Partnering with the US Navy: Water Storage Tank Maintenance on a Global Scale

Nicole A. Clarke
Manager, Eastern Region
Tank Industry Consultants
Water Tank Inspection Program

Naval Facilities Engineering and Expeditionary Warfare Center
(NAVFAC EXWC)
TIC’s Naval Deployment

15 Countries
19 States
92 Bases
577 Tanks
753 Projects

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TIC/Navy Partnership

- TIC began evaluating tanks for the Navy in 1987
- Indefinite Delivery/Indefinite Quantities contract since 2001
Challenges

- Mobilization of Equipment and Crews
  - Resolve issues “on the fly”
    - Japan - Tramped through jungles to locate the tanks
    - Bahrain – Inspection equipment took five months to be returned
    - Island facilities - Barges and private planes
    - Armed escorts
    - Local civilian “officials”
    - Local laws and regulations
Locating Tanks in Japan

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Endangered Wildlife

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Coconut Crab
Near Hurricane in Australia

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Travel Restrictions

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CAUTION
WATCH FOR SEALS
ON ROADWAY
Challenges

- Myriad of Types of Structures
  - Steel – welded, bolted, and riveted
  - Concrete
  - Stainless Steel
  - Fiber-Reinforced Plastic (FRP)
  - High-Density Polyethylene (HDPE)
  - Earthen
  - Square Tanks with Concave Contour
Challenges

Safe Working Practices over and above standard OSHA requirements

- Site-specific HASPs
- Certificates of third-party training for all climbing personnel
  - Tower climbing
  - Self rescue
  - Rope access
  - High-angle rescue
High Angle Rescue Training
Successful Tank Management Program!

Tank Rating & Ranking

Comprehensive Tank Evaluation

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Comprehensive Tank Evaluation

- Identify Deficiencies
  - Sanitary
  - Safety
  - Security
- Coatings Evaluation
- Structural Evaluation
- Certified Professional Engineering Report

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Inspection Standards and Guidelines

- AWWA D101 Inspection of Water Tanks and Related Facilities (currently being rewritten)
- AWWA M42 Steel Water-Storage Tanks
- AWWA Steel Water Storage Tanks Handbook
- NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
Selecting a Tank Engineering and Inspection Company

- Registered Professional Engineer
- Extensive Knowledge of:
  - Industry standards
  - Traditional engineering disciplines
  - Specialized training
  - Tank construction practices
  - Surface cleaning and cleanliness standards
  - Familiar with tank design and maintenance

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AWWA M42 Steel Water-Storage Tanks
Selecting a Tank Engineering and Inspection Company

- Effective Communications Skills to:
  - Interpret specifications
  - Resolve potential issues

- Climbing Abilities and Knowledge of:
  - Proper rigging
  - Safety practices
  - Respect for heights

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AWWA M42 Steel Water-Storage Tanks
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Tank Evaluation Methods

- Drained
- ROV
- Dive
Drained Evaluation
Benefits

- Tank has been drained and silt removed
- Thoroughly evaluate surfaces that are adjacent to ladders and that can be accessed by rigging
- Measure metal loss in water-bearing surfaces
Drained Evaluation

Disadvantages

- Tank must be removed from service
- Condition of roof structure require further evaluation
ROV Evaluation
ROV Evaluation

Benefits

- Tank not removed from service
- Easy to combine with a “raft” evaluation
- Get a general idea of coating condition
ROV Evaluation
Disadvantages

- Measurements limited
- Extensive silt can reduce visibility
- Does not remove silt
- Cannot be performed if ice caps in tank
Diving Evaluations
Dive Evaluation
Benefits

- Removed from service for minimal time period
- Easy to combine with a “raft” evaluation
- Get a general idea of coating condition
- Can measure metal loss found in water-bearing surfaces, piping, column bases
Dive Evaluation
Disadvantages

- Tank must be removed from service briefly
- Extensive silt can reduce visibility
- Cannot be performed if ice caps in tank

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OSHA 29 CFR Part 1910, Subpart T – Commercial Diving Operations

- Valid Commercial Diving Certification
  - Association of Diving Contractors
  - International (ADCI)
  - Diver Certification Board of Canada (DCBC) Company Field Records. This includes the company’s dive logs and the diver’s personal dive logs.
Commercial Diving Certification

- 434 Hour Program of Classroom and Dive Time
- Approx. $40,000 per diver
OSHA 29 CFR Part 1910, Subpart T – Commercial Diving Operations

- Company Training Programs Completion Statements or Equivalent Proof of Competency
- Safe Practices Manual
Navy  EM385-1-1
Navy HASP

- Dive Operations Plan
- Activity Hazard Analysis (AHA)
- Site-Specific Risk Assessment
- Emergency Management Plan
- Dive Personnel Qualifications
- US Navy Dive Tables

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# Activity Hazard Analysis (AHA)

**Activity/Work Task:** Diving  

**Project Location:** 2 tanks at the Naval Air Station Corpus Christi, TX  

**Contract Number:** N62583-10-D-0340  

**Date Prepared:** 11/25/2013  

**Prepared by (Name/Title):** Jennifer Coon, CHMM, CET Safety Director  

**Reviewed by (Name/Title):**

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## Risk Assessment Code (RAC) Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Frequent</th>
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<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
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**Step 1:** Review each “Hazard” with identified safety “Controls” and determine RAC (See above).

- “Probability” is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.
- “Severity” is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

**Step 2:** Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.

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## Job Steps  

1. Spread tarp on roof adjacent to manhole  
2. Disinfect wetsuit (see Disinfection AHA)  
3. Enter tank (see Confined Space Entry AHA)  
4. Perform evaluation while diving  
5. Exit tank

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## Hazards  

- Oxygen deficiency  
- Engulfment  
- Fatigue

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## Controls  

- Use air monitor continuously, diver must have back-up air bottle  
- Lockout/Tagout of all valves for filling/emptying the tank as well as electrical controls  
- Maintain communications between diver and crew  
- Review emergency response procedures prior to each dive  
- Inspect all dive and safety equipment prior to each use

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**RAC**

- M  
- M  
- M
Condition Rating and Maintenance Prioritization System

Anytown, USA
What is it?

- A computerized management tool for comparing the relative overall condition of the infrastructure within the same water system in order to simplify long-term maintenance prioritization.
Why use it?

- To estimate the cost of the forecasted maintenance schedule and better manage maintenance priorities and funds.
- Baseline for smaller systems to develop maintenance program
Baseline to Establish Tank Management Program or Inventory

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<th>Start</th>
<th>Finish</th>
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System Size

Less than 10 to more than 500
Elements of System

● Field and Engineering Evaluation

♦ Numerical ratings for various aspects of the tank including:
  • Structural Condition
  • Sanitary Condition
  • Safety Condition
  • Coating Condition
  • Corrosion Protection
  • Seismic Analysis
  • Tank and Site Security
Elements of System

- Transfer Data into Program
Elements of System

- Program performs multiple logical and mathematical functions to determine, among other things:
  - Style of tank
  - Condition of the exterior coatings
  - Condition of the interior coatings
  - Presence of regulated heavy metals in the coatings
  - Seismic rating (if applicable)
  - Structural rating
  - Safety rating
  - Sanitary rating
  - Overall comparative rating tanks within the system.
Elements of System

- Economic Factors
  - Based on the determined scope of work
Spreadsheet
Maintenance Prioritization Template

- Data entry from field evaluation
Maintenance Prioritization Template

- Mathematical Calculations and Logic

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Maintenance Prioritization Template

- Tank Data
- Rankings & Characteristics
- Budgets
A. Rankings

1. Tank Data
   - Name
   - Pressure Zone
   - HWL
   - Heavy Metals
   - Tank Style
   - etc...
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<thead>
<tr>
<th>TANK NAME</th>
<th>TIC #</th>
<th>CONSTRUCTION</th>
<th>TANK TYPE</th>
<th>TANK CAPACITY (gallons)</th>
<th>DATE EVALUATED</th>
<th>CATHODIC PROTECTION</th>
<th>DIAMETER (FT)</th>
<th>SHELL HEIGHT (FT)</th>
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A. Rankings

2. Tank Rating

- Structural
- Safety
- Sanitary
- Security
- P/C/M
- Seismic
- Weighted Combination
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<th>TANK NAME</th>
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<th>TYPE</th>
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## Maintenance Prioritization Template

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### A. Rankings

### 3. Budget Factors

- Historical
- Forecasted
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<thead>
<tr>
<th>TANK NAME</th>
<th>JOB #</th>
<th>2018 ESTIMATED FUNDING</th>
<th>2019 ESTIMATED FUNDING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrich Unit #1</td>
<td>E012.165</td>
<td>$902,000</td>
<td>$600,000</td>
<td>Metal loss and missing bolts/nuts on interior surfaces and rake arms.</td>
</tr>
<tr>
<td>Roosevelt Avenue Tank</td>
<td>E012.124</td>
<td>$495,000</td>
<td>$721,000</td>
<td>2017 - Inadequate balcony safety railing dimensions, lack of balcony access, and no interior safe-climbing device</td>
</tr>
<tr>
<td>Hummocks Spheroid</td>
<td>E012.96</td>
<td>$728,000</td>
<td>$479,000</td>
<td>2017 - No overflow screen, no clog-resistant vent, safe-climbing device not located on bottom 12 ft of access tube ladder, no interior wet ladder safe-climbing device</td>
</tr>
<tr>
<td>Highland Ave. Standpipe, East Tank</td>
<td>E012.175</td>
<td>$600,000</td>
<td>$1,636,000</td>
<td>No roof vent, no overflow pipe, unlocked vandal deterrent, holes in top shell ring, and ineffective screening at shell-to-roof gap</td>
</tr>
<tr>
<td>Highland Ave. Standpipe, West Tank</td>
<td>E012.176</td>
<td>$721,000</td>
<td>$1,636,000</td>
<td>No roof vent, no overflow pipe, unlocked vandal deterrent, holes in top shell ring, and ineffective screening at shell-to-roof gap</td>
</tr>
<tr>
<td>Haddon Heights Standpipe #1, West Tank</td>
<td>E012.177</td>
<td>$479,000</td>
<td>$1,636,000</td>
<td>Warped roof vent pallet and lack of self-closing gate at roof access platform.</td>
</tr>
<tr>
<td>Burton Hill Tank</td>
<td>E012.170</td>
<td>$1,374,000</td>
<td>$1,374,000</td>
<td>No exterior safe-climbing device, holes in roof plates, uncovered cathodic protection anode hand holes, roof vent not of clog-resistant design, and roof manhole unlocked.</td>
</tr>
<tr>
<td>Crest Drive Reservoir</td>
<td>E012.184</td>
<td>$571,000</td>
<td>$3,554,000</td>
<td>3 holes in roof cap plate, inadequate top platform safety railing, no dedicated means of interior wet ventilation, unlocked roof manholes, no access tube ladder safe-climbing device, no interior wet ladder safe-climbing device.</td>
</tr>
<tr>
<td>Newstead Tank</td>
<td>E012.185</td>
<td>$3,554,000</td>
<td>$3,671,000</td>
<td>Gaps at roof vent pallet, and no safety railing on the roof.</td>
</tr>
<tr>
<td>Oak Tree Tank #2</td>
<td>E012.173</td>
<td>$3,554,000</td>
<td>$3,671,000</td>
<td>Gaps at roof vent pallet and no roof safety railing.</td>
</tr>
<tr>
<td>Oak Tree Tank #1</td>
<td>E012.172</td>
<td>$3,554,000</td>
<td>$3,671,000</td>
<td>Gaps at roof vent pallet and no roof safety railing.</td>
</tr>
<tr>
<td>Fellowship Road Tank</td>
<td>E012.182</td>
<td>$1,043,000</td>
<td>$1,043,000</td>
<td>Roof exterior could not be accessed at the time of the field evaluation, and no roof safety railing.</td>
</tr>
<tr>
<td>Sunset Road Tank</td>
<td>E012.171</td>
<td>$615,000</td>
<td>$615,000</td>
<td>Roof exterior could not be accessed at the time of the field evaluation, and no roof safety railing.</td>
</tr>
<tr>
<td>Gibberson Standpipe</td>
<td>E012.138</td>
<td>$571,000</td>
<td>$3,554,000</td>
<td>Roof exterior could not be accessed at the time of the field evaluation, and no roof safety railing.</td>
</tr>
<tr>
<td>Walnut Glen Tank</td>
<td>E012.098</td>
<td>$615,000</td>
<td>$615,000</td>
<td>Roof exterior could not be accessed at the time of the field evaluation, and no roof safety railing.</td>
</tr>
</tbody>
</table>
Benefits

- Ease of scheduling and budgeting for tank maintenance.
- Easy-to-understand comparison of all tanks within system.
- Allows PROACTIVE response to future needs.
Consistent Detailed Evaluations based on Sound Engineering Practices

+ Method for Tracking and Rating Maintenance Requirement

Successful Tank Management Program

Tank Industry Consultants
Questions?

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