The testing is being conducted under DLA Energy's Leak Detection Centrally Managed Program (CMP) to meet annual test requirements of AOC. A copy of the AOC is provided in Appendix A.

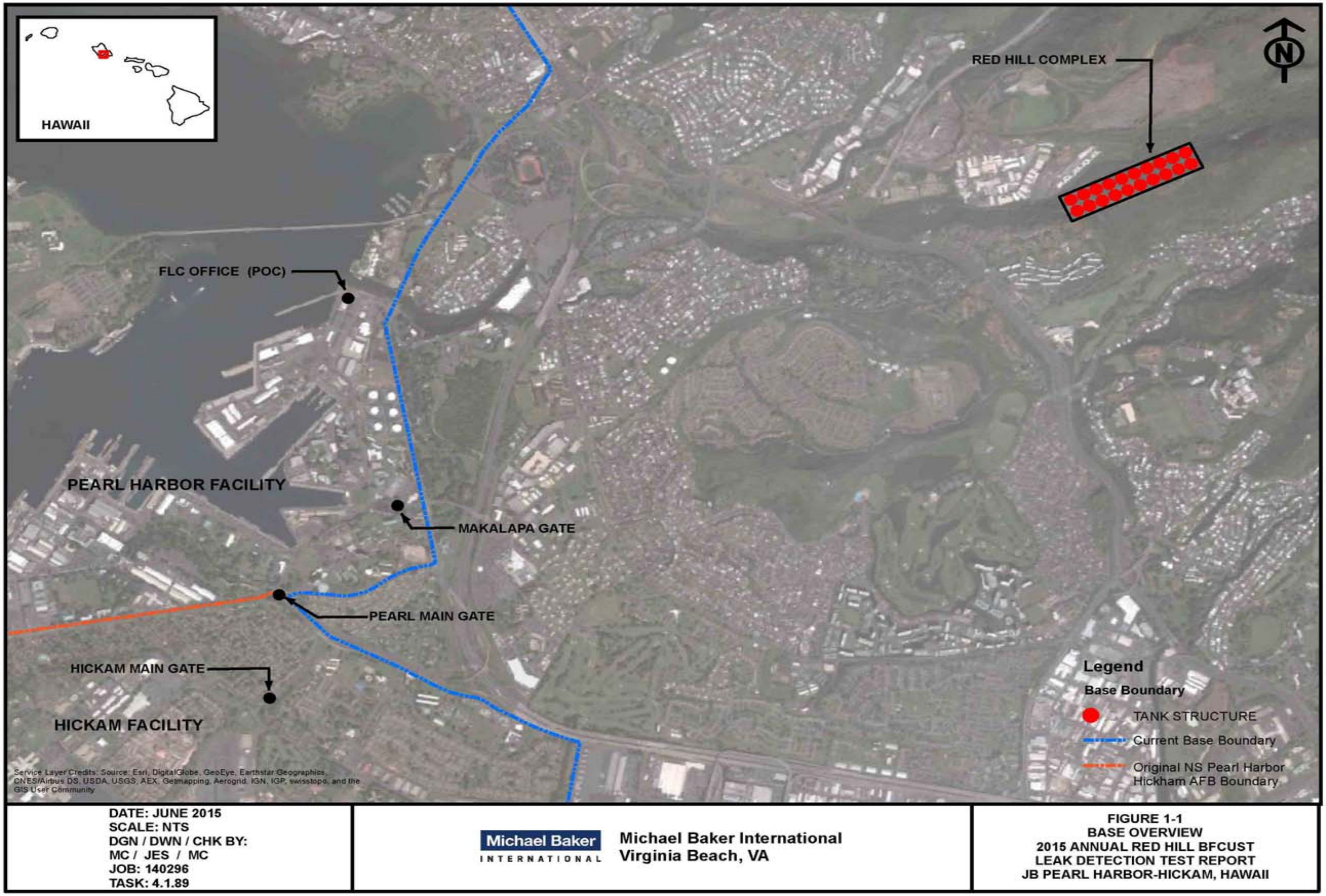
1.2 Site Background and History

JB Pearl Harbor- Hickam is located on the island of Oahu, approximately 8 miles northwest of Honolulu, Hawaii. The fueling operations at JB Pearl Harbor-Hickam are under the Navy's Fleet Logistics Center Pearl Harbor.

The Red Hill storage complex is located approximately three miles north-east of the base (Figure 1-1). The Red Hill storage complex was constructed between 1940 and 1943. The Red Hill storage complex consists of 20 BFCUSTs (BFCUST 1 – 20) that are each 12,600,000-gallon single-walled steel, that are 100-feet in diameter and 250-feet in height. Eighteen of the 20 tanks are in-service; BFCUSTs 1 and 19 were permanently removed from service prior to 2009. BFCUST 2 – 6 store Jet Propellant (JP)-8, BFCUST 7 – 12, 18 and 20 store JP-5, and BFCUST 13 – 17 store F-76. The top and bottom portions of the BFCUSTs are accessible via a tunnel system. The BFCUSTs receipt, issue, and water drain piping are connected to JB Pearl Harbor Navy Facility via carbon steel piping of various diameters located in the tunnel system associated to the bottom portion of the BFCUSTs. All piping isolation valves are equipped with double block and bleed valves.

In response to a product spill in January 2014 from BFCUST 5, when it was placed back in service after completing internal inspections and repairs, an AOC was negotiated between the CNRH, DLA Energy, Hawaii DOH and the EPA Region 9 which requires the annual testing of the BFCUST at Red Hill. The biennial test event originally schedule to begin in February 2015 was moved up to start in October 2104 and revised to annual testing to meet AOC requirements.

Figure 1-1: Location Map – Red Hill Storage Complex



1.3 Historical Leak Detection Results

Prior to this test event leak detection testing was conducted biennially as a DLA Energy Leak Detection CMP best management practice (BMP). The last biennial tests on 15 of the 18 BFCUSTs were completed from 23 January 2013 through 5 April 2013. The Mass Technology Corporation (MTC) leak detection tests were successful with no detectable leaks above the test method's minimum detectable leak rate (MDLR) of 0.7 gallons per hour (gph) (Ref 01). BFCUSTs 5, 14, and 17 were out-of- service during the 2013 test event for internal inspections and were not tested.

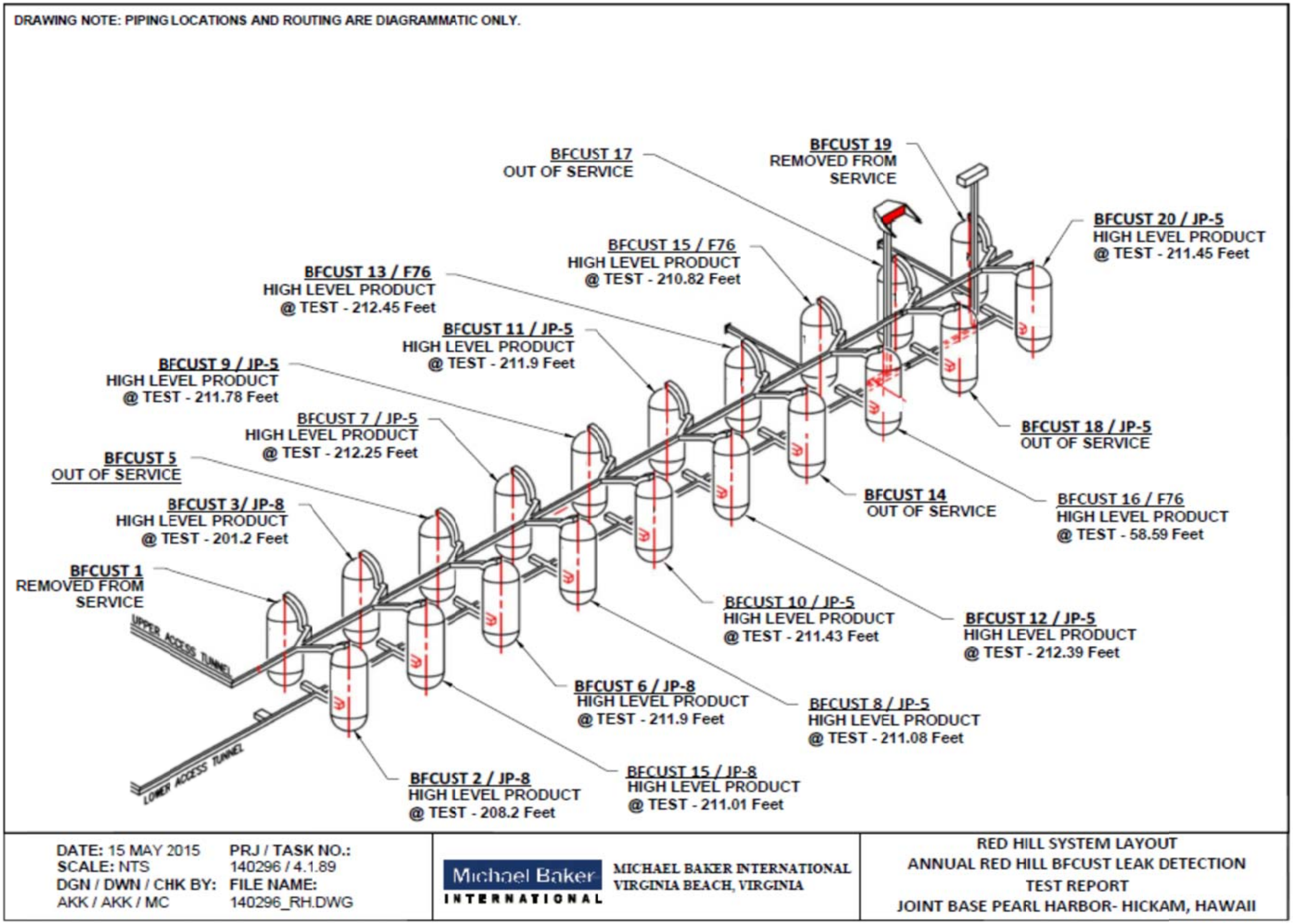
1.4 Project Scope

MTC leak detection tests on 14 of the 18 BFCUSTs were performed from 14 October 2014 through 14 May 2015. Note that the 2015 biennial test event of the Red Hill tanks, initially schedule for the first quarter of 2015, was initiated in October 2014 in response to the annual test requirements agreed upon in the AOC. Table 1-1 provides a description of the systems tested. Figure 1-2 provides a layout diagram of the Red Hill storage complex.

Table 1-1: Items Tested

Asset Designation	Tank Diameter (Feet)	Tank Height (Feet)	Tank Volume (Gallons)	Product	Associated Tank Piping								Comments
					Diameter (Inches) Length (Feet)						Total Length (Feet)	Volume (Gallons)	
					3/4	4	6	8	12	20			
BFCUST 1	100	250	12,600,000	-	-	-	-	-	-	-	-	-	Permanently Removed from Service
BFCUST 2	100	250	12,600,000	JP-8	-	-	1.2	0.5	0.5	0.5	2.7	13	-
BFCUST 3	100	250	12,600,000	JP-8	50	-	1.7	-	0.5	0.5	52.7	14	-
BFCUST 4	100	250	12,600,000	JP-8	-	-	1.2	0.5	0.5	0.5	2.7	13	-
BFCUST 5	100	250	12,600,000	JP-8	-	-	1.2	-	1	2.5	4.7	44	Out-of-Service for Inspection
BFCUST 6	100	250	12,600,000	JP-8	-	-	1.2	-	1	2.5	4.7	44	-
BFCUST 7	100	250	12,600,000	JP-5	-	-	1	-	0.5	0.5	2	12	-
BFCUST 8	100	250	12,600,000	JP-5	45	-	2	1.5	1	0.5	50	21	-
BFCUST 9	100	250	12,600,000	JP-5	-	1	-	-	0.7	0.5	2.2	12	-
BFCUST 10	100	250	12,600,000	JP-5	-	-	12	-	1	0.5	13.5	31	-
BFCUST 11	100	250	12,600,000	JP-5	-	-	1	-	1	0.5	2.5	15	-
BFCUST 12	100	250	12,600,000	JP-5	-	-	1.2	-	1	2.5	4.7	44	-
BFCUST 13	100	250	12,600,000	F-76	50	-	1.7	-	0.5	0.5	52.7	14	-
BFCUST 14	100	250	12,600,000	F-76	-	-	1.2	-	1	2.5	4.7	44	Out-of-Service for Inspection
BFCUST 15	100	250	12,600,000	F-76	50	-	3	1.5	0.5	0.3	55.3	17	-
BFCUST 16	100	250	12,600,000	F-76	-	-	1.7	3	1	3	8.7	58	-
BFCUST 17	100	250	12,600,000	F-76	-	-	3	1.5	0.5	0.3	55.3	17	Out-of-Service for Inspection
BFCUST 18	100	250	12,600,000	JP-5	-	-	1.7	3	1	3	8.7	58	Out-of-Service for Maintenance
BFCUST 19	100	250	12,600,000	-	-	-	-	-	-	-	-	-	Permanently Removed from Service
BFCUST 20	100	250	12,600,000	JP-5	-	-	1	1	-	0.3	2.3	8	-

Figure 1-2: Red Hill System Layout



1.5 Project Team

Michael Baker subcontracted MTC to perform the leak detection testing. Field-testing oversight, coordination with facility fuels representatives, quality assurance/quality controls, and final report preparation and submission were provided by Michael Baker personnel.

1.6 Qualifications of Testing Procedures Used

The testing procedures used were those defined as the MTC - Precision Mass Measurement Systems SIM-1000 / CBU-1000 (24 hour test) leak detection method. Determination of leakage is based on the criteria established in the Ken Wilcox Associates, Inc. third party evaluation as listed by the National Work Group on Leak Detection Evaluations (NWGLDE) (Ref 02). The MTC Precision Mass Measurement System (24 hour test) is certified with a capability to detect leaks on a tank proportional to the product surface area (PSA) with a probability of detection (P_D) of 95 percent and probability of a false alarm (P_{FA}) of 5 percent. Due to the height of the tanks, a total of 120 hours of testing was performed for each test, consisting of 48 hours for initial stabilization of tank and product and five consecutive 24 hour test events (120 hours).

By performing a number of non-overlapping tests in sequence and averaging the resultant leak rates, a modified threshold can be established for declaring a leak. Through standard statistical analysis, the larger the number of tests used in the averaging will result in a lower threshold and, therefore, a smaller size leak can be detected with a 95 percent P_D.

24 hour test 50,000 gallons or greater

For tanks with PSA of 1,257 ft^2 or less, leak rate is 0.1 gallons per hour (gph) with PD = 97.9% and PFA = 5%.

For tanks with larger PSA, leak rate equals [(PSA in ft^2 ÷ 1,257 ft^2) x 0.078 gph].

Leak rate may not be scaled below 0.1 gph.

Example:

For a 100 foot diameter tank with PSA = 7850 ft^2; leak rate = [(7850 ft^2 ÷ 1,257 ft^2) x 0.078 gph] = 0.49 gph.

Using the statistical analysis of five test events: 0.49 gph ÷ Square Root of 0.49 gph = 0.2178 gph.

The 0.7 gph MDLR previously quoted for the testing of the Red Hill tanks in 2009, 2011, and 2013 was established during the inaugural biennial test event in 2009. Due to the height and unconventional spherical bottom construction of the tanks, MTC established a conservative test MDLR of 0.7 gph. Based on the consistency of the previous biennial test data and the results of a simulated leak evaluation performed by Ken Wilcox Associates Inc. in May 2009 (Ref 03), MTC is confident in revising the test MDLR to 0.5 gph. The 0.5 gph MDLR is still conservative relative to the test method calculated rate of 0.22 gph.

2.0 LEAK DETECTION TESTING AND RESULTS

MTC's test reports are provided in Appendix A. The 14 BFCUSTs were leak detection tested with no detectable leak above the established test method's MDLR of 0.5 gph. BFCUSTs 5, 14, 17, and 18 were out-of-service during the test event and, therefore, not tested. In addition, BFCUST 16 was temporarily isolated from receiving additional fuel during the test event, due to fuel quality issues and was tested at less than the tank's high product level. Test results are listed in Table 2-1.

Table 2-1: Test Results

Asset Designation	Height (Feet)	Diameter (Feet)	Test Product Height (Feet)	Product	Certified MDLR (gph)	Test Date	Result
BFCUST 1	250	100	Permanently Removed from Service				
BFCUST 2	250	100	208.2	JP-8	0.5	11 February – 16 February 2015	Pass
BFCUST 3	250	100	210.2	JP-8	0.5	14 February – 19 February 2015	Pass
BFCUST 4	250	100	211.01	JP-8	0.5	16 October – 23 October 2014	Pass
BFCUST 5	250	100	Out-of-Service for Inspection				
BFCUST 6	250	100	211.9	JP-8	0.5	14 October – 21 October 2014	Pass
BFCUST 7	250	100	212.25	JP-5	0.5	15 November – 22 November 2014	Pass
BFCUST 8	250	100	211.08	JP-5	0.5	14 October – 21 October 2014	Pass
BFCUST 9	250	100	211.78	JP-5	0.5	22 October – 29 October 2014	Pass
BFCUST 10	250	100	211.43	JP-5	0.5	31 October – 7 November 2014	Pass
BFCUST 11	250	100	211.9	JP-5	0.5	18 February – 23 February 2015	Pass
BFCUST 12	250	100	212.39	JP-5	0.5	6 November – 13 November 2014	Pass
BFCUST 13	250	100	212.45	F-76	0.5	29 April – 4 May 2015	Pass
BFCUST 14	250	100	Out-of-Service for Inspection				
BFCUST 15	250	100	210.82	F-76	0.5	9 May – 14 May 2015	Pass
BFCUST 16	250	100	58.59	F-76	0.5	4 May – 9 May 2015	Pass
BFCUST 17	250	100	Out-of-Service for Inspection				
BFCUST 18	250	100	Out-of-Service for Maintenance				
BFCUST 19	250	100	Permanently Removed from Service				
BFCUST 20	250	100	211.45	JP-5	0.5	29 October – 5 November 2014	Pass

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

Fourteen of the 18 BFCUSTs passed the 2015 biennial leak detection testing. BFCUSTs 5, 14, 17 and 18 were out-of-service and were not tested. The test of BFCUST 16 test was not conducted at the fill height (~210 feet) due to operational limitations; testing was conducted at ~58 feet.

3.2 Recommendations

Annual leak detection testing of the 14 BFCUSTs should be initiated on or before the annual anniversary date of 14 October 2015 under DLA Energy's Leak Detection CMP to comply with AOC agreement. In addition, the DLA Energy Leak Detection CMP should be notified immediately when BFCUST 16 can be filled to its full fill height and when remaining four BFCUSTs (BFCUST 5, 14, 17 and 18) are each placed back in service in order for leak detection testing to be completed to comply with AOC agreement.

4.0 REFERENCES

Ref 01 Final 2013 Biennial Integrity Testing Report Of Bulk Field Constructed Underground Storage Tank 2 – Red Hill Underground Storage Fuel Storage Facility, Joint Base Pearl Harbor - Hickam, Hawaii. Prepared for DLA Energy, Ft. Belvoir, Virginia, under NAVFAC Atlantic Contract N62470-10-D-3000-0026. Dated; 17 April 2013.
(Typical individual tank report for 15 BFCUSTs tested - 2013 Biennial test event)

Ref 02 Listing by the NWGLDE (22nd Edition): Mass Technology Corporation – Precision Mass Measurement Systems SIM-1000 and CBU-1000 (24 hour test) – BULK UNDERGROUND STORAGE TANK LEAK DETECTION METHOD (50,000 gallons or greater).
Issue Date: 23 August 1999
Revision Date: 29 December 2011
http://www.nwglde.org/evals/mass_technology_a.html

Ref 03 Testing of the Mass Technology Corporation SIM-1000 Leak Detection System on 12 Million Gallon Tanks at Red Hill. Prepared for: Michael Baker Jr. Inc. Prepared By: Ken Wilcox Associates, Inc.
Dated 7 May 2009

APPENDIX A –

ADMINISTRATIVE ORDER ON CONSENT
RED HILL BULK FUEL STORAGE FACILITY, OAHU, HAWAII

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9

THE DEPARTMENT OF HEALTH
STATE OF HAWAII

IN THE MATTER OF:

THE UNITED STATES DEPARTMENT OF THE NAVY	)	EPA DKT NO. RCRA 7003-R9-2015-01
AND	)	DOH DKT NO. 15-UST-EA-01
DEFENSE LOGISTICS AGENCY	)	
RESPONDENTS	)	
RED HILL BULK FUEL STORAGE FACILITY, OAHU, HAWAII	)	

ADMINISTRATIVE ORDER ON CONSENT

1. INTRODUCTION

(a) This administrative order on consent ("AOC") is entered into voluntarily by the DEPARTMENT OF HEALTH, STATE OF HAWAII ("DOH"); the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY ("EPA") Region 9; the UNITED STATES DEPARTMENT OF THE NAVY ("Navy"), acting by and through the COMMANDER, NAVY REGION HAWAII ("CNRH"); and DEFENSE LOGISTICS AGENCY ("DLA"). DOH, EPA, Navy, and DLA are collectively referred to as the "Parties." DOH and EPA are collectively referred to as the "Regulatory Agencies." This AOC is a joint administrative action taken by the DOH and EPA concurrently and pursuant to their respective state and federal authorities to regulate underground storage tanks ("USTs") and waste and to protect drinking water, natural resources, human health, and the environment.

(b) This AOC provides for the performance by Navy and DLA of a release assessment, response(s) to release(s), and actions to minimize the threat of future releases in connection with the field-constructed bulk fuel USTs, surge tanks, pumps, and associated piping at the Red Hill Bulk Fuel Storage Facility ("Facility"), located near Pearl Harbor, on the island of Oahu in the State of Hawaii, and on any property that may be affected now or in the future by petroleum or other substances released from the Facility, as specified in Attachment A ("Statement of Work" or "SOW"). The term "Site" as used in this AOC includes the Facility and any area where petroleum or other substances released from the Facility come to be located. The primary objectives of this AOC are to take steps to ensure that the groundwater resource in the vicinity of the Facility is protected and to ensure that the Facility is operated and maintained in an environmentally protective manner.

(c) Navy and DLA's participation in this AOC shall not constitute or be construed as an admission of liability. Navy and DLA neither admit nor deny the factual allegations and legal conclusions set forth in this AOC (Sections 4 and 5, Findings of Fact and Conclusions of Law).

(d) The Parties acknowledge that this AOC has been negotiated in good faith and that this AOC is fair, reasonable, protective of human health and the environment, and is in the public interest.

2. <u>JURISDICTION</u>

(a) The State of Hawaii obtained EPA state program approval, effective on September 30, 2002, for Hawaii's UST program to operate in lieu of EPA's UST program under Subtitle I of the Resource Conservation and Recovery Act of 1976 ("RCRA"), as amended, 42 United States Code ("U.S.C.") § 6901 *et seq.* DOH enters into this AOC in accordance with its authority, vested in the Director of Health, to regulate USTs in conformance with EPA state program approval and the provisions of chapters 340E, 342D and 342L of the Hawaii Revised Statutes ("HRS") and the rules promulgated pursuant thereto.

(b) EPA Region 9 enters into this AOC pursuant to the authority vested in the Administrator of EPA by Section 7003 of RCRA, 42 U.S.C. § 6973, which authority has been delegated to the Regional Administrators of EPA by Delegations 8-22-A and 8-22-C (April 20, 1994), and redelegated to, among others, the Director of the Land Division of EPA Region 9 by Delegations R9-8-22-A (October 10, 2014) and R9-8-22-C (October y 10, 2014).

(c) Navy and DLA agree to undertake and complete all actions required by the terms and conditions of this AOC.

3. PARTIES BOUND

(a) This AOC shall apply to and be binding upon the Parties and their successors and assigns. Navy and DLA are jointly and severally liable under this AOC.

(b) Navy and DLA shall notify the Regulatory Agencies in writing as soon as the decision to transfer or sell any property covered by this AOC is known by Navy or DLA but no later than prior to the sale or transfer. In addition, Navy and DLA shall provide a copy of this AOC to any successor to the Site prior to the effective date of such change. No change in ownership or operation of any property covered by this AOC or in the status of Navy and DLA shall in any way alter, diminish, or otherwise affect Navy and DLA's obligations and responsibilities under this AOC, except by agreement of the Parties in accordance with Section 8 or as required by subsequently enacted legislation pertaining to transfer of the Facility.

(c) Navy and DLA shall provide a copy of the AOC, or a website address for accessing this AOC, to all of its supervisory personnel who work on actions related to this AOC and prime contractors or prime consultants retained to conduct or monitor any portion of work performed pursuant to this AOC within seven (7) days of the date that the last Party signs the AOC as described in Section 25 ("Effective Date") or date of such retention, whichever is later. Navy and DLA shall condition all contracts with the aforementioned on compliance with the terms and conditions of this AOC. Navy and DLA shall instruct all supervisory personnel who work on actions related to this AOC and prime contractors or prime consultants retained to conduct or monitor any portion of work to perform such work in accordance with the requirements of this AOC.

4. FINDINGS OF FACT

(a) CNRH is a division of Navy. CNRH is the command responsible for providing, maintaining, and improving shore infrastructure, service, support, and training to enable fleet operations; CNRH oversees all Navy supporting commands involved in the operation or maintenance of the Facility.

(b) DLA is a combat logistics support agency of the United States Department of Defense ("DoD") providing the military services with the full spectrum of logistics, acquisition, and technical services. As the DoD executive agent for bulk petroleum, DLA executes the integrated materiel management responsibility for bulk petroleum owned by the DoD and is responsible for bulk petroleum supply management from source of supply to the point of customer acceptance, with emphasis on improving efficiency. In accordance with DoD policy, DLA plans, programs, budgets, and provides funding for the operation, maintenance and repair of the Facility.

(c) Navy and DLA are the operators of the Facility.

(d) The Facility is located near Pearl Harbor on the island of Oahu, State of Hawaii.

(e) The Facility includes twenty (20) field-constructed steel USTs ("Tanks"). The Tanks are constructed of steel, encased by an estimated minimum of 2.5 to 4 feet of concrete surrounded and supported by basalt bedrock.

(f) Each tank has a fuel storage capacity ranging from approximately 12.5 to 12.7 million gallons for a total of approximately 250 million gallons of fuel. However, as of the Effective Date of this AOC, two (2) of the twenty (20) Tanks are not currently in operation.

(g) The Facility was constructed and became operational in the 1940s. The Tanks and related components at the Facility are unique.

(h) Federal and State programs for the management of USTs were first published in the 1980s. In January 2000, the State of Hawaii promulgated rules requiring owners and operators of such facilities to report suspected or confirmed releases from USTs. EPA granted final approval for the State of Hawaii's UST program on September 30, 2002, in lieu of Federal rules regarding USTs. On November 18, 2011, EPA proposed revisions to strengthen the 1988 Federal UST regulations including requirements for field-constructed USTs and new requirements for secondary containment and operator training. On April 16, 2012, the public comment period for the proposed regulations closed. Under the proposed rules, most provisions of the proposed regulations would become effective three years after the final rule is issued.

(i) The Tanks at the Facility have been used at various times to store the following fuels: diesel marine fuel, diesel oil, Navy Special Fuel Oil ("NSFO"), Navy distillate ("ND"), aviation gasoline ("AVGAS"), motor gas ("MOGAS"), Jet Propulsion Fuel No. 5 ("JP-5") and Jet Propulsion Fuel No. 8 ("JP-8").

(j) As of the Effective Date of this AOC, Navy stores three types of fuels at the Facility: JP-5, JP-8, and diesel marine fuel.

(k) The Waimalu and Moanalua Aquifers ("Aquifer identification and classification for Oahu: Groundwater protection strategy for Hawaii," February 1990), which are underground sources of drinking water, are located near the Facility. The Waimalu Aquifer covers an area of 15,193 acres and the Moanalua Aquifer covers an area of 4,442 acres.

(l) Navy Well 2254-01 is located west and hydraulically downgradient from the Facility. This well feeds into the Joint Base Pearl Harbor-Hickam Water System.

(m) The Honolulu Board of Water Supply's ("BWS") Halawa Shaft, which is part of a public water system, is near the Facility.

(n) The BWS's Moanalua Well, which is part of a public water system, is near the Facility.

(o) The first report by Navy to DOH of a release from the Facility occurred on November 10, 1998, when petroleum-stained basalt cores were discovered beneath the Tanks.

(p) In the early 2000s, Navy performed transverse cores beneath each tank and discovered evidence of staining beneath nineteen (19) of twenty (20) Tanks.

(q) On December 9, 2013, Navy placed one of the Tanks (Tank #5) at the Facility back into service after it had undergone routine scheduled maintenance. The maintenance work consisted of cleaning, inspecting, and repairing multiple sites within the tank. Upon placing Tank #5 back into service, Navy commenced filling the tank with petroleum.

(r) On January 13, 2014, Navy discovered a loss of fuel from Tank #5 and immediately notified DOH and EPA. On January 13, 2014, Navy began transferring fuel from Tank #5 to other Tanks at the Facility. The transfer of all fuel from Tank #5 was completed on January 18, 2014. On January 16, 2014, Navy verbally notified DOH and EPA of a confirmed release from Tank #5. On January 23, 2014, Navy provided written notification to DOH. Navy estimates the fuel loss at approximately 27,000 gallons.

(s) The total amount released to the environment, both attributable to the January 2014 event and historical releases, is unknown.

(t) Following the January 2014 release, Navy increased the frequency of monitoring and performed additional monitoring of Navy Well 2254-01 and shall continue to monitor Navy Well 2254-01 in accordance with the Groundwater Protection Plan approved by DOH and that will be updated in accordance with the SOW. Current drinking water monitoring results confirmed compliance with federal and state Maximum Contaminant Levels for drinking water both before and after the January 2014 release.

(u) Marine diesel and jet fuels in general, and Jet Propulsion Fuels 5 and 8 (JP-5 and JP-8) in particular, are composed of a broad, dynamic and heterogeneous mixture of chemical constituents. Chronic exposure to these constituents can be harmful to human health. The rates at which these constituents naturally degrade in the environment are highly variable.

5. CONCLUSIONS OF LAW AND DETERMINATIONS

(a) Hawaii Conclusions of Law and Determinations:

(i) Navy and DLA are "persons" as defined in HRS §342L-1 [40 C.F.R. § 280.12].

(ii) Navy is the "owner" of the Facility as defined in HRS §342L-1 [40 C.F.R. § 280.12].

(iii) Navy and DLA are the "operators" of the Facility as defined in HRS §342L-1 [40 C.F.R. § 280.12].

(iv) The Waimalu and Moanalua Aquifers are "underground sources of drinking water" as that term is used in HRS chapter 340E and are "State Waters" as defined in HRS §342D-1.

(v) BWS's Halawa Shaft and Moanalua Well are parts of a "public water system" as defined in HRS §340E-1 and are "State Waters" as defined in HRS §342D-1.

(vi) There have been "releases" of "regulated substances" into the environment from Tanks at the Facility, as those terms are defined by HRS §342L-1 [40 C.F.R. § 280.12].

(vii) There have been releases of "contaminants" into the environment from Tanks at the Facility, as that term is defined in HRS §340E-1.

(viii) There have been discharges of "wastes" and "water pollutants" as those terms are defined in HRS §342D-1.

(ix) Navy and DLA, as the owner and/or operator of the Facility are subject to requirements regarding response and remediation in HRS chapter 342L and Hawaii Administrative Rules ("HAR") chapter 11-281 [40 C.F.R. § 280 Subpart E] and are subject to orders which may be necessary to protect the health of persons who are or may be users of a public water system as provided in HRS chapter 340E and the rules promulgated pursuant thereto including, but not limited to, HAR §11-19 and 11-20, and are subject to administrative orders and civil actions which are necessary to address discharges to state waters as provided for in HRS chapter 342D. Additionally, the Facility, which is federally owned and operated, is subject to "all administrative orders and all civil and administrative penalties or fines, regardless of whether such penalties or fines are punitive or coercive in nature or are imposed for isolated, intermittent, or continuing violations in the same manner and to the same extent as any person is subject to such requirements," as codified in 42 U.S.C. § 6991f.

(x) The actions Navy and DLA have agreed to perform in accordance with this AOC are necessary to address potential impacts to human health, safety and the environment, as envisioned by HRS §§ 340E-4, 342D-9, 342D-10, 342D-11, 342L-8, 342L-9 and 342L-52, due to historical, recent and potential future releases at the Facility.

(b) EPA Conclusions of Law and Determinations:

(i) Navy and DLA are "persons" as defined in Section 1004(15) of RCRA, 42 U.S.C. § 6903(15).

(ii) EPA has determined that any fuel released from the Facility would be a "solid waste" within the meaning of Section 1004(27) of RCRA, 42 U.S.C. § 6903(27).

(iii) EPA has determined that Navy and DLA have contributed to or are contributing to the handling, storage, treatment, transportation or disposal of solid waste at the Facility.

(iv) EPA has determined that Navy and DLA's handling, storage, treatment, transportation, or disposal of solid waste may present an imminent and substantial endangerment to health or the environment.

(v) The actions required by this AOC may be necessary to protect health and the environment.

(vi) Navy and DLA are departments, agencies or instrumentalities of the Executive Branch of the federal government, and as such, are persons subject to the requirements of Sections 6001 and 9007 of RCRA, 42 U.S.C. §§ 6961, 6991f.

6. WORK TO BE PERFORMED

(a) Based upon the administrative record for the Site and the Findings of Fact (Section 4) and Conclusions of Law and Determinations (Section 5) set forth above, and in consideration of the promises set forth herein, it is hereby agreed to and ordered that Navy and DLA comply with all provisions of this AOC, including, the SOW, Attachment A, which is incorporated into and made an enforceable part of this AOC. The term "Work" shall mean all the activities and requirements, including but not limited to all deliverables, specified in the AOC and SOW. A deliverable is any report or other document listed under Section 9 of the SOW or otherwise expressly required to be submitted under this AOC.

(b) The Work undertaken pursuant to this AOC shall be conducted in accordance with all applicable EPA and DOH guidance, policies and procedures, and this AOC, and is subject to approval by the Regulatory Agencies.

(c) Navy and DLA shall undertake and complete all of the Work to the satisfaction of the Regulatory Agencies.

(d) Navy and DLA shall commence performing their obligations under this AOC upon its Effective Date.

(e) The DOH Project Coordinator shall be DOH's designated representative for the Site. As of the Effective Date of this AOC, the DOH Projector Coordinator shall be:

Steven Y.K. Chang, P.E., Chief
Solid and Hazardous Waste Branch
Department of Health
919 Ala Moana Blvd., Room 212
Honolulu, Hawaii 96814
(808) 586-4226
Steven.Chang@doh.hawaii.gov

The EPA Project Coordinator shall be EPA's designated representative for the Site. As of the Effective Date of this AOC, the EPA Project Coordinator shall be:

Bob Pallarino
U.S. EPA Region 9
Underground Storage Tank Program Office
75 Hawthorne Street (LND-4-3)
San Francisco, California 94105
(415) 947-4128
Pallarino.Bob@epa.gov

The Navy and DLA Project Coordinator shall be Navy and DLA's representative for the Site. As of the Effective Date of this AOC, the Navy and DLA Project Coordinator shall be:

Jimmy Miyamoto
Deputy Operations Officer
NAVFAC Hawaii
400 Marshall Road
JBPHH, HI 96860-3139
(808) 471-0196
james.miyamoto@navy.mil

Any of the Parties may change their Project Coordinators at any time. Any of the Parties making such change will provide the other Parties with written notice within fourteen (14) days of such a change.

(f) Unless otherwise provided in this AOC, all reports, correspondence, notices, or other submittals relating to or required under this AOC shall be in writing and shall be sent to the "Project Coordinators" at the addresses specified above. Unless otherwise specified in the SOW, all reports, correspondence, notices or other submittals related to or required under this AOC may be delivered via email to the addresses above, or if otherwise agreed to by the Parties, by U.S. Postal Service or private courier service to the address above. The Regulatory Agencies may require Navy and DLA to submit a follow-on paper copy of any submission. All correspondence shall include a reference to the "Red Hill Administrative Order on Consent."

7. REGULATORY AGENCIES' APPROVAL OF DELIVERABLES

(a) Deliverables required by this AOC shall be submitted to the Regulatory Agencies for approval or modification pursuant to Subparagraph (b). The Regulatory Agencies must receive all deliverables by the due date specified in this AOC or by schedules developed pursuant to this AOC.

(b) After review of any deliverable that is required pursuant to this AOC, the Regulatory Agencies will: (a) approve, in whole or in part, the submission; (b) approve the submission upon specified conditions; (c) modify the submission to cure the deficiencies; (d) disapprove, in whole or in part, the submission, directing that Navy and DLA modify the submission; or (e) any combination of the above. However, the Regulatory Agencies will not modify a submission without first providing Navy and DLA at least one notice of deficiency and an opportunity to cure within thirty (30) days, except where the Regulatory Agencies determine that to do so would cause serious disruption to the Work or where the Regulatory Agencies have disapproved previous submission(s) due to material defects and the Regulatory Agencies determine that the deficiencies in the submission under consideration indicate a bad faith lack of effort to submit an acceptable deliverable.

(c) In the event of approval, approval upon conditions, or modification by the Regulatory Agencies, pursuant to Subparagraph (b), Navy and DLA shall proceed to take any action required by the deliverable, as approved or modified by the Regulatory Agencies subject only to Navy and DLA's right to invoke the Dispute Resolution procedures set forth in Section 14 (Dispute Resolution) with respect to the modifications or conditions made by the Regulatory Agencies. In the event that the Regulatory Agencies modify the submission to cure the deficiencies pursuant to Subparagraph (b) and the Regulatory Agencies determine the submission has a material defect, the Regulatory Agencies retain their right to seek stipulated penalties, as provided in Section 15 (Penalties).

(d) Upon receipt of a notice of disapproval, in whole or in part, Navy and DLA shall, within thirty (30) days or such longer time as specified by the Regulatory Agencies in such notice, correct the deficiencies with respect to any disapproved part and resubmit the deliverable for approval. Any stipulated penalties applicable to the submission, as provided in the stipulated penalty provisions of Section 15 (Penalties), shall be stayed during the thirty (30) day opportunity to cure period or other specified period. A written explanation will accompany any disapproval, in whole or in part, by the Regulatory Agencies, including the identification of a material defect.

(e) Notwithstanding the receipt of a notice of disapproval, Navy and DLA shall proceed, at the direction of the Regulatory Agencies, to take any action required by any unrelated non-deficient portion of the submission. Implementation of any unrelated non-deficient portion of a submission shall not relieve Navy and DLA of liability for stipulated penalties for the disapproved portion under Section 15 (Penalties).

(f) In the event that a resubmitted deliverable, or portion thereof, is disapproved by the Regulatory Agencies, the Regulatory Agencies may again require Navy and DLA to correct the deficiencies, in accordance with the preceding Paragraphs. The Regulatory Agencies also retain the right to modify or develop the plan, report or other item, consistent with Subparagraph (b). Navy and DLA shall implement any action as required in a deliverable which has been modified or developed by the Regulatory Agencies, subject only to Navy and DLA's right to invoke the procedures set forth in Section 14 (Dispute Resolution).

(g) If upon resubmission, a deliverable is disapproved or modified by the Regulatory Agencies due to a material defect previously identified by the Regulatory Agencies in accordance with Subsection 7(d), Navy and DLA shall be deemed to have failed to submit such deliverable timely and adequately unless Navy and DLA invoke the dispute resolution procedures set forth in Section 14 (Dispute Resolution) and the Regulatory Agencies' action to disapprove or modify a deliverable is overturned pursuant to that Section. The provisions of Section 14 (Dispute Resolution) and Section 15 (Penalties) shall govern the implementation of the Work and accrual and payment of any stipulated penalties during Dispute Resolution. If the Regulatory Agencies' disapproval or modification is upheld, stipulated penalties shall accrue for such violation from the date on which the initial submission was originally required, as provided in Section 15 (Penalties).

(h) All deliverables required to be submitted to the Regulatory Agencies under this AOC, shall, upon approval or modification by the Regulatory Agencies, be incorporated into and made enforceable under this AOC. In the event the Regulatory Agencies approve or modify a portion of a deliverable required to be submitted to the Regulatory Agencies under this AOC, the approved or modified portions shall be enforceable under this AOC. Navy and DLA shall implement all deliverables in accordance with the schedule and provisions approved by the Regulatory Agencies.

8. MODIFICATION OF THE SOW AND THIS AOC AND ADDITIONAL WORK

(a) Modification of the Work in the SOW

(i) If at any time during the implementation of the SOW, Navy and DLA identify a need for a compliance date modification or modification of the Work in the SOW, Navy and DLA shall submit a memorandum documenting the need for the modification to the Project Coordinators of the Regulatory Agencies. The Project Coordinators of the Regulatory Agencies will determine if the modification is warranted and will provide written approval or disapproval. If disapproved, the Regulatory Agencies will provide a written explanation of the reason for the disapproval. Any approved, written modification of a compliance date or modification of Work required by this AOC shall be incorporated by reference into this AOC.

(ii) In the event that during the performance of this AOC, Navy and/or DLA encounters any condition or situation that constitutes an emergency situation or may present an immediate threat to human health or the environment, Navy and DLA shall immediately take all appropriate actions to prevent and/or minimize such emergency or threat, and shall immediately notify the DOH Project Coordinator and the EPA Project Coordinator. Navy and DLA shall take such immediate and appropriate actions in consultation with the DOH Project Coordinator and the EPA Project Coordinator. Navy and DLA shall then submit to DOH and EPA written notification of such emergency or threat at the Site within twenty-four (24) hours of such discovery and, if further action is required, submit a plan to further mitigate the threat within seven (7) days of sending the written notification of the emergency. After approval or approval with modification of the plan by the Regulatory Agencies, Navy and DLA shall implement the plan as approved or modified and the plan shall be incorporated by reference into and made part of this AOC and be enforceable as such. In the event that Navy and DLA fail to take appropriate response action as required by this Paragraph, either or both of the Regulatory Agencies may take a response action consistent with their statutory and regulatory authorities and may require Navy and DLA to reimburse them for their response costs pursuant to those authorities.

(b) Modification of this AOC

(i) This AOC may be modified only by the mutual agreement of the Parties. Any agreed modifications shall be in writing; be signed by all the Parties; have as their effective date the date on which the last Party signs the modification; and be incorporated into and be enforceable under this AOC.

(ii) No informal advice, guidance, suggestion, or comment by the Regulatory Agencies regarding deliverables submitted by Navy and DLA shall relieve Navy and DLA of their obligation to obtain such formal approval as may be required by this AOC, and to comply with all requirements of this AOC unless it is modified as provided under this AOC. Any deliverables, required by this AOC are, upon approval by the Regulatory Agencies, incorporated into and enforceable under this AOC.

(iii) In the event future regulatory requirements for field-constructed USTs are determined by the Regulatory Agencies to conflict with the Work to be performed under this

AOC, such that Navy and DLA could not comply with both this AOC and the regulatory requirements, the Parties will make good faith efforts to promptly resolve such conflict.

(c) Additional Work. The Regulatory Agencies may determine, or Navy and DLA may propose, that certain tasks or activities are necessary in addition to or in lieu of the Work when such additional performance is necessary for protection of human health and the environment. The Regulatory Agencies may determine that Navy and DLA shall perform additional work and the Regulatory Agencies will specify, in writing, the basis for the determination that additional work is necessary. Within thirty (30) days after the receipt of such determination, Navy and DLA shall have the opportunity to meet or confer with the Regulatory Agencies to discuss any additional work. Upon meeting or conferring, the Parties shall agree on a schedule for submitting a work plan for additional work; Navy and DLA shall either invoke dispute resolution or submit the schedule for approval within thirty (30) days from Navy and DLA's meeting or conferring on the additional work, unless otherwise agreed to by the Parties. Upon approval of a work plan, Navy and DLA shall implement the work plan in accordance with the schedule and provisions contained therein. The work plan shall be incorporated by reference into and made a part of this AOC and be enforceable as such.

9. DOCUMENT CERTIFICATION

(a) Any deliverable specifically listed in the SOW and submitted by Navy and DLA pursuant to this AOC shall be certified by the Commander of Navy Region Hawaii or the Regional Engineer for CNRH or designee but no lower than the Deputy Regional Engineer. Certification of additional deliverables may be required, if specified as a requirement in an approved implementation plan.

(b) The certification required by Paragraph 9(a) above, shall be in the following form:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fines and imprisonment for knowing violation.

Signature:________________________________

Name:____________________________________

Title:____________________________________

Date:____________________________________

10. SAMPLING, ACCESS AND DOCUMENT AVAILABILITY

(a) Sampling and Analysis

(i) All results of sampling, testing, modeling or other data generated (including raw data, which shall be made available if requested) by Navy and DLA, or on Navy and DLA's behalf, during implementation of this AOC shall be submitted to the Regulatory Agencies within thirty (30) calendar days of Navy and DLA's receipt of the data. Data shall be provided in the same format that it was provided to Navy and DLA unless a different format is otherwise agreed to by the Parties. Upon request, the Regulatory Agencies will make available to Navy and DLA data generated by DOH or EPA for the purposes of oversight of the Work unless it is exempt from disclosure by any federal or state law or regulation. All sampling and analysis shall be subject to a quality assurance and control process as specified in the SOW.

(ii) Navy and DLA shall provide written notice to the Regulatory Agencies at least seven (7) calendar days prior to conducting field sampling, or as otherwise agreed to by the Parties. At the Regulatory Agencies' request, Navy and DLA shall allow split or duplicate samples to be taken by the Regulatory Agencies.

(b) Access to Areas Controlled by Navy and/or DLA

(i) EPA has the authority to enter the Site under federal environmental law and DOH has authority to enter the Site under state law.

(ii) Navy and DLA shall provide the Regulatory Agencies and/or their representatives with access to the Site at all reasonable times for the purposes consistent with the provisions of this AOC. Such access shall include, but not be limited to: inspecting records, logs, contracts, and other documents relevant to implementation of this Agreement; reviewing and monitoring the progress of Navy and DLA, their contractors, and lessees in carrying out the activities under this AOC; conducting tests that the Regulatory Agencies deem necessary;

assessing the need for planning additional response actions at the Site; and verifying data or information submitted to the Regulatory Agencies.

(iii) Navy and DLA shall honor all requests for access to the Site made by the Regulatory Agencies subject to the requirements in Subparagraph (v). Navy and DLA may require presentation of credentials showing the bearer's identification and that he/she is an employee or agent of the Regulatory Agencies, including contractors employed by either of the Regulatory Agencies. Navy and DLA's Project Coordinator or his/her designee shall provide briefing information, coordinate access and escort to restricted or controlled-access areas, arrange for base passes, and coordinate any other access requests that arise. Navy and DLA shall use their best efforts to ensure that conformance with the requirements of this Subsection do not delay access.

(iv) The rights granted in this Section to the Regulatory Agencies regarding access shall be subject to regulations and statutes, as may be necessary to protect national security information ("classified information") as defined in Executive Order 12958. Such requirement shall not be applied so as to unreasonably hinder the Regulatory Agencies from carrying out their responsibilities and authority pursuant to this AOC.

(v) The Facility is a controlled access area and subject to safety and security requirements. Other parts of the Site may be controlled or restricted. Navy and DLA shall provide an escort whenever the Regulatory Agencies require access to controlled or restricted areas for purposes consistent with the provisions of this AOC. The Regulatory Agencies shall provide reasonable notice to the Navy and DLA Project Coordinator, or his or her designee, to request any necessary escorts for such areas. Navy and DLA shall not require an escort to any area of the Site unless it is a restricted or controlled-access area. Upon request of the Regulatory Agencies, Navy and DLA shall promptly provide a written list of current restricted or controlled-access areas of the Site.

(vi) Upon a denial of any aspect of a request of access, Navy and DLA shall provide an immediate explanation of the reason for the denial, including reference to any applicable regulations, and upon request, a copy of such regulations. Within forty-eight (48) hours, Navy and DLA shall provide a written explanation for the denial. To the extent possible, Navy and DLA shall expeditiously provide a recommendation for accommodating the requested access in an alternate manner.

(vii) Pursuant to this Section, any denial of access contrary to the terms of this AOC at reasonable times to any portion of the Site, where a request for access was made for the purposes of enforcing the requirements of federal or state law, or implementing or enforcing this AOC, shall be construed as a violation of the terms of this AOC subject to the penalty provisions outlined in Section 15 (Penalties) of this AOC.

(c) Access to Areas Not Controlled by Navy and/or DLA

Where action under this AOC is to be performed in areas owned by, or in possession of, someone other than Navy or DLA, Navy and DLA shall use their best efforts to obtain all necessary access agreements in a timely manner. Navy and DLA shall commence efforts to obtain such agreements within thirty (30) days of approval of any Work for which access is necessary. Any such access agreement shall provide for access by the Regulatory Agencies and their representatives to move freely in order to conduct actions that the Regulatory Agencies determine to be necessary. The access agreement shall specify that Navy and DLA are not the Regulatory Agencies' representative(s) with respect to any liabilities associated with activities to be performed. Navy and DLA shall provide DOH's Project Coordinator and EPA's Project Coordinator with copies of any access agreements. Navy and DLA shall immediately notify the Regulatory Agencies if after using Navy and DLA's best efforts, they are unable to obtain such agreements within the time required. Best efforts as used in this Paragraph shall include, at a minimum, a certified letter from Navy and DLA to the present owner of such property requesting access agreements to permit Navy and DLA, the Regulatory Agencies, and the Regulatory Agencies' authorized representatives to enter such property, and the offer of payment of reasonable sums of money in consideration of granting access. Navy and DLA shall, within ten (10) calendar days of receipt of a denial of access, submit in writing, a description of their efforts to obtain access. The Regulatory Agencies may, at their discretion, assist Navy and DLA in obtaining access. Where access on state owned property is needed, DOH will make best efforts to assist Navy and DLA with access.

(d) Document Availability

All data, information, and records created or maintained for purposes of implementation of this AOC, and all records relating to Facility operations and maintenance, or to site conditions, shall be made available to the Regulators upon request unless Navy or DLA assert a claim that such documents are legally privileged from disclosure and meets the burden of demonstrating to the Regulatory Agencies that such a privilege exists. Navy and DLA may assert a claim that certain documents or portions of documents are protected from public disclosure under federal or state law (e.g., documents exempt from disclosure under applicable laws such as FOIA, Procurement Integrity Act, Privacy Act, etc.). Navy and DLA shall clearly mark the material in which such a claim is asserted (e.g., documents shall be marked on each page and shall be reasonably segregated) and cite to the legal authority allowing withholding. If no such claim accompanies the information when it is submitted to the Regulatory Agencies, it may be made available to the public by EPA or DOH without further notice to Navy and DLA. Navy and DLA agree not to assert such claims with respect to any data related to Site conditions, including but not limited to, sampling, analytical, monitoring, hydrogeologic, scientific, chemical or engineering data or any other documents or information evidencing conditions at or around the Site.

(e) Nothing in this AOC shall be construed to limit the Regulatory Agencies' right of access, entry, inspection, and information gathering pursuant to applicable law.

11. COMPLIANCE WITH OTHER LAWS

Navy and DLA shall perform all actions required pursuant to this AOC in accordance with all applicable local, state, and federal laws and regulations. Navy and DLA shall use best efforts to obtain or cause their representatives to obtain all permits and approvals necessary under such laws and regulations in a timely manner so as not to delay the Work required by this AOC.

12. FUNDING OF THE WORK

(a) It is further agreed to and ordered that Navy and DLA shall timely seek sufficient funding through their budgetary processes to finance and perform all the Work. Navy and DLA recognize the requirements of this AOC as necessary actions subject to the provisions of Executive Order 12088 requiring request of sufficient funds in the agency budget. It is the expectation of the Parties to this AOC that all obligations of Navy and DLA arising under this AOC will be fully funded.

(b) Any requirement for the payment or obligation of funds, including stipulated penalties, by Navy or DLA, established by the terms of this AOC may be subject to the availability of appropriated funds. No provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341.

(c) If Navy and DLA determine that there are insufficient funds to carry out the Work in accordance with the AOC, Navy and DLA shall notify the Regulatory Agencies within thirty (30) days thereafter and request a meeting to work with the Regulatory Agencies to explore cost-savings or re-scoping measures to off-set the shortfall. The meeting shall be held within thirty (30) days of the request for the meeting, unless otherwise agreed to by the Parties. If re-scoping or cost savings measures are not sufficient to offset the shortfall such that schedules developed pursuant to this AOC should be modified, then Navy and DLA shall submit a modified schedule to the Regulatory Agencies for approval within the time frame agreed to in the meeting. The time frame agreed to in the meeting shall be in writing, signed by the Parties and be enforceable under this AOC. If funds are not available in any year to fulfill Navy and DLA's obligations under this AOC and the Parties are unable to agree on cost-savings or re-scoping measures to offset the shortfall or a modified schedule, DOH and EPA reserve their respective rights to initiate any action against any person(s) or to take any response action which would be appropriate absent this AOC.

13. <u>REIMBURSEMENT OF DOH COSTS</u>

(a) Subject to the provisions of this Paragraph, Navy and DLA agree to pay reasonable service charges incurred by DOH with respect to the Work. Reasonable service charges shall mean reasonable and necessary costs above and beyond normal regulatory responsibilities (i.e., required overtime or contracted effort) that DOH incurs in monitoring Navy's and DLA's performance under this AOC to determine whether such performance is consistent with the requirements of this AOC, including costs incurred in reviewing plans, reports and other documents submitted pursuant to this AOC. Reasonable service charges incurred by DOH shall be limited to no more than fifty thousand dollars ($50,000) per calendar year unless otherwise agreed in writing by Navy and DLA. DOH shall advise Navy and DLA prior to accruing any costs for which it intends to seek reimbursement pursuant to this section and shall obtain concurrence that such costs are reasonable. Navy and DLA shall make good faith efforts to negotiate a separate cooperative agreement with DOH which will detail the modalities for payment of reasonable service charges incurred by DOH with respect to the Work. If Navy, DLA, and DOH cannot agree on the reasonableness of the proposed costs, they shall attempt to resolve any disputes under this Section amongst themselves. In the event that a separate cooperative agreement is developed, any dispute resolution related to this Paragraph shall be pursuant to that agreement and applicable regulation and shall not be subject to Section 14 (Dispute Resolution).

(b) DOH reserves the right to bring an action against Navy and DLA under any applicable law for recovery of all reasonable service charges incurred by DOH with respect to the Site that have not been reimbursed by Navy and DLA if Navy and DLA and DOH fail to enter into a separate cooperative agreement or make other arrangements for reimbursement of reasonable service charges incurred by DOH with respect to the Work.

14. DISPUTE RESOLUTION

(a) The Parties intend to work cooperatively to avoid disputes in the implementation of the AOC. The Parties shall make reasonable efforts to resolve disputes informally at the lowest level. The process for dispute resolution set forth in this Section shall be the exclusive remedy through which the Parties resolve any and all disputes arising from this AOC and the implementation and execution of the Work. At any point during the dispute resolution process, Navy and DLA may withdraw their dispute and commence or resume the previously disputed Work in accordance with direction from the Regulatory Agencies.

(b) A dispute resolution committee (“DRC”) shall serve as the initial forum for resolution of disputes for which agreement has not been reached through informal dispute resolution among the Parties. Each Party shall designate one individual and an alternate to serve on the DRC, and may change those designations at will, with written notice to be provided to the other Parties, but shall at all times have persons so designated and available to participate in the dispute resolution process as needed. The persons designated to serve on the DRC shall be employed at the senior management level (e.g., Senior Executive Service (SES) or equivalent) or be delegated the authority in writing to participate on the DRC by an SES or equivalent level official, or higher, for the purposes of dispute resolution under this agreement.

(i) Within thirty (30) days after any action which leads to or generates a dispute, the disputing Party shall submit to the DRC a written statement of dispute setting forth the nature of the dispute, the disputing Party's position with respect to the dispute and the technical, legal and factual information the disputing Party is relying upon to support its position.

(ii) Prior to any Party's issuance of a written statement of dispute, the disputing Party shall engage the other Parties in informal dispute resolution among the Project Coordinators and/or their immediate supervisors. During this informal dispute resolution period, the Parties shall meet and/or confer as many times as are necessary to discuss and attempt resolution of the dispute.

(iii) Within twenty (20) calendar days of receipt by the DRC of the disputing Party's written request for formal dispute resolution, unless additional time is provided by the DRC, the other Parties may submit their own statements of position with respect to the dispute to the DRC for its consideration.

(iv) The DRC shall have forty-five (45) calendar days from the date it receives a timely written request from the disputing Party for formal dispute resolution to unanimously resolve the dispute and issue a written decision signed by the designee of each Party then serving on the DRC, except that such designees may agree unanimously to extend the period of time to reach decision if necessary. This decision may include any necessary findings and instructions, as appropriate, to proceed with Work interrupted or delayed by the dispute.

(c) In the event the DRC is unable to unanimously resolve the dispute within the forty-five (45) day period, the written statement of dispute shall be forwarded to the Senior Executive Committee (SEC) for resolution, within ten (10) days after the close of the forty-five (45) day period. EPA's representative on the SEC is the Regional Administrator of EPA Region 9. DOH's representative on the SEC is the Director of Health. Navy's representative on the SEC is the Commander Navy Installations Command. DLA's representative on the SEC is the Chief of Staff of DLA. The SEC members shall, as appropriate, confer, meet, and exert their best efforts to resolve the dispute and issue a unanimous written decision signed by all Parties. If unanimous resolution of the dispute is not reached within thirty (30) days of elevation to the SEC, the Regional Administrator of EPA Region 9 shall issue a written position on the dispute within forty (40) days of elevation to the SEC. The Assistant Secretary of the Navy for Energy, Installations & Environment, or the Director of DLA, within thirty (30) days of the EPA's Regional Administrator's issuance of the EPA's position, may issue a written notice elevating the dispute to EPA's Assistant Administrator of the Office of Enforcement and Compliance Assurance (EPA Assistant Administrator) for resolution. In the event that Navy, DLA or DOH elects not to elevate the dispute to the EPA Assistant Administrator within the designated thirty (30) day escalation period, the other Parties shall be deemed to have agreed with the EPA's Regional Administrator's written position with respect to the dispute.

(d) Upon elevation of the dispute to the EPA Assistant Administrator pursuant to Paragraph 14(c) above, the EPA Assistant Administrator will review and resolve the dispute. Upon request, and prior to resolving the dispute, the EPA Assistant Administrator will meet and confer with the Assistant Secretary of the Navy for Energy, Installations & Environment, the Director of DLA, and the Governor to discuss the issue(s) under dispute. The EPA Assistant Administrator will resolve the dispute within thirty (30) days of receipt of the dispute, unless the Assistant Secretary of the Navy for Energy, Installations & Environment, the Director of DLA, or the Governor request a meeting with the EPA Assistant Administrator prior to resolving the dispute, in which case the dispute will be resolved within thirty (30) days of such meeting. Upon resolution, the EPA Assistant Administrator will provide the other Parties with a written final decision setting forth resolution of the dispute.

(e) The existence of a dispute and the Regulatory Agencies' consideration of matters placed in dispute shall not excuse, toll, or suspend any compliance obligation or deadline required pursuant to this AOC during the pendency of the dispute resolution process except as agreed by the Regulatory Agencies in writing pursuant to Section 8 of this AOC or determined by the Administrator or his or her designee. In the event that a dispute is resolved in favor of Navy and DLA pursuant to this Section, stipulated penalties incurred with respect to the specific subject of that dispute will not be due and owing.

(f) Within thirty (30) calendar days of receipt of any final decision and instructions with respect to any dispute resolved pursuant to the procedures specified in this Section, unless otherwise specified in the decision, Navy and DLA shall incorporate the final decision and instructions into the appropriate plan, schedule or procedures and implement this AOC in accordance with such plan, schedule or procedures.

(g) Resolution of a dispute pursuant to this Section constitutes a final resolution of any dispute arising under this AOC. All Parties shall abide by all terms and conditions of any final resolution of dispute obtained pursuant to this Section of the AOC.

15. PENALTIES

(a) In the event that Navy and/or DLA fails to comply with any term, condition or requirement of this AOC, EPA and/or DOH may assess and Navy and DLA shall be liable for stipulated penalties in the amounts set forth in this Section unless a Force Majeure event has occurred as defined in Section 17 (Force Majeure) and the Regulatory Agencies have approved the extension of a deadline as required by that Section. Compliance with this AOC by Navy and DLA shall include completion of any Work in accordance with this AOC and within the specified time schedules approved under this AOC. A stipulated penalty may be assessed in an amount not to exceed $5,000 for the first week (or part thereof) and $10,000 for each additional week (or part thereof) for which a failure set forth in this Subsection occurs.

(b) Stipulated penalties incurred pursuant to this Section shall begin to accrue on the day after complete performance is due or the day the violation occurs and shall continue to accrue until the violation is corrected to the satisfaction of the Regulatory Agencies.

(c) Upon determining that Navy and DLA have failed in a manner set forth in this Subsection, the EPA or the DOH will notify Navy and DLA. Any such notification shall be in writing. If the failure in question is not already subject to dispute resolution at the time such notice is received, Navy and DLA shall have thirty (30) days after receipt of the notice to invoke dispute resolution on the question of whether the failure did in fact occur and whether there is no mitigating reason for the failure. Where dispute resolution is invoked, no assessment of a stipulated penalty shall be final until the conclusion of dispute resolution procedures related to the assessment of the stipulated penalty. Notwithstanding any other provision of this Section, the Regulatory Agencies may, in their unreviewable discretion, waive any portion of stipulated penalties that have accrued pursuant to this AOC.

(d) No later than sixty (60) days after receipt of a written demand for payment from the Regulatory Agencies, unless the dispute resolution provisions of Section 14 (Dispute

Resolution) are invoked, Navy and DLA shall pay the penalty. If the stipulated penalties become payable by Navy and DLA, they shall pay one half (50%) of the total penalty amount by cashier's or certified check payable to the "State of Hawaii Director of Finance" for deposit into the Hawaii's Leaking Underground Storage Tank Fund [HRS § 342L-51] and delivered to the Director's Office, 1250 Punchbowl Street, Honolulu, Hawaii. They shall pay the other half (50%) of the total penalty amount by certified or cashier's check payable to the United States Treasury and delivered to the U.S. Environmental Protection Agency. Cincinnati Finance Center, Box 979077, St. Louis, MO, or other agreed-to method. All payments by Navy and DLA shall reference Navy and DLA's name and address, and the docket number for this action.

(e) This Section shall not affect Navy or DLA's ability to obtain an extension of a timetable, deadline, or schedule pursuant to Section 8 of this AOC.

(f) Nothing in this AOC shall be construed to render any officer or employee Navy or DLA personally liable for the payment of any stipulated penalty assessed pursuant to this Section.

16. ENFORCEABILITY

(a) The Parties agree to exhaust their rights under Section 14 (Dispute Resolution), prior to DOH exercising any rights to pursue a civil action and seek judicial review that it may have.

(b) Subject to the Dispute Resolution Provisions of Section 14 and the Regulatory Agencies' Covenants in Section 19, nothing in this AOC shall preclude the State of Hawaii from seeking to enforce the terms and conditions of this AOC as a final order of DOH against Navy and DLA in a civil action to collect penalties and/or enforce its provisions pursuant to HRS §§ 340E-4, 340E-8, 342D-9, 342D-10, 342D-11, 342L-8, 342L-9, 342L-12, and 342L-52, Section 7002 of RCRA, 42 U.S.C. § 6972, or in a civil action for breach of this AOC and from seeking any other relief as may be necessary to protect the public health, a source of drinking water and the environment. However, DOH will not seek to collect, in a judicial proceeding, civil penalties for a breach of this AOC if it or EPA has already collected such penalties under the penalty provisions of this AOC for the same matter, or if such penalties have been overturned through the dispute resolution process of Section 14.

(c) Failure to diligently conduct the Work may subject Navy and DLA to an action under Section 7002 of RCRA, 42 U.S.C. § 6972.

(d) Navy and DLA waive their opportunity to confer with the Administrator of EPA pursuant to 42 U.S.C. § 6961(b)(2) and any right to further review of the issuance of this AOC pursuant to any provisions of state and federal law.

(e) In any action to enforce the terms of this AOC, all Parties agree to be bound by the terms of the AOC and agree to not contest the validity of this AOC, its terms or conditions, or the procedures underlying or relating to them in any action brought by the Regulatory Agencies to enforce its terms.

17. FORCE MAJEURE

(a) Navy and DLA agree to perform all requirements under this AOC within the time limits established under this AOC, unless the performance is delayed by a force majeure. For purposes of this AOC, a force majeure is defined as any event arising from causes beyond the control of Navy and DLA, or Navy or DLA’s contractors, that delays or prevents performance of any obligation under this AOC despite Navy and DLA's best efforts to fulfill the obligation. The requirement that Navy and DLA exercise “best efforts to fulfill the obligation” includes using best efforts to anticipate any potential force majeure event and best efforts to address the effects of any potential force majeure event: (1) as it is occurring, and (2) following the potential force majeure event, such that the delay is minimized to the greatest extent possible. Force majeure does not include financial inability to complete the Work, increased cost of performance, changes in Navy and DLA’s business or economic circumstances, or inability to attain media cleanup standards.

(b) If any event occurs or has occurred that may delay the performance of any obligation under this AOC, whether or not caused by a force majeure event, Navy and DLA shall orally notify the Regulatory Agencies within forty-eight (48) hours of when Navy or DLA knew or should have known that the event might cause a delay. Such notice shall: (1) identify the event causing the delay, or anticipated to cause delay, and the anticipated duration of the delay; (2) provide Navy and DLA’s rationale for attributing such delay to a force majeure event; (3) state the measures taken or to be taken to prevent or minimize the delay; (4) estimate the timetable for implementation of those measures; and (5) state whether, in the opinion of Navy and DLA, such event may cause or contribute to an endangerment to public health or the environment. Navy and DLA shall undertake best efforts to avoid and minimize the delay. Failure to comply with the notice provision of this Paragraph and to undertake best efforts to avoid and minimize the delay shall waive any claim of force majeure by Navy and DLA. Navy and DLA shall be deemed to have notice of any circumstances of which their contractors had or should have had notice.

(c) If the Regulatory Agencies determine that a delay in performance or anticipated delay in fulfilling a requirement of this AOC is or was attributable to a force majeure, then the time period for performance of that requirement will be extended as deemed necessary by the Regulatory Agencies. If the Regulatory Agencies determine that the delay or anticipated delay has been or will be caused by a force majeure, then the Regulatory Agencies will notify Navy and DLA, in writing, of the length of the extension, if any, for performance of such obligations affected by the force majeure. Any such extensions shall not alter Navy and DLA's obligation to perform or complete other tasks required by this AOC which are not directly affected by the force majeure.

(d) If the Regulatory Agencies disagree with Navy and DLA’s assertion of a force majeure, then Navy and DLA may elect to invoke the dispute resolution provision, and shall follow the procedures set forth in Section 14 (Dispute Resolution). In any such proceeding, Navy and DLA shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that Navy and DLA’s best efforts were exercised to avoid and mitigate the effects of the delay, and that Navy and DLA complied with the requirements of this Section. If Navy and DLA satisfy this burden, then the Regulatory Agencies will extend the time for performance as the Regulatory Agencies determine is necessary.

18. RESERVATION OF RIGHTS

(a) Notwithstanding any other provisions of this AOC, the Regulatory Agencies retain their authority to take, direct, or order any and all actions necessary to protect public health, any source of drinking water or the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances, pollutants, or contaminants, or hazardous or solid waste or constituents of such wastes, on, at, or from the Facility, including but not limited to the right to bring enforcement actions under RCRA, the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), the Clean Water Act ("CWA"), the Safe Drinking Water Act ("SDWA"); HRS chapters 340E, 342D and 342L; and any other applicable statutes or regulations. However, unless required on an emergency basis, no such action shall be taken in relation to any activity within the scope of this AOC unless a Party has first made good faith efforts to address the issue through a modification to this AOC and, if necessary, through the Dispute Resolution process set forth in Section 14.

(b) The Regulatory Agencies reserve all of their statutory and regulatory powers, authorities, rights, and remedies, both legal and equitable, which may pertain to Navy and DLA's failure to comply with any of the requirements of this AOC.

(c) Navy and DLA reserve all of their statutory and regulatory rights and defenses both legal and equitable, including but not limited to rights and defenses against third parties. Nothing in this AOC shall be taken as an admission of fact or law in any dispute with a third party or in any dispute outside the context of enforcement of this AOC.

(d) This AOC is not intended to be nor shall it be construed to be a permit. Navy and DLA acknowledge and agree that EPA or DOH's review and approval of the Work does not constitute a warranty or representation that the Work will achieve the required cleanup or performance standards. Compliance by Navy and DLA with the terms of this AOC shall not relieve Navy and DLA of their obligations to comply with applicable local, state, or federal laws and regulations.

19. <u>REGULATORY AGENCIES' COVENANTS</u>

(a) Except as provided in Section 18 (Reservation of Rights), EPA covenants not to take administrative action against Navy or DLA pursuant to Section 7003 of RCRA, 42 U.S.C. § 6973, for the Work. EPA's covenant shall take effect upon the Effective Date of this AOC. EPA's covenant is conditioned upon the satisfactory performance by Navy and DLA of their obligations under this AOC. EPA's covenant extends only to Navy and DLA and does not extend to any other person.

(b) Except as provided in Section 18 (Reservation of Rights), DOH covenants not to take administrative enforcement action against Navy or DLA with respect to any Work on the condition that the Work is consistent with Navy's and DLA's obligations under this AOC and/or that the Work has been satisfactorily completed and approved by the DOH.

20. OTHER CLAIMS

By issuance of this AOC, the Regulatory Agencies assume no liability for injuries or damages to persons or property resulting from any acts or omissions of Navy and DLA. The Regulatory Agencies shall not be deemed a party to any contract, agreement or other arrangement entered into by Navy and DLA or its officers, directors, employees, agents, successors, assigns, heirs, trustees, receivers, contractors, or consultants in carrying out actions pursuant to this AOC.

21. RECORD RETENTION

(a) Navy and DLA shall preserve all records related to the Facility in accordance with the appropriate federal records retention schedule. In addition, Navy and DLA shall preserve all documents shared with the Regulatory Agencies relating to the Work performed under this AOC, monitoring data, and other raw data generated pursuant to this AOC, for at least ten (10) years following the termination of the AOC. Navy and DLA shall make such records available to DOH or EPA at their request.

(b) All substantive documents exchanged between the Parties relating to the Work performed under this AOC and all monitoring data related to the Facility shall be stored by Navy and DLA in a centralized location at the Site, or an alternative location mutually approved by the Project Coordinators to promote easy access by the Regulatory Agencies or their representatives.

22. PRESIDENTIAL EXEMPTION

The Parties recognize that the President may exempt a solid waste management facility from requirements of RCRA pursuant to 42 U.S.C. § 6961(a) or a UST from the requirements of RCRA pursuant to 42 U.S.C. § 6991f for a period of time not to exceed one (1) year after the President grants the exemption. This exemption may be renewed. Navy and DLA shall obtain access to and perform all actions required by this AOC within all areas inside those portions of the Site, which are not the subject of or subject to any such exemption by the President.

23. PUBLIC COMMENT

(a) Upon signature by Navy and DLA, the Regulatory Agencies shall provide public notice, a public meeting and a reasonable opportunity for public comment on the proposed settlement. After consideration of any comments submitted during a public comment period of not less than thirty (30) days (which the Regulatory Agencies may extend), the Regulatory Agencies may sign this AOC, or withhold consent, or seek to amend all or part of this AOC if the Regulatory Agencies determine that comments received disclose facts or considerations which indicate that this AOC is inappropriate, improper, or inadequate.

(b) If a modification is necessary, the Regulatory Agencies shall transmit a modified copy of the AOC to Navy and DLA for review and signature, or further negotiations, as appropriate. If the modification is determined by the Regulatory Agencies to be significant, the process for public comment, described in Section 23(a), will repeat.

24. SEVERABILITY

If any provision of this AOC or the application of this AOC to any party or circumstances is held by any judicial authority to be invalid, the remainder of the AOC shall remain in full force and effect.

25. EFFECTIVE DATE

After this AOC is signed by each of the Parties and after the public comment period and review as described in Section 23 (Public Comment), this AOC shall become effective. The undersigned representatives certify that they are fully authorized to enter into the terms and conditions of this AOC and to bind the party they represent to this document.

26. TERMINATION AND SATISFACTION

The provisions of this AOC shall be deemed fully satisfied upon the Regulatory Agencies' execution of a written acknowledgement ("Acknowledgement") specifying that Navy and DLA have demonstrated to the satisfaction of the Regulatory Agencies that the terms and conditions of this AOC have been fully and satisfactorily completed. Prior to termination of this AOC, the Parties shall discuss whether an agreement, or additional regulation, is necessary to ensure continued protection of health and the environment. Termination of this AOC shall not terminate Navy and DLA's obligation to comply with Sections 10 (Sampling and Access) and 21 (Record Retention) of this AOC or the Regulatory Agencies' reservation of rights in Section 18.

IN WITNESS WHEREOF, the Parties have duly executed this presents as of the day and year subscribed below.

Agreed this 27th day of MAY, 2015.

By:

Richard L. Williams, Rear Admiral
Commander Navy Region Hawaii, U.S. Navy

Administrative Order on Consent
In the Matter of Red Hill Bulk Fuel Storage Facility
EPA Docket No: RCRA 7003-R9-2015-01
DOH Docket No: 15-UST-EA-01

Agreed this 27th day of May, 2015.

By: Renee L. Roman

Renee L. Roman, Chief of Staff
Defense Logistics Agency

It is so ORDERED and Agreed this ______day of ______, 2015.

By: ____
Keith Kawaoka, Deputy Director
Department of Health

APPROVED: ____
AS TO Wade H. Hargrove III, Deputy Attorney General
FORM Hawaii Department of Attorney General

It is so ORDERED and Agreed this ______day of ______, 2015.

By: ____

Jeff Scott, Director, Land Division
Region 9, U.S. Environmental Protection Agency

APPENDIX B –

MASS TECHNOLOGY CORPORATION TEST REPORTS

Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 2 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________
Ricky Slaughter

Date: 03-13-2015

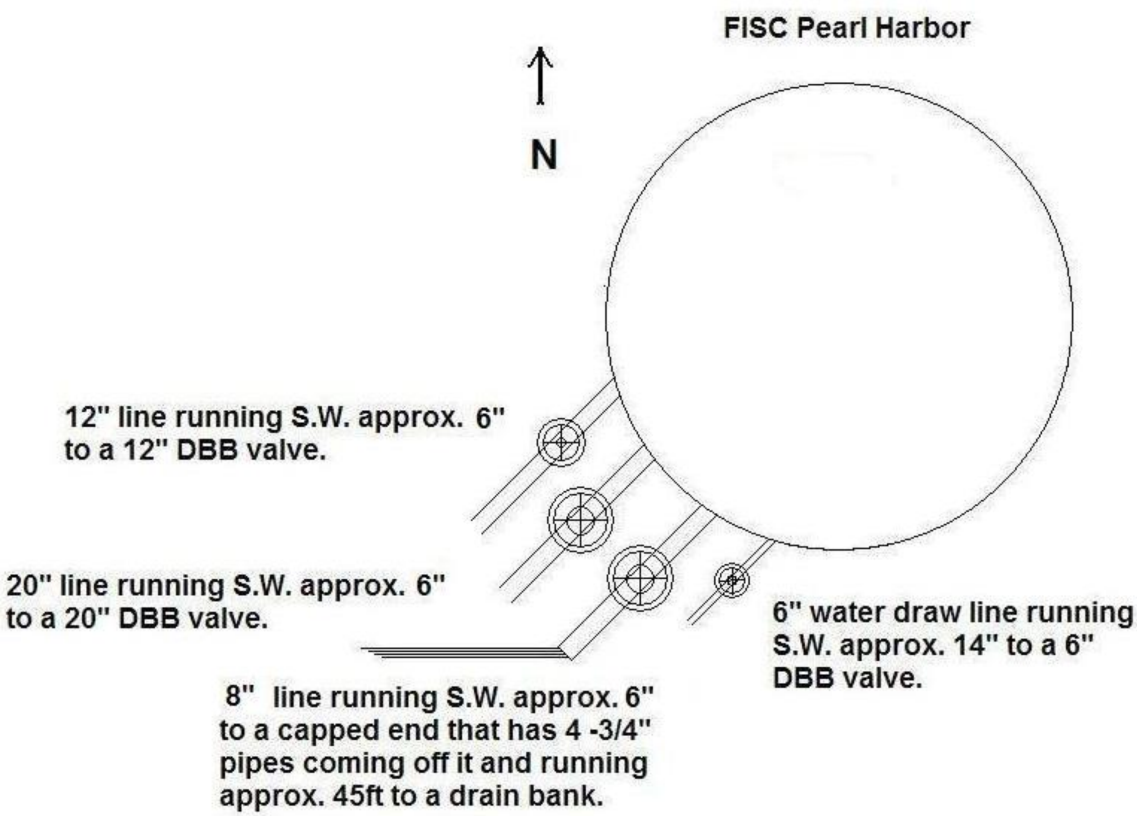
Summary

Testing of Tank # 2 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced February 11, 2015 and was completed February 16, 2015. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 2: After 120 hours of testing the tank is certified to be tight.

Tank Data Tank # 2

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-8
Specific Gravity:	0.80	Product Level:	208.2 ft.
Start Date:	02/11/2015	Completion Date:	02/16/2015
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

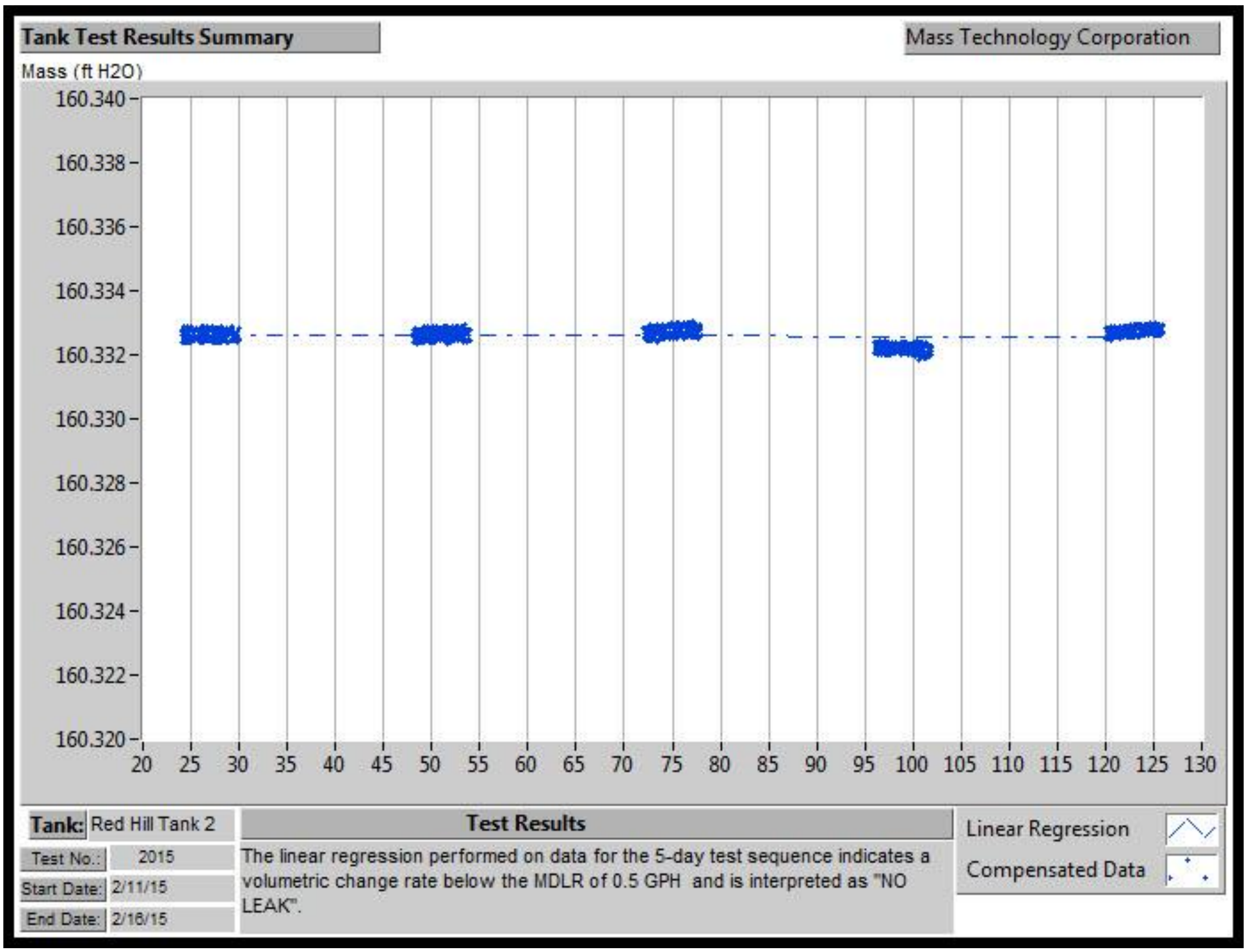


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 120-hour period. A linear regression of the recorded fluid mass data resulted in a change rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 2 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 3 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Ricky Slaughter

Date: 03-13-2015

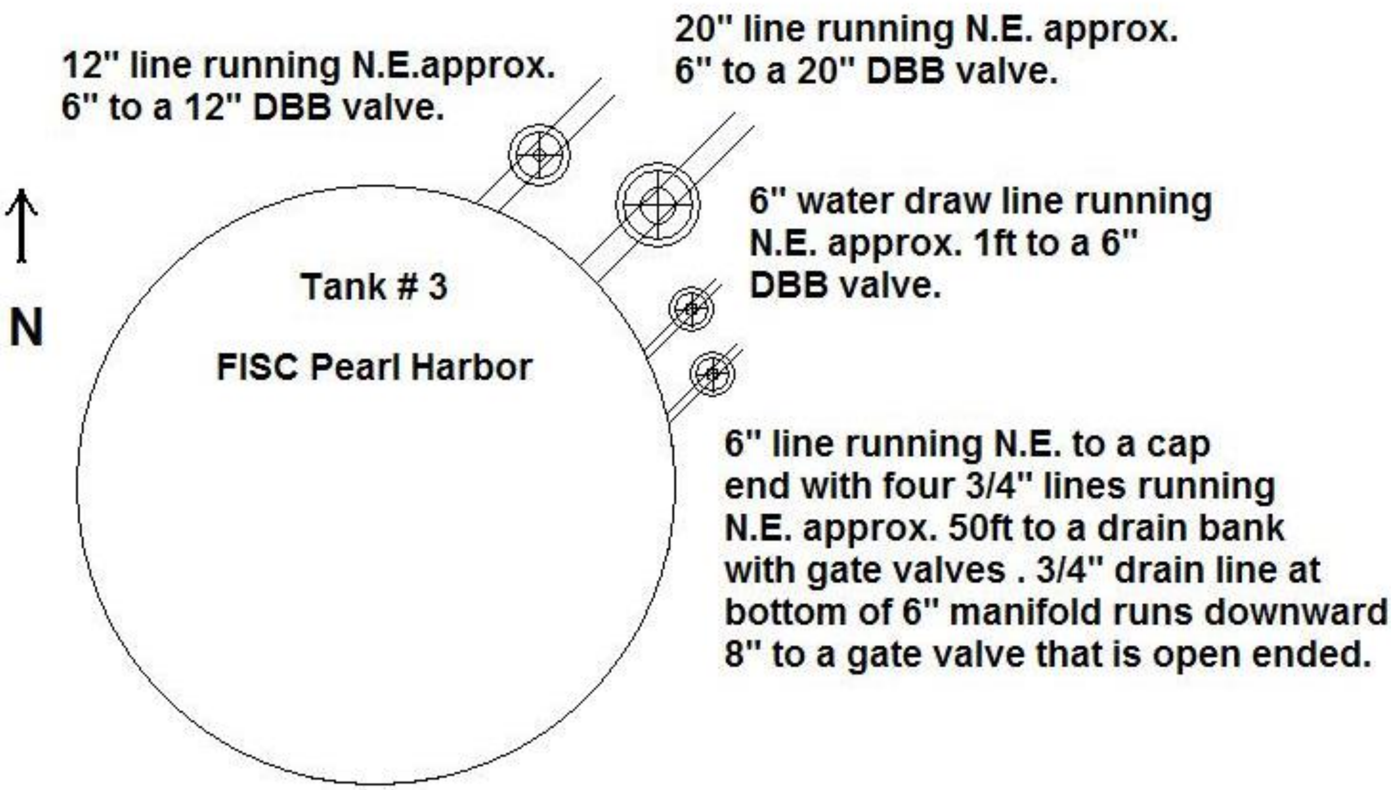
Summary

Testing of Tank # 3 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced February 14, 2015 and was completed February 19, 2015. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 3: After 120 hours of testing the tank is certified to be tight.

Tank Data Tank # 3

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-8
Specific Gravity:	0.80	Product Level:	210.2 ft.
Start Date:	02/14/2015	Completion Date:	02/19/2015
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

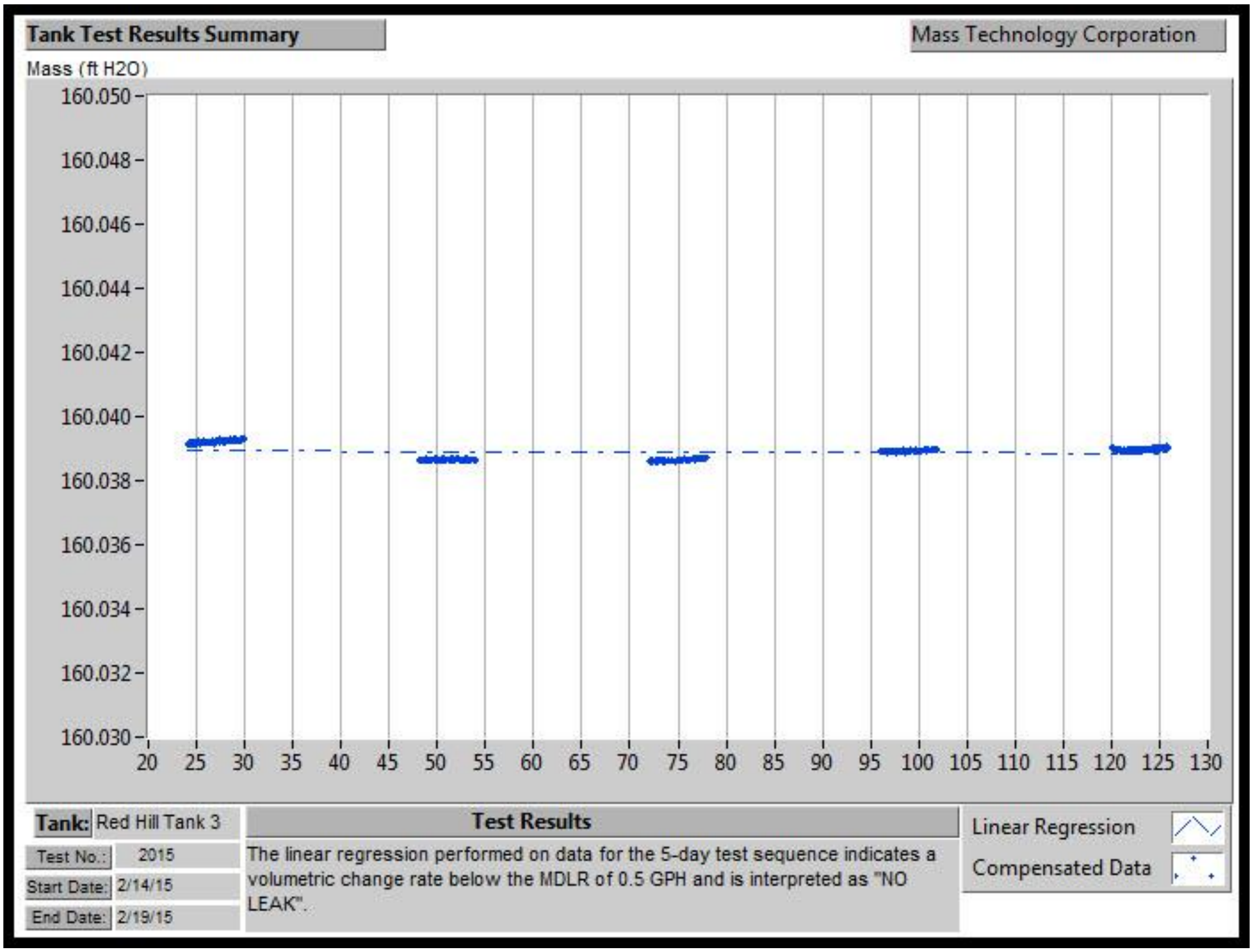


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 120-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 3 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 4 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________
Ricky Slaughter

Date: 12-10-2014

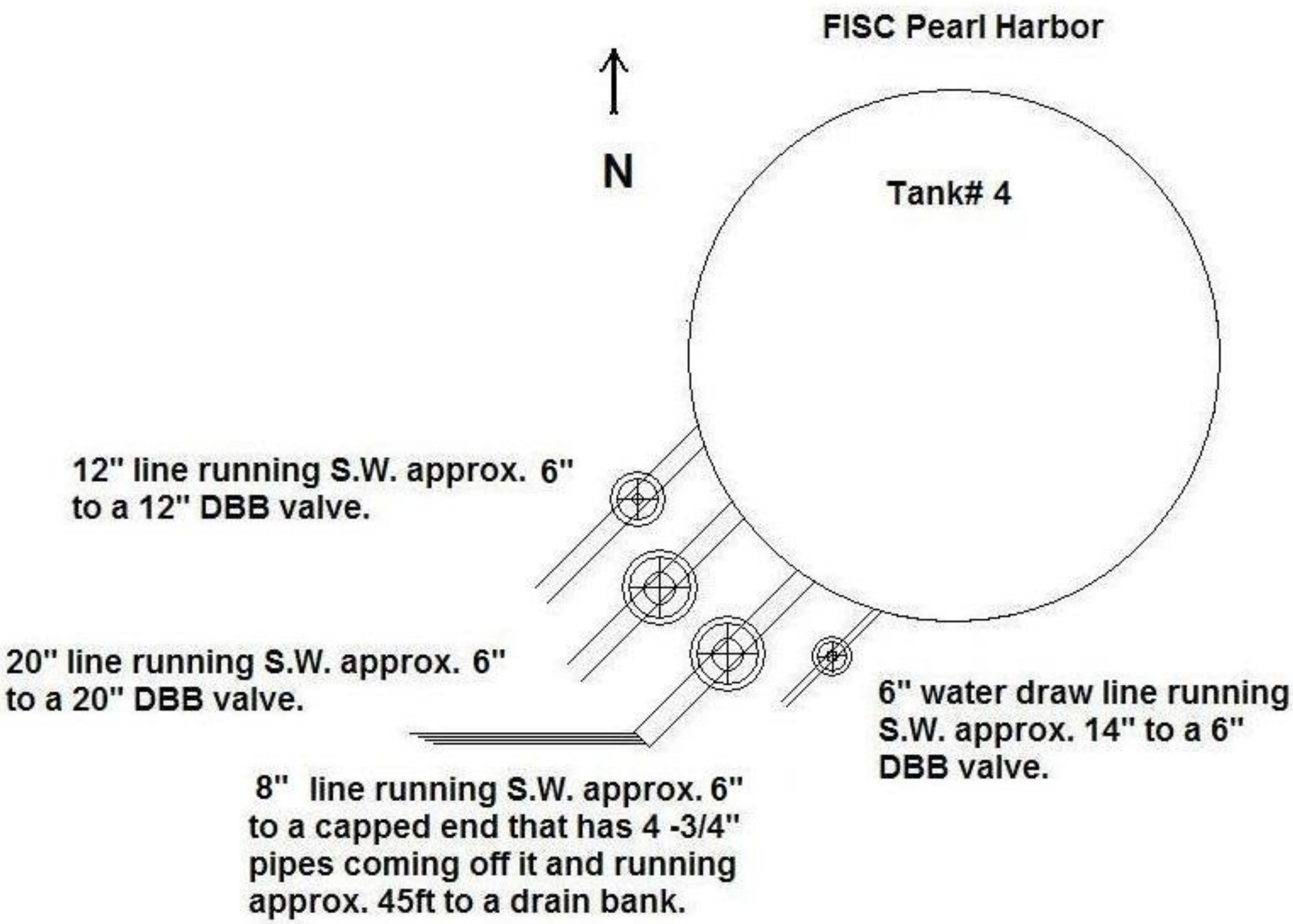
Summary

Testing of Tank # 4 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced October 16, 2014 and was completed October 23, 2014. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 4: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 4

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-8
Specific Gravity:	0.80	Product Level:	211.01 ft.
Start Date:	10/16/2014	Completion Date:	10/23/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

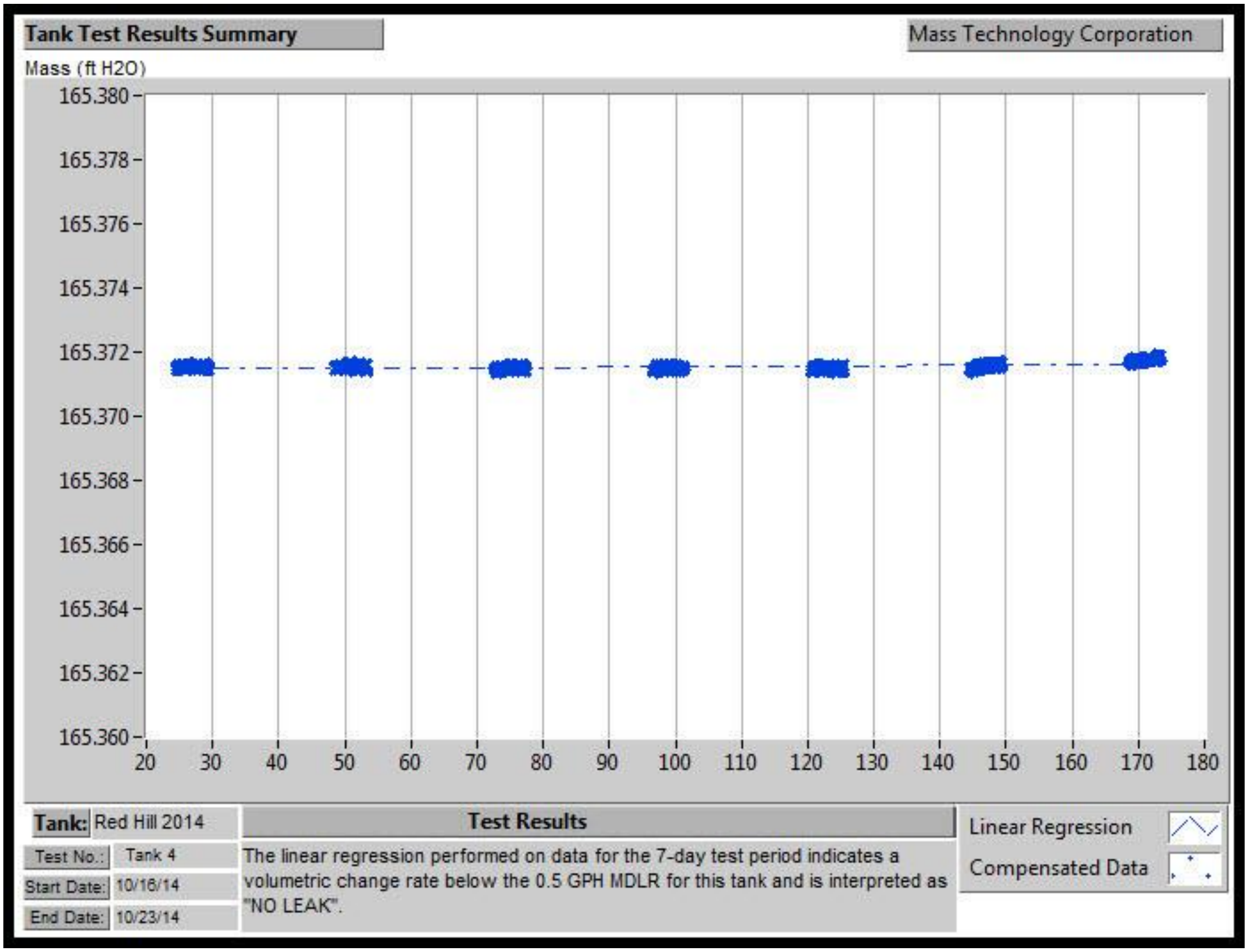


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 4 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 6 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Ricky Slaughter

Date: 12-10-2014

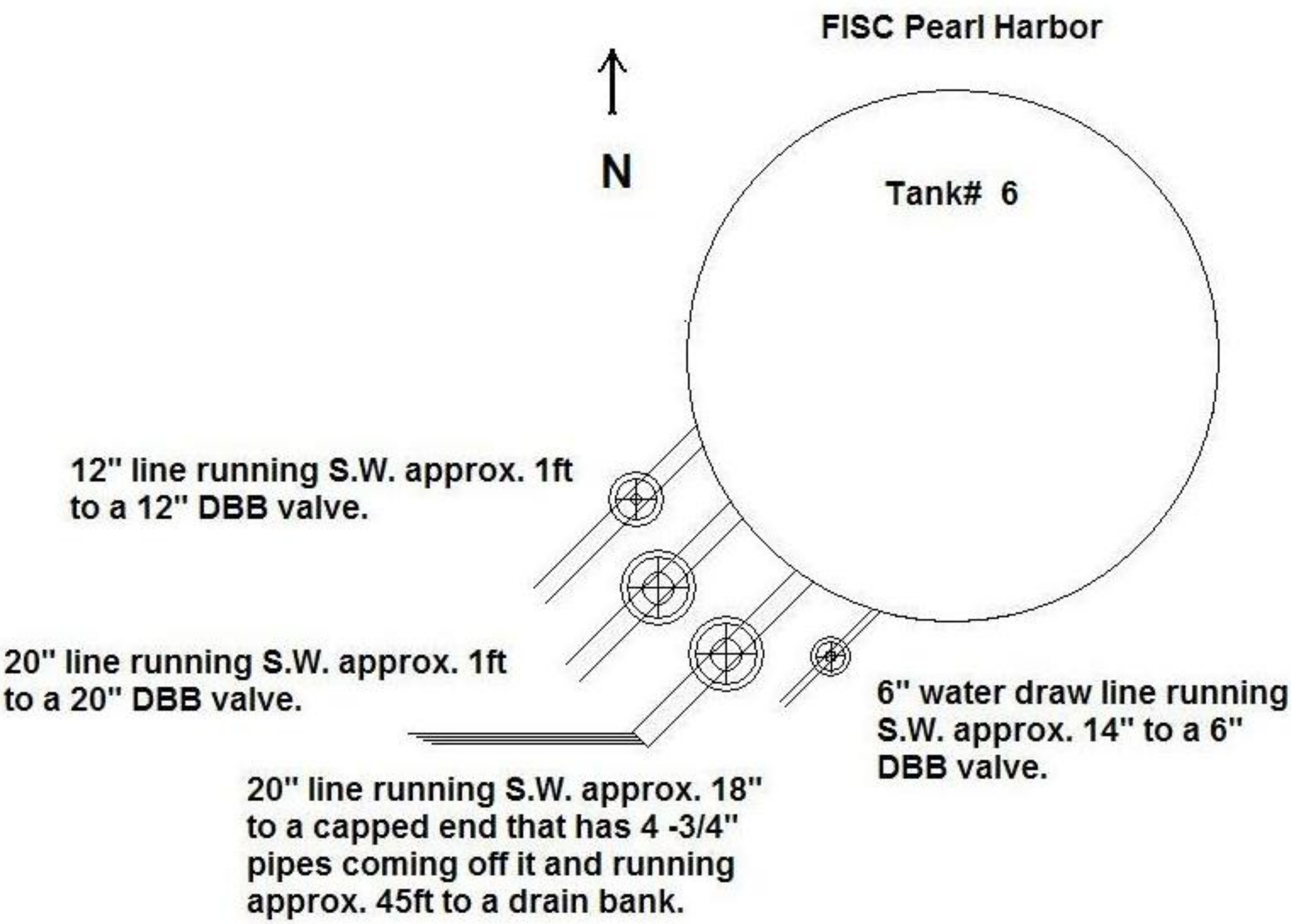
Summary

Testing of Tank # 6 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced October 14, 2014 and was completed October 21, 2014. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 6: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 6

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-8
Specific Gravity:	0.80	Product Level:	211.9 ft.
Start Date:	10/14/2014	Completion Date:	10/21/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

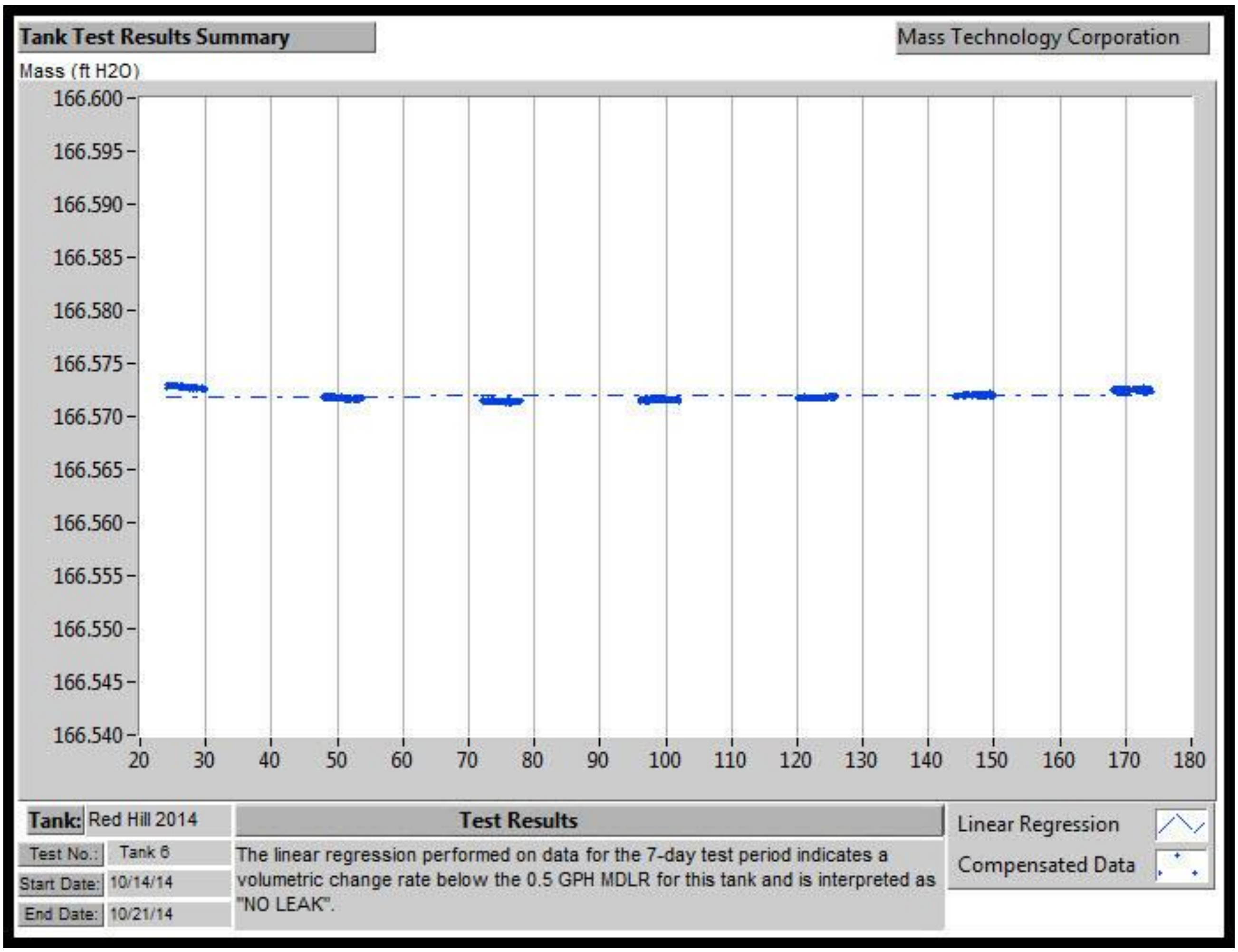


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 6 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 7 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Date: 12-10-2014
Ricky Slaughter

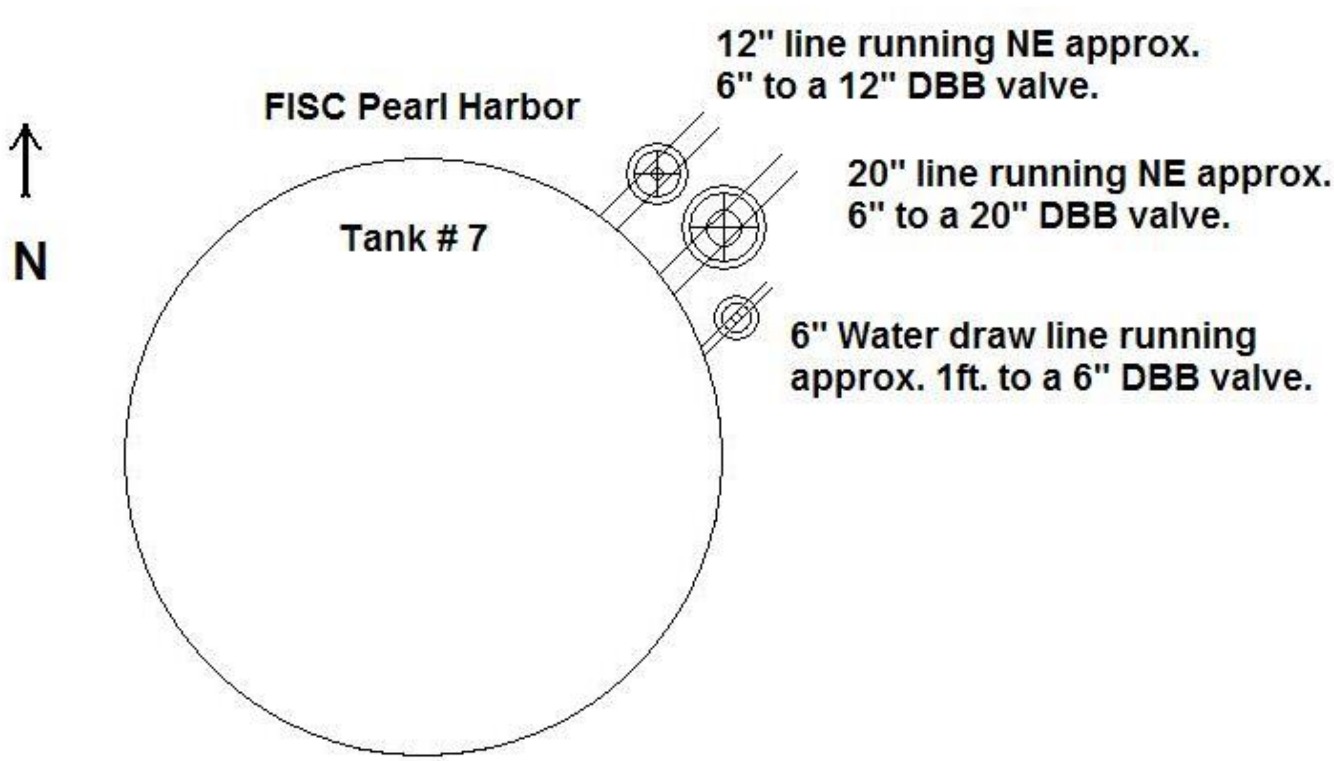
Summary

Testing of Tank # 7 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced November 15, 2014 and was completed November 22, 2014. The tank contained JP-5 and a precision leak test was conducted. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 7: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 7

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	212.25 ft.
Start Date:	11/15/2014	Completion Date:	11/22/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

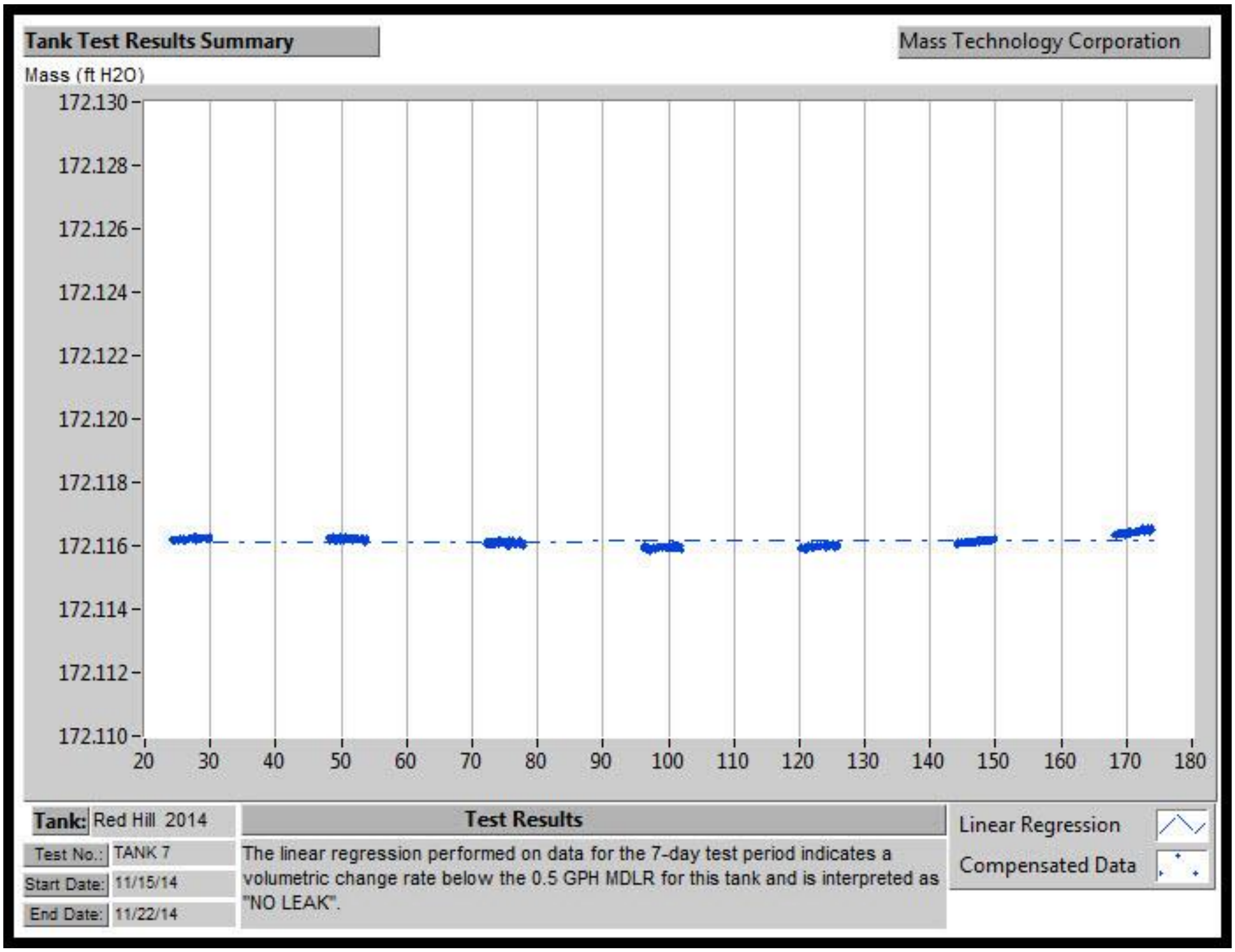


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 7 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 8 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Date: 12-10-2014
Ricky Slaughter

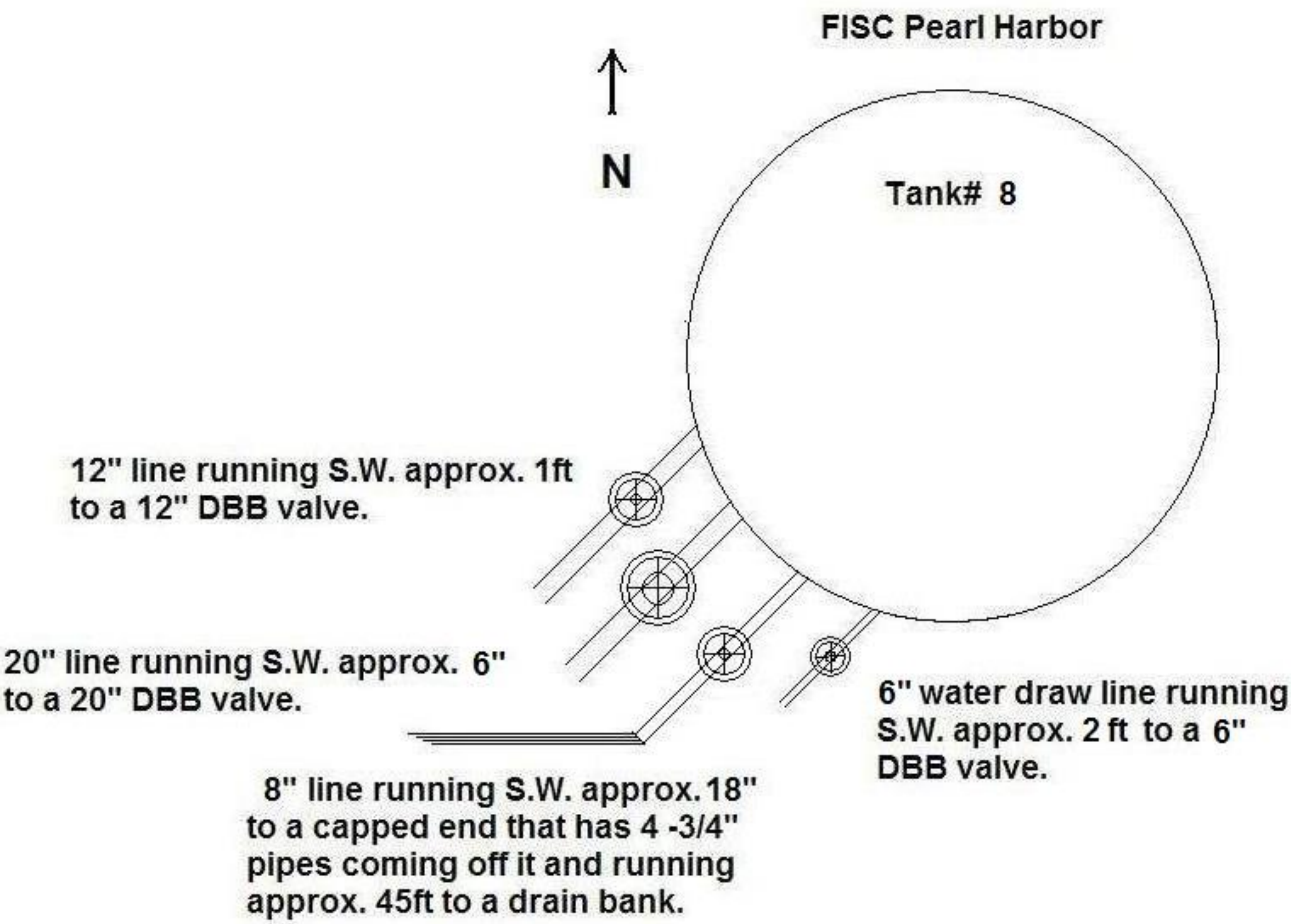
Summary

Testing of Tank # 8 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced October 14, 2014 and was completed October 21, 2014. The tank contained JP-5 and a precision leak test was conducted. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 8: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 8

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	211.08 ft.
Start Date:	10/14/2014	Completion Date:	10/21/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

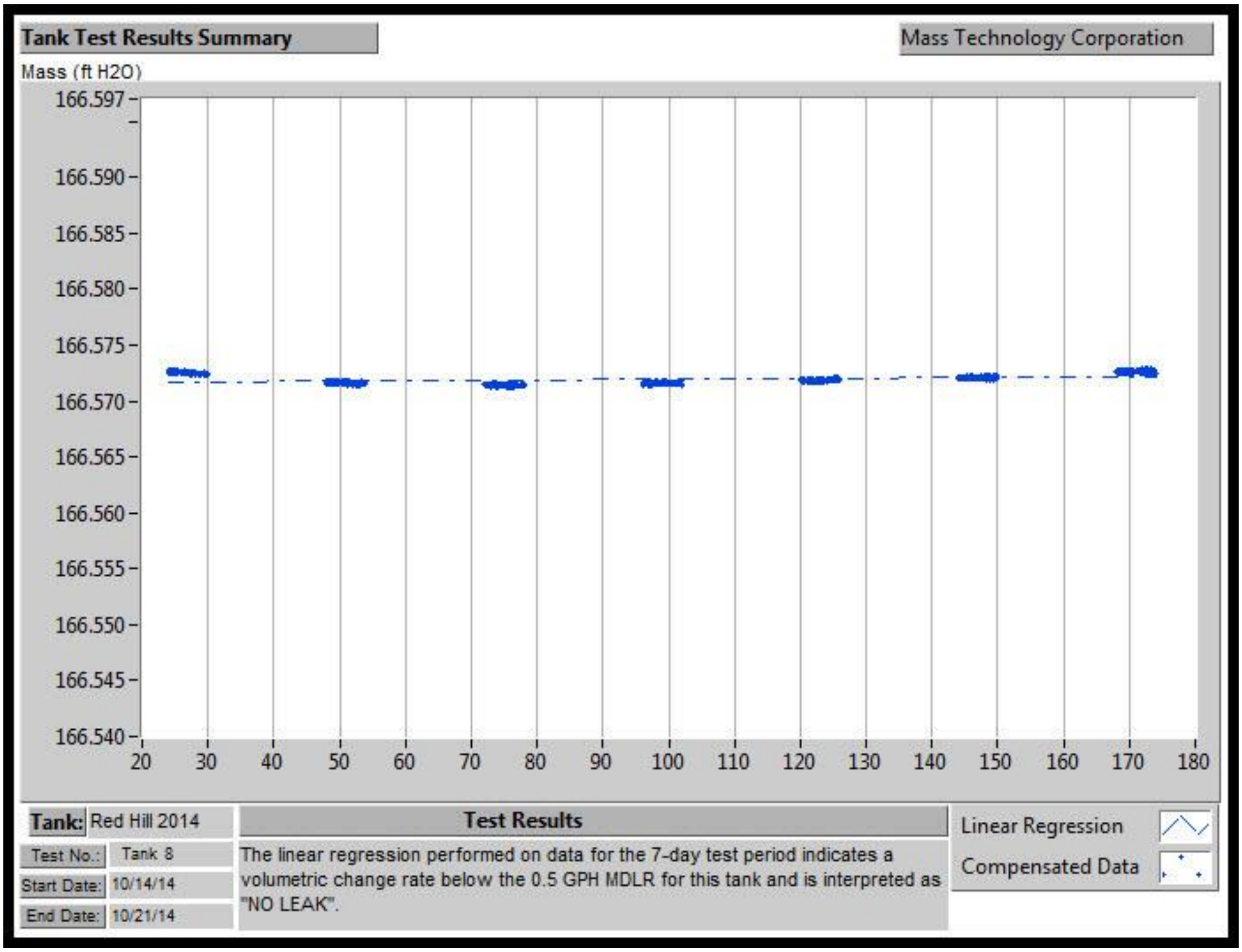


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 8 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 9 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Ricky Slaughter

Date: 12-10-2014

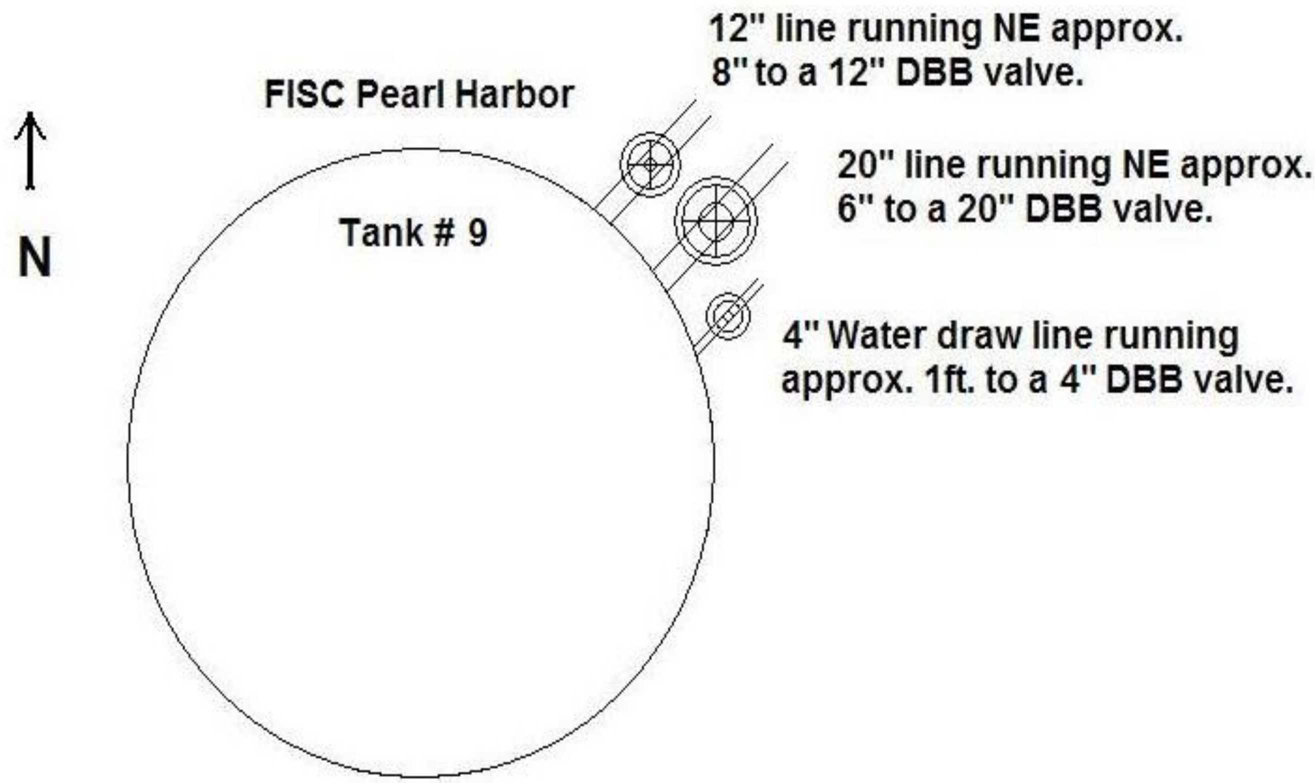
Summary

Testing of Tank # 9 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced October 22, 2014 and was completed October 29, 2014. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 9: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 9

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	211.78 ft.
Start Date:	10/22/2014	Completion Date:	10/29/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

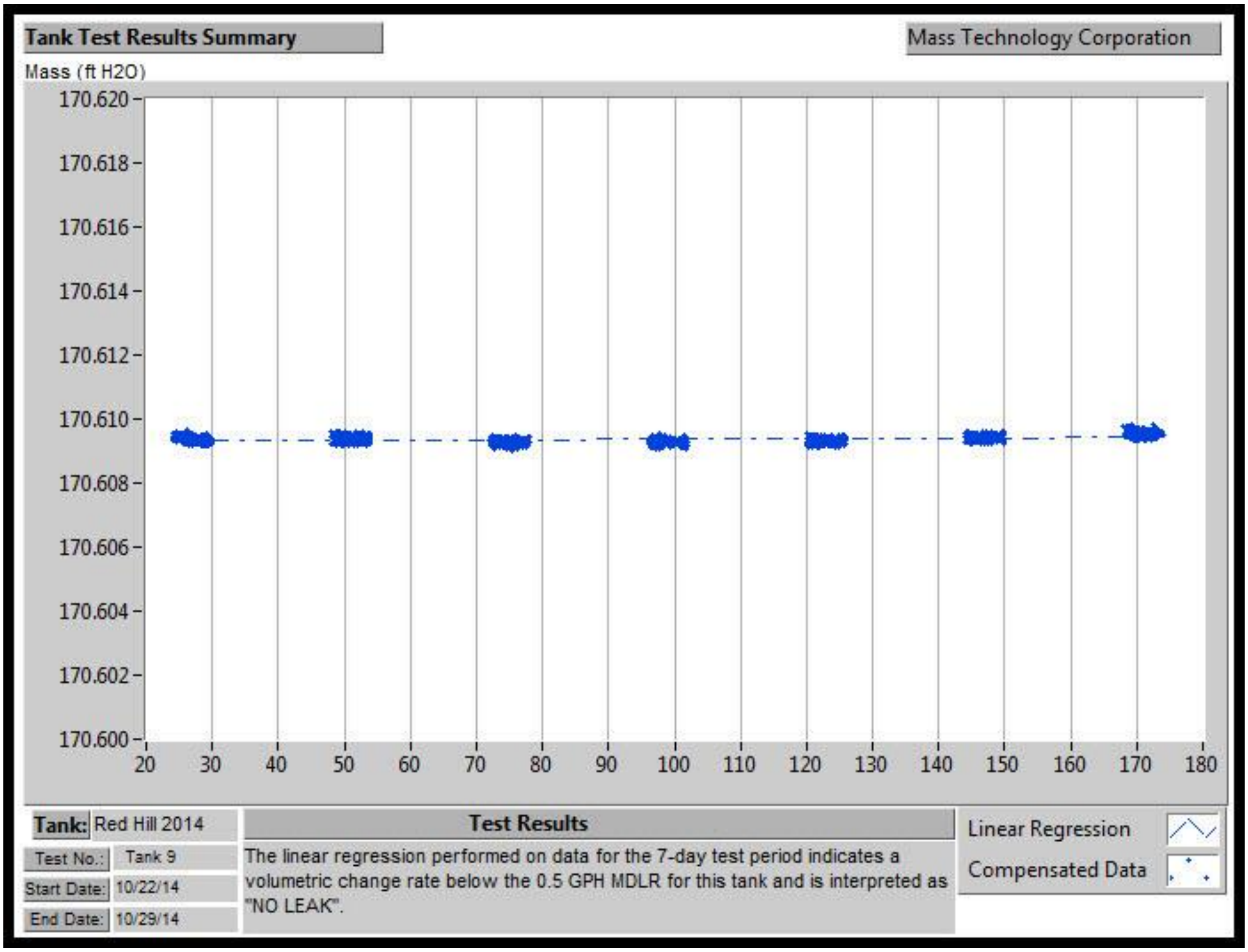


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

<u>Results</u>

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 9 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 10 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Date: 12-10-2014
Ricky Slaughter

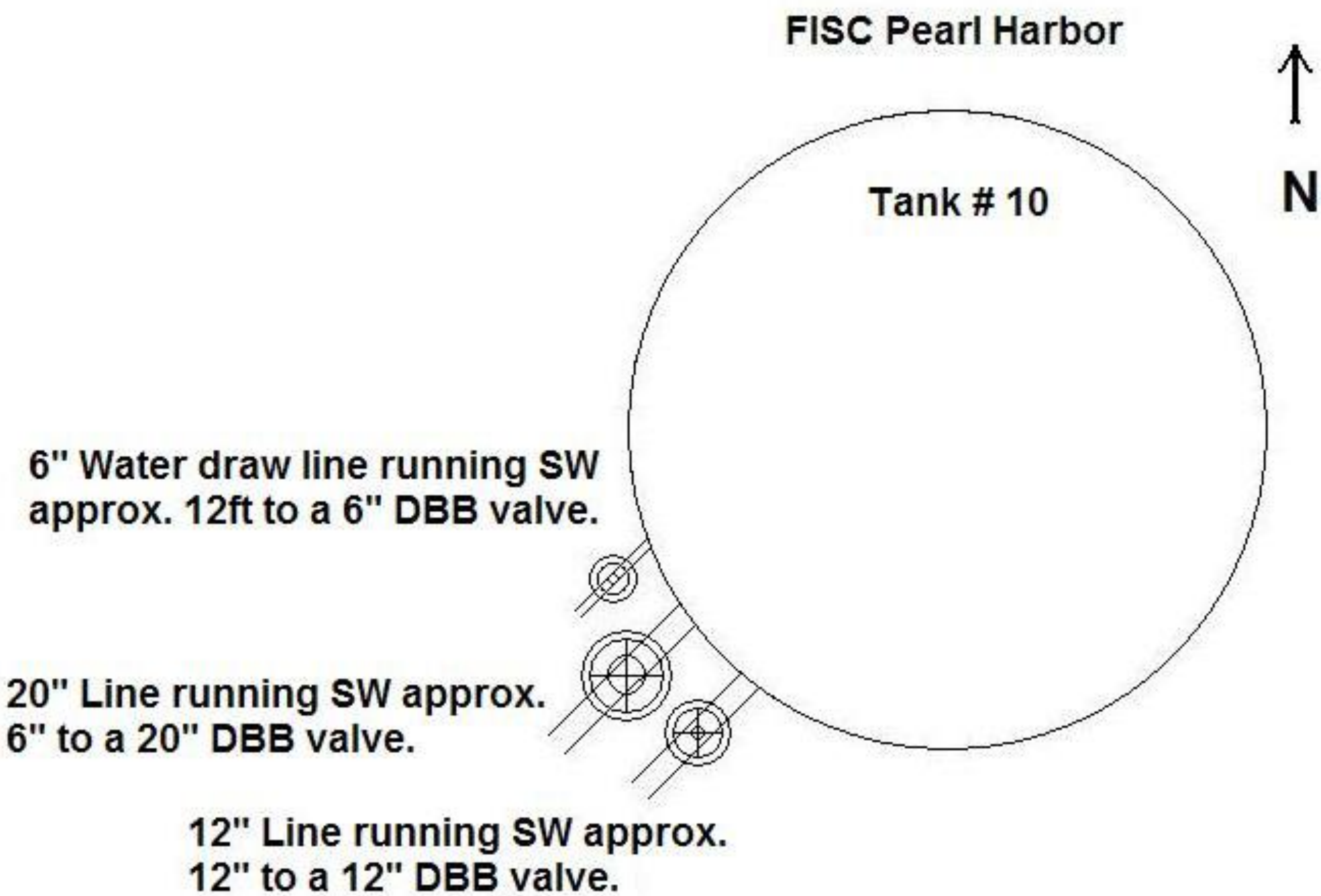
Summary

Testing of Tank # 10 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced October 31, 2014 and was completed November 7, 2014. The tank contained JP-5 and a precision leak test was conducted. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 10: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 10

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	211.43 ft.
Start Date:	10/31/2014	Completion Date:	11/07/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

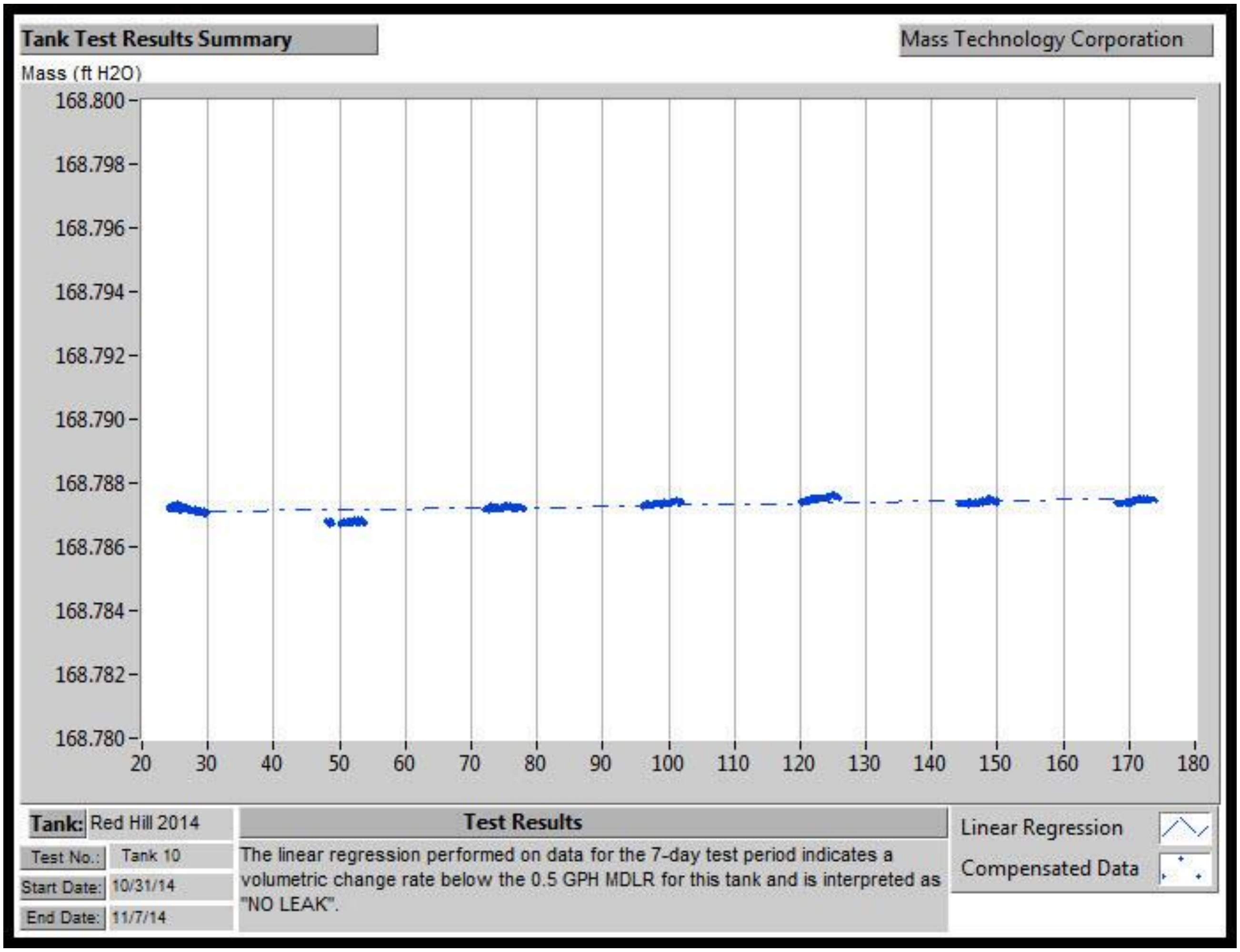


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

<u>Results</u>

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 10 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 11 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Ricky Slaughter

Date: 03-13-2015

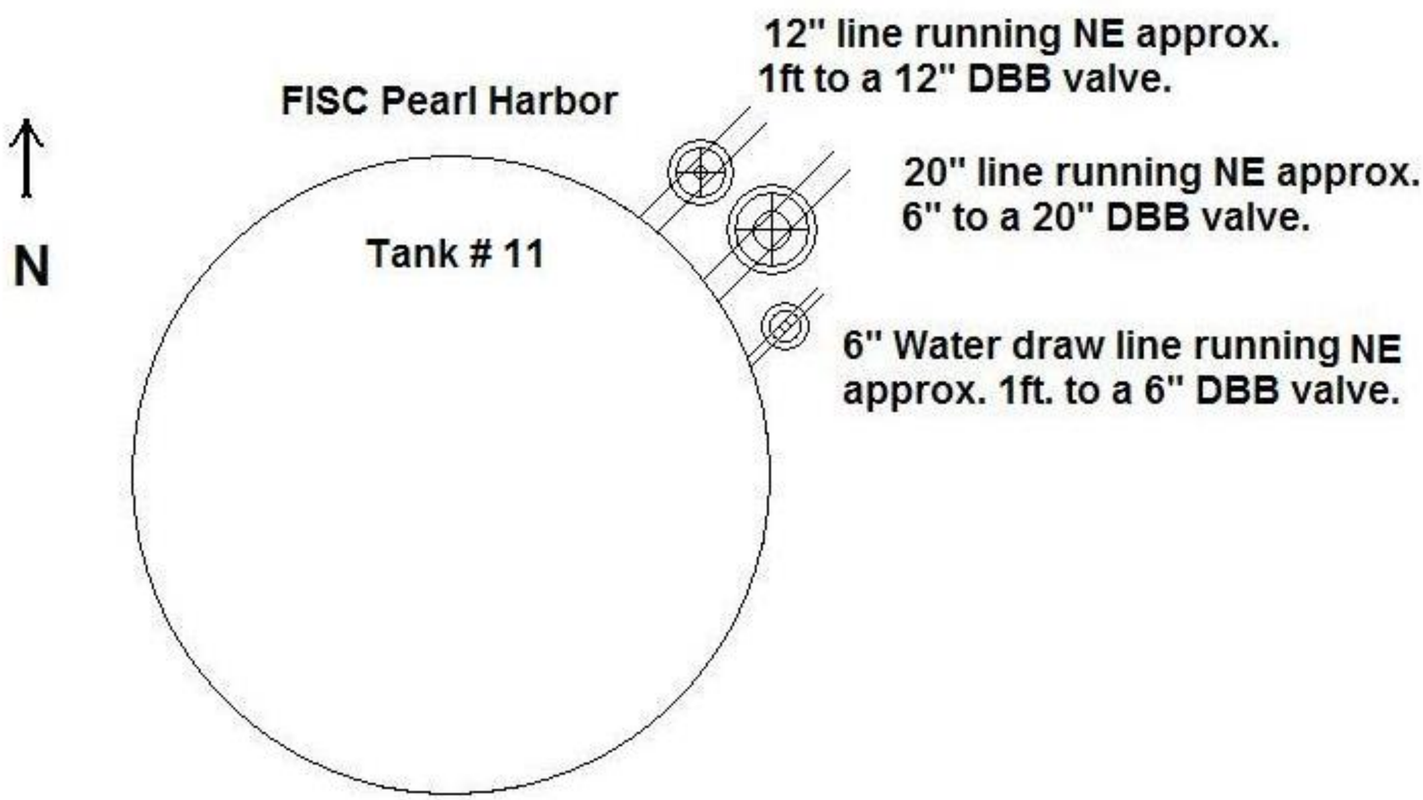
Summary

Testing of Tank # 11 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced February 18, 2015 and was completed February 23, 2015. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 11: After 120 hours of testing the tank is certified to be tight.

Tank Data Tank # 11

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	211.9 ft.
Start Date:	02/18/2015	Completion Date:	02/23/2015
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

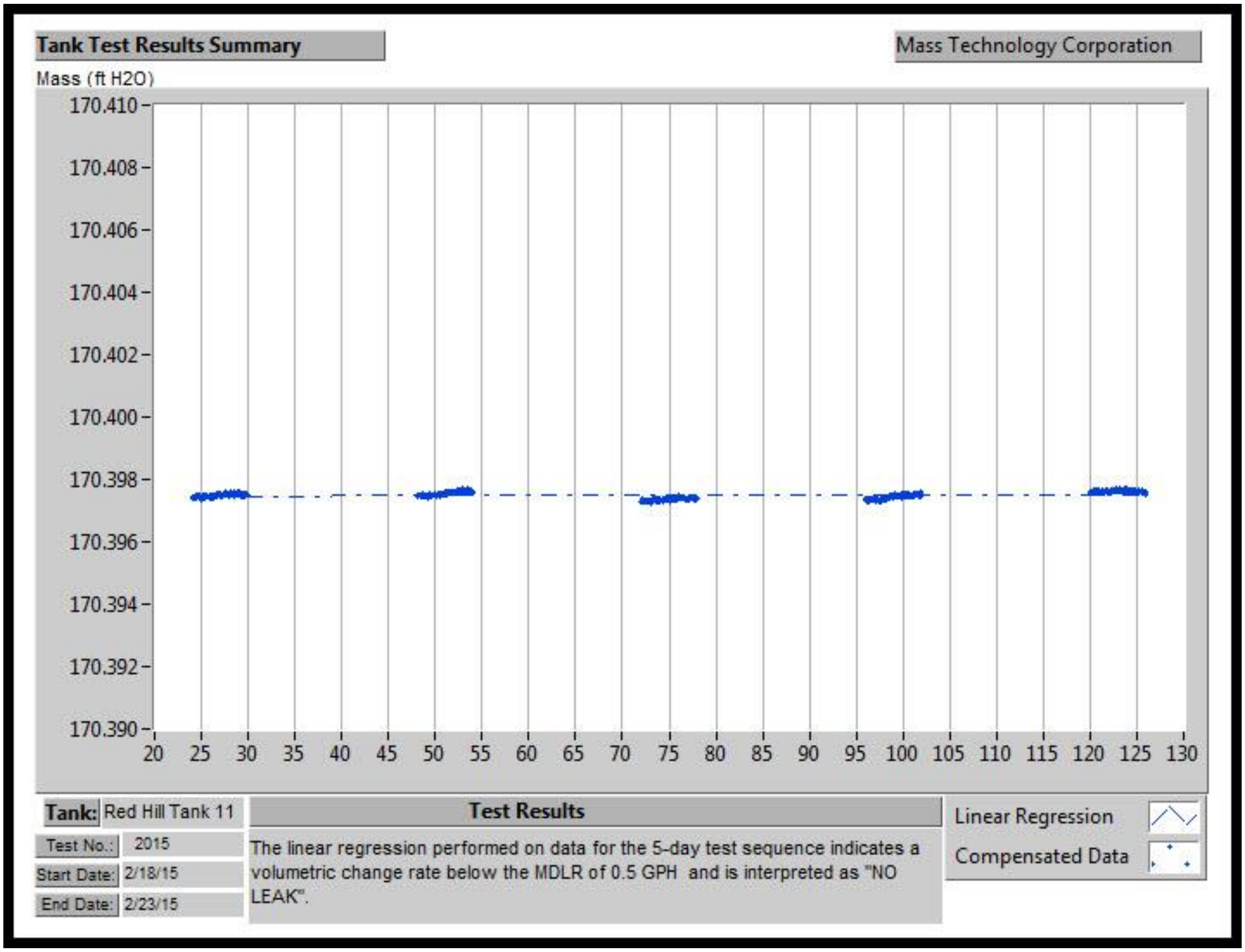


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 120-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 11 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 12 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Ricky Slaughter

Date: 12-10-2014

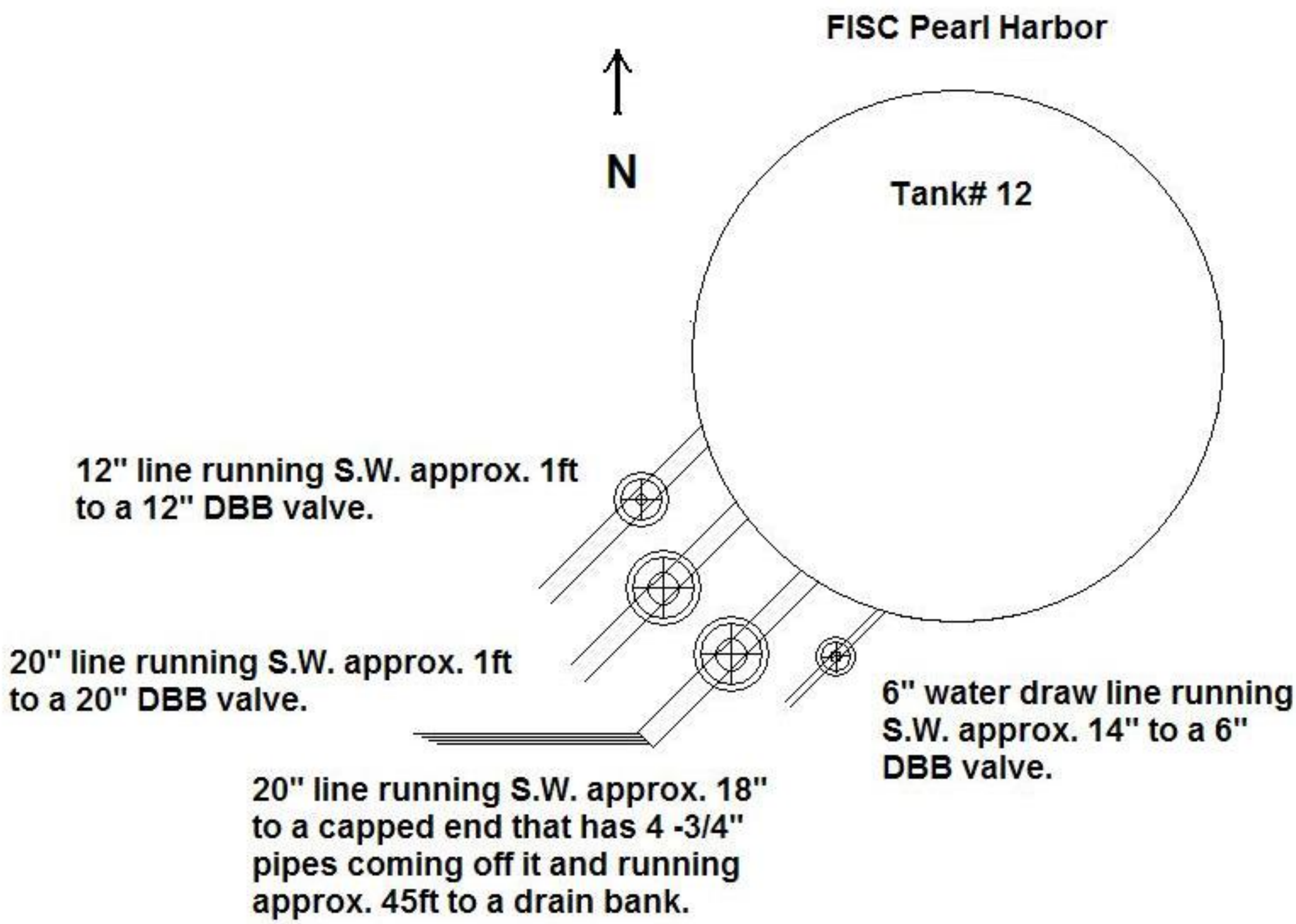
Summary

Testing of Tank # 12 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced November 6, 2014 and was completed November 13, 2014. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 12: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 12

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	212.39 ft.
Start Date:	11/06/2014	Completion Date:	11/13/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

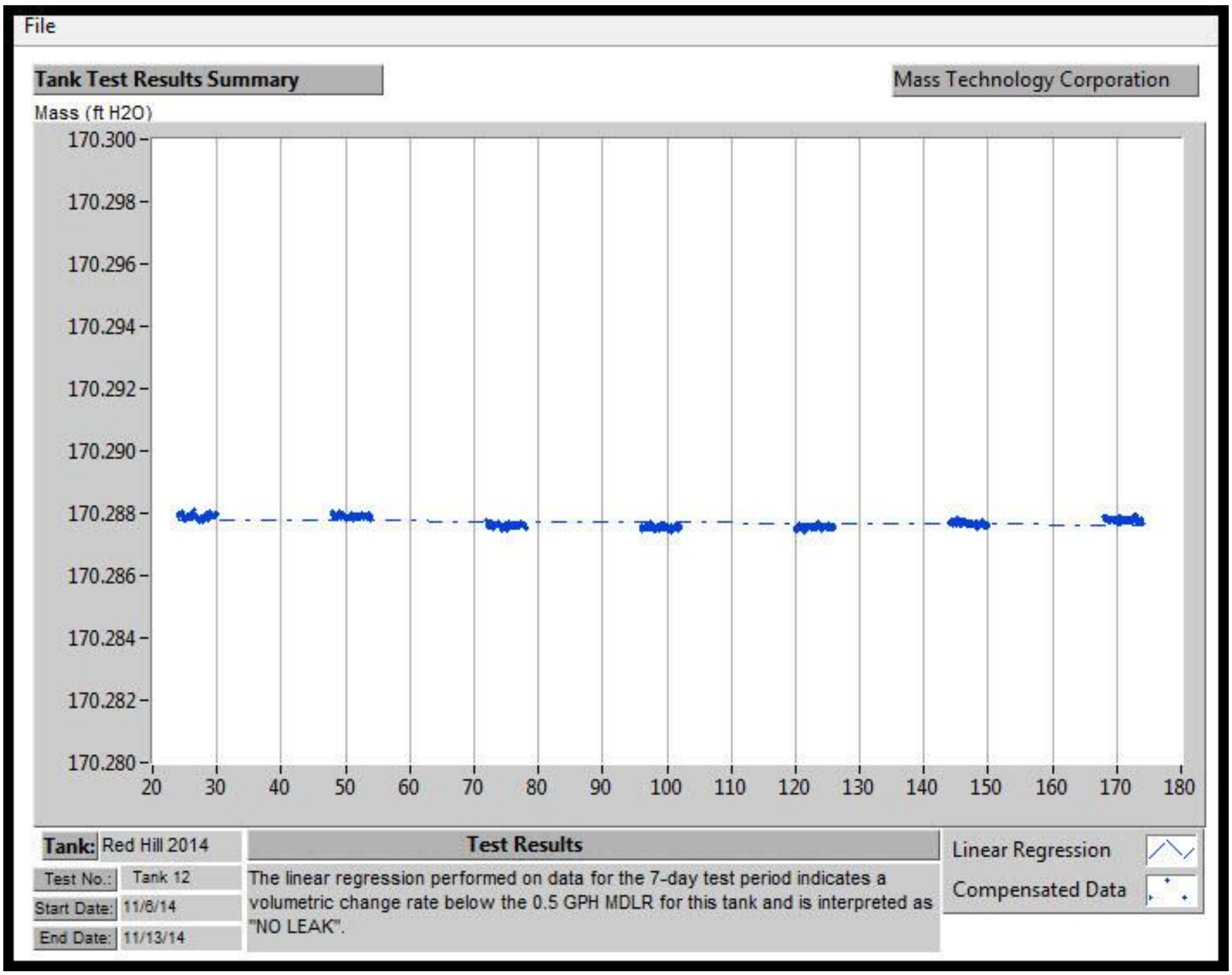


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 12 is certified to be tight.



Mass Technology Corporation

Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 13 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Date: 05-18-2015
Ricky Slaughter

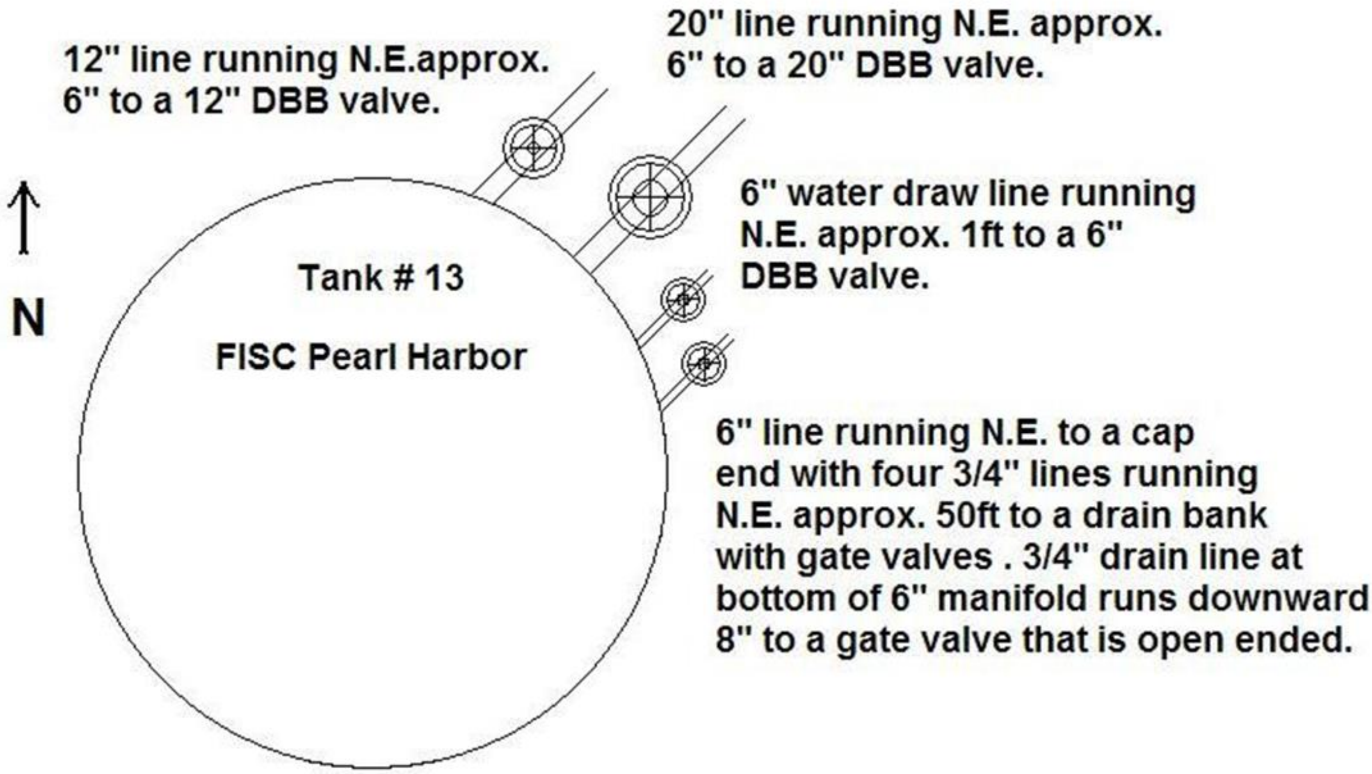
Summary

Testing of Tank # 13 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced April 29, 2015 and was completed May 4, 2015. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 13: After 120 hours of testing the tank is certified to be tight.

Tank Data Tank # 13

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	F76
Specific Gravity:	0.84	Product Level:	212.45 ft.
Start Date:	04/29/2015	Completion Date:	05/04/2015
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

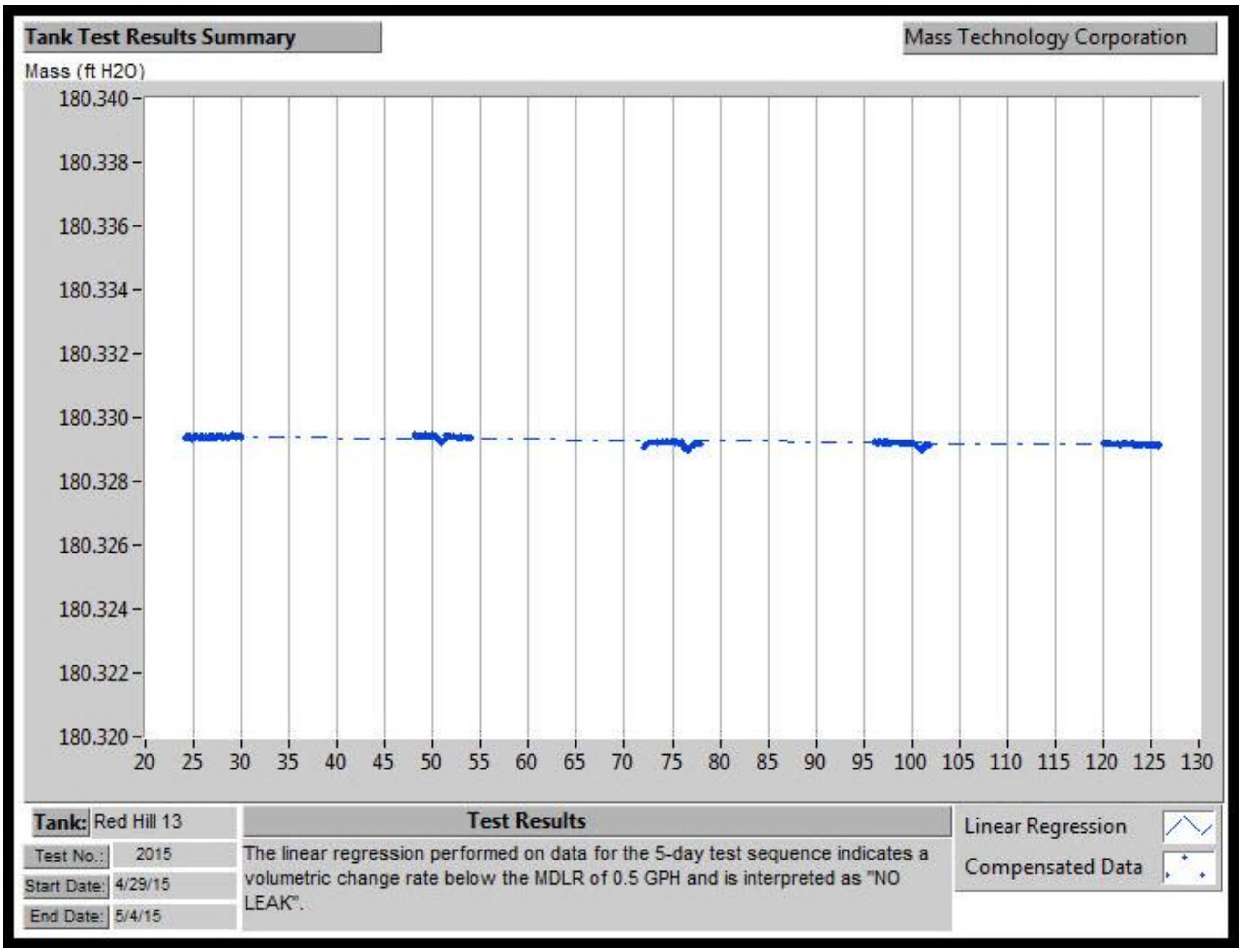


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 120-hour period. A linear regression of the recorded fluid mass data resulted in a change rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 13 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 15 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Date: 05-18-2015
Ricky Slaughter

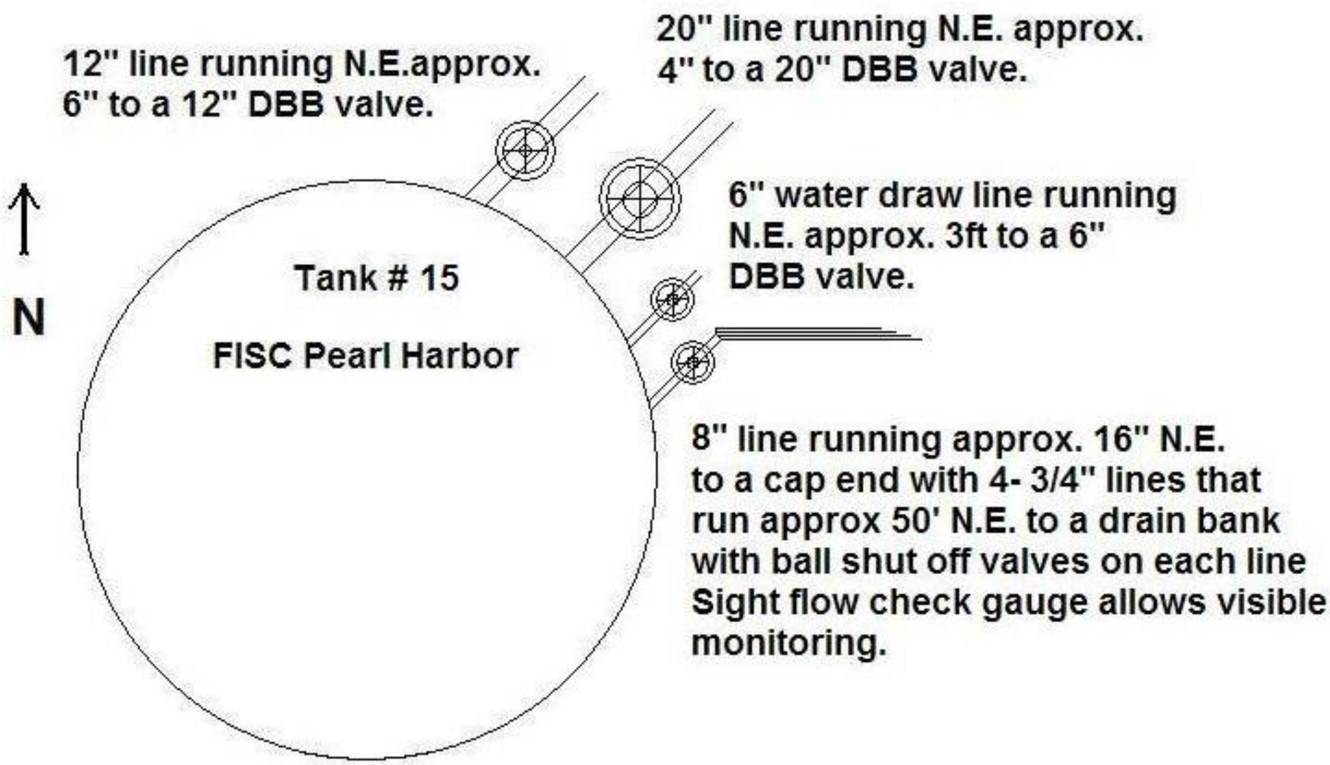
Summary

Testing of Tank # 15 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced May 9, 2015 and was completed May 14, 2015. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 15: After 120 hours of testing the tank is certified to be tight.

Tank Data Tank # 15

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	F76
Specific Gravity:	0.84	Product Level:	210.82 ft.
Start Date:	05/09/2015	Completion Date:	05/14/2015
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

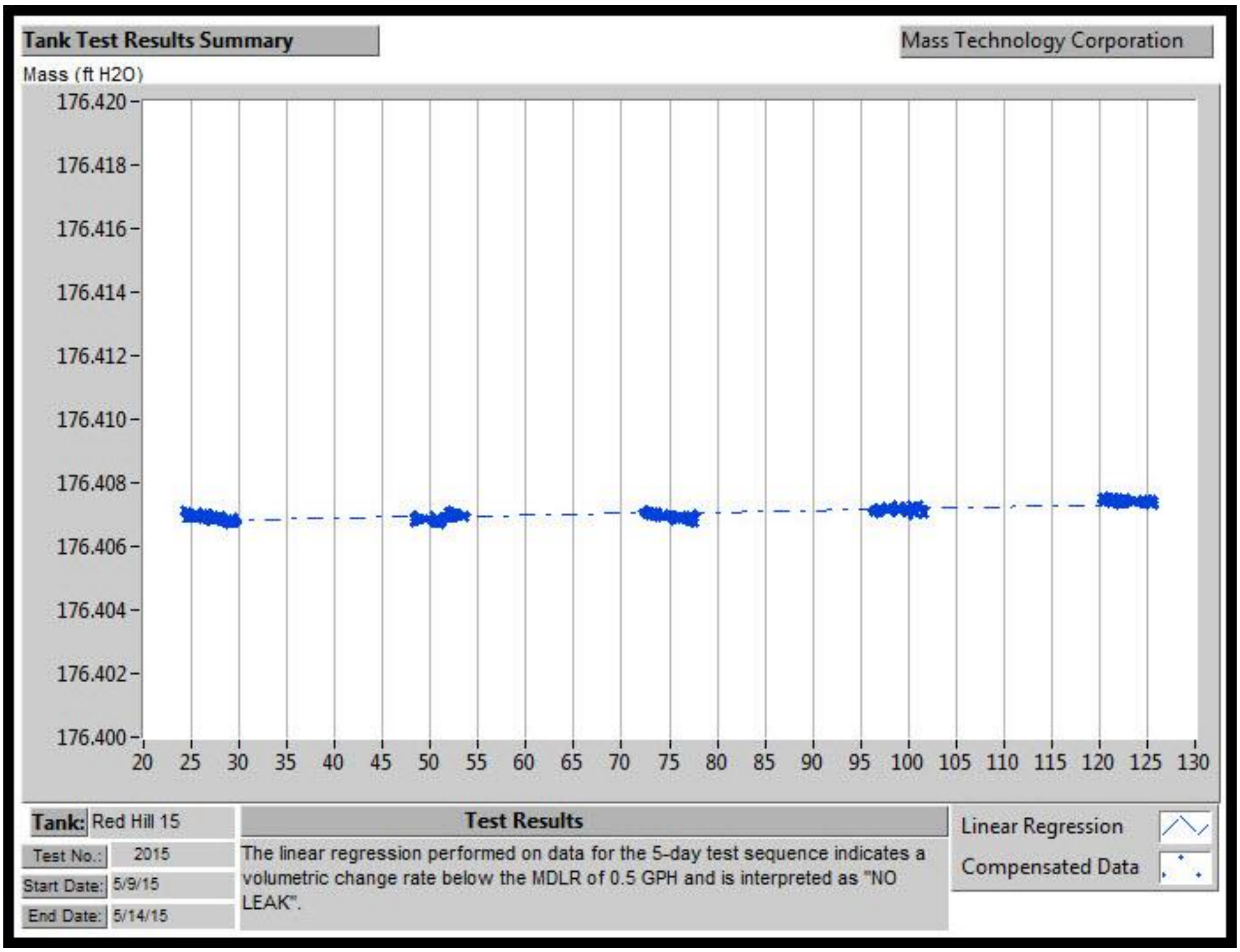


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 120-hour period. A linear regression of the recorded fluid mass data resulted in a change rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 15 is certified to be tight.



Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 16 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________
Ricky Slaughter

Date: 05-18-2015

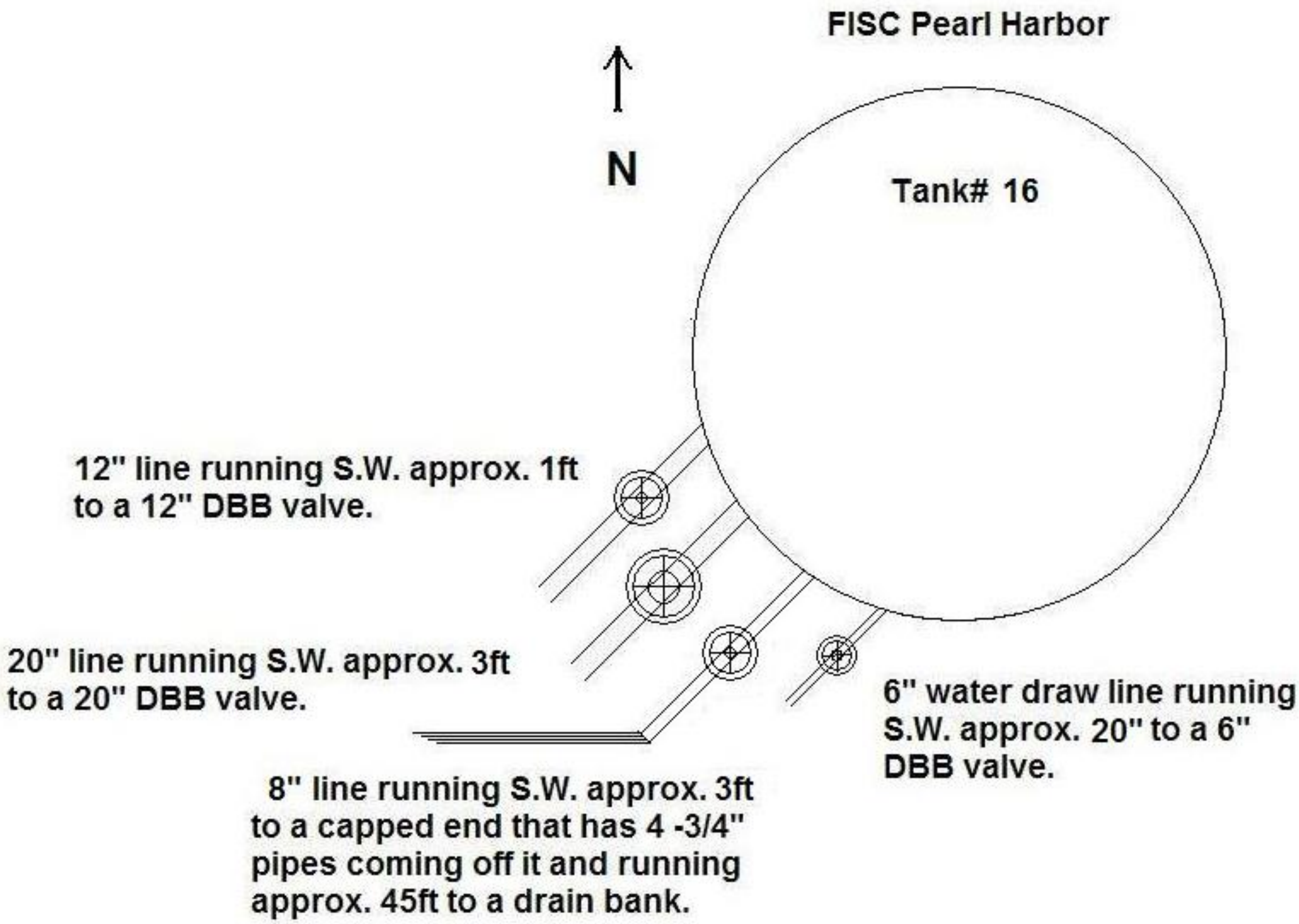
Summary

Testing of Tank # 16 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced May 4, 2015 and was completed May 9, 2015. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 16: After 120 hours of testing the tank is certified to be tight.

Tank Data Tank # 16

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	F76
Specific Gravity:	0.84	Product Level:	58.59 ft.
Start Date:	05/04/2015	Completion Date:	05/09/2015
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

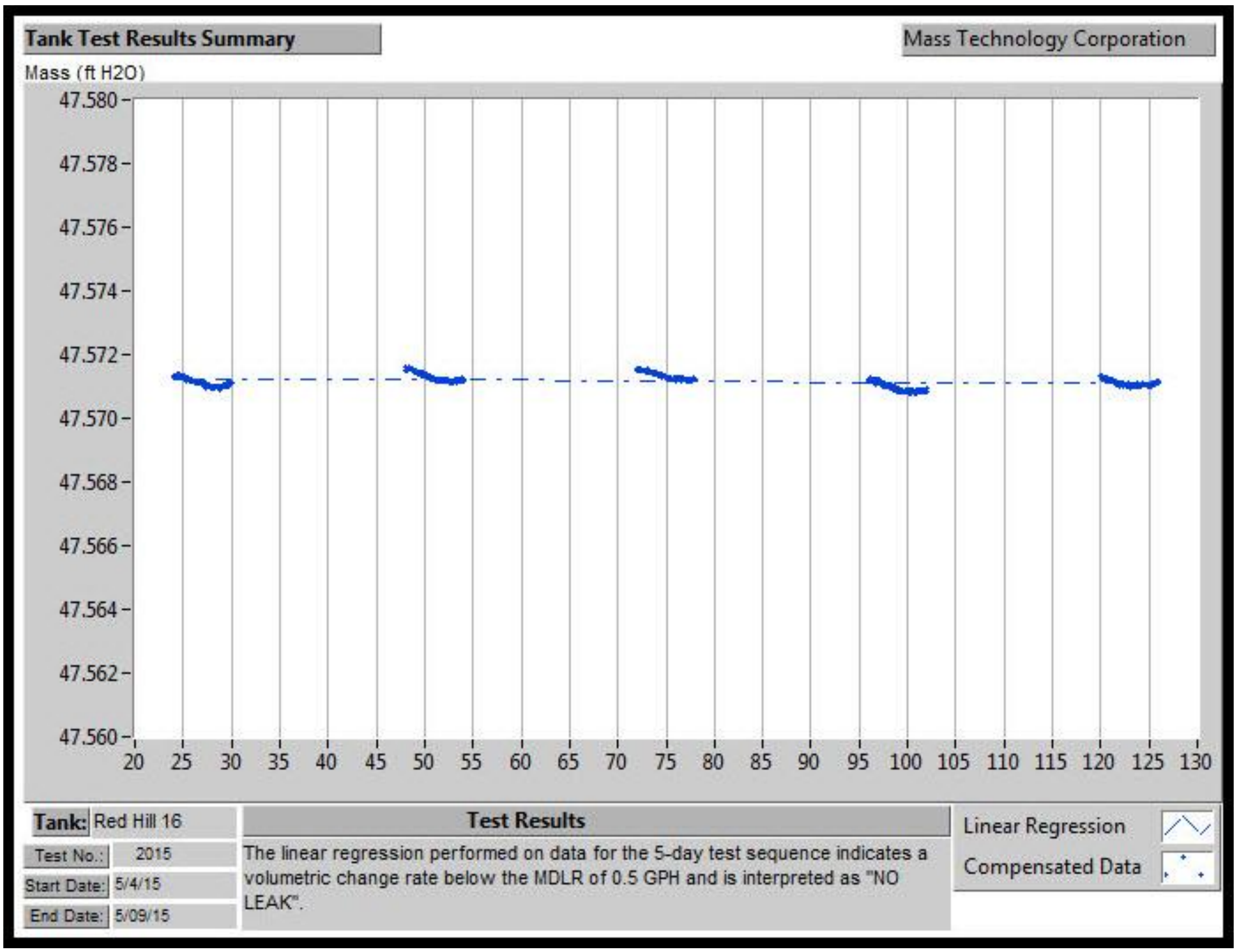


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 120-hour period. A linear regression of the recorded fluid mass data resulted in a change rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 16 is certified to be tight.



Mass Technology CORPORATION

Precision Leak Measurement Report
P.O. Box 1578
Kilgore, Texas 75662

FISC Red Hill
Pearl Harbor, HI

Project Manager – Mr. Mark Caldon

Site Supervisor – Travis Ricketson

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform the required annual tightness testing of Tank # 20 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: ______________________ Date: 12-10-2014
Ricky Slaughter

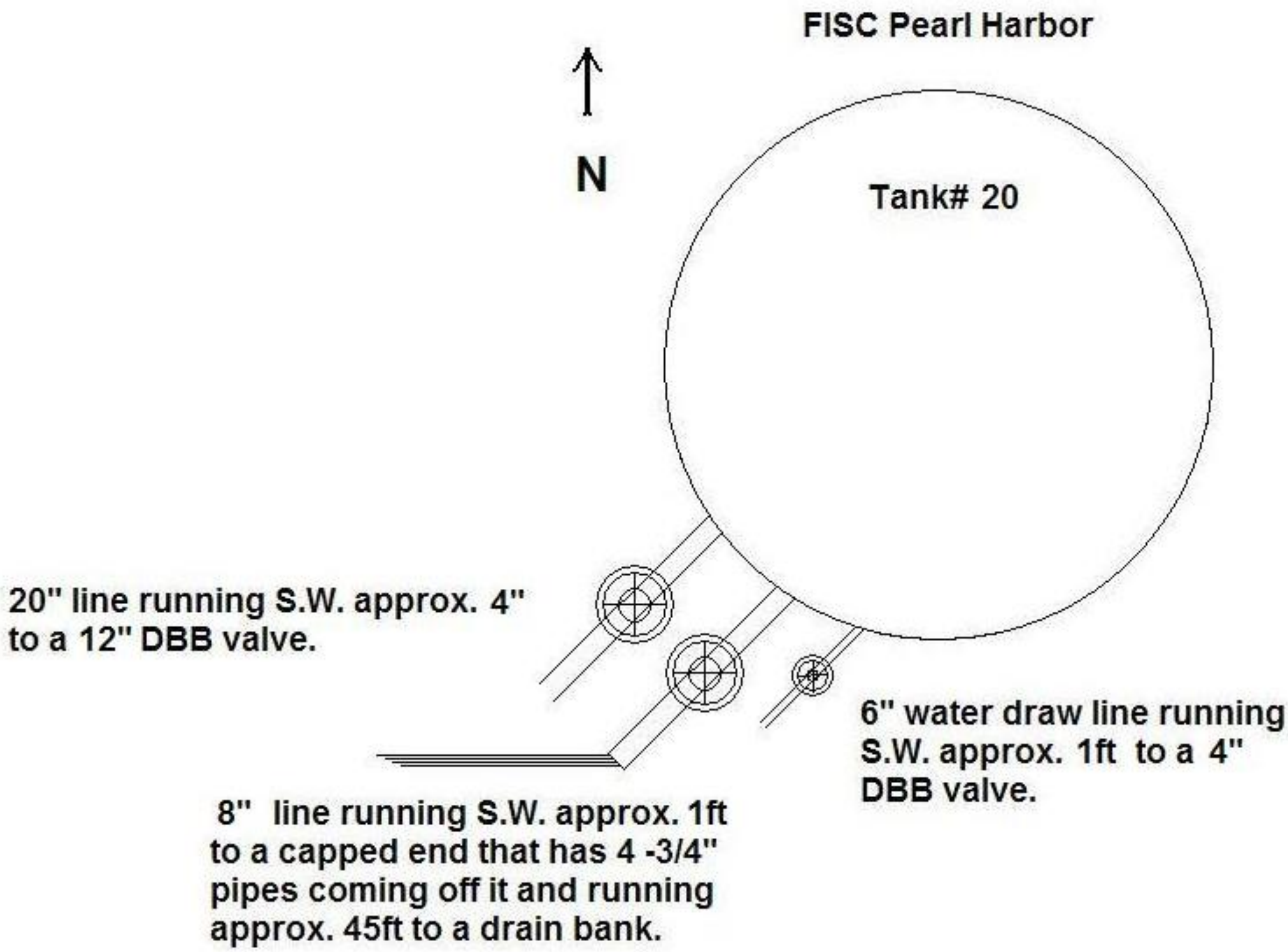
Summary

Testing of Tank # 20 a 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced October 29, 2014 and was completed November 5, 2014. The tank contained JP-5 and a precision leak test was conducted. The result of that testing is that the tank system is determined to be tight to isolation. All tank valves were adequately secured such that no unusual readings were noted. Testing was performed using the Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 20: After 168 hours of testing the tank is certified to be tight.

Tank Data Tank # 20

Diameter:	100 ft.	Height:	250 ft.
Tank Type:	Vertical UST	Contents:	JP-5
Specific Gravity:	0.82	Product Level:	211.45 ft.
Start Date:	10/29/2014	Completion Date:	11/05/2014
Unit Operator:	Travis Ricketson	Test Results:	Certified Tight

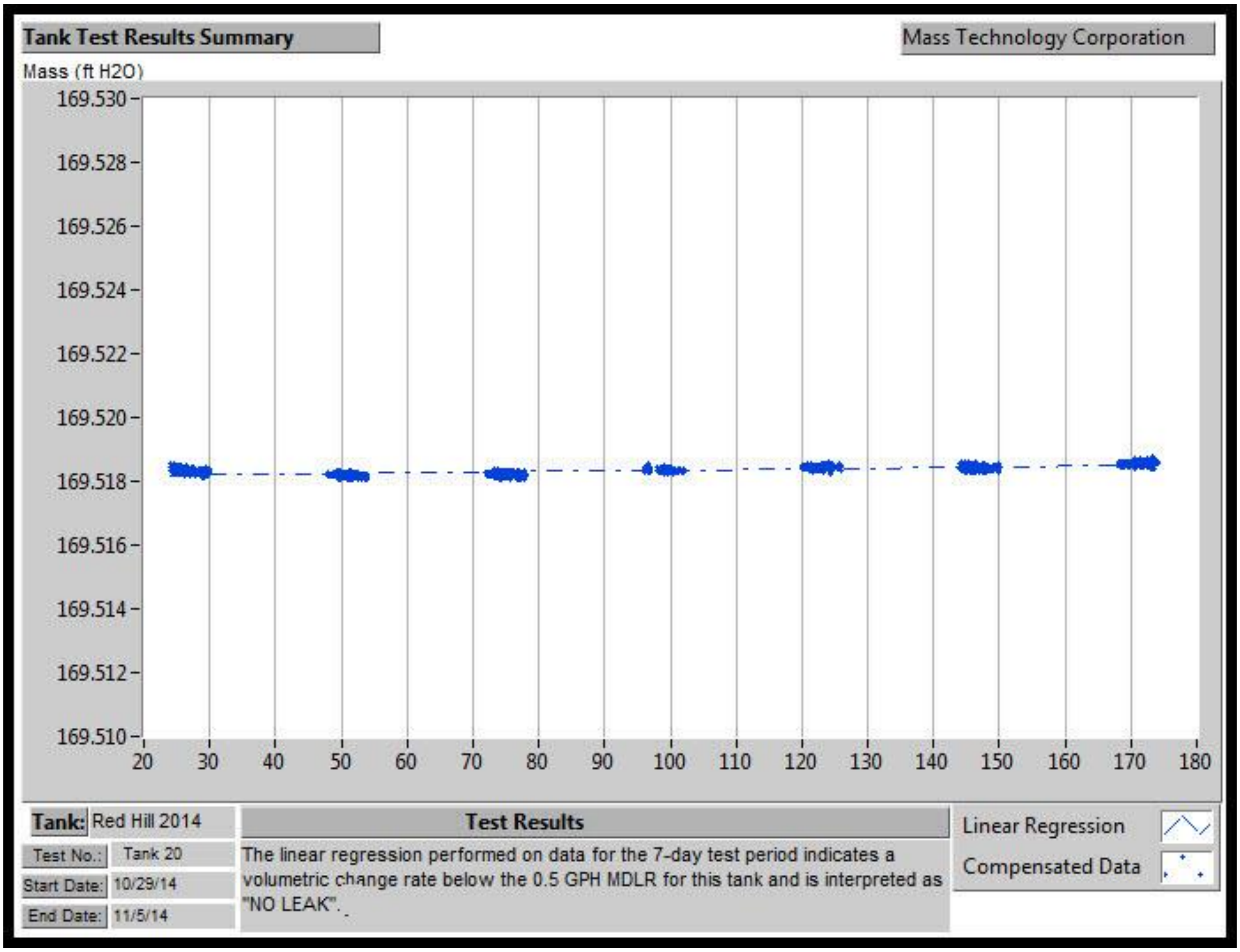


All dimensions, line locations, sizes and valve descriptions have been furnished by the facility operator.

Results

The fluid mass data was recorded over a 168-hour period. A linear regression of the recorded fluid mass data resulted in a leak rate detected below the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank # 20 is certified to be tight.



DFSP PEARL HARBOR UNSCHEDULED FUEL MOVEMENT (UFM) STANDARD OPERATING PROCEDURE (SOP)

a. Enclosures:

(1) UFM Report
(2) Weekly UFM Summary Report

b. Procedure:

a. In the event an Unscheduled Fuel Movement (UFM) alarm is received, the following procedures will be executed:

1. When a UFM is received, immediately silence the alarm and print the event.
2. If the UFM is received for one of the Red Hill tanks, order the Red Hill Gauger to investigate the lower tank gallery and tank suction valves for evidence of leakage or a valve that is not fully shut. If the UFM is received for one of the Upper Tank Farm (UTF) tanks, to include tank 301, B-1, B-2, Surge 1-4, order the Kuahua Rover to investigate the tank berm area and skin valves.
3. Order the Gauger/Rover to manually close the Tank suction/fill valves and put the valve/s into high torque.
4. The Control Room Operator (CRO) shall place the affected tank into an evolution, then immediately remove it from evolution. Make the appropriate annotations if the UFM clears. If the UFM does not clear, continue to execute procedures (e) through (m).
5. Order the Gauger/Rover to manually gauge the affected tank.
6. The CRO will compare the manual reading to the current AFHE reading and annotate any discrepancies.
7. The CRO will compare the most recent manual gauge to the last recorded manual measurement to determine if the fuel level has changed since the last applicable issue, receipt or sample.
8. If the most recent manual measurement matches the last manual measurement (within 3/16"), but the AFHE reading is not within 3/16th inch, then the problem probably resides with the AFHE.
9. If the problem resides with the AFHE, then email the Bulk Fuel Operations Supervisor, the Fuel Operations supervisor, the Deputy Director, and the Director with your causative research and clearly state that this appears to be an AFHE problem rather than a fuel leak.
10. If the problem resides with the AFHE, then the Control Room Operators will be responsible for having the affected tank

11. manually gauged daily, during the Mid-watch for Red Hill tanks or early on the swing watch for all outside tanks, unless directed otherwise by Management.
12. If the most recent manual measurement does not match the last manual measurement(decrease in excess of 3/16"), then the Control Room Operator on watch will call the Bulk Fuel Operations Supervisor, Fuel Operations Supervisor, the Deputy Director, and Director immediately. In addition, the control room operator will direct the Red Hill rover to conduct manual measurements every two hours until directed otherwise by Management. For outside tanks, if it is not safe for one person to do the top gauge due to inclement weather, poor lighting, or other reason, tell management and call in an additional employee to assist the rover (using standard overtime procedures).

3. Reports:

a. When a UFM is received the operator will fill out and submit for review a UFM report (Encl (1)). The UFM report will provide details as to what occurred, what action was taken, the cause, a comparison of the last manual gauge and the gauge required by item 1.e above, and a review and signature block. This report will be sent to the Bulk Fuel Operations supervisor, the fuel operations supervisor, the Deputy Director and the Director.
b. Weekly, on the Thursday mid-watch, the CRO will print out a UFM AFHE report, fill out the Weekly UFM report (Encl (2)), and provide copies of all UFM reports that occurred during that week. That will be forwarded to the Fuel Operation Supervisor for review.
c. The fuel Operation Supervisor will forward the report to the Bulk Fuel Operations supervisor, the fuel operations supervisor, the Deputy Director and the Director for review and concurrence.

4. Emergency Phone Contacts:

Name	Position	Office	Cell
Samuel Perfecto	Bulk Ops Sup	808-473-7805	808-479-1063
Thomas Williams	Ops Supervisor	808-473-7824	808-561-4677
John Floyd	Deputy Director	808-473-7801	808-780-3703
LCDR Lovgren	Director	808-473-7833	808-690-0115

5. Additional Comments:

a. When in doubt, immediately call the Bulk Fuel Operations Supervisor, the Fuel

Operations supervisor, the Deputy Director, the Director or CDO (until someone is reached) stating all findings and clearly stating there is a possible leak.

Approved by: LCDR Andrew Lovgren
Director

UFM REPORT

12/25/2015

Background:	EXAMPLE: At (time), on (Day of the week), December 25, 2015, Red Hill tank 0110 had a UFM
Action:	At (time) placed the tank into an evolution to remove the alarm
	At (time) the Red Hill Rover checked lower and upper tunnels
	(all Conditions were normal or the following problems were found)
	At (time) the Red Hill rover top gauged tank 0110
	The comparison from the last top gauge is 01/16"
Cause:	I believe the AFHE computer for tank 0110 may need calibration or to be reset. Tank 0110 dropped down to 207'-09-15/16". The tank is still in an evolution for AFHE fuel level movement and for monitoring. Also, the BS&W has risen from 0'-00-00" to 05'-07-05/16". The BS&W level alarm has been activated on AFHE for tank 0110.

Top Gauge of Tank 0110:

	Date:	Time:	Top Gauge	Rover Name
Previous:	20-Dec-15	4:00 PM	211'-08-06/16"	D. Cardona
Current:	25-Dec-15	5:20 AM	211'-08-06/16"	J. Espenida

Originator and Review:

		Name
Created by:	Concur/Do Not Concur	Alex Bayudan
Bulk Supervisor:	Concur/Do Not Concur	Sam Perfecto
Fuel Operation Supervisor:	Concur/Do Not Concur	Tom Williams
Deputy Director:	Concur/Do Not Concur	John Floyd
Director:	Concur/Do Not Concur	LCDR Lovgren

Encl (1)

WEEKLY UFM SUMMARY REPORT 2/11/2016

Background:	Example: For the week of 04 - 11 February, there were no UFM to Report.
Action:	No action required
Cause:	N/A

Top Gauge of Tank 0110:

	Date:	Time:	Top Gauge	Rover Name
Previous:				
Current:				

Originator and Review:

		Name
Created by:	**N/A**	Edgar Pascua
Bulk Supervisor:	**Concur/Do Not Concur**	Sam Perfecto
Fuel Operation Supervisor:	**Concur/Do Not Concur**	Tom Williams
Deputy Director:	**Concur/Do Not Concur**	John Floyd
Director:	**Concur/Do Not Concur**	LCDR Lovgren

ENCL (2)

Market Survey of Leak Detection Systems for the Red Hill Fuel Storage Facility, Fleet Industrial Supply Center, Pearl Harbor

Prepared for:

Defense Energy Support Center

Prepared under:

AFCEE Contract FA8903-04-D-8684-0008

Prepared by:

Michael Baker Jr., Inc.
Virginia Beach, Virginia

July 3, 2008

Market Survey of Leak Detection Systems for the Red Hill Fuel Storage Facility,
Fleet Industrial Supply Center, Pearl Harbor

TABLE OF CONTENTS

APPENDICIES

Appendix A – Vista Leak Detection LRDP-24-RH; Third Party Certification

Appendix B – MTC Pilot Test Results for Tanks 9 & 15 (March 2008) and Baker Supporting Trip Report

Appendix C - Draft NWGLDE Listings: Varec Leak Manager

Executive Summary

Michael Baker Jr. Inc (Baker) was contracted to conduct a market survey to serve as the first step in evaluating a comprehensive and cost-effective solution for a leak-detection system at the Red Hill facility. Baker conducted a search of possible technologies, manufacturers, and installers of petroleum equipment that have experience with leak detection in very large storage tanks.

The following is a list of candidates that were short listed based on prior experience at Red Hill or technology capable of leak detection on very large storage tanks.

- Asteroid Scientific Comet Software
- Varec Leak Manager Software and Enraf 854 ATG
- Gauging System Inc MTG 3000 and AFHE Control System
- Gauging System Inc MTG 3012 with stand alone leak detection system
- hydroGEOPHYISICS HRR-LDM
- Mass Technology Corporation MTPMMS
- Vista Leak Detection, Inc LRDP-24-RH

The candidates were evaluated using a set of criteria common to leak detection evaluations such as, Third Party Evaluation, Leak Detection Sensitivity, Instrument reliability, Customer Support, and System Installation, and Compatibility with existing ATG/AFHE infrastructure. A decision matrix was used to score and rank the technologies to identify strengths and weakness of each methodology. The issue of relative costs were also evaluated and included.

The results of this evaluation can be seen in the summary of Table 7-1. The results of this Market Survey have identified seven potential candidates for use as leak detection at Red Hill. The seven can generally be grouped as follows:

- The two highest ranked candidate technologies are both routinely used by the DOD and private industry for Integrity Testing of bulk storage tanks. While both are third party certified only Vista's LRDP-24-RH has been third party certified on the Red Hill Tanks. While the third party listing of the National Working Group for Leak Detection Evaluators (NWGLDE) that govern the use of the Mass Technology Corporation MTPMMS is still valid (no upper limit on capacity listed) and the theories and analysis remains the same the equipment has been slightly modified to deal with the higher pressures than normally experienced during this type of testing. It is Baker's opinion that while the system still produces a valid test, third party certification of this modified method should be performed specifically for Red Hill.

- The MTC MTPMMS system is better suited for use at Red Hill mainly due to the construction challenges faced by utilizing the Vista LRDP-24-RH method (clean and empty the tank to install equipment).

- Either MTC or Vista systems can be installed permanently and test run nearly continuously by either the operators or contractors.

- The middle three ranked systems all resulted in nearly the same scores. They are all some form of ATG system with analytical software to detect leaks. One relies on adjusting the existing AFHE system (which may or may not be practical) to make use of the existing ATG and the other two are newer variations of existing systems used in the industry.

- The use of the hydroGEOPHYISICS system seems unwarranted at this time due to the lack of this system in similar uses in industry.

- The lowest ranked system, the Asteroid Scientific Comet system, is analytical software required to be tied to a form of ATG. The use of another form of software with the existing ATG does not appear as attractive as other options considered. Use of the off site post operation analysis to confirm a suspected leak is attractive, but not a primary leak detection method.

Based on the Market Survey and evaluation of the systems it is Baker's opinion that the Mass Technology Corporation's MTPMMS system would be the best option as a primary leak detection solution for Red Hill. In addition Baker recommends that MTC Perform Point in time testing as soon as practical with a formal third party evaluation to conclusively identify the minimum detectable leak rate for this system in these USTS.

If the government chooses to go forward with any of the solutions identified in this Market Survey (other than point in time MTC MTPMMS testing) the next prudent step would be to perform a feasibility study. The focus of the feasibility study would be to identify and research specific design solutions, develop preliminary engineering design documentation (including cost estimates) that can give the government a realistic look at the required funding necessary to implement a solution.

1 Introduction

The objective of this market survey is to identify and research both commercially available and innovative technologies that may be used to solve the challenge of leak detection of the very large underground storage tanks (USTs) operated by the Fleet Industrial Supply Center Pearl Harbor (FISC PH) at Red Hill.

Defense Energy Support Center (DESC) and the Navy have tasked Michael Baker Jr. (Baker) with conducting a “Market Survey” of available technologies for leak detection of the very large USTs operated by FISC PH at Red Hill. Due to the extreme size of these storage tanks, typical off-the-shelf UST or bulk storage tank leak-detection systems are not applicable without modifications. Baker has been tasked to survey commercially available and new technologies that could be applied to the challenge of leak detection on the Red Hill USTs. This survey is being conducted under Delivery Order 008 of Contract FA8903-04-D-8684.

The Red Hill tanks pose a potential threat to an underlying critical water resource supplying potable water to the Navy and others in the vicinity of the Oahu facility. To mitigate this threat a contingency plan entitled “Red Hill Bulk Fuel Storage Facility Contingency Plan” was developed by TEC, Inc. for the Navy in 2007 which included an investigation into the implementation of a leak detection system. In response to this requirement, this market survey has been developed as the first phase within a multi-phased project involving the identification, research, selection, and pilot-scale testing and reporting of one or more technologies with the ability to detect leaks in these USTs.

1.1 Red Hill Site Layout and History

The FISC PH facility is located on the island of Oahu, Hawaii. While many of the FISC fuel operations and facilities are located in and around the port area of the main US Naval base on the southern coast of the island, the Red Hill Bulk Storage Facility is located several miles north of the main Navy base in a rural mountain area (see Section 9 figure 9-1). The Red Hill complex consists of the bulk USTs, transfer piping, control rooms and other incidental facilities dedicated to the operation of a large bulk storage terminal (see Section 9 figure 9-2). The entire complex is located underground and is tied directly to Pearl Harbor Navy Base through a tunnel system.

The USTs consists of 20 vertical, field-constructed welded steel structures surrounded by concrete built during 1941 to 1943 into the rock of Red Hill. Each tank has a nominal capacity of twelve million (12,000,000) gallons, and all but three tanks (Tank 1, 2 &19) were reported to be actively storing fuel. Tank 2 is temporarily out of service for a scheduled formal evaluation and Tanks 1 and 19 are permanently out of service.

The need for leak detection systems of these tanks is not new. As far back as the initial commissioning of these tanks, attempts have been made to identify and correct leaks to the tanks. However one thing has remained constant since these tanks were commissioned in 1943 and that is that the technology available to detect leaks in the tanks still lags behind the required level of measurement needed to protect the groundwater in the aquifer surrounding the tanks.

1.2 Current Regulatory Compliance Obligations – Leak Detection Systems

The two main regulatory drivers focused on leak detection for USTs located within the United States are the federal UST regulations and any specific State regulations. The federal UST regulations are codified in 40 CFR 280 and specifically, Subpart D "Release Detection" relates to the focus of this project. However, since these USTs are "field constructed" they are deferred from most parts of 40 CFR 280 including the requirements of leak detection systems required in Subpart D. This is an excerpt from 40 CFR 280 identifying this:

> **40 CFR 280.10 Applicability.**
>
> **(c) *Deferrals.* Subparts B, C, D, E, and G do not apply to any of the following types of UST systems:**
>
> **(5) UST systems with field-constructed tanks.**

The portions of 40 CFR 280 that these systems must comply with are Subpart A, F, H and I. None of these Subparts include any specifics relative to leak detection.

The State of Hawaii regulations relating to the requirements of UST systems are included in the *"Hawaii State Regulations Title 11, Department of Health, Chapter 281 - Underground Storage Tanks."* Like 40 CFR 280 the State of Hawaii specifically defers "Field Constructed" USTs from the requirements of leak detection. This is identified in the state regulations "Hawaii Administration Rules" section 11-281-01 "Applicability". These regulations and the associated deferral are nearly identical in verbiage to the requirements of 40 CFR 280. The only sections that are applicable to the field constructed USTs at Red Hill do not include requirements for leak detection.

2 Leak Detection and Underground Storage Facilities

It is important to begin an evaluation of leak detection capabilities for Red Hill with a brief discussion of the general characteristics of leak detection of USTs.

Generally, there are three basic principals to which leak detection systems operate for USTs and they are:

- Directly measuring changes in some physical properties (level, mass, volume, etc.) of the stored liquid inside the UST and comparing that to what is expected.

- Measuring for some physical property of the liquid (or other marker) outside of the UST system and comparing that to what is expected.

- Constructing the storage tank system within a containment structure and inspecting for the stored product collecting in the containment structure.

2.1 Direct In-Tank Measurements

Historically, fuel system operators have been performing the first type of leak detection listed above for as long as there have been storage tanks. Simply stated, an operator would measure the depth (level) of product in the tank and compare it to what was expected to be in the tank (considering issues, receipts, etc.). Obviously, several factors influence the quality of this leak detection measurement most notably being the accuracy of the level measurement.

The level to which accurate measurements could be made would generally be the major factor in determining the allowable discrepancy and the ultimate determination of a leak. If a gasoline station operator could accurately measure the product level in his USTs with his gauging stick to 1/8" on a daily basis then he could really only determine if he were losing product if the measured changes from anticipated levels were more than 1/8" per day. On a gasoline system UST with a relatively small product surface area this equates detectable leaks with relatively small leak rates. This of course is not true of large bulk tanks with equally large product surface areas

As time went on devices became available that could automatically and more accurately measure the liquid level. These are generally referred to as Automatic Tank Gauges (ATGs). ATGs were then coupled with data collection systems to obtain level measurements over a period of time and analytical software to help determine for the operator the potential existence of a leak. Over time the industry became aware of physical factors such as changes in product temperature affecting liquid level measurements and these were accounted for in the calculation/determination of a leak. As the industry got more sophisticated better measuring devices and computer systems were introduced to help to more accurately account for all of these factors and determine if leaks existed. However one major factor still drove the sensitivity to which a leak could be determined and that is the accuracy of the "raw" product level measurement.

For a majority of the UST industry this is currently not an issue. The surface area of all "shop fabricated" UST systems is relatively small even at their greatest point (nearly all shop built USTs are some form of horizontal cylinder and therefore the surface area changes with changing product level) a measurable change in product depth still only equates to a relatively small change in volume. Since most regulations governing "shop built" USTs have a mandatory leak determination rate of 0.2 gallons per hour (gal/hr) the product measuring devices available today are capable of detecting a change of level in the UST that equates to this volumetric change. This is not true however of the larger "field constructed" USTs.

Since field constructed USTs have surface much larger than the traditional shop fabricated USTs the same liquid level measuring devices used to detect leaks on the smaller USTs will only detect leaks of much larger volumes. Since most field constructed USTs are deferred from specific leak detection regulatory requirements, this has not traditionally been a problem for the industry, and as a result relatively little effort has been directed at solving leak detection issues for large field constructed storage tanks. This factor coupled with the fact that as an industry very few field constructed USTs exist outside the DOD has led to relatively few solutions for this problem.

Some of the innovative technologies developed in the recent past have focused both on increasing the level of accuracy of the liquid level measurement as well as several technologies focusing on detection of anomalies outside of the UST.

2.2 Outside Tank Detection Systems

At some point in the history of UST leak detection it became obvious that one way of detecting that a tank was leaking was to find product outside of the tank. Devices such as groundwater or soil vapor monitoring wells were installed around the tank systems with the hopes of determining an increase of petroleum in the environment adjacent to the tank. Advances in this technology included placing automated sensors in the monitoring wells that would alarm when petroleum was detected as well as the use of chemical markers placed in the fuel in the tank. These chemical markers would be more volatile than the petroleum vapors aiding in their detection. Outside tank leak detection technologies can be employed as continuous or point in time testing.

Like direct in-tank measurements, certain limitations exist for this type of technology as well. One challenge is the issue of existing contamination. If a UST leaks and product is released into the environment it will be detected by these outside tank sensors. Once the tank is repaired and placed back into service a certain amount of residual contamination can be expected even after remediation. That means the sensitivity of the leak detection system will be diminished as any new leak will have to overcome the background concentrations of the existing contamination before it can be registered as a new leak. This is also true of chemical marker (Tracer) testing.

Another factor to be considered in the effectiveness of an outside the tank leak detection system is the suitability of the site relative to geologic and hydrogeologic conditions. Obviously monitoring soil vapors in a site that is blasted from rock or is perpetually saturated with groundwater will create challenges for the system to detect a leak. A thorough evaluation of the site should always be undertaken prior to the implementation of such an approach.

2.3 Containment System Detection

One obvious drawback to all of the methods of leak detection discussed so far is that if a leak is detected it is, by some accounts, already too late and that is most especially true for leak detection systems with higher leak detection rates. Whether it is through direct in-tank measurements or outside tank detection techniques the fact exists that once a leak is detected there has already been some degree of impact on the environment. To help mitigate this problem the industry developed double-walled or contained UST systems. These systems basically are completely contained within some additional form of structure with a two-fold benefit. First, detection of a leak is somewhat simplified. Placing some type of sensor in the interstitial space (the space between the primary tank wall and the containment structure) can alert an operator to a leak by the very existence of something within the interstitial space. Secondly there is the added feature that this release has been captured before it has escaped into the environment.

This type of leak detection system is nearly always incorporated into the initial design/manufacture/construction of a UST system. While, upgrading an existing single walled system to that of a double walled system is possible it is most often too cost prohibitive to be implemented.

2.4 Inventory Control versus Precision Leak Detection

It should be stated that there is a definite distinction between inventory control and precision leak detection. In many cases level measurements obtained by ATG are only needed to give the operators an indication of product inventory on hand. The level of accuracy needed for routine inventory control is far less than that required for precision leak detection.

3 Initial Candidate Selection

Baker was contracted to conduct this market survey to serve as the first step in evaluating a comprehensive and cost-effective solution for a leak-detection system at the Red Hill facility. Baker conducted a search of possible technologies, manufacturers, and installers of petroleum equipment that has experience in leak detection in large storage tanks. Based upon Baker's experience with established firms conducting leak detection, a literature review of established and novel technologies was conducted. Trade publications and journals were also used for sources.

The typical selection of a leak detection solution for USTS, whether for a military or a commercial facility is quite straight forward. The owner/operator or his agent typically searches a list of pre-qualified systems capable of solving their particular problem and that are acceptable to the regulators. These pre-qualified lists are usually either managed by the State or the National Working Group for Leak Detection Evaluators (NWGLDE).

In the case of the Red Hill USTs there are two main issues that make the traditional approach to selecting leak detection more challenging. First, since these USTs are field constructed and not regulated by either state or federal UST regulations there are no pre-approved State listed systems applicable for this site. Secondly, there are basically NO other bulk POL UST systems elsewhere in the world (with the possible exception of the FISC Yokosuka -Hakosaki USTs) that are as large and deep as these tanks. As a result since this is a one of a kind site nobody has undergone NWGLDE listing specifically with these tanks in mind (other than Vista Leak Detection who were paid by the Navy to perform their test and get third party evaluated, but were never listed with the NWGLDE) .

3.1 Historic and Existing Leak Detection at Red Hill

As a first step in identifying potential leak detection system candidates Baker began by looking at the historic and existing systems utilized at Red Hill. This section provides a brief history of the leak-detection systems that have been used in the past. The following Table is a listing of the previously installed or tested systems at Red Hill. A more detailed discussion of the systems follows in the remainder of Section 3.1.

Table 3-1 Historic and Existing Leak Detection Systems at Red Hill					
Technology	**Type of Test**	**Historic or existing**	**Theoretical minimum detectable leak rate**	**Comments**	**Candidate Selected for additional consideration at Red Hill**
Tell Tale System	Continuous	Historic	Unknown	Long term degradation by corrosion made system unusable. Unrealistic to repair system or install new.	No
Asteroid Scientific Comet	Continuous (Point in Time for post operation analysis)	Historic	Unknown	Original system tied to float level gauge system that has been removed. System can be tied to existing GSI ATG system. System can also be used as post operation analytical tool	Yes
Vista Leak Detection LRDP-24-RH	Point in Time	Existing in Tank 9 only	0.59 gal/hr	Third Party Certified to 0.59 gal/hr. For installation tanks must be empty and cleaned.	Yes

Table 3-1 Historic and Existing Leak Detection Systems at Red Hill					
Technology	**Type of Test**	**Historic or existing**	**Theoretical minimum detectable leak rate**	**Comments**	**Candidate Selected for additional consideration at Red Hill**
GSI MTG 3000 ATG System and AFHE Software Interface	Continuous	Existing	¾" change in fluid level	Difficult to determine minimum detectable leak rate. Need to understand if baseline is reset after weekly level data dump and how water draw offs are handled, With adjustments this system may be suitable as a leak detection system. Rigorous third party evaluation would be recommended to assess minimum detectable leak rate.	Yes
Groundwater Monitoring	Point in Time	Existing	Unknown	Not truly a valid form of primary leak detection. Other requirements may necessitate its continued use.	Not as a primary form of leak detection
Under Tank Vapor Monitoring Probes	Point in Time	Existing	Unknown	Effectiveness limited and dependent on probe location and geologic setting.	Not as a primary form of leak detection

3.1.1 Tell Tale System

The USTs at Red Hill were initially equipped with the simplistic "Tell-Tale" systems, which were eliminated from 16 of the 20 tanks because of operational problems. The original Tell-Tale systems consisting of tubes connected to the outer tank walls for visual gauging of oil levels were ineffective because of corrosion and clogging. Repair or retrofitting these systems would be cost prohibitive.

3.1.2 Asteroid Scientific Corporation Comet System

Asteroid Scientific (Asteroid) is a professional systems engineering firm and has a history of inventory control experience at the Red Hill facility. This system is a software package only that is tied to some form of tank gauging provided by others. Their COMET® system can receive data from a combination of level gauging equipment, temperature, and pressure sensors installed within a UST. This data will be used as input to their proprietary software that analyzes the data for leaks.

In 1970 Asteroid installed an inventory control system with a centralized electronic data transfer system. Subsequent improvements were made to the data transfer mechanisms. This system was adversely affected by corrosion and ultimately degraded to the point of being inoperable. The fluid level measurements used in the initial Asteroid system were tied to a basic float system that was ultimately removed/abandoned. The Asteroid system had the ability to analyze tank data from fluid level measurement devices, (either the original float system or the current ATG) off line from transmitted data files and arrive at a leak detection rate. Although the procedure still exists as an option, it is not currently part of the installed software owned or operated by FISC PH.

It is claimed by the manufacturer that the COMET® system can provide a leak detection rate of 0.2 to 0.5 gal/hr using the interface with existing ATG sensors and as long as those sensors provide a minimum level of resolution in level of 1/64th of an inch, and temperature of 0.001°F. No third party certification could be discovered for the COMET® system during the research by Baker personnel.

3.1.3 Vista Leak Detection LRDP

The Low-Range Differential Pressure (LRDP) system is offered by Vista Leak Detection Inc (Vista). This is a mass-based leak detection and monitoring system for bulk USTs and aboveground storage tanks (ASTs). The LRDP can be permanently installed for on-line monitoring and periodic tightness testing, or it can be transported to a site for a one-time tightness test. The performance of interest for Red Hill utilizing the LRDP is specifically tied to a third party evaluation performed in 2001 for the LRDP-24-RH.

In 2001 an evaluation was performed by the Navy on a Vista System. The Vista system is a form of in tank leak detection that utilizes Low-Range Differential Pressure to very accurately measure differential pressures between the product in the tank and a reference tube installed in the tank. A differential pressure can then be tied to a change in product level. In 2001 a leak detection rate of 0.59 gallon per hour (gph) at a 95 percent probability of detection was verified by third-party tests on a prototype of the LRDP-24-RH system in tank 9 at Red Hill. The system was considered to be operationally and cost prohibitive by the Government at that time for installation in all 20 tanks.

3.1.4 Gauging Systems Inc MTG 3000 TGI ATG and AFHE System

In 2001, The Mass Tank Gauging System 3000 (MTG 3000) from Gauging Systems Inc. (GSI) capable of measuring temperature and pressure was installed on all the USTs at Red Hill. This ATG system was tied directly to the Automated Fuel Handling Equipment (AFHE) control system and acts as the fluid level measuring module for that overall control system. The MTG 3000 is both a hybrid and hydrostatic tank gauge. Each tank is fitted with a vertical array of 21 temperature sensors (one every 10 feet) and four pressure sensors (three at the bottom and one in the vapor space). The MTG 3000 system records temperature and pressure in ATG mode, and the software converts these to mass and level. This data is then used in the tank level module of the AFHE system. Reportedly the AFHE system does currently perform a gross leak detection analysis by alerting operators to a change of 0.75” compared to some baseline level measurement.

Although the data from the MTG 3000 was considered suitable for inventory control and gross leak detection within the AFHE system (if properly calibrated), FISC noted certain concerns and limitations with the system as currently configured including the lack of a precision (sub 1.0 gal/hr) leak-detection capability.

In the present configuration the MTG 3000/AFHE system will currently at best alarm at a 0.75" loss in one week; the period which the current AFHE system stores level data. That equates to a minimum detectable leak rate of approximately 23.5 gallons/hr if that loss is over a one week period. This is poor performance for a precision leak detection rate and some adjustment of the AFHE software would be needed to make use of the 1/64" sensitivity of the existing ATG claimed by its manufacturer, GSI. Ultimately if the AFHE system can be modified to detect a leak by a fluid level change of closer to the 1/64" over a time greater than the current one week period theoretically this system could be used for leak detection. It would be highly recommended that such a system be rigorously evaluated by a third party to get an accurate assessment of the true sensitivity of the minimum detectable leak rate.

Because of the variety of existing sensors, AFHE equipment, and ATGs that currently exist, FISC's initial hope was to utilize the existing ATG and AFHE equipment for leak detection. The goal would be to monitor liquid levels in the tank with the ATG/AFHE equipment and with post operation analyses performed by Asteroid (either on-site with government lease/purchase of the software or with off-site analysis through some other contracting method) verify any suspected leaks.

3.1.5 Groundwater Monitoring

Both potable groundwater supply wells and groundwater monitoring wells are located in the vicinity of the Red Hill storage tanks. While these are routinely sampled and analyzed for petroleum products which does constitute a form of "outside the tank" leak detection it should not be considered a primary solution for leak detection of these tanks.

3.1.6 Under Tank Vapor Monitoring Probes

Currently 17 of the active 18 Bulk USTs are equipped with simple form of leak detection consisting of under tank vapor monitoring probes. The final probe array is scheduled to be installed in summer 2008. This system relies on permanent installation of probes installed beneath the USTs that are used as vapor sampling locations. The theory of this system as that any leaked product will travel to the monitoring probes and an increase in concentration of petroleum product vapor in the soil vapor sample can be detected with an electronic monitoring device. This is currently being performed as point in time testing on a monthly frequency.

In theory this system is similar to soil vapor monitoring systems used at many gas station to comply with the requirements of leak detection under 40 CFR 280 or the use of Tell-Tale piping under Bulk ASTs. The main drawback however to this system as that the geologic setting for the probe array locations is unknown and highly suspect. To work adequately soil vapor monitoring probes must be installed in a location conducive to the transport of the leaked petroleum product directly to the monitoring probe array. While the actual geologic setting of the Red Hill system is unknown it seems unlikely to be a homogeneous, highly porous soil capable of allowing transport of product to the monitoring probes. Verification of the adequate operation of this system appears impossible and it should not be relied upon as a primary source of leak detection.

3.2 NWGLDE Listed Bulk UST Leak Detection Systems

As the second step in identifying potential candidates Baker utilized the National Working Group for Leak Detection Evaluators. The NWGLDE is an organization of State and Federal environmental regulators who are actively managing leak detection system third party certifications. After a potential leak detection system vendor has undergone rigorous third party evaluation it can petition for listing on the NWGLDE. This credential is extremely important when selecting a leak detection system as it validates the claims made by leak detection system manufacturers or vendors.

Baker searched the NWGLDE listings for theoretically appropriate leak detection solutions for bulk UST systems. Table 3-2 depicts the search results.

While many of the bulk UST systems listed with the NWGLDE are not bound by an upper tank capacity or product depth, it is unlikely that anyone considered the Red Hill tanks when listing them with the NWGLDE. This is not realistic, as several of the methods rely on factors that would be affected by the extreme depth of the product. Since the industry that the NWGLDE serves does not have bulk USTs the size (depth) of Red Hill it is understandable that they did not specifically consider this in their listing.

Its Baker's opinion that many of them will not work at Red Hill as listed. There are others that do show promise and that should be reevaluated for the Red Hill tanks specifically. The systems are listed as applicable with no upper threshold of product depth and are certified but may in fact need modifications to the equipment to work under the conditions at Red Hill. These are systems of greatest interest to this Market Survey and are evaluated in more detail in the remainder of this document.

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
ASTTest Services, Inc.	ASTTest Mass Balance Leak Detection System Continuous Test Method	[(product surface area in ft² ÷ 5,575 ft²) x 0.88 gph]/ [(product surface area in ft² ÷ 5,575 ft²) x 0.44 gph]/13,938 ft².	Applicable with theoretical anticipated leak rate of 1.35 gal/hr	No information available for vendor. May no longer be available. “Probe” installations generally require the tank to be cleaned and emptied.	No
Engineering Design Group, Inc.	EDG XLD 2000 Plus (Revision 1.02) Leak Detection System (MTS DDA Magnetostrictive Probe) Continuous Test Method	[(product surface area in ft² ÷ 12,074 ft²) x 1.92 gph]/ [(product surface area in ft² ÷ 12,074 ft²) x 0.96 gph]/12,076 ft².	Not applicable- Red Hill tanks too large	N/A	No
Engineering Design Group, Inc.	Ronan X-76 CTM Automatic Tank Gauging System (MTS Level Plus UST Probe) (Continuous Test Method)	[(product surface area in ft² ÷ 564 ft²) x 0.2 gph]/ [(product surface area in ft² ÷ 564 ft²) x 0.96 gph]/846 ft².	Not applicable- Red Hill tanks too large	N/A	No

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
Leak Detection Technologies, LLC (Listed separately not in Bulk UST section)	MDleak Enhanced Leak Detection Method (Point in Time Test method)	0.05 gph/ A tank system should not be declared tight when tracer chemical or hydrocarbon greater that the background level is detected outside of the tank. Not limited by capacity.	Not applicable- Impossible to array probes appropriately and non-homogenous backfill outside parameters of method applicability	N/A	No
MassTechnology Corp.	Precision Mass Measurement System (24 hr test) (Point in Time Test Method)	[(product surface area in ft² ÷ 1,257 ft²) x 0.1 gph]/[(product surface area in ft² ÷ 1,257 ft²) x 0.05 gph]/3,143 ft².	Not applicable- Red Hill tanks too large	N/A	No
Mass Technology Corp.	Precision Mass Measurement System (48 hr test) (Point in Time Test Method)	[(product surface area in ft² ÷ 6,082 ft²) x 0.294 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 0.147 gph]/6,082 ft².	Not applicable- Red Hill tanks too large	N/A	No

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
Mass Technology Corp.	Precision Mass Measurement System (72 hr test) (Point in Time Test Method)	[(product surface area in ft² ÷ 14,200 ft²) x 0.638 gph]/[(product surface area in ft² ÷ 14,200 ft²) x 0.319 gph]/35,500 ft².	Applicable with theoretical anticipated leak rate of 0.2 gal/hr	Due to extreme depth of tank leak a different pressure transducer is needed than original system. Theoretical results with this equipment is 0.5-0.6 gal/hr	Yes
Praxair Services, Inc. (originally listed as Tracer Research, Corp.)	Tracer ALD 2000 Automated Tank Tightness Test (Continuous Test Method)	0.05 to 0.1 gph/ A tank system should not be declared tight when tracer chemical or hydrocarbon greater that the background level is detected outside of the tank./Not limited by capacity.	Not applicable- Impossible to array probes appropriately and non-homogenous backfill outside parameters of method applicability	N/A	No

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
Praxair Services, Inc. (originally listed as Tracer Research, Corp.) (Listed separately not in Bulk UST section)	Non-Volumetric Tank Tightness Test Method (Point in Time Test Method)	0.05 to 0.1 gph/ A tank system should not be declared tight when tracer chemical or hydrocarbon greater that the background level is detected outside of the tank./Not limited by capacity.	Not applicable- Impossible to array probes appropriately and non-homogenous backfill outside parameters of method applicability	N/A	No
Universal Sensors and Devices, Inc.	LTC-1000 (Mass Buoyancy Probe) (Continuous Test Method)	[(product surface area in $ft^2 \div 14{,}244\ ft^2$) x 1.4 gph]/[(product surface area in $ft^2 \div 14{,}244\ ft^2$) x 0.7 gph]/35,610 ft^2.	Applicable with theoretical anticipated leak rate of 0.42 gal/hr	No information available for vendor. May no longer be available "Probe" installations generally require the tank to be cleaned and emptied.	No

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
Universal Sensors and Devices, Inc.	LTC-2000 (Differential Pressure Probe) (Continuous Test Method)	[(product surface area in ft² ÷ 14,244 ft²) x 3.0 gph]/[(product surface area in ft² ÷ 14,244 ft²) x 1.5 gph]/35,610 ft².	Applicable with theoretical anticipated leak rate of 0.90 gal/hr	No information available for vendor. May no longer be available. “Probe” installations generally require the tank to be cleaned & emptied.	No

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
Varec, Inc. (originally listed as Coggins Systems, Inc., and later as Endress + Hauser Systems and Gauging)	Fuels Manager and Remote Terminal Unit (RTU/8130) (MTS Magnetostrictive Probe) (Continuous Test Method)	[(product surface area in ft² ÷ 616 ft²) x 0.2 gph]/[(product surface area in ft² ÷ 616 ft²) x 0.1 gph]/924 ft².	Not applicable- Red Hill tanks too large	N/A	No
Varec, Inc. (originally listed as Coggins Systems, Inc., and later as Endress + Hauser Systems and Gauging)	Leak Manager with Barton Series 3500 ATG (48 hour test) (72 hour test) (Continuous Test Method)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 1.0 gph]/15,205 ft².	Applicable with theoretical anticipated leak rate of 1.40 gal/hr	This system is in use at many DOD facilities. Varec is currently studying this software with next generation ENRAF gauges for better sensitivity.	Yes, but with newer ENRAF B.V. Gauges for improved sensitivity.
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-24 (V1.0.2, V1.0.3) (Point in Time Test Method)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 or 3.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x (2.0 or 3.0 gph - 0.223 gph)]/15,205 ft².	Applicable with theoretical anticipated leak rate of 2.58 gal/hr	Actual Third party evaluation testing performed on Tank 9 with LRDP-24-RH achieved leak rate of 0.59 gal/hr	Yes, but with LRDP-24-RH with third party certified leak rate of 0.59 gal/hr

Table 3-2 NWGLDE Listing for Bulk UST Leak Detection Systems					
Vendor	**Test Method & Test Type**	**Leak Rate/Threshold/Max Product Surface Area**	**Theoretical Applicability to Red Hill**	**Realistic Applicability to Red Hill**	**Selected for additional consideration**
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-48 (V1.0.2, V1.0.3) (Point in Time Test Method)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 2.0 or 3.0 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x (2.0 or 3.0 gph - 0.188 gph)]/15,205 ft^2.	Applicable with theoretical anticipated leak rate of 2.62 gal/hr	Actual Third party evaluation testing performed on Tank 9 with LRDP-24-RH achieved leak rate of 0.59 gal/hr	Yes, but with LRDP-24-RH with third party certified leak rate of 0.59 gal/hr
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-24 (V1.1) (Point in Time Test Method)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 0.856 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x 0.632 gph]/15,205 ft^2.	Applicable with theoretical anticipated leak rate of 0.89 gal/hr	Actual Third party evaluation testing performed on Tank 9 with LRDP-24-RH achieved leak rate of 0.59 gal/hr	Yes, but with LRDP-24-RH with third party certified leak rate of 0.59 gal/hr
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-48 (V1.1) (Point in Time Test Method)	[(product surface area in ft^2 ÷ 6,082 ft^2) x 0.749 gph]/[(product surface area in ft^2 ÷ 6,082 ft^2) x 0.563 gph]/15,205 ft^2.	Applicable with theoretical anticipated leak rate of 0.80 gal/hr	Actual Third party evaluation testing performed on Tank 9 with LRDP-24-RH achieved leak rate of 0.59 gal/hr	Yes, but with LRDP-24-RH with third party certified leak rate of 0.59 gal/hr

A few clarifications are required for the results shown in Table 3-2. First, Vista's Third Party Certification for the LRDP-24-RH is included in Appendix A. This is not listed on the NWGLDE as it only applies to these tanks and in a discussion with Vista it was reported that it was not worth the cost or effort to list them on the NWGLDE.

Secondly, several of the systems are listed as applicable with no upper threshold of product depth. This is not realistic as several of the methods rely on factors that would be affected by the depth of the product. Since the industry that this group serves does not have bulk USTs the size (depth) of Red Hill it is understandable that they did not specify consider this in their listing. Table 3-2 lists systems that are certified, but may in fact need modifications to the equipment to work in under the conditions at Red Hill.

3.2.1 Mass Technology Corporation

The Mass Technology Corporation (MTC) *Mass Technology Precision Mass Measurement System* (MTPMMS) measures the differential pressure between one point at the bottom of the contained fluid and another point in the vapor space immediately above the fluid surface. The pressure at or near the bottom of the tank corresponds to the mass above the measuring point and independent of liquid level changes caused by the thermal expansion and contraction of the product under test.[1] It is a field-proven and third-party certified technology. It is claimed that a leakage rate of 0.8 gph in a tank of 100,000 barrel capacity can be detected by their technology.

Mass Technology Corporation's system is a third party certified system that would need some enhancements to work in the deeper tanks of Red Hill. Since the third party system generally operates on traditional cut/cover USTs the deeper Red Hill USTs would require the system to be upgraded to deal with the higher pressures associated with these deeper than usual tanks. While the theories and technology are identical to their standard third party certified test a newer pressure transducer would be required and it is not exactly clear whether this change to the MTC test equipment "invalidates" the third party certification or if it would just be considered an "enhancement" necessary for a test at this depth.

[1] H. Kendall Wilcox, *Evaluation of the Mass Technology Precision Mass Measurement System on Bulk Field-Constructed Tanks (2,000,000 Gallon Vertical Tank Evaluation)* http://www.kwaleak.com/certifications/Mass%20Technology_Bulk%20Tank_1998_03_25.pdf March 1998

3.2.2 Varec Leak Manager and ITT Barton 3500 Gauge

Varec's Leak Manger software and Barton 3500 ATG is used in some DOD installations to perform leak detection for Bulk storage tank systems. The Varec software utilizes the ATG data to determine if a tank is leaking. The use of Varec's Leak Manager Software coupled with the ITT Barton 3500 gauge is another such system that would probably need modification given the depth of these USTs. Therefore Baker would suggest that instead of researching this system it would make better sense to research the next generation of this technology which is the Leak Manager Software coupled with an Enraf B.V. ATG. This new system is undergoing third party evaluation on bulk cut/cover USTs at FISC Point Loma. See Section 3.3.3 for a discussion of this new technology.

3.2.3 Vista Leak Detection Systems

Vista has several leak detection systems listed on the NWGLDE. However, the one most applicable to Red Hill is the system that was tested and third party certified on Red Hill Tank 9 in 2001. This is discussed in Section 3.1.3

3.3 Innovative and State of the Art Leak Detection Systems

In addition to the historic leak detection systems and those identified in an initial candidate search of the NWGLDE, Baker researched other potential candidates. These are typically systems that are either new to the leak detection industry and do not yet see the benefit of being listed or are vendors that have similar systems already in use and listed, but are developing new systems that are not yet fully third party evaluated.

The following listed in Table 3-3 were identified as innovative or state of the art and warrant further technological evaluation.

Table 3-3 Innovative or State of the Art Leak Detection Systems				
Vendor	**System**	**Test Type & Theoretical minimum detectable leak rate**	**Comments**	**Candidate Selected for additional consideration at Red Hill**
hydroGEOPHYISICS	HRR-LDM	Continuous Test Unknown Leak Rate	Unable to obtain copy of third party evaluation to determine applicability to Red Hill Site	Yes
Gauging Systems Inc.	MTG 3012 Multi-function Tank Gauge	Continuous Test Unknown Leak Rate	Next Generation of existing tank gauge system already installed at Red Hill coupled with the components needed to make a stand alone leak detection system. MTG is a third party certified Gauge by another independent evaluation group.	Yes
Varec, Inc.	FuelsManager with Enraf 854 ATG (Servo Buoyancy Probe)	Continuous Test 2.17 gal/hr	Next generation of Leak Manager system used widely in DOD. Third Party certification Pending. Like all probe and gauge systems construction and sensitivity at Red Hill site maybe an issue.	Yes
Varec, Inc.	Fuels Manager with MTS M-Series ATG (MTS Magnetostrictive Probe)	Continuous Test 3.25 gal/hr	Next generation of Leak Manager system used widely in DOD. Third Party certification Pending. Not as promising as Enraf 854 ATG system.	No

3.3.1 hydroGeophysics HRR-LDM

High Resolution Resistivity-Leak Detection and Monitoring (HRR-LDM), a new methodology developed by hydroGEOPHYSICS, Inc. (HGI), was performance evaluated during a three-month EPA-guided test at a mock tank site in the Hanford 200E Area, Richland, WA. HGI has been working very closely with CH2M-Hill Group in successfully applying ex-situ approaches to leak detection based on geophysical resistivity methods at the Hanford Site in Southeast Washington. HGI is using their leak detection methods to perform real-time monitoring at several large single-shell storage tanks containing high-level radioactive wastes that have capacities of on the order of about 1 million gallons of waste each. They are familiar with the Red Hill facility having been involved in the preparation of proposals of how their methods could be applied to the Red Hill facility in response to a solicitation in the 2004.

3.3.2 GSI MTG 3012 Multi-function Tank Gauge

In its current configuration, the existing GSI MTG 3000 ATG system itself does not perform leak detection, but rather works with the AFHE system to perform a form of leak detection. Gauging Systems Inc has tested and developed several improvements to the algorithms, sensor housings, transducers, transmitter cards and the system programs (RH calc) since the existing installation. The *MTG 3012 Multi-function Tank Gauge* provides both quantitative and qualitative measurement of product. Increased resolution and stability would be required of the existing ATG sensor array readouts and data transfer system, as well as high resolution level measurement, appropriate analytical software and a user interface for a certifiable leak detection system. The MTG™ (tank gauge) is third party certified for leak detection (Mass sensitivity) by IOML (International Organization of Legal Metrology) R-125 for "Measuring systems for the mass of liquids in storage tanks".[2]

3.3.3 Varec Leak Manager with Enraf 854 ATG (Servo Buoyancy Probe)

As identified in Section 3.2.2 Varec's Leak Manger software is used in some DOD installations to perform leak detection for Bulk storage tank systems. The software is tied to ATG data

[2] *MTG™ 3012 "Multi-function Tank Gauge,* http://www.gaugingsystemsinc.com/article.cfm?id=100

determine if a tank is leaking or not. All Varec leak Manager systems are therefore tied to the sensitivity of the ATG in use at the site. In order to increase the sensitivity of the MDLR of the Leak Manager systems Varec has gone to newer generation ATGs than the ITT Barton 3500s described in Section 3.2.2. The remainder of this section discusses the system utilizing the Enraf Enraf 854 ATG (Servo Buoyancy Probe)

Enraf B.V. specializes in the development, manufacture, and support of the precision instrumentation and software for bulk storage management. Enraf B.V. provides products that utilize level and hydrostatic gauging. Temperature sensors and radar level gauges are also used to complement the inventory measurement.

In a telephone conversation between Baker Personnel (J.C. Davis, 2008) with Tom Graves, Enraf B.V., he indicated that Enraf B.V., and Varec® are conducting a leak detection test at Point Loma DFSP to obtain data for third party certification. At the time of the conversation, the test was completed and the results were submitted to the NWGLDE, but official listing on by the work group was not available at the time of this report date.

On 06 June 2008 Baker was provided with a copy of the draft NWGLDE listing of this system. This listing is provided in Appendix C and indicates that the third party certified minimum detectable leak rate (MDLR) for this system will be tied to the product surface area. According to this proposed NWGLDE listing the MDLR for the Red Hill USTs would be approximately 2.17 gal/hr. However, the major issue with this proposed listing is that it identifies a maximum tank size as 2,100,000 gallons and therefore the applicability of this system at Red Hill is highly questionable. Additional testing and third party certification of this system specifically for Red Hill would be required to make a decision as to the actual MDLR on these tanks.

3.3.4 Varec Leak Manager with MTS M-Series ATG (Magnetostrictive Probe)

In addition to the Leak Manger and Enraf 854 ATG leak detection system Varec has also recently submitted another Leak Manger and ATG system to the NWGLDE for listing. This system utilizes the MTS M-Series ATG. The draft NWGLDE listing is presented in Appendix C. This system appears to be both less sensitive and more problematic to install than the Enraf 854 gauge described in Section 3.3.3. It appears from the draft listing that a sensor pipe must be installed in the tank and it must be maintained annually. Additionally temperature sensors must be installed on 18 inch centers from the bottom of the tank. It would appear that of the two new Varec Leak Manager systems the MTS ATG system is a less desirable candidate than the Enraf system. No further evaluation should be considered.

3.4 Initial Candidate Selection Summary

In the previous sections Baker has considered the historic, NWGLDE listed, and innovative/state of the art leak detection solutions with potential at Red Hill. Table 3-4 is a summary of those technologies that warrant further evaluation due to their perceived applicability to this unique challenge.

Table 3-4 Initial Candidate Selection Summary				
Vendor	**System**	**Test Type**	**Theoretical minimum detectable leak rate**	**Comments**
Asteroid Scientific	Comet	Continuous (Point in Time for post operation analysis)	Unknown	Original system tied to float level gauge system that has been removed. System can be tied to existing GSI ATG system. System can also be used as post operation analytical tool
Vista Leak Detection	LRDP-24-RH	Point in Time	0.59 gal/hr	Third Party Certified to 0.59 gal/hr. For installation tanks must be empty and cleaned. Coordination with existing tank structures needed.

Table 3-4 Initial Candidate Selection Summary				
Vendor	**System**	**Test Type**	**Theoretical minimum detectable leak rate**	**Comments**
Gauging Systems Inc ATG System and AFHE Software Interface	MTG 3000 and AFHE Existing system	Continuous	Unknown Tied to MTG accuracy	Difficult to determine minimum detectable leak rate. Need to understand if baseline is reset after weekly level data dump and how water draw offs are handled, With adjustments this system may be Suitable as a leak detection system. Rigorous third party evaluation would be recommended to assess minimum detectable leak rate.
Mass Technology Corp.	Precision Mass Measurement System	Point in Time	anticipated leak rate of 0.5 gal/hr	Due to extreme depth of tank leak a different pressure transducer is needed than original system. Theoretical results with this equipment is 0.5-0.6 gal/hr Simple to perform with no in tank construction needed for testing

Table 3-4 Initial Candidate Selection Summary				
Vendor	**System**	**Test Type**	**Theoretical minimum detectable leak rate**	**Comments**
Varec, Inc.	FuelsManager with Enraf 854 ATG (Servo Buoyancy Probe)	Continuous Test	2.17 gal/hr	Next generation of Leak Manager system used widely in DOD. Third Party certification Pending and is not applicable to tanks the size of the Red Hill USTs Like all probe and gauge systems construction and sensitivity at Red Hill site may be an issue. Coordination with existing tank structures needed.
hydroGEOPHYISICS	HRRLDM	Continuous Test	Unknown Leak Rate	Unable to obtain copy of third party evaluation to determine applicability to Red Hill Site

Table 3-4 Initial Candidate Selection Summary				
Vendor	**System**	**Test Type**	**Theoretical minimum detectable leak rate**	**Comments**
Gauging Systems Inc.	MTG 3012 Multi-function Tank Gauge	Continuous Test	Unknown Leak Rate	Next Generation of existing tank gauge system already installed at Red Hill coupled with the components needed to make a stand alone leak detection system. Coordination with existing tank structures needed. MTG is a third party certified Gauge by another independent evaluation group.

4 Evaluation Criteria

A decision matrix will be used to aid in the selection of the most appropriate technology for further consideration. A decision matrix is a chart that allows a team or individual to systematically identify, analyze, and rate the strength of relationships between sets of information. The matrix is especially useful for looking at large numbers of decision factors and assessing each factor's relative importance. The evaluation criteria described in the following paragraphs will be used in the decision matrix chart.

Each criterion will be assigned a weight to demonstrate the relative importance of each function. Leak rate sensitivity and third party certification have been assigned the highest weight of 5 since they have a combined effect on a system evaluation. Instrument reliability was given a weight of 3 to demonstrate the importance consistency of the leak detection system. The remaining criterion was determined to be important to include in the matrix but have the lowest value of 2 assigned. The following criteria will be used in the decision matrix:

- Third party certification- Ensure that the leak detection systems under review meet EPA and/or other regulatory performance standards

- Leak rate sensitivity- Quantify the minimum detection leak rate

- Compatibility with existing MTG-3000 and/or existing AFHE® system- Optimize and refine the existing ATG inventory and control system to better meet the goals of a leak detection system that is protective of the environment and human health.

- Instrument reliability- Define and quantify instrument accuracy and service life

- Customer support & reliability- Identify the effort required to train facility operators and perform scheduled leak detection tests.

- System installation- Define the level of difficulty to install the leak detection system in the unique UST environment.

A rank-order for all options will be given according to how well each meets the criterion, with 1 being the option that is least desirable according to that criterion. Multiply each option's rating by the weight. Add the points for each option. The option with the highest score will not necessarily be the one to choose, but the relative scores can generate meaningful discussion.

5 Evaluation

This section evaluates each methodology by each criterion and provides a discussion of the system parameters.

5.1 Asteroid Scientific Comet Software with existing ATG

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	0	3	1	1	0	2

The COMET system has not been certified by an independent third party evaluator and receives the lowest score in this column. Asteroid claims that the COMET system is capable of detecting leaks at the 0.2 to 0.5 gallons per hour leak rate on a monthly basis. This rate will obviously depend on the ATG and other hardware that the software utilizes for liquid level measurements. The quoted leak rate values are based on theoretical inputs that may not be possible to achieve in practical implementation and without the third party certification this leak rate is unproven. Also the probability of detection, usually 95% for certified leak detection systems was not published and cannot be verified.

A request for information was sent via email from Baker to Asteroid for a technological description, but no response was provided and repeated phone messages were not returned. The request for information contained questions regarding the COMET leak detection system and inquired about measurement inputs. The reliability of the COMET system is unknown and cannot be determined without feedback from Asteroid.

The compatibility with the MTG to provide the necessary level data to compute leak detection is valid, but integration to the AFHE system appears problematic. This gained them a score of 1 in this category. The Customer Support criterion was given a low score based on their lack of response to the questionnaire and the critical tone of their website to the Red Hill leak detection effort.

If this software upgrade were to be utilized with the existing ATG system it would be a straightforward installation process gaining them a maximum score in this category.

5.2 Vista Leak Detection, Inc LRDP-24-RH

	3^{rd} party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	5	5	1	3	1	0

Vista Leak Detection developed the Low Range Differential Pressure (LRDP-24-RH) for the Red Hill facility and performed a pilot test in June and August of 2001. A third party evaluation was performed during the test and a Minimum Detectable Leak Rate of 0.59 gallons per hour was determined. Although the Vista technology is not compatible with the MTG gauging system, reliability is satisfactory based upon Baker's observations with Vista's technology. The most significant drawback to this alternative is the installation difficulty. The key component of the LRDP is the vertical "reference" tube, which spans the full usable height of the tank. This installation requires that the tank be emptied and taken out of service and coordination with existing tank structures is required.

While there is no apparent way to integrate a Vista Leak Detection system with the ATG/AFHE it would be possible to utilize the existing data transfer (fiber optic) system to get data the Pearl Harbor FISC control center. This gives them a score of 1 for this category.

Vista has performed integrity testing and leak detection services for the DOD for several years with adequate success. However, company realignments and staffing has caused reduced customer service focus in the last few years earning them a reduced score in this category.

5.3 Gauging System Inc. MTG 3000 and AFHE System (existing)

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	1	2	2	3	2	2

The Tank Gauging System at Red Hill is a hybrid MTG 3000, and has been certified by the International Organization of Legal Metrology (OIML) for “Measuring system for the mass of liquids in storage tanks”. It was installed under a proof of concept contract and later expanded to the remainder of the Red Hill tanks. This system is coupled with the AFHE control system installed under Space and Naval Warfare Command (SPAWAR) oversight.

A minimal score for the third party certification was given since even though the MTG itself is certified (albeit the certification does not follow U.S. EPA regulatory performance standards) the entire existing Leak Detection system is really run by the AFHE system and this combination has not been third party certified. Additionally the “hybrid” caveat to the nomenclature of the MTG suggests that this system, like most ATG systems, was not evaluated on a tank of the size of the Red Hill USTs leading to the questioning of the validity of the third party certification.

The existing leak rate sensitivity for the GSI MTG 3000 coupled with the AFHE system is reportedly based on a product level change of 0.75”. It is unclear at the facility how this level change is effected by the routine weekly purging of the level data files or such operational parameters as water draw-off. If the level change is directly tied to the starting level data for the week then the minimum detectable leak rate would be nearly 24 gal/hr over the week (0.75” level change in one week). This is relatively poor performance.

The compatibility with the existing MTG equipment is excellent although in a conversation with GSI representatives, the existing industrial PC and software (RH calc) are old and in need of upgrading. Instrument reliability was given high marks since it has not moving parts and has only one electrical connection and point of maintenance. Customer Service was also given a high rating based on availability and product documentation for GSI and the involvement of SPAWARS for the AFHE interface.

This system is currently installed and the upgrades could be performed on both the ATG and the AFHE software that could improve the overall capabilities of this system.

5.4 Mass Technology Corporation MTPMMS

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	4	5	1	3	2	2

Mass Technology Corporation MTPMMS has received third party certification for bulk UST leak detection from Ken Wilcox Associates in accordance with U.S. EPA protocols and is listed on the NWGLDE. Modification to the test equipment is necessary to deal with the greater pressures associated with testing these deeper than usual USTs and therefore it is somewhat questionable as to whether the third party certification is completely valid. Since the theories and technologies used are still the same as the initially certified system it is Bakers opinion that the third party remains valid even given this change of component and therefore a score of 4 was assigned. To achieve a score of 5 and certainly before the Government were to implement this technology as a primary form of leak detection it would be recommended that the upgraded system be third party evaluated specifically for the Red Hill site.

As part of this Market Survey Baker and MTC performed a Pilot Test of this modified system on two if the Red Hill USTs in February 2008. The results of this test were that no leaks above the minimum detectable leak rate of 0.5 gal/hr were noted on Tank 9 for a 10 day test or tank 15 for a

5 day test. The test reports and supporting Baker Trip Report for the MTC testing of tanks 9 and 15 are included in Appendix B.

The Mass Technology and MTG/AFHE equipment are not compatible. However, if a permanent MTC system were to be installed at Red Hill the existing data transfer system (fiber optics) could be utilized gaining them minimum score in this category. The reliability of Mass Technology is good due to the non-intrusive, non-hazardous safe operation. The test is not dependant on temperature and requires a short stabilization time. Customer support has been very responsive to DESC on their Centrally Managed Integrity Testing Program. System installation is given a top rating due to the single point of entry and easy retrieval. No tank cleaning is required for test equipment installation.

5.5 Varec Leak Manager Software and Enraf 854 ATG

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	3	3	1	2	2	0

Enraf B.V is the supplier of the high precision instrumentation and software for bulk storage operations, but does not provide leak detection software. The Enraf instrumentation can be used as the data input necessary for third party certified software to obtain leak detection. The Varec Leak Manager is PC-based software used to process probe data. This combination was recently evaluated on standard cut/cover USTs to become a third party certified leak detection system. This third party certification is valid only to tanks of 2.1 million gallons and therefore is not applicable to the unique USTs at the Red Hill site. It is possible that further testing could be perform to get this system certified on these unique tanks to get a validated, third party certified leak rate. This outstanding question results in a reduced score in the first two categories being evaluated.

While there is no apparent way to integrate the ENRAF/Varec system with the MTG/AFHE it would be possible to utilize the existing data transfer (fiber optic) system to get data the Pearl Harbor FISC control center. This gives them a score of 1 for this category. Both Enraf and Varec are known and utilized by the Department of Defense in gauging and leak detection capacities and therefore this system receives favorable scores in customer support.

Although historically systems produced by these companies are reliable the actual Instrument Reliability for such a new technology is not known and therefore receives a reduced score. Installation of most any ATG system in these USTs is problematic and may even require the emptying and cleaning of the tanks and therefore a minimal score is given for this type of application.

5.6 hydroGEOPHYSICS HRR-LDM

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	0	2	1	3	2	1

This technology was performance tested at the Hanford Site, WA but has not received an independent third party certification and cannot provide precise leak rate sensitivity. Due to the fact that the technology is ex-situ, compatibility with the existing MTG is non-existent. Their reliability and support was given a high score since they have been performance tested at the Hanford Site. hydroGEOPHYSICS is familiar with the Red Hill facility and has submitted proposals for installation of a High Resolution Resistivity-Leak Detection and Monitoring (HRR-LDM) at Red Hill in 2004.

While there is no apparent way to integrate a hydroGeophysics system with the MTG/AFHE it would be possible to utilize the existing data transfer (fiber optic) system to get data the Pearl Harbor FISC control center. This gives them a score of 1 for this category.

Ex-situ installation of any system in the Red Hill area would most likely be very problematic, but since it does not involve emptying the USTs it receives a moderate score in the System Installation category. The installation of the system electrodes will also depend on electrical interference with normal facility operations.

5.7 Gauging System Inc. MTG 3012 with Stand alone Leak Detection

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation
Weight	5	5	2	3	2	2
Score	3	3	1	2	2	0

The GSI MTG 3012 is a next generation ATG system with stand alone leak detection system capability. Gauging Systems Inc has tested and developed several improvements to the algorithms, sensor housings, transducers, transmitter cards and the system programs (RH calc) since the existing MTG 3000 installation.

Since increased resolution and stability would be required of the existing MTG-TGI sensor array readouts and data transfer system, as well as high resolution level measurement, appropriate analytical software and a user interface for a certifiable leak detection system this essentially is a new installation of an ATG system similar to what is currently installed (albeit with stand alone leak detection capability). As stated previously the installation of any improved ATG probes is difficult leading to a minimal score in the installation category.

The MTG™ 3012 (tank gauge) is third party certified for leak detection (Mass sensitivity) by IOML (International Organization of Legal Metrology) R-125 for "Measuring systems for the mass of liquids in storage tanks".[3] The leak rate sensitivity has been tested to 0.9 gph over a 24 hour period and 0.49 gph over a 72 hour period, but without following the U.S. EPA regulatory

[3] *MTG™ 3012 "Multi-function Tank Gauge,* http://www.gaugingsystemsinc.com/article.cfm?id=100

performance standards nor in tanks the depth of the Red Hill USTs. This gains them a moderate score in the categories of leak rate sensitivity and third party certification.

Instrument reliability was given high marks since it has not moving parts and has only one electrical connection and point of maintenance. Customer Service was also given a high rating based on availability and product documentation.

5.8 Evaluation of Comparative Costs

This Market Survey has focused on the technical merits of the individual systems to gauge the relative potential for successful implementation of a leak detection system. It is however important to also discuss the relative costs of these systems. This will aid in selecting which systems to consider for further evaluation.

It should be noted that possibly the most significant factor in the cost to install leak detection systems on these USTs comes in the emptying and cleaning costs. Some of the solutions presented are some form of ATG that would require construction inside the tanks. Obviously in order to do this the tanks need to be emptied, cleaned and made safe for worker entry. In addition any of the gauging systems would have to consider the coordination of existing structures within the tank such as ladders/elevators, stilling wells, etc. Any system requiring this type of installation will be judged as being a relatively high cost for implementation.

Generally the cost for implementing these leak detection systems falls into the following categories:

Low:

- MTC MTPMMS: This system has a relatively low construction cost to implement. Since the probe system is flexible it can be lowered to the bottom of the USTs from the gauging port on top of the tank. This means that there is no requirement to empty or clean the tank to install equipment. There also does not appear to be significant issues of coordination with the existing structures within the tanks. This ease of installation was verified during the Pilot Testing of this system when testing of two USTs was completed with virtually no installation effort short of opening the gauge port and lowering the flexible probe system to the bottom of the tanks. Retrieval of the probes proved equally unremarkable.

- Asteroid's Comet Software with existing ATG. This is basically just utilizing the existing ATG data with a new and potentially off-site leak detection software package with no significant construction. It would only entail software and is therefore relative low in cost to implement.

- Gauging System Inc. MTG 3000 and AFHE (existing system with modifications to AFHE software). This is basically upgrading or modifying the AFHE software to evaluate the level data provided by the existing ATG. No in tank construction would be required and therefore the relative cost would be low.

Medium:

- hydroGEOPHYISICS HRR-LDM. This solution would entail installation of ex-situ probes around the tanks at Red Hill. This could be significantly challenging given the location, but probably not as expensive as any of the solutions requiring the cleaning of the tanks.

High:

- Vista Leak Detection, Inc LRDP-24-RH. This solution requires the tanks to be emptied and cleaned for construction of in tank probes and sensors. This results in a relatively high cost for installation. Vista has provided a "order of magnitude cost" of $150,000 per tank for the installation of this system beyond the cost to clean and empty the tanks.

- Varec Leak Manager and Enraf 854 ATG. This solution also most likely requires the tank to be emptied and cleaned to perform construction inside the tank. This results in a relatively high cost for installation.

- Gauging System Inc. MTG 3012. This solution also most likely requires the tank to be emptied and cleaned to perform construction inside the tank. This results in a relatively high cost for installation.

5.8.1 Detailed Cost Estimating

The focus of this Market Survey was to research leak detection systems that have potential to operate successfully in the unique situation of the Bulk USTs at Red Hill. To fully implement such a complex project will require more in depth study and design. It is therefore impossible at this time to develop detailed cost estimates since no preliminary engineering designs exist for any of these leak detection system solutions.

It is recommended that as a next step to implementing a leak detection solution a detailed feasibility study is performed on the solutions identified in this Market Survey that show a potential for success. The focus of the feasibility study would be to identify and research specific design solutions, develop preliminary engineering design documentation (including cost estimates) that can give the government a realistic look at the required funding necessary to implement a solution.

6 Decision Matrix

Table 6-1 Decision Matrix

	3rd party certification	Leak Rate sensitivity	Compatibility with MTG/AFHE	Instrument Reliability	Customer Support	System Installation	**Total**
Weight	5	5	2	3	2	2	19 max.
Asteroid Scientific Comet Software with existing ATG (relative cost – Low)	0	3	1	1	0	2	7
Vista Leak Detection, Inc LRDP-24-RH (relative cost – High)	5	5	1	3	1	0	15
Gauging System Inc. MTG 3000 and AFHE (existing system with modifications to AFHE) (relative cost – Low)	1	2	2	3	2	2	12
Mass Technology Corporation MTPMMS (relative cost – Low)	4	5	1	3	2	2	17
Varec Leak Manager & Enraf 854 ATG (relative cost – High)	3	3	1	2	2	0	11
hydroGEOPHYISICS HRRLDM (relative cost – Medium)	0	2	1	3	2	1	9
Gauging System Inc. MTG 3012 (relative cost – High)	3	3	1	2	2	0	12

7 Conclusions

Baker has researched and evaluated potential leak detection system technologies for use at the Red Hill Fuel Storage Complex at FISC Pearl Harbor, HI. Available information was used to assemble a decision matrix as shown in Table 6-1. To help summarize the results of that evaluation the systems are ranked and disused in Table 7-1.

Table 7-1 Potential Technologies Rankings				
Ranking (Best to worst)	Vendor	System	Decision Matrix Score	Comments
1	Mass Technology Corporation	MTPMMS	17	Pilot testing performed at Red Hill achieved a point in time test to a reported minimum detectable leak rate of 0.5 gal/hr. Formal Third Party evaluation should be done to document Pilot Testing results of minimum detectable leak rate if technology is selected. Testing can be done as either point in time or permanently installed. Simple installation that does not require tank to be emptied. Relative cost is Low
2	Vista Leak Detection, Inc	LRDP-24-RH	15	Third Party certified to 0.59 gal/hr. Testing can be done as either point in time or permanently installed. Significant construction challenges to install reference tube (for either permanent or point in time testing). Tank must be emptied and cleaned for worker entry. Coordination with existing structures within the tanks (stilling wells, ladders, elevator systems) must be considered and adds to the cost. Relative cost is High

Table 7-1 Potential Technologies Rankings				
Ranking (Best to worst)	Vendor	System	Decision Matrix Score	Comments
3	Gauging System Inc.	MTG 3000 and AFHE (existing system with modifications to AFHE)	12	Existing ATG and AFHE Control System Currently performs inventory control and gross leak detection. Potential exists to modify AFHE system to obtain better leak detection results. Additional research and coordination with SPAWAR required to assess feasibility of approach and identify theoretical minimum detectable leak rate Formal Third Party evaluation should be done to document results of minimum detectable leak rate if technology is selected for Red Hill. Relative cost is low

Table 7-1 Potential Technologies Rankings				
Ranking (Best to worst)	Vendor	System	Decision Matrix Score	Comments
4	Gauging System Inc.	MTG 3012 (stand alone)	12	A new ATG system with stand alone leak detection capabilities Next generation of ATG currently used at Red Hill Significant construction challenges if new sensors are needed Tank must be emptied and cleaned for worker entry. Coordination with existing structures within the tanks (stilling wells, ladders, elevator systems) must be considered and adds to the cost. Relative cost is High

Table 7-1 Potential Technologies Rankings				
Ranking (Best to worst)	Vendor	System	Decision Matrix Score	Comments
5	Varec, Inc.	Leak Manager & Enraf 854 ATG	11	Draft Third party evaluation listing for NWGLDE available. System not certified for tanks larger than 2.1 million gallons. Theoretical results expected from Third Party Evaluation may differ from actual results in the field due to size of USTs at Red Hill. Formal Third Party evaluation should be done to document results of minimum detectable leak rate if technology is selected for Red Hill. Significant construction challenges to install equipment inside the tanks. Tank must be emptied and cleaned for worker entry. Coordination with existing structures within the tanks (stilling wells, ladders, elevator systems) must be considered and adds to the cost. Relative cost is High

Table 7-1 Potential Technologies Rankings				
Ranking (Best to worst)	Vendor	System	Decision Matrix Score	Comments
6	hydroGEOPHYISICS	HRRLDM	9	Not currently used for POL system leak detection Unknown theoretical detection limit Not currently third party evaluated for POL leak detection in any circumstance let alone Red Hill. Ex-Situ installation may be difficult at Red Hill. Formal Third Party evaluation should be done to document results of minimum detectable leak rate if technology is selected for Red Hill. Relative cost is Medium
7	Asteroid Scientific	Comet Software with existing ATG	7	Software analytical tool used with ATG. ATG data can be sent off-site for analysis Limited applicability Relative cost is low

As can be seen in the summary of Table 7-1 the results of this Market Survey have identified seven potential candidates for use as leak detection at Red Hill. The seven can generally be grouped as follows:

- The two highest ranked candidate technologies are both routinely used by the DOD and private industry for Integrity Testing of bulk storage tanks. While both are third party certified only Vista's LRDP-24-RH has been third party certified on the Red Hill Tanks. While the third party listing of the NWGLDE that govern the use of MTC's MTPMMS is still valid (no upper limit on capacity listed) and the theories and analysis remains the same the equipment has been slightly modified to deal with the higher pressures than normally experienced during this type of testing. It is Baker's opinion that while the system still produces a valid test, third party certification of this modified method should be performed specifically for Red Hill.

- The MTC MTPMMS system is better suited for use at Red Hill mainly due to the construction challenges faced by utilizing the Vista LRDP-24-RH method (clean and empty the tank to install equipment).

- Either MTC or Vista systems can be installed permanently and test run nearly continuously by either the operators or contractors.

- The middle three ranked systems all resulted in nearly the same scores. They are all some form of traditional ATG system with analytical software to detect leaks. One relies on adjusting the existing AFHE system (which may or may not be practical) to make use of the existing ATG and the other two are newer variations of existing systems used in the industry.

- The use of the hydroGEOPHYISICS system seems unwarranted at this time due to the lack of this system in similar uses in industry.

- The lowest ranked system, the Asteroid Scientific Comet system, is analytical software required to be tied to a form of ATG. The use of another form of software with the existing ATG does not appear as attractive as other options considered. Use of the off site post operation analysis to confirm a suspected leak is attractive, but not a primary leak detection method.

It should be noted that the uniqueness of the USTs at Red Hill leads to a significant challenge in selecting appropriate leak detection. The fact that there really are no other USTs comparable to these leads to a total lack of focus by industry to solve such a leak detection system problem. This phenomenon and its relevance to the situation at Red Hill can be summarized as follows:

- No similarly large USTs exist elsewhere in the world so industry has not focused its attention to the problem of leak detection for such tanks. There just are not enough of them to warrant the cost of developing a certified solution.

- Even the leak detection systems that have been developed for large USTs or cut/cover tanks and have undergone formal third party evaluations to prove that their technology works often have their certification limited by an maximum tank size, usually the size of the tank that the evaluation was performed on. The test is most often done on the largest tank that is available to the tester and evaluator and these are typically drastically smaller in size than the Red Hill USTs.

- Conversely several of the methods that are third party certified with no upper limits to the method could in fact be significantly challenged by such large USTs. It was probably just never a consideration that such tanks existed and needed to be tested and therefore no upper level cap was deemed necessary

- While several of the systems evaluated for this Market Survey have their third party certification limited by a maximum tank size it is possible that they in fact could work on the Red Hill USTs. Only site specific evaluation would determine this conclusively.

8 Recommendations

Based on the Market Survey and evaluation of the systems it is Baker’s opinion that the Mass Technology Corporation’s MTPMMS system would be the best option as a primary leak detection solution for Red Hill. In addition Baker recommends that MTC Perform Point in time testing as soon as practical with a formal third party evaluation to conclusively identify the minimum detectable leak rate for this system in these USTS.

If the government chooses to go forward with any of the solutions identified in this Market Survey (other than point in time MTC MTPMMS testing) the next prudent step would be to perform a feasibility study. The focus of the feasibility study would be to identify and research specific design solutions, develop preliminary engineering design documentation (including cost estimates) that can give the government a realistic look at the required funding necessary to implement a solution.

9 Figures

Figure 9-1

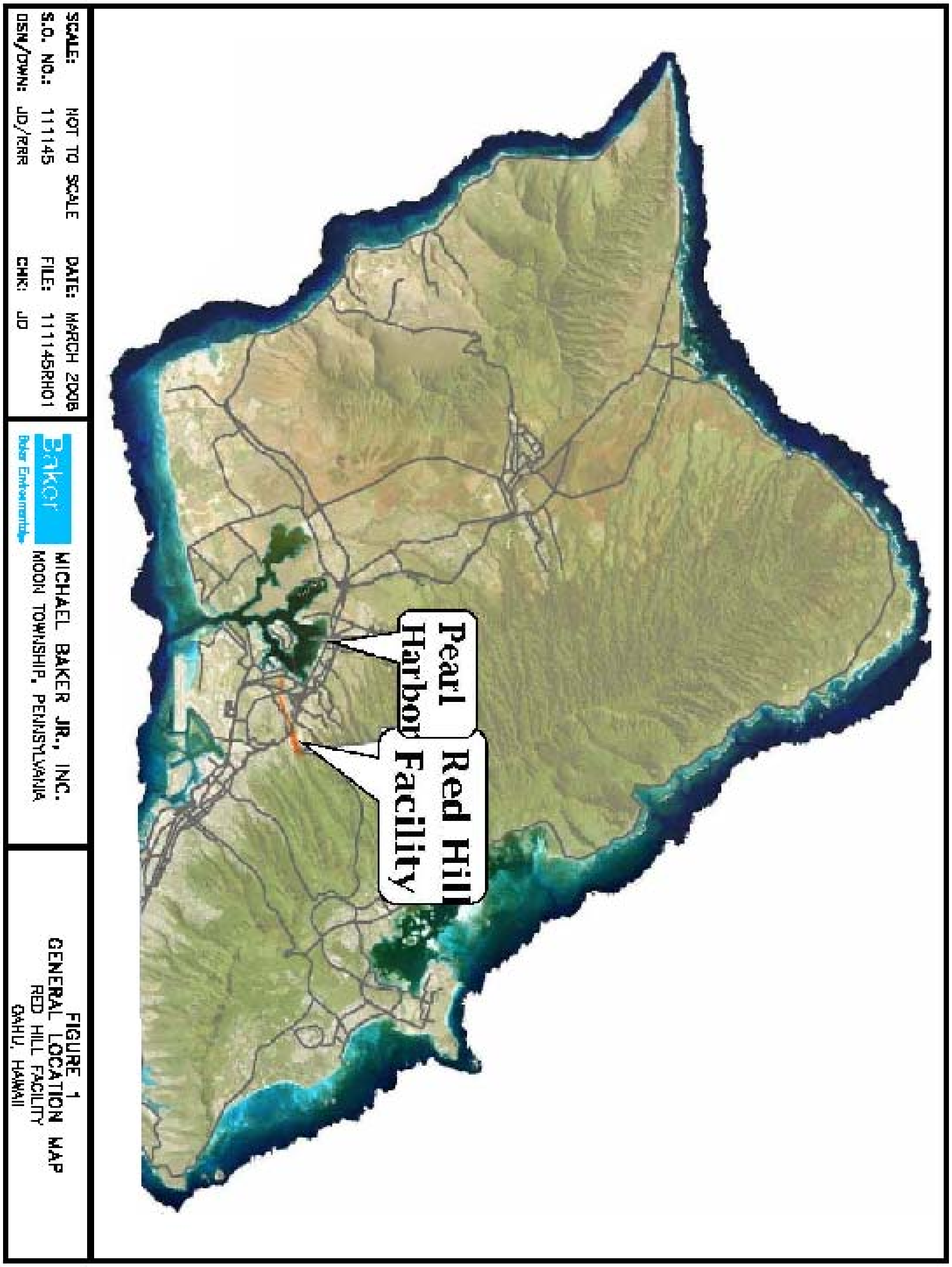
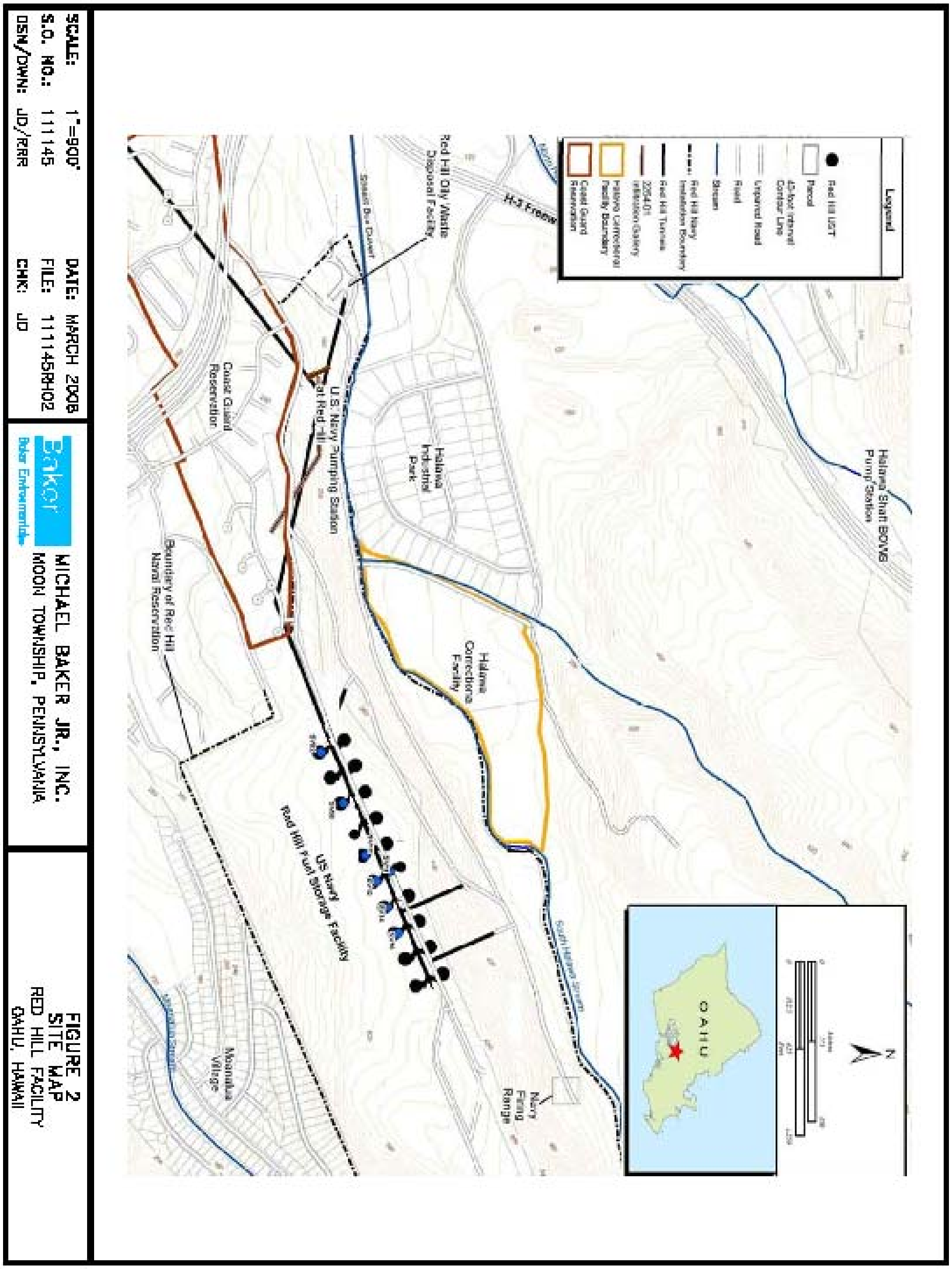

Pearl Harbor
Red Hill Facility
SCALE: NOT TO SCALE
S.O. NO.: 111145
DSN/DWN: JD/RRR
DATE: MARCH 2006
FILE: 111145RH01
CHK: JD
Baker
MICHAEL BAKER JR., INC.
MOON TOWNSHIP, PENNSYLVANIA
FIGURE 1
GENERAL LOCATION MAP
RED HILL FACILITY
OAHU, HAWAII

Figure 9-2


SCALE: 1"=900'
S.O. NO.: 111145
DSN/DWN: JD/RRR
DATE: MARCH 2008
FILE: 111145RH02
CHK: JD
Baker
MICHAEL BAKER JR., INC.
MOON TOWNSHIP, PENNSYLVANIA
FIGURE 2
SITE MAP
RED HILL FACILITY
OAHU, HAWAII
Legend
Red Hill UST
Parcel
Road
Stream
Red Hill Tunnels
Halawa Shaft BOWS Pump Station
H-3 Freew
Red Hill City Waste Disposal Facility
Halawa Industrial Park
U.S. Navy Pumping Station at Red Hill
Coast Guard Reservation
Boundary of Red Hill Naval Reservation
Halawa Correctional Facility
US Navy Red Hill Fuel Storage Facility
South Halawa Stream
Navy Firing Range
Moanalua Village
OAHU
N

Appendix A

Vista Leak Detection
LRDP-24-RH
Third Party Evaluation

Addendum to the Evaluation of the LRDP-24 and the LRDP-24-n on Bulk Field-Constructed Tanks

Final Report

PREPARED FOR:

Naval Facilities Engineering Service Center and Vista Research, Inc.

August 28, 2001

KWA

Ken Wilcox Associates, Inc.
1125 Valley Ridge Drive, Grain Valley, MO 64029, USA
Voice (816) 443-2494, Fax (816) 443-2495
E-mail info@kwaleak.com, Web http://www.kwaleak.com

Addendum to the Evaluation of the LRDP-24 and the LRDP-24-n on Bulk Field-Constructed Tanks

Final Report

PREPARED FOR:

Naval Facilities Engineering Service Center
1100 23rd Avenue
Port Hueneme, CA 93043-4370

Vista Research, Inc.
755 North Mary Avenue
Sunnyvale, CA 94085

August 28, 2001

Preface

This report describes a third independent evaluation of the LRDP-24 and the LRDP-24-n as leak detection systems for bulk field-constructed tanks. This evaluation was conducted to determine the performance of these two LRDP methods for use in the 12,500,000-gal underground storage tanks (USTs) located at the Red Hill Underground Fuel Storage Facility. This report is an addendum to previous evaluation reports for the LRDP-24 and the LRDP-24-n and should be used in conjunction with them. .[1, 2, 3, 4] This report is considered an addendum, because it applies only to these bulk Red Hill tanks. Modifications to the standard evaluation protocol [5] were made to accommodate the requirements of testing a tank with such a large volume and with curved walls. These tanks, which typically store product at intervals of approximately 9 months without a fuel transfer, require testing during this period. As a consequence, only one fuel transfer (or delivery) was included in the evaluation.

Testing was conducted at the Fleet & Industrial Supply Center, Pearl Harbor (FISCPH) in Honolulu, Hawaii in June and July 2001. The test tank was a nominal 12,500,000-gallon tank that was 250- ft high, 100-ft in diameter, with a 50-ft high dome at the top and the bottom and a 150-ft straight section in the middle. Earlier evaluations of the LRDP-24 were conducted on tanks with volumes of 600,000-gallons and 2,100,0000- gallons with respective diameters of 88-ft and 122.5-ft. The leak simulations, data collection, data analysis, and reporting were conducted by Ken Wilcox Associates, Inc.

This report was prepared by Mr. Jeffrey K. Wilcox and Dr. H. Kendall Wilcox. Technical Questions regarding this evaluation should be directed to Ms. Leslie A. Karr, NFESC at (805) 982? 1618 and Dr. Joseph W. Maresca, Jr., Vista Research, Inc., at (408) 830-3306.

KEN WILCOX ASSOCIATES, INC.

Jeffrey K. Wilcox

Jeffery K. Wilcox

Approved:

H. Kendall Wilcox

H. Kendall Wilcox, President
August 28, 2001

[1] Evaluation Update of the LRDP-24 on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., December 4, 2000.
[2] Evaluation Update of the LRDP-24-n on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., December 4, 2000.
[3] Evaluation of the LRDP-24 on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., January 29,1998.
[4] Evaluation of the LRDP-24-5 on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., January 29, 1998.
[5] Alternative Test Procedures for Evaluating Leak Detection Methods: Mass-based and Volumetric Leak Detection Systems for Bulk Field-constructed Tanks", Ken Wilcox Associates, Inc., November 2000.

Table of Contents

1.0 Introduction

This report describes an independent evaluation of the LRDP-24 and LRDP-24-n for use in the 12,500,000-gal, bulk underground storage tanks (USTs) located at the Red Hill Underground Fuel Storage Facility, Honolulu, Hawaii. These LRDP systems were developed by the Naval Facilities Engineering Service Center (NFESC) and Vista Research, Inc., to conduct leak-detection tests on bulk field-constructed tanks and are currently included on the 8th Edition list of methods of the National Work Group on Leak Detection Evaluations that have been evaluated acceptably. The evaluation was conducted because the top and bottom sections of these Red Hill tanks have curved walls. Twelve tests were conducted in June and July 2001 with nominal leak rates ranging from 1 to 4 gal/h. A modified version of the bulk tank protocol[1] was used for the evaluation. The calculations and results contained in this report use the procedures described in the bulk tank protocol. Users of the LRDP equipment should, however, use this report in conjunction with earlier evaluation reports.[2,3,4 5]

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[1] Alternative Test Procedures for Evaluating Leak Detection Methods: Mass-based and Volumetric Leak Detection Systems for Bulk Field-constructed Tanks", November 2000.

[2] Evaluation Update of the LRDP-24 on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., December 4, 2000.

[3] Evaluation Update of the LRDP-24-n on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., December 4, 2000.

[4] Evaluation of the LRDP-24 on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., January 29, 1998.

[5] Evaluation of the LRDP-24-5 on Bulk Field-Constructed Tanks, Final Report, Prepared for Naval Facilities Engineering Service Center and Vista Research, Inc., January 29, 1998.

2.0 Description of the Test Tank

Testing was done in Honolulu, Hawaii at the Fleet & Industrial Supply Center, Pearl Harbor (FISCPH) in Tank No. 9 of the Red Hill Underground Fuel Storage Facility. Tank No. 9 has a nominal volume of 12,500,000 gallons and is 250 ft high, 100 ft in diameter, with a 50-ft high dome at the top and the bottom and a 150 ft straight section in the middle. Tank No. 9 has 2-ft thick vertical concrete walls lined with welded steel plate. Testing was done at 226.551 ft, which has a volume of 12,153,944 gallons. The tank contained JP-5 fuel during the evaluation.

Openings in the tank were available for the LRDP system equipment and for the KWA leak simulation equipment. The test tank was made available to KWA staff 24 hours a day for the duration of the evaluation. KWA staff was present for the duration of the evaluation and defined the testing schedule of the evaluation.

3.0 Description of the LRDP-24 and the LRDP-24-n Systems

A description of the LRDP-24 that was provided by NFESC and Vista Research follows:

The Low Range Differential Pressure (LRDP) system is a mass-based system for testing bulk tanks for leaks. The system fully compensates for both thermally induced fuel level changes and for evaporation and condensation. The system is specifically configured to significantly improve the precision of the pressure measurements and to reduce the thermal drift of the pressure transducer. Thus, an off-the-shelf, industrial grade differential pressure sensor can be used in the system.

The key component of the LRDP system is a vertical reference tube that spans the full usable height of the tank. The middle 150 ft of the reference tube has a constant diameter. The top and bottom 50 ft of the reference tube is shaped to match the geometry of the upper and lower domes of the tank. The fuel in the tank is allowed to enter or leave the reference tube through a valve located at the bottom of the tube. When the tank is to be tested for the possibility of a leak, the valve is closed, isolating the fuel in the tube from the fuel in the tank. With the exception of a level change due to a leak, the level of the fuel in the reference tube mimics the level of the fuel in the tank. The differential pressure sensor, which is placed in a sealed container at the bottom of the tube (and tank), is used to detect very small level (pressure) changes between the fuel in the tube and the fuel in the tank. Thus, when the valve is closed, the differential pressure sensor directly senses and quantifies the fuel level changes due to a leak, if a leak is present.

An industrial grade differential pressure sensor can be used in the system, because the measurement configuration only requires measurements to be made over a height range of ±0.5 inches and not over the entire height of the tank. As used in the evaluation, this configuration increased the precision of the differential pressure sensor by a factor of 300 over a system that did not use a reference tube. Thermally induced drift of the pressure sensor is avoided, because it is housed at the bottom of the tank and is not subject to ambient air conditions. The performance of the LRDP system can be easily verified any time the valve is in the open position, because the differential level (pressure) changes are known to be zero.

The test duration of the LRDP system will depend on the tank size and the desired performance. The LRDP-24 uses a test duration of 24 hours. The LRDP-24-n averages up to n (for n<12) separate 24-h tests with the LRDP-24 before applying the threshold. The system was operated as a stand-alone system with the leak rates reported automatically at the conclusion of the testing.

4.0 Leak Simulation Equipment

The leak simulation procedures used in the evaluation were those described in the bulk tank protocol, which are identical to those described in the standard EPA protocols for ATG and volumetric systems.

Leak simulations were conducted at the bottom of the tank by removing fuel from the tank through one of the sample valves. The pressure at the bottom of the tank was approximately 75 psi. One end of the hose was connected to the sample valve and the other to a flow meter equipped with a needle valve to control the flow rate. The flow rate was measured volumetrically at the beginning of the test and again at the end. The flow rate could be visually monitored with the flow meter at any time. Because of the extremely stable ambient conditions in the tunnel, the flow rate was very stable and exhibited almost no drift over the test period.

5.0 Description of the Evaluation Procedures

Tables 1 and 2 summarize the test conditions and the leak rate data that were present during the evaluation. NFESC and Vista Research installed the LRDP system in the test tank in its normal configuration. Testing was carried out using the manufacturer's normal test routine. Leak simulations were induced at the bottom of the tank through one of the sample ports. The leak rate reported by the LRDP-24 was compared to the actual induced leak rate. A statistical analysis of the data was used to determine the performance characteristics of the test method.

A total of 12 tests were conducted with the LRDP-24. Product deliveries were not made during the evaluation because of the size and typical operational use of the test tank. Testing was done at 226.551 ft, which has a volume of 12,153,944 gallons. Test times were 24 hours for each of the 12 tests. Leak simulations were controlled and monitored by KWA throughout the duration of the testing.

Table 1. Testing Conditions

Test No.	Date at Completion Of Last Fill (m/d/y)	Time at Completion Of Last Fill (hhmm)	Wait Time (hours)	Product Level (%)	Product Temperature Differential (Deg F)	Date Test Began (m/d/y)	Time Test Began (m/d/y)	Date Test Ended (m/d/y)	Time Test Ended (m/d/y)	Test Time (hours)
1	N/A	N/A	N/A	97%	N/A	06/27/01	1040	06/28/01	1040	24.0
2	N/A	N/A	N/A	97%	N/A	06/28/01	1040	06/29/01	1040	24.0
3	N/A	N/A	N/A	97%	N/A	06/29/01	1252	06/30/01	1252	24.0
4	N/A	N/A	N/A	97%	N/A	06/30/01	1505	07/01/01	1505	24.0
5	N/A	N/A	N/A	97%	N/A	07/01/01	1640	07/02/01	1252	20.2
6	N/A	N/A	N/A	97%	N/A	07/03/01	0930	07/04/01	0930	24.0
7	N/A	N/A	N/A	97%	N/A	07/04/01	1015	07/05/01	1015	24.0
8	N/A	N/A	N/A	97%	N/A	07/05/01	1050	07/06/01	1050	24.0
9	N/A	N/A	N/A	97%	N/A	07/06/01	1125	07/07/01	1125	24.0
10	N/A	N/A	N/A	97%	N/A	07/07/01	1200	07/08/01	1200	24.0
11	N/A	N/A	N/A	97%	N/A	07/08/01	1220	07/09/01	1220	24.0
12	N/A	N/A	N/A	97%	N/A	07/09/01	1220	07/10/01	1220	24.0

Table 2. Leak Rate Data

Test No.	Wait Time (hours)	Product Level (%)	Product Temperature Differential (deg F)	Nominal Leak Rate (gal/h)	Induced Leak Rate (gal/h)	Measured Leak Rate (gal/h)	Meas.-Ind. Leak Rate (gal/h)	Product Temperature Start of Test (deg F)	Product Temperature End of Test (deg F)	Temperature Change (deg F)
1	N/A	95%	N/A	3.0	2.690	2.535	-0.155	83.9	83.9	0.00
2	N/A	95%	N/A	3.0	2.710	2.639	-0.071	83.9	83.9	0.00
3	N/A	95%	N/A	0.0	0.000	0.058	0.058	83.9	83.9	0.00
4	N/A	95%	N/A	1.0	1.170	0.800	-0.370	83.9	83.9	0.00
5	N/A	95%	N/A	2.0	2.145	2.007	-0.138	83.9	83.9	0.00
6	N/A	95%	N/A	0.0	0.000	0.144	0.144	83.9	83.9	0.00
7	N/A	95%	N/A	3.0	3.080	3.205	0.125	83.9	83.9	0.00
8	N/A	95%	N/A	4.0	4.040	3.763	-0.277	83.8	83.8	0.00
9	N/A	95%	N/A	1.0	1.691	1.549	-0.142	83.8	83.8	0.00
10	N/A	95%	N/A	3.0	3.300	3.349	0.049	83.8	83.8	0.00
11	N/A	95%	N/A	2.0	2.430	2.210	-0.220	83.8	83.8	0.00
12	N/A	95%	N/A	0.0	0.000	0.017	0.017	83.8	83.8	0.00

6.0 Calculations

This section describes the procedures for calculating the results contained in Section 7.0. The procedures were taken from the bulk tank protocol.

6.1 Calculation of Probability of False Alarm (P_{FA}), Probability of Detection (P_D), and Minimum Detectable Leak (MDL)

All of the statistical calculations described in the standard EPA test protocol for volumetric systems apply to evaluations conducted on large bulk tanks. The threshold and MDL to obtain a probability of detection (P_D) of 95% and probability of false alarm (P_{FA}) of 5% are to be reported for the evaluation. Procedures for determining the P_D, P_{FA}, and MDL are contained in the standard EPA test protocol for volumetric systems[1] and are summarized below.

From the differences between the leak rates reported by the system, L_i, and the induced leak rates, IL_i,

$$D_i = L_i - IL_i. \tag{6-1}$$

The bias is estimated by the mean of the differences:

$$B = \Sigma\, D_i/N, \tag{6-2}$$

where N is the number of tests (usually 12) in the evaluation and the summation is over all differences. The variance of the differences is found using the formula

$$V = \Sigma\, (D_i - B)^2/(N - 1). \tag{6-3}$$

The standard deviation, S, is the square root of the variance. A test of whether the bias is zero is based on the statistic

$$t = (N)^{1/2}\, B/S, \tag{6-4}$$

which is compared to the two-sided value from a t-distribution with N-1 degrees of freedom. For N=12, the appropriate value from the t-table is 2.201. If the absolute value of t is less than the value from the t-table, then B is negligible. This means that zero is substituted for B in the following equations.

---

[1] Standard Test Procedures for Evaluating Leak Detection methods: Volumetric Tank Tightness Testing Methods", pages 28-33 describe procedures for calculating the P_D, P_{FA}, and MDL.

Probability of False Alarm

The probability of a false alarm, P_{FA}, is the probability that the measured leak rate will exceed the threshold for declaring a leak when the testing is done on a tight tank. If C denotes the threshold, then the probability of a false alarm is estimated from

$$P_{FA} = P\,[t > (C - B)/S]. \qquad (6\text{-}5)$$

This probability is calculated by computing the term (C – B)/S using the specified threshold C and the bias, B, and standard deviation, S, computed from the test results. The result is used with a t-distribution with 11 degrees of freedom. A table of the t-distribution is used to find the probability that a t-statistic with 11 degrees of freedom exceeds the computed value.

Probability of Detection

The probability of detecting a leak depends on the specific leak rate. For a leak rate of size R, the probability of detection, P_D, is given by

$$P_D = P\,[t > (C - R - B)/S]. \qquad (6\text{-}6)$$

In the formula, the threshold, C, is specified as before, the leak rate for which the P_D is calculated is R, and B and S are calculated from the test data as before. The term (C - R - B)/S is computed. A t-distribution with 11 degrees of freedom is used to look up the probability that a t-statistic exceeds the calculated value.

Setting the Threshold

The threshold, C, may be set to give a specified probability of false alarm. For example, if a P_{FA} of 5% is desired, use the t-table to determine that the probability is 5% that a t-statistic with 11 degrees of freedom will exceed 1.796. To choose C, set

$$(C - B)/S = 1.796 \qquad (6\text{-}7)$$

and solve for C to get

$$C = (1.796)(S) + B \qquad (6\text{-}8)$$

which reduces to

$$C = (1.796)(S) \qquad (6\text{-}9)$$

if B is zero.

Here B and S have been calculated from the test data.

Finding the Minimum Detectable Leak Rate.
For a specified threshold C, the smallest leak rate that can be detected with a specified probability, e.g. 95%, can be determined as the minimum detectable leak rate, MDL. This is accomplished by using a t-table to find the probability that a t-statistic with 11 degrees of freedom will exceed –1.796. Set

$$(C - R - B)/S = -1.796 \tag{6-10}$$

The value of R that solves the above equation is the MDL for the threshold C.

$$MDL = C - B + 1.796\ (S) \tag{6-11}$$

The value of R that satisfies the previous equation using the threshold for a 5% P_{FA} is the MDL for a 5% P_{FA} and a 95% P_D. This is the smallest leak rate that is detectable with 95% probability using the threshold C. Note if the bias is not statistically significantly different from zero it is taken to be zero.

Operation of the LRDP-24.
If $R \geq$ MDL, the LRDP-24 is operated to achieve a P_D = 95% and a $P_{FA} \leq 5\%$. The threshold, C, of the LRDP-24 is given by

$$C = R - 1.796\ (S) + B \tag{6-12}$$

which reduces to

$$C = R - 1.796\ (S) \tag{6-13}$$

if B is zero. The P_{FA} for C and S is given by Eq. (6-5). As an example, if R = 1.0 gal/h and S = 0.163 gal/h, then C = 0.707 gal/h for B = 0, and the P_{FA} = 0.059%, which is reported as $P_{FA} < 1\%$.

6.2 Averaging of Test Results

The performance of a leak detection system can be improved significantly by combining the results of two or more independent tests. Averaging more than one test result to achieve better performance is a recognized statistical technique. The bulk tank protocol addresses some of these statistical processes. The two most common applications of averaging is to use it (1) to detect smaller leak rates, R_n, with the same P_D and P_{FA}, or (2) to minimize the P_{FA} without changing the P_D or the specific leak rate, R, to be detected. An example is given in Section 7.2

The performance of the LRDP-24-n system, where n is the number of independent tests averaged together, is obtained using the *standard deviation of the mean* test result, S_m, of the LRDP-24 system. The standard deviation of the mean test result can be determined from the standard deviation of the single-test results, S, computed as part of the evaluation. Once the standard deviation of the mean test result is known, the performance of the mean (average) test result (in terms of P_D and P_{FA}) can be computed using the same methods as for the single test results. This is accomplished by substituting S_m for S in the above equations.

For independent tests, S_m of the LRDP-24 is obtained from S and the number of tests, n, averaged together. The standard deviation of the mean, S_m, is given by

$$S_m = S /(n)^{0.5} \qquad (6\text{-}14)$$

For the first application of averaging mentioned above, the specified leak rate R_n can be computed from R using

$$R_n = R / n^{0.5}, \qquad (6\text{-}15)$$

where R is the specified leak rate when n = 1. The threshold, C_n, used to detect this R_n is computed using

$$C_n = R_n - 1.796\,(S_m). \qquad (6\text{-}16)$$

6.3 Water Detection Mode (if applicable)

The calculations for a bulk tank water detector are identical to those described in the standard ATGS protocol. The LRDP is a mass-based system, however, and the water detection mode calculations do not apply to it.

6.4 Tank Size Limitations

For the bulk tank protocol, tank size limitations are based on surface area for mass based systems. Table 3 illustrates applying the evaluation to tanks of differing sizes.

Table 3. Tank Size Limitations

	Product Surface Area	Product Volume	Leak Rate Scaling
Scaling Limits	Maximum 2.5 X Area (No minimum) *See Note Below	50,000 gallon Minimum, No Maximum	Yes, but not below 0.2 gal/h
* Extrapolation beyond this surface area requires 6 additional tests in larger tanks using the same test procedures and parameters. The surface area limitation will then be equal to the surface area of the tank used in the confirmatory tests.			

Since no other bulk USTs have curved walls, scaling is not reported as part of this evaluation.

6.5 Rate and Threshold

The test data are used to calculate the basic statistics described in the bulk tank protocol. Once the data are available and the statistics have been calculated the following results are to be reported.

1. The standard deviation
2. The threshold for declaring a leak
3. The minimum detectable leak rate
4. The target leak rate
5. The P_{FA} and P_D for the target leak rate

The test developer is allowed to select any target leak rate and threshold as long as the results are within the specifications of the regulatory agency. In general, the results must show that the system is capable of detecting the target leak rate with a probability of detection of 95% or greater and a probability of false alarm of 5% or less. The threshold can be adjusted within these limits to either reduce the false alarm rate or improve the probability of detecting a small leak. The P_D and P_{FA} are assumed to remain constant for the purpose of scaling the results to other tank sizes.

The vendor may choose to report the test results using more than one target leak rate and threshold. Some regulatory agencies may choose to reject one or more of the calculations based on the applicable regulatory standards.

6.6 Leak Rate and Threshold Scaling

The bulk tank protocol describes procedures for scaling the leak rate and threshold to tank sizes different than the tank used in the evaluation. The standard deviation of the evaluation tank is multiplied by the ratio of the surface areas of the size of tank to which the evaluation results are to be applied. This can be expressed mathematically by the equation

$$S_2 = S_1 \times A_2/A_1 \qquad (6\text{-}17)$$

where S_1 is the population standard deviation obtained from the evaluation test data using a reference tank, S_2 is the population standard deviation to be used to predict performance on a tank of a different size, A_1 is the surface area of the evaluation reference tank, and A_2 is the surface area of the new tank.

The scaling is limited by the following restrictions.

1. The tank must be field constructed;
2. It must be a vertical wall tank;
3. The method must be based on mass measurement rather than volumetric principles;
4. The scaling is based on the product surface area rather than tank volume;

The maximum size tank that may be tested is determined by consideration of the performance of the method as measured by the standard deviation. The standard deviation is scaled up or down using equation 6-17. A new minimum leak rate for a P_D of 95% must then be calculated if the tank has a different product surface area than the evaluation tank. For example, to apply a method that has been evaluated on a tank with a surface area of 2,000 sq. ft. and a measured standard deviation of 0.5 gal/h to a tank with a surface area of 3,000 sq. ft, a new minimum detectable leak based on a standard deviation of 0.75 gal/h would be used.

The maximum tank size to which the method may be applied is limited to not more than 2.5 times the surface area of the tank used for the evaluation. A maximum value of 5% for the P_{FA} is permitted. Using 5% for P_{FA}, when the corresponding P_D reaches the limit set by the regulations, no further scaling is permitted. Scaling to smaller tanks is allowed, but scaling to target rates smaller than 0.2 gal/hr is not permitted.

When scaling the results, the appropriate standard deviation for the test tank should be used, if the results are based on a single test. If the results are based on the average of n tests, then the base standard deviation used for scaling is S_m.

Since the evaluation tank is not solely constructed with vertical walls, scaling does not apply for this evaluation.

6.7 Maximum Temperature Differences and Stabilization Times

The bulk tank protocol contains procedures for calculating the maximum difference in temperature that can be present between the product in the tank and that added to fill the tank before a valid leak test can be conducted. These procedures require that product deliveries with temperature differentials be done during the evaluation. Since there were no product deliveries done for this evaluation, these calculations cannot be done.

The bulk tank protocol also contains procedures for calculating the minimum stabilization time required to conduct a valid leak test following a product delivery. Since there were no product deliveries done for this evaluation, these calculations also cannot be done. In any case, product deliveries at the FISCPH tanks are relatively rare, and it is likely that stabilization times will be substantially long before the LRDP-24 or the LRDP-24-n conducts testing following deliveries.

6.8 Test Time

The test time is measured from the start of data collection to the end of the data collection. Test times for all tests are included in the average.

7.0 Results

7.1 Probability of False Alarm (P_{FA}), Probability of Detection (P_D), and Minimum Detectable Leak (MDL)

Basic Statistics
The basic statistics are calculated from the differences between the vendor's reported leak rate and the actual leak rate induced by KWA. Basic statistics include the variance, mean squared error, standard deviation, and bias.

Bias
Bias is the average of the differences between the reported and the actual leak rate. The vendor's analysis algorithm included removing a constant calibration value of 0.6 gal/h from the measured volume rate; this calibration constant may change from one tank to another. The bias of the evaluation test results, after calibration, was -0.082 gal/h, which is not significant.

Variance
The variance was calculated to be 0.0266 gal^2/h^2.

Standard Deviation
The variance was calculated to be 0.163 gal/h.

Mean Squared Error
The variance was calculated to be 0.0310 gal^2/h^2.

Probability of Detection (P_D) and Probability of False Alarm (P_{FA})
Table 4 below contains the P_D and P_{FA} for several threshold/leak rate combinations that were selected by the vendor.

Table 4. Summary of the P_D and P_{FA} Results

No.	Threshold (gal/h)	Leak Rate (gal/h)	P_D	P_{FA}
1	0.293	0.586	95%	5%
2	0.707	1.0	95%	<1%
3	0.877	1.17	95%	<1%
4	1.707	2.0	95%	<<1%
5	2.707	3.0	95%	<<1%

Minimum Detectable Leak Rate
The minimum detectable leak rate is 0.586 gal/h when the threshold is set at 0.293 gal/h. If the leak rate is less than 0.586 gal/h, or if a threshold other than 0.293 gal/h is used, the P_D and P_{FA} will not meet the 95/5 criteria.

7.2 Averaging of Test Results

Table 5 summarizes the leak rate, R_n, that can be detected for some of the leak rates R computed for n = 1 in Table 4.

Table 5. Illustration of the Leak Rate, Rn, that can be Detected by Averaging n Test Results Together.

Number of Averages, n	**R_n = Specified Leak Rate of the Averaged Test Result**			
	(gal/h)	(gal/h)	(gal/h)	(gal/h)
1	0.586	1.000	2.000	3.000
2	0.414	0.707	1.414	2.121
4	0.293	0.500	1.000	1.500
6	0.239	0.408	0.816	1.225
9	0.195	0.333	0.667	1.000
12	0.169*	0.289	0.577	0.866
P_D	95%	95%	95%	95%
P_{FA}	5.0%	<1%	<<1%	<<1%
C_n	$(0.586/n^{0.5})$ - $1.796*S_m$	$(1.0/n^{0.5})$ - $1.796*S_m$	$(2.0/n^{0.5})$ - $1.796*S_m$	$(3.0/n^{0.5})$ - $1.796*S_m$

* Any R_n less than 0.2 gal/h can only be used at 0.2 gal/h.

As an example, the leak rate, R_n, that can be detected by the LRDP-24-n with a P_D = 95% and a P_{FA} = 5.0% is 0.2 gal/h when n = 9 test results are averaged together. A threshold of $C_{n=9}$ = 0.098 gal/h is used.

7.3 Water Detection Mode

The LRDP system is a mass-based system, which will detect increases and decreases in mass in the tank. Water leaks into or out of the tank are detected as changes in mass and the tank operator is alerted if a problem exists. The calculations for a bulk tank water detector are identical to those described in the standard ATGS protocol. The water detection mode calculations do not apply to the LRDP system.

7.4 Tank Size Limitations

The maximum size tank that the results of this evaluation can be applied to is 2.5 times the product surface area of the evaluation tank. As stated in Section 6.6, since the evaluation tank is not solely constructed with vertical walls, scaling does not apply for this evaluation.

7.5 Rate and Threshold

NFESC and Vista Research have selected several target leak rates and thresholds to report results for in this report, which are listed in Table 6 below. The basic statistics were obtained from the test data using the calculations described in the bulk tank test protocol. The bulk tank protocol states that the following results are to be reported after the data are available and the statistics have been calculated.

Table 6. Summary of the Rates and Thresholds

No.	Standard Deviation (gal/h)	Threshold (gal/h)	Target Leak Rate (gal/h)	P_D (%)	P_{FA} (%)	Minimum Detectable Leak Rate (gal/h)
1.	0.163	0.293	0.586	95%	5%	0.586
2.	0.163	0.707	1.0	95%	<1%	N/A
3.	0.163	0.877	1.17	95%	<1%	N/A
4.	0.163	1.707	2.0	95%	<<1%	N/A
5.	0.163	2.707	3.0	95%	<<1%	N/A

7.6 Leak Rate and Threshold Scaling

The evaluation was performed for the 12,500,00-gal bulk USTs at the Red Hill Facility. No scaling is reported.

7.7 Maximum Temperature Differences and Stabilization Times

Since product deliveries were not done for this evaluation, calculations cannot be done to determine the maximum allowable temperature differences following deliveries and the required stabilization time. NFESC and Vista Research specify that a 24-hour stabilization time following a delivery should be used before conducting a valid leak detection test. Product deliveries at the FISCPH tanks are relatively rare, and it is likely that the stabilization time will be longer than 24 hours in most cases.

7.8 Test Time

The average test time was 23.7 hours. One of the 12 tests was terminated 3.7 h short, but was approved for use in the evaluation by the vendor. All of the other tests conducted for the evaluation had test times of 24 hours as specified by the vendor.

8.0 Summary of LRDP-24 and LRDP-24-n Performance Parameters and Limitations

8.1 Volume and Surface Area Limitations

This evaluation was performed specifically for the 12,500,000-gal bulk USTs found at the Red Hill Underground Fuel Storage Facility. As a consequence, no scaling is reported.

8.2 Temperature Differential and Minimum Stabilization Time Limitations

Product deliveries were not made during the evaluation and temperature differential limitations and minimum stabilization time limitations cannot therefore be specified. The vendor specifies a minimum stabilization time of 24 hours after a product delivery.

8.3 Test Duration

The average test time was 23.7 hours. The vendor specifies a test time of 24 hours.

Appendix A

EPA Results Forms

Method Name and Version: LRDP-24 Version a-rh
Date of Certification: August 28, 2001

Results of U.S. EPA Alternative Test Procedures
Bulk Field-Constructed Tank
Mass-Based Leak Detection Method

This form describes the performance of the leak detection method described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to a modification of the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Volumetric Tightness Testing Methods." The full evaluation report also includes a form describing the method and a form summarizing the test data.

Tank owners using this leak detection system should keep this form on file to provide compliance with the federal regulations. Tank owners should check with State and local agencies to make sure this form satisfies their requirements.

Leak Detection Method Description

Name LRDP-24

Version number a-rh

Vendor(s)

NFESC 1100 23rd Avenue (street address) Port Hueneme, CA 93043-4370 (city) (state) (zip) (805) 982-1618 (phone)	Vista Research, Inc. 755 North Mary Avenue (street address) Sunnyvale, CA 94085 (city) (state) (zip) (408) 830-3300 (phone)

Evaluation Results

This method ( ) does (X) does not use multiple tests. If multiple tests are used, the results are based on _____ independent tests. The results apply only when ____ tests are performed and the estimated leak rates averaged.

This Leak Detection Method which declares tank to be leaking when the measured leak rate exceeds the threshold of TLR - 0.293 gallons per hour, has a probability of false alarm [P_{FA}] of ≤ 5 % for tests conducted on tanks with a surface area [A] of 7,854 sq. ft or less. The TLR is the target leak rate in gal/h. The TLR can have any value greater than or equal to 0.586 gal/h.

The corresponding probability of detection [P_D] of a TLR $\geq$ 0.586 gallon per hour leak is 95 %, where the TLR can have any value greater than or equal to 0.586 gal/h.

Evaluation Results (continued)

The standard deviation of the test data results was 0.163 gal/hr. The performance of the method is computed using 0.163 gal/h.

The smallest leak that can be detected with a probability of detection of 95% and a probability of false alarm of 5% [MDL] is 0.586 gal/hr in a tank with a surface area of 7,854 sq. feet.

The minimum water level (threshold) in the tank that the method can detect is N/A inches.

The minimum change in water level that can be detected by the method is N/A inches (provided that the water level is above the threshold).

Test Conditions During Evaluation

The evaluation testing was conducted in a nominal 2,100,000 gallon tank with a surface area of 7,854 sq. ft. The tank was constructed of (X) steel ( ) fiberglass (X) concrete ( ) other (describe)

The tank geometry included vertical walls and was 100.0 (X) feet in diameter or ______ ( ) feet long and ______ ( ) feet wide and 250 feet deep.

The tests were conducted with the tank product level 97 % full.

The product used in the evaluation was JP-5.

The temperature differences between product added to fill the tank and product already in the tank ranged from N/A deg F to N/A deg F, with a standard deviation of N/A deg F.

The system was operated as an automatic device. (X) Yes ( )No

Limitations on the Results

The performance estimates above are only valid when:

- The method has not been substantially changed.
- The vendor's instructions for installing and operating the Leak Detection Method are followed.
- The tank contains a product identified on the method description form.
- The tank is a field-constructed tank with vertical walls of constant cross section.
- The waiting time after adding any substantial amount of product to the tank is 24 hours 0 minutes.
- The total data collection time for the test is at least 24 hours 0 minutes.
- The maximum product surface area is 7,854 square feet.

Limitations on the Results (continued)

- The evaluation applies only to the 12,500,000-gal bulk USTs at the Red Hill Underground Fuel Storage Facility.
- The threshold for declaring a leak is adjusted for different tank sizes by multiplying the ratio of the product surface area used in the evaluation, which was 7,854 square feet, and the product surface area in the tank being tested. The detectable leak rate is scaled up or down by multiplying in the same way.
- The detectable leak rate ( ) may (X) may not be scaled below 0.2 gal/h.
- Other limitations specified by the vendor of determined during testing:

Procedural Information

State the procedures used to compensate for the presence of a water table above the bottom of the tank.

If a water leak is present, into or out of the tank, the leak will be detected as an inflow.

State the procedures used to determine when the tank is stable.

Tank stability is not an issue for mass measurement systems.

State the procedures used to account for fuels of different volatility.

No procedural changes are necessary. The reference tube compensates for evaporation and condensation.

Other Information

Summary of Test Procedure Modifications

Temperature Variations were achieved by: (describe briefly)

The volume of the test tank (nominally 12,500,000 gallons) was too large to physically create temperature variations. Deliveries were not simulated, because fuel transfers to fill the tanks are accomplished infrequently, and fuel is typically stored for approximately 9 months before being transferred out of the tank. The tank was filled approximately five days before the start of the evaluation. No temperature measurements were made.

Other Modifications: (describe briefly)

Method Name and Version: LRDP-24 Version a-rh
Date of Certification: August 28, 2001

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	0.163 gal/h	0.163 gal/h	0.163 gal/h
Target Leak Rate, TLR	1.000 gal/h	2.000 gal/h	3.000 gal/h
Vendor's Threshold	0.707 gal/h	1.707 gal/h	2.707 gal/h
PFA	< 1%	<< 1%	<< 1%
PD(for target leak rate)	95%	95%	95%
MDL	0.586 gal/h	0.586 gal/h	0.586 gal/h
* Standard deviation based on (X) a single test or ( ) average of ________ tests.			

Note: Additional copies of this table for other leak rate may be included as desired.

Summary of Performance Estimates and Scaling (Threshold is based on setting the PD = 95% and the PFA = 5%.)

	Test Tank/Tank 1		
Diameter	100.0 feet		
Surface Area	7,854 sq. feet		
Standard Deviation*	0.163 gal/h		
Target Leak Rate, TLR	0.586 gal/h		
Vendor's Threshold	0.293 gal/h		
PFA	5%		
PD(for target leak rate)	95%		
* Standard deviation based on (X) a single test or ( ) average of ________ tests.			

> **Safety disclaimer: This test procedure only addresses the issue of the Leak Detection Method's ability to detect leaks. It does not test the equipment for safety hazards.**

Certification of Results

I certify that the Leak Detection Method was installed and operated according to the vendor's instructions and that the results presented on this form are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

H. Kendall Wilcox
(signature)

Grain Valley, Missouri, 64029
(city, state, zip)

August 28, 2001
(date)

(816) 443-2494
(phone number)

Method Name and Version: LRDP-24-n Version a-rh
Date of Certification: August 28, 2001

Results of U.S. EPA Alternative Test Procedures
Bulk Field-Constructed Tank
Mass-Based Leak Detection Method

This form describes the performance of the leak detection method described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to a modification of the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Volumetric Tightness Testing Methods." The full evaluation report also includes a form describing the method and a form summarizing the test data.

Tank owners using this leak detection system should keep this form on file to provide compliance with the federal regulations. Tank owners should check with State and local agencies to make sure this form satisfies their requirements.

Leak Detection Method Description

Name LRDP-24-n

Version number a-rh

Vendor(s)

NFESC 1100 23rd Avenue (street address) Port Hueneme, CA 93043-4370 (city) (state) (zip) (805) 982-1618 (phone)	Vista Research, Inc. 755 North Mary Avenue (street address) Sunnyvale, CA 94085 (city) (state) (zip) (408) 830-3300 (phone)

Evaluation Results

This method (X) does ( ) does not use multiple tests. If multiple tests are used, the results are based on n independent tests. The results apply only when $1 < n \leq 12$ tests are performed and the estimated leak rates averaged.

This Leak Detection Method which declares tank to be leaking when the measured leak rate exceeds the threshold of $TLR-(0.293/n^{0.5})$ gallons per hour, has a probability of false alarm [P_{FA}] of ≤ 5 % for tests conducted on tanks with a surface area [A] of 7,854 sq. ft or less. The TLR is the target leak rate in gal/h. The TLR can have any value greater than or equal to $(0.586/n^{0.5})$ gal/h such that the TLR $\geq$ 0.20 gal/hr.

The corresponding probability of detection [P_D] of a $TLR \geq (0.586/n^{0.5})$ gallon per hour leak is 95 %, where the TLR can have any value greater than or equal to $(0.586/n^{0.5})$ gal/h such that the TLR $\geq$ 0.20 gal/hr.

Evaluation Results (continued)

The standard deviation of the test data results was 0.163 gal/hr. The performance of the method is computed using $(0.163/n^{0.5})$.

The smallest leak that can be detected with a probability of detection of 95% and a probability of false alarm of 5% [MDL] is $(0.586/n^{0.5})$ gal/hr in a tank with a surface area of 7,854 sq. feet.

The minimum water level (threshold) in the tank that the method can detect is

N/A inches.

The minimum change in water level that can be detected by the method is

N/A inches (provided that the water level is above the threshold).

Test Conditions During Evaluation

The evaluation testing was conducted in a nominal 2,100,000 gallon tank with a surface area of 7,854 sq. ft. The tank was constructed of (X) steel ( ) fiberglass

(X) concrete ( ) other (describe)

The tank geometry included vertical walls and was 100.0 (X) feet in diameter or ______ ( ) feet long and ______ ( ) feet wide and 250 feet deep.

The tests were conducted with the tank product level 97 % full.

The product used in the evaluation was JP-5.

The temperature differences between product added to fill the tank and product

already in the tank ranged from N/A deg F to N/A deg F, with a standard deviation of

N/A deg F.

The system was operated as an automatic device. (X) Yes ( )No

Limitations on the Results

The performance estimates above are only valid when:

- The method has not been substantially changed.
- The vendor's instructions for installing and operating the Leak Detection Method are followed.
- The tank contains a product identified on the method description form.
- The tank is a field-constructed tank with vertical walls of constant cross section.
- The waiting time after adding any substantial amount of product to the tank is 24 hours 0 minutes.
- The total data collection time for the test is at least 24 hours 0 minutes.
- The maximum product surface area is 7,854 square feet.

Method Name and Version: LRDP-24-n Version a-rh
Date of Certification: August 28, 2001

Limitations on the Results (continued)

- The evaluation applies only to the 12,500,000-gal bulk USTs at the Red Hill Underground Fuel Storage Facility.
- The threshold for declaring a leak is adjusted for different tank sizes by multiplying the ratio of the product surface area used in the evaluation, which was 7,854 square feet, and the product surface area in the tank being tested. The detectable leak rate is scaled up or down by multiplying in the same way.
- The detectable leak rate ( ) may (X) may not be scaled below 0.2 gal/h.
- Other limitations specified by the vendor of determined during testing:

Procedural Information

State the procedures used to compensate for the presence of a water table above the bottom of the tank.

If a water leak is present, into or out of the tank, the leak will be detected as an inflow.

State the procedures used to determine when the tank is stable.

Tank stability is not an issue for mass measurement systems.

State the procedures used to account for fuels of different volatility.

No procedural changes are necessary. The reference tube compensates for evaporation and condensation.

Other Information

Summary of Test Procedure Modifications

Temperature Variations were achieved by: (describe briefly)

The volume of the test tank (nominally 12,500,000 gallons) was too large to physically create temperature variations. Deliveries were not simulated, because fuel transfers to fill the tanks are accomplished infrequently, and fuel is typically stored for approximately 9 months before being transferred out of the tank. The tank was filled approximately five days before the start of the evaluation. No temperature measurements were made.

Other Modifications: (describe briefly)

Method Name and Version: LRDP-24-n Version a-rh
Date of Certification: August 28, 2001

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.163 gal/h	$0.163/n^{0.5}$ = 0.115 gal/h	$0.163/n^{0.5}$ = 0.081 gal/h
Target Leak Rate, TLR	$1.000/n^{0.5}$ = 1.000 gal/h	$1.000/n^{0.5}$ = 0.707 gal/h	$1.000/n^{0.5}$ = 0.500 gal/h
Vendor's Threshold	$0.707/n^{0.5}$ = 0.707 gal/h	$0.707/n^{0.5}$ = 0.500 gal/h	$0.707/n^{0.5}$ = 0.353 gal/h
PFA	< 1%	< 1%	< 1%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.586 gal/h	$0.586/n^{0.5}$ = 0.414 gal/h	$0.586/n^{0.5}$ = 0.293 gal/h
Number of Tests = n	1	2	4
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.067 gal/h	$0.163/n^{0.5}$ = 0.054 gal/h	$0.163/n^{0.5}$ = 0.047 gal/h
Target Leak Rate, TLR	$1.000/n^{0.5}$ = 0.409 gal/h	$1.000/n^{0.5}$ = 0.334 gal/h	$1.000/n^{0.5}$ = 0.289 gal/h
Vendor's Threshold	$0.707/n^{0.5}$ = 0.289 gal/h	$0.707/n^{0.5}$ = 0.236 gal/h	$0.707/n^{0.5}$ = 0.204 gal/h
PFA	< 1%	< 1%	< 1%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.239 gal/h	$0.586/n^{0.5}$ = 0.20 gal/h	$0.586/n^{0.5}$ < 0.2 gal/h
Number of Tests = n	6	9	12
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.163 gal/h	$0.163/n^{0.5}$ = 0.115 gal/h	$0.163/n^{0.5}$ = 0.081 gal/h
Target Leak Rate, TLR	$2.000/n^{0.5}$ = 2.000 gal/h	$2.000/n^{0.5}$ = 1.414 gal/h	$2.000/n^{0.5}$ = 1.000 gal/h
Vendor's Threshold	$1.707/n^{0.5}$ = 1.707 gal/h	$1.707/n^{0.5}$ = 1.207 gal/h	$1.707/n^{0.5}$ = 0.854 gal/h
PFA	<< 1%	<< 1%	<< 1%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.586 gal/h	$0.586/n^{0.5}$ = 0.414 gal/h	$0.586/n^{0.5}$ = 0.293 gal/h
Number of Tests = n	1	2	4
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.067 gal/h	$0.163/n^{0.5}$ = 0.054 gal/h	$0.163/n^{0.5}$ = 0.047 gal/h
Target Leak Rate, TLR	$2.000/n^{0.5}$ = 0.816 gal/h	$2.000/n^{0.5}$ = 0.667 gal/h	$2.000/n^{0.5}$ = 0.577 gal/h
Vendor's Threshold	$1.707/n^{0.5}$ = 0.697 gal/h	$1.707/n^{0.5}$ = 0.569 gal/h	$1.707/n^{0.5}$ = 0.493 gal/h
PFA	<< 1%	<< 1%	<< 1%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.239 gal/h	$0.586/n^{0.5}$ = 0.20 gal/h	$0.586/n^{0.5}$ < 0.2 gal/h
Number of Tests = n	6	9	12
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.163 gal/h	$0.163/n^{0.5}$ = 0.115 gal/h	$0.163/n^{0.5}$ = 0.081 gal/h
Target Leak Rate, TLR	$3.000/n^{0.5}$ = 3.000 gal/h	$3.000/n^{0.5}$ = 2.121 gal/h	$3.000/n^{0.5}$ = 1.500 gal/h
Vendor's Threshold	$2.707/n^{0.5}$ = 2.707 gal/h	$2.707/n^{0.5}$ = 1.914 gal/h	$2.707/n^{0.5}$ = 1.354 gal/h
PFA	<< 1%	<< 1%	<< 1%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.586 gal/h	$0.586/n^{0.5}$ = 0.414 gal/h	$0.586/n^{0.5}$ = 0.293 gal/h
Number of Tests = n	1	2	4
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.067 gal/h	$0.163/n^{0.5}$ = 0.054 gal/h	$0.163/n^{0.5}$ = 0.047 gal/h
Target Leak Rate, TLR	$3.000/n^{0.5}$ = 1.225 gal/h	$3.000/n^{0.5}$ = 1.000 gal/h	$3.000/n^{0.5}$ = 0.866 gal/h
Vendor's Threshold	$2.707/n^{0.5}$ = 1.105 gal/h	$2.707/n^{0.5}$ = 0.902 gal/h	$2.707/n^{0.5}$ = 0.781 gal/h
PFA	<< 1%	<< 1%	<< 1%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.239 gal/h	$0.586/n^{0.5}$ = 0.20 gal/h	$0.586/n^{0.5}$ < 0.2 gal/h
Number of Tests = n	6	9	12
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Note: Additional copies of this table for other n and leak rates may be included as desired.

Method Name and Version: LRDP-24-n Version a-rh
Date of Certification: August 28, 2001

Summary of Performance Estimates and Scaling (Threshold is based on setting the PD = 95% and the PFA = 5%.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.163 gal/h	$0.163/n^{0.5}$ = 0.115 gal/h	$0.163/n^{0.5}$ = 0.081 gal/h
Target Leak Rate, TLR	$0.586/n^{0.5}$ = 0.586 gal/h	$0.586/n^{0.5}$ = 0.414 gal/h	$0.586/n^{0.5}$ = 0.293 gal/h
Vendor's Threshold	$0.293/n^{0.5}$ = 0.293 gal/h	$0.293/n^{0.5}$ = 0.207 gal/h	$0.293/n^{0.5}$ = 0.147 gal/h
PFA	5%	5%	5%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.586 gal/h	$0.586/n^{0.5}$ = 0.414 gal/h	$0.586/n^{0.5}$ = 0.293 gal/h
Number of Tests = n	1	2	4
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Summary of Performance Estimates (Threshold is based on setting the PD = 95% such that the PFA is less than or equal to 5% and is as small as possible.)

	Test Tank/Tank 1	Test Tank/Tank 1	Test Tank/Tank 1
Diameter	100.0 feet	100.0 feet	100.0 feet
Surface Area	7,854 sq. feet	7,854 sq. feet	7,854 sq. feet
Standard Deviation*	$0.163/n^{0.5}$ = 0.067 gal/h	$0.163/n^{0.5}$ = 0.054 gal/h	$0.163/n^{0.5}$ = 0.047 gal/h
Target Leak Rate, TLR	$0.586/n^{0.5}$ = 0.239 gal/h	$0.586/n^{0.5}$ = 0.20 gal/h	$0.586/n^{0.5}$ < 0.2 gal/h
Vendor's Threshold	$0.293/n^{0.5}$ = 0.120 gal/h	$0.293/n^{0.5}$ = 0.098 gal/h	$0.293/n^{0.5}$ = 0.085 gal/h
PFA	5%	5%	5%
PD(for target leak rate)	95%	95%	95%
MDL	$0.586/n^{0.5}$ = 0.239 gal/h	$0.586/n^{0.5}$ = 0.20 gal/h	$0.586/n^{0.5}$ < 0.2 gal/h
Number of Tests = n	6	9	12
* Standard deviation based on ( ) a single test or (X) average of n tests.			

Note: Additional copies of this table for other n may be included as desired.

> **Safety disclaimer: This test procedure only addresses the issue of the Leak Detection Method's ability to detect leaks. It does not test the equipment for safety hazards.**

Certification of Results

I certify that the Leak Detection Method was installed and operated according to the vendor's instructions and that the results presented on this form are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

H. Kendall Wilcox
(signature)

Grain Valley, Missouri, 64029
(city, state, zip)

August 28, 2001
(date)

(816) 443-2494
(phone number)

Description
Bulk Field-Constructed Tank
Leak Detection Method

This section describes briefly the important aspects of the bulk tank leak detection method. It is not intended to provide a thorough description of the principles behind the system or how the equipment works.

Method Name and Version

LRDP-24 Version a-rh and the LRDP-24-n Version a-rh

Product

> Product type

For what products can this Method be used? (check all applicable)

(X) gasoline

(X) diesel

(X) aviation fuel

(X) fuel oil #4

(X) solvents

(X) other (list) Any liquid.

> Water level

Does the Method measure inflow of water as well as loss of product (gallon per hour)?

(X) yes

( ) no

Does the Method detect the presence of water in the bottom of the tank?

( ) yes

(X) no

Principle of Operation

What technique is used to detect leaks in the tank system?

( ) directly measure the volume of product change

(X) changes in head pressure

( ) changes in buoyancy of a probe

( ) mechanical level measure (e.g., ruler, dipstick)

( ) changes in capacitance

( ) ultrasonic

( ) change in level of float (specify principle, e.g., capacitance, magnetostrictive, load cell, etc.) ______________________

( ) acoustical signal characteristics of a leak

( ) identification of a tracer chemical outside the tank system

( ) other (describe briefly) ______________________

Temperature Measurement

How many temperature sensors are used to measure the product temperature?

(X) Product temperature not measured

( ) One sensor

( ) Two sensors

( ) Three sensors

( ) Four sensors

( ) Five sensors

( ) Other (describe briefly) ______________________

What type of temperature sensor is used?

(X) Product temperature not measured

( ) resistance temperature detector (RTD)

( ) bimetallic strip

( ) quartz crystal

( ) thermistor

( ) other (describe briefly) ______________________

If product temperature is not measured during a test, why not?

(X) the factor measured for change in level/volume is independent of temperature (e.g., mass)

(X) the factor measured for change in level/volume self-compensates for changes in temperature

(X) other (explain briefly) Reference tube in combination with differential pressure will compensate for temperature differences.

Data Acquisition

How are the test data acquired and recorded?

( ) manually

( ) by strip chart

(X) by computer

Procedure information

> Waiting times

What is the required waiting period between adding a large volume of product (i.e., a delivery) and the beginning of a test (e.g., filling from 50% to 90-95% capacity)?
 24 Hours 0 Minutes

Additional Comments: ______

> Test duration

What is the required time for collecting data?

 24 Hours 0 Minutes

Additional Comments: ______

What is the sampling frequency for the level and temperature measurements?

( ) more than once per second

( ) at least once per minute

(X) every 1-15 minutes

( ) every 16-30 minutes

( ) every 31-60 minutes

( ) less than once per hour

( ) variable (explain) ______

> Use of multiple tests

Does the procedure use the average leak rate from more than one test in reaching a conclusion?

(X) Yes (How many tests? (where n = 1 for the LRDP-24 and where 1< n =12 for the LRDP-24-n)

(X) No (for the LRDP-24

Does the procedure base its conclusion on the agreement of k out of n tests?

( ) Yes (A leak is indicated if ______ (specify k) out of _____ (specify n) tests indicate a leak.)

(X) No

> Identifying and correcting for interfering factors

How does the Method determine the presence and level of the ground water above the bottom of the tank?

(X) level of ground water above bottom of the tank not determined

( ) observation well near tank

( ) information from USGS, etc.

( ) information from personnel on-site

( ) presence of water in the tank

( ) other (describe briefly) ______________________________

Does the method measure inflow of water as well as loss of product?

(X) yes

( ) no

Additional Comments: ______________________________

____

____

How does the Method correct for the interference due to the presence of ground water above the bottom of the tank?

(X) no action

( ) system tests for water incursion

( ) different product levels tested and leak rates compared

( ) other (describe briefly) ______________________________

> Interpreting test results

How are level changes converted to volume changes (i.e., how is height-to-volume conversion factor determined)?

(X) actual level changes observed when known volume is added or removed (e.g., liquid metal bar)

(X) theoretical ratio calculated from tank geometry

(X) interpolation from tank manufacturer's chart

( ) other (describe briefly)

( ) not applicable; volume measured directly

How is the coefficient of thermal expansion (Ce) of the product determined?

( ) actual sample taken for each test and Ce determined from specific gravity

( ) value supplied by vendor of product

( ) average value for type of product

(X) other (describe briefly) Not required. Method is self-compensating for product temperature changes.

How is the leak rate (gallon per hour) calculated?

( ) average of subsets of all data collected

( ) difference between first and last data collected

(X) from data from last 24 hours of test period

(X) from data determined to be valid by statistical analysis

( ) other (describe) __________

What threshold value for product volume change (gallon per hour) is used to declare that a tank is leaking?

( ) 0.05 gal/hr	( ) 0.1 gal/hr	( ) 0.2 gal/hr
( ) 0.5 gal/hr	( ) 1.0 gal/hr	( ) 2.0 gal/hr

(X) Other $0.293/n^{0.5}$ gal/h for MDL = $0.586/n^{0.5}$ gal/h with a P(D) = 95% and a P(FA) = 5% in a tank to be tested with a surface area A = 7,854 sq. feet. For a target leak rate [TLR] greater than or equal to ($0.586/n^{0.5}$) in gal/h, the threshold is equal to TLR – ($0.293/n^{0.5}$) in gal/h. When n = 1, these results are for the LRDP-24.

Additional Comments: __________

Under what conditions are test results considered inconclusive?

( ) ground water level above the bottom of the tank

( ) soil not sufficiently porous

( ) too much variability in the data (standard deviation beyond a given value)

( ) unexplained product volume increase

(X) other (describe briefly) None

Exceptions

Are there any conditions under which a test should not be conducted?

( ) ground water level above the bottom of the tank

( ) large difference between ground temperature and delivered product temperature

( ) extremely high or low ambient temperature

( ) invalid for some products (specify) ______

(X) other (describe briefly) None

What are acceptable deviations from the standard testing protocol?

(X) lengthen the duration of test

( ) other (describe briefly) ______

( ) none

What elements of the test procedure are determined by personnel on-site?

(X) product level when test is conducted

(X) when to conduct test

(X) waiting period between filling tank and beginning test

(X) length of test (LRDP-24 requires a minimum test time of 24 hours.)

( ) determination of "outlier" data that may be discarded

( ) other (describe briefly) ______

( ) none

Appendix B

MTC Pilot Test Results
and
Supporting Baker Trip Report

Precision Leak Measurement Report

Customer Information:	FISC Red Hill Pearl Harbor, HI
Project Manager:	Mr. Christopher Caputi
Mass Technology Site Supervisor	Jimmy Wolford

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform precision tightness testing of Tank # 9 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: Larry D. Speaks Date: 03-20-2008
Larry D. Speaks

I declare under penalty of perjury that I am a licensed tank tester in the State of California and that the information contained in this report is true and correct to the best of my knowledge.

Test performed by: ______________ Date: 03-20-2008
Jimmy Wolford

License number: 90-1286

Mass Technology Corporation
P. O. Box 1578
Kilgore, Texas 75662
Phone (903) 986-3564
Fax (903) 984-3569

Table of Contents

Executive Summary

Testing of the 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced February 27, 2008 and was completed March 11, 2008. The tank was filled with JP-5 and a precision leak test was conducted. The result of that test indicates the tank is tight. Testing was performed using Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank 9: After 240 hours of testing the tank is certified tight.

Tank Data Tank 9

Diameter:	**100 ft.**	**Height:**	**250 ft.**
Tank Type:	**Vertical Underground**		
Contents:	**JP-5**		
Properties:	**0.82 Specific Gravity**		
Product Level:	**210 ft.**		

Test Data

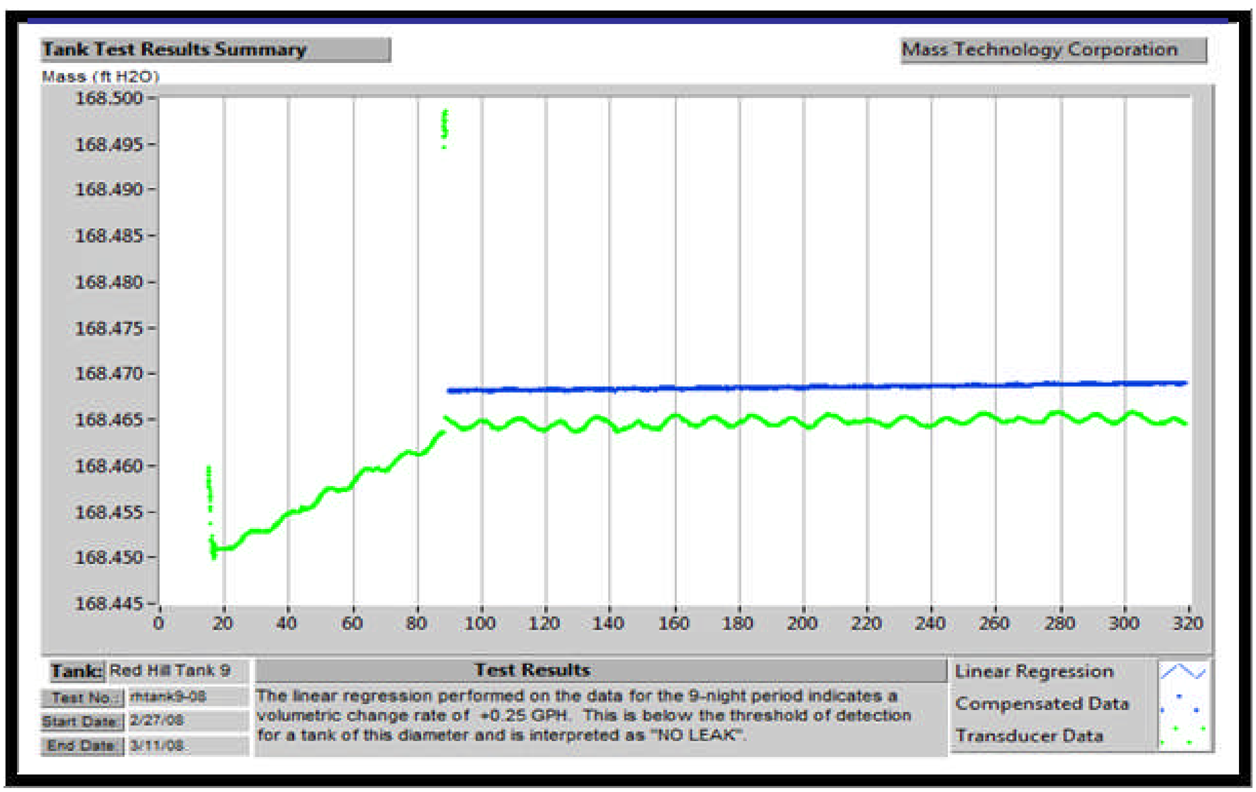
Start Date: 02-27-2008
Completion Date: 03-11-2008
Unit Operator: Jimmy Wolford

Test Results

Certified Tight

Summary of Results

The fluid mass data was recorded over a 240-hour test period. A linear regression of the recorded fluid mass data resulted in no leak detected above the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank has not been compromised and the tank is considered not to be leaking.



MTC Mass Technology CORPORATION

Precision Leak Measurement Report

Customer Information:	FISC Red Hill Pearl Harbor, HI
Project Manager:	Mr. Christopher Caputi
Mass Technology Site Supervisor	Jimmy Wolford

Scope of Work: Furnish all required management, labor, services, materials and equipment to perform precision tightness testing of Tank # 15 an underground fuel storage tank located at FISC Red Hill, Pearl Harbor, HI.

Report compiled by: Larry D. Speaks
Larry D. Speaks

Date: 03-20-2008

I declare under penalty of perjury that I am a licensed tank tester in the State of California and that the information contained in this report is true and correct to the best of my knowledge.

Test performed by: ______________________
Jimmy Wolford

Date: 03-20-2008

License number: 90-1286

Mass Technology Corporation
P. O. Box 1578
Kilgore, Texas 75662
Phone (903) 986-3564
Fax (903) 984-3569

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Executive Summary

Testing of the 12,600,000 gal underground storage tank located at FISC Red Hill, Pearl Harbor, Hawaii commenced March 6, 2008 and was completed March 11, 2008. The tank was filled with DFM and a precision leak test was conducted. The result of that test indicates the tank is tight. Testing was performed using Mass Technology Corporation protocols set out in the third party evaluations. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank was not compromised and the test is considered conclusive.

Tank 15: After 120 hours of testing the tank is certified tight.

Tank Data Tank 15

Diameter:	**100 ft.**	**Height:**	**250 ft.**
Tank Type:	**Vertical Underground**		
Contents:	**DFM**		
Properties:	**0.84 Specific Gravity**		
Product Level:	**211 ft.**		

Test Data

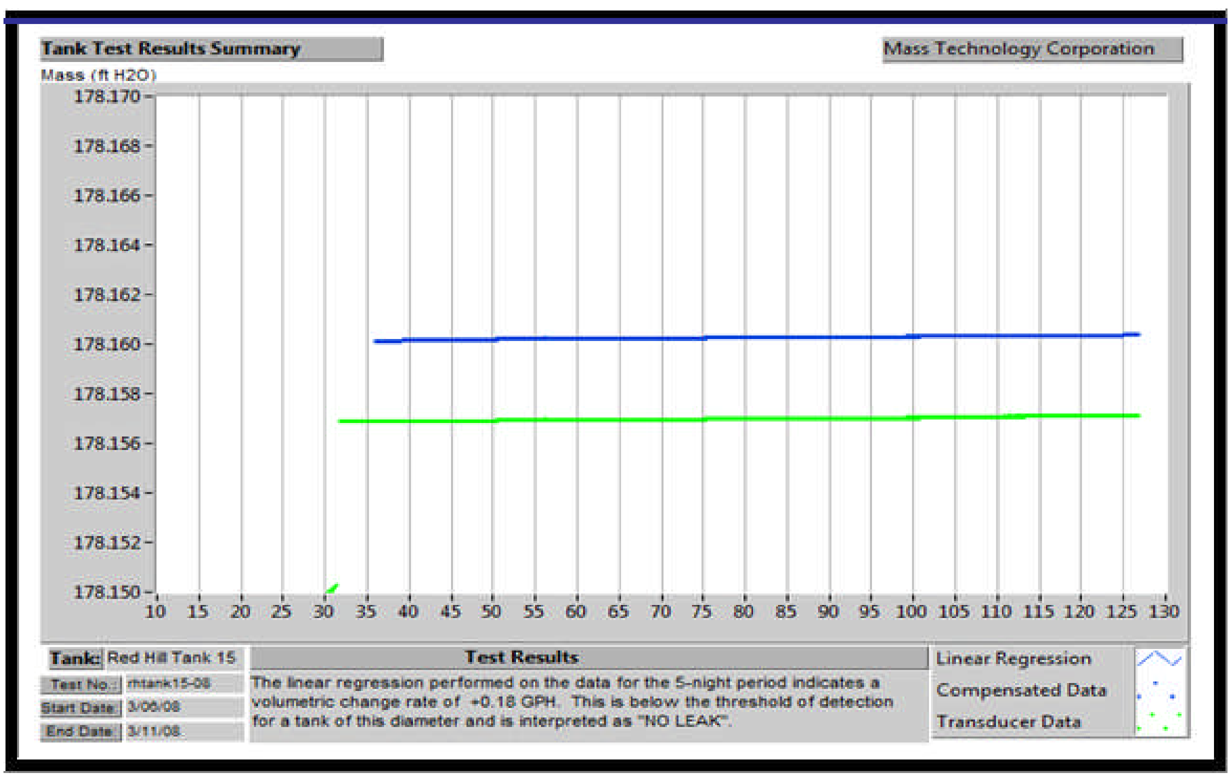
Start Date: **03-06-2008**
Completion Date: **03-11-2008**
Unit Operator: **Jimmy Wolford**

Test Results

Certified Tight

Summary of Results

The fluid mass data was recorded over a 120-hour test period. A linear regression of the recorded fluid mass data resulted in no leak detected above the minimum detection level of 0.5 gallons per hour. All tank valves were adequately secured such that any fluid loss was isolated to leakage. Therefore, the containment integrity of the tank has not been compromised and the tank is considered not to be leaking.



Trip Report
FISC Pearl Harbor
MTC Pilot Testing
In Support of
Leak Detection Market Survey

Introduction:

Baker and Mass Technology Corporation (MTC) mobilized to FISC Pearl Harbor, Hawaii on Monday February 25th 2008 to begin a Pilot test of the MTC leak detection system on one of the USTs at the Red Hill Bulk Storage Complex. The intent of this test was to evaluate the suitability of MTC testing on the large USTs at Red Hill. This information would be included in the Leak Detection Market Survey being developed by Baker for DESC and NAVSUP (NOLSC) at Ft Belvoir.

Background:

Baker is developing and documenting potential technologies available to provide leak detection on the 12,000,000-gallon USTs located at the Red Hill Storage Complex at FISC Pearl Harbor, HI. This "Market Survey" of leak detection technologies will be used by the government to help select an appropriate system to provide a leak detection solution for these tanks. One of the potentially useful technologies short-listed by Baker was the MTC leak detection system. This system utilizes a precision mass measurement probe installed from a tank top opening to the bottom of the UST. Through data collection and software analysis leaks can be detected under 1.0 gallons per hour. The government directed Baker to perform a pilot test on one of the USTs at Red Hill to determine what physical or logistics challenges would be encountered during such testing which may detract from the potential use of such a system.

Site Visit and Pilot Test:

Monday February 25th 2008

Baker and MTC mobilized to FISC Pearl Harbor, Hawaii on Monday February 25th 2008.

Tuesday February 26th 2008

The first order of business was a Kickoff meeting hosted by the FISC office. This meeting took place on Tuesday 26 February 2008 from 8am until approximately 10:30 am. A list of the attendees of this meeting follows:

Name	Organization	Telephone	email
Victor Peters	FISC Pearl Harbor	808 479-0127	Victor.Peters@ Navy.mil
Lee Edwards	DESC Mid Pac	808 473-4311	Lee.Edwards@ DLA.mil
Lt Col Joy Griffith	DESC Mid Pac	808 473-4291	Joy.Griffith@ DLA.mil
Jimmy Wolford	MTC	903 987-5888	JWolford@ mtctesting.com
Chris Caputi	Baker	757 631-5490	ccaputi@ mbakercorp.com
George Cook	FISC Pearl Harbor	808 473-7833	George.Cook@ Navy.mil
John Roundy	DES DP	808 473-4286	John.Roundy @DLA.mil
Terry Strack	FISC Pearl Harbor	808 473-7892	Terry.Strack@ Navy.mil
Raelynn Della Sala	NAVFAC COMNAVREG HI	808 471-1171 Ext. 337	Raelynn.DellaSala @ Navy.mil
Alan Sugihara	NAVFAC HI	808 471-5094	Alan.Sugihara@ Navy.mil
Incheol Pang	NAVFAC NFESC	808 473-7898	Incheol.Pang@ Navy.mil
Steven Butler	FISC Pearl Harbor	808 473-7856	Steven.C.Butler@ Navy.mil
Al Hoyle	FISC Pearl Harbor	808 473-7805	Alfred.Hoyle@ Navy.mil
Calvin Lee	FISC Pearl Harbor	808 473-7816	Calvin.Lee@ Navy.mil

A copy of the agenda items discussed at this meeting is provided as Attachment A.

Generally, the kickoff meeting followed this agenda and focused on the particulars of this MTC test event and how best to proceed. Beyond these logistics items the following two major points were discussed:

> It was decided at this meeting that to provide an equal comparison to the Vista LRDP Leak Detection system that had been evaluated as a form of leak detection for these USTs in 2001, the MTC test should be performed on the same UST. Tank 9, a JP-5 tank filled to an approximate height of 209', would be the tank selected for this MTC test.
>
> It was also determined that FISC PH wished to receive a copy of the tank testing report as a stand alone report in addition to the copy that would ultimately be incorporated into the Market Survey Report due on 31 March 2008.

After this kickoff meeting concluded, Baker, MTC, and Ms. Terry Strack of FISC PH proceeded to the Red Hill complex to look at the site and begin preparations for the tank test. It was identified during this inspection that the manual gauging port located on top of UST 9 was of (nominal) 3" inside diameter. MTC had been told that the gauging hatches on these tanks were greater than 6" in diameter and had brought test equipment based on that dimension. The rest of the day was spent finding a local machine shop able to turn down the diameter of the test equipment to fit into the gauging port of Tank 9.

Wednesday February 27th 2008

Baker and MTC arrived on site at the FISC PH office at 8 am to get the necessary passes to access Red Hill. At about 9 am Baker and MTC arrived on site at Red Hill Tank 9 and began setting up the MTC test equipment. At noon Baker and MTC went to the machine shop in Honolulu and obtained the newly modified test equipment and returned to Red Hill. The final touches were put on the test gear and the test was initiated at approximately 3pm. Baker, MTC and Ms. Strack then inspected the piping associated with Tank 9 in lower tunnel to determine that if there was a problem detected during testing how the variables such as valve bleed by could be addressed. It was decided due to the labor required not to drain the lines or manipulate valves unless a problem was detected . The tank fluid level was noted to be 209' 9 and 15/16th inches as the test was set up (see Photo 1).

Photo 1 Tank 9 ATG on Feb 27th 2008 at 10:43 am
(note level is 209' 9 and 15/16th")

Thursday February 28th 2008

Baker and MTC checked on the status of the test at approximately 10 am. It was noted that a small increase in the mass was being detected within the test. Baker and MTC decided to monitor the test for another 24 hours before deciding if the increasing trend would normalize and level out or if in fact there was a true increase being detected.

The FISC PH POC was out with a personal issue.

Friday February 29th 2008

Baker and MTC checked on the status of the tank and did determine that the test was in fact monitoring an increase in product in the tank. It was also noted that the existing MTG Tank gauge was also fluctuating between 209' 09 and 15/16th inches and 209' 10 and 00/16th inches (see photos 2 and 3). This fluctuation was not noted during the test set up on the 27th. Baker and MTC wondered if the tank level gauge may also be reading an increase in product level and was at the threshold of detection by the gauge (1/16th of an inch). Baker/MTC met with Ms Strack at the FISC office and asked if historic tank level data was available for that tank to see if the MTG tank gauge was detecting an increase over time. It was discovered that the FISC office only holds the tank level data from Sunday to Saturday after which time it is purged from the computer system. Data was available from Sunday February 24th thru Friday February 29th. The hardcopy of the data provided to Baker showed the fluid level to be fairly constant within a range of about plus/minus 0.04" (slightly less than 1/16th of an inch). This did not seem to show an obvious rise of product level as expected by the results of the MTC test so far.

Photo 2 Tank 9 ATG on Feb 29th 2008 at 8:53 am
(note level is 209'10")

Photo 3 Tank 9 ATG on Feb 29th 2008 at 8:54 am
(note level is 209' 9 and 15/16th")

Baker/MTC and the FISC office determined that the next action taken would be to drain the pipes connected to the tank to relieve any potential of hydrostatic pressure head from nearby tanks from causing valve bleed by and causing the tank level to rise. This piping drain was performed Friday afternoon by FISC personnel, but given the levels and pressures in this piping there did not appear to be any chances of valve bleed by. MTC continued to log data and would determine over the weekend if the system continued to show a rising level or if it would stabilize.

During the late morning Baker met with Mr. Vic Peters of FISC to discuss some of the technical issues of the existing gauge system, AFHE, and the Asteroid system. This data will be incorporated into the Market Survey report.

During the afternoon Baker met with Ms. Terry Strack to discuss her needs for piping pressure testing. She is hoping to use the DESC centralized program to perform the USCG required annual pressure piping testing as well as pressure testing of the Hickam AFB transfer line. Baker will put together a scope of work to be bid to appropriate test vendors to perform this work. Baker will submit a draft of this SOW to Ms Strack to ensure all of her requests are included.

Baker demobilized from the Hawaii at 6pm on Friday. MTC remained to monitor the test.

Saturday March 1st 2008

MTC continued to monitor the tank test

Sunday March 2nd, 2008

MTC continued to monitor the tank test

Monday March 3rd, 2008

MTC contacted Baker and indicated that the pressure transducers had seemed to normalize and the system was testing normally (no liquid level gain issue). Baker authorized MTC to perform another 4 day test on another tank to see if the level gain experience in the beginning of this test would be indicative of testing all of these USTs.

Friday March 7th 2008

MTC contacted Baker and informed them that a second test had been begun on Tank 15 on Thursday. The same initial level gain was also being recorded during that time. It seems to be an issue that during the initial portion of the test the pressure transducers take a few days to normalize during which time a slight gain will be recorded. MTC will document this phenomenon while continuing to test Tank 15 over the weekend. MTC plans on terminating both tests on Monday and demobilizing on Tuesday.

ATTACHEMENT A

Kickoff Meeting Agenda

FISC Pearl Harbor
Red Hill UST Integrity Testing
To Support the
2008 Red Hill UST Leak Detection Market Survey
Kick-off Meeting Agenda

1. Introductions

Chris Caputi, P.E. – Michael Baker Jr. inc. – Project Manager
Jimmy Wolford- Mass Technology Corporation
John Davis, P.E. – Michael Baker Jr. inc. – Project Engineer

2. Purpose

To research leak detection solutions available for the USTs at Red Hill and specifically to perform the MTC Pilot Test.

3. Background

Tanks regulated by 40 CFR 112 not 280 – coordination with SPCC
DOH driven requirements for Leak Detection
No off the shelf solutions for leak detection
Previous Market Surveys performed
Vista LRDP system evaluated and 3rd party certified
No permanent actions taken towards tank leak detection

4. 2008 Leak Detection Market Survey

Research available technologies to perform leak detection on the Red Hill USTs
Develop short list of reasonable potential candidates
Pilot test MTC
Discuss Data averaging and "Mountain Home AFB" approach for MTC and Vista LRDP
Provide evaluation matrix
Provide recommendations

5. Pilot testing of MTC

Purpose of this visit (26 Feb 2008) is to determine the suitability/challenges of MTC testing.

6. Submittal of Results

Results of the MTC testing will be 1) Formal point in time test report for DESC/FISC/Navy records and 2) an appendix in the "Market Survey" – Due 31 March 2008.

7. Specifics/Schedule of MTC Pilot Test

Logistics and Set up (acquire nitrogen, mob equipment to test site, insert probe and hook up equipment)
Test Start
7-day test
Routine monitoring by MTC during test
Test demobilization
Test QA/QC
Reporting
Escorts and site access

8. Emergency Contact Information

Chris Caputi (757) 617-8004 (cell) or ccaputi@mbakercorp.com – (Blackberry)
Jimmy Wolford (903) 986-3564 (office – 24 hr)

9. Other DESC Related Items

Additional Market Survey data collection
USCG pipeline Pressure testing vs. Precision Integrity testing - Annual
Hickam AFB transfer line precision integrity testing vs. pressure testing. (Annual vs. biennial)
UFC 3-460 testing
Hickam AFB Hydrant system testing - biennial

10. Questions/Comments

Appendix C

Draft NWGLDE Listings
Varec Leak Manager

Revision Date: June XX, 2008

BULK UNDERGROUND STORAGE TANK LEAK DETECTION METHOD (50,000 gallons or greater)

VENDOR	EQUIPMENT NAME	LEAK RATE / THRESHOLD / MAX PRODUCT SURFACE AREA
ASTTest Services, Inc.	ASTTest Mass Balance Leak Detection System	[(product surface area in ft² ÷ 5,575 ft²) x 0.88 gph]/[(product surface area in ft² ÷ 5,575 ft²) x 0.44 gph]/13,938 ft²
Engineering Design Group, Inc.	EDG XLD 2000 Plus (Revision 1.02) Leak Detection System (MTS DDA Magnetostrictive Probe)	[(product surface area in ft² ÷ 12,074 ft²) x 1.92 gph]/[(product surface area in ft² ÷ 12,074 ft²) x 0.96 gph]/12,076 ft²
Engineering Design Group, Inc.	Ronan X-76 CTM Automatic Tank Gauging System (MTS Level Plus UST Probe)	[(product surface area in ft² ÷ 564 ft²) x 0.2 gph]/[(product surface area in ft² ÷ 564 ft²) x 0.1 gph]/846 ft²
Mass Technology Corp.	Precision Mass Measurement System (24 hour test)	[(product surface area in ft² ÷ 1,257 ft²) x 0.1 gph]/[(product surface area in ft² ÷ 1,257 ft²) x 0.05 gph]/3,143 ft²
Mass Technology Corp.	Precision Mass Measurement System (48 hour test)	[(product surface area in ft² ÷ 6,082 ft²) x 0.294 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 0.147 gph]/6,082 ft²
Mass Technology Corp.	Precision Mass Measurement System (72 hour test)	[(product surface area in ft² ÷ 14,200 ft²) x 0.638 gph]/[(product surface area in ft² ÷ 14,200 ft²) x 0.319 gph]/35,500 ft²
Praxair Services, Inc. (originally listed as Tracer Research, Corp.)	Tracer ALD 2000 Automated Tank Tightness Test	0.1 gph/A tank system should not be declared tight when tracer chemical or hydrocarbon greater than the background level is detected outside of the tank./Not limited by capacity.
Universal Sensors and Devices, Inc.	LTC-1000 (Mass Buoyancy Probe)	[(product surface area in ft² ÷ 14,244 ft²) x 1.4 gph]/[(product surface area in ft² ÷ 14,244 ft²) x 0.7 gph]/35,610 ft²
Universal Sensors and Devices, Inc.	LTC-2000 (Differential Pressure Probe)	[(product surface area in ft² ÷ 14,244 ft²) x 3.0 gph]/[(product surface area in ft² ÷ 14,244 ft²) x 1.5 gph]/35,610 ft²
Varec, Inc. (originally listed as Coggins Systems, Inc. and later as Endress+Hauser Systems and Gauging)	Fuels Manager and Remote Terminal Unit RTU/8130 (MTS Magnetostrictive Probe)	[(product surface area in ft² ÷ 616 ft²) x 0.2 gph]/[(product surface area in ft² ÷ 616 ft²) x 0.1 gph]/924 ft²
Varec, Inc. (originally listed as Coggins Systems, Inc. and later as Endress+Hauser Systems and Gauging)	Fuels Manager with Barton Series 3500 ATG (48 hour test) (72 hour test)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 1.0 gph]/15,205 ft²
Varec, Inc.	FuelsManager with Enraf 854 ATG (Servo Buoyancy Probe)	[(product surface area in ft² ÷ 11,786 ft²) x 3.00 gph]/[(product surface area in ft² ÷ 11,786 ft²) x 1.50 gph]/ 11,786 ft²
Varec, Inc.	FuelsManager with MTS M-Series ATG (MTS Magnetostrictive Probe)	[(product surface area in ft² ÷ 11,786 ft²) x 4.50 gph]/[(product surface area in ft² ÷ 11,786 ft²) x 2.25 gph]/ 11,786 ft²
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-24 (V1.0.2, V1.0.3)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 or 3.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x (2.0 or 3.0 gph - 0.223 gph)]/15,205 ft²
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-48 (V1.0.2, V1.0.3)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 or 3.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x (2.0 or 3.0 gph - 0.188 gph)]/15,205 ft²
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-24 (V1.1)	[(product surface area in ft² ÷ 6,082 ft²) x 0.856 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 0.632 gph]/15,205 ft²

Issue Date: June XX, 2008

Varec, Inc.

Fuels Manager with Enraf 854 ATG
(Servo Buoyancy Probe)

BULK UNDERGROUND STORAGE TANK LEAK DETECTION (50,000 gallons or greater)

Certification	Leak rate is proportional to product surface area (PSA). For tanks with PSA of 11,786 ft^2, leak rate is 3.00 gph with PD = 95.3% and PFA = 4.7% For other tank sizes, leak rate equals [(PSA in ft^2 ÷ 11,786 ft^2) x 3.00 gph]. Example: For a tank with PSA = 10,000 ft^2; leak rate = [(10,000 ft^2 ÷ 11,786 ft^2) x 3.00 gph] = 2.54 gph. **Leak rate may not be scaled below 0.2 gph.**
Leak Threshold	Leak threshold is proportional to product surface area (PSA). For tanks with PSA of 11,786 ft^2, leak threshold is 1.50 gph. For other tank sizes, leak threshold equals [(PSA in ft^2 ÷ 11,786 ft^2) x 1.50 gph]. Example: For a tank with PSA = 10,000 ft^2; leak threshold = [(10,000 ft^2 ÷ 11,786 ft^2) x 1.50 gph] = 1.27 gph. A tank system should not be declared tight if the test result indicates a loss or gain that equals or exceeds the calculated leak threshold.
Applicability	Gasoline, diesel, aviation fuel. Other liquids may be tested after consultation with the manufacturer.
Tank Capacity	Use limited to single field-constructed vertical tanks 50,000 gallons to 2,100,000 gallons. Maximum product surface area (PSA) is 11,786 ft^2. Tank must be at least 44% full.
Waiting Time	None. Testing may be initiated immediately following a delivery provided a minimum of 72 hours of quality data are collected and analyzed.
Test Period	Minimum of 72 hours. There must be no dispensing or delivery during test.
Temperature	Measurement not required by this system. System is self-compensating for product temperature changes. Buoyancy of float changes with product density in response to temperature changes.
Water Sensor	None. Water ingress leaks are measured as an increase in product level inside the tank.
Calibration	Servo product level measurements must be verified annually and, if necessary, calibrated in accordance with manufacturer's instructions.
Comments	Not evaluated using manifolded tank systems. Tests only portion of tank containing product. As product level is lowered, leak rate in a leaking tank decreases (due to lower head pressure). Consistent testing at low levels could allow a leak to remain undetected.

Evaluated in a nominal 2,100,000 gallon vertical underground tank with diameter of 122.5 ft., height of 23.4 ft., and PSA of 11,786 ft^2.
System is a volumetric measurement test method.

Varec, Inc.
5834 Peachtree Corners East
Norcross, GA 30092
Tel: (770) 447-9202

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494
Date of Evaluation: 04/07/08

Issue Date: June XX, 2008

Varec, Inc.

Fuels Manager with MTS M-Series ATG
(MTS Magnetostrictive Probe)

BULK UNDERGROUND STORAGE TANK LEAK DETECTION (50,000 gallons or greater)

Certification	Leak rate is proportional to product surface area (PSA). For tanks with PSA of 11,786 ft², leak rate is 4.50 gph with PD = 96.3% and PFA = 3.7% For other tank sizes, leak rate equals [(PSA in ft² ÷ 11,786 ft²) x 4.50 gph]. Example: For a tank with PSA = 10,000 ft²; leak rate = [(10,000 ft² ÷ 11,786 ft²) x 4.50 gph] = 3.80 gph. **Leak rate may not be scaled below 0.2 gph.**
Leak Threshold	Leak threshold is proportional to product surface area (PSA). For tanks with PSA of 11,786 ft², leak threshold is 2.25 gph. For other tank sizes, leak threshold equals [(PSA in ft² ÷ 11,786 ft²) x 2.25 gph]. Example: For a tank with PSA = 10,000 ft²; leak threshold = [(10,000 ft² ÷ 11,786 ft²) x 2.25 gph] = 1.91 gph. A tank system should not be declared tight if the test result indicates a loss or gain that equals or exceeds the calculated leak threshold.
Applicability	Gasoline, diesel, aviation fuel. Other liquids may be tested after consultation with the manufacturer.
Tank Capacity	Use limited to single, field-constructed, vertical-walled tanks having a capacity of 50,000 to 2,100,000 gallons. Maximum product surface area (PSA) is 11,786 ft². Tank must be at least 44% full.
Waiting Time	None. Testing may be initiated immediately following a delivery provided a minimum of 72 hours of quality data are collected and analyzed.
Test Period	Minimum of 72 hours. There must be no dispensing or delivery during test.
Temperature	Average for product is determined by resistance temperature detectors (RTDs) located at 18 inch increments from the bottom of the tank.
Water Sensor	Must be used to detect water ingress. Minimum detectable water level in the tank is based on the length of the probe as follows: <25 feet = 3.0 inches <40 feet = 3.8 inches <60 feet = 4.7 inches The water sensor “inactive zone” can be countered by installing the probe over the tank sump. Minimum detectable change in water level is 0.015 inch. Water ingress sensing is continuous and independent of leak detection testing.
Calibration	No scheduled maintenance or recalibration is required. The sensor pipe should be checked annually for build up of process material. Floats should move freely along the sensor pipe. If they do not, routine cleaning should be performed.
Comments	Not evaluated using manifolded tank systems. Tests only portion of tank containing product. As product level is lowered, leak rate in a leaking tank decreases (due to lower head pressure).

Consistent testing at low levels could allow a leak to remain undetected.
Evaluated in a nominal 2,100,000 gallon vertical underground tank with diameter of 122.5 ft., height of 23.4 ft., and PSA of 11,786 ft².
System is a volumetric measurement test method.

Varec, Inc.
5834 Peachtree Corners East
Norcross, GA 30092
Tel: (770) 447-9202

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494
Date of Evaluation: 04/07/08

Addendum 1 to the Market Survey of Leak Detection Systems for the Red Hill Fuel Storage Facility, Fleet Industrial Supply Center, Pearl Harbor

Prepared by: Michael Baker Jr., Inc.
Date: 19 May 2014

Due to the ongoing concern for appropriate leak detection on the Red Hill Bulk Field Constructed USTs (BFCUSTs) Baker was asked to reevaluate the initial Market Survey prepared in 2008 in terms of any new or emergent technologies appropriate to the Red Hill facility. Baker performed a new internet search of the National Working Group for Leak Detection Evaluators (NWGLE) in hopes of finding new technologies that could provide a solution.

A search of the latest NWGLDE listing revealed the following three technologies not initially discussed in the Market Survey:

- Varec Fuels Manager with MTS M-Series ATG
- Varec Fuels Manager with ENRAF 854 ATG
- Vista LRDP-24 V1.0.2 and V1.0.3

Neither of the Varec systems is appropriate to the Red Hill tanks as their technology is limited to 2,100,000 gallon USTs maximum.

The Vista listing is essentially the same technology as those discussed in the Vista section of the 2008 Market Survey. While this system is applicable to the Red Hill Tanks the need to empty and clean the tanks prior to installing the system is a significant drawback to its use.

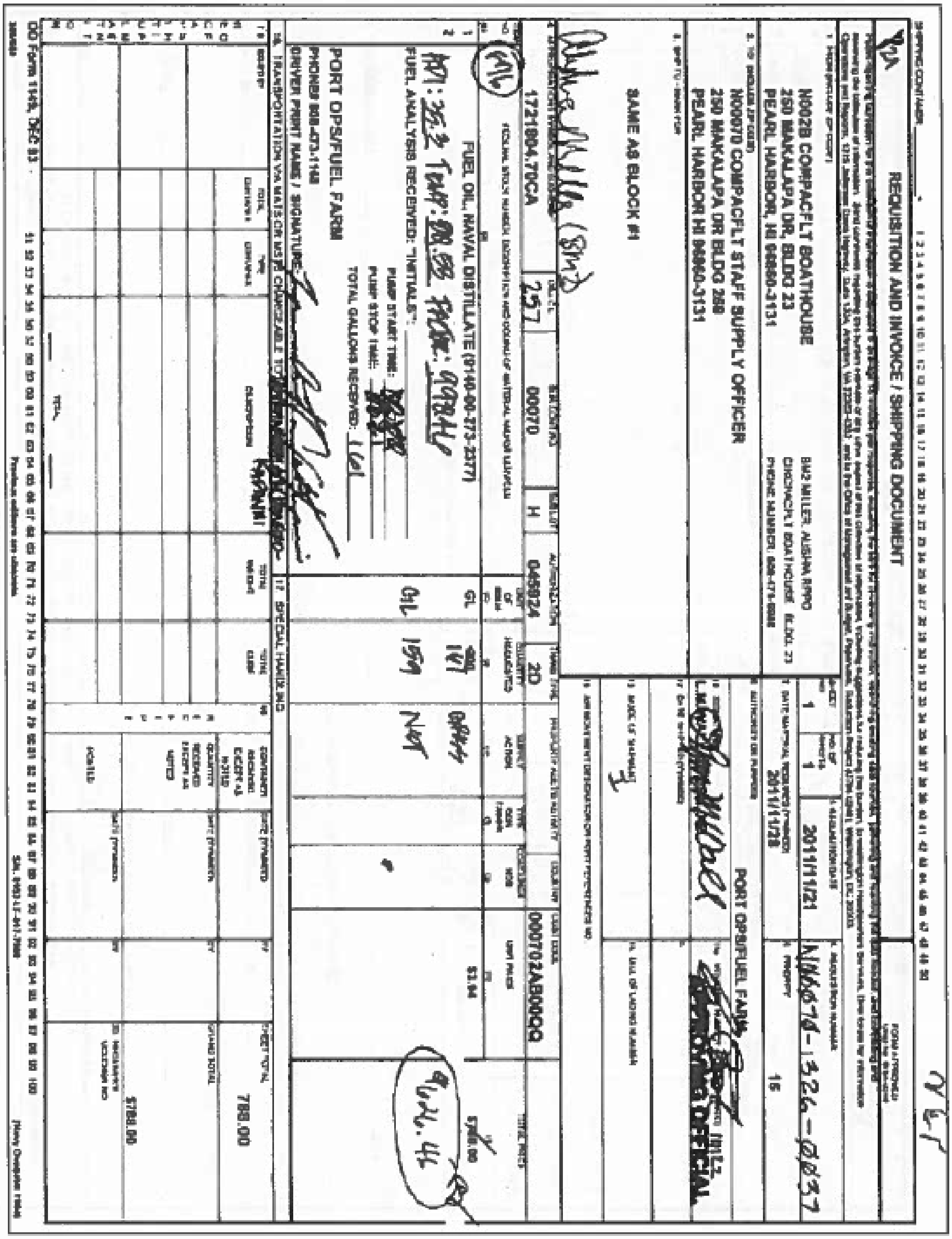
Additionally, Baker contacted the NWGLDE and asked specifically if there were any new methods for Bulk UST leak detection currently being reviewed the working group. In an email from Peter R. Rollo he stated the following:

> I am the team leader for the NWGLDE Aboveground and Bulk Storage Tank Methods group. At present we don't have any new systems or test methods being evaluated or due to be evaluated by the NWGLDE for bulk underground storage tanks (greater than 50,000 gallons). Feel free to contact the workgroup should you have any additional questions.
>
> Peter R. Rollo
> Engineer IV
> DNREC – Tank Management Section
> Phone: 302-395-2500
> Fax: 302-395-2555
> E-Mail: Peter.Rollo@state.de.us

Conclusions:

No new technologies have been identified since the submittal of the 2008 Market Survey that provides a new or better solution then those researched previously.

Sample of Completed DD Form 1149



REQUISITION AND INVOICE / SHIPPING DOCUMENT

1. FROM (INCLUDE ZIP CODE)
N002B COMPACFLT BOATHOUSE
250 MAKALAPA DR, BLDG 23
PEARL HARBOR, HI 96860-3131

BM2 MILLER, ALISHA RPPO
CINCPACFLT BOATHOUSE BLDG. 23
PHONE NUMBER: 808-473-0088

2. TO (INCLUDE ZIP CODE)
N00070 COMPACFLT STAFF SUPPLY OFFICER
250 MAKALAPA DR BLDG 250
PEARL HARBOR HI 96860-3131

3. SHIP TO - MARK FOR
SAME AS BLOCK #1

Sheet no.: 1 | No. of sheets: 1 | Requisition date: 2011/11/21 | Requisition number: N00070-1326-0037
Date material required: 2011/11/28 | Priority: 15
Authority or purpose: PORT OPS/FUEL FARM
Signature: APPROVING OFFICIAL
Mode of shipment: 1

Appropriations symbol and subhead	Obj. class	Bur. control	Sub-allot	Authorization acct'g activity	Trans type	Property acct'g activity	Country	Cost code
1721804.70CA	257	00070	H	045924	2D			000702AB00QQ

Item no.	Federal stock number, description and coding of material and/or services	Unit of issue	Quantity requested	Supply action	Type cont.	Container nos.	Unit price	Total price
1	FUEL OIL, NAVAL DISTILLATE (9140-00-273-2377)	GL	200 / 161				$3.94	$788.00
2	API: 35.3 TEMP: 88.53 FACTOR: .99841	GL	159	NET				626.44

FUEL ANALYSIS RECEIVED: "INITIALS":
PUMP START TIME:
PUMP STOP TIME:
TOTAL GALLONS RECEIVED: 161

PORT OPS/FUEL FARM
PHONE# 808-473-1148
DRIVER PRINT NAME / SIGNATURE:

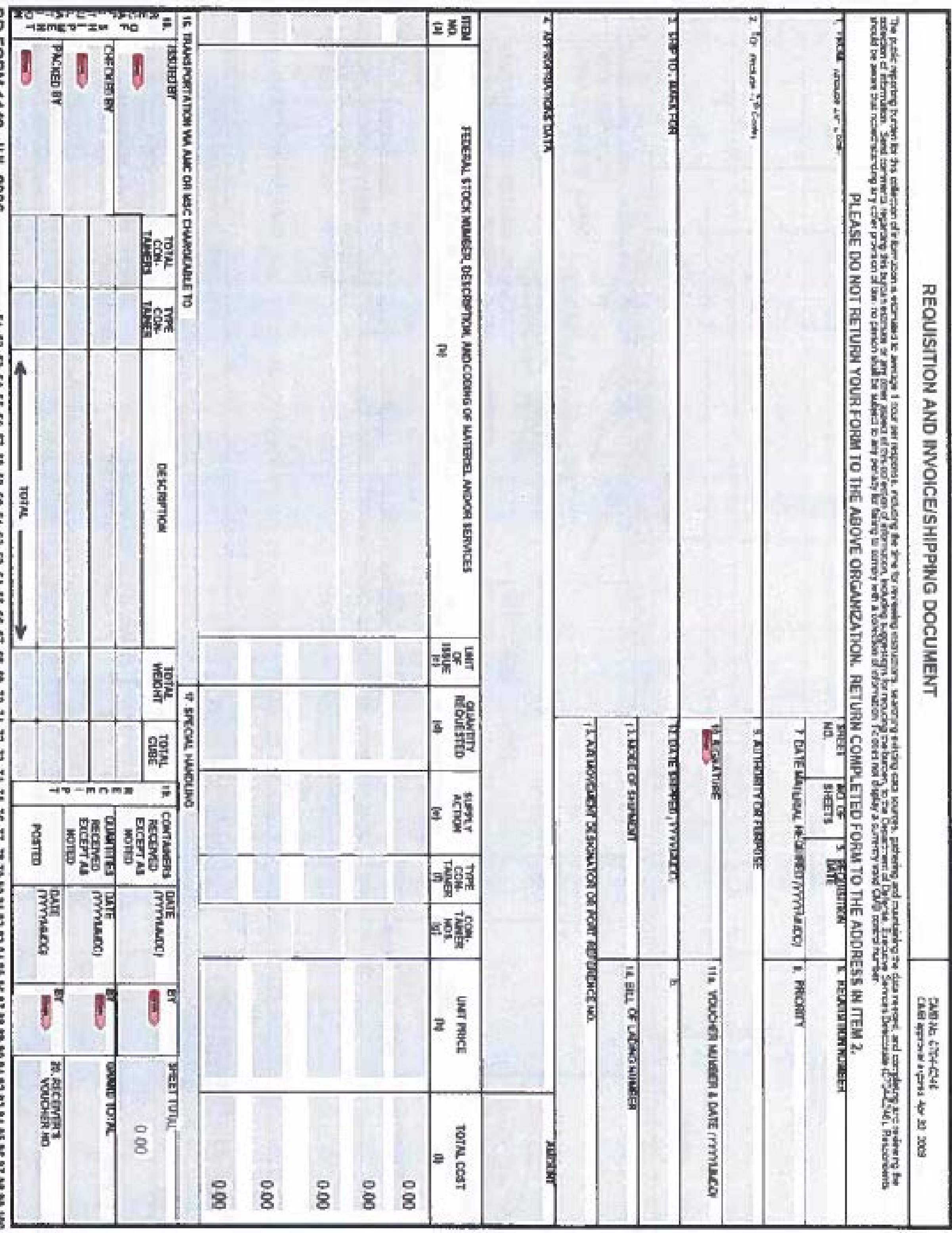
16. TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO
17. SPECIAL HANDLING

Sheet total: 788.00
Grand total: $788.00

DD Form 1149, DEC 83 — Previous editions are obsolete. — S/N. 0102-LF-011-7000

SAMPLE OF DD FORM 1149

Sample of Blank DD Form 1149



SHIPPING CONTAINER TALLY

REQUISITION AND INVOICE/SHIPPING DOCUMENT

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION. RETURN COMPLETED FORM TO THE ADDRESS IN ITEM 2.

1. FROM
2. TO
3. SHIP TO - MARK FOR
4. APPROPRIATIONS DATA
5. REQUISITION DATE
6. REQUISITION NUMBER
7. DATE MATERIAL REQUIRED (YYYYMMDD)
8. PRIORITY
9. AUTHORITY OR PURPOSE
10. SIGNATURE
11a. VOUCHER NUMBER & DATE (YYYYMMDD)
12. DATE SHIPPED (YYYYMMDD)
13. MODE OF SHIPMENT
14. BILL OF LADING NUMBER
15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NO.
16. TRANSPORTATION VIA AMC OR MSC CHARGEABLE TO
17. SPECIAL HANDLING
20. RECEIVER'S VOUCHER NO.

ITEM NO. (a)	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND/OR SERVICES (b)	UNIT OF ISSUE (c)	QUANTITY REQUESTED (d)	SUPPLY ACTION (e)	TYPE CONTAINER (f)	CONTAINER NOS. (g)	UNIT PRICE (h)	TOTAL COST (i)
								0.00
								0.00
								0.00
								0.00
								0.00

DD FORM 1149, JUL 2006

SAMPLE OF DD FORM 1149

Example of Blank DD Form 1348-7

DOD MILSPETS DFSP SHIPMENT AND RECEIPT DOCUMENT

SHIPMENT INFORMATION

1. PRODUCT CODE	2. NSN	3. UNIT OF ISSUE
4. QUANTITY DETERMINATION METHOD		5. QUANTITY
6. DOCUMENT NUMBER		7. SHIPMENT DATE (MMM DD YYYY)
8. MODE OF TRANSPORT		9. BATCH/CARGO NUMBER
10. UPLOAD START DATE (MMM DD YYYY)	11. UPLOAD END DATE (MMM DD YYYY)	

SHIPPING AND RECEIVING ACTIVITY INFORMATION

	a. SHIPPING ACTIVITY	b. RECEIVING ACTIVITY
12. DFSP NAME:		
13. DODAAC:		
14. DFSP ADDRESS (Line 1):		
(Line 2):		
(Line 3):		
(Line 4):		
15. POINT OF CONTACT NAME:		
16. POINT OF CONTACT PHONE:		

17.a. SHIPPING DFSP AUTHORIZED REPRESENTATIVE SIGNATURE	17.b. DATE (MMM DD YYYY)

MATERIAL RECEIPT

18. VERIFIED RECEIPT QUANTITY	19. VARIANCE QUANTITY	20. VARIANCE %	21. RECEIPT DATE (MMM DD YYYY)
22. QUANTITY DETERMINATION METHOD			
23. RECEIVING DFSP AUTHORIZED REPRESENTATIVE SIGNATURE			24. DATE (MMM DD YYYY)

25. SHIPMENT RELEASE INFORMATION/ADDITIONAL DATA/REMARKS

IN THE EVENT OF AN EMERGENCY CONTACT: DOD HAZARDOUS HOTLINE: 1-800-851-8061
DESC OPERATIONS CENTER: (703) 767-8420

DD FORM 1348-7, AUG 2006 PREVIOUS EDITION MAY BE USED.

SAMPLE OF DD FORM 1348-7

Example of Blank DD Form 250

MATERIAL INSPECTION AND RECEIVING REPORT	*Form Approved* *OMB No. 0704-0248*

The public reporting burden for this collection of information is estimated to average 30 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Executive Services and Communications Directorate (0704-0248). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE ABOVE ORGANIZATION.
SEND THIS FORM IN ACCORDANCE WITH THE INSTRUCTIONS CONTAINED IN THE DFARS, APPENDIX F-401.

1. PROCUREMENT INSTRUMENT IDENTIFICATION (CONTRACT) NO.	ORDER NO.	6. INVOICE NO./DATE	7. PAGE OF	8. ACCEPTANCE POINT
2. SHIPMENT NO.	3. DATE SHIPPED	4. B/L TCN	5. DISCOUNT TERMS	
9. PRIME CONTRACTOR CODE		10. ADMINISTERED BY CODE		
11. SHIPPED FROM (If other than 9) CODE	FOB:	12. PAYMENT WILL BE MADE BY CODE		
13. SHIPPED TO CODE		14. MARKED FOR CODE		

15. ITEM NO.	16. STOCK/PART NO. DESCRIPTION (Indicate number of shipping containers - type of container - container number.)	17. QUANTITY SHIP/REC'D*	18. UNIT	19. UNIT PRICE	20. AMOUNT

21. CONTRACT QUALITY ASSURANCE

a. ORIGIN

☐ CQA ☐ ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract, except as noted herein or on supporting documents.

DATE SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

TYPED NAME:

TITLE:

MAILING ADDRESS:

COMMERCIAL TELEPHONE NUMBER:

b. DESTINATION

☐ CQA ☐ ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract, except as noted herein or on supporting documents.

DATE SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

TYPED NAME:

TITLE:

MAILING ADDRESS:

COMMERCIAL TELEPHONE NUMBER:

22. RECEIVER'S USE

Quantities shown in column 17 were received in apparent good condition except as noted.

DATE RECEIVED SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

TYPED NAME:

TITLE:

MAILING ADDRESS:

COMMERCIAL TELEPHONE NUMBER:

** If quantity received by the Government is the same as quantity shipped, indicate by (X) mark; if different, enter actual quantity received below quantity shipped and encircle.*

23. CONTRACTOR USE ONLY

DD FORM 250, AUG 2000 PREVIOUS EDITION IS OBSOLETE. Adobe Professional 8.0

SAMPLE OF DD FORM 250

NAVSUP

DAILY TRUCK RACK ISSUE WORKSHEET

PRODUCT: ____________ ISSUE TANK: ____________ API: ________ TEMP: ________ FACTOR: __________ DATE: ____________ OPERATOR: ____________/____________

ACTIVITY AND VEHICLE NUMBER	CORRECTED			METER READING (BIG NUMBERS)	NET	METER # 1 (ADIT 1) TOTALIZER		GROSS QUANTITY ISSUED BY TOTALIZER		METER # 2 (BLDG 490) TOTALIZER	
	API	TEMP	FACTOR			OPENING	CLOSING	# 1	# 2	OPENING	CLOSING
TRUCK TOTAL GROSS							TOTAL GROSS				
							GROSS 1 + 2				
							TRUCK TOTAL				
							LOSS / GAIN + / -				

FISC TRANS VEHICLE #	OPENING BALANCE	GALS LOADED	TOTAL	SHIP / ACTIVITY	AMOUNT ISSUED	BALANCE	GALS / LOSS

FLC Fuel Form 7 ev 1, 20 Jul 11)

SAMPLE OF BARGE/TRUCK INVENTORY – DAILY & SUMMARY REPORT

TRANSFER RECORD

PUMPHOUSE: UGPHSE / LOADING RACK **PRODUCT: JP-5** **DATE:**

FROM	GAUGE		WATER		GROSS BBLS	TEMP	FACTOR	START	TO	GAUGE		WATER		GROSS GALS/BBLS	TEMP	FACTOR	GAIN LOSS	INV. GROSS GALS/BBLS
	FT	IN	FT	IN		API	NET BBLS	FINISH		FT	IN	FT	IN		API	NET GALS/BBLS		NET GALS/BBLS

SAMPLE OF EVOLUTION FUEL TRANSFER

Fri 03/25/2016 TANK INVENTORY - BARRELS 16:37:26

TANK NAME	LEVEL	GROSS	NET	BS&W	(GR-BSW) *VCF	ULLAGE	API	TEMP	VCF
TANK-0102	[redacted]	[redacted]	[redacted]	0.00	[redacted]	[redacted]	43.3000	79.83	0.98995
TANK-0103	*			0.00	*		44.1000	81.27	0.98912
TANK-0104				0.00			43.0000	82.31	0.98873
TANK-0105				0.00			43.7000	79.23	0.00000
TANK-0106				0.00			43.2000	82.22	0.98875
TANK-0107				0.00			40.0000	77.40	0.99152
TANK-0108				0.00			42.1000	77.81	0.99110
TANK-0109				0.00			41.3000	78.37	0.99091
TANK-0110				0.00			43.0000	78.46	0.99068
TANK-0111				0.00			42.2000	78.57	0.99071
TANK-0112				0.00			42.4000	80.11	0.98991
TANK-0113				0.00			36.5000	77.31	0.99188
TANK-0114				0.00			36.5000	80.20	0.00000
TANK-0115				0.00			36.9000	76.77	0.99211
TANK-0116				0.00			39.4000	79.52	0.99055
TANK-0117				0.00			41.8000	77.23	0.00000
TANK-0118				0.00			40.7000	62.64	0.99871
TANK-0120				0.00			42.2000	77.34	0.99133
TANK-1				19.79			44.0000	81.81	0.98886
TANK-2				18.55			39.9000	80.05	0.99023
TANK-3				0.00			39.5000	78.58	0.99099
TANK-4				12.10			32.0000	79.44	0.99120
TANK-B1	4' 0" 3	1,417.2	1,404.7	436.14	972.39	7,548.8	34.1000	79.21	0.99116
TANK-B2	19' 2" 4	9,573.7	9,483.9	44.98	9,439.3	354.30	34.6000	80.31	0.99062
TANK-46	[redacted]	[redacted]	[redacted]	0.00	[redacted]	[redacted]	43.7000	76.07	0.00000
TANK-47	*			0.00			33.1000	73.48	0.00000
TANK-48				1.96	*		38.5000	74.30	0.99315
TANK-53				0.00			42.1000	77.42	0.99130
TANK-54				1.01			31.9000	75.78	0.99287
TANK-55				2.71			39.9000	76.11	0.99216
TANK-1811I	4' 4" 0	173.29	172.02	0.00	172.02	257.69	31.9000	78.12	0.99268
TANK-1811R	5' 3" 14	115.96	115.06	0.00	115.06	104.19	32.0000	79.09	0.99228
TANK-1812I	7' 1" 4	324.62	322.33	0.00	322.32	108.28	27.4000	77.98	0.99293
TANK-1812R	4' 6" 3	94.45	93.80	0.00	93.80	127.95	27.3000	77.76	0.99303
TANK-301	7' 6" 2	1,494.0	1,480.8	0.01	1,480.8	2,462.9	40.1000	78.11	0.99116

TANK PRODUCT INVENTORY - BARRELS

PRODUCT	GROSS	NET	(GR-BSW) *VCF	ULLAGE	HEEL	PL VOL.	ISSUABLE
DFM	[redacted] *	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
JP5							
JP8							
WO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lube2190	339.63	334.63	334.63	361.87	32.33	2.83	307.29
Lube9250	452.65	446.86	446.86	236.23	32.55	2.83	420.10
Ballast	11,029.9	10,888.6	10,411.7	7,903.1	3,204.6	39.00	7,825.3

BARGE / TRUCK INVENTORY - BARRELS

BARGE/TRUCK NAME	GROSS VOLUME	NET VOLUME	API	TEMP
96-49146	30.74	30.74	27.4000	82.01
96-49147	47.55	47.55	31.9000	76.94
96-47913	114.50	113.50	39.7000	77.82
96-47206	0.00	0.00	34.6000	81.57
	0.00	0.00	0.0000	0.00
YON-328	0.00	0.00	34.6000	0.00
YON-335	4,301.5	4,263.6	35.9000	79.00
	0.00	0.00	0.0000	0.00
	0.00	0.00	0.0000	0.00
	0.00	0.00	0.0000	0.00
	0.00	0.00	0.0000	0.00
	0.00	0.00	0.0000	0.00
	0.00	0.00	0.0000	0.00

SAMPLE OF PRODUCT INVENTORY – DAILY & SUMMARY (PAGE 1)

*Privileged, subject to critical infrastructure information claim, 5 USC 552(b)(3); 10 U.S.C. 130(e).

PRODUCT	GROSS VOLUME	NET VOLUME	API	TEMP	VCF
DFM	4,301.5	4,263.6	35.9000	79.00	0.00000
JP5	114.50	113.50	39.7000	77.82	0.00000
JP8	0.00	0.00	0.0000	0.00	0.00000
WO	0.00	0.00	0.0000	0.00	0.00000
2190	47.55	47.55	31.9000	76.94	0.00000
9250	30.74	30.74	27.4000	82.01	0.00000
BALLAST	0.00	0.00	0.0000	0.00	0.00000

Fri 03/25/2016 TANK VOLUME COMPARISON - BARRELS 16:37:26

TANK NAME	CURRENT GROSS	PREVIOUS GROSS	GROSS DIFFERENCE	CURRENT NET	PREVIOUS NET	NET DIFFERENCE
TANK-0102	[redacted]					
TANK-0103						
TANK-0104						
TANK-0105						
TANK-0106						
TANK-0107						
TANK-0108						
TANK-0109						
TANK-0110						
TANK-0111	*Privileged, subject to critical infrastructure information claim, 5 USC 552(b)(3); 10 U.S.C. 130(e).					
TANK-0112						
TANK-0113						
TANK-0114						
TANK-0115						
TANK-0116						
TANK-0117						
TANK-0118						
TANK-0120						
TANK-1						
TANK-2						
TANK-3						
TANK-4						
TANK-301	1,494.0	1495.4	-1.4	1,480.8	1481.8	-1.0
TANK-B1	1,417.2	1356.1	61.1	1,404.7	1344.0	60.7
TANK-B2	9,573.7	9576.0	-2.3	9,483.9	9484.7	-0.8
TANK-46	[redacted]					
TANK-47	*Privileged, subject to critical infrastructure information claim, 5 USC 552(b)(3); 10 U.S.C. 130(e).					
TANK-48						
TANK-53						
TANK-54						
TANK-55						
TANK-1811R	115.96	158.8	-42.9	115.06	157.6	-42.5
TANK-1811I	173.29	173.3	0.0	172.02	171.9	0.1
TANK-1812R	94.45	94.5	0.0	93.80	93.8	0.0
TANK-1812I	324.62	324.6	0.0	322.33	322.2	0.1

SAMPLE OF PRODUCT INVENTORY – DAILY & SUMMARY (PAGE 2)

Pearl Harbor Defense Fuel Support Point
Evolution Ticket

Client Name : HICKAM <11-4>
Document Number : WO #30000038
Evolution ID : 21656
Type : ISSUE
P-Code :
Product : JP8
Vol. Cor. Factor: 0.98948
API : 43.0000
Start Time : 03/25/2016 08:22:28
Stop Time : 03/25/2016 15:59:51

	Evol Net BBLs	Evol Gross BBLs	Start/Stop Level	Start/Stop Net BBLs	Start/Stop Gross BBLs
Source 1 : TANK-0104	9,815.6	9,927.5	178' 3" 6	222486.3	225017.8
:			171' 1" 10	212670.7	215094.8
Source 2 :	0.00	0.00		0.0	0.0
:				0.0	0.0
Source 3 :	0.00	0.00		0.0	0.0
:				0.0	0.0
Source 4 :	0.00	0.00		0.0	0.0
:				0.0	0.0
Source Totals(BBLs):	9,815.6	9,927.5			
Source Temperature(F):	82.31				
Source Vol. Cor. Factor:	0.98873				
Intermediate :	0.00			0.0	0.0
:				0.0	0.0
Destination 1: METER VC14-JP8	9,785.9	9,889.9		0.0	0.0
:				0.0	0.0
Destination 2:	0.00	0.00		0.0	0.0
:				0.0	0.0
Destination 3:	0.00	0.00		0.0	0.0
:				0.0	0.0
Destination 4:	0.00	0.00		0.0	0.0
:				0.0	0.0
Destination Totals(BBLs):	9,785.9	9,889.9			
Destination Temperature(F):	82.70				
Destination Vol. Cor.Factor:	0.98948				

Out of Tolerance: NO

Source/Destination Totals Used: DEST

Evolution Total Net Volume: 9,785.9 BBLs 411,008 Gallons

Evolution Total Gross Volume: 9,889.9 BBLs 415,376 Gallons

SAMPLE OF EVOLUTION TICKET

TWENTY-FIRST EDITION, 2014

LIST OF LEAK DETECTION EVALUATIONS FOR STORAGE TANK SYSTEMS

January 24, 2014

NWG
LDE

WWW.NWGLDE.ORG

This Edition Reviewed for Consistency with Website

DISCLAIMER

GENERAL

Appearance on this list is not to be construed as an endorsement by any regulatory agency nor is it any guarantee of the performance of the method or equipment. Equipment should be installed and operated in accordance with all applicable laws and regulations.

This list of Leak Detection Evaluations was prepared by a work group consisting of State and EPA members and is limited to evaluations of leak detection equipment and procedures or systems, conducted by an “independent third-party evaluator” (see Appendix “Glossary of Terms”) and reviewed by the work group. This list includes evaluations conducted in accordance with either EPA Standard Test Procedures for Evaluating Leak Detection Methods (EPA/530/UST-90/004 through 010) or other test procedures accepted by the NWGLDE as equivalent to the EPA standard test procedures (see Part III “Acceptable Test Protocols”).

The National Work Group on Leak Detection Evaluations (NWGLDE) does not guarantee the performance of any leak detection method or equipment appearing on this List, nor does it warrant the results obtained through the use of such methods or equipment.

SPECIFIC

- The NWGLDE does not evaluate methods or equipment and appearance on this List does not mean they are automatically acceptable for use in any particular state or local jurisdiction.
- The NWGLDE List is not an EPA List, nor does appearance on this list constitute endorsement or approval by the NWGLDE or EPA. Anyone claiming that a device or method is “EPA approved” because it appears on this list is making a false claim.
- The NWGLDE makes no representations concerning the safe operation of any method or equipment. Users of any method or equipment appearing on this List assume full responsibility for the proper and safe operation of said equipment and assume any and all risks associated with its use.
- On each data sheet, this List reports parameters and data values for methods, equipment, and software that are specific to the most current third-party evaluation submitted to the NWGLDE. Subsequent modifications or changes to the method, equipment, or software may produce parameters and data values that are significantly different than the listed third-party evaluation parameters and data values. It is the responsibility of the local implementing agency to accept or reject those modifications or changes.
- Since long term material compatibility with the product stored is not addressed in test procedures and evaluations, the NWGLDE makes no representations as to the compatibility of leak detection equipment with the product stored.
- Unless specifically indicated on the individual data sheets, performance with alternative fuels has not been demonstrated **with the following exception:**

  Biodiesel B6 through B20 meeting ASTM D7467 and biodiesel B100 meeting ASTM D6751 may be used with all equipment listed for diesel whether or not these alternative fuels are included on individual data sheets. This exception DOES NOT APPLY to leak detection test methods using Out-Of Tank Product Detection (Vapor Phase) for B6-B20, and Out-Of Tank Product Detection (Liquid and Vapor Phase) and any tracer-based test methods for B100. For these methods, individual data sheets will have to be referenced to determine applicability.

Alabama Department of Environmental Management
adem.alabama.gov

January 24, 2014

MEMORANDUM

TO: Vendors of Leak Detection Equipment/Systems, Regulators, and Other Interested Parties

FROM: Curt D. Johnson, NWGLDE Chair CDJ

RE: ***National Work Group on Leak Detection Evaluation's (NWGLDE) List of Leak Detection Evaluations for Storage Tank Systems***

The National Work Group on Leak Detection Evaluations is proud to make available our **21st Edition, 2014 of the "List of Leak Detection Evaluations for Storage Tank Systems"**. Each year the NWGLDE publishes a new edition of the "List" that can be downloaded from our web site. This and all previous editions of the "List" are available from our web site on the "Downloads" page in both Adobe ® Portable Document Format (PDF) and Microsoft ® Word format (DOC). There is also a web site version of the "List" that is kept up-to-date with new and revised listings on a monthly basis throughout the year. Changes made to the web site "List" since the issue date of the most recent edition of the "List" are noted on our web site under "News and Events". We invite you to visit our web site at the following address:

http://www.nwglde.org/

For help with accessing anything on our web site, please contact our web master, Marcia Poxson, at poxsonm@michigan.gov, or give her a call at (517) 373-3290.

If you need to contact members of the work group, information is included for contacting them after this memo. Also, the work group team and team leaders are listed on the page following the member "List" to help you determine whom you may need to contact. However, this information is more likely to be current on our web site and can be found under "Group Members" and "Team Leaders".

Vendors should send new third-party evaluations, which were performed by an "independent third-party evaluator" (see Glossary of Terms), to be reviewed by the work group to **the team leader and all the members of the team**. To enable the work group to properly review the evaluations, **one (1) copy** of all applicable information indicated in the enclosed "Leak Detection Equipment Review - Document List" must be sent to the team leader and each team member.

In the interest of expediting third-party evaluation reviews, maintaining consistency among evaluations, and adhering to the accepted evaluation protocols, the NWGLDE has adopted the following policies:

1. **In order for an evaluation to be listed, third-party evaluation reports must clearly state which protocol was used to conduct the evaluation. The Work Group will not review any evaluations that do not follow either:**
   a. **A Standard EPA protocol, or**
   b. **An alternative protocol, e.g., a national voluntary consensus standard or other accepted test procedures developed by an independent third-party. *Currently, the mechanism to obtain approval of alternative protocols is to first submit them to a peer review committee. Once the peer review committee determines that the protocol conforms with the minimum requirements as***

described in the "Foreword" to each of the EPA protocols, they will forward the protocol to the appropriate Work Group Team Leader and recommend that the Work Group add the protocol to the "List". The Work GroupTeam will then review the protocol to confirm the peer review committee determination.

c. **An existing protocol that has been amended for a specific evaluation.** ***Currently, the mechanism to obtain approval of amended protocols is to have the evaluator submit the amendment to the appropriate Work Group Team Leader prior to conducting the evaluation. The Team will review the amendment and either approve it or suggest modifications.***

2. **Changes to a listed protocol need to be discussed with the Work Group before testing, or before continuing testing if the evaluator identifies concerns during testing. Regular communication with Work Group members can expedite an evaluation's review.**
3. **If a problem is discovered with a third-party test after a system data sheet has been added to the "List", or if a listed system is modified by the vendor in such a way that the changes affect how it detects and/or quantifies a leak, the vendor shall be given a reasonable time period to provide the necessary information to clarify or modify the listing. The data sheet listing may be removed from the "List" if:**
   a. **The vendor must re-evaluate the system,**
   b. **The vendor fails to meet the time frame set by the Work Group,**
   c. **The vendor fails to respond to take the appropriate actions.**

   The system data sheet may be reinstated on the "List" after all third-party test concerns are resolved. If concerns cannot be resolved or if there is no response from the vendor, the system will no longer appear on the "List".

Since the first draft "List" was sent out back in January of 1995, the "List" has sometimes been referred to as the "EPA work group list of approved leak detection equipment". The work group and EPA are concerned that similar statements may appear in sales literature distributed by vendors. We request that no one refer to the "List" in this way for the following reasons:

1. **This is not an EPA or EPA work group list.** This "List" was prepared by an **independent** work group consisting of state and EPA members.

2. **Neither EPA nor the work group approves leak detection equipment or procedures.** The "List" does not include "approved" leak detection equipment/procedures. It includes leak detection equipment/procedures that the work group has reviewed. This review has confirmed that the leak detection equipment/procedures were third-party tested in accordance with either an EPA or other acceptable test protocol. The review also confirmed that the equipment/procedures met EPA performance standards under test conditions. Approval or acceptance of leak detection equipment and procedures is the responsibility of the implementing agency, which in most cases is the state environmental agency. Please read the work group "Disclaimer" on page ii.

Attachments: Work Group Members, Work Group Teams, Leak Detection Equipment Review Document List, Latest Edition of List of Leak Detection Evaluations for UST Systems

NWGLDE LEAK DETECTION EQUIPMENT/METHOD EVALUATION REVIEW - DOCUMENT LIST

(Revised October 12, 2011)

The following is a checklist of the documentation required by the NWGLDE for review of third-party evaluations of storage tank system leak detection equipment/methods. As much as possible, please send the information electronically.

☐ 1. Documentation establishing intellectual property ownership of the leak detection method.

2. A complete third-party evaluation report, including:
☐ a. Details of the evaluation procedure if the EPA standard procedure was not used for the evaluation. If the EPA evaluation procedure was used, list any deviations or modifications to the procedure.
☐ b. Version of equipment software, if equipment uses software.
☐ c. A complete set of all the EPA required attachment sheets.
☐ d. Individual test logs and/or field notes.
☐ e. Statistical calculations and any applicable graphs or charts generated during the evaluation.
☐ f. A statement from the evaluator confirming that all equipment at the test site was properly maintained and calibrated to the level of accuracy necessary for a valid evaluation.

☐ 3. An outline of the manufacturer's operating procedures for the equipment/system. The summary procedure must be dated and include a revision number, if applicable. A copy of the summary procedure must be provided to the third-party evaluator for enclosure in the report. Also required is a statement from the manufacturer confirming the use of the submitted procedure during the evaluation.

☐ 4. A complete installation/operations manual for the equipment/system.

☐ 5. A sample of the test report (including field work-sheets) which will be submitted to the owner/local implementing agency.

☐ 6. An outline of the test procedures in high groundwater areas. These procedures should be reviewed for adequacy by the third-party evaluator and a statement to that effect should be included with the report.

☐ 7. An outline of the test procedures for manifolded tank systems. These procedures should be reviewed for adequacy by the third-party evaluator and a statement to that effect should be included with the report.

☐ 8. An affidavit from the manufacturer confirming that there are no mutual financial interests between the equipment manufacturer and the third-party evaluator.

☐ 9. A resume, including all applicable formal training and experience, from personnel who conducted the evaluation.

☐10. Equipment calibration procedures and manufacturer recommended schedule of calibration.

☐11. Digital picture(s), or link(s) to picture(s) of the leak detection equipment (300 dpi or greater are best) are requested, but not required. If provided, the Work Group will include the picture(s) on the web site listing.

☐12. The name, address, e-mail address, and phone number of the <u>technical personnel</u> serving as the manufacturer's representative for the response to the regulatory agency questions on the equipment/system. Also, the URL for the manufacturer's web site, if applicable.

☐13. Correspondence letters from state agencies who have reviewed the equipment/system.

14. The following documentation for all permanently-installed leak detection equipment:
☐a. An outline of the maintenance procedure (including a list of the parts or functions of the system to be checked, calibrated, or programmed) for the annual functional test by authorized service personnel.
☐b. An outline (1-2 pages) "Equipment Check Guidelines for Inspectors" prepared by the manufacturer. This summary should guide local agency inspectors on proper field procedures to follow when inspecting equipment for proper operation, for attempting to access the stored history (for alarms or failed tests) to determine compliance with state requirements.
☐c. A sample of the reports generated and/or printed by the equipment (for all equipment models), and an explanation of the items in the report, if not self-explanatory.
☐d. Information on how the control panel modules connected to the various probes are labeled. The information on the panel should be directly comparable to the equipment name, model/part/probe number which will be included in the committee's list. If necessary, a permanent label containing that information should be affixed to the panel.

15. The following documentation for the systems using tracer analysis:
☐a. The name and certification of the laboratory analyzing vapor samples.
☐b. Quality Assurance Manual of the laboratory.
☐c. The method and amount of tracer injection.
☐d. The vapor sample collection method and chain of custody records.
☐e. The third-party certification for capability of the system to detect leaks from the ullage portion of the tank.

16. The following documentation for the mechanical and electronic line leak detectors:
☐a. The maximum vertical rise of pipeline allowed above the transducer, controller or leak detector.

WORK GROUP MEMBERS **Revised 01/3/14**

MEMBER	ADDRESS	PHONE/FAX/E-MAIL
Curt Johnson, Chair	Alabama Department of Environmental Management PO Box 301463 Montgomery, AL 36130-1463	(334) 271-7986 Fax (334) 270-5631 cdj@adem.state.al.us
Lamar Bradley, Vice Chair	Tennessee Department of Environment and Conservation Division of Underground Storage Tanks William R. Snodgrass Tennessee Tower 312 Rosa L. Parks Avenue, 12th Floor Nashville, TN 37243	(615) 532-0952 Fax (615) 532-0199 lamar.bradley@tn.gov
Greg Bareta	Permit & Licensing Section Bureau of Weights & Measures Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) Petroleum Products and Tanks 141 NW Barstow Street, 4th Floor Waukesha, WI 53188-3789	(262) 523-3044 Fax (262) 521-5187 greg.bareta@wisconsin.gov
Michael Juranty	New Hampshire Department of Environmental Services Waste Management Division Oil Compliance Section PO Box 95 29 Hazen Drive Concord, NH 03302-0095	(603) 271-6058 Fax (603) 271-2181 michael.juranty@des.nh.gov
Shaheer Muhanna	Georgia DNR - EPD 4244 International Parkway, Suite 104 Atlanta, GA 30354	(404) 362-2579 Fax (404) 362-2654 SHAHEER_MUHANNA@dnr.state.ga.us
Heather Peters	Missouri Department of Natural Resources 1730 East Elm Street Jefferson, MO 65101	(573) 751-7877 Fax (573) 526-5268 heather.peters@dnr.mo.gov
Marcia Poxson	Michigan Department of Environmental Quality Remediation Division Storage Tank and Contract Unit 525 West Allegan Street PO Box 30246 Lansing, MI 48909-7741	(517) 373-3290 Fax (517) 335-2245 poxsonm@michigan.gov
Helen Robbins	Connecticut Department of Environmental Protection 79 Elm Street Hartford, CT 06106	(860) 424-3291 Fax (860) 424-4061 helen.robbins@ct.gov
Peter Rollo	DNREC – Tank Management Section 391 Lukens Drive New Castle, DE 19720	(302) 395-2500 Fax (302) 395-2555 peter.rollo@state.de.us
Tim Smith	U.S. EPA/OUST (Mail Address): 1200 Pennsylvania Ave., NW 5402P Washington, DC 20460 (Fed Ex Address): Two Potomac Yard (North Bldg.) 2733 S. Crystal Drive Arlington, VA 22202	(703) 603-7158 Fax (703) 603-0175 smith.timr@epamail.epa.gov

WORK GROUP TEAMS **Revised 1/6/14**

TEAM	LEADER	MEMBERS
Automatic Tank Gauging (ATG) and Volumetric Tank Tightness Test (VTTT) Methods	Lamar Bradley	Mike Juranty
Continuous In-Tank Leak Detection Methods	Shaheer Muhanna	Helen Robbins Heather Peters
Non-Volumetric Tank Tightness Test Methods	Helen Robbins	Mike Juranty
Line Leak Detection Methods	Greg Bareta	Heather Peters
Statistical Inventory Reconciliation (SIR) Methods	Lamar Bradley	Shaheer Muhanna Heather Peters
Interstitial Monitoring and Out-of-Tank Detector Methods	Tim Smith	Peter Rollo Lamar Bradley
Aboveground and Bulk Storage Tank Methods	Peter Rollo	Greg Bareta Marcia Poxson
Secondary and Spill Containment Test Methods	Shaheer Muhanna	Tim Smith Mike Juranty
List Administration and Surveys	Curt Johnson	Marcia Poxson Helen Robbins Heather Peters

Revision Date: April 15, 2013

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PART II - LEAK DETECTION EQUIPMENT/SYSTEMS SPECIFICATIONS (Continued)

BULK UNDERGROUND STORAGE TANK LEAK DETECTION METHOD (50,000 gallons or greater)

VENDOR	EQUIPMENT NAME	LEAK RATE/THRESHOLD/ MAX PRODUCT SURFACE AREA
ASTTest Services, Inc.	ASTTest Mass Balance Leak Detection System	[(product surface area in ft² ÷ 5,575 ft²) x 0.88 gph]/[(product surface area in ft² ÷ 5,575 ft²) x 0.44 gph]/13,938 ft²
Engineering Design Group, Inc.	EDG XLD 2000 Plus (Revision 1.02) Leak Detection System (MTS DDA Magnetostrictive Probe)	[(product surface area in ft² ÷ 12,074 ft²) x 1.92 gph]/[(product surface area in ft² ÷ 12,074 ft²) x 0.96 gph]/12,076 ft²
Engineering Design Group, Inc.	Ronan X-76 CTM Automatic Tank Gauging System (MTS Level Plus UST Probe)	[(product surface area in ft² ÷ 564 ft²) x 0.2 gph]/[(product surface area in ft² ÷ 564 ft²) x 0.1 gph]/846 ft²
Leak Detection Technologies International	MDleak Enhanced Leak Detection and Leak Location Method	0.005 gph/A tank should not be declared tight when chemical marker is detected outside of the tank/Not limited by capacity.
Mass Technology Corp.	Precision Mass Measurement Systems SIM-1000 and CBU-1000 (24 hour test)	[(product surface area in ft² ÷ 1,257 ft²) x 0.1 gph]/[(product surface area in ft² ÷ 1,257 ft²) x 0.05 gph]/ 3,143 ft²
Mass Technology Corp.	Precision Mass Measurement Systems SIM-1000 and CBU-1000 (48 hour test)	[(product surface area in ft² ÷ 6,082 ft²) x 0.294 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 0.147 gph]/6,082 ft²
Mass Technology Corp.	Precision Mass Measurement Systems SIM-1000 and CBU-1000 (72 hour test)	[(product surface area in ft² ÷ 14,200 ft²) x 0.638 gph]/[(product surface area in ft² ÷ 14,200 ft²) x 0.319 gph]/ 35,500 ft²
Praxair Services, Inc. (originally listed as Tracer Research, Corp.)	Tracer ALD 2000 Automated Tank Tightness Test	0.1 gph/A tank system should not be declared tight when tracer chemical or hydrocarbon greater than the background level is detected outside of the tank./Not limited by capacity.
Universal Sensors and Devices, Inc.	LTC-1000 (Mass Buoyancy Probe)	[(product surface area in ft² ÷ 14,244 ft²) x 1.4 gph]/[(product surface area in ft² ÷ 14,244 ft²) x 0.7 gph]/35,610 ft²
Universal Sensors and Devices, Inc.	LTC-2000 (Differential Pressure Probe)	[(product surface area in ft² ÷ 14,244 ft²) x 3.0 gph]/[(product surface area in ft² ÷ 14,244 ft²) x 1.5 gph]/35,610 ft²
Varec, Inc. (originally listed as Coggins Systems, Inc. and later as Endress+Hauser Systems and Gauging)	Fuels Manager and Remote Terminal Unit RTU/8130 (MTS Magnetostrictive Probe)	[(product surface area in ft² ÷ 616 ft²) x 0.2 gph]/[(product surface area in ft² ÷ 616 ft²) x 0.1 gph]/924 ft²
Varec, Inc. (originally listed as Coggins Systems, Inc. and later as Endress+Hauser Systems and Gauging)	Fuels Manager with Barton Series 3500 ATG (48 hour test) (72 hour test)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x 1.0 gph]/15,205 ft²
Varec, Inc.	FuelsManager with Enraf 854 ATG (Servo Buoyancy Probe)	[(product surface area in ft² ÷ 11,786 ft²) x 3.00 gph]/[(product surface area in ft² ÷ 11,786 ft²) x 1.50 gph]/ 11,786 ft²
Varec, Inc.	FuelsManager with MTS M-Series ATG (MTS Magnetostrictive Probe)	[(product surface area in ft² ÷ 11,786 ft²) x 4.50 gph]/[(product surface area in ft² ÷ 11,786 ft²) x 2.25 gph]/ 11,786 ft²
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-24 (V1.0.2, V1.0.3)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 or 3.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x (2.0 or 3.0 gph - 0.223 gph)]/15,205 ft²
Vista Research, Inc. and Naval Facilities Engineering Service Center	LRDP-48 (V1.0.2, V1.0.3)	[(product surface area in ft² ÷ 6,082 ft²) x 2.0 or 3.0 gph]/[(product surface area in ft² ÷ 6,082 ft²) x (2.0 or 3.0 gph - 0.188 gph)]/15,205 ft²

Mass Technology Corp.

Precision Mass Measurement Systems SIM-1000 and CBU-1000

ABOVEGROUND STORAGE TANK LEAK DETECTION METHOD

Certification	Leak rate of 1.717 gph with PD = 95% and PFA = 5%. **The US EPA has not set a minimum detectable leak rate for aboveground storage tank systems at the time of this evaluation.**
Leak Threshold	0.859 gph. A tank system should not be declared tight if the test result indicates a loss or gain that equals or exceeds this threshold.
Applicability	Gasoline, diesel, jet fuel, fuel oil up to #6. Other liquids may be tested after consultation with the manufacturer.
Tank Capacity	AST's with surface areas from 7,854 to 30,172 sq. ft. and diameter's from 100 to 196 feet. Tank must be 20% full.
Waiting Time	Minimum of 20 minutes.
Test Period	Minimum of 20 hours. There must be no delivery, transfer, or dispensing during test.
Temperature	One Resistance Temperature Detector (RDT) attached to the bubbler unit.
System Features	This system uses nitrogen under pressure conveyed to the bottom of the tank via a hose to generate (bubbler unit) and release small bubbles at the tank bottom. The pressure required to produce the bubbles is equal to the hydrostatic head pressure produced by the fluid in the tank plus one atmosphere. This pressure is measured by a pressure transducer. The measured differential pressure is a direct measurement of the mass of the fluid in the tank.
Calibration	The differential pressure transducer is benchmark calibrated by the manufacturer. Annual calibration is performed by the CBU/SIM unit and returned to the manufacturer if results fall outside the benchmark calibration values. RTDs are calibrated annually. Barometer is replaced every five years.
Comments	Data set is filtered to extract only night time data to eliminate the effects of radiant solar heating. The CBU/SIM control unit is not rated for installation in areas where an explosive ignition risk may exist. Method may be applied to steel, concrete, aluminum, or fiberglass tanks with either fixed or floating roofs. Bubbler test pressure must not exceed 18 psig.

Mass Technology Corp.
P. O. Box 1578
Kilgore, TX 75663
Tel: (903) 986-3564
E-mail: info@mtctesting.com
URL: www.mtctesting.com

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494
Date of Evaluation: 07/31/06

Issue Date: August 23, 1999
Revision Date: December 29, 2011

Mass Technology Corp.

Precision Mass Measurement Systems SIM-1000 and CBU-1000 (24 hour test)

BULK UNDERGROUND STORAGE TANK LEAK DETECTION (50,000 gallons or greater)

Certification	Leak rate is proportional to product surface area (PSA). For tanks with PSA of 1,257 ft^2 or less, leak rate is 0.1 gph with PD = 97.9% and PFA = 2.1%. Calculated minimum detectable leak rate is 0.078 gph with PD = 95% and PFA = 5%. For tanks with larger PSA, leak rate equals [(PSA in ft^2 ÷ 1,257 ft^2) x 0.1 gph]. Example: For a tank with PSA = 2,000 ft^2; leak rate = [(2,000 ft^2 ÷ 1,257 ft^2) x 0.1 gph] = 0.16 gph.
Leak Threshold	Leak threshold is proportional to product surface area (PSA). For tanks with PSA of 1,257 ft^2 or less, leak threshold is 0.05 gph. For tanks with larger PSA, leak threshold equals [(PSA in ft^2 ÷ 1,257 ft^2) x 0.05 gph]. Example: For a tank with PSA = 2,000 ft^2; leak threshold = [(2,000 ft^2 ÷ 1,257 ft^2) x 0.05 gph] = 0.08 gph. A tank system should not be declared tight if the test result indicates a loss or gain that equals or exceeds the calculated leak threshold.
Applicability	Gasoline, ethanol blends up through E100, diesel, aviation fuel, fuel oil #4. Other liquids may be tested after consultation with the manufacturer.
Tank Capacity	Use limited to single field-constructed vertical tanks. Performance not sensitive to product level.
Waiting Time	Minimum of 1 hour, 6 minutes after delivery or dispensing. Valve leaks and pump drain-back may mask a leak. Allow sufficient waiting time to minimize these effects. Waiting times during evaluation ranged from 62 minutes to 31 hours.
Test Period	Minimum of 24 hours. There must be no dispensing or delivery during test.
Temperature	Measurement not required by this system.
Water Sensor	None. Water leaks are measured as increase in mass inside tank.
Calibration	Differential pressure sensor must be checked regularly in accordance with manufacturer's instructions.
Comments	Tests only portion of tank containing product. As product level is lowered, leak rate in a leaking tank decreases (due to lower head pressure). Consistent testing at low levels could allow a leak to remain undetected. Evaluated in a nominal 120,000 gallon, vertical underground tank with product surface area (PSA) of 1,257 ft^2. Averaging of multiple tests may be used to improve the performance of the system.

Mass Technology Corp.
P. O. Box 1578
Kilgore, TX 75663
Tel: (903) 986-3564
E-mail: info@mtctesting.com
URL: www.mtctesting.com

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494
Dates of Evaluation: 03/25/98, 02/04/11

RH TANK 5 FILLING
AFTER OUT OF SERVICE FOR REPAIRS

This SOP is to establish procedures for safe filling of RH Tank 5 that has been emptied for inspection and repairs.

Personnel on site at subject tank are as follows:
Contractor representative
NAVFAC EXWC/HI observer or NAVSUP FLCPH Fuel Department personnel

Issue tanks: RH tank 0102, 0104, UTF 53.

Start Date/Time: Monday, 08 December 2013 at 0800

PROCEDURE:

1. Fuel Department Control Room will coordinate valve opening on empty tank with the contractor/NAVFAC EXWC or HI/Fuel Department observer.
2. Contractor/SPAWAR Rep/Fuel Department Control will validate valves have opened and fuel is moving into subject tank.
3. Equalize the level of tank 0105 with fuel from tank 0102.
4. Fuel Department Control will shut down operation in event personnel on site indicate valves and/or lines are leaking.
5. Fuel Department Control will ensure initial flow is no more than 1000 bbls. per hour.
6. Contractor and Fuel Department personnel on site will monitor the skin valves and the manhole cover for leaks until fuel level reaches the inlet height and monitor up to 20 feet.

NOTE: Fill rate will be increased to 3000 BBLS/hour when tank level is at 20 ft. Maintain this flow rate until the tank level reaches 50 feet. After reaching this height the fill rate will be increased to the normal fill rate (5,000-7,000 bbls/hr).

7. Fuel Department personnel on site will report to control on the hour for the first 8 hours or until the end of the day shift (1600 hours). Fill operations will secure NLT 1600 on the first day. At around 1800, Fuel Department personnel will obtain 1 quart of bottom sample (visual sample). A manual measurement (top-gauge) of the tank’s fuel height will be taken to compare against AFHE prior to tank filling restart.
8. Tank filling will restart in morning at 0800 hours. Fuel Department will monitor and report on conditions every 2 hours.
9. When the fuel levels have equalized, close tank 0102. Fuel Department control operator will re-align valves to receive fuel from tank <u>0104</u>.
10. Fill rate will be increased to 3000 BBLS/hour when tank level is at 20 ft. Maintain the flow rate until the tank level reaches 50 feet. After reaching this height the fill rate will be increased to the normal fill rate (5,000-7,000 bbl./hr).

11. When the fuel levels have equalized, close tank 0104. Fuel Department control operator will re-align valves to receive fuel from UTF tank 53. From here on until completion, fuel will come from UTF tank 53.
12. When tank level is within 5 ft of first hatch cover (Upper Tunnel) Fuel Department personnel will be on site until fuel is over the hatch cover. At this point if cover is leaking control will drop level below cover. If weeping and controllable then stop filling. Notify Fuel Department engineering staff. The fuel will not pass the hatch cover over the swing or grave shifts. If within 5 feet during the end of the day shift, stop the evolution and restart at 0800 the following work day.
13. Upon completion, bottom samples and all level samples will be drawn for laboratory testing.
14. A log sheet will be kept to document all times, personnel on site and conditions as they occur.

DFSP PEARL RETURN TO SERVICE (RTS) STANDARD OPERATING PROCEDURE (SOP)

1. MATERIALS, REPORTS, AND REFERENCES:

SPECIAL MATERIALS	• Gauging equipment • Automatic tank gauging equipment • Hand held radios • Personal protective equipment
FORMS	• Gauging log • UFM Report
REFERENCES	• NAVSUPGLSINST 10345.1 (Dated: 9 May 15) • DoD 4140.25-M, DoD Management of Bulk Petroleum Products, Natural Gas, and Coal • 33 CFR Part 154, Facilities Transferring Oil or Hazardous Materials in Bulk • 29 CFR §1910.38, Occupational Safety and Health Standards • MIL-STD 3004D: Quality Surveillance for Fuels, Lubricants, and Related Products • UFC 3-460-01, Unified Facilities Criteria, Petroleum Fuel Facilities • MO-230, Maintenance and Operation of Petroleum Fuel Facilities • Unscheduled Fuel Movement (UFM) Standard Operating Procedures (SOP)
REQUIRED DELIVERABLES PRIOR TO FILLING TANK	• Tank completion checklist NAVSUP-E form 072-01 • Suitability to return to service letter • Custody turn over letter • Completed inspection report with caveats, clarifications, or limitations, and calculations and analysis • Certified calibration "strapping" charts • C-701 Review of inspection report with recommended holding points • Tank Specific RTS Operations Order

2. SAFETY:

a. The Fuel Distribution System employee must be familiar with the safety data sheet for product to facilitate the safe handling of fuels.
b. During all transfer operations, safety is the primary concern.
c. Inspection of tank interior for readiness by terminal personnel prior to placing tank back in service.
d. Personnel shall not perform any tank fill operations until a Tank Turnover/Return to Service Certification Letter is received from the repair contractor.
e. The Commanding Officer shall be notified via the Code 700 Director prior to initiating the tank fill.
f. Notify Key Personnel and Emergency Contacts of evolution. In the event of a critical emergency, all fuel transfer evolutions shall immediately secure and implement the emergency response plan.
g. Provide firefighting equipment status to the Terminal Supervisor.
h. Verify that safety equipment and communication equipment is working properly and available at the fuel farm.

3. PLANNING AND REVIEW:

a. Determine the receipt and issue tanks for the procedure.
b. Validate inventory levels of specified receipt and issue tanks, and calculate the estimated time.
c. Determine the valve lineups to transfer the fuel from the issue tank to the receipt tank.
d. Determine which pump(s) will be used
e. Determine the incremental heights for each for each static period. As a general rule, each leg will be determined by taking the following into consideration: • Location and height of the lap welds for each course • Length of time the tank has been out of service (i.e. if the tank has been out of service for several years, consider taking a more conservative approach to filling the tank such as using smaller increments and/or

longer static periods)
f. Determine the number of personnel requirement to the evolution.
g. Compare the manual tank gauges to the ATG readings of the receipt tank to verify accuracy. If there is a significant difference, re-gauge the tanks and compare again.
h. Verify that no other tanks and/or piping routes are open to the specified piping lineup.

4. PROCEDURE:

a. Fill designated tank pipeline with product up to tank skin valve.
b. First incremental fill level. Slow-fill tank (<3 feet per second) until fill inlet nozzle is completely submerged NOTE : A 24 hour wait time is not required for this step.
c. Continue initial fill, until fuel is just above manway and any cut that may have been used access into the tank and stop. That will conclude the first leg of the fill process.
d. A 24 hour wait time will be the minimum standard between each leg of the tank fill process Note: Hold times between each incremental fill level. The hold times shall be extended, as required, until gauge results reach steady state for at least 24 hours before moving to the next incremental fill level.
e. On a 30 minute basis during the transfer evolution, the employee shall inspect the tank and pipeline for any leaks and report the results to the Supervisor for documentation and corrective action.
f. Monitor issue tank levels to ensure a low-level condition will not occur.
g. Monitor receipt tank levels to prevent it from being overfilled. The storage tanks are equipped with high and high-high level alarms, as well as high level shut off valves on the receipt lines.
h. Tank gauging during the operation shall be conducted by the following methods; manual gauging and AFHE/ATG readings on the receipt tank and issue tank.
i. The following methods shall be utilized in reporting end of day inventories. Manual gauging will be utilized for total fuel quantity received in receipt tank and

AFHE/ATG will be utilized for total fuel quantity issued from the issue tank.

j. Perform and maintain an accurate gauging trend analysis during the entire operation.

Caution: A minimum waiting time of 30 minutes after completion of fuel receipts, transfers or movements is required before insertion of any objects into storage tanks. This is a safety measure to permit relaxation of electrostatic charges as required by the MIL-STD-3004D para. 5.9.4

Note: Do Not Proceed to next step until Terminal Supervisor has received a notification of readiness and everything is clear.

k. Continue incremental fill levels as required, until gauge results reach the predetermined level for test of the tank.

5. OPERATION ORDER:

a. The operation will be detailed in the tank specific operations order and will contain the following basic elements:
- Open system valves
- Open issue tank valves
- Open receipt tank valves
- Align and start pump/s if tank to tank transfer is not possible.
- Observe the piping and transfer procedure by checking the ATG system, walking the piping path, looking for leaks and by checking for consistent pressures and transfer rates. A large decrease in pressure or rate may relate to pumping problems or line rupture. Large increases may be caused by pipeline blockage or a fail valve. If large fluctuations are observed, shut down the operation until the cause is determined.
- Stop the transfer at the predetermined level as determined by 2.e. above.
- Close receipt tank valves
- Close system valves as required
- Close issue tank valves

6. POST-OPERATION ACTION:

a. Once system is secured, wait one hour to allow the tank to settle

b. After one hour, hand gauge the tank

c. Verify accuracy of ATG/AFHE.
- Have outside agency calibrate if needed

d. As a minimum, the tank will be hand gauged ever four hours by operations

personnel.
e. Compare most recent hand gauge with all previous hand gauges and if there is a change of 1/8 inch, perform a complete system inspection to determine the cause of the drop in level. The following will be considered or performed: • Check the skin valve for complete closure and tighten or place in high torque as needed. • Have a different operations employee gauge then tank to see if the trend still exists or if tank gauging techniques are the problem • Inspect the tank for indications of leaks, areas that may be deforming, or any other unusual condition • Check the pipeline for indications of leaks • Check the level of other tanks to see if fuel is moving to another tank though valve that leak by
f. Document all actions in the Operators log.

7. ALARM RESPONSE PROCEDURES:

a. All tanks being returned to service shall be considered as suspect for potential leaks. As such, believe in your alarms and take action as required.
b. Of particular concern are Unscheduled Fuel Movements (UFM). Whenever a UFM is received, follow the requirements of the UFM SOP.

8. EMERGENCY DRAIN DOWN PROCEDURES:

a. The tank specific Operations Order will include an emergency drain down procedure. The procedure will include (but is not limited to) the following: • Receipt tank or tanks • Pumps • Valve alignment • Special instructions

Approved by:

LCDR Andrew Lovgren
Director