**DEPARTMENT OF THE NAVY**
COMMANDER
NAVY REGION HAWAII
850 TICONDEROGA ST STE 110
JBPHH, HAWAII 96860-5101

5750
Ser N4/ 0648
December 1, 2017

**CERTIFIED NO: 7015 0640 0002 4677 9725**

Mr. Bob Pallarino
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105

**CERTIFIED NO: 7015 0640 0002 4677 9732**

Mr. Steven Y.K. Chang, P.E., Chief
State of Hawaii Department of Health
Solid and Hazardous Waste Branch
919 Ala Moana Boulevard, Room 210
Honolulu, HI 96814

Dear Mr. Pallarino and Mr. Chang:

SUBJECT: ADMINISTRATIVE ORDER ON CONSENT STATEMENT OF WORK SECTION 4 TEST PLAN FOR EVALUATING LEAK DETECTION METHODS AT THE RED HILL BULK FUEL STORAGE FACILITY (RED HILL), JOINT BASE PEARL HARBOR-HICKAM, OAHU, HAWAII

Per the Conditional Approval letter received on July 26, 2017 and in compliance with the approved, revised Section 4.5 Scope of Work, the Department of Navy and the Defense Logistics Agency (DLA) have enclosed the Test Plan/Protocols for your consideration and review.

If you have any questions, please contact Mark S. Manfredi, the Red Hill Regional Program Director/Project Coordinator at (808) 473-4148 or at mark.manfredi@navy.mil.

Sincerely,

R. D. HAYES, III
Captain, CEC, U.S. Navy
Regional Engineer
By direction of the
Commander

Enclosure(s): 1) Administrative Order On Consent Section 4 Test Plan for Evaluating Leak Detection Methods at The Red Hill Fuel Storage Complex (Unredacted)
2) Administrative Order On Consent Section 4 Test Plan for Evaluating Leak Detection Methods at The Red Hill Fuel Storage Complex (Redacted)

Red Hill Administrative Order on Consent, Conditional Approval Deliverable

Section: 4.6 Test Plan for Evaluating Leak Detection Methods at Red Hill

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.

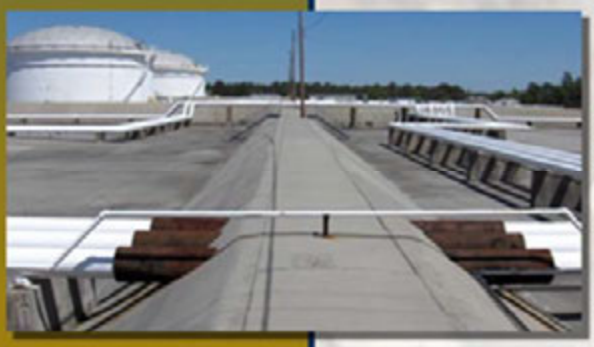
Signature: _____

CAPT Richard D. Hayes, III, CEC, USN
Regional Engineer, Navy Region Hawaii

Date: 11/30/2017

# TEST PLAN FOR EVALUATING LEAK DETECTION METHODS AT THE RED HILL FUEL STORAGE COMPLEX

## JOINT BASE PEARL HARBOR-HICKAM, HAWAII



***Prepared for:***
**Defense Logistics Agency Energy**
**Fort Belvoir, Virginia**

*Prepared under:*
**Naval Facilities Engineering Command Atlantic**
**Contract N62470-10-D-3000-0048**

*Submitted by:*
**Michael Baker International**
**Virginia Beach, Virginia**

*Date:*
**2 NOVEMBER 2017**

**FOR OFFICIAL USE ONLY**

Michael Baker INTERNATIONAL

***Project: 140296***
***Task: 8.0.1***

# TEST PLAN FOR EVALUATING LEAK DETECTION METHODS AT THE RED HILL FUEL STORAGE COMPLEX

## JOINT BASE PEARL HARBOR-HICKAM, HAWAII

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**2 November 2017**

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# 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 prepare a test plan to evaluate certain leak detection (LD) test methods that would be applicable for LD testing the eighteen (18) bulk field-constructed underground storage tanks (BFCUSTs) at the Red Hill Fuel Storage Complex, located at Joint Base (JB) Pearl Harbor-Hickam, Hawaii. The test plan to evaluate certain LD test methods is in support of the Administrative Order on Consent (AOC) Attachment A: Statement of Work (SOW) Sections 4.5: New Release Detection Alternatives SOW and 4.6: New Release Detection Alternatives Report. The cited portion of the AOC Attachment A: SOW is in Appendix A.

## 1.2 Site Background

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

The Red Hill Fuel Storage Complex is located approximately three miles north-east of the base and is used as a bulk fuel storage facility. Fuel is issued and received at the Red Hill Fuel Storage Complex from JB Pearl Harbor-Hickam via a transfer pipeline. The Red Hill Fuel Storage Complex consists of 20 BFCUSTs (BFCUSTs 1 through 20) that are constructed of single-walled steel vertical capsules; 100-feet in diameter, with a 50-foot radius hemispherical bottom, a 150-foot barrel, and a 50-foot radius hemispherical top. Two of the 20 tanks (BFCUST 1 and 19) were removed from service prior to 2009. Fuels stored include: commercial aviation jet fuel with military additives (F-24), Jet Propellant 5 (JP-5), and diesel fuel marine (F-76).

## 1.3 Project Scope

The scope of this project is to prepare a test plan to evaluate certain LD test methods that would be applicable for the 18 BFCUSTs at the Red Hill Fuel Storage Complex. The evaluation test plan includes three LD testing methods, applied by three equipment vendors: 1) the Gauging System Inc. (GSI), Multifunction Tank Gauge (MTG) system 2) the Mass Technology Corporation (MTC), Precision Mass Measurement System, and 3) the Vista Precision Solutions Inc. (VPSI), Low-Range Differential-Pressure (LRDP) System. The evaluation of the LD methods is to be based on the United States Environmental Protection Agency's (US EPA's) Standard Test Procedures (Reference 3.1). An independent third-party evaluator (Evaluator) will induce a set of controlled leaks during the evaluation testing, collect the evaluation testing data from the three vendors, and apply computational statistics in accordance with project guidelines on the evaluation testing results provided by the three vendors.

## 1.4 Evaluation Testing Protocol

The testing protocol for the LD testing evaluation at Red Hill shall be based on Standard Test Procedures (Reference 3.1), industry standard practices, and points agreed upon by the stakeholders of the AOC. The following points include certain agreed-upon departures to Sections 2, 5, 6 and 7, of the Standard Test Procedures document. NOTE: Section 2.0 provides further details that applies to the testing protocol:

### 1.4.1 Section 2 – Scope and Applications

a) The LD method's ability to detect a target leak rate (TLR) in gallons per hour (gph), shall have a probability of 95-percent or higher, while operating at a false alarm rate of 5-percent or less.

### 1.4.2 Section 5 – Apparatus and Materials

a) Section 5.1 – Tanks
   i) Testing will be conducted on a single tank;
   ii) An initial test, or trial run, under stable, no-leak conditions will be conducted immediately following each of the changes in tank product level, to confirm tank and equipment functionality.
b) Section 5.2 – Test Equipment
   i) In general, the test equipment will consist of a method for monitoring product volume or level; compensation for temperature may also be included. The method will also include

instrumentation for collecting and recording the data and procedures for using the data to calculate a leak rate and interpret the results as a pass or fail for the tank;

ii) Test equipment shall be operated by trained personnel who regularly use the equipment in commercial tests, per the LD system manufacturer.

c) Section 5.3 – Leak Simulation Equipment

i) Leaks will be induced in the tank by removing product at a constant rate, measuring the amount of product removed and the time of collection, and calculating the resulting induced leak rate;

ii) Leak simulation equipment, shall be capable of simulating leaks within +/- 30-percent of the nominal leak rates.

d) Section 5.4 – Product

i) Testing will be conducted without the addition of product at different temperatures than that of the fuel already in the tank. Methods of heating and cooling the fuel shall not be applied during testing.

e) Section 5.5 – Miscellaneous

i) Testing will be conducted at three (3) tank product levels. The procedures established for each tank product level are as follows:

(1) The transfer of product will be initiated, until the target product level height is achieved;

(2) Time is allotted for product settling;

(3) One (1) trial run test, under no-leak conditions, will be run to verify tank and equipment tightness;

(4) Four (4) evaluation tests will be run;

(5) The cycle restarts with the transfer of product to achieve the second (and third) product level height(s);

(6) During evaluation testing, controlled leaks will be induced by the Evaluator; induced leak rates will be kept blind to the vendors.

### 1.4.3 Section 6 – Testing Procedure

The test procedure utilizes two (2) factors: the size of the leak and tank deformation due to pressure changes associated with product level changes. The empty-fill cycles produced prior to each test will not be incorporated.

a) Section 6.1 – Environmental Data Records, applicable test conditions (i.e. weather and tank data) will be recorded.

b) Section 6.2 – Induced Leak Rates and Temperature Differentials

i) Fifteen (15) tests will be conducted in total, which includes one (1) trial run test and four (4) evaluation tests, at each of the three (3) tank product levels;

ii) Four (4) nominal leak rates will be induced by the Evaluator during evaluation testing, as multiples of the target leak rate (TLR): [redacted]

iii) Temperature differential conditions will not be applied during testing;

iv) The order of induced leak rates applied during evaluation testing will be randomized. One trial run test will be conducted after each of three product transfers. The trial run tests will be conducted under no-leak conditions to verify tank and equipment tightness after each product transfer;

v) Notational conventions shall be applied;

vi) Optional Experimental Design shall not be applied to testing;

c) Section 6.3 – Testing Schedule (See Table 1-1)

d) Section 6.4 – Testing Problems and Solutions

i) If a vendor reports an inconclusive or invalid single test, the result will be recorded in the evaluation report, and the test may be conducted again;

ii) If a vendor reports more than one test as inconclusive or invalid, the Navy will provide final direction on how to proceed on whether testing will be conducted again.

### 1.4.4 Section 7 – Calculations

The calculations called for in the EPA Tank Tightness Testing Protocol will be performed (calculations are incorporated by reference and not reproduced here.) The estimation of the standard deviation of the predicted leak rates shall be included. In addition to these cited calculations, the Evaluator anticipates adding the regression (or general linear model) approach. In this approach, the Evaluator will treat the induced leak rates as independent (X) variables, and the leak rates reported by each vendor as dependent (Y) variables. The Evaluator will thus estimate a regression equation, of the form:

$$Y = a + bX + L_i + \varepsilon,$$

Where Y is the vendor-reported leak rate, a is the intercept, b is the slope, X is the induced leak rate, $L_i$ is a potential effect of the product level [redacted] and $\varepsilon$ is the error. This applied equation will enable the Evaluator to separately estimate bias (represented by a non-zero intercept), a slope significantly different from one, and a possible effect of different product levels $L_i$ on the performance of the leak detection method.

**Table 1-1: Three Block Evaluation Testing Protocol**

| Test No. | Block No. | Randomization | Nominal Induced Leak Rate | Tank Product Level Factor |
|---|---|---|---|---|
| 1 | 1 | Trial Run Test | No-leak condition | Level 1 |
| 2 | | 2 | [redacted] | |
| 3 | | 1 | [redacted] | |
| 4 | | 3 | [redacted] | |
| 5 | | 4 | [redacted] | |
| 6 | 2 | Trial Run Test | No-leak condition | Level 2 |
| 7 | | 1 | [redacted] | |
| 8 | | 4 | [redacted] | |
| 9 | | 2 | [redacted] | |
| 10 | | 3 | [redacted] | |
| 11 | 3 | Trial Run Test | No-leak condition | Level 3 |
| 12 | | 2 | [redacted] | |
| 13 | | 4 | [redacted] | |
| 14 | | 1 | [redacted] | |
| 15 | | 3 | [redacted] | |

## 2.0 APPLIED TESTING PROTOCOL AND EVALUATION TEST PLAN

### 2.1.1 Applied Testing Protocol

The following provides details to the evaluation testing protocol discussed in Section 1.4:

a) Testing will be conducted on a single tank, identified as BFCUST 9, currently storing JP-5;
b) Three LD system equipment vendors will conduct testing simultaneously;
c) [redacted];
d) The target leak rate (TLR) established for evaluation testing will be [redacted];
e) A total of fifteen (15) tests will be conducted: three (3) trial run tests and twelve (12) evaluation tests;
f) Three (3) trial run tests will be conducted after each of three product transfers. The trial run tests will be conducted under no-leak conditions to verify tank and equipment tightness after each product transfer;
g) Twelve (12) evaluation tests will be conducted using a two-factor format: 1.) multiple induced leak rates, and 2.) multiple tank product levels:
   i) Four (4) nominal leak rates will be induced during evaluation testing, as multiples of the TLR: [redacted] The order of induced leak rates applied during evaluation testing will be randomized and kept blind to the vendors;
   ii) Three (3) tank product levels will be used for evaluation testing:
   [redacted]
h) [redacted]
i) Leak measurement equipment, shall be capable of measuring leaks set to multiples of the TLR: [redacted] with a minimum of three significant figures of accuracy;
j) Computational statistics will be used to analyze the slope regression, which is defined as the relationship between the induced leak rate and the measured leak rate;
k) Three-block evaluation testing protocol: See Table 1-1.

### 2.1.2 Evaluation Testing Plan

The following evaluation test plan has been developed to conduct evaluation testing efficiently and includes working on weekends and holidays. Prior to testing, each LD system vendor and the Evaluator will have installed/setup equipment on the subject tank to be tested (BFCUST 9). See the Evaluation Test Plan in Table 2-1.

**Table 2-1: Evaluation Test Plan**

| Task | Task Owner | Description | Duration |
|---|---|---|---|
| 1 | Navy | Secure BFCUST 9 level @ [redacted] | [redacted] |
| 2 | Navy | Product Settling Time | [redacted] |
| 3-14 | Vendors, Evaluator | Block 1 – Evaluation Testing | [redacted] |
| 15 | Navy | Secure BFCUST 9 level @ [redacted] | [redacted] |
| 16 | Navy | Product Settling Time | [redacted] |
| 17-27 | Vendors, Evaluator | Block 2 – Evaluation Testing | [redacted] |
| 28 | Navy | Secure BFCUST 9 level @ [redacted] | [redacted] |
| 29 | Navy | Product Settling Time | [redacted] |
| 30-40 | Vendors, Evaluator | Block 3 – Evaluation Testing | [redacted] |

## 3.0 REFERENCES

3.1 *"Standard Test Procedures For Evaluating Leak Detection Methods, Volumetric Tank Tightness Testing Methods";* United States Environmental Protection Agency. Date: March 1990.

# *APPENDIX A*

## *ADMINISTRATIVE ORDER ON CONSENT*
## *IN THE MATTER OF RED HILL BULK FUEL STORAGE FACILITY,*
## *ATTACHMENT A STATEMENT OF WORK*
## *SECTIONS 4.5 AND 4.6*

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

# Attachment A
# Statement of Work

## Contents

### 4.5 New Release Detection Alternatives Scope of Work

Within ninety (90) days from the Final Scoping Meeting, Navy and DLA shall submit the New Release Detection Alternatives Scope of Work to the Regulatory Agencies for approval.

### 4.6 New Release Detection Alternatives Report

Within twelve (12) months from approval of the New Release Detection Alternatives Scope of Work, Navy and DLA shall submit a New Release Detection Alternatives Report to the Regulatory Agencies for approval.

The New Release Detection Alternatives Report shall include:

a. A description of existing practices;
b. Static and dynamic release detection system alternatives;
c. Tank tightness alternatives;
d. Comparison of the effectiveness of existing and alternative technologies; and
e. A decision matrix.

### 4.7 New Release Detection Alternatives Decision Meeting

Within sixty (60) days from the Regulatory Agencies' approval of the New Release Detection Alternatives Report, Navy and DLA shall schedule and hold a Decision Meeting to be attended by the Parties. The purpose of the Decision Meeting is to determine subsequent actions for implementing the new release detection alternatives as appropriate. The Regulatory Agencies will not make final decisions on the New Release Detection Alternatives until the New Release Detection Alternatives Decision Document is submitted under Section 4.8.

### 4.8 New Release Detection Alternatives Decision Document and Implementation

Within sixty (60) days after the Decision Meeting, Navy and DLA shall submit a Release Detection Alternatives Decision Document, including an implementation plan and schedule, to the Regulatory Agencies for approval. Once approved by the Regulatory Agencies, Navy and DLA shall implement the Release Alternatives Decision Document in accordance with the approved schedule.

## 5. Corrosion and Metal Fatigue Practices

The purpose of the deliverables to be developed and work to be performed under this Section is to evaluate the possibility and extent of corrosion and metal fatigue as well as practices to control corrosion and metal fatigue at the Facility. Based on this evaluation, procedures under Sections 2 or 3 of this SOW may be modified to improve control of corrosion and metal fatigue.

Navy and DLA shall maintain records of and continue efforts to complete internal cleaning and inspection of the aboveground pipelines in the tunnels within the Facility.