Red Hill Bulk Fuel Storage Facility Scoping Meeting
AOC Section 3 Tank Upgrade Alternatives
November 30 – December 4, 2015

Presented By:
Enterprise Engineering, Inc.
Freeport, Maine

Under Contract To:
HDR Engineering, Inc.
Honolulu, Hawaii

Prepared For:
NAVFAC Pacific
Joint Base Pearl Harbor-Hickam, Hawaii

Contract Number: N62742-13-D-0001
Delivery Order 0009
AOC Section 3
Tank Upgrade Alternatives

AOC 3.0 Tank Upgrade Alternatives Deliverables

The purpose of deliverables to be developed and work to be performed must result in:

- Identify and evaluate tank upgrade alternatives (TUA)
- Select and implement the BAPT and TIRM procedures that can be applied
- Integrate discussion on TUA Alternative, and appropriate BAPT Release Detection/Tank Tightness Testing
AOC Section 3
Scoping Meeting

- AOC 3.1 Scoping Meeting(s) for TUA Report
  - Within 30 days from effective date of the AOC conduct an initial scoping meeting
  - Purpose of the Meeting:
    - Detail the contents of the Scope of Work for the TUA Report
    - Discuss criteria for decision making
    - Decide whether additional Scoping Meetings are needed
  - An initial Scoping Meeting was conducted 27 Oct 2015
AOC Section 3
Scoping Meeting 27 OCT 2015

Highlights of Items Discussed

- Previous EEI studies
- Current Tank Upgrade Study (HDR/EEI)
  - A-E Scope based on AOC SOW version as of 30 April 2015
  - In Progress Review Meeting conducted 4 - 5 August 2015
- Elements of Scope of Work for TUA Report
- Evaluation/Decisions Criteria
- Role of Subject Matter Experts (SME)
- Quality Assurance / Quality Control
- Items to be further discussed at 30 November Face-to-Face Meeting
Action Items

- NAVFAC Pacific to provide EPA and DOH review comments on In Progress Report
- EPA and DOH to provide comments on In Progress Report
- EEI to give presentation on In Progress Report
AOC Section 3
Face to Face Meeting

- AOC 3.1 Continuation of AOC Scoping Meeting
AOC Section 3
TUA Scope of Work

- AOC 3.2 TUA Scope of Work
  - Due within 90 days of final Scoping Meeting
  - Navy/DLA submit TUA scope to Regulatory Agencies for Approval
AOC Section 3
TUA Report

- AOC 3.3 TUA Report
  - Due within 12 months from Regulatory Agencies approval of the Scope of Work
  - The purpose of the report is to identify and evaluate various tank upgrade alternatives that can be applied to the tank at the Red Hill Bulk Fuel Storage Facility
  - The report shall evaluate the following:
    - Current tank upgrade procedures
    - Secondary containment alternatives
    - Coatings
    - Liners / Bladders
    - Associated release detection systems
    - Any other alternative deemed promising
## AOC Section 3
### TUA Deliverables and Timeline

<table>
<thead>
<tr>
<th>Deliverable/Milestone</th>
<th>Date/Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOC Effective Date</td>
<td>28 SEPT 2015</td>
</tr>
<tr>
<td>Initial Scoping Meeting for TUA Report (within 30 days of Effective Date of AOC)</td>
<td>27 OCT 2015</td>
</tr>
<tr>
<td>Face-to-Face Scoping Meeting for TUA Report</td>
<td>30 NOV to 4 DEC 2015</td>
</tr>
<tr>
<td>TUA Scope of Work</td>
<td>Within 90 days of final Scoping Meeting</td>
</tr>
<tr>
<td>TUA Report</td>
<td>Within 12 months from Regulatory Agencies’ approval of the Scope of Work</td>
</tr>
<tr>
<td>Regulatory Review and Approval of TUA Report</td>
<td>TBD</td>
</tr>
<tr>
<td>TUA Decision Meeting</td>
<td>Within 60 days of Regulator Agencies’ approval of TUA Report</td>
</tr>
<tr>
<td>TUA Decision Document and Implementation</td>
<td>Within 60 days from Decision Meeting</td>
</tr>
</tbody>
</table>
AOC Section 3
Tank Upgrade Alternatives

- Preliminary TUA Report
  Under contract to NAVFAC HI, HDR and EEI have completed a Jump start to the TUA, based on the preliminary AOC SOW.

Although the final AOC SOW has differences, the material developed to date does have relevancy and will be presented as a snapshot of ideas.
Step 1: Identify Available Tank Upgrade Technologies
First Pass List of TUA technologies

- Brainstorm of initial TUA concepts to test against initial screening criteria to determine if worthy of additional evaluation
- Separated into groups by primary characteristic

Step 1: Identify Available Technologies
Tank Interior Upgrade Technologies

- Repair steel liner
  - Patch Plates and Welding
- Coatings
  - Epoxy (thin film)
  - Polysulfide Modified Epoxy Novolac (thin film)
  - Urethane (thin film)
  - Polyurea (thick film)
  - Thermal Spray Aluminum (Metalizing)
  - Thermal Spray Ceramic
  - Glass

Step 1: Identify Available Technologies
Tank Interior Upgrade Technologies

- **Liners**
  - Single Wall Fiberglass
  - Double Wall Fiberglass with Release Detection (TankBau system)
  - Rubber Lining (bonded to existing steel liner)
  - Flexible Membrane
  - Carbon Fiber Sheet
  - Carbon Fiber Sandwich Panel
  - Carbon Steel
  - Stainless Steel

Step 1: Identify Available Technologies
Tank Interior Upgrade Technologies

- Liners
  - Stainless Steel Membrane (similar to LNG membrane tank concept)
  - Dimple Jacket
  - Weld Overlay
  - Concrete
  - Gunite
  - Ceramic Tile

Step 1: Identify Available Technologies
Tank Exterior Upgrade Technologies

- Encapsulation
  - Cementitious Grout
  - Chemical Grout (Types of chemical grout include urethane, polyurethane, sodium silicate, and acrylic)
- Cut-off Pan below Tank
- Sheet Pile Wall
- Cryogenic (Ice layer outside Tank)
Tank Upgrade Technologies

Step 2: Initial Screening Considerations
Tank Upgrade Alternatives
Initial Screening Considerations

Any viable upgrade alternative should as a minimum be:

- Constructible and Testable (after construction)
- Inspectable and Repairable (future integrity assessment)
Tank Upgrade Alternatives
Initial Screening Consideration Definitions

- **Constructible**: Can be constructed in field at Red Hill using traditional construction means and methods
- **Testable**: Can be tested and shown acceptable during construction and startup/commissioning
- **Inspectable**: Able to determine integrity on a periodic basis either in service and/or out of service
- **Repairable**: Able to be repaired in field at Red Hill using traditional construction/repair means and methods
Step 3: Identify Tank Upgrade Alternatives
Tank Upgrade Alternatives

- Single Wall Tank No Secondary Containment
- Double Wall Tank / Secondary Containment

Step 3: Identify Tank Upgrade Alternatives
Single Wall Tank
No Secondary Containment

- Single Wall Tank Upgrade Concepts for further evaluation
  - 1A Restoration of Existing Tank with improved TIRM procedures
  - 1B Restoration of Existing Tank Plus Interior Coating
  - 1C Restoration of Existing Tank plus Metalizing on Existing Steel Liner
  - 1D Rubber Lining bonded to Existing Steel Liner
  - 1E Replace Existing Steel Liner (remove existing)
- These concepts include replacing the existing single wall concrete encased piping from the tank to the first valve outside tank with double wall construction

Step 3: Identify Tank Upgrade Alternatives
Each of the Single Wall Tank - No Secondary Containment Alternatives is described in the In Progress Review Report.

Step 3: Identify Tank Upgrade Alternatives
Single Wall Tank
No Secondary Containment

- Associated Release Detection
  - A technology based method of determining a release via appropriate sensors and computer based algorithm software considered mandatory for any single wall TUA concept
  - Additional discussion under AOC Section 4, Release Detection / Tank Tightness Testing

Step 3: Identify Tank Upgrade Alternatives
Double Wall Tank with Secondary Containment for Evaluation

- Double Wall / Secondary Containment Concepts for further evaluation
  - 2A Composite Double Wall Tank (Carbon Steel)
  - 2B Composite Double Wall Tank (Duplex Stainless Steel)
  - 3A Tank within a Tank (Carbon Steel)
  - 3B Tank within a Tank (Duplex Stainless Steel)
  - 4 Double Wall Fiberglass System
  - 5A Steel Liner Plates Welded to Existing Steel Liner
  - 5B Steel Liner Plates with Expanded Metal Plate between Existing Steel Liner and Steel Liner
  - 6 Stainless Steel Membrane with insulation over existing steel liner (similar to LNG Concept)
  - 7 Flexible Membrane Liner, not bonded to steel liner

These concepts include replacing the existing single wall concrete encased piping from the tank to the first valve outside tank with double wall construction.
Double Wall Tank with Secondary Containment for Evaluation

- Each of the Double Wall Tank with Secondary Containment Alternatives is described in the In Progress Review Report
Double Wall Tank / Secondary Containment

- Associated Release Detection
  - Only simple technology needed to identify liquid outside of tank containment primary barrier

Step 3: Identify Tank Upgrade Alternatives
Step 4: Evaluate Tank Upgrade Alternatives
Current TUA evaluation required development of Evaluation Attributes, to identify common elements and differences between each alternative.

The Attributes were to be presented without weighting for use by others in determining the BAPT.

A change in this direction is required to meet the final AOC requirements.

Current Evaluation Attributes presented for info only.

Step 4: Evaluate Tank Upgrade Alternatives.
Tank Fuel Volume Considerations

- Each overall TUA results in its own resultant net usable volume for fuel storage.
- The resultant usable volume is important as it drives the number of tanks needed to meet total Red Hill storage requirements.
- [Redacted] tanks currently needed to meet current requirements.
Tank Upgrade BAPT Evaluation Attributes

**NAVFAC BAPT Evaluation Attributes**

- Impact on current fuel storage
  - Does alternative result in reduction of container capacity compared to existing tank?
Tank Fuel Volume Considerations

Step 4: Evaluate Tank Upgrade Alternatives
Tank Upgrade BAPT Evaluation Attributes

**NAVFAC BAPT Evaluation Attributes**

- **Secondary Containment**
  - Does the alternative provide secondary containment?
  - What does the secondary containment consist of?

- **Associated Release Detection System**

- **Commercially available products – Existing Tank Preparation and Repairs/Construction**
  - What materials are needed?
  - Are the materials readily available?

**Step 4: Evaluate Tank Upgrade Alternatives**
Tank Upgrade BAPT Evaluation Attributes

NAVFAC BAPT Evaluation Attributes

- Commercially available products – Release Detection
  - Is the release detection system an “off the shelf” item, readily available?
  - Or is an enhanced system with sensors and computer based algorithm software required?
- Facilities/sites the technology has been utilized and its performance
- Design or anticipated service life
- Operating requirements
- Maintenance requirements

Step 4: Evaluate Tank Upgrade Alternatives
Tank Upgrade BAPT Evaluation Attributes

**NAVFAC BAPT Evaluation Attributes**

- Testing and commissioning procedures
- Rational for the testing and commissioning procedures

Step 4: Evaluate Tank Upgrade Alternatives
Tank Upgrade BAPT Evaluation Attributes

**NAVFAC BAPT Evaluation Attributes**

- **Risks**
  - Environmental (ability to contain and locate leaks)

- **Benefits**
  - Environmental (ability to contain and locate leaks)

- **Reliability**

- **Ability to repair failures**

- **Manufacturer’s technical information**

- **Applicability to tanks at Red Hill**

**Step 4: Evaluate Tank Upgrade Alternatives**
**NAVFAC BAPT Evaluation Attributes**

- Compatibility with current release detection system
- Compatibility with current tank tightness tests
- Compatibility with existing ancillary equipment and if required, upgrades to implement the technology
- Cost
- Maintenance Cost
- Construction Schedule

**Step 4: Evaluate Tank Upgrade Alternatives**
Tank Upgrade BAPT Evaluation Attributes

- Primary Positive Attributes
- Primary Negative Attributes
- Constructible and Testable
- Future Inspectability and Reparability
- Dependency on Existing Tank Integrity

Step 4: Evaluate Tank Upgrade Alternatives
Tank Upgrade BAPT Evaluation Attributes

**Added Evaluation Attributes**

- **Capabilities (Release Detection)**
  - Ability to contain and locate leaks
- Lower Dome Treatment Considerations and Alternatives
- Upper Dome Treatment Considerations and Alternatives
- Quality Control and Quality Assurance (during inspection and construction)

**Step 4: Evaluate Tank Upgrade Alternatives**
A BAPT Summary Matrix is provided in the In Progress Review Report (Table 2-4)

### Step 4: Evaluate Tank Upgrade Alternatives

#### TABLE 2-4
**TANK UPGRADE ALTERNATIVES - BAPT DECISION MATRIX**

<table>
<thead>
<tr>
<th>Item</th>
<th>1A Restoration of Tank</th>
<th>1B Restoration of Tank plus Interior Coating</th>
<th>1C Restoration of Tank plus Metallizing and Interior Coating on Existing Steel Liner</th>
<th>2A Composite Tank (Double Wall) and Carbon Steel</th>
<th>2B Composite Tank (Double Wall) - Duplex Stainless Steel</th>
<th>3A Tank within a Tank (Carbon Steel)</th>
<th>3B Tank within a Tank (Duplex Stainless Steel)</th>
<th>4 Stainless Steel Liner Placed over Existing Steel Liner</th>
<th>5B Stainless Steel Liner Placed over Existing Steel Liner</th>
<th>6 Rubber Liner Bonded to Existing Steel Liner</th>
<th>7 Flexible Membrane Liner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Restoration of Tank</td>
<td>Restoration of Tank plus Interior Coating</td>
<td>Restoration of Tank plus Metallizing and Interior Coating on Existing Steel Liner</td>
<td>Double wall barrel and lower dome with release detection</td>
<td>Same as 2A. Use of stainless steel, eliminates coatings.</td>
<td>Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.</td>
<td>Same as 3A. Use of stainless steel, eliminates coating of liner</td>
<td>Double wall with release detection</td>
<td>Double wall with release detection</td>
<td>None identified</td>
<td>None identified</td>
</tr>
<tr>
<td><strong>Primary Positive Attributes</strong></td>
<td>Low cost</td>
<td>Low cost</td>
<td>Low cost</td>
<td>Double wall barrel and lower dome with release detection</td>
<td>Same as 2A. Use of stainless steel, eliminates coatings.</td>
<td>Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.</td>
<td>Same as 3A. Use of stainless steel, eliminates coating of liner</td>
<td>Double wall with release detection</td>
<td>Double wall with release detection</td>
<td>None identified</td>
<td>None identified</td>
</tr>
<tr>
<td><strong>Primary Negative Attributes</strong></td>
<td>Single wall, must rely on BAPT release detection system</td>
<td>Single wall, must rely on BAPT release detection system</td>
<td>Single wall, must rely on BAPT release detection system</td>
<td>Difficulty of flare gas for metallizing</td>
<td>Double wall barrel and lower dome with release detection</td>
<td>Same as 2A. Use of stainless steel, eliminates coatings.</td>
<td>Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.</td>
<td>Double wall with release detection</td>
<td>Double wall with release detection</td>
<td>None identified</td>
<td>None identified</td>
</tr>
</tbody>
</table>

- Single wall, must rely on BAPT release detection system
- Double wall barrel and lower dome with release detection
- Same as 2A. Use of stainless steel, eliminates coatings.
- Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.
- Double wall with release detection

- Single wall, must rely on BAPT release detection system
- Double wall barrel and lower dome with release detection
- Same as 2A. Use of stainless steel, eliminates coatings.
- Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.
- Double wall with release detection

- Single wall, must rely on BAPT release detection system
- Double wall barrel and lower dome with release detection
- Same as 2A. Use of stainless steel, eliminates coatings.
- Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.
- Double wall with release detection

- Single wall, must rely on BAPT release detection system
- Double wall barrel and lower dome with release detection
- Same as 2A. Use of stainless steel, eliminates coatings.
- Exterior of tank easily visible and inspectable. Existing tank serves as secondary containment.
- Double wall with release detection
Thank You