Red Hill Administrative Order on Consent Scope of Work Deliverable

SECTION 2.2: TANK INSPECTION, REPAIR, AND MAINTENANCE REPORT, dated 11 October 2016

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 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: ______________________

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

Date: 9 OCT 2016

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NAVFAC Naval Facilities Engineering Command
ENGINEERING AND EXPEDITIONARY WARFARE CENTER

SITE SPECIFIC REPORT
SSR-NAVFAC EXWC-CI-1655
11 OCTOBER 2016

RED HILL FACILITY
TANK INSPECTION, REPAIR, AND MAINTENANCE REPORT
ADMINISTRATIVE ORDER ON CONSENT (AOC) STATEMENT OF WORK (SOW), SECTION 2.2

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14. ABSTRACT

This Tank Inspection, Repair, and Maintenance (TIRM) Report has been prepared per the Administrative Order on Consent (AOC) In the Matter of Red Hill Bulk Fuel Storage Facility, Attachment A, Statement of Work, Section 2.2. The first scoping meeting occurred on 27 October 2015, and several more face-to-face meetings and phone conferences between December 2015 and June 2016. On 10 June 2016, EPA/DOH provided a letter stating that the objectives outlined in sections 2.1 and 3.1 of the AOC have been met, and that they are satisfied with the Navy/DLA's proposal. This report follows the TIRM report outline provided to EPA/DOH on 23 March 2016 and responses provided during the phone conference on 3 June 2016.

15. SUBJECT TERMS

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EXECUTIVE SUMMARY

In January 2010, Willbros Government Services, LLC (WGS) was awarded a contract by the Navy to clean, inspect, and repair Red Hill Tanks 5 and 17. In the months following, WGS mobilized to the job site, cleaned and ventilated Tank 5 to a condition of gas-free and safe for entry, and prepared it for inspection. Their subcontractor for tank inspection, TesTex, Inc., began work in mid-August 2010, finished at the end of September, and submitted their report in mid-October. WGS supported TesTex, Inc., during the inspection with lights, ventilation, scaffolding, and other required tank safety measures, and self-performed an API Standard (Std) 653 inspection. The WGS inspection results and recommended repairs were approved and accepted by the Navy in August 2011. A contract modification was awarded mid-December 2011 for Tank 5 mechanical and coating repairs, and repair work commenced. A total of 760 patch plates and repaired welds were completed by WGS in 2012. All tank repairs including sandblasting and coating repairs were completed in late June 2013.

The tank inspector of record reported Tank 5 suitable for service and returned it to the operator, Fleet Logistics Center Pearl Harbor (FLCPH). FLCPH started filling Tank 5 in December 2013 with JP-8 turbine fuel. The tank was filled to a depth of 105 feet by 12 December 2013. The tank was filled from 105 feet to 224 feet in ten separate fuel transfers between 13 December 2013 and 6 January 2014. During filling, the Navy discovered an inventory discrepancy, reported a release to the regulatory agencies on 13 January 2014, and commenced defueling the same day. Tank 5 was defueled by 17 January 2014.

There is concern regarding whether a fuel release from a Red Hill tank might migrate through the reinforced concrete, the layer of pressure injected grout, and the layer of gunite into the surrounding lava rock, travel downward through the lava rock, and contaminate the aquifer underlying Red Hill at an elevation just above sea level. The bottom of Tank 5 is an estimated 100-feet above the groundwater lens. The Navy operates a Maui-type water well under Red Hill about 1000-feet makai (towards Pearl Harbor) of Tank 5. The Honolulu Board of Water Supply operates wells on either side of Red Hill in the area of Moanalua and Halawa Valleys.

In mid-March 2014, the Navy commenced an investigation into the cause of the release. WGS was directed to re-enter Tank 5 and investigate the release. Defective workmanship in welding by WGS was found in Tank 5. The defective welds had not been not discovered and corrected by WGS due to poor inspection and ineffective quality control. From the initial and follow-on investigations, it was determined the release was not caused by deficient inspection methodology or corrosion of the tank shell. The underlying cause of the release from Tank 5 was unrepaired gas test holes and defective fillet welds on patch plates which covered the gas test holes. Contributory factors to the underlying cause of the release were identified, all of which were related to human failures.

This Tank Inspection, Repair, and Maintenance (TIRM) Report has been prepared per the Administrative Order on Consent (AOC) In the Matter of Red Hill Bulk Fuel Storage Facility, Attachment A, Statement of Work, Section 2.2. The first scoping meeting occurred on 27 October 2015, and several more face-to-face meetings and phone conferences between December 2015 and June 2016. On 10 June 2016, EPA/DOH provided a letter stating that the objectives outlined in sections 2.1 and 3.1 of the AOC have been met, and that they are satisfied with the Navy/DLA's proposal. This report follows the TIRM report outline provided to EPA/DOH on 23 March 2016 and responses provided during the phone conference on 3 June 2016.

This report is separated into five (5) parts as described as follows:

a. The first part is to provide a general description of the report, history of the construction and previous TIRM projects, and a description of constraints that need to be considered in executing a TIRM project at Red Hill.
b. The second part provides a description of the work that was performed in Tank 5 including the cleaning, inspection, repair, and repair verification, recommissioning phases and other considerations for the work performed in Tank 5.
c. The third part provides lessons learned during the work performed in Tank 5. The first Chapter in this Part (Chapter 9) provides very extensive Tank 5 incident report that describes the underlying causes and contributory causes of the release.
d. The fourth part provides the current and planned improvements of the Red Hill Tank Inspection, Repair, and Maintenance processes. This part includes information of the NAVFAC contracting processes, API Std 653 requirements, API RP 580 discussion, scheduling of future tank inspections, and other planned actions at Red Hill independent of the TIRM work.
e. The fifth part is a summary of planned and future options for the TIRM recommendations.

ACRONYMS AND ABBREVIATIONS

A2LA	American Association for Laboratory Testing
ACOR	Alternate Contracting Officer's Representative
ACOE	United States Army Corps of Engineers
ADA	Antideficiency Act
A-E	Architect-Engineer
AFCEE	Air Force Center for Environmental Excellence
AFHE	Automated Fuel Handling Equipment
AFPD	Air Force Policy Directive
AFM	Air Force Manual
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
AOC	Administrative Order on Consent
AP	Acquisition and Procurement
API	American Petroleum Institute
APP	Accident Prevention Plan
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
AST	Aboveground Storage Tank
ASTM	American Society for Testing Materials
ATG	Automatic Tank Gauge
AWS	American Welding Society
BBL(S)	Barrel(s); Volume unit of product comprised of 42 US gallons
BCA	Business Case Analysis
BFET	Balanced-Field Electromagnetic Testing
BIG	Baker Inspection Group
BMS	Business Management System
C-7	Abrasive Blasting Program (SSPC)
CA	Construction Agent
CFR	Code of Federal Regulations
CHINFO	Chief of Naval Information Office
CIH	Certified Industrial Hygienist
CIR	Clean, Inspect, and Repair
CLP	Critical Lift Plan
CM	Construction Manager
COAR	Contracting Officer's Authorized Representative

COR	Contracting Officer's Representative
CQC	Contractor Quality Control
CQM	Construction Quality Management
CS	Carbon Steel
CSI	Construction Specification Institute
CSCP	Confined Space Competent Person
CWI	Certified Welding Inspector
DB	Design-Build
DBB	Design Bid Build
DAO	Departmental Accountable Official
DARS	Defense Acquisition Regulations System
DASN	Deputy Assistant Secretary of the Navy
DFAR	Defense Federal Acquisition Regulations
DFARS	Defense Federal Acquisition Regulations Supplement
DFT	Dry Film Thickness
DISA	Defense Information Systems Agency
DLA	Defense Logistics Agency
DM	Design Manager
DoD	Department of Defense
DoN	Department of the Navy
DOH	Department of Health
DOR	Designer of Record
DUI	Driving Under the Influence (conviction)
E&IHI	Engineering & Inspections Hawaii, Inc.
EA	Executing Agent
EDWOSB	Economically Disadvantaged Women-Owned Small Business
EEI	Enterprise Engineering, Inc.
EM	Engineer Manual
EP	Engineer Pamphlet
EPA	Environmental Protection Agency
ET	Engineering Technician
EXWC	Engineering and Expeditionary Warfare Center
F-76	Diesel Fuel Marine
FAR	Federal Acquisition Regulation
FEAD	Facilities Engineering and Acquisition Division
FISC	Fleet Industrial Support Center

FLC	Fleet Logistics Center
FLCPH	Fleet Logistics Center Pearl Harbor
G&A	General & Administrative
GFE	Government Furnished Equipment
GLS	Global Logistics Support
GPM	Gallons per Minute
GPOL	Global Petroleum Oil Lubricants Contract
HASP	Health and Safety Program
HECO	Hawaiian Electric Company
HIDOH	Hawaii State Department of Health
IBC	Intermediate Bulk Container
IDIQ	Indefinite-Delivery/Indefinite Quantity
IGCE	Independent Government Cost Estimate
JBPHH	Joint Base Pearl Harbor Hickam
JP-5	Aviation Turbine Fuel
JP-8	Aviation Turbine Fuel
KO	Contracting Officer
KVA	Kilovolt-Amperes (unit of apparent electrical power)
KWA	Ken Wilcox Associates
LAT	Lower Access Tunnel
LD	Liquidated Damages
LFET	Low-Frequency Electromagnetic Testing
LFM	Liquid Fuel Maintenance
LOTO	Lock Out Tag Out
LPTA	Lowest Price Technically Acceptable
LRDP	Low-Range Differential Pressure (leak detection)
LT	Leak Testing
MACC	Multiple Award Construction Contract
MAOP	Maximum Allowable Operating pressure
MAWP	Maximum Allowable Working Pressure
MFG	Manufacturer’s
MIDPAC	Middle Pacific
MILCON	Military Construction
MT	Magnetic Particle Testing

MTG	Manual Tank Gauge
NA	Not Applicable/Accessible
NAICS	North American Industry Classification System
NACE	National Association of Corrosion Engineers
NAVFAC	Naval Facilities Engineering Command
NAVFACINST	Naval Facilities Instruction
NAVSUP	Naval Supply Systems Command
NDE	Non-Destructive Examination
NDT	Non-Destructive Testing
NFAS	Naval Facilities Acquisition Supplement
NFESC	Naval Facilities Engineering Service Center
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NLT	No Later Than
NMCARS	Navy Marine Corps Acquisition Regulation Supplement
NPDES	National Pollutant Discharge Elimination System
NTR	NFESC Technical Representative
NWGLDE	National Work Group of Leak Detection Evaluations
ODC	Other Direct Costs
OES	Optical Emission Spectroscopy
OICC	Officer in Charge of Construction
OOS	Out of Service
OPNAVINST	Chief of Naval Operations Instruction
OSBP	Office of Small Business Programs
OSHA	Occupational Safety and Health Administration
PACNAVFAC	Pacific (Division), Naval Facilities (Engineering Command) (now NAVFAC PAC, or Naval Facilities [Engineering Command] Pacific)
PCAS	Post Construction Award Services
PE	Professional Engineer
PET	Price Evaluation Team
PM	Project Manager
PMI	Positive Material Identification
POA&M	Plan of Action & Milestones
POC	Point of Contact
POD	Probability of Detection
POL	Petroleum, Oils, and Lubricants

POLMAC	Petroleum Oil and Lubricant Multiple Award Contract
PQP	Private Qualified Person
PRCS	Permit - Required Confined Space
PT	Penetrant Testing
QASP	Quality Assurance Surveillance Plan
QA	Quality Assurance
QC	Quality Control
QCM	Quality Control Manager
RBI	Risk Based Inspection
RFI	Request for Information
RFP	Request for Proposals
RH	Red Hill
RHT5	Red Hill Tank 5
RP	Recommended Practice
RT	Radiographic Testing
SBA	Small Business Administration
SBSP	Small Business Subcontracting Plan
SLOFEC	Saturated Low Frequency Eddy Current
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SOW	Statement of Work
SPAWAR	Space and Naval Warfare Systems Command
SRM	Sustainment, Repair, Modernization
SSA	Source Selection Authority
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board
SSHO	Site Safety and Health Officer
SSP	Source Selection Plan
SSPC	Society for Protective Coatings (formerly Steel Structures Painting Council)
SST	Source Selection Team
STI	Steel Tank Institute
SWPPP	Storm Water Pollution Prevention Plan
SWUT	Shear Wave Ultrasonic Testing
TAD	Temporary Assigned Duty
TIRM	Tank Inspection, Repair, and Maintenance

TO	Task Order
TOEP	Task Order Evaluation Plan
UAT	Upper Access Tunnel
UCF	Uniform Contract Format
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
USACE	United States Army Corps of Engineers
UST	Underground Storage Tank
UT	Ultrasonic Testing
UTF	Upper Tank Farm
VBT	Vacuum Box Testing
VOC	Volatile Organic Compound
VT	Visual and Optical Testing
WBDG	Whole Building Design Guide
WGS	Willbros Government Services, LLC.
WOSB	Women-Owned Small Business
WP	Work Plan
XRF	X-ray Fluorescence

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PART E – TIRM RECOMMENDATIONS SUMMARY

LIST OF ATTACHMENTS

AO	WGS Free Product Report
AP	WGS Tank 5 Pressure Testing Procedure Jun 2014
AQ	WGS Tank 5 Pressure Testing Report Jun 2014
AR	QASP RHT5 Warranty Rework
AS	WGS Tank 5 Suitability For Service Statement
AT	WGS Repair Work Plan Red Hill Tank 5
AU	WGS D-0132 Basic Award
AV	WGS Sample and Drain Line Drawings
AW	WGS Tank 5 Repairs - Repair NDE QC Data
AX	List of Welder PQR
AY	API Inspector Qualifications
AZ	NAVSUP GLS Instruction 10345.1 - Fuel Tank Return to Service
BA	Contract Number N62742-03-C-1402-All
BB	Red Hill Tank 5 Inspection SOW
BC	Generic 653 SOW April2010
BD	UFGS Section 33 56 17.00 20
BE	UFGS Section 33 56 18.00 20
BF	Telltale Leak Detection System
BG	DLA ATG Policy Letter 2009
BH	NAVSEA 5104 14 Aug 2011 RSO Application
BI	NAVFACINST 5104 1
BJ	Report on the Trip to Pacific Division Naval Facilities Command
BK	Acquisition Schedule Red Hill CIR
BL	Overall CIR Schedule without modification
BM	Red Hill Tank CIR Contract Sequencing
BN	Contract Number N39430-15-D-1632-0005 Tanks 14, 17, 18
BO	Contract Number N39430-15-D-1632-0004 Tanks 4, 13
BP	NAVFAC Drawing No. 7019544 MILCON P-060

PART A – INTRODUCTION

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CHAPTER 1- REPORT INTRODUCTION

1-1 BACKGROUND

Since the inadvertent fuel release from Red Hill Tank 5 that occurred from 9 December 2013 to 17 January 2014, there have been hundreds of phone calls, written communications, and face-to-face meetings amongst the stakeholders at Navy, Defense Logistics Agency (DLA), Environmental Protection Agency (EPA), and Hawaii State Department of Health (HIDOH); interested parties including the Honolulu Board of Water Supply, the Honolulu media; state and local elected officials; and the general public. All want to know what happened, why it happened, the nature of the contamination risk to the fresh water aquifer under Red Hill, what can be done to stop the fuel before it reaches the aquifer, and what can be done to make sure something like this never happens again. The result of the dialogue is the Administrative Order on Consent (AOC) between Navy/DLA and EPA/HIDOH which was finalized and signed in September 2015.

The AOC includes a Statement of Work (SOW) which outlines a path forward to answer the questions raised, and plans an overall course of action comprised of multiple sub-courses of action to resolve the issues at hand. This report expands on Section 2 of the SOW outline entitled Tank Inspection, Repair, and Maintenance (TIRM) as described in the following paragraph.

1-2 PURPOSE AND SCOPE

The purpose of the TIRM report is to review and expand upon the issues that have been agreed to by Navy/DLA and EPA/HIDOH in the AOC. It is important that the processes of the future inspection, repair, and maintenance of the Red Hill tanks are defined in order to ensure that the goal of keeping the tanks permanently leak-free going forward can be met. The report examines the pros and cons of past, current, and emerging means and methods for work on the tanks in order to provide the basis for decisions on a strategy that can best achieve the goal of leak-free tanks.

1-3 HISTORY OF TIRM AT RED HILL

This paragraph discusses the original construction and historical TIRM standards that have been performed in the past.

1-3.1 Original Construction, 1940 – 1943

Contractor – Morrison-Knudsen. The Navy employed 29 inspectors to inspect the work of Pacific Naval Air Base Contractors in the construction of the Red Hill Facility. Most of the inspectors worked for the Navy's Concrete Laboratory.

1-3.1.1 Upper Dome

The upper dome was the first part of each tank to be constructed. It was built first in order to provide overhead protection for the miners so they could safely excavate the vault in which the tank would be constructed. As the shell plates in the upper dome were placed and welded together, they were supported by a falsework of H-beams bolted together in the shape of an upside down bowl. The upper dome shell plate butt joints were welded together from the back side (or outside). The upper dome butt welds were inspected and leak tested, as reported by the Navy Bureau of Yards and Docks: "When the steel in each upper dome was being set and welded, every foot of weld was visually inspected by climbing over the entire dome with a flashlight." The welds were further tested by spraying a heavy stream of water on each weld and inspecting the underside for leaks.

1-3.1.2 Lower Dome and Barrel

Following construction, the lower dome and barrel of each tank were checked for leaks in two ways. From Navy technical reports and Builders for Battle by David O. Woodbury [1]: "[Using the tell-tale pipes in reverse] Air was introduced under pressure beneath the steel lining; soapy water was applied to each joint, and leaks were located by telltale bubbles. Bad welds and leaky joints were chipped out and rewelded." To recheck for leaks in joints and to verify the shell plates were tight, each tank was filled with water in 5-foot increments. The tell-tale pipes were used to detect any water leaking through the shell plates and welds. If water appeared in the tell-tales, low pressure air was again introduced via the tell-tales behind the tank shell plates into the interstitial space between the back side of the shell plates and the reinforced concrete. Any holes through the shell plates or butt welds showed up as bubbles in the tank. Welders working from a boat inside the tank marked the source of the bubbles. The water level was then lowered to expose the hole so the welders could repair it. As a final test, each tank was completely filled with water up into the 5-foot diameter neck at the top of the tank, and the height of the water level was closely monitored. In the 5-foot diameter neck, a liquid level change of 1/8-inch equals 1.53 gallons. The acceptance criterion was no more than ½-inch level drop (6.12 gallons) in 24 hours. If a level change exceeded the criterion, workers returned to the search and repair mode.

1-3.2 The Early Years, 1943 – 1960

a. Most tank cleaning, inspection, and repair work was executed by in-house maintenance forces at Naval Supply Center Pearl Harbor Fuel Department. A lesser number of repairs were executed by Pearl Harbor Naval Shipyard and Public Works Department personnel.
b. Tell-tales and tank gauges were used as indicators of fuel loss. In addition to visual inspection, as was done during the original construction, the tell-tales were used to find leaks by introducing air under pressure behind the tank shell with water in the tank.
c. During service intervals, the tell-tale pipes at or near the bottom of the tanks experienced significant corrosion on the external surfaces of the piping due to salt water in the bottom of the tanks. Many tell-tale leak indications were found to be false due to holes corroded through the tell-tale piping itself. Attachment A contains photos of typical tell-tale piping corrosion.
d. From 1942 when Red Hill began operation, and until the Chevron refinery was built on Oahu in the early 1960s, all fuel was delivered to Pearl Harbor by tanker ships. In heavy weather, waves washing over the deck of a fully loaded tanker ship would result in seawater entering the cargo tanks through vents. The rolling of the ship helped to mix the seawater with the fuel and when a tanker docked at Pearl Harbor, the salt water was offloaded along with the fuel. The salt water settled to the bottom of a Red Hill tank and exposed the tell-tale piping to increased corrosion rates.

1-3.3 Conversion Project 1960 – 1962

Contractor – Red Hill Contractors, a joint venture of Gunther & Shirley Co., E.V. Lane Corp., and Gibbons & Reed Co. This was the first major tank rehabilitation project at Red Hill. The purpose of the project was to isolate Tanks 17 through 20 from the other non-volatile tanks, pipelines, tunnels, ventilation, and slop systems; and convert them to store volatile fuel. Major scope items of work for the tanks included cleaning, seal welding the 2” x ¼” backer bars which covered the shell plate joints in the upper dome and the upper 12-feet of the barrel, removal of the 1942 vintage tell-tale systems, installation of upgraded tell-tale systems, sandblasting, and coating the entire interior of the tanks with a polyurethane coating system formulated by the Naval Research Laboratory. The new tell-tale systems were used to detect and locate leaks, first with the JP-5 in the tank, and then with water. The tell-tales were also used to introduce air behind the shell plates to locate leaks. Bad welds were chipped out and re-welded. Finally, a new gauging system was installed with the capability to measure the fuel level to the nearest one-thousandth of a foot. The contractors work was inspected and monitored by Government inspectors working for the Navy.

1-3.4 Repair Non-Volatile Section Project, 1970 – 1972

The second major tank rehabilitation project at Red Hill covered Tanks 5, 6, and 12. Major scope items included cleaning, inspection and repair of existing welds, installation of sample piping, installation of new tank gauging equipment, modification of the 8-foot diameter manway, installation of stairways and landings around the outside of the center tower from the catwalk to the top of the tank, removal of the 1942 vintage tell-tale system, and installation of an upgraded tell-tale system. The new tell-tale system in combination with water in the tank for staging was used to test the shell plates and shell plate welds for leaks. All inspection was performed by Government inspectors working for the Navy's Officer in Charge of Construction (OICC). From Section 15C of the project specification: "the welded seams and all other welds contributing to water-tightness will be inspected by the Officer in Charge using such methods which, in his opinion, will best serve the purpose. All defective welds discovered by the inspection by the Officer in Charge shall be chipped and re-welded by the Contractor. Welding, welding procedure and qualification of welders shall conform to the requirements of military standard MIL-STD-00248." Leaks in the butt welded joints between shell plates in the upper dome were addressed first by removing the 2" wide x ¼" thick backer bar and chipping and re-welding the butt weld. If that didn't work, the backer bar was placed over the joint and seal welded along its edges.

1-3.5 FY-78 Military Construction (MILCON) Modernization Project P-060, 1978 – 1984

a. Contractor – Hawaiian Dredging and Construction. Scope covered Tanks 1 through 16 and included cleaning, complete removal of all tell-tale piping and patching of all tell-tale through-shell holes, removal and replacement of fuel sampling pipes, weld inspection and repair, and sandblasting and coating the entire interior of the tank with a polyurethane coating system formulated by the Naval Research Laboratory. All inspection was by Government inspectors working for OICC Middle Pacific (MIDPAC).
b. This work was reported in an article entitled Red Hill Modernized published in the Summer 1984 edition of The Navy Civil Engineer Magazine. The Contractor designed, built and installed three scaffold systems to access the tank shell. To access the upper dome a rotating

truss system was mounted on the center tower. Air-powered platforms traveled on an inclined track attached to the truss system. To access vertical walls in the barrel and portions of the lower dome, platforms were suspended by wire rope from monorail tracks installed near the upper dome (Attachments B and C).

c. Some work in the upper dome, barrel, and upper portions of the lower dome were accessed using two telescoping box booms attached to opposite legs of the center tower. A two man work basket with a climber motor was suspended by wire rope was attached to the end of the boom near the tank wall (Attachment D). Tank surface areas and weld joints were visually inspected. Weld indications such as porosity, slag entrapment, weld splatter, undercuts, voids, and lack of penetration were ground smooth where required. In addition, all the weld joints were inspected by vacuum box testing.
d. Lining Tank Repair: All defective and suspect welds were ground down and re-welded. Numerous angle clips, pipe stubs and other protrusions were cut off and ground smooth. Corrosion pits in the tank bottoms were filled in with weld material. In isolated locations, where corrosion was extensive, steel patch plates were welded on. In the upper dome and top 12-feet of the barrel of Tanks 1 through 16, all butt welded joints covered with 2” x ¼” backer bars were encapsulated with channels the edges of which were seal welded to the shell plates.
e. Destructive Investigation Prior to Design: Prior to initiation of design, coupons were removed from the ¼-inch steel liner on the lower wall and the ½-inch tank bottom plate to determine the backside condition of the 40-year old steel. The backsides of the steel plates were found to be in almost new condition with mill scale intact.

1-3.6 Repair Tank 19 Project, 1991 – 1993

Contractor – Abhe & Svoboda, Inc. This project was Phase I of a two phase project. Scope included an upgraded tank ventilation system, upgraded electrical power to support the Phase II tank repairs, protection of the existing 1961 vintage tell-tale piping, installation of two telescoping booms with man-baskets and a platform scaffold beneath the catwalk (where the booms cannot reach) for the Phase II tank shell inspection and repairs, installation of Occupational Safety and Health Administration (OSHA) compliant ladders and landings on the center tower from the tank bottom to the catwalk level, and upgrade of the elevator in the center tower to meet OSHA requirements[1].

[1] Upgrade of the elevator in the tower was later deleted from the contract.

Phase II of the project, which was to inspect and repair the tank was never executed, and since 1993 Tank 19 has been out of service.

1-3.7 Clean, Inspect, and Recoat Tanks Project, 1994 – 1996
Contractor – AMAN Environmental Construction Inc. Project scope included cleaning and visual inspection of all areas of Tanks 6, 7, 8, 9, 10, 12, 13, 14, and 16. For the 20-foot diameter bottom plate and the first course of sloping plates in the lower dome of Tanks 6, 9, 12, 13, and 14, abrasive blasting and inspection in accordance with API Std 653 was performed, along with repair of defects identified during the inspection, and recoating. Tanks 6, 9, 12, 13, and 14 were inspected in accordance with the applicable requirements of API Std 653 by Leif Woodman of Conam MMP Inspections, Inc., API Std 653 Certification No. 1059. The project specification called for the inspector to be certified in accordance with API Std 653, Supplement 1 of January 1992. Tools used in the API inspection included a pit gauge, ultrasonic thickness tester, soap film, and vacuum boxes of various configurations. See Attachment E for the API Std 653 inspection report for Tank 13. Repairs to the tank shell included repair of existing welds by chipping and re-welding, and welding patch plates onto the tank shell. Inspection of the repairs was performed by personnel from the Navy Public Works Center Pearl Harbor and AMAN CQC. Attachments F, G, and H, are the available API Std 653 inspection reports.

1-3.8 Emergency Repairs for Red Hill Tanks, 1997 – 1998
Contractor – Dames & Moore. The entire tank shell of Tanks 6, 7, 8, 10, and 16 were inspected in accordance with the applicable requirements of API Std 653 by Thomas Kitchen of Mid-Atlantic Environmental Co., API Std 653 Certification No. 1891. All welds were inspected visually. Suspect existing welds, repaired welds, and new welds were checked using dye penetrant testing. Coating was inspected visually and by taking dry film thickness readings. Repairs to the steel tank shell and the coating on the tank shell were done in accordance with the recommendations in the API 653 inspection reports.

1-3.9 Repair Red Hill Tanks 1, 15, 6, and 16 Project; 2004 – 2007, Contract No. N62742-03-C-1402

a. Contractor – Dunkin & Bush, Inc. (Dunkin & Bush). Tank 1 was cleaned only. After Tank 15 was cleaned by Dunkin & Bush the tank shell was inspected and tested jointly by Jurva Leak Testing and TesTex Inc., (TesTex).

b. Jurva tested for leaks by injecting helium gas behind the shell plates and used a helium mass spectrometer to test for helium leaking back into the tank through faulty welds and holes in the shell plates.
c. TesTex used low-frequency electro-magnetic scanners to look for corrosion on the backside of shell plates and piping. When defects were detected, ultrasonic thickness measurements were taken to determine the actual metal thickness. Welds were inspected with eddy current probes. When indications of weld defects were found, shear wave ultrasonic testing was performed to establish remaining thickness. Certain weld flaws were also inspected using the vacuum box method. Both Jurva and TesTex were initially under contract to the Architect & Engineer (A&E) of record, Thermal Engineering.
d. This contract was the first time that helium had been used at Red Hill to find leaks and the first time electromagnetic scanners had been used to detect corrosion on the backside of the shell plates and flaws in welds as part of the API 653 inspection. Later in the project, the TesTex contract was novated from Thermal Engineering to Weston Solutions and the electromagnetic scanning work continued in Tanks 15, 16 and 6.

1-3.10 Inspect Repair Red Hill Tanks 6, 15, and 16, 2007, Contract No. FA8903-04-D-8681/0176

Contractor – Weston Solutions. This contract was executed by the Air Force Center for Environmental Excellence and it cleaned, performed a modified API Std 653 inspection Tanks 6, 15, and 16. TesTex used low-frequency electro-magnetic scanners to look for corrosion on the backside of shell plates and piping on these three tanks. Attachment I is the contract documents. Attachments J, K, and L are the modified API Std 653 inspection reports.

1-3.11 Clean and Repair Red Hill Tanks 6, 15, and 16, 2007, Contract No. N62742-03-C-1402

Contractor – Dunkin and Bush. This contract was executed by Naval Facilities Engineering Command Pacific (PACNAVFAC) and it cleaned and repaired Tanks 6, 15, and 16. TesTex used low-frequency electro-magnetic scanners to look for corrosion on the backside of shell plates and piping on these three tanks. Attachment BA is the contract documents.

1-3.12 Clean, Inspect, and Repair Red Hill Tanks 2 and 20, 2008 – 2010, Contract No. N47408-04-D-8503/0031

Contractor – Shaw Environmental Inc. Subcontractors – TesTex, Engineering & Inspections Hawaii, Enterprise Engineering, Dunkin & Bush. These two tanks were scanned with the electromagnetic methods provided by TesTex. The API Std 653 inspector was Ken McNamara of Engineering & Inspections Hawaii, API Std 653 Certification No. 0873. Attachment M is the contract documents. Attachments N and O contain the modified API Std 653 inspection reports.

1-3.13 Clean, Inspect, and Repair Red Hill Tanks 5 and 17, 2010 – 2016, Contract No. N62583-09-D-0132/0003

Contractor – WGS. Subcontractors identified in Chapters 4 and 5. These two tanks were scanned with the electromagnetic methods provided by Testex. The API Std 653 inspector was Tim D. Anderson of WGS, API Std 653 Certification No. 37258. The API Std 653 inspection on Tank 17 was not completed. Attachment P is the contract documents. Attachment T contains the modified API Std 653 inspection report on Tank 5. The contract was closed in 2016.

1-3.14 Clean, Inspect, and Repair Red Hill Tanks 4 and 14, 2012 – 2016, Contract No. N62583-09-D-0132/0019

Contractor – WGS. Tank 14 was cleaned in 2015. Tank scanning and API inspections on Tanks 4 and 14 were not started. The contract was closed in 2016.

1-3.15 Planned Contract Actions

See Chapter 20 for discussion of planned and recently awarded tank inspection, repair, and maintenance contracts.

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CHAPTER 2 – GENERAL CONSTRUCTION ISSUES

2-1 INTRODUCTION

This Chapter discusses the general construction challenges which constrain productivity during the cleaning, inspection, and repairs of the Red Hill fuel storage tanks.

2-2 TRANSPORTATION

2-2.1 Time for transportation of equipment and material from mainland to the Port of Honolulu has to be provided in the construction schedule. Some material can be air-freighted, but primarily the material will have to be shipped or barged into the Port of Honolulu. This effort can take a few weeks, and could be longer if there are issues with the ship (breakdown) or the stevedores (Union Strike or the Union President's Birthday).

2-2.2 Transportation of Equipment and Material from Port of Honolulu to Red Hill. All material and equipment must be transported by truck from the Port of Honolulu or the airport to the site. The road from the Moanalua Freeway (Halawa Valley Road) to the Red Hill tank farm can be very congested. There is heavy truck traffic in the industrial area, the quarry, and the concrete plant.

2-2.3 There are vehicle weight limitations due to erosion on the Navy-owned road (Icarus Way) between some of the tunnel access points in the Red Hill tank farm. See Chapter 20 for plans to repair this road.

2-3 QUALIFIED PERSONNEL

The pool of qualified, certified, and skilled personnel is limited on Oahu, Hawaii. Most personnel will have to mobilize from the mainland. Personnel time on-island may be limited due to the stress from being away from family and normal routines. Construction schedules could be affected due to the time it takes to find replacements, and to obtain security clearances for replacement personnel.

2-4 SECURITY

Once qualified skilled and unskilled personnel are hired, they are required to pass the scrutiny of a background investigation. The workers cannot have criminal offenses, DUI and drug convictions, no-fly list, late child support payments, etc. In addition, all of the offenses are not published by the security office, so the employer is not able to pre-screen their employees to determine if they will be able to work on the project.

"Workers" are welders, fitters, laborers, coating specialists, riggers and weight-handlers, inspectors, electricians, and API Std 653 inspectors in addition to the project manager, site manager, quality control manager, and safety manager. Foreign nationals are not allowed on the restricted site.

Once contractor personnel provides the required information to the security office, four (4) to six (6) months is needed to process the application and provide the security clearances. If there are problems with the paperwork that is submitted and has to be resubmitted, the schedule of four (4) to six (6) months starts over again.

2-5 ELECTRICAL POWER

2-5.1 The following is a list of equipment requirements for each phase of the clean, inspect, and repair of a Red Hill tank that requires electrical power:

	Equipment	Quantity
Opening/Venting		
	Lighting (Rope)	2
	Lighting (Flood)	2
	Hand Tools/Chargers	2
	Ventilation Fans (Pre Gas-Free)	3
	Ventilation Fans (Post Gas-Free)	3
Cleaning		
	Lighting (Basket)	2
	Lighting (Flood)	12
	Hand Tools/Chargers	2
	Ventilation Fans	3
	Hydraulic Pump	2
	PC3E Motor (lift for baskets)	2
	Power Washer	2
Inspection		
	Lighting (Basket)	2
	Lighting (Flood)	12
	Hand Tools/Chargers	4
	Ventilation Fans	3

	Hydraulic Pump	2
	PC3E Motor (lift for baskets)	2
Repairs		
	Lighting (Basket)	2
	Lighting (Flood)	12
	Hand Tools/Chargers	4
	Ventilation Fans	3
	Hydraulic Pump	2
	PC3E Motor (lift for baskets)	2
	Welding Machine	2
	Industrial dehumidifier	1
Closing/Return To Service		
	Lighting (Rope)	2
	Lighting (Flood)	2
	Hand Tools/Chargers	2
	Ventilation Fans	3

The size and number of dehumidification equipment can vary greatly depending on several factors. Based on this equipment list (excluding dehumidifier), the electrical power requirement is estimated at 210 KVA and 225 Amps.

2-5.2 Personnel safety is a major concern if there is an outage while work is on-going in the tank. If electrical power fails, all lights, ventilation, and the lifts become non-operational, leaving the tunnels and tank dark. Flashlights or personal lighting are mandatory equipment required to be carried at all times while working in the facility. Suspended scaffold baskets can be lowered by hand when there is no power. In addition, the 32” product line nozzle may be closed to egress due to the ventilation system as discussed in paragraph 2-7 below.

2-5.3 There are three sources of power for work in the Red Hill Tanks.

a. Portable Generator(s)
This method enables a contractor to have adequate power and not rely on the Navy or Hawaiian Electric Company (HECO), so there should not be outages. The disadvantage is the Clean Air Permit requirement, the amount of fuel consumed, and required daily maintenance of the generators which will need to be transported and placed into service at the

site. In addition, due to distances between the tunnel access points, more than one generator might be required to supply electrical current.

b. Navy Power Provided To Contractor(s)
The Contractor will need to pay for the power, will be limited to existing system voltages, and can only receive a limited amount of current. The amount of power available depends on other in-progress construction work and ongoing operations in the facility. During the WGS contract, there was not enough Navy electrical power available for working on three tanks simultaneously. The Government may incur additional cost for contractor downtime that occurs during outages. See Chapter 20 for additional information on the planned upgrade to Navy supplied power, and other projects that may require power which the Navy may or may not be able to provide.

c. Power Obtained Directly From HECO
The Contractor can set up an account with HECO and install new temporary transformer(s) and electrical service. The disadvantage is there could still be power outages. However the service voltages and amount of current will not be limited. The cost to install new temporary service must be compared to the cost of operating generators to determine economic feasibility.

2-5.4 Contractor supplied generators, Navy power, and HECO power have been used during previous and current contracts at the Red Hill tank farm. During a contract in which there were five tanks out-of-service at the same time, the power source was HECO. On another project in which there were two tanks out-of-service at the same time, the power source was the Navy with contractor installed transformers and distribution panelboards.

2-5.5 A permit issued by the State of Hawaii, Board of Health, Clean Air Branch is required for internal combustion generators. This process is included in the pre-construction planning phase.

2-6 WATER

Water is required for the tank cleaning, hydrostatic testing of the nozzles, and safety showers.

2-6.1 Location of Closest Water Source

The water is pumped from the Red Hill pumping station to the tank on top of the hill. The water is gravity drained into piping in both the upper and lower tunnels.

2-6.2 Quantity of Water Required

There is enough water to clean the tank and for the nozzle hydrostatic tests. There is enough water pressure to clean at least two tanks simultaneously. Paragraph 2-11 below discusses the removal of the water and sludge.

2-7 VENTILATION OF TANK FOR DEGASSING AND OCCUPANCY

The current ventilation system is balanced to have the same amount of supply and exhaust air. The tunnel is not considered to be confined space since it has this ventilation system.

Duct for fresh air supply, dehumidification, and exhaust to support work inside a Red Hill tank is required to originate and terminate outside of the tunnel in order to not affect the balanced ventilation system. The duct must extend to the bottom of a tank (fuel vapors are heavier than air). Ventilation must be sufficient to provide sufficient oxygen concentration between 19.5% and 23.5% (Navy 22%) in the tank.

2-7.1 Confined Space Permit Requirements

2-7.1.1 Confined space entry references are:

- EM 385-1-1 Section 33
- 29 CFR 1926.21 (b) (6) Construction
- 29 CFR 1910.146 General Industry
- UFGS Section 01 35 26 Governmental Safety requirements (Latest)
- ANSI Z 111.7
- OPNAVINST 5100.23G (Chapter 27)

2-7.1.2 The definition of a confined space per EM 385-1-1 is:

- Is large enough and so configured that a person can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit [such that the entrant's ability to escape in an emergency would be hindered (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry; doorways are not considered a limited means of entry or egress)]; and
- Is not designed for continuous worker occupancy.

Therefore, a Red Hill tank is classified as a Confined Space.

2-7.1.3 A Permit-Required Confined Space (PRCS) is one that meets the definition of a confined space and has one or more of the following:

- Contains or has potential to contain a hazardous atmosphere
- Contains the potential for engulfment
- Internal configuration that can trap or asphyxiate entrant
- Any other serious safety or health hazards

Typical Permit-Required Confined Space:

- Chemical storage tanks
- Waste or storage pits
- Grain bins
- Underground tunnels
- Railroad cars under construction

A Red Hill Tank could be classified as a permit-required confined space.

2-7.1.4 Requirements for a Permit Required Confined Space are:

- The Contractor must assign a Safety Supervisor or Confined Space Competent Person (CSCP) to identify all Confined Spaces and determine entry rules and requirements in accordance with EM 385-1-1.
- Entry into PRCSs shall comply with the requirements of 29 CFR 1910.146.
- Confined space permit has to be issued daily, or more frequently if conditions change. Note: It takes ½ - 1 hour to ventilate and check gases every morning in order for the confined space permit is issued by the CSCP. This must be performed before any entry into a Red Hill tank.
- A confined space attendant (hole-watch) is to be located on the outside of the tank at all times. The attendant's responsibilities include:
    - Know the hazards that may be faced during entry
    - To continuously maintain an accurate count of entrants
    - To communicate with entrants
    - Not to perform duties that might interfere
    - To monitor activities inside and outside the space
    - Warn unauthorized persons
    - To summon rescue and other emergency services

2-7.2 Equipment Requirements

The list of equipment required for dehumidifying, ventilating a tank, and maintaining the required oxygen level throughout the inspection and repair of the tank is very extensive. Properly sized supply and exhaust ducts need to be installed from the tank to an upper tunnel access point. Electrical power to dehumidifiers and fans is required as shown in paragraph 2-5 above.

2-8 FUEL INVENTORY

Constraints on tanks that can be empty and out of service (OOS) are provided in Chapter 19.

2-9 ACCESS TO TANK

2-9.1 Access to a Red Hill Tank is through the upper tunnel access points and the lower tunnel access point. The equipment required, such as the ductwork, power, water, compressed air, etc. has to be install in a manner that does not impede access. Simultaneous work on two to four separate tanks is planned so there will be two to four sets of equipment in the tunnels. There are also other construction projects occurring as listed in Chapter 20. The Fleet Logistics Center Pearl Harbor (FLCPH) operators require access to all of the active tanks at all times. The active tanks and equipment undergo regular in-service maintenance as listed in Chapter 8. Tours of Tank 19, which occur at least monthly, also have to be accommodated.

2-9.2 Manway

The only walk-in access to the tank is through an eight (8) foot diameter manway. This is located at the upper tunnel. <u>All equipment, materials, tools and personnel have to be brought through this manway</u>. A door sheet cannot be cut into the tank shell to provide additional access as is the ordinary practice on an above ground storage tank.

2-9.3 Equipment

The Government owned locomotive and flat cars will not be used as Government Furnished Equipment (GFE) by a Contractor since they are needed to be used by the Government. All equipment, materials, and tools have to be transported through the tunnel with contractor’s means and methods such as, but not limited to, their own locomotive and flat cars.

2-10 DEHUMIDIFICATION

The temperature in the tanks is warm due to lights and welding. The humidity and dew point must be controlled during surface preparation and coating.

Dehumidifying the air will cool down the temperature resulting in a better work environment inside the tank, which increases the work performance.

In order to control the humidity, very large dehumidifiers are provided as part of the ventilation system. The dehumidifiers require a significant amount of power.

2-11 DISPOSAL OF RINSATE AND SLUDGE

The rinsate (oily water from tank cleaning) and sludge (solid material) are removed through one of the nozzles in the bottom of the tank. The rinsate is normally drained in intermediate bulk container (IBC) totes (275 gallons) and sludge is placed into drums. The totes and drums are then transported on towed flat cars with an electric rubber-tired cart or contractor-supplied locomotive through the lower tunnel to the lower tunnel access point at Red Hill. The totes and drums are transferred to trucks for disposal at the lower tunnel access point. Appropriate manifesting documents are used and tracked to insure proper disposal.

The existing slop line cannot be used since this line is used by the operators to remove the water from the tank bottom on adjacent tanks.

2-12 COMPRESSED AIR

There are existing compressed air lines in the upper tunnel from one of the upper tunnel access points up to Tank 16. These air lines were installed by a previous Contractor. The compressed air is used during the operation of the booms and for any air impact tools. The Contractor can use the existing compressed air lines after they have been tested and repaired or he can install new lines.

There is also a compressed air line in the lower tunnel. It might be available for use by contractors.

2-13 LAY-DOWN AREA

There is limited space outside of the two upper tunnel access points for the Contractor’s laydown area. The Contractor needs space for their office, vehicle parking, material staging, and fabrication area. This area is also required for the ventilation, dehumidification, generators, and air compressors. There may be more than two Contractors working simultaneously on the tanks, so this limited space has to be shared. There will be other construction contracts on-going as stated in Chapter 20, in which these Contractors will also need a lay-down area next to these access points.

This is the minimum equipment required for the TIRM projects, which cannot be staged at an off-site location.

2-14 COMMUNICATIONS

2-14.1 In order for the Contractor to communicate from outside the tunnel to the tank, the Contractor is required to install a hard communication cable in the tunnel. Cellular devices do not work in the tunnel. The primary purpose of the hard line is for the tank attendant to summon rescue and other emergency services, but it can also be used for communication between the project manager located outside of the tunnel (in the trailer) and the site manager at the tank.

2-14.2 Inside of the tank, the workers can communicate by using hand-held radios. These radios operate by line-of-sight. The tank attendant can also communicate with the workers inside of the tank.

2-14.3 Communications during hydrostatic testing of nozzles is a challenge. The Contractor’s radios cannot penetrate the 20-feet of concrete between the bottom of the tank and the lower access tunnel. Contractors are required to provide means of communication between personnel in a tank and those in the lower tunnel.

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PART B - TANK 5 CLEANING, INSPECTION, REPAIR AND MAINTENANCE PRACTICES

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CHAPTER 3 – TANK 5 CLEANING

3-1 INTRODUCTION

This Chapter provides information on the standard industry practices during the tank cleaning and power washing of Tank 5. It also describes issues pertaining to Quality Control and Quality Assurance during the power washing of Tank 5.

3-2 SUMMARY OF THE PROCESS SELECTED

3-2.1 WGS contract (Attachment P) required the tank to be cleaned in accordance with API Std 2015, API RP 2016, and United Facilities Guide Specification (UFGS) Section 01351 (which was later converted to UFGS Section 01 35 26, Governmental Safety Requirements). These documents provide requirements for safe entry, not for how clean the tank should be or the water pressure to be used to clean the tank.

3-2.2 On 5 August 2010, WGS started pressure washing the tank to clean the tank for safe entry. At this time, their daily reports stated that there were areas of disbonding and blistering of the coating system. The daily report is included as Attachment Q.

3-3 BASIS FOR WHY THIS PARTICULAR PROCESS FOR CLEANING WAS IMPLEMENTED

3-3.1 WGS stated in their Work Plan (Attachment R) that they planned to use a "high pressure" spray wash to clean the tank. The Work plan specified the following levels of pressure:

Category	Pressure (psi)	Purpose
Low pressure	<3500	Remove material not bonded to surface
Standard pressure	3500-20,000	Remove rust, scale, or epoxy coating
Ultra high pressure	> 20,000	Cutting and stripping operations

Since their work plan stated "high pressure", it appears that they used pressure in the range of 10-20,000 psi.

3-3.2 On 14 October 2010, WGS submitted Request for Information (RFI) #6 (Attachment S) which requested NAVFAC EXWC to consider removing the loose and disbonded coating which would allow them to perform a better visual inspection of the tank surfaces. The RFI stated: "Remove excess or loose paint which has disbonded, flaking and loosely adhered to the tank surfaces. These conditions are found over most of the tank surfaces and needs to be removed to properly perform the visual inspection and prevent masking indication or problem areas. The loose, disbonded or flaking coating will be removed by high pressure washing. The loose paint chips will be collected and placed into 55 gal drums. The drums will be removed from the tank and staged for disposal. Disposal and drum cost by other RFI, quantity that will be developed unknown." On 9 November 2010, NAVFAC EXWC issued a modification to the contract for this work.

3-3.3 The tank was scanned by TesTex from 18 August to 24 September 2010. Indications and prove-up results were marked on the shell plates. The subsequent power wash authorized by the contract modification for RFI #6 removed the majority of the TesTex marking of the indications and prove-ups along with the damaged coating. TesTex returned to Tank 5 to remark the indications and prove-ups.

3-4 SUMMARY OF RECORDS

See Attachment List

3-5 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM FOR CLEANING

- WGS did not perform a test patch of the pressure wash, nor did they provide NAVFAC EXWC the actual pressure used.
- WGS Quality Control (QC) manager did not stop the pressure washing when it was noticed that the coating was disbonding from the steel tank shell.
- The NAVFAC' s Quality Assurance did not monitor the effect of the initial pressure washing.
- NAVFAC relied on the expertise of the Contractor.

CHAPTER 4 – TANK 5 INSPECTION

4-1 INTRODUCTION

This Chapter addresses the current TIRM practices for Tank 5, including inspection procedures performed on Tank 5 and other tanks; inspection technologies and their capabilities; quality-control procedures; portions of the tank that were inspected; and organizations and individuals conducting inspection.

Prime Contractor and Subcontractors for Tank 5

Willbros Government Services, LLC (WGS)	Prime Contractor – responsible for entire contract, including quality control, site management, and site safety
Marine Chemist Hawaii	Marine Chemist services as needed for additional project support
TesTex	NDE testing of the tank and components
Baker Inspection Group	Magnetic particle and ultrasonic inspections
Engineering & Inspection of Hawaii	NDE testing and inspections as needed for additional project support
Pacific Commercial Services	Cleaning and disposal services as needed for additional project support. Equipment rental as needed for additional project support
Hawaii Marine	Cleaning and disposal services as needed for additional project support
Hawaiian Pumping	Cleaning and disposal services as needed for additional project support
Interspec, LLC	Tank calibrations and strapping as needed for project support
Gauge Point Calibrations	Tank calibrations and strapping as needed for project support
Chemitrol	Portable toilets – supply, service, and maintenance
Kealohalani Equip & Rental	Equipment fuel supply
Mr. Sandman	Equipment rental as needed for additional project support
FKS	Equipment rental as needed for additional project support
Hawaiian Rent All	Equipment rental as needed for additional project support
Rolloffs	Hawaii Site trash containers
Valve Service & Supply	Materials supply and service as needed for project support
Abhe and Svoboda	Not listed in Work Plan, but shown on Daily Reports for surface preparation and coating
CSI Services	Not listed in Work Plan, but shown on Daily Reports for surface preparation inspection and coating inspection

NAVY/DLA

Defense Logistics Agency (DLA)	Planning, programming, budgeting, and funding projects for maintenance, repair, minor construction, and environmental compliance for POL facilities
Fleet Logistics Center Pearl Harbor (FLCPH)	Red Hill operator. Logistics and supply-support services to US forces and allied forces in Mid-Pacific region
Naval Facilities Engineering Command (NAVFAC) Engineering and Expeditionary Warfare Center (EXWC)	Contracting team. Quality assurance, project management, and design management
Naval Facilities Engineering Command Hawaii (NAVFACHI)	Quality assurance, construction management, safety oversight

4-2 SUMMARY OF THE PROCESS SELECTED

4-2.1 Non-Destructive Testing (NDT) – Inspection

NDT was performed on Tank 5 by TesTex as a subcontractor to WGS. TesTex conducted NDT on Red Hill Tank 5 from 18 August to 24 September 2010. At this point TesTex had previously completed similar-type inspections on Red Hill Tanks 2, 6, 15, and 20 using many of the same TesTex technicians. The same supervising engineer led the inspection team on all previous tanks. He had developed a standard procedure and order of work, which was used for Tank 5.

From Attachment T, TesTex Inspection Report on Red Hill Tank 5 dated 15 October 2010, Appendix A, Section 1.0, Introduction, the work is described as follows:

> This inspection focused on 100% testing of the Floor, Lower Dome, Barrel, Extension, and Upper Dome areas. The inspection was performed with the TesTex developed ***TS-2000 NDT Multi-channel System*** (for plate scanning) using the principles of the ***Low Frequency Electromagnetic Technique***) and the ***Hawkeye 2000 System*** **(**for weld testing) focusing on surface and subsurface cracking and pinholes. <u>All defected areas found with the above-mentioned TesTex equipment were backed up and sized using regular **_Ultrasonic Technique, Ultrasonic Shear Wave Technique_** and **_Magnetic_**</u>

Particle Technique. The ***Ultrasonic Shear Wave Technique*** was an additional service used which measured the depth of detected weld defects, provided they were oriented in a position that could be tested.

4-2.1.1 Low-Frequency Electromagnetic Testing (LFET)

An electromagnetic driver with two ends is placed on the surface of a metal, and a sensor is placed between the two ends of the driver. The driver emits a low-frequency (3-40 Hz) alternating-current signal, and the sensor detects the magnetic fields between the two poles of the driver. Flaws in the metal distort the magnetic fields; this distortion is recorded in the form of amplitude and phase deviations. The wider the flaw in the metal, the more sensors record shifts in the magnetic signal. The signal is then converted into percentages of material loss using numerical tables. Refer to Attachment T.

Equipment, Capabilities, and Reliability:

a. TesTex Falcon Mark II 2000[1]

   Description: This device is designed to perform LFET inspection on the ferrous surfaces of fuel tanks. It has LFET sensors mounted on wheels. In conjunction with the Viper Crawler system, it can also be used to scan walls. [1]

   Capabilities: Can detect metal plate surface crack, back-side corrosion, and as little as 5% wall thinning [1]. Tank plates can be covered 100% due to “a sixteenth inch modular swath containing 32 probe heads” (Attachment T, Appendix A, Sub-Appendix C). The incoming signal is processed and translated into percentages of wall loss based on calibration tables. Probability-of-detection (POD) curves, describing the probability of detecting a flaw versus the flaw size, were not supplied in the WGS or TesTex reports. Depending on the model, a swath up to 330 mm (13 in) can be covered in one pass on a flat surface. [1]

   Probability of Detection: POD curves, describing the probability of detecting a flaw versus the flaw size, were not supplied in the WGS or TesTex reports in Attachment T. However, according to a published article about nondestructive techniques used to inspect a pipeline in Alaska in

[1] N.B.: The WGS portion of Attachment T mentions that the Falcon Mark II 2000 was used in LFET inspection at Red Hill Tank 5. However, the TesTex portion of the report discusses the device but does not state it was utilized.

2006 [2], LFET demonstrated 100% POD at 25% wall loss on defects such as isolated pitting at a 3:1 aspect ratio. The LFET equipment used to produce the data for the POD analysis in Alaska was manufactured and operated by TesTex.

b. TesTex TS-2000 [3][2]

Description: The TesTex TS-2000 is a handheld LFET device with scanners mounted on small wheels. The scanners do not contact tank surfaces [3]. Due to its small size, it can be easily used to inspect tank walls, like the vertical barrel regions of Red Hill tanks, unlike the Falcon Mark II 2000, which is heavier and can only inspect horizontal surfaces below it [1]. Furthermore, in contrast to the Falcon Mark II 2000, the TS-2000 has scanners that have a diameter of only a few millimeters, enabling it to detect pitting and other micro-scale flaws [3].

Capabilities: 8-channel scanner; multiple sensors allow for greater sensing of cracks and pits. As with the Falcon Mark II 2000, the received signal is transformed into percent-wall-loss data with calibration tables. It can be connected to a computer for further analysis (Attachment T). Because the sensors have diameters of only a few millimeters, tiny defects like pits can be detected, and scanning in general is in high resolution. In addition, hydrogen damage, erosion, cracks, chemical gouging, and corrosion cells are detectable as well. It operates at 10-Hz frequency or lower. Up to 3,000 linear feet can be inspected by one team of certified technicians in a single 10-12 hour shift in a Red Hill tank. [3] The number of technicians on this team varies depending on the number of flaws discovered, the condition of the tank surface, and the means of scaffolding. Generally, inspection is performed in two-person teams. TesTex was able to increase the efficiency during the inspection by 65% by having only one person in each basket. They were able to have more scans per man-hour due to less “wait” time if there were two people in the basket.

Detection Accuracy: From Attachment T, TesTex Inspection Report on Red Hill Tank 5 dated 15 October 2010, Appendix A Sub-Appendix C (Test Methods, Procedures and Equipment Description), Detection Accuracy:

[2] N.B.: While the TesTex portion of Attachment T mentions that this device was used in Red Hill Tank 5 inspection, the WGS portion of the report does not mention the tool.

> The ***TesTex, Inc.*** developed lock-in amplifier is capable of measuring very low level signals in the microvolt range and can measure small phase angle changes of a fraction of a degree, even in the presence of a considerable amount of noise. This system, when used in conjunction with the calibration standards: partial and through-wall pitting, gradual wall thinning, Hydrogen damage, etc. and their respective calibration curves, allows us to measure small gradual wall losses on the order of 10%, pits of diameter 0.062" (1.57mm), and vibration/fret wear of five volume percent.

Items Inspected by LFET: Liner plates' thickness and back-side corrosion thereon, in all portions of the tank body (bottom, lower dome, barrel shell, extension, and upper dome). Specific indications that were detected using LFET were pitting, general corrosion, back-side corrosion, and thinned areas. (Attachment T).

The LFET devices, TS-2000 and the Falcon Mark II 2000 are adaptable for use on tank wall vertical surfaces such as the barrel at Red Hill Tank 5, and both devices can be used on the tank floor as well. Attachment T does not specifically state which device, or if both devices, were used during the inspection.

According to TesTex, LFET devices can find both delaminations and wall loss. However, TesTex's testing procedures do not involve distinguishing those two kinds of flaws with LFET; instead, ultrasonic testing is used to tell these flaws apart as it backs up LFET scans.

4-2.1.2 Balanced-Field Electromagnetic Testing (BFET) [4]

An electromagnetic probe is placed near a metallic body. The deviation of the electromagnetic field is recorded; the vertical and horizontal components of the signal are phase-shifted to decrease the noise in the measured magnetic field (Attachment T).

Equipment, Capabilities, and Reliability: The TesTex Hawkeye 2000 is a technology based on eddy current principles of electromagnetic techniques which is able to detect flaws on and immediately below the surfaces of welds. It is advantageous to use for locations that are difficult to reach (Attachment T). Its frequency range is 5 Hz to 30 kHz, and in one pass, it can assess both sides of a butt weld, covering 101 mm (4 in). Features it can detect include porosity, slag, undercuts, and cracks. As for cracks in particular, they can be found up to 3 mm or 0.125 inch deep from the surface of carbon steel. The technique is quantitative and can be used to size the length and length of cracks. It works much faster than magnetic-particle and dye-penetrant testing, capable of scanning up to 0.3 m/s (1 ft/s). [4]

Items Inspected by BFET: Welds. Locations include lower dome-bottom interface, and the reinforcing pads and supports in the fixed drain line on the tank bottom (Attachment T). TesTex has stated that all welds in the tank were accessible to BFET.

4-2.1.3 Longitudinal Ultrasonic Testing (UT)

General Description: A transducer emits high-frequency sound waves, also called ultrasonic waves, which are propagated through the material being scanned. The transducer records the time between when the waves are released and when the waves' echoes are received into the transducer. If there is a flaw in the material, the time between release and echo is shortened (compared to the same amount of time for a non-flawed material) because the wave is propagated across a shorter distance. [5] In UT, particles in the material can collectively oscillate in response to the energy present in the sound waves being propagated. One way they can oscillate is by moving back and forth in the same direction as the sound waves, or in other words, in the longitudinal direction. [6]

Two devices were used for longitudinal UT: the Krautkramer USN-60 (Attachment T) and the Krautkramer DMS-2.

Equipment, Capabilities, and Reliability:

a. Krautkramer USN-60
The Krautkramer USN-60 (Attachment T) has 15-Hz to 6-kHz pulse repetition frequency, 250-kHz to 25-MHz frequency range; steel scanning range of 1 mm to 28 m (0.040" to 1100"). Echoes can be adjusted using Multiple Curve Distance Amplitude Curve/Time Corrected Gain. Up to 16 points can be recorded. Test modes include dual-, through-, and pulse echo-transmission. [7]
b. Krautkramer DMS-2
The Krautkramer DMS-2 is an ultrasonic device used to find the thickness of a metal. Both the WGS report and the TesTex report (Attachment T) mention this equipment. According to TesTex, the Krautkramer DMS-2 is used for longitudinal-wave testing only. It can measure thickness

independently of material defects, and can measure and display thicknesses of metals and their coatings separately at the same time. It can detect back-side corrosion and minor pitting. The probe is zeroed automatically according to inspection conditions. Its measuring range is 0.2 mm to 635 mm (0.008” to 25.00”) for steel. Its test mode is only ultrasonic pulse-echo, but measurement modes include Dual Multi, MIN Capture, and dual- and single-element. [8]

Items Inspected:

a. Krautkramer USN-60
   The WGS Tank 5 Inspection Report (Attachment T) states in paragraph 5.5 that “traditional ultrasonic longitudinal and shearwave inspection (was used) for proofing areas”. In addition, TesTex stated that longitudinal UT was implemented “to confirm suspected defect areas found with the Falcon 2000 and TS 2000 and to give wall remaining at these spots”.
b. Krautkramer DMS-2
   The DMS-2 was used to prove up metal-thickness defects and corrosion defects that had initially been found using LFET (Attachment T).

4-2.1.4 Shearwave Ultrasonic Testing (SWUT)

SWUT operates on the same principle as longitudinal-wave UT as described above, but the materials’ particles move perpendicular to the direction of the sound waves. [6] Shearwave testing is also called angle beam testing. It is used to determine flaws’ dimensions and their depth within a material, primarily for defects that are not parallel to the material’s surface (Attachment T).

Equipment, Capabilities, and Reliability (refer to the Baker Inspection Group portion of Attachment T):

a. Krautkramer USN-60
   15-Hz to 6-kHz pulse repetition frequency, 250-kHz to 25-MHz frequency range; steel scanning range of 1 mm to 28 m (0.040” to 1100”). Echoes can be adjusted using Multiple Curve Distance Amplitude Curve/Time Corrected Gain. Up to 16 points can be recorded. Test modes include dual-, through-, and pulse echo-transmission. [7]
b. Avenger EZ
   Range of 0.1016-8636 mm (0.4”-340”). 300-Hz pulser. Calibration modes are delay, range, zero, and velocity. 500-kHz to 15-MHz frequency range.

Automatic probe recognition, single- or dual-element. Angle, delay, contact, single, and dual operational modes. Simultaneous display of A-trace and B-scan possible. [9]

c. Panametrics Transducer: Part of UT equipment.
d. Sonotech Couplant: Required to form couplant between transducer and metal.
e. American Society of Mechanical Engineers (ASME) Calibration Block: Used to calibrate UT equipment.

Items Inspected (Attachment T):

All possible locations of weld flaws in the tank that had been scanned using BFET, in all regions other than the interface between the floor and lower dome. At the floor-lower dome interface, only the first six inches of welds between Course 1's plates, immediately above the interface, were scanned using SWUT (Attachment T). Per TesTex, all welds that were accessible were inspected.

The reason shearwave scanning was performed on only the first six inches above the floor-lower dome interface was that this particular region of each Red Hill tank was believed to have a higher density of defects. The first Red Hill tank TesTex inspected, Tank 15, was found to have five defects at the interface between the floor and lower dome. These defects were discovered when Jurva Leak Testing, a subcontractor, injected helium behind Tank 15 and TesTex backed up those discoveries with their own instruments (more information on the Tank 15 contract work is in Chapter 10). TesTex stated that the higher concentration of defects in this region led to enhanced scrutiny, including the use of SWUT, on each tank's floor-lower dome interface in subsequent Red Hill inspections.

Portions that are particularly noted as having been scanned by a specific instrument are described below and are mentioned in Attachment T as well.

1. Krautkramer USN-60

   The WGS inspection report mentions that the Krautkramer USN-60 was used for SWUT to assess "Component integrity and wall thickness" (Section 4.0), but neither the TesTex report nor the reports by Baker Inspection Group mention it. Baker does mention that their angle beam ultrasonic inspections were performed with other equipment, namely, the

Avenger EZ instrument, the Panametrics transducer, the Sonotech couplant, and the ASME calibration block (Attachment T).

2. Avenger EZ
According to NDT Systems, the producer of the Avenger EZ, POD depends on the material's grain structure as well as the transducer's frequency and size. Baker Inspection Group was contacted but did not have Avenger EZ's POD data.

4-3 TEST PERSONNEL AND CERTIFICATIONS

4-3.1 From Attachment R WGS Tank 5 and 17 Clean, Inspect, and Repairs Project Execution Work Plan, Section 5.0, Personnel Certifications:

KEY PERSONNEL

POSITION	**PERSONNEL NAME**	**QUALIFICATIONS**
Project Manager /API 653 Inspector	Tim Anderson	B.S., Mechanical Engineering API Std 653 Cert – #494 Tank Inspector API 570 Cert – #1080 Piping Inspector API 510 Cert – #5034 Pressure Vessel Inspector AWS CWI Welding Inspector ASNT Level II – UT, MT, PT, RT, VT, LT 23 years' POL facilities experience including work in remote Syrian and Omani deserts 23 years' industry experience DOT Registered Tank Inspector / Engineer
Project Engineer	Gene Humes, P.E.	M.S., Civil Engineering 35 years engineering and construction of piping systems experience. Professional Engineer – #10844
Site Manager / Field Superintendent	Reed Cavin	7 years' POL Facilities and Industrial Construction and Maintenance experience SPCC C-7 Certification Hazardous Waste, Confined Space, Lead, Scaffolding Operator Certified Construction and Site Superintendent

		at Redhill – Completing 6 tank projects Experience in the coordination of multiple personnel and subcontractors performing in limited areas
Tanks – Subject Matter Expert	Doug Bayles, P.E.	Professional Engineer – #11288-C HI Professional Engineer – Reg. 47 States API 653 Cert – #1904 Tank Inspector API Committee Member 20 years' POL Facilities and Industrial Construction and Maintenance experience

Other Significant Personnel Involved:

API 653 Inspector	Kenneth McNamara	(Additional Inspection Support as Needed) 12 years' experience of inspections in the POL industry including work in remote areas 2 years inspecting tanks in Red Hill Facility for FISC

It appears that only a few of the WGS, TesTex, and Baker Inspection personnel listed in Attachment R, are the same ones listed in Attachment T, as shown below.

Pressure-test technicians
- Reed Cavin (WGS)
- Robert Chapman (WGS)
- Pat Collins (WGS)

ASNT NDE Level II technicians
- Jassel Bolden (company not specified)
- Pat Hayden (company not specified)
- Chris Kocher (company not specified)
- Boyd Magil (company not specified)
- Larry McDougal (TesTex)
- Joe Wolfe (Baker Inspection Group)

Magnetic-particle and ultrasonic technician

- Joe Wolfe (Baker Inspection Group)

4-4 TANK INSPECTION PROCESS

4-4.1 Tank Inspection Test Order of Work

Following the initial flaw detection by TesTex, an inspector from Baker Inspection Group performed shearwave ultrasonic testing on all welds between the floor and Lower Dome Course 1. This inspector then backed up and sized all weld flaw indications found with the TesTex Hawkeye system. Details are in Attachment T.

Appendix A of Attachment T gives highly-detailed information on the TesTex inspection results on each accessible plate of the tank surface, with tank maps depicting the precise points at which each flaw was detected and which type of flaw was found. However, there is no information on which person inspected each plate.

Regardless of the level of QC oversight performed by WGS pursuant to their QC plan (Section 4.8 of Attachment T), the process TesTex followed in executing the tank inspection was inherently self-checking. First, they scanned the plates and welds throughout the tank to locate flaws. Second, other TesTex technicians proved up the flaws that were located in plates throughout the tank. Third, an independent company, Baker Inspection Group, re-tested all floor-to-Lower Dome Course 1 welds, and backed up and sized all weld indications located by TesTex (with the Hawkeye system) throughout the tank. All work was done by experienced, qualified, and certified technicians. Details are in Attachment T.

4-4.2 General (Attachment T)

Thickness measurements, flaws, and corrosion were found by LFET; these results were proved up by UT, especially for conditions of welds and of walls.

Welds were inspected for cracks using BFET; test results were proved up by magnetic-particle tests and UT shearwave inspections.

4-4.3 Scheduling (Attachment T)

Week 1: Surface-area scans on the floor plates, Course 1, and part of Course 2 using TS-2000 (LFET). Weld scans in the same area using Hawkeye 2000 (BFET).

Week 2: LFET and BFET scans, with baskets, on courses 2, 3, and 4 of the lower dome were performed. The barrel scan was commenced.

Week 3: Barrel scan (LFET and BFET) continued to 50% completion at end of week.

Week 4: Barrel scan (LFET and BFET) continued to 95% completion at end of week.

Week 5: Barrel scan including the area of tank shell located directly beneath the catwalk (LFET and BFET) was finished. LFET scanner could not access Course F, so an ultrasonic trolley was used instead. The extension was also scanned (LFET and BFET).

Week 6: Courses B, C, and D of the upper dome were inspected (LFET and BFET). In addition, the upper dome's course E was inspected, but as with Course F, an ultrasonic trolley was employed instead of an LFET scanner. Moreover, a UT technician used magnetic particle testing (MT) on the welds of the interface between the lower dome and the floor and shearwave UT on parts of the weld between the plates of Course 1. BFET inspection was conducted on welds all over the tank, and defect locations were confirmed.

Unspecified in schedule: BFET scan was conducted on all welds in the upper dome. UT spot checks were performed in the lower tunnel's 32" and 18" lines. LFET scans were done on the inside and cover of the manway.

4-5 OTHER INSPECTIONS (coatings, structural, checklist)

4-5.1 Coating Inspection

4-5.1.1 Processes

CSI Services, a subcontractor of WGS, conducted coating inspections in Red Hill Tank 5. The following information is taken from CSI Services' Daily Coating Inspection Report on Red Hill Tank 5, Report No. 2 (Attachment U), dated 6 November 2012, regarding surface preparation on the lower bowl of the tank and actual soluble-salt testing.

> **Comments.** Assumed duties as CSI QC Inspector at Tank # 5 Red Hill. I accomplished the pre-blast inspections including […] degrease check

throughout the lower bowl section of Tank 5 using the visual and clean white rag method. The checks were [satisfactory].

The contractor accomplished the soluble salt testing on various locations throughout the tank. No salts were detected on any surfaces with the exception of one test on the bottom flat part of the tank which measured 1 μg/cm. Upon further inspection of the lower flat part of the tank I noticed visible salts. Upon inquiry of why there would be salts in that area, I was told that a hydro test was conducted on a pipe using firemain (salt) water[3] and some had leaked out due to improper purging of the line. The contamination appeared to be localized. The contractor cleaned the area with [Chlor*rid][4] but was not re-tested.

Due to safety concern with [FLCPH][5] any further surface preparation has been postponed.

It appears the tank bottom (Lower Dome) and possibly other parts of the tank may not have been re-tested for chlorides before they were coated; the few reports by the National Association of Corrosion Engineers (NACE) inspector list only a couple of chloride tests. The Work Plan for surface preparation, prepared by Abhe & Svoboda (Attachment V) states:

Soluble Salts Test

At randomly selected locations, soluble salts testing will be conducted at a rate of three (3) tests for the first 1000 ft² and one (1) test for every 2000 ft² thereof. Concentrate testing of bare steel at area of corrosion pitting. Approximately 30% of the tests on bare steel will be performed at welds, divided equally between horizontal and vertical welds. The concentration of soluble salts will be measured and utilized to dictate the necessity of chloride, sulfate, or nitrate ion removal.

4-5.1.2 Results

The surface preparation and coating inspection reports are shown in Attachment U.

[3] N.B. The water/fire main at Red Hill supplies fresh water, not saltwater. Thus the water main could not have been the source of the salt.
[4] There is a misprint in the original report. Upon being contacted, CSI Services clarified the error.
[5] The original report reads “FLP.” In 2016, CSI Services personnel were asked about the term FLP, but they did not recall it, noting that it may have been a term used by another organization at the time of the report (2012). NAVFAC EXWC presumes that CSI Services intended to write “FLCPH” (Fleet Logistics Center Pearl Harbor) and that FLCPH, upon observing unsafe working conditions, ordered CSI Services to stop work on surface preparation.

Coating inspection was performed by a NACE inspector; refer to Attachments U and W.

Prior to the new coating applied under this project, the existing coating was applied in 1982 under FY-78 MILCON Project P-060. Tank 5 was emptied, cleaned, and repaired, and the entire tank shell was sandblasted and coated with a thin-film polyurethane formulated by the Naval Research Laboratory. The 20-foot diameter flat plate at the center of the tank bottom and a few feet up the first ring of sloping plates was sandblasted and coated with flame sprayed aluminum before the polyurethane was applied. It was thought that the polyurethane would adhere better to the more porous aluminum in the presence of tank bottom water.

Inspection of other Red Hill tanks which received the flame sprayed aluminum found that over time, the aluminum sacrificed itself to the steel and formed aluminum oxide. With no aluminum to adhere, the polyurethane coating disbonded from the steel plates at the center of the tank bottom. Refer to Attachment X, NAVFAC Drawing No. 7019545, “Modernization of Red Hill POL Facility (P-060): Tank Coating Sections and Details”.

4-5.2 Center Column (Tower)

4-5.2.1 Structural Integrity: (Attachment T), Section 5.5 “Tank Inspections and Methodologies” contains the following:

> [WGS] inspected and evaluated the tank’s structural tower and catwalk structures after gas freeing the tank. Minor repairs were made [to the] tank’s structural tower and catwalk structures to replace missing bolts and inadequate structural sections.

Additionally, Section 6.7 “Tank Tower and Structure” of Attachment T reads:

> Overall the tower structure and catwalk were found in good condition. Some areas were observed with light scattered corrosion and pitting. The areas of corrosion and pitting observed were in various sizes, configurations and depths; no relevant corrosion or areas of concern were found.

4-5.2.2 Repairs Required Prior to Tank Inspection: Section 6.7 “Tank Tower and Structure” of Attachment T continues:

Scattered bolts were observed loose and missing during the inspection. The missing bolts were replaced in (52) locations and others were retightened to ensure joint integrity. The items identified and repaired [were] re-inspected to ensure the overall structural integrity of the tower and catwalk for the inspection activities.

4-5.3 The API Std 653 Tank Out-of-Service Inspection Checklist contains items that, by standard, are examined for proper operation. It contains the following sections, as listed in Attachment T, Appendix B. The table below indicates the extent to which WGS completed each item in the Checklist.

Item in API Standard 653 Tank Out-of-Service Inspection Checklist	Extent of completion
• Overview	• Partial
• Tank Exterior	• N/A
• Bottom Interior Surface	• Partial
• Shell Seams and Plate	• Partial
• Shell-mounted Overflows	• N/A
• Roof Interior Surface	• N/A
o General	o N/A
o Fixed Roof Support Structure	o N/A
• Fixed Roof Appurtenances	• N/A
o Inspection and Light Hatches	o N/A
o Staging Support Connection	o N/A
o Breathers and Vents	o N/A
o Emergency P/V [Pressure/Vacuum] Hatches	o N/A
o Sample Hatch	o N/A
• Floating Roof	• N/A
o Roof Deck	o N/A
o Floating Roof Pontoons	o N/A
o Floating Roof Cutouts	o N/A
o Floating Roof Supports	o N/A
• Floating Roof Seal Assemblies	• N/A
o Primary Shoe Assembly	o N/A
o Primary Toroidal Assembly	o N/A
o Rim-mounted Secondaries	o N/A
• Floating Roof Appurtenances	• Partial
o Roof Manways	o N/A
o Rim Vent	o N/A
o Vacuum Breaker, Breather Type	o N/A
o Vacuum Breaker, Mechanical Type	o N/A
o Roof Drains: Open Systems, Including Emergency Drains	o N/A
o Closed Drain Systems: Drain Basins	o N/A
o Closed Drain Systems: Fixed Drain Line on Tank Bottom	o Complete
o Closed Drain Systems: Flexible Pipe Drain	o N/A

o Closed Drain Systems: Articulated Joint Drain o Autogauge System and Alarms • Common Tank Appurtenances o Gauge Well o Sampling Systems: Roof Sample Hatches o Shell Nozzles o For Nozzles Extended Into the Tank o Diffusers and Air Rolling Systems o Swing Lines Manway Heater Racks o Mixer Wear Plates and Deflector Stands • Access Structures o Handrails o Platform Frame o Deck Plate and Grating o Stairway Stringers o Rolling Ladder	o N/A o N/A • Partial o N/A o N/A o Complete o Complete o N/A o N/A o N/A • Partial o Complete o Complete o Complete o N/A o N/A

4-5.3.1 Modified Out-of-Service Inspection: In Appendix E of Attachment T, WGS notes the following [emphasis added]:

> Willbros Government Services, LLC [WGS] was contracted to perform tank isolation, cleaning, (NDE) non-destructive examinations and testing, visual inspection and an evaluation of the [tank's] suitability for service. <u>The inspection and evaluation was in accordance with API Standard 653</u>, Tank Inspection, Repair, Alteration and Reconstruction, Latest Edition and project specifications listed in the specifications section of the tank inspection report. <u>The inspection and evaluation was modified to fit the conditions and configuration of the Tank 5 (Tank 5) underground storage tank (UST)</u> located in the Redhill Complex, Pearl Harbor, [Oahu,] HI.

Furthermore, Section 5.5.8 "Inspection Checklists" of Attachment T states:

> Inspection checklists from [API 653] for an In-service and / or Out-of-service checklist [were] completed and [they are] located in App. B. The majority (>90%) of the items listed are not-applicable items due to the configuration of the tank.

The API Std 653 checklist in paragraph 4-5.3 of this report, without any of the items totally marked "NA" by WGS for "Not applicable/accessible" in Attachment T, is shown below.

- Overview *
- Bottom Interior Surface *

- Shell Seams and Plate *
- Floating Roof Appurtenances *
  - o Closed Drain Systems: Fixed Drain Line on Tank Bottom **
- Common Tank Appurtenances *
  - o Shell Nozzles **
  - o For Nozzles Extended Into the Tank **
- Access Structures *
  - o Handrails **
  - o Platform Frame **
  - o Deck Plate and Grating **

4-5.3.2 API Std 653 Inspector's Certification: The API Std 653 inspector for the Red Hill Tank 5 inspection was Timothy D. Anderson, Certification No. 37258, as mentioned in Attachment T. His qualifications are presented in pp. 237-239 of the WGS Work Plan (Attachment R).

4-5.3.3 Attachment T, Section 7.0 "Recommendations" provides a summary list of repairs throughout the surface of the tank. The list is divided into three categories: "Mandatory Repairs," "Short Term Repairs," and "Long Term Repairs."

WGS recommended that repairs be performed before Tank 5 could be returned to service. The summary is reproduced below. As mentioned in the lists below, Attachment T contains more comprehensive tables of all recommended repairs on the tank surface, describing their types, locations, and sizes. Chapter 5 describes some of the terminology used in the WGS report.

7.1 Mandatory Repairs – Immediate repairs required before returning tank to service

- Repair (2) areas found with through wall holes.
- Repair weld where torch gouged through the weld seam, completely open joint connection, leak or hole equivalent.
- Repair leak found in the telltale system.
- Replace or repair lines failed during Hydrotesting.
- Weld Discontinuities or Defects - Which exceed code limits.
- Un-Welded Seams – One (1) seal plate and one (1) nozzle, leak or hole equivalent.
- Repair areas where pits, gouges or corrosion is below the minimum thickness (t_{min}) required.

- Detailed list provided in Tables 6-1 through 6-4.

7.2 Short Term Repairs – Repair indications or flaws found that have the criteria which exceeds the intended service and operational interval. (10yr)

- Repair areas where pits, gouges or corrosion is below the minimum thickness (t_{min}) required for this interval.
- Repair coating in areas required to eliminate corrosion cells on internal surfaces, extend component service life and inspection intervals.
- Detailed list provided in Tables 6-1 through 6-4.

7.3 Long Term Repairs – Repair indications or flaws found that have the criteria which exceeds the intended service and operational interval. (20yr)

- Repair areas where pits, gouges or corrosion is below the minimum thickness (t_{min}) required for this interval.
- Repair coating in areas required to eliminate corrosion cells on internal surfaces, extend component service life and inspection intervals.
- Detailed list provided in Tables 6-1 through 6-4.

4-6 NOZZLE INSPECTIONS

4-6.1 Tank 5 contains five nozzles and one casing sleeve pipe, all extending from the bottom of the tank to the Lower Access Tunnel (LAT). Two of the nozzles are product lines, one is the bottom drain, one is an out-of-service steam line, and one is an out-of-service condensate line. Although steam and steam-condensate casing pipes are present, they were never utilized. A summary of the five nozzles and the casing sleeve is given below.

4-6.1.1 32" diameter fuel nozzle pipe from the 32" flange located 1' above the tank bottom to the 20" skin valve flange in the LAT.

Vertical - 8' with 7' embedded in concrete beneath the tank. Inside the tank the 32" pipe rises vertically an additional 7' from the 32" flange to the horizontal vortex preventer plate.

Horizontal - 44'-11" with approximately 43-11"' embedded in concrete beneath the tank. The last 5'-7" of horizontal pipe is a 32" to 20" concentric reducer that ends at the 20" skin valve flange. The reducer is connected to the 32" diameter pipe with a circumferential weld.

The vertical and horizontal pipe sections are connected by a 45-degree pipe section with mitered welded joints.

4-6.1.2 18" diameter fuel nozzle pipe from the 18" flange 1' above the tank bottom to the 12" skin valve flange in the LAT.

Vertical - 8'-10" with 7'-10" embedded in concrete beneath the tank. Inside the tank the 18" pipe rises diagonally from the 18" flange 22' along the slope of the lower dome to a height of 7'-6" above the tank bottom.

Horizontal - 58'-5" with approximately 57-5"' embedded in concrete beneath the tank. The last 2'-9" of horizontal pipe is an 18" to 12" concentric reducer that ends at the 12" skin valve flange. The reducer is connected to the 18" diameter pipe with a circumferential weld.

The vertical and horizontal pipe sections are connected by a 45-degree pipe section with mitered welded joints.

4-6.1.3 8" diameter low point drain (slop line) nozzle pipe from the tank bottom to a blind flange in the LAT. The opening in the tank bottom is sealed closed with a welded cover plate and the nozzle pipe is abandoned in-place.

Vertical - 17'-8" with 17'-8" embedded in concrete beneath the tank.

Horizontal - 47'-9" with approximately 46-9"' embedded in concrete beneath the tank. The last 1'-0" of horizontal pipe is an 8" to 6" concentric reducer that ends at the 6" skin valve flange. The reducer is connected to the 8" diameter pipe with a circumferential weld.

The vertical and horizontal pipe sections are connected by a long radius elbow with circumferential welds.

4-6.1.4 8" diameter steam line casing pipe from a welded pipe end cap approximately 6" above the tank bottom to an 8" welded pipe end cap in the LAT. The pipe nozzle is abandoned in-place.

Vertical - 8'-4" with 7'-10" embedded in concrete beneath the tank.

Horizontal - 44'-7" with approximately 45-7"' embedded in concrete beneath the tank.

The vertical and horizontal pipe sections are connected by a right angle mitered welded joint.

4-6.1.5 6" diameter steam condensate line casing pipe from a welded pipe end cap approximately 6" above the tank bottom to a 6" welded pipe end cap in the LAT. The pipe nozzle is abandoned-in-place.

Vertical - 8'-4" with 7'-10" embedded in concrete beneath the tank.

Horizontal - 45'-5" with approximately 44’-5" embedded in concrete beneath the tank.

The vertical and horizontal pipe sections are connected by a right angle mitered welded joint.

4-6.1.6 18" diameter casing sleeve from the Lower Dome to the LAT.

Length is 31'-11".

Casing sleeve contains four 0.75" diameter sample lines and one 4" diameter low point drain (slop) line.

4-6.2 Nozzle Pressure Testing

4-6.2.1 WGS provides a description of its pressure-testing procedure in its Work Plan (Attachment R) in a chapter titled “Pressure Test Procedure NDT-3.” This procedure can be summarized as follows:

a. WGS uses hydrostatic testing as its method of pressure testing. The test temperature and pressure are calculated based on the design of the tank and of the piping under inspection.
b. All nozzles and flanges not being tested are plugged. Only approved plugging materials can be employed. All plugs are then visually inspected by Quality Control.
c. “Hydro Trees” (test schematics) are designed to meet or to exceed WGS specifications.
d. Municipal tap water with 50 ppm chloride or lower is used as the testing medium. However, if this water poses risks to the structure during testing, another liquid may be utilized.

e. Testing will involve a calibrated gauge whose dial range is between 1.5 times and 4 times the pressure used in hydrostatic testing.
f. Connections with fills and vents are made as needed.
g. The testing area is blocked, with tape, from uninvolved persons.
h. The testing liquid's temperature is checked to meet the design specifications of the structure under test.
i. The testing medium is made to fill the structure until all pockets of gas are forced out. Once venting is finished, the vent valve is shut.
j. An unobstructed view of the pressure gauge is constantly provided to the pump operator so pressure can be monitored at any time. The operator stays at the test site until the end of testing, unless a qualified person relieves the operator in the middle of testing.
k. The pressure in the structure is increased gradually until the specified test pressure is attained; it is ensured never to be more than 106% the specified pressure.
l. If, in the middle of the test, personnel find a leak, pressure is decreased to 2/3 of either the maximum working pressure or the test pressure, whichever is lower.
m. After the duration of time specified for testing, the pressure is decreased to 2/3 of the test pressure.
n. All connections and joints are visually examined in detail. The Quality Control Inspector logs the results on the pertinent Hydrostatic/Pneumatic Pressure Test Form and, if the test is to meet ASME Code, on the Job Traveler.
o. Once testing is complete, the structure is depressurized, and the pressure gauge is monitored to ensure that zero pressure has been reached.
p. Vent and drain valves are opened. If the structure is large, the vent is opened first. Stagnant water is cleared out of open lines through elevation.

4-6.2.2 WGS's Pressure Test Log (Attachment AA) includes these testing parameters:
a. Maximum operating pressure: 100 psi
b. Operating pressures: 0-100 psi
c. Required test pressure: 150 psi (150% maximum operating)
d. Final test pressure: 150 psi
e. Duration of test: 4 hr

4-6.3 Pressure-Test Results: An Executive Summary is in Attachment AA.

Attachment T summarizes the pressure-test results as follows:

> Pressure Testing Failures –
> - The 32” diameter main line internal connection flange failed twice and gaskets were changed to compensate for the out of plane and wavy surface. The third hydro test application passed.
> - Sample Lines – Failed and leaked at various joint connections.
> - Slop / Drain Line – Failed and leaked. The internal hose leaked during pressure testing and the casing will not hold pressure due to a coupling which was damaged by operations approximately one year previously.

Additionally, WGS’s Pressure Test Log (Attachment AB) indicates that the 20” inlet (32” internal piping) and 12” inlet (16” internal piping) passed integrity pressure testing. WGS again performed hydrotesting on the 20” inlet (32” internal) and 12” inlet (16” internal) piping in 2014 as part of the Warranty Investigation work. Chapter 6 contains more information about the 2014 hydrotesting procedure and results.

4-7 TANK INSPECTION PROCESS METHODOLOGY

According to Attachment R, Section 4.5.2 Tank Inspections:

> The inspection of Red Hill Complex Tanks 5 and 17 shall be carried out according to the requirements of API Standard 653, Tank Inspection, Repair, Alteration and Reconstruction; and as supplemented by this Statement of Work. The inspections will be performed in a safe and professional manner, and the inspection, preliminary and final field report, and tank evaluation will be completed in accordance with applicable federal and local regulations.
>
> [WGS] will provide the onsite [API Standard 653] and visual inspection, NDT data review and integrity analysis. [WGS] will provide certified [API Standard 653] and/or STI inspector as appropriate to complete the project. [WGS] will utilize Engineering and Inspection of Hawaii to assist as needed. […]
>
> The inspector will be assisted by our on-site personnel as needed to perform the visual inspection. [TesTex] and the [API Standard 653] inspector are qualified to ASNT NDE Level II in performing all NDE inspections. The [API Standard 653] inspector will monitor the NDE testing and review the test data acquired for potential areas of concern and to have follow-up proof UT inspections.

> Our [API Standard 653] inspector is experienced in tank design, fabrication, repair, construction, inspection, operation and behavior [and] will perform the tank engineering evaluation.

Section 4.5.2 of Attachment R further details which portions of the tank its subcontractor TesTex would inspect and which inspection methods TesTex would use for each portion.

WGS's API Std 653 inspector would perform research on the historical records of the tank, including specifications, data, previous reports, repairs, retrofits, and physical properties. The inspector would then conduct an overall overview of the tank in terms of API 650 and 653 standards, and API Recommended Practice 651[6]. Subsequently, each portion of the tank would be reviewed by the inspector: in order, the shell, the dome roof, the bottom and lower tome, the foundation, and the appurtenances. In-service and out-of-service checklists would be adapted from API Std 653, and each item on these checklists would be marked N/A, passable (highly or marginally), or recommended for repair, as appropriate. Refer to Attachment R.

Despite the WGS statement that the API Std 653 inspector conducted historical research, WGS did not include detailed results in the Inspection Report (Attachment T). In particular, WGS did not indicate the 8" slop line had been slip-lined under MILCON Project P-060, as indicated in NAVFAC Drawing No. 7019544 (Attachment BP).

After the API Std 653 initial inspection, another subcontractor, Interspec, LLC, would calibrate (strap), dimension, and chart the tank using the Optical Method specified by API in its Manual of Petroleum Measurement Standards. Refer to Attachment R for details.

4-8 SUMMARY OF RECORDS

a. See Attachment List
b. Below is a list of supporting records contained in Attachment T:
    - Main:

[6] The WGS work plan (Attachment R) stated the API Std 653 inspector would perform a general overview of the tank for compliance with API RP 651 Cathodic Protection of Aboveground Petroleum Storage Tanks. The WGS inspection report was silent regarding findings of the inspector with regard to this overview.

  - Pages 30-139: “Tank Inspection Data”: Lower Dome, Shell Plates, Shell Extension Plates, Upper Dome
  - Pages 141-63: “Table 7-1 Summary of Tank Repairs”
- Appendix A:
  - Section 2.0: Unit Details (tank dimensions, instrumentation used in inspection, etc.)
  - Section 3.0: Tank Maps (locations of defects discovered)
  - Section 4.0: Inspection Flaw Summary
  - Sub-Appendix F: Defect Area Photographs and Magnetic Particle Report (contains raw data from TesTex subcontractor, Baker Inspection Group: Magnetic Particle Inspection Report and Ultrasonic Inspection Report)
  - Sub-Appendix G: Shear Wave Report and Calibrations (contains raw data from TesTex subcontractor, Baker Inspection Group: Ultrasonic Inspection Report and Ultrasonic Inspection Location Report)
- Appendix B: Project Checklist / Tank Inspection Checklist
- Appendix D:
  - Main: Project Photographs
  - Section D-1: Project API Inspection Photographs
  - Section D-2: Project NDT Photographs
- Appendix F: Miscellaneous Data – Tank 5 Historical Records and Data

4-9 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM FOR INSPECTION

4-9.1 Process of Verifying Proper Operation of Test Equipment

4-9.1.1 In general, the TesTex equipment (Falcon 2000, TS-2000, and Hawkeye 2000) is prepared for inspection with calibration standards. According to TesTex, these standards are 0.250" thick coupons of carbon steel machined with wall-loss gradients and pits with specific depths and diameters. Every day of inspection, before each shift, after each work stoppage, and after each loss of power, the TesTex equipment was checked against these standards.

4-9.1.2 The TS-2000 is positioned directly on a horizontal or vertical plate. Its software, “TS 2000 PLATE SCAN”, has an auto-set function that zeroes the scanner’s measurements, “selects the right time constant, sets the gains of the internal amplifiers, and ensures that the data is displayed on the screen as it is being collected” (Attachment T, Appendix A, Sub-Appendix C).

4-9.1.3 In Attachment T, Appendix A, Sub-Appendix H, TesTex notes in its inspection procedure that “The [Hawkeye] probe should be used on the calibration plate periodically to assure proper function.” However, it does not say if the probe was actually calibrated in this way.

4-9.1.4 Baker’s Ultrasonic Inspection Report for the floor “T” joints, which involved a UT tool called the Avenger EZ, notes that “Calibration was performed at the beginning of the shift 12:23 PM on 9/21/2010 and verified at 5:23 PM 9/21/2010.” (The inspection was performed 21-25 September 2010.) An ASME calibration block was used. No further details were given. Similar notes are provided in Baker’s other Ultrasonic Inspection Reports, which used the same test equipment and calibration block (Attachment T).

4-9.1.5 Baker Inspection Group noted that test equipment was calibrated against standards before and after each workday.

4-9.2 QC During Inspection and Testing

4-9.2.1 For a description of WGS’s three phases of control for in-process inspection, refer to Attachment R, paragraphs 4.8.3 to 4.8.6.

4-9.2.2 TesTex has written detailed inspection procedures for all Red Hill Tanks, found in Attachment T, Appendix A, Sub-Appendix H. These procedures include step-by-step instructions on how to examine each portion of the tank, specifically outlining what direction along the tank surface to scan and which instrument settings will be used. The location of each detected flaw location was marked with paint and recorded on a data sheet, a copy of which was provided to the inspection Point of Contact (POC) at the start of the next day. Weekly, copies of the data sheets were sent to TesTex headquarters.

For inspecting the floor, the TesTex TS-2000 LFET device is calibrated to specific software and frequency settings. Technicians calibrate their devices at the start of each workday against a calibration plate (Attachment T).

For inspecting the lower dome, TesTex notes (Attachment T):

> If a project coordinator is on site during the first week, this person will scan all welds below 3’ on course 2 to include course 1 and the floor. Otherwise, the four technicians will scan these welds as each section is done.

> Additionally, all intersection welds between course 1 and the floor must be retested using Shear Wave Ultrasonic Technique. This is performed when a Certified Ultrasonic Technician is available. Also, all possible defect locations found in welds throughout the tank, will be backed up with Shear Wave Ultrasonic technique [SWUT]. In addition, all welds will be visually inspected for pinholes. These pinhole areas, if found to have depth, will be marked for later Shear Wave sizing.

While the TesTex procedures also mention how to inspect the barrel, the expansion joint, and the extension, they do not specify the scanning devices' settings or back-up measurement procedures (Attachment T).

For each of the courses of the Upper Dome, TesTex has a back-up measurement plan as follows (Attachment T).

> Some tanks have a channel over the welds of the upper dome. If this is the case, the face of the channels will be scanned with a TesTex developed 2" wide LFET scanner. In addition, U.T. spot checks will be done at the bottom of each vertical channel where they intersect a horizontal channel. Hawkeye weld scanning will also be done on the welds to each side of the channels.

Finally, TesTex also performs back-up inspections on the pipes (Attachment T).

> The 18 and 32-inch supply pipes in the lower tunnel under the tank will be U.T. spot-checked. A technician is to [crawl] into the 32 inch line and take 4 circumferential U.T. readings every foot. The 18-inch line is too small to enter into, so the U.T. readings are taken at 8" and 18", just inside of the pipe. Additional methods may be used such as, Shear Wave Ultrasonics on the welds or special designed LFET scanners for I.D. surface inspections.

Moreover, TesTex has several other documents for inspecting specific portions of tanks. Because they are controlled documents, they are not attached here, and only their generalities are discussed.

a. Tank-Floor Inspection:
   In a separate document regarding procedures for tank-floor inspection, TesTex specifies that it utilizes a device it has developed, the Falcon 2000 system, to inspect carbon-steel tank floors through the LFET. Data-

interpreters must be Level II-certified or higher, with proper training as specified by TesTex.

TesTex has outlined a step-by-step procedure on how to use the Falcon Sr., Falcon Jr., and Wingspan scanners. Furthermore, it has special instructions for inspecting coated areas.

As for flaw quantification, TesTex has made several notes on software settings, flaw verification, situations requiring UT, and checking by senior personnel in engineering and in management.

b. Non-Entry Tank-Floor Inspection:
In another separate document, TesTex outlines its specifications for inspecting floors of aboveground storage tanks, using LFET, without entering them. The TS-2000 system is used in this inspection method, and its functionality is checked against a calibration plate. The inspection procedure lists several steps on what settings the TS-2000 should have immediately prior to inspection.

As with tank-floor inspection with personnel entry, the procedure for inspection without entry mentions special procedures for coated surfaces.

c. Hawkeye Inspection:
TesTex has a document that lists procedures for inspecting flat surfaces with their flat-bottomed Hawkeye system and for inspecting welds with their angled Hawkeye system. As with the tank-floor inspection procedures, the procedures for inspecting welds and flat surfaces contain steps on how to set up the software on the Hawkeye system, how to calibrate it prior to inspection, and how to rotate it during inspection.

4-9.2.3 Baker Inspection Group (now Mistras): Although NAVFAC requested Baker to provide its QC procedures for Red Hill Tank 5, Baker did not provide them.

4-9.2.4 Coating inspection was performed by a NACE inspector; refer to Attachments U and W for details.

4-9.2.5 For the complete WGS quality control plan, refer to Attachment R, Section 4.8 “Quality Assurance.”

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CHAPTER 5 – TANK 5 REPAIR

5-1 INTRODUCTION

The Statement of Work for the Tank 5 Repairs for Modification (Mod) 09 of the WGS contract (Attachment AC) included mechanical repairs. Requirements included qualification and certification standards for non-destructive examination (NDE)[1] examiners. The contract requirements cited industry code ASME B31.3 and standard API Std 650. Both citations contain requirements which result in the same industry certification standard for examiners (ASNT SNT-TC-1A).

The Mod 09 Statement of Work stated:

"d. Perform following repairs in accordance to API [Std] 650, [Std] 653, UFGS [Section] 09 97 13.15 [Low VOC Polysulfide Interior Coating of Welded Steel Petroleum Fuel Tanks] and UFC 3-460-03 [O&M: Maintenance of Petroleum Systems].

a. Perform welding repairs on 138 locations identified with weld flaws.
b. Perform 6" patch plate repairs on 532 locations identified with holes, gouges, or pits.
c. Perform 12" patch plate repairs on 36 locations identified with corrosion or pits.
d. Perform 24" patch plate repairs on 3 locations identified with corrosion or pits.
e. Perform 20" x 37" patch plate repair at 1 location identified with corrosion or pits.
f. Minimum preparation work shall be required for welding patch plates on all locations. After requested repairs, all required NDTs shall be performed, including vacuum box test and Magnetic Particle Testing (MT). NDE personnel shall be certified in accordance with ASME B31.3.
g. Remove and replace all interior and exterior sample lines. New interior sample tubes shall be installed along the tank center tower. The end of those sample tubes in the lower access tunnel shall be isolated with skin valves and be of similar configuration to the updated sampling systems on other tanks. The updated sampling stations shall include the installation of a funnel return system (provided by others). The new piping shall have pipe tracing, as- built documentation, and permanent

[1] For purposes of this Chapter, NDE and NDT are interchangeable.

labeling at the sample station. The system shall be hydrotested to 1.5 Maximum Allowable Operating pressure (MAOP). All required NDT's shall be performed after required repairs. NDE personnel shall be certified in accordance with ASME B31.3.

h. Install new datum plate with ½"-thick CS plate on the bottom of Tank 5. Dimension and location shall be determined at the site to accommodate the existing MTG probe and potential future automatic tank gauging system. All required NDTs shall be performed after required repairs. NDE personnel shall be certified in accordance with ASME B31.3.
i. Replace 6" slop line with new 4" flexible line from tank bottom to the isolation skin valve in lower access tunnel.
j. Clean, refurbish, and re-coat 20" Double Block and Bleed Valve. The valve shall be refurbished as required by Manufacturer standards. Once completed the valve shall be hydrotested to 1.5 times the flange class rating. Results shall be included in tank completion report and provided upon request.
k. Clean, refurbish, and re-coat 12" Double Block and Bleed Valve. The valve shall be refurbished as required by Manufacturer standards. Once completed the valve shall be hydrotested to 1.5 times the flange class rating. Results shall be included in tank completion report and provided upon request.
l. Clean, refurbish, and re-coat 6" Double Block and Bleed Valve. The valve shall be refurbished as required by Manufacturer standards. Once completed the valve shall be hydrotested to 1.5 times the flange class rating. Results shall be included in tank completion report and provided upon request.
m. Clean, refurbish, and re-coat 12" Ball Valve. The valve shall be refurbished as required by Manufacturer standards. Once completed the valve shall be hydrotested to 1.5 times the flange class rating. Results shall be included in tank completion report and provided upon request.
n. Remove existing coating from the lower dome to accommodate new coating system. The coating shall be removed and the surface to be prepared to minimum Society for Protective Coatings (SSPC) SP 10 level. Submit documentation that the blaster is qualified by SSPC to the SSPC C-7 Dry Abrasive Blaster Qualification Program.
o. Current coating samples shall be collected and tested for any hazardous content. Abrasive blasting procedure must be determined based on the test result.

p. New coating system shall be applied to lower dome up to 36" above the spring/expansion joint[2]. Coating procedure shall be in accordance to UFGS [Section] 09 97 13.15 [Low VOC Polysulfide Interior Coating of Welded Steel Petroleum Fuel Tanks]. All coating material submittal shall be submitted to the Government for review and approval prior to any issuance of purchase order. Minimum qualification requirements for coating contractor include SSPC QP-1 certification and verifiable previous coating application experience in steel tank with fluoropolyurethane coating material. All relevant qualifications of coating contractor shall be submitted to the Government for review and approval.

q. Humidity control unit may not be required for this coating application. It is the Contractor's responsibility to prove that the interior condition of Tank 5 can remain under the manufacturer's recommended relative humidity level inside the tank.

r. Level III inspector from a SSPC QP-5 certified coating Inspection Company shall be hired to perform blasting and coating application inspection. All qualifications of the company and individual inspector shall be submitted to the Government for review and approval.

s. If conventional abrasive blasting method is employed, disposal of used abrasive blast material shall be done in accordance to all local, state and federal regulations. Disposal issue shall be addressed in waste management plan under Environmental Protection Plan.

t. Abrasive blasting is considered as hot work. The Contractor is responsible to obtain all necessary permits prior to any abrasive blasting work. Refer section 5.2 b[3]."

5-2 NON-DESTRUCTIVE TESTING – REPAIR

The Statement of Work required the following for the NDE inspectors: "Non-destructive examination Inspector Qualifications: Submit certification that inspection and nondestructive testing personnel, including inspectors performing visual inspections, and qualified in accordance with the requirements of API [Std] 650 and ASNT SNT-TC-1A for Level II in the applicable nondestructive testing method. And [sic] AWS certified weld inspector, qualified in accordance with AWS QC 1, shall be considered

[2] The use of the term "expansion joint" is ambiguous here. Coating was contracted for, and was applied to the lower dome and 36" above the barrel-lower dome joint.
[3] This reference pertains to a section within the Mod 09 contract document.

qualified to perform visual inspections only, in lieu of an ASNT Level II visual inspector."

The meaning of this requirement is that the American Welding Society (AWS) certified weld inspector was only allowed to perform visual inspection. The certified American Society for Nondestructive Testing (ASNT) level II technicians were allowed to perform examinations for only the methods in which they were certified.

5-2.1 Visual Inspection

All weld repairs to existing welds and all new welds were to be inspected visually per API Std 653. All work was required to be performed per API Std 653 as stated in the Statement of Work as indicated in paragraph 5.1 above.

See Chapter 9 for additional information about the WGS visual inspection process.

5-2.2 Magnetic-Particle Testing (MT)

All weld repairs to existing welds and all new welds were required to be inspected with MT pursuant to the Mod 09 Statement of Work as quoted in paragraph 5.1 above.

WGS did not perform MT as required. See Chapter 9 for additional information.

5-2.3 Dye-Penetrant Testing (PT)

WGS performed dye-penetrant testing on welds as allowed per API Std 653. Penetrant testing was not a requirement in the Mod 09 Statement of Work.

See Chapter 9 for additional information about the WGS dye-penetrant testing and results.

5-2.4 Vacuum Box Testing (VBT)

All weld repairs to existing welds and all new welds were to be inspected with Vacuum box testing as stated in the Mod 09 Statement of Work as quoted in paragraph 5.1 above.

WGS did not perform VBT as required. See Chapter 9 for additional information.

5-3 TEST PERSONNEL AND CERTIFICATIONS

Attachment AD provides the certifications for the nondestructive test personnel.

5-4 OTHER INSPECTIONS (coatings, structural, checklist)

5-4.1 The Tank 5 Inspection Report (Attachment T), provides the following information for the Tank Tower and Structures inspection and repairs that were completed:
"Overall the tower structure and catwalk were found in good condition. Some areas were observed with light scattered corrosion and pitting. The areas of corrosion and pitting observed were in various sizes, configurations and depths; no relevant corrosion or areas of concern were found. Scattered bolts were observed loose and missing during the inspection. The missing bolts were replaced in (52) locations and others were retightened to ensure joint integrity[4]. The items identified and repaired we re-inspected to ensure the overall structural integrity of the tower and catwalk for the inspection activities. The catwalk handrails were observed to be approximately 36" in height, below the required 42" as required per OSHA for platform handrails."

5-4.2 The Tank 5 Inspection Report (Attachment T), provides the following information for the Tank Coatings:
"During initial tank entry the coating was observed to have several major areas of deterioration and concern. The majority of the bottom dome and up several of the lower shell courses had major deterioration, flaking, disbonding and missing in large areas. The shell and upper dome was in fair condition with scattered random areas of deterioration, flaking, disbonding and missing.

The coating continued to dry out after being in immersed service for a long duration; additional disbonding and flaking were observed. This continued during the inspection and NDE testing activities until it reached the point it was hindering the inspection process. An RFI was submitted to NAVFAC Engineering Service Center to high pressure blast off the loose and disbonded areas for inspection and examination activities. The loose and disbonded areas were blasted off in accordance with the RFI, which revealed that approximately 70-80 % of the interior coating has deteriorated and

[4] N.B. The missing, replaced, and tightened bolts relate to the tower and catwalk structures. They are not related to the hydraulic integrity of the tank.

observed in poor condition. The coating needs to be properly removed and repaired in the critical sections in accordance with Naval specifications."

5-4.3 Attachment AE provides the API Std 653 Out-of-Service Checklist for Tank 5.

5-5 REPAIR RECOMMENDATIONS

5-5.1 WGS Inspection Report (Attachment T), stated the following summary of recommended repairs. Explanations for some of the indications are noted below.

"[WGS] and Testex found over (800+) various indications and flaws during the API Std 653 modified inspection and NDE examination of Tank 5 surfaces and components. Most of these indications or flaws are relatively small in overall size and repair(s) that will be required. The indications found varied in type, cause and severity as listed in Section 1.1. Due to the types of indication or flaw sizes, depths and conditions found in Tank 5; it was found not suitable to return to service until all of the items identified are repaired as appropriate for the intended service and operational interval. The following table list in Section 7.0 describes the repairs by type, size, classification and action to be taken. Reference the following Table 7-1 Summary of Tank Repairs for the complete list of repairs for each plate, location along with the associated repair(s) required and classification type.

Mandatory Repairs – Immediate repairs required before returning tank to service.

- Repair (2) areas found with through wall holes.
- Repair weld where torch gouged through the weld seam, completely open joint connection, leak or hole equivalent.
- Repair leak found in the telltale system.
- Replace or repair lines failed during hydrotesting.
- Weld Discontinuities or Defects (non through-wall) - which exceed code limits
- Un-Welded Seams – One (1) seal plate and one (1) nozzle, leak or hole equivalent.
- Repair areas where pits, gouges or corrosion is below the minimum thickness (tmin) required.

- Detailed list of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 through 6-4 and 7-1[5].

Short Term Repairs – Repair indications or flaws found that have the criteria which exceeds the intended (10yr) service and operational interval.

- Repair areas where pits, gouges or corrosion is below the minimum thickness (tmin) required for this interval.
- Repair coating in areas required to eliminate corrosion cells on internal surfaces, extend component service life and inspection intervals.
- Detailed list of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 through 6-4 and 7-1.

Long Term Repairs - Repair indications or flaws found that have the criteria which exceeds the intended (20yr) service and operational interval.

- Repair areas where pits, gouges or corrosion is below the minimum thickness (tmin) required for this interval.
- Repair coating in areas required to eliminate corrosion cells on internal surfaces, extend component service life and inspection intervals.
- Detailed list of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 through 6-4 and 7-1."

5-5.2 The following are explanations of the terminology that describes the indications.

a. During MILCON P-060 steel cover channels (structural steel shape) were welded over the original backer bars that provided backing for the full penetration horizontal and vertical butt welds between the shell plates in the upper dome and the 12 foot high extension at the top of the barrel. The term "tell-tale" in the WGS recommendations was mis-identified and in actuality one of the cover channels. Therefore, the hole was not in the tank shell. Refer to Attachment AF for the FY-78 MILCON P-060, Repair Red Hill Fuel Storage Facility – Scope of Work.
b. What was identified by WGS as "back-seepage" or "release" from outside the tank shell was in actuality fuel which had become trapped between the tank shell and a cover channel, and had seeped back into the tank through the hole in the cover channel.

[5] These tables refer to tables within the WGS Inspection Report, Attachment T

c. There were through-wall indications in the upper dome which were above the maximum fill height.
d. The inspection report contradicts itself regarding weld cracking. The summary states that there was one (1) weld crack, but the tables do not indicate any location where a cracks was found.

5-5.3 Note that Attachment T is a draft inspection report. It was never accepted by NAVFAC EXWC. WGS did not submit a final inspection report. The final completion report which provides as-built documentation of the repairs was never received from WGS.

5-6 REPAIRS – WELDING

5-6.1 WGS submitted approved weld procedure specifications and procedure qualification records for groove and fillet welds in the work plan (Attachment AG). These records were consistent with industry practice and ASME Section IX. The work plan provided for welding processes SMAW, FCAW, and GTAW. The work plan stated welding procedures would be chosen to match job scope, engineering, and contract requirements. See Chapter 9 for additional information.

WGS drilled gas test holes in the tank shell to sample for hydrocarbon vapors due to fuel which may have been in the tank shell to concrete interstice. The installation of the holes is industry practice per API RP 2510. The WGS inspection report stated "The tank is located underground and there is no way to determine the back side of the plate is in a safe and gas free environment. WGS will drill a ¼" dia. hole for gas testing on all repairs that could provide sufficient back wall surface heating to ignite any hydrocarbons. This is a safety requirement since hydrocarbons have been found in contact with the back wall surfaces in the past tanks. The test port will be located so the new patch plate will cover the test port location."

WGS did not repair the gas test holes before they installed patch plates over the holes. See Chapter 9 for additional information.

5-6.2 Welder Performance Qualification records were received (Attachment AH). These records were consistent with industry practice and ASME Section IX. See Chapter 9 for additional information.

5-7 TANK REPAIRS – MISCELLANEOUS

5-7.1 A partial list of repairs, in addition to the tank repairs, that were performed is in paragraph 5-1. Below are additional repairs:

- Remove sections from tower where booms connect, reinstall stairway sections when booms removed
- Remove elevator box/frame completely, not to be reinstalled and cut into pieces
- 12" MOV valve removal and reinstallation
- Install lifting jack stands and hoist to remove the valve
- Isolate power and disconnect MOV/install scaffolding
- Drain piping section at valve branch piping to MOV valve
- Unbolt MOV valve and transport to staging area outside
- Reinstall valve after repairs are completed
- Install new gaskets at valve flanges
- Remove drain pump, lifting and scaffolding equipment
- Inspect and clean area
- Remove loose and disbonding paint from tank surfaces [sic] (shell, upper and lower domes) by high pressure washing
- [Construct] Handrail Extension
- Remove Shell Channel Extensions – Boom Interference
- Abrasive blast existing coating at affected weld seams in the original scope's coating boundary to enable inspection of extent of weld spatter.
- Inspect weld seams and quantify (approximately) linear feet requiring removal of weld spatter identified in the Clean, Inspect, and Repair.
- Remove weld spatter sufficiently to meet surface preparation standards.
- Apply one additional stripe coat to welds within original scoped coating boundary

5-7.2 A description of how these additional repairs were performed is unavailable because WGS has not provided a completion report as of 28 September 2016. A representative daily report dated 16 January 2013 from WGS during abrasive blasting and API Std 653 inspection is included as Attachment AI.

5-8 TANK REPAIR PROCESS METHODOLOGY

The repair process used was very similar to the process used to repair other bulk storage tanks at Red Hill, and hundreds of storage tanks throughout the Navy inventory. This process is standard in the industry, is compliant with API Std 653, and has been used on numerous occasions without problems.

5-9 SUMMARY OF RECORDS

See Attachment List

5-10 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM FOR REPAIR

5-10.1 Welder Identification Marking

The WGS work plan provides procedures for welder identification. The plan states "Each welder shall be responsible for stamping his assigned symbol adjacent to the weld he has made. This will be done with a low stress steel die stamp or a halogen-free paint marker. Weld maps shall be maintained by the Inspector." This is a practice consistent with industry. See the WGS Tank 5 repairs – repair/NDE/QA/QC Data (Attachment R).

5-10.2 Weld Visual Inspection

See the WGS Tank 5 repairs – repair/NDE/QA/QC Data (Attachment R).

5-10.3 QC Log Of Inspections

See the WGS Tank 5 repairs – repair/NDE/QA/QC Data (Attachment R).

5-10.4 QA Review of Log of Inspections

NAVFAC EXWC attempted to reconcile the log of inspection data with the log of repairs made. However, reconciliation has not been able to be performed due to the inability to cross-reference the two data sets.

CHAPTER 6 – TANK 5 REPAIR VERIFICATION (WARRANTY WORK)

6-1 INTRODUCTION

This Chapter provides information about the investigation which took place to determine if there was a release, the location of the release, and the steps taken once the locations and underlying cause of the release was determined. Chapter 9 contains details on the underlying cause of the release. This section also provides information on steps taken to mitigate risk due to problems with workmanship performed by WGS, and information concerning an additional Quality Assurance (QA) effort taken during the warranty work.

6-2 SUMMARY OF THE PROCESS SELECTED

a. The Navy initially determined the loss of product most likely resulted from a release caused by defects in material or workmanship in the performance of the contract. Remedies pursuant to the Warranty of Construction Clause, Federal Acquisition Regulation (FAR) 52.246-21, were invoked by the Contracting Officer. On 4 February 2014 the Navy directed WGS to identify and correct deficiencies in Tank 5 as stated in Attachment AJ. This direction initiated the warranty investigation.
b. The Tank 5 warranty work took place in three phases. The first phase was forensic in nature with the objective to investigate and determine the underlying cause of the release. This investigation found the release was due to defects in workmanship. After 17 unrepaired gas test holes through the tank shell were found, the underlying cause of the release was clear and the forensic phase ended. Additional information on the forensic phase is contained in Chapter 9.
c. In October 2014, the second phase of warranty work was initiated with an investigation to determine the extent of deficient work in Tank 5. See Attachment AK, which is an October 2014 letter from the Contracting Officer to WGS. This work included a search for free product in the interstitial space between the steel tank shell and the reinforced concrete (See Attachment AO), and inspection by WGS of all repair work which had been performed by WGS. The inspection involved performing vacuum box testing, MT, and an API Std 653 inspection at every repair site, as well as a visual inspection by the API Std 653 inspector of the entire tank. The second phase was conducted under oversight from NAVFAC and also a

third party engineering firm. The Tank 5 Visual Inspection Report resulting from this inspection is provided in Attachment AL.

d. In August 2015 WGS provided the Mag Particle and Vacuum Box Inspection of Tank 5 report (Attachment AM). WGS stated in this report that "all failed locations will be repaired per the API Std 653 Code specifications as outlined in the Work Plan (WP) and all indications in adjacent welds will be covered in this process." This report initiated the third phase of warranty work in which WGS repaired all deficiencies identified during the second phase. The third phase was conducted under oversight from NAVFAC and also a third party engineering firm. As of September 2016, field work for the third phase is complete.
e. Due to problems with the work performed by WGS and the length of time Tank 5 had been out of service, in July 2016 the Government made a decision to re-scan the shell plates and reinspect Tank 5 independent of WGS. Information regarding the plan to reinspect Tank 5 is in Chapter 20.

6-3 TANK REPAIR VERIFICATION PROCESS METHODOLOGY

Pursuant to Hawaii Administrative Rules 11-281-76, WGS performed a Free Product Reclamation Procedure in the interstitial space between the steel shell and reinforced concrete (Attachment AN). No product was found (Attachment AO).

WGS provided a warranty repair work plan (Attachment W). The plan included quality control in conformance with UFGS Section 01 45 00 Quality Control.

The scope of the plan was as follows: "The Warranty SOW for TK5 under this Work Plan is limited to perform the required Lock Out Tag Out (LOTO) to isolate the tank; clean the tank for personnel access; perform Non Destructive Examination (NDE) and visual inspection of the repaired areas on the tank for defective workmanship or repairs and perform any necessary repairs on any identified areas of defective workmanship performed under the original SOW or contract modifications. Perform pressure testing of new or modified piping systems within the tank limits from internal to exterior connections. A general overview visual inspection will be performed on the tank surfaces to look for obvious areas of concern or failure outside of the areas to be inspected for the original repair work completed. Any warranty repairs performed will be performed in accordance with the same requirements under the original TO or contract modification SOW."

WGS performed hydrotesting on the tank nozzle piping in June 2014 during the first phase of the warranty investigation. Both nozzles passed hydrotesting. The WGS hydrotesting procedure from June 2014 is in Attachment AP. The WGS report on the Tank 5 hydrotesting results from June 2014 is in Attachment AQ.

NAVFAC's QA oversight during the warranty work included third party review of the WGS QC. The oversight included independent visual inspection, vacuum box testing, and MT. In February 2015 at the end of the second phase of the warranty investigation, WGS reported findings which included locations requiring repair. NAVFAC concurred with their report.

During the third phase of the warranty work, WGS repaired all defects found during the second phase. In May 2016 during third party QA oversight of the repairs, substandard work was detected in random testing of completed repairs. The random testing was performed pursuant to the Quality Assurance Surveillance Plan (QASP, Attachment AR). The number of failed tests exceeded the threshold established in the QASP acceptance sampling plan, and thus all repairs were considered to have failed. Subsequently, WGS again reinspected all repair locations and repaired deficient work. This was again conducted under oversight from NAVFAC and also a third party engineering firm. As of September 2016, the field work of the third phase is complete.

6-4 ADVANTAGES AND LIMITATIONS

6-4.1 Advantages

Without actual proof, NAVFAC assumed WGS workmanship was the cause of the release when the warranty letter (Attachment AK) was issued to WGS. If WGS did not find any defects in their work, the Government might have had to compensate WGS for their inspection. The NAVFAC's assumption was based on the perceived leak rate, and previous experience in finding an unrepaired gas test hole after tank repair on an above ground storage tank with secondary containment. Having the ability to invoke the Warranty Clause was advantageous in order to immediately investigate and determine the cause of the release.

NAVFAC EXWC was able to rapidly award a task order to an A-E Contractor for third-party QA during the WGS warranty work phases of the project. The

Navy has multiple-award fixed-price task order A-E contracts available for Petroleum, Oils, and Lubricants facilities engineering. This type of contract is awarded based on qualifications for specific work. Availability of an appropriate A-E contract enabled the Navy to quickly award to an engineering company with expertise and experience in this specific type of work.

6-4.2 Limitations

Under the Warranty Clause, the NAVFAC EXWC was only able to direct WGS to reinspect work which had been performed in the contract and was unable to require that WGS start from the beginning and perform a new API Std 653 inspection. See Chapter 21 for future planned API Std 653 inspection for Tank 5.

6-5 SUMMARY OF RECORDS

See Attachment List

6-6 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM FOR REPAIR VERIFICATION

During the second and third phases of the warranty work, the quality control program of WGS followed UFGS Section 01 45 00 [1]. They provided a qualified Quality Control Manager (QCM) who reported to company management.

NAVFAC's verification of the repairs followed NAVFAC P-445 Construction Quality Management Program [2] (P-445). QA was provided by NAVFAC and third party personnel. For this QA effort, P-445 was exceeded in several ways. The QA level of effort by NAVFAC's construction management personnel was full time. The third party level of effort was above and beyond ordinary QA practice in that they performed independent nondestructive testing and executed an acceptance sampling plan of random tests on repair locations. These actions by NAVFAC and the third party confirmed results of the WGS QC program during the warranty repair phase.

6-6.1 Advantages of the QC/QA Program During the Tank 5 Warranty Work:

Providing full time oversight has the advantage of familiarization with the idiosyncrasies of the unique Red Hill tanks. An advantage of the third party is expertise specific to these types of storage tanks is targeted towards repair activities which are crucial in the determination the storage tank is suitable for service. An advantage of using an Acceptance Plan is that deficient conditions are detected prior to acceptance by NAVFAC.

6-6.2 Limitations of the QC/QA Program During the Tank 5 Warranty Work: Personnel with the skill set necessary to perform inspection and quality control on the unique Red Hill tanks were difficult to find. Individuals who suffer from claustrophobia and/or acrophobia are not suitable for the work.

a. Full-time oversight is inconsistent with P-445 which requires, on most contracts, the QA personnel to visit the work site each day. For a Red Hill tank QA oversight required tank entry and surveillance from the scaffold work platform on a regular basis.
b. The cost of full time QA may exceed its benefits. The pace of work is so slow that full-time QA may not be productive.
c. Acceptance sampling detects a deficient product only after it is completed. Consequently, it does not result in real-time correction of deficiencies and does not correct the work process.

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[2] NAVFAC, "NAVFAC P-445 Construction Quality Management Program," 8 June 2000. [Online]. Available: https://acc.dau.mil/adl/en-US/534067/file/65799/NAVFAC%20P-445.pdf. [Accessed 1 September 2016].

CHAPTER 7 – RECOMMISSIONING

7-1 INTRODUCTION

This Chapter provides information on the recommissioning documentation, process, and background for the refilling of Tank 5 which took place December 2013 through January 2014.

7-2 SUITABILITY FOR SERVICE STATEMENT

The WGS Certified Tank Inspector provided a "Suitability for Service Statement," which stated that Tank 5 was suitable for continued service at the specified operational interval and could be placed back in normal operation. Attachment AS is the Suitability for Service statement which was signed by Tim D. Anderson, WGS API Std 653 Inspector, dated 27 June 2013.

7-3 TANK FILLING PROCESS

7-3.1 Following the Suitability for Service statement submittal, the tank was prepared for filling. This included the removal of all equipment from inside the tank, re-installation of the Automatic Tank Gauge (ATG) equipment, re-installation of the skin valves, removal of lock-out/tag-out, and installation of the 8-foot diameter dished head over the manway opening.

Meanwhile FLCPH prepared the Standard Operating Procedure (SOP) for safe filling Tank 5 after repairs. The process that was used to fill Tank 5 in December 2013 is provided in the "Current Fuel Release Monitoring Systems Report" AOC SOW, Section 4.3, dated 16 August 2016.

On 8 December 2013 FLCPH initiated the tank filling process. During the filling operation, when the fuel height reached the flange on the 8-foot diameter manway at the Upper Tunnel level, WGS was on-site to check the manway for weeps and drips. FLCPH continued filling when no weeps or drips were found.

7-3.2 Maintenance and Operation Manuals

7-3.2.1 MO-230

The MO-230 (dated August 1990) is NAVFAC's "Maintenance and Operation of Petroleum Fuel Facilities" manual. This manual establishes basic standards and procedures for development and conduct of maintenance programs designed to assure the readiness and dependability of Navy shore facilities which are sources of petroleum fuels for ships, aircraft and vehicles of all types. This manual was last published in 1990. It is still used, but often supplemented with the UFC 3-460-03 document. This manual does provide information on how to safely clean and inspect a tank, but it does not provide information on how to return a tank to service after it has been cleaned and inspected. [1]

7-3.2.2 UFC 3-460-03F

The UFC 3-460-03F is titled "OPERATION AND MAINTENANCE: MAINTENANCE OF PETROLEUM SYSTEMS." This manual implements Air Force Policy Directive (AFPD) 32-10, Installations and Facilities, by providing guidance for base and command liquid fuels maintenance (LFM) personnel with guide procedures for field maintenance of permanently installed Air Force owned, leased, or controlled petroleum storage and dispensing systems. This document was published in 2003, but was actually a reformatting of the Air Force Document AFM 85-16 which was published in August 1981. AFM 85-16 states in the Safety section: "Avoid surface agitation by limiting the initial fill rate into a fuel storage tank to less than 0.91 meter (3 feet) per second. Maintain this flow rate until the floating roof or pan is afloat and the fill pipe is completely submerged, or until the fill pipe is completely submerged in all other tanks. NOTE: Wait thirty minutes after loading or unloading an aboveground fuel tank before allowing anyone on it." [2]

7-3.2.3 Piping Configuration in the Bottom of a Red Hill Tank

Red Hill tanks are filled using the 32", and either 18" or 16"[1] diameter piping. The 32" piping ends in a vertical standpipe that discharges into the tank approximately 7-feet above the tank bottom and near the center of the tank. There is a vortex preventer over the open end of the pipe. The 18" or 16" piping also connects to a discharge nozzle inside the tank. The discharge nozzle is an angled pipe that ends near the sloping wall of the Lower Dome approximately 7-feet above the tank bottom. It discharges upward and has no vortex preventer. To avoid splash-filling the tank bottom, initial filling of the tank should be done very slowly at a rate of 500 barrels per hour (350 gpm) or less until the depth of fuel reaches 15-feet.

[1] The configuration of whether 16" or 18" diameter piping is present in a tank depends on how the tank was constructed.

7-4 TANK RECOMMISSIONING PROCESS METHODOLOGY

The recommissioning process used was similar to the process that was used in recommissioning tanks 2 and 20 in 2008. There were no issues during the commissioning of these tanks, so there was no known reason to change it.

7-4.1 In any event, a tank-specific commissioning plan has to be prepared shortly prior to commissioning a tank. At this time, the fuel levels of the other tanks will be known, so the location where the fuel will be transferred from can be determined. The preferred method is to transfer from one Red Hill Tank to another Red Hill tank by gravity. However, this method can only be used until the fuel level in both tanks equalize. Another method is to pump fuel from one of the tanks in the Upper Tank Farm. This is the least preferred method due to the temperature difference between the fuel in the aboveground tanks in the Upper Tank Farm and the underground Red Hill tanks. See Chapter 17 for the discussion of temperature differences. A more time intensive alternative is to gravity drain fuel from a Red Hill tank to one of the underground surge tanks, and then pump that fuel from the surge tank back to Red Hill and into tank that is being commissioned. Keeping the fuel underground will minimize its temperature change, but pumping will increase the fuel temperature.

7-4.2 In addition, the tank-specific commissioning plan needs to be prepared shortly prior to commissioning the tank in order to specify the personnel who will be performing the required tasks during the commissioning.

7-5 SUMMARY OF RECORDS

See Attachment List

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[1] Naval Facilities Engineering Command, "Maintenace and Operation of Petroleum Fuel Facilities," August 1990. [Online]. Available: https://www.wbdg.org/ccb/NAVFAC/OPER/mo230.pdf. [Accessed 18 August 2016].

[2] Department of Defense, "UFC 3-460-03: Operation and Maintenance: Maintenance of Petroleum Systems," August 1981. [Online]. Available: https://www.wbdg.org/ccb/DOD/UFC/ufc_3_460_03.pdf. [Accessed 18 August 2016].

CHAPTER 8 – TANK 5 ADDITIONAL INFORMATION

8-1 INTRODUCTION

This Chapter provides (1) the requirements for record-keeping of documents associated with contract management and regulatory requirements, (2) current maintenance requirements and a checklist for Red Hill Tank 5, and (3) information of the current scaffolding procedures used during the cleaning, inspection, and repair of the Red Hill tanks.

8-2 RECORD KEEPING

a. Part 4.801 of the FAR requires the head of each office performing contracting, contract administration, or paying functions to establish files containing the records of all contractual actions. The normal contents of a contracting office file are provided in FAR 4.803:
   1. Purchase request, acquisition planning information, and other presolicitation documents.
   2. Justifications and approvals, determinations and findings, and associated documents.
   3. Evidence of availability of funds.
   4. Synopsis of proposed acquisition as required by Part 5 or a reference to the synopsis.
   5. The list of sources solicited, and a list of any firms or persons whose requests for copies of the solicitation were denied, together with the reasons for denial.
   6. Set-aside decision including the type and extent of market research conducted.
   7. Government estimate of contract price.
   8. A copy of the solicitation and all amendments thereto.
   9. Security requirements and evidence of required clearances.
   10. A copy of each offer or quotation, the related abstract, and records of determinations concerning late offers or quotations. Unsuccessful offers or quotations may be maintained separately, if cross-referenced to the contract file. The only portions of the unsuccessful offer or quotation that need be retained are:
       - Completed solicitation sections A, B, and K;
       - Technical and management proposals;
       - Cost/price proposals; and

- Any other pages of the solicitation that the offeror or quoter has altered or annotated.

11. Contractor's representations and certifications (see FAR 4.1201(c)).
12. Preaward survey reports or reference to previous preaward survey reports relied upon.
13. Source selection documentation.
14. Contracting Officer's determination of the Contractor's responsibility.
15. Small Business Administration Certificate of Competency.
16. Records of Contractor's compliance with labor policies, including equal employment opportunity policies.
17. Data and information related to the Contracting Officer's determination of a fair and reasonable price. This may include:
    - Certified cost or pricing data;
    - Data other than certified cost or pricing data;
    - Justification for waiver from the requirement to submit certified cost or pricing data; or
    - Certificates of Current Cost or Pricing Data.
18. Packaging and transportation data.
19. Cost or price analysis.
20. Audit reports or reasons for waiver.
21. Record of negotiation.
22. Justification for type of contract.
23. Authority for deviations from this regulation, statutory requirements, or other restrictions.
24. Required approvals of award and evidence of legal review.
25. Notice of award.
26. The original of:
    - The signed contract or award,
    - All contract modifications, and
    - Documents supporting modifications executed by the contracting office.
27. Synopsis of award or reference thereto.
28. Notice to unsuccessful quoters or offerors and record of any debriefing.
29. Acquisition management reports (see Subpart 4.6).
30. Bid, performance, payment, or other bond documents, or a reference thereto, and notices to sureties.
31. Report of postaward conference.
32. Notice to proceed, stop orders, and any overtime premium approvals granted at the time of award.

33. Documents requesting and authorizing modification in the normal assignment of contract administration functions and responsibility.
34. Approvals or disapprovals of requests for waivers or deviations from contract requirements.
35. Rejected engineering change proposals.
36. Royalty, invention, and copyright reports (including invention disclosures) or reference thereto.
37. Contract completion documents.
38. Documentation regarding termination actions for which the contracting office is responsible.
39. Cross-references to pertinent documents that are filed elsewhere.
40. Any additional documents on which action was taken or that reflect actions by the contracting office pertinent to the contract.
41. A current chronological list identifying the awarding and successor Contracting Officers, with inclusive dates of responsibility.
42. When limiting competition, or awarding on a sole source basis, to economically disadvantaged women-owned small business (WOSB) concerns eligible under the WOSB Program in accordance with subpart 19.15, include documentation:
    - Of the type and extent of market research; and
    - That the North American Industry Classification System (NAICS) code assigned to the acquisition is for an industry that the Small Business Administration (SBA) has designated as:
        - o Underrepresented for Economically Disadvantaged WOSB (EDWOSB) concerns; or
        - o Substantially underrepresented WOSB concerns.

b. The normal contents of a contract administrative office contract file are provided in FAR 4.803:
    1. Copy of the contract and all modifications, together with official record copies of supporting documents executed by the contract administration office.
    2. Any document modifying the normal assignment of contract administration functions and responsibility.
    3. Security requirements.
    4. Certified cost or pricing data, Certificates of Current Cost or Pricing Data, or data other than certified cost or pricing data; cost or price analysis; and other documentation supporting contractual actions executed by the contract administration office.
    5. Preaward survey information.
    6. Purchasing system information.

7. Consent to subcontract or purchase.
8. Performance and payment bonds and surety information.
9. Postaward conference records.
10. Orders issued under the contract.
11. Notice to proceed and stop orders.
12. Insurance policies or certificates of insurance or references to them.
13. Documents supporting advance or progress payments.
14. Progressing, expediting, and production surveillance records.
15. Quality assurance records.
16. Property administration records.
17. Documentation regarding termination actions for which the contract administration office is responsible.
18. Cross reference to other pertinent documents that are filed elsewhere.
19. Any additional documents indicating actions taken by or reflecting actions by the contract administration office pertinent to the contract.
20. Contract completion documents.

c. The normal contents of a paying office contract file are provided in FAR 4.803:
   1. Copy of the contract and any modifications.
   2. Bills, invoices, vouchers, and supporting documents.
   3. Record of payments or receipts.
   4. Other pertinent documents.

d. Documents required to be kept in the Contracting Officer Representative file pursuant to Naval Facilities Instruction (NAVFACINST) 4200.1:
   1. Copy of Contracting Officer's Representative (COR) Appointment Letter (signed and acknowledged) and other documentation describing the COR's duties and responsibilities;
   2. Copy of contract/order and all modifications;
   3. Record of each individual surveillance conducted, the results, and any actions taken;
   4. Minutes of Post-Award Conference, if conducted;
   5. Copy of all other critical correspondence, including e-mails, between COR and the Contractor, including any approvals provided;
   6. Copy of all critical written communications with the Contracting Officer, Requiring Activity Representative, and COR Supervisor;

7. Copy of trip report where visits to Contractor's offsite facility or other contract related travel that requires temporary assigned duty (TAD) travel;
8. Log of all deliverables as required by the contract/order.
9. Copy of COR Reports;
10. Documentation of significant changes affecting the contract, such as mergers, re-negotiations, labor disputes, plant shutdowns, etc.

e. When a storage tank is evaluated, repaired, altered, or reconstructed in accordance with API Std 653, the following information as applicable, is required to be made a part of the owner/operator's records for the tank:
   1. Calculations for component evaluation for integrity, including brittle fracture considerations, re-rating (including liquid level), repair and alteration considerations.
   2. Construction and repair drawings.
   3. Additional support data including, but not limited to, information pertaining to:
      - Examinations (including thicknesses)
      - Material test reports/certifications
      - Tests
      - Radiographs (radiographs shall be retained for at least one year)
      - Brittle fracture considerations
      - Original tank construction data (date, as-built standard, etc.)
      - Location and identification (owner/operator's number, serial number)
      - Description of the tank (diameter, height, service)
      - Design conditions (liquid level, specific gravity, allowable stress, unusual design loadings, etc.)
      - Shell material and thickness by course
      - Tank perimeter elevations
      - Construction completion record
      - Basis for hydrostatic test exemption

f. Documents that are required to be kept per the State of Hawaii in compliance with HAR 11-281.

   The August 2013 version of HAR 11-281 does not have inspection, repair, or maintenance requirements for the field-constructed tanks at Red Hill. However, Section 1.8 of the Red Hill AOC Statement of Work says:

> On June 22, 2015, EPA promulgated new regulations that apply to field-constructed underground storage tank systems. These new regulations will not become legally enforceable in states with federally-approved programs, such as the State of Hawaii, until the state's rules are updated, and the state successfully receives federal approval of their revised regulations. Notwithstanding this schedule, Navy and DLA shall begin coordination with the Regulatory Agencies in order to comply with the new federal UST regulations ... applicable to the Facility as soon as possible.

From 40 CFR § 280.33, Repairs Allowed:

> 1. (d) … repairs to tanks and piping must be tightness tested ... within 30 days following the date of the completion of the repair.
> 2. (g) UST system owners and operators must maintain records ... of each repair until the UST system is permanently closed or undergoes a change-in-service

From 40 CFR § 280.252, Additions, exceptions, and alternatives for UST systems with field-constructed tanks and airport hydrant systems:

> 1. (d)(3) Recordkeeping for release detection. Owners and operators must maintain release detection records according to the recordkeeping requirements in Section 280.45.

Excerpt from 40 CFR § 280.45, Release Detection Recordkeeping:

> All UST system owners and operators must maintain records in accordance with § 280.34 demonstrating compliance with all applicable requirements of this subpart. These records must include the following:
>
> (a) All written performance claims pertaining to any release detection system used, and the manner in which these claims have been justified or tested by the equipment manufacturer or installer, must be maintained for 5 years, or for another reasonable period of time determined by the implementing agency, from the date of installation. Not later than October 13, 2018, records of site assessments required under § 280.43(e)(6) and (f)(7) must be maintained for as long as the methods are used. Records of site assessments developed after October 13, 2015 must be signed by

> a professional engineer or professional geologist, or equivalent licensed professional with experience in environmental engineering, hydrogeology, or other relevant technical discipline acceptable to the implementing agency;
>
> (b) The results of any sampling, testing, or monitoring must be maintained for at least one year, or for another reasonable period of time determined by the implementing agency, except as follows:

> (1) The results of annual operation tests conducted in accordance with § 280.40(a)(3) must be maintained for three years. At a minimum, the results must list each component tested, indicate whether each component tested meets criteria in § 280.40(a)(3) or needs to have action taken, and describe any action taken to correct an issue; and
>
> (2) The results of tank tightness testing conducted in accordance with § 280.43(c) must be retained until the next test is conducted; and (3) The results of tank tightness testing, line tightness testing, and vapor monitoring using a tracer compound placed in the tank system conducted in accordance with § 280.252(d) must be retained until the next test is conducted; and

> (c) Written documentation of all calibration, maintenance, and repair of release detection equipment permanently located on-site must be maintained for at least one year after the servicing work is completed, or for another reasonable time period determined by the implementing agency. Any schedules of required calibration and maintenance provided by the release detection equipment manufacturer must be retained for five years from the date of installation.

g. The Contracting Officer maintains the contract file in accordance with FAR 4.801. The COR maintains the COR file in accordance with NAVFACINST 4200.1. API Std 653 documents are contained within the tank inspection report and are maintained by FLCPH.

8-3 MAINTENANCE OF TANKS IN RED HILL

8-3.1 MO-230 Maintenance Requirements

The MO-230 does not provide a maintenance checklist. It provides details of equipment that is normally in a fuel facility (i.e., pumps, pressure relief valves, pressure gauges, pipeline, valves, tanks, etc.), and the procedures to maintain the equipment.

The MO-230 will be superseded by the UFC 3-460-03: Operation and Maintenance: Maintenance of Fuel Facilities. This new UFC includes a maintenance checklist of all of the components in a Fuel facility. (This document cannot be released to the public until it has received all approving signatures and is published in the Whole Building Design Guide.)

8-3.2 The following is an abbreviated maintenance checklist for Tank 5. The checklist with each step is located at FLCPH.

a. Verify the operation of the high-level switch (part of Automated Fuel Handling Equipment (AFHE))
   - Frequency: Annually

b. Test Operate the tank skin valves
   - Frequency: Annually

c. Check AFHE probe operation
   - Frequency: Annually or as needed if out of calibration

d. Bottom Drain Valve Position Switch operation
   - Frequency: Annually

e. Draw water from the tank monthly.
   - Frequency: Monthly (we have water monitoring AFHE capability in real time)

f. Verify the accuracy of the AFHE by manual comparison against a National Institute of Standards and Technology (NIST) certified tape.
   - Frequency: Every six (6) months

g. Check the level gauge records.
   - Frequency: Daily

h. Apply field-erected tank monthly inspection to the maximum extent possible. Visually inspect tank and appurtenances for evidence of leaks, distortions, and settlement at accessible locations. Items noted during the inspection will be documented for follow-up action by an authorized inspector (Refer to Attachment G for the Field-Erected Tank Monthly Inspection Checklist).

- Frequency: Monthly

i. Check tank under static storage conditions for 24 hours using existing inventory management system to determine if petroleum losses are occurring. If leakage is noted, further investigation shall be conducted in accordance with Military Service-specific guidelines.
   - Frequency: Monthly

j. Apply field-erected tank annual inspection to the maximum extent possible. Visually inspect tank and appurtenances for evidence of leaks, distortions, and settlement at accessible locations. Visually inspect piping/valves for leaks and cracking in concrete walls and floors. Retain records of inspections reports for five years (Refer to Attachment G for the Field-Erected Tank Annual Inspection Checklist).
   - Frequency: Annually

k. Perform a modified Out-of-Service API Std 653 internal inspection to evaluate the tank for conditions which may affect the operational integrity of the tank floor, shell, columns and roof by certified API Std 653 inspector. API Std 653 provides a checklist to be used as part of the assessment; however, the certified API Std 653 inspector must modify this checklist to incorporate specific needs of underground field-constructed tanks.
   - Frequency: Every ten years or as recommended by an appropriately certified tank inspector in the previous API Std 653 inspection report.

l. Conduct Tank Cleaning: Unless otherwise mandated by operational concerns or Military Service directives, schedule and conduct tank cleaning based upon the frequency listed below. After cleaning, tanks shall be stenciled in accordance with Section 8-8.1 Tank Stenciling Requirements.
   - Frequency: During out-of-service inspection cycle, unless required more frequently due to potential fuel quality issues.

8-4 BASKET POSITIONING (SCAFFOLDING)

WGS accessed Tank 5 shell and dome plates with two rotating, articulating, and telescoping box booms. Each box boom supported wire rope upon which a suspended work platform ascended and descended and was able to rotate and access 180 degrees of tank shell. The Navy considered the system, for purposes of safety, to be a critical lift in accordance with EM 385-1-1.

Notes from the WGS inspection report state, “After all of the structural repairs (on the center tower) were completed and checked, WGS installed two (2) boom systems on the tower structure with man baskets. The man baskets were utilized to access all the internal surfaces areas of the tank for testing and inspection” (Attachment T).

8-4.1 A description of the design and operation of the WGS suspended scaffolding and adjustable boom systems are quoted below from the WGS Critical Lift Plan (CLP).

Summary The purpose of this lift plan is to provide the overall relevant details of the intended lift(s) in the Red Hill Complex for Tanks Tank 5 and Tank 17 for TO 003 and Tank 4 and Tank 14 for TO 019. The lifts are similar in layout, equipment, configuration, loadings and operations. This CLP is per EM-385 requirements. The suspended scaffolding is operated by a local operator from inside the personnel basket and adjustable boom system is operated by an operator located at a stationary position from the catwalk. Each operator has clear sight of all operations being performed with no visible restrictions. The details provided in the CLP are for the worst case scenarios, including maximum loads and boom angles. Description of Equipment The suspended scaffolding and adjustable boom system is comprised of several key components. The overall system is a professional engineered designed system and custom built components in accordance with industry standards for scaffolding systems, Occupational Safety and Health Administration (OSHA) 1926.451 and EM-385. The system is designed to meet the capacity requirements for these types of systems; to which this specific system meets or exceeds all of the specified requirements. This type of system has been operated in the Red Hill Complex safely for over 34 years of service; known records since 1980.

a. Adjustable Boom Section

The suspended scaffolding and adjustable boom system is attached to the existing tower structural components of the tank's internal structure at two locations.

- The lower point is at the boom and swing actuator connection. The connection is attached to the existing structure by a fabricated section and bolted to the tower structure by four (4) high tensile strength American Society for Testing Materials (ASTM) A325 grade bolts.
- The upper point is at the boom cable block connection. The connection is attached to the existing structure by a fabricated section and bolted to the tower by four (4) high tensile strength ASTM A325 grade bolts.

The boom section is manufactured out of high strength structural tubing and fitted with a hydraulic ram and controls. The boom is configured with slide plated, guides and mechanical safety stops. The boom is fabricated in two sections for installation and maintenance of the hydraulic ram; which is bolted in the middle at a plate connection. The boom is configured with external lugs, tensioning cables and turnbuckles for additional support of the boom system to provide additional support with the tensioning cables. The end of the boom has a fixed connection point for the suspended scaffold cables, and two lifeline cables for the scaffold occupants. The hydraulic section of the boom will extend to a fixed point to the limit of the hydraulic ram section or the fixed structural / mechanical safety stops. The hydraulic section of the boom is controlled from the catwalk platform where the operator is stationed during all lifts.

b. Suspended Scaffolding System

The suspended scaffolding system is connected to the adjustable boom section at the fixed connection point at the end of the boom. The cables are connected with UL listed and tested shackles and cables clamps. The suspended scaffolding system is supported and operates with a two 5/16" cable system. The first cable acts as the primary motor and load cable. The secondary cable provides a secondary load and brake cable in the event there is a cable malfunction or problem. The suspended scaffolding motor operates completely independent of the boom system for up and down functions. The basket operator controls this function from the swing stage basket scaffolding system.

c. Operating Procedures

The suspended scaffolding system is operated by two operators / trained personnel. The suspended scaffolding is operated by a local operator from inside the personnel basket and adjustable boom system is operated by an operator located at a stationary position from the catwalk. Each operator has clear sight of all operations being performed with no visible restrictions. The details provided in the CLP are for the worst case scenarios, including maximum loads and boom angles. The suspended scaffolding system operating procedures are per the manufacturer's (MFG) recommended operating procedures for each component section. Reference the MFG operating procedures for detailed instructions or information. All operators will be properly trained per the WGS specified requirements and certified to operate the section of equipment and controls designated. Note: Anti-Two block controls and systems are not required or feasible for this type of system. The basket operator is located next to the basket motor in the basket and controls the up and down function from the basket. The basket operator cannot create a continual winching action that would damage the cable or motor system. The motor has built in safeties and senses if the motor is in a bind or load which would exceed the capacities, then trips the safeties and stalls out; locking the motor and cable in a controlled safety shutdown. The motor must be reset manually by the operator before it will operate again.

Rigging

The suspended scaffolding and adjustable boom system is configured with adjustable, moving and components that have cables, hydraulically and pneumatic controlled systems. All of the components of the system are UL Listed, manufactured and tested assemblies prior to being installed into the suspended scaffolding and adjustable boom system. After all components are assembled, the entire assembly is load tested again. The suspended scaffolding and adjustable boom system is similar in the overall components and cabling of a crane system, but doesn't have a winch or variable load that is controlled by the platform operator. All communications are handled via radio and in visual eye sight of the operator. Hand signals are not utilized unless radio communications are down, but that is not practical due to backup systems that are in place at all times. If hand signals would be required, they are standard crane and lifting or boom signals as illustrated in Section 18 of the WGS Health and Safety Program (HASP).

Trial Lift Meeting, Lift and Inspection

A lift meeting will be held prior to the CLP load test with all relevant parties to review all of the plans contents, requirements and test procedure. This is a repetitive lift performed daily and will not have trial lifts performed on a daily basis. The load test serves as the load test for the system over the period of the intended use, unless the system is altered or has a key component replaced and therefore needs to be retested. The entire suspended scaffolding and adjustable boom system will be inspected daily and prior to each shift by a competent person. The inspection will be per the inspection and checklist forms included in this CLP to ensure the system and components are safe for operation. Any component or section found not to meet the requirements will be flagged and the entire system will be tagged out of service until the item or deficiency has been corrected and re-inspected by a competent person and found to be safe for operation and meets all of the specified requirements.

Critical Lift Load Test
A load test will be performed to test and verify the integrity of the entire system after the installation has been completed. The system will be inspected by a competent person per the inspection and checklist forms to ensure everything is installed correctly and ready to operate. After all inspections and preliminary operational test are completed the system will have the weights / load added to the basket until the designated load limits specified in the CLP test requirements are achieved for 125% of the intended load capacity.

Environmental Conditions
The system is installed inside a UST and is not affected by external weather conditions. The environmental and atmospheric conditions are continually monitored for current condition and potential changes. If the conditions change due to upsets in the tunnel conditions, the work activities may be stopped depending on the actual conditions. When the conditions change or there is a relevant concern or alarm, all work activities will be stopped and the system will be shut down and de-energized.

8-4.2 Access to Areas of the Tank Shell

8-4.2.1 Lower Dome

The upper two courses of the lower dome were accessed by the WGS telescoping boom system. Other courses of the lower dome and the bottom are accessible by walking once personnel have been lowered to the tank bottom by the telescoping boom system or by using the center tower elevator.

8-4.2.2 Barrel

All areas of the barrel were able to be accessed by the telescoping boom system. Access underneath the catwalk was more difficult due to interference. This area was accessed by parking both booms against the shell and pulling the baskets towards each other.

8-4.2.3 Upper Dome

All areas of the upper dome were able to be accessed by the telescoping boom system. Access to the tank shell in the upper dome is slow because the range of reach is limited which requires many more repositioning actions. Access to the upper dome top course, which is above the fill height, was more difficult. This area was accessed by a combination of the telescoping boom system and a platform on the center tower.

8-4.3 Boom and Basket Positioning

Positioning is slow. In order to make a lateral movement in the barrel, or any movement in the upper dome, the operator must first retract the boom, then make the movement to the satisfaction of the basket occupants, and then telescope out to the shell. Following the positioning of the boom, the basket operator must then ascend or descend to the point of interest. The vertical rate of movement of the basket is limited by the speed of the power climber motor which is slow and temperature-limited. For walking access to the tank bottom, the basket must descend the entire distance and carefully land on the sloping shell plates of the Lower Dome in order for occupants to exit the basket. To return, the basket must ascend the same distance which, if traveled in one movement, requires periods of waiting to allow the climber motor to cool. The waiting periods can approach ten minutes and adversely affect productivity.

PART C – LESSONS LEARNED

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CHAPTER 9 – OBSERVATIONS AND INCIDENT INVESTIGATION

9-1 INTRODUCTION

WGS was awarded a contract to clean and inspect Red Hill Tank 5 on 13 January 2010. The contract was modified to repair Tank 5 on 15 December 2011. The work consisted of mandatory, short term, and long term repairs which were based on recommendations from the WGS API Std 653 Tank Inspector and tank engineer. Typical types of work were patch plate repairs, weld repairs, valve refurbishment, and a new coating system for the lower dome. Contract work proceeded under a WGS Work Plan (Attachment AT).

Repairs to Tank 5 were complete by 21 June 2013. Tank 5 was certified to be suitable for service on 27 June 2013 (Attachment AS) by API Std 653 Certified Inspector No. 37258 Tim D. Anderson. The Navy began filling operations on 9 December 2013. During filling, the Navy discovered an inventory discrepancy and reported a release to regulatory agencies on 13 January 2013 and drained product from Tank 5.

Further information about contractor quality control as it relates to lessons learned is provided in Chapter 11, and as it relates to future work is given in Chapter 16.

9-2 TANK 5 INCIDENT INVESTIGATION

9-2.1 Underlying Causes

9-2.1.1 Repairs

a. Standard of Care

The Navy contract with WGS required them to possess in-house capabilities or to employ an experienced engineering design firm (Attachment AU). WGS was required to provide a project engineer whose responsibility it was to diagnose, investigate, and analyze any and all technical issues. Since Tank 5 is a field constructed underground storage tank and is not amenable to full application of storage tank inspection standards designed for above ground storage tanks, a modified inspection approach prepared under the responsible charge of a professional engineer was standard practice. An API-certified tank inspector was required to inspect Tank 5 pursuant to the modified API Std 653 approach, and then perform a post-repair inspection of Tank 5 (Attachment AC). Welders were required to be qualified pursuant to ASME IX (Attachment

AC). Nondestructive testing examiners were required to be certified to be a Level II technician competent in relevant methods pursuant to requirements of ASNT (Attachment AC). A registered professional engineer familiar with API Std 653 was required to seal the tank inspection report and the suitability for service statement. This statement certified to the Navy an inspection had been performed, repairs had been completed, an inspection of repairs had been performed, and Tank 5 was suitable for active fuel service.

b. Tank 5 Contract Requirements

The contract to clean, inspect, and repair Tank 5 was awarded by Naval Facilities Engineering Service Center (NFESC) (Attachment P)[1]. The contract was compliant with the FAR. The FAR and component agency supplements are the primary means by which acquisition of supplies and services with appropriated funds are regulated. Various FAR clauses were incorporated into the Tank 5 contract, either in full text or by reference. Contract modifications to perform repairs to Tank 5 were based on findings of the inspection.

FAR 46.105 *Contractor Responsibilities* requires a Contractor to control quality of the work [1]. The NAVFAC implementation of FAR 46.105 is to control quality with a management system rather than discover problems after they occur.

FAR 52.246-12 *Inspection of Construction* requires a Contractor to "maintain an adequate inspection system and perform such inspections as will ensure that the work called for by this contract conforms to contract requirements [1]. The Contractor shall maintain complete inspection records and make them available to the Government." FAR Clause 52.246-12 was a part of the WGS contract with the Navy. Thus the Navy required WGS to implement a systematic QC program which would control quality of the work, inspect construction, and provide documentation.

Contract Modification 09 (Mod 09) awarded more than 700 repairs which involved welding to Tank 5 (Attachment AC). Repairs to Tank 5 were required to be performed substantially in accordance with API Std 653. Relevant sections of API Std 653 specify repair plate geometry, repair overlap at shell seams, weld spacing, and repair requirements for defective welds. Mod 09 also required VBT and MT by American Society

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[1] N.B.: NFESC later became NAVFAC Engineering and Expeditionary Warfare Center (NAVFAC EXWC).

for Nondestructive testing (ASNT) Level II technicians on all repairs. A post-repair inspection by the certified API Std 653 inspector was also required. Following the post-repair API Std 653 inspection, a suitability for service determination was required to be provided.

Mod 09 also required a construction certification report to be prepared during the construction phase and submitted after completion. Contents of the report were to include:

1. Details of the inspection
2. All test records and reports
3. Nondestructive testing results
4. QC documentation
5. As-built drawings indicating locations and types of repair
6. Personnel certifications (including welder)
7. Post-repair API Std 653 inspection results

c. Construction Specifications
The WGS Project Execution Work Plan contained a list of industry standards and documents entitled “APPENDIX A PROJECT SPECIFICATIONS” (Attachment AT). The list contained titles of API Standards and Recommended Practices, as well as five Unified Facilities Guide Specification numbers.

Guide specifications are documents which specify criteria for materials, equipment, and test methods. They describe products and materials, and the work necessary to incorporate them into construction. Standard practice is for guide specifications to be edited and tailored under the responsible charge of a professional engineer to produce project-specific construction documents. On Red Hill Tank 5, WGS produced a list of guide specification section numbers. However, a list of section numbers is not a construction specification. WGS did not produce construction specifications.

d. Construction Drawings
The WGS Project Execution Work Plan (Attachment AT) contained a set of seven project drawings sealed by a licensed professional engineer. The drawings included general information. In addition, WGS produced a set of five drawings for the sample and drain line repairs (Attachment AV). The drawings are annotated “Not for Construction” and “As-Built” and are

not sealed by a professional engineer. WGS did not produce detailed construction or shop drawings of tank repairs.

e. Field Procedures
The WGS Project Execution Work Plan (Attachment AT) contained company procedures for tank cleaning, nondestructive testing procedures, a field quality control manual, and key personnel resumes and certifications. The WGS work plan was suitable for general industry storage tank repair work. WGS did not subcontract and self-performed all welding, weld inspection, nondestructive examination, quality control, and API inspection during the repair phase.

f. Repairs Summary
Contract requirements required construction inspection by WGS in accordance with a QC plan. Contract requirements and industry consensus standards cite a level of care which would entail professional engineering in the preparation of construction drawings, details, and specifications. With the exception of the sample and drain line repairs, WGS did not work from construction specifications or detailed construction drawings. Instead, general-industry work-plan procedures were provided to the Navy.

Without guidance from engineered repair plans or specifications, success in repairing Tank 5 was dependent solely on performance from trade workers, QC oversight, and inspection of the repairs by the API Std 653 inspector.

9-2.1.2 QC Process Failure

a. WGS QC Program
The WGS Project Execution Work Plan contained a field quality control manual and various procedures. The WGS quality control manual was developed from United States Army Corps of Engineers (USACE) EP 715-1-2 which is a brief pamphlet describing the USACE's concept of contractor quality control [2]. The WGS quality control manual did not adhere to EP 715-1-2 in important elements such as:

1. A system for tracking construction deficiencies to ensure corrective action is taken in a timely manner

2. A Contractor Quality Control (CQC) staff of adequate size and technical capabilities to accomplish all quality control duties in a timely manner
3. A testing plan which lists tests to be performed, states who will be responsible for the results, and identifies who will prepare and sign reports

Manual P-445 [3] is the NAVFAC construction quality management program. Notwithstanding the fact WGS QC procedures were not developed from P-445, several aspects were consistent with the NAVFAC program. Performing three phases of control, identification of areas of responsibility and authority, and completion inspection procedures were consistent with P-445. However, the WGS QC program omitted several crucial aspects of P-445:

1. Internal rework procedures to identify, document, track, and sign off completion of deficiencies during construction
2. Test plan and log, to include tests required referenced by the specification paragraph number requiring the test, test frequency, and the person responsible for each test
3. Procedures for documenting quality control, inspection, and testing
4. Submittal procedures for reviewing shop drawings, samples, certificates, or other submittals for contract compliance, including the name of the person(s) authorized to certify submittals as compliant with the contract

In several areas the WGS QC plan complied with contract requirements. In many areas, the WGS QC plan did not comply with Navy or USACE QC management manuals. However the basic industry procedures stated in the WGS QC Program should have been adequate to manage quality of the work at Red Hill Tank 5. The administrative portion of the WGS QC plan was marginally compliant with Navy QC criteria. Thus, success in implementing the marginal QC plan on a complex project was dependent on adhering to the plan and effective performance by the QCM.

b. Quality Control Management
NAVFAC P-445 identifies guide specification UFGS Section 01 45 00 QUALITY CONTROL to incorporate NAVFAC specific requirements into the QC System which was required to be implemented by WGS. UFGS Section 01 45 00 requires the QCM to inspect all work for compliance with

the contract and to stop noncompliant work. In addition, the Section requires the QCM report findings to corporate management.

c. Concentration of Authority

The WGS work plan identified key personnel including the Project Manager Tim D. Anderson (who also served as the API Std 653 inspector), and the Site Manager (Attachment AT). The plan stated the Site Manager was to report directly to the WGS Project Manager. The work plan named the Site Manager to also perform the QCM role as collateral duty. Since the Site Manager has numerous production-related duties, collocating the QCM and Site Manager roles on a project as complex as Red Hill Tank 5 was a practice fraught with conflict of interest. In addition, performing QC management as collateral duty on a complex project diluted the effectiveness of QC management. By directing the QCM to report directly to the Project Manager, the independence of the QCM role, per core principles of P-445, was severed. It is unknown whether the QCM received oversight from the WGS corporate quality control program.

Performance qualification records were received for three individuals who had been certified by WGS to be qualified both as welders and as Level II nondestructive technicians. Each individual was certified to weld, to perform visual testing of welds, and to perform liquid penetrant testing (PT) examination of welds. The Project Manager Tim D. Anderson, who was stated to be an ASNT Level III examiner in Attachment AS signed the certifications which qualified the Level II nondestructive technicians. The Project Manager, Mr. Anderson, also signed the certifications which qualified the welders. Thus the welders were certified by WGS to inspect and examine their own, and other welder’s work. The certifying authority for both the welders and the NDE technicians was the Project Manager Tim D. Anderson, who was the same individual performing the in the roles of API Std 653 inspector, manager of the QCM, and manager of the Site Manager.

The Project Manager was stated in the WGS work plan to be responsible for “cost, schedule, and field construction quality control.” By removing the independence of the QCM role and vesting construction quality management responsibility in the Project Manager, WGS created a program wherein QC, production, cost, tank inspection, weld inspection, and nondestructive testing were managed by a single individual. The QCM was a manager in name only.

Reliance on one individual to manage such divergent interests as QC, production, cost, welding, weld inspection, and weld testing was perilous. The result of this practice was inadequate oversight which directly led to events described later in this Chapter. The WGS quality control management lines of authority, concentration of authority, and responsibility to control quality of the work was a wholesale departure from P-445 and UFGS Section 01 45 00.

d. Deviation from WGS QC Plan
The WGS work plan charged the QCM to perform “trend analysis and root cause analysis to identify potential problems”, prepare a test plan and log, and verify “testing procedures comply with the contract requirements.” Test methods identified in the plan and required in the contract to be performed included vacuum box testing, dye PT, and magnetic particle testing. Further discussion about VBT and MT is given below in paragraph *Incident Investigation*. There is no evidence the QCM complied with WGS internal quality control manual requirements. Whether the QCM controlled quality of the weld inspection and PT was unclear, as evidenced by the condition of welds observed by the Navy during the investigation in 2014. Thus quality control of the weld inspection and nondestructive liquid penetrant testing either was not performed or was performed in an incompetent manner. The WGS QC on-site program substantially deviated from the company QC plan.

e. Quality Control Management Summary
Construction quality management was relegated by WGS to coordinate status with production, cost, and project management. The QCM did not adhere to the QC plan, and neglected to comply with basic WGS internal company procedures. WGS concentrated an excessive amount of project authority in one individual. As a result the WGS QC program was verified to exhibit a lack of care, was ineffective, and was noncompliant with contract requirements.

f. Deficiency Reporting
The WGS work plan (Attachment R) described a deficiency report which documented “discrepancies in supplies, materials, and workmanship”, and included a summary of corrective actions. The deficiency data were reported to the WGS Project Manager. These data, if they existed, have

not been provided to the Navy. It is unknown whether deficient work was detected or reported by any employee of WGS prior to the fuel release.

At the conclusion of the repair phase, WGS submitted to the Navy QC documents which purported to show contract requirements had been met. An extensive repair log (Attachment AW) was produced which listed repairs, NDE of repairs, and whether rework had been performed. The log failed to include NDE methods MT or VBT. Included in the log were test and inspection dates, rework dates, and initials signifying individuals who performed examinations.

During the warranty investigation phase, numerous welds were observed which contained clearly rejectable defects. The same welds had been annotated in the repair log as complete. These observations controverted the repair-log data. It is unknown who produced the log and who within the WGS QC program was responsible for the veracity of its contents.

g. Deficiency Reporting Summary
At the end of the repair phase, WGS reported to the Navy that Tank 5 was suitable for service and ready to be filled (Attachment AS). The fact that unrepaired deficiencies existed throughout the tank was not reported. The fact that crucial examination and testing had not been performed was not reported. The lack of deficiency reporting by WGS was exacerbated by producing a quality control log (Attachment AW) which ostensibly reported that repairs, inspection, and testing of repairs were complete. The failure by WGS to report deficiencies in the Tank 5 repair work was a contributory factor in the cause of the fuel release.

9-2.1.3 Tank 5 Contractor Actions
Weld operations inside Tank 5 required certification by a Marine Chemist that the space was safe. As part of that certification, WGS drilled numerous 1/8-inch-diameter holes (gas-test holes) through the tank shell for purposes of sampling for the presence of hydrocarbon vapors. The WGS procedure was not to fill the gas test hole with weld metal, but instead, to cover it with a seal welded patch plate (Attachment T). In that procedure, the hydraulic boundary of the tank would become the fillet weld which attached the patch plate. WGS did not record, track, or report the installation and locations of gas test holes in Tank 5 during construction.

After Tank 5 repairs were completed, WGS reported all repairs had been reinspected and tested, all repairs were acceptable, and approved the return to normal operation for continued service. The API Std 653 certified inspector signed a statement certifying Tank 5 was suitable for service and fit for operation (Attachment AS). A reviewing licensed professional engineer was named on the form, but the engineer did not sign it.

The construction certification report which documented repairs and inspections as required in the contract (Attachment P) was requested from WGS. Some portions were received. Other portions were never received.

9-2.1.4 Incident Investigation

Following the Tank 5 filling, in January 2013 the Navy operators discovered an inventory anomaly which could not be reconciled. The tank was drained and a preliminary investigation was conducted. Initial results were:

1. Gauge logs showed a loss of product
2. There was the appearance of hydrocarbons on a lower cross tunnel wall below Tank 5
3. The vapor monitoring well near Tank 5 exhibited an increase in hydrocarbon vapors

The Navy determined the inventory loss to be a release and notified regulators. WGS was directed to re-enter Tank 5 and investigate the fuel release (Attachment AJ).

a. Deficiencies Observed

   During the initial phase of the investigation, WGS performed a visual inspection and nondestructive testing on some tank locations. Significant deficient conditions were observed. Deficiencies included:

   1. Nonconformance with API Std 653 standards on tank repairs
   2. Weld defects such as lack of fusion, incomplete welding, excessive porosity, and undercutting
   3. Failed VBT and rejectable MT results

   Numerous repairs were observed which did not meet contract requirements, WGS acceptance standards, or generally accepted industry standards. The failed vacuum box tests were symptomatic of a breach in the tank hydraulic boundary at the test sites.

b. Underlying Cause of the Release
Results were investigated further by removing a patch plate which contained defective welds at the site of a failed VBT. Beneath the patch plate a gas test hole, which had been drilled through the tank shell by WGS, was discovered. The gas test hole was the entry point for air which had been pulled through defective patch plate seal welds during the VBT. At other sites which contained defective patch plate welds but where gas test holes were not present, VBT results indicated no leak. Thus the breach in the integrity of Tank 5 was gas test holes combined with defective seal welds. When Tank 5 was filled with fuel, the typical leak path was through defects in the seal weld, through the joint between a patch plate and the tank shell, and through the gas test hole. The underlying cause of the fuel release from Tank 5 was unrepaired gas test holes and defective fillet welds on patch plates which covered the gas test holes.

c. Contractor Contributory Factors
Vacuum box testing of each repair was required in the contract. Vacuum box testing is a method of leak testing by which the unrepaired gas test holes and defective fillet welds would quickly have been detected during construction. It was discovered WGS had not performed vacuum box testing on the Tank 5 repairs. Due to incoherent WGS QC program lines of authority, it is unclear who was responsible for neglecting to order performance of VBT. The failure of WGS to perform vacuum box leak testing was a contributory factor in the cause of the fuel release.

MT of each repair by an ASNT level II technician was required in the contract. MT is a method of testing by which cracks, surface, and slightly subsurface discontinuities of defective fillet welds would have been detected during construction. It was discovered that WGS had not submitted qualification records for technicians certified in the MT method. Further, magnetic particle testing was discovered to have not been performed on the Tank 5 repairs. Due to incoherent WGS QC program lines of authority, it is unclear who was responsible for neglecting to order performance of MT. The failure of WGS to perform magnetic particle weld testing was a contributory factor in the cause of the fuel release.

During execution of the contract, WGS was responsible for performing quality control of their work in accordance with requirements. However, during the Tank 5 warranty phase investigation, it became clear that competent QC had not taken place. Noncompliant work had not been stopped and plainly visible defective work had been approved by the WGS QCM. Crucial nondestructive testing did not take place. There is no evidence the QCM attempted to direct performance of the required testing, reported the omitted testing, or even realized the test methods were required. Furthermore, QC documents were provided to the Navy which stated welding, inspection, and nondestructive testing had been performed in compliance with the contract and industry standards. Numerous controls were disregarded even though they were stated in the WGS QC Plan, and would have prevented crucial failures. The derelict and ineffective quality control program of WGS was a contributory factor in the cause of the fuel release.

The WGS work plan included procedures for welding, welder qualification, and weld inspection. Properly qualified weld procedure specifications were provided by WGS (Attachment AG). A list of welder performance qualification records was received by the Navy (Attachment AX). Welder performance qualification records were received (Attachment AH). The records certified the qualification test welds had been prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code. The WGS API Std 653 inspector signed qualification records to certify the welders. However, poor quality on some of the completed welds inside Tank 5 casts doubt on whether the welder was, in fact, capable of producing acceptable welds in accordance with requirements of ASME IX.

Regardless of welder competence, industry standards and the WGS quality control manual describe acceptable quality for welding and weld inspection. The API Std 653 inspector was also certified by the American Welding Society as a weld inspector (Attachment AY). However, during the warranty investigation phase, defective welding on patch plate repairs was observed to be rampant in Tank 5. Even a modicum of care in welding and in the inspection of welds would have detected hundreds of defects. Incompetent welding and weld inspection by WGS was a contributory factor in the cause of the fuel release.

Nondestructive PT was reported to have been performed satisfactorily on Tank 5 repair welds. The API Std 653 inspector was also certified by the American Society for Nondestructive Testing as a Level II examiner

(Attachment AY) in six nondestructive methods. In addition, the API Std 653 inspector was also stated to be an ASNT Level III examiner in five nondestructive methods (Attachment AS). Competent nondestructive examination would have detected hundreds of weld defects. Thus if PT had in fact been performed, it was done in such an incompetent manner that egregious defects in welding went undetected. Incompetent liquid penetrant examination by WGS was a contributory factor in the cause of the fuel release.

The contract required post-repair inspection of the repairs by the API Std 653 Inspector. There is no evidence the post-repair API Std 653 inspection took place. Noncompliance with API Std 653 standards, defective welds, and unrepaired gas test holes were not detected during the post-repair inspection of Tank 5, if it in fact was performed. After repairs were completed and after the post-repair inspections should have taken place, the API Std 653 Inspector Tim D. Anderson (Certification No. 37258) then certified to the Navy that Tank 5 was suitable for service (Attachment AS). In fact, Tank 5 contained numerous unrepaired through-wall holes and numerous deficient seal welds installed by WGS. The failure of WGS to perform an API Std 653 inspection of repairs, and then to certify to the Government that Tank 5 was suitable for service was a contributory factor in the cause of the fuel release.

d. Government Contributory Factor

The Tank 5 inspection and repair contract was awarded by NFESC in Port Hueneme California. Until the Tank 5 release, NFESC maintained COR and QA roles. Oversight for the quality of submittals and field work was provided by the NFESC technical representatives (NTR) with support from the on-island NAVFAC component for safety matters. The NTR conducted QA both onsite and from Port Hueneme. COR oversight was performed from Port Hueneme, California.

The Navy requires Quality Assurance to be performed pursuant to a quality assurance surveillance plan in compliance with Defense Federal Acquisition Regulations Supplement (DFARS) Part 246 [4]. Acceptable levels of quality, roles and responsibilities, and basic surveillance techniques are contained in a typical QA plan. However, the QA plan for oversight on Tank 5 was not located. Basic oversight techniques such as witnessing tests, reviewing QC plans, and monitoring QC program output were performed in an ineffective manner. Instead, substantial reliance was made on the suitability for service determination produced by the WGS API Std 653 inspector. The Navy underestimated performance risk and was over-reliant on the API Std 653 inspector to determine whether the tank was fit for service.

Prior to the Tank 5 release, the frequency and thoroughness of contract and technical oversight was believed by the Navy to have been sufficient. During the Tank 5 incident review it became clear that Navy oversight had failed to address the WGS lack of compliance with requirements and P-445. The installation and unrepaired condition of the gas test holes had gone undetected by the NTR. The omission of vacuum box testing by WGS had not been discovered, and clearly defective work had been accepted by the NTR.

The model of attempting to manage complex construction from a remote location was incongruous with NAVFAC core attributes, particularly “Accountability” and “Initiative” [5]. Thus QA oversight of the WGS QC Program was lacking and the failure of NAVFAC to perform satisfactory QA oversight was a contributory factor in the cause of the fuel release.

9-2.1.5 Incident Reporting and Process

On 13 January 2014, during the filling process, operators detected a product level discrepancy and determined a release had taken place. The response was to simultaneously move fuel out of Tank 5 and notify local and federal agencies.

9-2.1.6 Design Errors and Omissions and Construction Warranty

The Navy determined the loss of product most likely resulted from a leak caused by defects in material or workmanship in the performance of the contract. Remedies pursuant to the Warranty of Construction Clause, FAR 52.246-21, were invoked by the Contracting Officer. On 4 February 2014 the Navy directed WGS to identify and correct deficiencies in Tank 5 (Attachment AJ).

9-3 SUMMARY OF CAUSATION

A summary of the underlying cause and contributory factors of the Tank 5 fuel release are provided in Table 9-1.

Table 9 - 1 Tank 5 Underlying Cause and Contributory Factors of Tank 5 Fuel Release

Underlying Cause
Unrepaired gas test holes
Defective fillet welds on patch plates which covered the gas test holes

Contributory Factors
Failure by WGS to report deficiencies in the Tank 5 repair work
Failure of WGS to perform vacuum box leak testing of repair work
Failure of WGS to perform magnetic particle weld testing of repair work
The derelict and ineffective quality control program of WGS
Incompetent welding and weld inspection by WGS of repair work
Incompetent liquid penetrant examination by WGS of repair work
Failure of WGS to perform an API Std 653 inspection of repairs and then to certify to the Government that Tank 5 was suitable for service
Failure of NAVFAC to perform satisfactory QA oversight

9-4 FILLING PROCEDURES

9-4.1 Tank 5 Filling Procedures, December 2013

a. Fuel Department Control Room will coordinate valve opening on empty tank with the Contractor/NAVFAC EXWC or HI/Fuel Department observer.
b. Contractor/Space and Naval Warfare Systems Command (SPAWAR) Rep/Fuel Department Control will validate valves have opened and fuel is moving into subject tank.
c. Equalize the level of tank 0105 with fuel from tank 0102.
d. Fuel Department Control will shut down operation in the event that personnel on site indicate valves, lines, or both are leaking.
e. Fuel Department Control will ensure initial flow is no more than 1,000 bbl per hour.
f. 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 3,000 bbl/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).

g. 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 no later than (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.

h. Tank filling will restart in morning at 0800 hours. Fuel Department will monitor and report on conditions every 2 hours.
i. When the fuel levels have equalized, close tank 0102. Fuel Department control operator will re-align valves to receive fuel from tank 0104.
j. Fill rate will be increased to 3000 bbl/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).
k. When the fuel levels have equalized, close tank 0104. Fuel Department control operator will re-align valves to receive fuel from Upper Tank Farm (UTF) Tank 53. From here on until completion, fuel will come from UTF Tank 53.
l. 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.
m. Upon completion, bottom samples and all level samples will be drawn for laboratory testing.
n. A log sheet will be kept to document all times, personnel on site and conditions as they occur.

9-4.2 Tank Filling Instruction, 09 May 2015

In response to the release at Tank 5, Navy implemented new procedures to return a storage tank to service following a maintenance and repair evolution (Attachment AZ). The overriding philosophy is to consider newly-returned-to-service tanks as suspect for potential releases. Essential elements of the new return to service procedure are below.

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

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

2. 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. 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.
    b. A completed inspection report compliant with the applicable code including all required calculations and analysis.
    c. 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.
    d. 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.
    e. A statement signed by an agent of the Execution Agent and repair contractor that custody of the tank is returned to the activity.

3. 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.

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

1. Work with the Site Director to ensure the Tank Maintenance Record is updated appropriately.
2. 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.

3. Work with the Site Director to ensure warranty issues with the tank are tracked and reported back to the Execution Agent.

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

1. Review and comply with all facility management return to service requirements obtaining concurrence for returning the tank to service from the NAVSUP FLC Regional Fuels Engineer.
2. 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.
3. 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:
   a. Tank filling procedures with appropriately defined incremental fill levels and hold times
   b. Physical inspection, gauging, and trend analysis as appropriate upon reaching each incremental fill level; and
   c. 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.
4. Receive NAVSUP FLC Commanding Officer approval, through the NAVSUP FLC Regional Fuels Officer, to execute the Operations Order and return the tank to service.

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.

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

1. 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.

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

Preparation and execution of the tank return to service process shall be reviewed and approved by the NAVSUP FLC Commanding Officer.

9-5 ADDITIONAL CHANGES TO BE IMPLEMENTED

During the Tank 5 investigation, it became apparent to the Navy the existing process to repair a Red Hill tank needed to be improved. As a result, numerous changes have already been or are in the process of being implemented:

a. The NAVSUP tank filling instruction and return to service instruction from 9 May 2015 (Attachment AZ) will be a part of future contracts.
b. Usage of gas test holes will be managed, tracked, and reported. All gas test holes will be repaired with weld metal.
c. Construction management and COR oversight of tank repair will be performed by the local on-island NAVFAC component.
d. Adherence to P-445 and UFGS Section 01 45 00 will be required.
e. A Red Hill tank repair criteria will standardize many procedures.

9-6 ADDITIONAL OBSERVATIONS

9-6.1 Inspection Discussion

During the inspection phase of the contract, WGS employed a subcontractor who had significant experience scanning shell plates on five Red Hill tanks since 2007. The subcontractor had developed technologies and equipment specifically suited for unique conditions at Red Hill. Results of the five previous tank shell scan examinations were satisfactory. Chapter 4 describes the same methods as were used on Tank 5.

Redundant methods were used to scan the tank shell plates and welds for anomalies and backside corrosion. Indications were then proved up with quantitative techniques. Methods included LFET, BFET, UT, longitudinal and shear wave inspection (SWUT), MT, and PT. The entirety of the tank was scanned or examined.

Methods were optimized to target surfaces of the tank with specific technologies. For example, LFET was chosen to screen shell plates to detect wall loss, pitting, and backside corrosion. This enabled technicians to efficiently screen large areas of steel with minimal surface preparation, utilizing capabilities of the LFET equipment to discriminate between front and backside indications. Several variations of LFET equipment were used, depending on the particular geometry. BFET was chosen to scan welds due to its ability to detect surface and subsurface cracking and pinholes. UT and SWUT were chosen to prove up and quantify indications identified with LFET and BFET. MT testing was performed by a third party inspector on the lower dome cover plate welds due to the geometry of the welds.

A qualified subcontractor with substantial experience scanning Red Hill tank shell plates was used during the inspection of Tank 5. Personnel were very experienced at Red Hill and also in the technologies which were deployed. The technologies and equipment had been specifically optimized to scan Red Hill tank shell plates. Redundant techniques were used to minimize human factors. The shell scanning on Tank 5 during the inspection phase was performed in a robust and reliable manner. It was conducted with proper equipment and mature technologies and carried out by trained and experienced technicians.

The shell scanning was followed up by a visual inspection and hammer testing by a certified API Std 653 inspector. The inspector reviewed the tank-scanning data and made recommendations regarding repair. The Navy concurred with the recommendations and repaired all relevant indications. The Tank 5 repair recommendations were conservative. Table 9-2 contains a summary of the Tank 5 inspection and repair metrics.

Table 9 - 2 Tank 5 Inspection and Repair Summary

Year	Tank	Shell Scanning Technologies	Number Flaws	Number Repairs	Percent Flaws Repaired
2010	5	LFET, BFET, UT, SWUT	1021	710	70

9-7 PREVIOUS TANKS INFORMATION AND OUTCOMES

9-7.1 Red Hill Tank 5 was scanned and examined with personnel, technologies, and equipment identical to those in the previous five inspections of other Red Hill tanks. However the repair criteria were applied in a more conservative approach on Tank 5. The WGS Tank 5 engineer classified repair recommendations into criteria based on service life calculations. The classifications were mandatory (repairs required before returning tank to service), short term (flaws which are mandatory in less than 10 years), and long term (flaws which are mandatory in less than 20 years). Some flaws were later determined to have been misclassified, included in service life calculations, and recommended for repair. This misclassification resulted in a greater number of repairs. Thus the Navy award of repairs in all classifications (including flaws which had been misclassified) resulted in a more conservative repair approach to Tank 5 than had taken place in the previous five inspections.

The repairs which were performed on the five previous tanks were fewer but qualitatively similar to those performed on Tank 5. The same subcontractor and subcontractor technicians performed shell plate scanning on all six inspections. Table 9-3 contains a summary of the most recent six Red Hill tank inspection and repair metrics.

Table 9 – 3 Red Hill Inspection and Repair Summary

Year	Tank	Shell Scanning Technologies	Number Flaws	Number Repairs	Percent Flaws Repaired
2007	6	LFET, BFET, UT, SWUT	684	476	70
2007	15	LFET, BFET, UT, SWUT, VBT	198	109	55
2007	16	LFET, BFET, UT, SWUT	509	254	50
2008	2	LFET, BFET, UT, SWUT	172	42	24
2008	20	LFET, BFET, UT, SWUT	518	108	21
2010	5	LFET, BFET, UT, SWUT	1021	710	70

Since 2007, six Red Hill tanks have been inspected using very similar means and methods, and identical methodologies, technologies, and personnel. Of the six, only Tank 5 experienced failures which resulted in a fuel release.

The underlying cause and contributory factors of the release from Tank 5 are given in Table 9-1. They all took place during the repair phase of the contract and were unrelated to the tank scanning and inspection which was conducted. They demonstrate human failures, vulnerabilities exposed by reliance on contractor quality control, and the detrimental effects of an over-concentration of contractor authority.

Corrosion was not the underlying cause or a contributory factor to the release. The tank inspection methodology was not the underlying cause or a contributory factor to the release. The means, methods, and technologies utilized to inspect Tank 5 were unrelated to the release. In fact, the inspection produced solid tank scanning results consistent with the previous five inspections. The Tank 5 inspection technologies, equipment, and process were the same, albeit more mature, as those provided during previous inspections.

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CHAPTER 10 - LESSON #1 CONTRACTING

10-1 INTRODUCTION

This Chapter provides background information on the types of Contracts that have been used previously and currently for POL tank inspections and repairs and the processes to award these contracts.

10-2 SUMMARY OF ACQUISITION REGULATIONS

10-2.1 Federal Acquisition Regulations

10-2.1.1 The Federal Acquisition Regulations System is established for the codification and publication of uniform policies and procedures for acquisition by all executive agencies. The Federal Acquisition Regulations System consists of the FAR, which is the primary document, and agency acquisition regulations that implement or supplement the FAR.

10-2.2 Defense Federal Acquisition Regulations

10-2.2.1 The Defense Acquisition Regulations System (DARS) develops and maintains acquisition rules and guidance to facilitate the acquisition workforce as they acquire the goods and services DoD requires to ensure America's warfighters continued worldwide success.

10-2.2.2 The DFAR supplements the FAR regarding specific Defense requirements. The DFAR provides additional restrictions for the type of contracts that can be used, and the qualifications of the Defense Acquisition Community.

10-2.3 Department of Defense Supplements

10-2.3.1 Each Department of Defense has developed Supplements to the DFAR. These are: Army, Air Force, Defense Information Systems Agency (DISA), DLA, Navy-Marine Corps, US Special Operations, and US Transportation Command.

10-2.4 Navy Marine Corps Acquisition Regulation Supplement (NMCARS)

10-2.4.1 NMCARS establishes uniform Department of the Navy (DoN) policies and procedures implementing and supplementing the FAR and the Defense FAR Supplement (DFARS).

10-2.5 Naval Facilities Acquisition Standards

10-2.5.1 The NAVFAC Acquisition Standards (NFAS) provides general guidance to field Contracting Officers in the execution of their delegated authority. It implements or supplements the FAR, the DFARS, and NMCARS. It is not a stand-alone document, but must be read together with the FAR, DFARS, and NMCARS. In addition to NFAS, the NAVFAC Business Management System (BMS) provides standardized business processes and common practices to support the most efficient accomplishment of NAVFAC products and services.

10-2.6 Non-Defense Acquisition Regulations

10-2.6.1 Similar to the Department of Defense Acquisition Regulations, each Federal Agency also has its specific requirements. Examples are: Department of Labor, Department of Commerce, Department of Energy, Department of the Interior, Department of State, Department of the Treasury, and the Environmental Protection Agency.

10-3 CONTRACTING FOR TANKS PRIOR TO TANK 5

10-3.1 The following is a list of the contracts for the five tanks in the order they were worked prior to Tank 5. Attachments I through P are the contract documents.

Tank #	Contractor/ Subcontractor	Year	Execution Agent	Attach-ment #	Contract #
15	Weston Solutions (TesTex) – inspect	2006	AFCEE	I	FA8903-04-D-8681, Task Order 0176
15	Thermal Engineering (Jurva Leak Testing, TesTex) Dunkin & Bush – clean and repair	2006	PACNAVFAC	BA	N62742-03-C-1402
16	Weston Solutions (TesTex) – inspect	2006	AFCEE	I	FA8903-04-D-8681 Task Order 0176
16	Dunkin & Bush) – clean and repair	2006	PACNAVFAC	BA	N62742-03-C-1402
6	Weston Solutions (TesTex) – inspect	2006	AFCEE	I	FA8903-04-D-8681, Task Order 0176
6	Dunkin & Bush – clean and repair	2007	PACNAVFAC	BA	N62742-03-C-1402
2	Shaw (TesTex/BIG, EEI, E&IHI, Dunkin & Bush)	2008	NAVFAC EXWC	M	N47408-04-D-8503, Task Order 0031

20	Shaw (TesTex/BIG, E&IHI, Dunkin & Bush)	2008/9	NAVFAC EXWC	M, P	N47408-04-D-8503, Task Order 0031 & N62583-09-D-0039, Task Order 0005
5	Willbros Government Services (TesTex/BIG)	2011/4	NAVFAC EXWC	P	N62583-09-D-0132 Task Order 0003

10-3.2 Types of Contract

The following describes the types of Contracts that have been used for the Clean, Inspect, and Repair of the tanks at Red Hill Tank Farm Fuel Storage Facility.

10-3.2.1 Multiple Award Indefinite-Delivery/Indefinite-Quantity Construction Contract

a. The following are features of an indefinite-delivery/indefinite-quantity type contract (IDIQ)
   - Indefinite-quantity contracts provide for an indefinite quantity, within stated limits, of supplies or services during a fixed period.
   - An indefinite-quantity contract may also be combined with firm-fixed-price.
   - Indefinite-quantity contracts and requirements contracts permit flexibility in both quantities and delivery scheduling and allow ordering after requirements materialize.

b. Multiple Award Construction Contract (MACC)
   A MACC refers to an award that is made to multiple contractors from the same full and open solicitation. The award is based on selection factors such as their organization and personnel capabilities in performing POL projects, safety, and past performance. Once the Contractors are selected, then “Request for Proposals (RFP)” for individual task orders are issued to the Contractors. The Contractors then provide a technical and price proposal based solely on the specific requirements in the RFP. The Government reviews the technical proposal and rates and ranks their approach. A separate team evaluates the price proposals. Most of the awards are based on “Best Value” in which the technical and price proposals are weighed against each other, and the award is made to the Contractor that provides the best value to the Government to execute the individual project.

c. The Air Force Center for Environmental Excellence (AFCEE) contract, FA8903-04-D-8681, Task Order 0176 was a multiple award IDIQ-type contract. The Contractor, Weston Solutions, Inc. was selected by the Government to perform this specific task order.

d. The NAVFAC EXWC contracts N47408-04-D-8503, Task Order 0031and N62583-09-D-0039, Task Order 0005 were also multiple award IDIQ-type contracts. The second contract was considered as a “bridge” contract that enabled NAVFAC EXWC to continue working on the project, after the first contract had reached its overall allowable obligation (dollar amount) ceiling. These contracts were classified as “services” rather than construction. When they were developed in 2008, NAVFAC EXWC was primarily inspecting, testing, repairing POL facilities, such as truck fill stands, pipelines, pumphouses, etc., not tanks. These projects were small in dollar value (less than $500k), and did not involve major construction trades. The Services type contracts only required a Scope of Work, and a deliverable schedule. This type contract required the Contractor to develop a “Work Plan” rather than a design with plans and specifications.

e. The NAVFAC EXWC contract N62583-09-D-0132 Task Order 0003 was also a multiple award, IDIQ-type contract. It was very similar to the Shaw contract explained above. This is one of the replacement contracts to the multiple award contracts which Shaw was under contract for Tanks 2 and 20 as discussed above. This was also a “Services” type contract in which only a Work Plan was required, not a design with Plans and Specifications.

10-3.2.2 Construction Contract, Firm-Fixed Price.

a. The following are features of a firm-fixed price Contract:
   - It is used with sealed bidding or negotiated procurements.
   - It is used when adequate price competition is probable.
   - Multiple awards may be made.
   - Price is not subject to adjustment regardless of contract performance.
   - Contractor assumes all risk for costs and resulting profit or loss.
   - It provides maximum incentive for the Contractor to control costs and perform effectively.
   - It entails a minimum administrative burden.
   - It is preferred over other contract types since the Contractor assumes all risk.

b. The PACNAVFAC contract, N62742-03-C-1402, was a stand-alone firm-fixed price construction contract. It was a sealed bid, using full and open competition.

10-3.3 Process to Award

10-3.3.1 The process to award a multiple-award task-order construction contract is very long and has multiple teams working in unison to reach the overall objective. FAR 7.102 states that acquisition planning is required for every acquisition regardless of the dollar value. Increasingly greater detail and formality in documentation of the acquisition strategy for managing an acquisition is required as the acquisition becomes more complex and costly. DFARS 207.103 and NFAS 7.103 prescribe the criteria and thresholds for written Acquisition Plans. The acquisition for a IDIQ MACC contract for fuel facilities projects is both complex and costly.

10-3.3.2 Steps for planning for an acquisition include the following:

a. Determination of need: The Construction Agent (CA), NAVFAC, in this instance, needs to confirm with the Executing Agent (EA), DLA in this instance, that there is a need for a MACC Contract. The CA and EA develop a projection of the number, type of construction, and locations where these contracts will be executed. This projection determines the overall ceiling (amount that can be obligated on the overall MACC, the types of facilities that can be constructed, maintained, and repaired, and the locations where the work can take place.
   - Ceiling: The ceiling has to be reasonable and justifiable. The higher the ceiling, the more justifications and the more approvals are required. This effort equates to time and program development costs.
   - Types of Facilities: The POL MACC contract that has been used at Red Hill was developed for “Fueling systems and related facilities.” Therefore it can only be used for the facilities listed in the UFC 3-460-01, and support facilities such as piers, fuel laboratories, etc. The POL MACC contract cannot be used for construction of hangers, office buildings, runways, munitions bunkers, etc.
   - Location: The Navy’s fuel systems are located worldwide. However, if there is a need to limit the POL MACC contract to just one area (for instance, Red Hill), the contract would only be allowed to be used in that area. If another fuel system requires repair (for instance, Pacific Missile Range Facility Barking Sands), the Red Hill POL MACC contract could not be used.

b. Preparation of an Acquisition Development Plan. The purpose of acquisition planning is to ensure that the Government meets its needs in the most effective, economical and timely manner. Acquisition planning includes developing and documenting the overall strategy for managing the acquisition.

c. Preparation of a written Acquisition Plan: NMCARS 5207.103, subparagraph (d)(i) allows the content requirements prescribed in FAR 7.105 and DFARS 207.105 to be tailored for written acquisition plans in the following categories: Military construction, commercial items, overhaul and/or modification of naval vessels, small vessels and crafts, overhaul and/or modification of engines, operation and maintenance of weapon test/training ranges, ocean towage, commercial activities, architect-engineer, and major station maintenance and repair. The Acquisition Planning Team:

- Prepares the written Acquisition Plan using the format prescribed by FAR 7.105, DFARS 207.105, and NFAS 7.105, as applicable. Note: For all acquisitions with an estimated value of $100M or more (including options), the Acquisition Plan requires approval by Deputy Assistant Secretary of the Navy (Acquisition and Procurement) (DASN (AP)) and shall be prepared using the format in the Department of the Navy Acquisition Plan Guide. This Guide also provides guidance for the preparation of Acquisition Plans with an estimated value of <$100M.
- Ensures the following is included in the Acquisition Plan as required by FAR 7.105:
  - Milestones at which decisions should be made.
  - All technical, business, management, and other significant considerations controlling the acquisition.

10-3.3.3 Source Selection Procurement Activities. The list of steps required to procure the IDIQ MACC Contracts are:

a. Prepare Plan of Action and Milestones (POA&M): The original schedule is based on previous procurements of this type. However, the POA&M is updated/revised as appropriate throughout the solicitation process. The schedule can change due to more or less actionable items that occur during each of the steps listed below.

b. Determine Best Value Continuum Approach: The Acquisition team will select either the Tradeoff process or the Lowest Price Technically Acceptable (LPTA) process as the best value continuum approach for the acquisition. (Refer to FAR 15.101-1 and FAR 15.101-2. [1]) The team is to obtain approval of the proposed Source Selection Plan (SSP) by the Assistant Commander for Acquisition via the appropriate ACQ Division Director if a determination is made that non-cost price factors are more important than price in the Tradeoff process. (Refer to NFAS 15.304, subparagraph (a). [1])

c. Select the Source Selection Boards: Ensure all participants in the source selection process, referred to as the Source Selection Team (SST), including architects, engineers, CORs, Alternate Contracting Officer's Representatives (ACORs), etc., meet the qualifications, training, and licensing (ie: Professional Engineering (PE) License for engineers) requirements before their appointments to a board. (Refer to NAVFACINST 3540.1C, NFAS 1.602-2, and NFAS 15.303, subparagraphs (d)(1) and (2). [1]) The following boards and board members are to be identified at this time of the procurement action: Source Selection Authority, Source Selection Advisory Council, Source Selection Evaluation Board, and the Price Evaluation Team. Advisors, such as legal and safety are also identified. The board members are notified via a Source Selection Appointment letter which also requires the member to sign a non-disclosure agreement at the start of the source selection process.

d. Develop Evaluation Factors and Significant Subfactors. Evaluation factors and significant subfactors serve multiple purposes. They focus on and emphasize the important aspects of the Government's requirements and their relative importance to one another, and they communicate this emphasis to potential offerors. The factors and subfactors complement the performance work statement and statement of work by representing the key areas that will be used in the Source Selection Decision.

e. Develop SSP. The SSP includes the evaluation factors and significant sub factors, and the relative order of importance; adjectival ratings and their definitions; Basis of evaluation; statement that technical factors shall be equal to past performance and proposal submission requirements. The SSP is approved by approving officials in accordance with NFAS 15.303, subparagraph (e).

f. Synopsize the Requirement.

g. Prepare the Solicitation. The Solicitation is prepared using the appropriate format (e.g., Uniform Contract Format (UCF) or Construction Specification Institute (CSI) format). (Refer to FAR 15.204, FAR 15.205, NFAS 36.202, NFAS 37.1000, and NFAS 37.3100. [1]). The following is included in the solicitation:

- The appropriate form for the solicitation, offer, and award (SF 1442)

- Contract line item structure.
- Government requirements. For any elements included in the solicitation that are also included in the SSP (e.g., evaluation factors and significant subfactors, and relative order of importance, etc.), the solicitation language must be verbatim from the language in the SSP.
- Best value continuum approach selected.
- Proposal due date.
- Details of scheduled site visit(s).
- Requirement to submit a Small Business Subcontracting Plan (SBSP) pursuant to the criteria found in FAR 19.702.
- Requirement for offeror to submit bonds or other securities.
- For construction, Liquidated Damages (LDs).
- Buy American requirements. (Refer to FAR Part 25. [1])
- Requirement for the offeror to provide representations and certifications electronically.
- For IDIQ contracts, include use of undefinitized (unpriced) task orders as an ordering method only when the contract authorizes this method. (Refer to NFAS 16.505, subparagraph (d). [1])
- Applicable wage determination(s).

After the preparation of the Solicitation, a legal review is required per NFAS 1.602-1-100. In addition, a pre-solicitation Peer Review is obtained for solicitations and contracts with estimated values at $50M or more (including options) and document disposition of recommendations. (Refer to NFAS 1.170 and NMCARS 5201.170. [1] [2])

h. Issue Solicitation and respond to pre-proposal inquires to the solicitation. The technical representatives and other personnel involved in the solicitation will be involved in developing the response to the inquiries. If the response does not require a change to the solicitation, the inquiry may be responded to directly. If the response requires the solicitation to be changed, an amendment will be issued. A record of all inquiries will be maintained.
i. Conduct Pre-proposal conference.
j. Conduct Site Visit. Coordination with the technical office or site manager if a site visit will be made. All site visitors are recorded in the Site Visit Log.
k. Issue Amendments as determined during the inquiries, pre-proposal conference and/or site visit.

l. Verify Timely Receipt of Proposals, Proposal Modifications, or Proposal Revisions and Review Representations and Certifications. The proposals are safeguarded from unauthorized disclosure throughout the source selection process. As required by FAR 15.207 (Refer to FAR 3.104. [1]) In addition, all proposals are identified by the date and time received at the place specified in the solicitation.
m. Prepare Proposals for Evaluation. A process and controls for communication with industry, as well as internal Government team communication, to include the use of e-mail, during the source selection will be established.
n. Brief Board Members and Obtain Non-Disclosure Statements.
o. Distribute Proposals. Distribute non-cost/price proposals and all past performance information retrieved to the Source Selection Evaluation Board (SSEB). Distribute price proposals to the Price Evaluator or Price Evaluation Team (PET) when conducting price analysis. Distribute Small Business Utilization evaluation information to the Command Office of Small Business Programs (OSBP) Small Business Deputy. Note that the SSEB does not receive the Price Proposals, nor does the Price Evaluation Board receive the non-cost/price proposals when performing a Best Value Analysis.
p. Conduct Evaluation of Non-Cost/Price Factors. Note that all technical proposals are to be evaluated by the SSEB, no matter how many are received.
q. Document Findings of Non-Cost/Price Factors. The evaluation of the non-cost/price factors in accordance with the procedures outlined in the SSP under the SSEB and Source Selection Advisory Council (SSAC) is documented. All factors and subfactors are rated in accordance with the SSP for all proposals. The ratings are not compared to each proposal, but to the SSP itself.
r. Conduct and Document Informal Contractor Responsibility Determination. An informal responsibility determination of all prime offerors and team subcontractors in range for award is conducted to ensure no Contractor who is listed in the System for Award Management is included in the competitive range.
s. Conduct Price Evaluations: Conduct price evaluation in accordance with the procedures outlined in the Source Selection Plan under the Price Evaluator or Price Evaluation Team. (Refer to NFAS 15.303, subparagraphs (b) and (c) respectively. [1])

t. Document Cost or Price Evaluation Findings and Forward to the Source Selection Evaluation Board Chairperson. The documentation is to be per the Source Selection Plan.
u. Brief the Source Selection Advisory Council on the non-cost/price factors and the price analysis results.
v. Conduct Comparative (Tradeoff) Analysis. The SSEB prepares a comparative-analysis matrix to illustrate analysis of the proposals. The SSEB then makes a best-value award recommendation to the Source Selection Authority (SSA).
w. Brief Source Selection Authority. The SSAC prepares documentation in accordance with the Source Selection Plan and then obtains Legal Counsel's review. The review evaluations the documentation for completeness and compliance with the solicitation.
x. Determine and Document Source Selection Authority Decision. The SSA prepares a Source Selection Decision Document in accordance with the Source Selection Plan.
y. Prepare Pre-Business Clearance Memorandum. The Business Clearance memo provides the background of the actions to date and provides the reasoning and justifications for the recommendations of the competitive range of offerors.
z. Conduct Preaward Notification to Unsuccessful Offerors. This notification is to be in writing. The letter must state the basis for the determination and that a proposal revision will not be considered.
aa. Conduct Preaward Debriefings. An unsuccessful offeror may request a preaward debriefing by submitting a timely written request. The debriefing is held as soon as possible, but not later than the time at which post-award debriefings are held.
bb. Conduct Discussions. The Contracting Officer is to prepare discussion questions, obtain legal counsel review, notify each offeror that discussions have commenced, issue any amendments to the solicitation, and hold negotiations with each offeror.
cc. Request Final Proposal Revisions. The offerors are provided the opportunity to revise their proposals based on the discussions held.
dd. Evaluate Final Proposal Revisions. The revised proposals are provided to the SSEB for evaluation. The Source Selection process is repeated as necessary.
ee. Conduct and Determine Final Contractor Responsibility Determination of Potential Awardee(s). The Contracting Officer prepares documentation for final-contractor-responsibility determination of potential awardee(s) for the contract file.

ff. Prepare Post-Business Clearance Memorandum. The Contracting Officer prepares the documentation that provides all actions of all of the processes taken to date.

gg. Approve Small Business Subcontracting Plan (SBSP). The Contracting Officer and the Small Business Specialist review the SBSP and obtain concurrence from the Small Business Administration.

hh. Obtain Preaward Compliances. The Contracting Officer obtains clearances from the Preaward Peer Review, Preaward Equal Employment Opportunity, and the Chief of Naval Information Office (CHINFO) Notification.

ii. Obtain Funding. Funds are to be available in advance of appropriations.

jj. Appoint Post award Government Representatives. Prior to contract award, appropriate Government Representatives are appointed in writing (i.e., COARs, CORs, ACORs, and Departmental Accountable Officials (DAOs)). (Refer to NFAS 1.602-2. [1])

kk. Prepare and Distribute Award Documents and Prepare Post-Award Synopsis. The Contracting Officer ensures that no award is made to a Contractor with an active or inactive exclusion. The Contracting Officer (KO) then prepares and distributes the basic contract documents and prepares a post-award synopsis.

ll. Conduct Post-Award Debriefings. The Contracting Officer will conduct post-award debriefings as requested by the offerors.

10-3.4 Observations for Tanks 2, 6, 15, 16, and 20:

a. Of the five tanks worked prior to Tank 5, Tanks 1 (clean only), 15, 6, and 16, had tank-specific plans and specifications prepared for cleaning and repair.

b. The plans and specifications for Tank 15 were detailed in describing the specific features of the tank and somewhat prescriptive in nature. For example, the maximum allowable temperature and pressure of the wash water for cleaning the coated tank shell were specified.

c. The first three tanks (6, 15, and 16) were inspected under a task order to an AFCEE Petroleum Oil and Lubricant Multiple Award Contract (POLMAC) Contractor, and cleaned and repaired under a PACNAVFAC firm-fixed price, open competition contract.

d. Work under the two contracts overlapped since the firm-fixed-price Contractor first cleaned the tank, then supported the IDIQ Contractor's inspection work in the tank, and finally repaired the tank based on the findings of the inspection.

e. Tanks 2, 6, 15, 16, and 20 were cleaned and repaired by the same Contractor, Dunkin & Bush: three tanks as the prime Contractor and two as a subcontractor.

10-3.5 Inclusion of Available Contracts in Report Appendix

- Refer to paragraph 10-3.1.

10-4 CONTRACTING FOR TANK 5

10-4.1 The Contract that was awarded for the Clean, Inspect, Repair Tank 5 is an IDIQ MACC. There were five (5) Contractors that were awarded a contract using the process described in paragraph 10-3.3 above. Task orders awarded on this contract were competitively bid using a Best Value selection process as described in paragraph 10-6.1 below.

10-4.2 The procurement process for the five IDIQ MACC Contractors as described in paragraph 10-3.3 above was initiated in February 2008, and the contracts were awarded in July 2009.

10-4.3 The procurement process for the task order that was awarded to WGS for the Clean, Inspect and Repair Storage Tanks 5 and 17 was initiated around June 2009 and was awarded on 13 January 2010. The procurement process is described in paragraph 10-6 below.

10-4.4 General overview of the type of contract that was used for Tank 5 is as follows:

a. The IDIQ MACC contract was developed after several other types of contracts had been used to inspect fuel systems since 1992.
b. The first type of contract to inspect fuel systems was awarded in 1992. This was an A-E contract to inspect pipelines and fuel systems (not tanks). Following the guidelines from the Brooks Act, inspection is considered an A-E service. An extension to the inspection, repair of the facility that was caused by the inspection (destructive testing), can also be considered to be an A-E function, for example, construction required to cut out a stuck pig from a pipeline.
c. Following several inspections, including pressure tests, NAVFAC determined that a different method to inspect and then repair these fuel systems was required. In the 1990s, NAVFAC's policy was to develop plans and specifications using an A-E, and then solicit the work using full and open competition. This template was used on several pipeline

projects (make pipeline piggable and then pig the pipeline), all of them resulted in multiple change orders, and one was terminated for convenience. The cause of many of the issues was due to “differing site conditions” (as defined in FAR 48 CFR 51.236-2 [1]).

d. The next type of contract used was a single cost-plus-services contract, which was awarded using full and open competition. This contract was easy to administer since “differing site conditions” were able to be resolved immediately. However, full time Government presence was required to confirm costs incurred (personnel, equipment, and material), and the final audit of the contract took an extraordinary amount of time and effort. The main issue with this contract was that it was a sole-source contract once it was awarded, and there was no competition to keep the prices and quality of construction in check.

e. In 2008, NAVFAC decided to develop a different type of contract: a firm-fixed-price, multiple-award, task-order contract. This was also deemed to be a services type contract. The Unified Facilities Guide Specifications for Fuel Systems (all specifications with titles starting with “UFGS 33 52”) were being updated and were starting to be extensively used on all sustainment, repair, modernization (SRM) projects in addition to Congress-approved MILCON projects. Anticipating issues similar to the previous problems in developing plans and specifications for a Construction contract, the contract only referenced these specifications, which the Contractor was to use during the execution of the project.

f. The SOW for the non-tank projects for task orders on this contract required the Contractor to develop a “Work Plan”. The Work Plan was to include the following items:
   1. Scope of Work & Procedures
   2. Detailed Work Schedule
   3. Subcontracts
   4. Responsibilities of all parties
   5. Required permitting
   6. Accident Prevention Plan (APP) including Activity Hazard Analysis
   7. Hazardous Material Control
   8. Environmental Protection Plan
   9. Submission of Storm Water Pollution Prevention Plan (SWPPP) if required
   10. Discussion of disposal of contaminated soil or other materials
   11. Materials and Workmanship
   12. Quality Control and Testing/Reporting
   13. Transportation of Material and Equipment

14. Mobilization and Demobilization
15. Submittals required by the subcontractor(s)

The information developed by the Contractor by following this list is basically the same submittals required to develop plans and specifications, and the submittals resulting from them. Since this was a Services-type contract, the Statement of Work could not require submittals of plans and specifications.

g. *This is the type of Contract that was used for the Clean, Inspect, Repair of Tank 5. See paragraph 10-6 for the process that was used to award this task order.*
h. The task order for the Clean, Inspect, Repair of Tank 5 was one of the first task orders awarded on this new Contract. Tank 5 was the first Red Hill tank that WGS was awarded to clean, inspect, and repair.
i. It is typical for the Prime Contractor to subcontract the tank inspection work and perform the repair work, as was done by WGS. The Prime Contractor is responsible for all work performed under the Contract.

10-4.5 The statement of work for the Tank 5 project is included in Attachment BB.

10-5 BACKGROUND TO DEVELOP STATEMENT OF WORK

10-5.1 In 1992, the Statement of Work for the A-E to inspect a fuel system consisted of about five (5) pages that stated the location of the work and what needed to be done. The tasks ranged from performing a site visit to inspection of a pipeline using smart pigs.

10-5.2 The Statement of Work for the Cost-Plus Fixed Fee Contract and the first IDIQ MACC was a Statement of Work of about 20 pages. The following list is an outline of the standardized SOW for non-tank projects.

a. List of Tasks
b. References: Safety, UFC, ASME, CFR, NACE, NFPA, and UFGSs
c. Engineering Services:
    1. Work Plan
    2. Health and Safety Plan
    3. Submittal Register
    4. Certification Report
d. On-Site Services:
    1. Permits
    2. Implementation

   3. Materials, Workmanship, Quality Control and Testing
   4. Daily Reports
   5. Restrictions

e. Meetings
   1. General
   2. Site Visit
   3. Pre-Construction
   4. Progress Meetings

f. Government Points of Contact

g. Deliverables and Schedule

h. Bid Proposal Requirements

10-5.3 The Statement of Work for the Tank Clean, Inspect, Repair projects was developed concurrently with the award of the IDIQ MACC contract that was awarded in 2008. Several of the engineers at NAVFAC have obtained API Std 653 and STI SP001 certifications and it was normal for the engineers to be on-site full time during inspections and repairs of tanks. These engineers developed a standard SOW based on their experience and API Std 653 knowledge. This Statement of Work expanded the previously used IDIQ MACC contract from 20 pages to 55 pages. This SOW included not only the inspection requirements for API Std 653 tanks, but also STI tanks and cut-and-cover tanks. The U.S. Government owns and maintains numerous cut-and-cover tanks throughout the world, unlike the industry, so no industry standard exists for these types of inspections. In addition to inspection requirements of the tanks, per API Std 653, the SOW included the inspection of all components outside of the tank including piping, containment, drainage, and control systems. Frequently, the SOW was reviewed and revised based on lessons learned. In particular, the inspection of the piping inside of pump houses on top of cut-and-cover tanks was added.

10-6 PROCESS TO AWARD

The following is a list of the procedures to award a task order on the IDIQ MACC contract. Note that these steps are sequential to each other.

a. Obtain a need statement from the Customer.

b. Develop Statement of Work. The SOW was based on several years of development that provided the tasks that are to be performed, General Requirements, a list of UFGS specifications that are to be followed, and submittal requirements (Attachment BC).

c. Develop Independent Government Cost Estimate (IGCE). There is no RS Means catalog listing for cleaning, inspecting, and repairing fuel storage tanks, but NAVFAC EXWC has been executing this type of project for over ten (10) years, so there is past data that are used in developing the IGCE. The IGCE includes labor, travel, and other direct costs (ODC) for the Prime Contractor and labor, travel, ODC, material, and equipment for the subcontractor. Also included are General and Administrative (G&A) rates, fringe, overhead, profit, and performance bond costs for the prime and subcontractor(s). The Government also develops a schedule for the Statement of Work, in which the labor hours are estimated.
d. Develop Basis of IGCE. This document provides the schedule and the basis of assumptions made during the development of the IGCE.
e. Develop Task Order Evaluation Plan (TOEP). The intent of the evaluation plan is to define the source selection criteria for the evaluations of the proposals. The evaluation factors are Technical Approach, Past Performance, and Price. The TOEP defines the Adjectival Ratings for the Technical Approach and provides a list of information that the Government will be evaluating in the technical approach such as schedule, personnel, quality control, and overall approach in executing the scope. In addition, the TOEP states the information that the Contractor should submit in order for NAVFAC to evaluate the Contractor's past performance and price. The TOEP provides the Basis of Evaluation for each of the evaluation factors, and finally states if the award will be based on Best Value, or LPTA. If it is Best Value, it will state which factors are more important than the others and why.
f. Obtain Work Classification Determination. NAVFAC has developed a formalized process for the acceptance of funding documents by NAVFAC Comptrollers for projects exceeding $750K and define the project development and review requirements necessary to ensure compliance with the Antideficiency Act (ADA). This process requires a Subject Matter Expert to review and certify the project documentation for compliance with the ADA. The project engineer is required to develop a description of each task within the statement of work with its associated cost, so the SME can determine if the task is maintenance, repair, or construction. If the construction costs exceed $750K, then the project cannot be executed without reprogramming as a MILCON, which is a five (5)-year program. The Work Classification determination is required before funds can be requested.
g. The next step is to obtain the funding for the project. The funds for the DLA Capitalized facilities are provided by DLA. DLA has its "Enterprise

Business System" that ensures that funds provided are attached to a single real-property record and that all work is required for the real property.

h. Following receipt of funding, the project engineer submits a request to Acquisition that the latter send out the RFP. The request to Acquisition contains the SOW, IGCE, SME certification, and the TOEP.

i Acquisition then confirms that the SOW submitted is in scope to the overall IDIQ contract (i.e., the SOW is not for construction of a hangar if it is to be placed on the IDIQ MACC contract that was awarded for fuel-facilities work). Acquisition then prepares the RFP package and submits it to the Contractors.

j. The Contractors prepare their proposal. During this phase, there may be a site visit. The Contractors may also submit clarification questions, in which the technical and acquisition team researches. All questions and responses are sent to all Contractors.

k. The Contractors submit their proposal to the Contracting Officer in two sections; the first section contains the technical approach and past performance, and the second section contains the price. The Contracting Officer sends the first section to the technical team for their review and preparation of the technical evaluation. After the Contracting Officer reviews the technical evaluation, the Contracting Officer sends the second section to the technical team. The technical team reviews the price proposal, prepares their technical and price evaluation, and sends it to the Contracting Officer.

l. The Contracting Officer reviews the technical team's recommendation and prepares their business-clearance memo.

m. The Project Engineer requests the Financial Management Team to provide the required funding to Acquisition.

n. Upon receipt of funding, Acquisition prepares the task order to the selected Contractor.

10-7 FUNDING AND WORK CLASSIFICATION

10-7.1 As discussed in paragraph 10-6.f above, a Work Classification for each tank repair is to be performed prior to accepting funding for a project. Work Classification is as follows:

- Maintenance
- Repair
- Construction

10-7.2 Maintenance consists of tasks to maintain the facility. Typical maintenance tasks associated with Clean, Inspect, Repair tank projects are:
a. Clean
b. Re-paint (remove corrosion)
c. Inspect
d. Pressure wash
e. Apply chine sealant

10-7.3 Repair consists of tasks to replace components that have failed. Typical repair tasks associated with Clean, Inspect, Repair tank projects are:
a. Remove threaded plugs in nozzle
b. Replace rusted uni-strut and conduit
c. Repair tank-containment concrete
d. Replace rusted handle on valve
e. Rebuild valve
f. Install patch plates

10-7.4 Construction consists of tasks to install new components. Typical construction tasks associated with Clean, Inspect, Repair tank projects are:
a. Install new stilling wells
b. Extend the receipt diffuser piping 20 feet into tank
c. Install new scaffold supports
d. Provide a new Tank ID bracket and sign

10-7.5 Even though Construction tasks are minimal, this review must be performed for all task orders and all modifications to task orders.

10-8 OBSERVATIONS AND SHORTCOMINGS OF CONTRACTING FOR TANK 5

10-8.1 Lesson Learned: The contract must be more specific to explain expectations. As a lesson learned, the Navy and DLA are changing their process to require drawings and procedures. More on this topic will be explained in Chapter 16: Quality Control and Assurance of TIRM and Chapter 17: Options for Improving Current TIRM.

10-9 CONTRACTING SOLUTION OR IMPROVEMENT

10-9.1 In 2015, NAVFAC awarded an IDIQ MACC design-build contract for POL Construction work. NAVFAC has recently developed the 6-part format, which includes the Division 1 specifications (refer to the UFGS list in www.WBDG.com [3]), Scope of Work, and Performance Specifications listed in Divisions 2 through 48.

10-9.2 The Navy and DLA are developing new UFGSs for Tank Inspection and for Tank Repair. There is already one for Tank Cleaning. See Chapter 16 for more information on these specifications.

10-10 SOLUTION OR IMPROVEMENT RATIONALE DISCUSSION

a. The process to award multiple-award task-order firm-fixed-price contracts is very time- and resource-consuming. It is in the Government's best interest to prepare the contract in such a manner as to (1) ensure that the Statement of Work allows the predicted type and location of work to be performed using the contract, (2) only qualified Contractors will be selected, and (3) the cost per task order will be fair and reasonable. In addition, the contract must be able to include performance and prescriptive criteria, general conditions, and quality of work.

b. The GPOL MACC that was awarded in February 2015 requires the RFP for each task order to be in a 6-part design-build format. The parts are:

Part	Title
1	PROPOSAL FORMS AND DOCUMENTS
2	GENERAL REQUIREMENTS
3	PROJECT PROGRAM
4	PERFORMANCE TECHNICAL SPECIFICATIONS
5	PRESCRIPTIVE SPECIFICATIONS
6	ATTACHMENTS

These parts are further detailed in the Whole Building Design Guide (WBDG) website: http://www.wbdg.org/ndbm/ndbm.php

c. The 6-part RFP format for Tank Clean, Inspect, and Repair contracts can be over 1,000 pages. The SOW for the Tank 5 contract was 36 pages which only referenced the UFGS specifications and applicable codes. The 6-part format provides specifications for the task order for site access, submittals, quality control, and safety and health; documentation stating the work that is to be performed under the contract; and the prescriptive specifications for the qualifications and certifications of the personnel, products and materials, and the specific requirements for workmanship for each portion of the work.

d. The Contractors who have been awarded a GPOL MACC contract are competent, knowledgeable, and experienced in performing POL Tank Clean, Inspect, Repair projects, in addition to construction, sustainment, repair, and maintenance of all other types of POL facilities that are included in the UFC 3-460-01.

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CHAPTER 11 - LESSON #2 CONTRACTOR QUALITY CONTROL

11-1 INTRODUCTION

WGS did not produce a QC plan in accordance with established Navy criteria. Instead, WGS provided a Project Execution Work Plan which contained a field QC manual and various procedures. Minimum levels of quality were not established, site specific procedures were few, and lines of responsibility were incoherent in the WGS Work Plan. Further information about CQC, as it relates to observations, incident investigation, and the underlying cause of the Tank 5 release, is provided in Chapter 9.

11-2 OBSERVATION AND SHORTCOMING

11-2.1 Contractor Quality Control

The WGS Project Execution Work Plan contained a field QC manual and various procedures. The WGS QC manual was developed from USACE EP 715-1-2 which is a brief pamphlet describing USACE's concept of CQC. The WGS quality control manual did not adhere to EP 715-1-2 in important elements such as:

a. A system for tracking construction deficiencies to ensure that corrective action is taken in a timely manner.
b. A CQC staff of adequate size and technical capabilities to accomplish all QC duties in a timely manner.
c. A testing plan that lists tests to be performed, states who will be responsible for the results, and identifies who will prepare and sign reports.

11-2.2 Manual P-445 is the NAVFAC Construction Quality Management (CQM) Program. Fundamental to the CQM Program are the following tenets:

a. QC responsibilities have been contractually assigned to the Contractor. The Contractor controls the quality of the work.
b. The Government must assure that construction work conforms to contract requirements by ensuring that the CQC system is properly functioning.
c. The QA System establishes whether the Contractor has failed to meet quality requirements or carry out their contractual QC responsibilities.

d. The Government is not responsible for controlling the quality of the Contractor's work.
e. The level of quality is established by the specifications and drawings.

11-2.3 WGS QC procedures were not developed from P-445. However, several aspects of the plan were consistent with the NAVFAC program. Performing three phases of control, identifying of areas of responsibility and authority, and completing inspection procedures were consistent with P-445. However, the WGS QC program omitted several crucial aspects of P-445:

a. Internal rework procedures to identify, document, track, and sign off completion of deficiencies during construction.
b. A test plan and log, to include tests required referenced by the specification paragraph number requiring the test, test frequency, and the person responsible for each test.
c. Procedures for documenting quality control, inspection, and testing.
d. Submittal procedures for reviewing shop drawings, samples, certificates, or other submittals for contract compliance, including the name of the person(s) authorized to certify submittals as compliant with the contract.

11-2.4 In several areas the WGS QC plan complied with contract requirements. In many areas, the WGS QC plan did not comply with Navy or USACE QC management manuals. The basic industry procedures stated in the WGS QC Program should have been adequate to control the quality of the work at Red Hill Tank 5. However, basic industry procedures to control the quality of their work were not followed by WGS.

11-2.5 Manual P-445 identifies UFGS Section 01 45 00 QUALITY CONTROL to incorporate NAVFAC specific requirements into the QC System required to be implemented. UFGS Section 01 45 00 requires the QCM to inspect all work for compliance with the contract, and stop noncompliant work. In addition, the Section requires the QCM report findings to corporate management. UFGS Section 01 45 00 has controls quite adequate to control the quality of the work at Red Hill Tank 5. However UFGS Section 01 45 00 was not followed by WGS.

11-2.6 The WGS work plan identified key personnel including the Project Manager (who also served as the API Std 653 inspector) and the Site Manager. The plan stated the Site Manager was to report directly to the WGS Project Manager. The work plan named the Site Manager also to perform the QCM role as collateral duty. Since the Site Manager has numerous production-related duties, collocating the QCM and Site Manager roles on a project as complex as Red Hill Tank 5 was a practice fraught with conflict of interest. In addition, performing QC management as collateral duty on a complex project diluted the effectiveness of QC management. By directing the QCM report directly to the Project Manager the independence of the QCM role, per the core principles of P-445, was severed. It is unknown whether the QCM received oversight from the WGS corporate quality control program.

11-2.7 The Project Manager was stated in the WGS work plan to be responsible for "cost, schedule, and field construction quality control." By removing the independence of the QCM role and vesting CQM responsibility in the Project Manager, WGS created a program wherein QC, production, and cost were managed by a single individual. The QCM was a manager in name only. The WGS QCM lines of authority and responsibility to control quality of the work were a wholesale departure from P-445 and UFGS Section 01 45 00.

11-2.9 The WGS work plan charged the QCM to perform "trend analysis and root cause analysis to identify potential problems", prepare a test plan and log, and verify that "testing procedures comply with the contract requirements." Test methods identified in the plan and required in the contract to be performed included vacuum box testing, dye PT, and magnetic-particle testing. There is no evidence the QCM complied with WGS internal QC manual requirements. Whether the QCM controlled quality of the weld inspection and PT was unclear, as evidenced by the condition of welds observed by the Navy during the investigation in 2014.

11-3 SOLUTION OR IMPROVEMENT

11-3.1 The Navy acknowledges the fact that problems with CQC contributed to the Tank 5 release. The underlying cause and contributory factors of the release from Tank 5 are discussed in Chapter 9. As related to CQC, the cause and contributory factors demonstrate human failures and not a breakdown of the P-445 system. The Navy has confidence in the P-445 program. Lessons learned from the Tank 5 release as related to quality control include:

a. Contractor QC cannot be relied upon without adequate QA oversight.
b. The QCM must have the independence to report findings to company management and the Government without fear of project-level reprisal.
c. UFGS Section 01 45 00 must be implemented fully on every contract.

11-3.2 Lessons learned from the Tank 5 release as related to Government QA include:

a. Contract COR oversight function will be located on-island at the NAVFAC component.
b. Navy construction management will be located on-island at the NAVFAC component.
c. Navy management of the design and the tank inspection data will be performed by NAVFAC EXWC in Port Hueneme, California.

11-4 SOLUTION OR IMPROVEMENT RATIONALE DISCUSSION

UFGS Section 01 45 00 describes the QC System the Contractor is required to establish and maintain. NAVFAC has published several tailored versions (e.g., UFGS Section 01 45 00.05 20 Design and Construction Quality Control) of the basic UFGS Section 01 45 00. Depending on the type of contract, NAVFAC will select the appropriate tailored version of UFGS Section 01 45 00 when creating contract requirements. In this report, in discussions of improvements to the TIRM, the generic UFGS Section 01 45 00 will continue to be described even though NAVFAC will deploy the appropriately-tailored Section in contract documents. NAVFAC has an established business management system with robust procedures in place to manage construction QA. Thus, improvements to the QC system are procedural in nature. The Government's construction manager has the responsibility to perform adequate construction QA oversight and assure the QC system is being effective.

Specific improvements to TIRM procedures are detailed in Chapter 16.

CHAPTER 12 - LESSON #3 REFILLING PROCEDURE

12-1 INTRODUCTION

This Chapter provides information on the refilling procedure that was used in the refilling of Tank 5, and the solution of how the tank will be filled in the future.

12-2 OBSERVATION AND SHORTCOMING

12-2.1 Tank Filling Procedures

The process that was used to fill Tank 5 in December 2013 is provided in the "Current Fuel Release Monitoring Systems Report" AOC SOW, Section 4.3, dated 16 August 2016.

12-3 SOLUTION OR IMPROVEMENT

NAVSUP 10345.1 NAVSUP Global Logistics Support (GLS) Instruction 10345.1 (Attachment AZ) was issued on 9 May 2015. This instruction provides the requirements for the documentation that is required prior to returning a tank back into service after cleaning, inspecting, or repairs. This instruction requires the Site Director or designee to develop Standard Operating Procedures and a tank-specific Operations Order, to obtain approval of these documents, and not to deviate from these documents during refilling of the tank.

12-4 SOLUTION OR IMPROVEMENT RATIONALE DISCUSSION

The NAVSUP instruction recognizes that in addition to having the proper documentation from the organization that performed the work on the tank, it also requires well-thought-out documentation on how to move fuel from one tank to another and check for any issues that may have occurred while the tank was out of service. This instruction applies to all fuel storage tanks, from the small aboveground factory-fabricated tanks to the large Red Hill tanks.

In 2016, the UFC 3-460-03 Maintenance of Fuel Facilities was rewritten and is in the approval process. (The document cannot be released to the public until it has received all approving signatures and is published on the Whole Building Design Guide.) This new edition of the UFC 3-460-03 will incorporate the requirements stated in the NAVSUP GLS Instruction 10345.1. Therefore, this lesson learned has been incorporated into the criteria for all DoD tanks to follow when returning the tanks to service.

CHAPTER 13 - LESSON #4 GOVERNMENT QUALITY ASSURANCE

13-1 INTRODUCTION

The Tank 5 inspection and repair contract was awarded by NFESC in Port Hueneme, California. Until the Tank 5 release, NFESC maintained the COR and QA roles. Oversight for the quality of submittals and field work was provided by the NTR with support from the on-island NAVFAC component for safety matters. The NTR conducted QA both onsite and from Port Hueneme. Several individuals served in the NTR role. The COR function was performed from Port Hueneme, California.

13-2 OBSERVATION AND SHORTCOMING

13-2.1 Government Quality Assurance

13-2.1.1 The Navy requires QA to be performed pursuant to a quality assurance surveillance plan in compliance with DFARS 246. The intended purpose of a QA Plan is to describe systematic methods used to monitor performance and identify the required documentation and resources necessary to ensure the contractor quality control program is effective. Acceptable levels of quality, roles and responsibilities, and basic surveillance techniques are contained in a typical QA plan. However, the QA plan for oversight on Tank 5 cannot be located. Basic oversight techniques such as witnessing tests, reviewing QC plans, and monitoring QC program output were performed in an ineffective manner. The NTR was present during acceptance of the coating system, but it could not be determined whether oversight of weld inspection had been performed. Since either there was no QA plan or it could not be located, the NTR did not have a basis to assess whether oversight was adequate.

13-2.1.2 Prior to the Tank 5 release, the Navy believed that the frequency and thoroughness of contract and technical oversight were sufficient. The Contractor’s API certified inspectors had been found to be well-trained and trustworthy. Suitability for Service Certifications by API Std 653 inspectors had been found to be a reliable method to assess whether repaired storage tanks were, in fact, tight. The Tank 5 NTR was engaged in coordinate roles in numerous simultaneous projects being executed worldwide. Thus, as had been done on numerous occasions, the NTR relied on the suitability for service certification produced by the API Std 653 inspector. The Tank 5 release exposed a vulnerability to reliance on an industry-certified inspector.

During the Tank 5 incident review it became clear Navy QA oversight had failed to address lack of compliance with requirements and with P-445. The omission of vacuum box testing had not been discovered, and clearly defective work had been accepted by the NTR. The NTR was unaware of the installation, unrepaired condition, and lack of reporting of the gas test holes.

Shortcomings in the Navy QA oversight were found to be:

a. The QA Plan for Navy technical oversight could not be located.
b. Basic oversight was performed in an ineffective manner, such as not being required to physically inspect the work in the tank.
c. Navy relied on the suitability-for-service certification produced by the API Std 653 inspector.
d. The omission of crucial nondestructive testing was not detected.
e. The existence of the unrepaired gas test holes was not known.

13-3 SOLUTION OR IMPROVEMENT

The model of attempting to manage complex construction from a remote location was examined and determined to be incongruous with NAVFAC core attributes. The requirement for more rigorous construction management was clear, and the existing QA process to repair a Red Hill tank needed to be improved. As a result of these lessons, numerous changes have been implemented:

a. The NAVSUP tank filling instruction and return to service instruction from May 2015 will be a part of future contracts.
b. Usage of gas test holes will be managed, tracked, and reported. All gas test holes will be repaired.
c. Construction management oversight of tank repair will be performed by the local on-island NAVFAC component using established procedures in a business management system to closely monitor contractor quality control.
d. Adherence to P-445 and UFGS Section 01 45 00 will be required.
e. A Red Hill tank repair criteria will be standard procedure.
f. Contract COR oversight function will be located on-island at the NAVFAC component.
g. Navy design and management of the tank inspection data will be performed by NAVFAC EXWC in Port Hueneme, California.

More detail on future contractor quality control and Government QA requirements is provided in in Chapter 16.

13-4 SOLUTION OR IMPROVEMENT RATIONALE DISCUSSION

The concept of managing construction from a remote location can only apply to low risk projects. Red Hill tank repair projects do not fit NAVFAC's low risk acceptance guidance. NAVFAC has an established business management system with robust procedures in-place to manage construction. In order to leverage the benefits of that system, the decision was made to change responsibility for contract administration and technical oversight to the local NAVFAC component. Thus, on-island forces will control contract administration as well as provide construction quality assurance. Technical support will be available through the NAVFAC business line. NAVFAC EXWC will manage oversight of design quality. This course correction will align Red Hill tank-repair contracts with current NAVFAC business practice.

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CHAPTER 14 – LESSON #5 CLEANING AND INITIAL INSPECTION

14-1 INTRODUCTION

This Chapter provides information on the cleaning procedure that was used in the refilling of Tank 5, and the solution of how the tank will be cleaned in the future.

14-2 OBSERVATION AND SHORTCOMING

14-2.1 Pressure Washing

a. The UFGS Section 33 65 00 Cleaning Petroleum Storage Tank does not specify the maximum allowable pressure and temperature for pressure washing.
b. WGS Work Plan (Attachment R) states "A high pressure spray wash of the tank interior and internal components shall be conducted." The pressure for cleaning Tank 5 is not specified.
c. WGS Work Plan (Attachment R) lists the following categories of water blasting:

Category	Pressure (psi)	Purpose
Low pressure	<3,500	Remove material not bonded to surface
Standard pressure	3,500-20,000	Remove rust, scale, or epoxy coating
Ultra high pressure	> 20,000	Cutting and stripping operations

d. WGS Tank 5 Inspection report (Attachment T), Section 1.0 states: "[WGS] cleaned the tank by high pressure washing all internal surfaces." The actual pressure used for cleaning Tank 5 is not specified.
e. WGS Tank 5 Inspection report (Attachment T), Section 6.1, Summary of Indications and Flaws states: "The coating has disbonded, flaked, or deteriorated over 80% of all internal surface areas."

14-2.2 The coatings in the Upper Dome and Barrel of the previous five tanks that were cleaned, inspected, and repaired were not as badly deteriorated after pressure wash cleaning as the coating in Tank 5. The condition of the coating in the Lower Dome of Tank 5 was consistent with the previous tanks.

14-3 SOLUTION OR IMPROVEMENT

14-3.1 Lessons Learned for Tank Cleaning

a. Government specifications should specify the maximum allowable pressure and temperature for washing the tank with pressure sprayers (water blasters).
b. The specifications should provide requirements for the Contractor to perform Quality Control on the procedure by pressure washing a test patch to determine the effects of pressure on the coating and eliminate the problem of coating disbondment due to too high of pressure.
c. The Government should review the Contractor’s Work Plan to insure that the maximum allowable pressure and temperature are specified.
d. The Government personnel should perform on-site quality assurance during the Contractor’s tank cleaning operation, ie, on the work platform or in the man-basket with the tank cleaning personnel to insure that the maximum allowable pressure and temperature of the wash spray (water blast) is not exceeded; and to insure that back-seepage, dis-bonded coating, and blisters in the coating are carefully checked and marked for further inspection.

14-4 SOLUTION OR IMPROVEMENT RATIONALE DISCUSSION

a. UFGS Section 33 65 00 will be updated to include the pressure washing specification appropriate for the coating system that is currently in the tanks. Previous pressure washing of other Red Hill tanks was 200 psi or less and 135 degrees Fahrenheit or less which removed loose coating, but did not cause well-adhered coating to disbond. This pressure satisfactorily cleaned the tank, but did extend the time required to clean the tank.
b. UFGS Section 33 65 00 will be updated to require additional quality control for performing a test patch to ensure that the pressure washing will not cause well-adhered coating to disbond from the tank shell.
c. Include Government QA surveillance of the cleaning and pressure washing of the tank in the QASP.

CHAPTER 15 – LESSON #6 – ADDITIONAL LESSONS

15-1 INTRODUCTION

This Chapter provides an overall summary of the lessons learned during the cleaning, inspection, and repair of Tank 5 and the planned solution and improvements regarding these observations.

15-2 OBSERVATIONS AND SHORTCOMINGS

The Navy has reviewed all aspects of the storage-tank inspection, repair, and maintenance program at Red Hill. Various chapters discuss shortcomings and lessons learned from this review. Culled from the chapters, the lessons learned are included here for convenience:

a. The removal of the tell-tale leak detection and collection system has eliminated the Navy's real-time leak detection system. The system was designed to be an indicator of leakage, recover leaked fuel, identify location in the tank where a leak might be located, and provide relief from hydrostatic pressure on leaked fuel. Refer to the AOC SOW, Section 3, Tank Upgrade Alternatives, for additional discussions for the best available practicable technology concerning the tell-tale leak detection system.
b. The facility has limited power capacity to support multiple contractors working in the facility concurrently.
c. The cleaning of Tank 5 used excessive water pressure, which removed most of the remaining coating on the tank barrel and some of the markings made during inspection and nondestructive testing.
d. Even though the tank was inspected using the same method used during the inspection of previous tanks, the contract did not require documentation on the reliability and quality of the tank plate and of weld-scanning detection, such as POD curves.
e. It is necessary for the contract to require specifications and drawings of tank repairs so that both the Contractor and Government can track the work.
f. The Contractor’s QC plan should adhere to P-445, not a non-Navy document.
g. There was an over-concentration of Contractor project authority that led to incoherent roles.

h. There is a very high probability that the welders may have inspected or performed NDE on their own work. If any rework was identified, it would have led to schedule delay and reprisals due to failure to perform adequately.
i. The contract did not require the gas test holes to be repaired with weld metal.
j. The Navy QA oversight plan needs to be well-developed, resourced, and executed.
k. The Contract must be more specific to explain the Government's expectations, such as the requirements for submittals, quality control, design, and construction means and methods.
l. The Contractor QC cannot be relied upon without adequate Government QA oversight.
m. The Contractor's QCM must have the independence to report findings to company management and the Government without fear of project-level reprisal.
n. UFGS Section 01 45 00 on every contract must be implemented fully.
o. Neither the Navy nor DLA could provide a drawing showing the precise location of each leak point in Tank 5.

15-3 SOLUTION OR IMPROVEMENT

Improvements to implement course corrections to address the above lessons learned are listed below.

a. Re-installation of the tell-tale leak detection and collection systems as discussed in Chapter 21. Refer to the AOC SOW, Section 3, Tank Upgrade Alternatives, for additional discussions for the best available practicable technology concerning the tell-tale leak detection system.
b. Upgrade of the Power Supply is currently being implemented as noted in Chapter 20.
c. A revision to UFGS Section 33 65 00 is planned as noted in Chapter 21.
d. A new UFGS guide specification for Inspection of Fuel Storage Tanks is under development as noted in Chapter 21.
e. A newly awarded multiple-award, task-order design-build contract specific to POL work is now mandated to be used as noted in Chapter 21.
f. The new contract format will include UFGS Section 01 45 00 as noted in Chapter 21.
g. Adherence to UFGS Section 01 45 00 is mandated in future contracts.

h. The new UFGS guide specification for Repair of Fuel Storage Tanks, which is under development, will disqualify a welder from inspecting or performing NDE on one's own work.
i. The new UFGS guide specification for Repair of Fuel Storage Tanks establishes, as the minimum repair criterion, all gas test holes will be filled with weld metal.
j. NAVFAC QA, design, project, and construction management roles are now distributed as noted in Chapter 21.
k. The new UFGS guide specifications for Inspection and Repair of Fuel storage tanks, along with adherence to UFGS Section 01 45 00, will state the Navy's expectations. In addition, the NAVFAC's design QA role has been identified as noted in Chapter 21.
l. The NAVFAC's construction QA will be performed by the on-island component of NAVFAC as noted in Chapter 21.
m. Future contracts shall specifically state that the QCM will report directly to corporate management, not to the Project Manager.
n. Adherence to UFGS Section 01 45 00 will be mandatory in future contracts as noted in Chapter 21.
o. A project to develop as-is drawings of each tank is being planned as noted in Chapter 21.

15-4 SOLUTION OR IMPROVEMENT RATIONALE DISCUSSION

Many of the solutions and improvements were already being planned and implemented prior to the Tank 5's fuel release. Site-specific improvements are currently being investigated and evaluated. In addition, Navy and DLA are constantly reviewing new technologies to determine their effectiveness and the risks involved, while also not taking on science projects that may not result in increased capability and could also be detrimental to the facility and to the environment.

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PART D – IMPROVEMENTS AND FUTURE OF TIRM

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CHAPTER 16 - QUALITY CONTROL AND QUALITY ASSURANCE AFTER TANK 5

16-1 INTRODUCTION

This Chapter addresses the changes being made to improve the Government's Quality Assurance processes and the effect to the Contractor's Quality Control. The changes include (1) the development of a project team, (2) defining the roles, responsibility, and qualifications of the Government's project team, (3) development of specific prescriptive specifications that define the Contractor's means and methods to be used during the inspection and repair, (4) requiring the Contractor to "single-hat" the site project superintendent, Quality Control manager, and site safety manager, and (5) QCM will report directly to the main office QC manager and not to the site manager or project manager.

16-1.1 Quality control per P-445 is defined as the Construction Contractor's system in place during execution to manage and control and document his own, his supplier's and his subcontractor's activities in order to comply with contract requirements.

16-1.2 Quality Assurance per P-445 is defined as the Government's system in place to monitor the Quality Control efforts of the Construction Contractor.

16-2 POL MACC CONTRACT INFORMATION

In February 2015, NAVFAC EXWC, using unrestricted full and open competition, awarded an indefinite delivery/indefinite quantity multiple award construction contracts for petroleum, oils and lubricants fuel systems at various locations worldwide. Work to be performed under this contract includes construction repair services for clean, inspect and repair, sustainment, restoration and modernization, and related services for the Petroleum, Oil and Lubricants Fuel System Program. The source selection was best value and award was made to eight contractors based on criteria such as past performance, execution approach, and technical expertise. The contract includes provisions for ordering firm fixed price task orders.

16-3 EXISTING SPECIFICATIONS

16-3.1 The Whole Building Design Guide contains links to UFCs and UFGS guide specifications used in NAVFAC contracts.
https://www.wbdg.org/

16-3.2 The Army Corps of Engineers maintains a web site which contains links to typical standard designs (AST, Cut and Cover, etc.) used in NAVFAC design documents.
http://apps.hnc.usace.army.mil/stddgn/Library.aspx

16-4 GOVERNMENT QUALITY ASSURANCE

16-4.1 Submittal Reviews

On previous contracts, NFESC maintained COR and QA roles. Oversight for the quality of submittals and field work was provided by the NTR with support from the on-island NAVFAC component for safety matters. The NTR conducted QA both onsite and from Port Hueneme. COR oversight was performed from Port Hueneme, California. On all future contracts, NAVFAC will separate the QA roles between the on-island component (NAVFACHI) and NAVFAC EXWC. Construction management will be performed from NAVFACHI and the design management will be performed from NAVFAC EXWC. Construction submittals will be reviewed by the construction manager (CM) and design submittals will be reviewed by the design manager (DM). Construction QA, safety oversight, and contract administration will be performed by NAVFACHI. The COR will be located at NAVFACHI. This division of submittal review responsibilities is consistent with the current NAVFAC functional alignment and business management system.

16-4.2 On-Site Surveillance

NAVFAC has established requirements for Government personnel who are assigned to perform on-site surveillance. These are listed below.

16-4.2.1 Safety Regulations

The Facilities Engineering and Acquisition Division (FEAD) (ie: NAVFACHI) is responsible for allocating resources in order to manage risk of the work being performed. Surveillance to ensure contractors are compliant with Section 01 35 26.05 20 Government Safety Requirements for Design-Build, EM 385-1-1, and the accepted Accident Prevention Plan is the responsibility of the FEAD's construction management team.

16-4.2.2 Education, Experience, and Certifications

The skillset of the construction manager and the engineering technician are tailored to the project requirements. Training, knowledge, and experience include:

a. Ability to manage large and complex construction projects and lead the FEAD project team to effectively carry out responsibilities.
b. Knowledge of standard construction management business procedures and ability to carry them out.
c. Ability to obtain advanced COAR authority by virtue of having fulfilled training and experience requirements.
d. Advanced knowledge of CQM concepts, including quality assurance and quality control processes, standard procedures and contract requirements.
e. Ability to tailor quality control, submittal, and close-out specification sections to assure proper contractor quality control system/organization for the project.
f. Advanced knowledge of UFGS, UFC and local conditions that impact contract execution and operations.
g. Advanced ability to evaluate contractor APP and Activity Hazard Analysis (AHA) for quality and thoroughness.
h. Advanced knowledge of safety requirements for construction operations. Ability to enforce/ensure appropriate practices are planned and carried out.
i. Advanced ability to develop QA Plans for construction projects.
j. Advanced knowledge of Design-Build (DB) and Design Bid Build (DBB) acquisition and construction delivery procedures.
k. Knowledge of roles and responsibilities of Government team members and standard procedures for performing QA on design-build contracts.
l. Advanced knowledge of mechanical systems and their QA.

16-4.3 Development of a Specification for Tank Inspections

16-4.3.1 NAVFAC has developed a tank inspection specification for a Red Hill tank. This will standardize many aspects of a Red Hill inspection, reduce variability in inspection results, and provide the basis for substantive reports upon which facility management planning can be based. The tank inspection performance specification will:

a. Provide references to industry standards and practices.
b. Define common terminology.
c. Include detailed submittal requirements such as the certification of inspectors and NDE technicians.

d. Establish minimum qualification requirements for key personnel and specialty service companies.
e. Require NDE reliability testing.
f. Establish a professional data management system.
g. State minimum inspection design requirements.
h. Require management of gas test holes.
i. Provide for destructive testing.

Part 3 of the specification provides requirements for execution of the storage tank inspection. This part requires examination by specific nondestructive methods, sets destructive testing requirements, provides inspection criteria for visual, shell scan, weld scan, and thickness measurements. Vent and nozzle piping inspection and testing requirements are provided. Reporting inspection results as well as specific reports detailing results of reliability testing and metallurgical analysis are required. NAVFAC will tailor the specification for each contract. See Attachment BD for the tank inspection specification.

16-4.4 Development of a Specification for Tank Repairs

16-4.4.1 NAVFAC has developed a tank repair specification for a Red Hill tank. This will standardize many aspects of repair, reduce variability in performance, and provide the basis for record drawings documenting conditions to and changes made to a tank. The Tank Repair Performance specification will:

a. Provide references to industry standards and practices.
b. Define common terminology.
c. Include detailed submittal requirements such as the certification of inspectors and welders.
d. Establish minimum qualification requirements for key personnel and specialty service companies.
e. State minimum repair design requirements.
f. Establish repair requirements for gas test holes.
g. Establish weld inspection and nondestructive examination frequency and acceptance criteria.
h. Require tank inspection and validation of predictive repairs to occur during the design phase of the contract.
i. Require a professional data management system.
j. Specify standards for materials used in repair.
k. Require in-progress review of repairs by API Std 653 inspector.

16-4.4.2 The Tank Repair Performance specification includes detailed submittal requirements such as the certification of the welders, NDE technicians and materials. Part 3 of the specification provides requirements for “Workmanship”. NAVFAC will tailor the specification for each contract. See Attachment BE for the tank repair specification.

16-5 CONTRACTOR QUALITY CONTROL PLAN

16-5.1 Design and Construction Quality Control

UFGS Section 01 45 00.05 20 Design And Construction Quality Control will be used in each contract. This section is the NAVFAC refinement to UFGS Section 01 45 00 which implements P-445 and sets minimum requirements for the contractor QC program. NAVFAC will tailor the specification for each contract to state the QC Manager must manage the QC organization, report to an officer of the firm, and shall not be subordinate to the Project Superintendent, Project Engineer, or the Project Manager. The QCM will not be allowed to be the Site Safety and Health Officer (SSHO).

16-5.2 Superintendent and Project Manager

UFGS Section 01 30 00.05 20 Administrative Requirements for Design-Build will be used in each contract. This section implements, among other things, requirements for the site superintendent (site manager) and the project manager. In addition to experience requirements, the project manager and site superintendent will be required to have completed the course entitled "Construction Quality Management for Contractors" prior to the start of construction. Despite this training in QC management, NAVFAC will tailor the specification for each contract to state the Site Superintendent cannot be the QCM or the SSHO.

16-5.3 Submittal Procedures

UFGS Sections 01 30 00.05 20 and 01 33 10.05 20, respectively Construction Submittal Procedures and Design Submittal Procedures will be used in each contract. The sections provide general requirements for how submittals to the Government will be managed. The submittals to be managed are identified primarily in each particular specification section. The QCM is required to manage the approval of, and the flow of submittals to the Government. Some submittals will be approved by the Design Engineer of Record, some by the QCM, and some by the Government. Submittals not reserved for Government approval will be submitted for information. NAVFAC will tailor the specifications for each contract.

Each particular UFGS section contains specific submittals which are required. They are organized into submittal description categories such as shop drawings, design data, product data, preconstruction submittals, test reports, certificates, and field reports. NAVFAC will tailor the specification sections for each contract.

16-5.4 Government Safety Requirements

UFGS Section 01 35 26.05 20 Government Safety Requirements for Design-Build is the NAVFAC refinement to UFGS Section 01 35 26 and will be used in each contract. This section implements EM 385-1-1 and sets minimum requirements for the contractor safety program. NAVFAC will tailor the specification for each contract to state SSHO cannot be the QC Manager or the Project Superintendent.

16-6 GOVERNMENT QUALITY ASSURANCE SURVEILLANCE

16-6.1 NAVFAC maintains a business management system which contains a current process for design build quality management. Pursuant to the process, the CM and Engineering Technician (ET) will:

a. Review contract requirements for Government approvals required before construction, Government surveillance submittals and Government approvals required, but not before construction.
b. Review contract requirements for Government involvement in verification and acceptance testing and inspections, such as fire protection system testing.
c. Using the Contractor's three week look ahead schedule determine the appropriate personnel that will participate in QC/Progress meetings.
d. Ensure the Contractor's PM, CM and Designer of Record (DOR), as well as key subcontractors, participate in QC and progress meetings throughout design and construction as necessary for key decisions.
e. Assure submission and review of "daily" report package as necessary to keep up with issues at the construction:
    1) QC Report.
    2) Contractor Production Report.
    3) CQC Specialist Reports.
    4) Three Phases of Control Checklists.
    5) Test Reports.
    6) Rework Items List.
    7) QC Meeting Minutes.

8) Monitor jobsite progress.
9) Quality Assurance Documentation.
10)QC report.

f. QA report (QA reports are not mandated by FAR, but should be prepared in order to document issues not recorded on the Contractor's QC report).
g. Return any report containing Government exceptions (e.g. uncorrected deficiencies) to the Contractor for follow-on response/action. NOTE: Contractor is responsible for maintaining a deficiency log (rework items list.
h. Maintain record files of all QC reports and QA reports.
i. Review Contractor's QC staff to ensure adequate staff for all necessary design and construction QC functions.
j. Cursory review QC Plan development as design develops, noting submittal log (most construction submittals will be internal to Contractor – DOR) and testing plan.
k. Monitor manufacturer's representatives during installation and testing of specified (noted in specifications or product information) materials and products per QA Plan.
l. Assure QC Manager provides QC certifications required in contract:
   1) Design certification.
   2) QC Report certification.
   3) Invoice certification.
   4) Completion certification.
m. Monitor testing and submission of test reports.
   1) Assure Contractor performs required tests and test reports are submitted.
   2) Assure Contractor keeps testing log up to date.
n. Coordinate with Government representatives who will participate in acceptance and/or verification testing for specialized systems, such as fire protection, generators, pressure vessels, etc.
o. Coordinate with Government or other representatives who will certify specialized installations, such as pressure vessels, elevators, etc.
p. Monitor re-work:
   1) Assure deficient work is corrected prior to continuing with work that will render the deficient work inaccessible.
   2) Assure Re-Work Items list is kept up to date.
   3) Issue Construction Contract Non-Compliance Notice (NAVFAC 4330/36) notices for deficiencies not corrected in a reasonable time and manner.

4) Assure Contractor addresses/corrects issues that were the basis for issuing non-compliance notices.

q. Provide feedback to Contractor for both effective and deficient management of project.

16-6.2 Government QA Roles and Responsibilities

NAVFAC has established and defined contract roles in the business management system. For inspection and repair of fuel storage tanks, NAVFAC has developed a training and operating procedure standard to provide guidance necessary to handle the unique program requirements. To target core competencies within the NAVFAC enterprise, the project management, design management, and construction management responsibilities are situated between different individuals at several NAVFAC components. The roles and responsibilities NAVFAC has established are listed below.

16-6.2.1 Project Manager (PM)

The PM is responsible for management of the project (scope, cost, Anti-Deficiency Act compliance, and schedule) from design authorization to project closeout. The PM role is at NAVFAC EXWC. Qualifications for the PM role include capabilities for independent communication, facilitation and mediation, conflict resolution, business integration, briefing, and experience with large and complex projects. Registration as a professional engineer is encouraged and preferred, but is not required.

16-6.2.2 Design Manager (DM)

The DM is responsible for management of the design, project technical team, and post construction award services (PCAS) services during construction. The DM/SME role is at NAVFAC EXWC and for projects at Red Hill is at the senior level. Qualifications for the DM role include cognizance of, and responsiveness to NAVFAC execution requirements while ensuring that principles of design excellence are maintained. The DM will be responsible for consistent delivery of design services tailored to each Red Hill tank, application and development of criteria, and adaptation of standards to meet unique facility requirements. The senior DM should be professionally licensed.

Additional lead responsibilities are:

a. Reviewing Technical Submittals, RFIs, and Deliverables
b. Reviewing/Acceptance Tank Inspection Report

c. Receiving Tank Certification Report
d. Set requirements for oversight of Contractor's tank inspection and testing

16-6.2.3 Construction Manager (CM)

The CM is responsible for the management of the DB construction contract from contract award to contract closeout. The CM role is at NAVFACHI. Qualifications for the CM role include cognizance and responsiveness to NAVFAC execution requirements while ensuring that principles of project quality, cost, timeliness, and safety are maintained. The CM will be required to have knowledge of processes, policies and technical elements of construction engineering and management, construction quality management training, construction safety training, and construction technical support capability.

Additional lead responsibilities are:

a. Field Coordination with Contractor.
b. Oversight of Contractor's Inspection and Testing.
c. Safety Oversight.
d. Environmental Oversight.
e. Receiving Submittals, RFIs, and Deliverables.
f. Reviewing Administrative Submittals, RFIs, and Deliverables.
g. Receiving Tank Inspection Report.
h. Final Acceptance.

16-6.2.4 Contracting Officer Representative (COR)

The COR responsibilities are provided per the Contracting Officer designation letter and may be the same as the CM. The COR role is at NAVFACHI.

16-6.2.5 Government Role Summary

In the lifecycle of a Project, after project authorization, the development of the Tank Clean, Inspect, and Repair (CIR) RFP and award of the CIR contract is the primary led by the PM/DM. At tank CIR Contract award, the primary project effort shifts to execution of the construction led by the CM. The coordination for the repair recommendations and award of the repair modification is led by the PM/SME in support of the CM. Good communication and cooperation between the PM, DM/SME, CM, and all project team members throughout the lifecycle of the project is imperative to success.

16-7 THIRD PARTY QUALITY ASSURANCE

16-7.1 NAVFAC routinely requires third party oversight (first tier subcontractor) to oversee areas of work. Examples of third-party oversight and the required certifications include coating inspection company (Society for Protective Coatings SSPC QP 5), marine chemist (NFPA), coatings specialist (SSPC Protective Coatings Specialist), hazardous materials abatement clearance (PQP), nondestructive examination technician (ASNT Level II), inspection of repairs (API Std 653 tank inspector), Certified Industrial Hygienist (CIH), and testing laboratory (A2LA). In addition, NAVFAC has on occasion deployed services of independent third-party specialists such as API Std 653 inspector, mechanical inspector, welding inspector, QA oversight, and calibration company.

Independent third-party inspections provide an additional level of oversight into specialty matters. Some of the services can be required in the DB construction contract and some require an additional contract action to procure the services. There are some time impacts involved with performing independent third party reviews. The time required to execute new contract actions can be prohibitive. There can be loss of production involved with waiting for third party inspections to finish. Professional differences in opinion on difficult to reconcile subjective matters can result from an independent review.

16-7.2 In the case of a Red Hill tank, independent inspection of repairs by an API Std 653 inspector is believed to have a diminished return compared to the same requirement on a traditional aboveground API Std 650 tank. The learning curve for the facility is steep and the Navy believes requiring the API Std 653 inspector of record to inspect repairs is a more effective approach to ensuring repairs are completed in accordance with the Standard.

NAVFAC does not intend to deploy full time third party QA construction oversight. The benefits to providing full time QA oversight are exceeded by the lack of productivity associated with work at Red Hill. NAVFAC does intend to deploy subject matter expertise to support design and construction QA oversight. Should more intensive QA be required, the local NAVFAC component has several ready avenues of reach-back support available, both from within NAVFAC and through contract actions.

16-7.3 Since third party inspection can result in construction delays, the ability to deploy these services is best utilized during the formation of the contract to avoid delay costs.

16-8 QA/QC HISTORY FOR THE PREVIOUS TANKS AT RED HILL

16-8.1 Prior to NAVFAC adoption of P-445 in January 2000, Government personnel had the responsibility to perform inspection of contractor work. P-445 implemented a new process in which contractor provides inspection through the contractor quality control program, and Government oversees the CQC program with quality assurance.

However in 2008, NFESC continued to perform a version of Government inspection during work performed on Red Hill Tanks 2 and 20 in that near full time oversight of contractor work was provided by a NAVFAC engineer. Red Hill Tank 5 was the first contract at Red Hill in which the CQC – QA oversight process was expected to have been fully followed. As detailed in Chapter 9, not only was full-time inspection not performed but QA oversight was less than satisfactory. Refer to Chapter 1 for more history of how inspection services have been performed at Red Hill.

16-8.2 Current NAVFAC practice is to award DB contracts at NAVFAC EXWC and transfer administrative contracting authority to the local NAVFAC component (ie: NAVFACHI). The Procuring Contracting Officer holds a turnover meeting after contract award to transfer knowledge and contract files to the Administrative Contracting Officer. The PM and CM attend the turnover meeting and establish the NAVFAC working relationships.

16-8.3 NFESC developed a SOW for clean inspect and repair of a storage tank. Over time the SOW was refined to incorporate additional requirements as the result of lessons learned. General requirement specifications were not edited for the contract. Instead selections based on the general requirements were tailored into in each SOW to address unique requirements. The SOW was also expanded to include numerous types of facilities to increase effectiveness. Numerous elements of the SOW are included in the current NAVFAC DB 6-part format RFP as corporate knowledge transfer. Refer to Chapter 10 for information on the previously used SOW and the current DB 6-part format RFP.

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CHAPTER 17- OPTIONS FOR IMPROVING THE TIRM PROCEDURE

17-1 INTRODUCTION

This Chapter addresses options for improving the TIRM Procedures. Options addressed are the development of new UFGS specifications for tank inspection and tank repair, tank access, installation of tell-tales, performing a hydrostatic test, coating, and commissioning.

17-2 DEVELOPMENT OF A NEW SPECIFICATION FOR TANK INSPECTION

All UFGS Sections follow a standardized format as follows:

PART 1 GENERAL

- 1.1 Summary
- 1.2 References
- 1.3 Definitions
- 1.4 Administrative Requirements
- 1.5 Performance
- 1.6 Qualifications
- 1.7 Submittals
- 1.8 Quality Assurance
- 1.9 Delivery, Storage, Handling
- 1.10 Project/Site Conditions
- 1.11 Safety
- 1.xx Other General Information as needed

PART 2 PRODUCTS

- Includes prescriptive information for all materials that are to be used for this specific specification.
- Cannot Sole Source material (ie: a specific manufacturer of a pump). The pump can be specified as meeting the requirements of API Std 610, and the performance and material composition of its components, not a specific pump manufacturer. (Refer to UFGS Section 33 52 43.23 Aviation Fuel Pumps [1])

PART 3 EXECUTION

- Includes prescriptive information on the workmanship processes to be used during the construction for this specification.
- Can state how to perform the process. ie: “Pump alignment shall be accomplished by the factory technician or a millwright trained in

pump alignment, and with the use of dial gauges or laser alignment equipment."

17-2.1 Tank Inspection Specification
Attachment BD is the Draft Specification for the Red Hill Tank Inspection.

17-2.1.1 Part 1 provides:

a. Definitions of the personnel associated with tank inspection, hot work, maximum allowable working pressure (MAWP), Tank Inspections, and types of repairs.
b. Administrative Requirements which covers sequencing of tank inspections, meeting, safety, and regulatory requirements.
c. Submittals requirements for preconstruction, design, and test reports.
d. Quality Control Qualification and Certification for the tank engineer, tank inspector, piping inspector, non-destructive examination company, non-destructive examiner, POD Analyst, and Testing Laboratories.
e. Design requirements for Tank Plate Access, Environmental conditions, gas test holes, tank geometric data, API Std 653 inspection (modified approach), non-destructive testing, piping and nozzle inspections, and all of the applicable submittals.
f. Requirements for returning the tank to service.
g. Requirements for the Suitability for Service Statement.
h. Requirements for preparation of the procedure that will be used for entry and re-entry of the tank.

17-2.1.2 Part 2 states the requirements for:

a. Qualification of Test Plate for calibration of test equipment.
b. Tank Piping Hydrostatic testing including plan, and requirements for the instrument calibration, recording instruments, temperature instruments, and volume equipment.
c. Non-Destructive Examinations, including probability of detection, metal loss and crack criteria.
d. Non-Destructive Equipment and operator.
e. Data Management.
f. Material to return the tank to service.

17-2.1.3 Part 3 states the requirements for:

a. Control of Hazardous Energy.
b. Tank Plate Access (ie: Scaffolding).
c. Gas-free environment.

d. Gas test hole installation.
e. Geometric survey.
f. Photographic Documentation.
g. Storage Tank Inspection, which includes:
    - Tank Shell and Appurtenances
    - Structure
    - Substrate
    - Vent Piping
    - Coating Inspection
    - Engineering Assessment
    - Protect in Place
h. NDE Techniques.
    - Visual Examination
    - Tank Shell Scan
    - Weld Scan
    - Thickness measurements
    - Vacuum Box Testing
i. Piping and nozzle inspection.
    - Tank piping hydrostatic testing
    - Valves
j. Test Hole Repair.
k. Destructive Testing.
l. Tank Calibration.
m. Data Management.
n. Tank Return to Service.
o. Inspection Report.
    - Preliminary Report
    - Full Inspection Report
p. NDE Reliability Report.

17-2.2 Detection and measurement of corrosion on a Red Hill tank has been and will continue to be performed via electromagnetic and ultrasonic methods described in Chapter 4 of this report. Establishing and improving the reliability of technologies used to detect backside corrosion is of principal interest to the Navy. Attachment BD details the procedures to test equipment and operators in order to validate the thresholds of detection and to quantify the probability that relevant indications are being detected. Destructive testing to will be conducted on each Red Hill tank to establish the shell plate metallurgy and mechanical properties, and verify weldability. Attachment BE provides details. Details of complementary destructive testing are contained in the AOC SOW, Section 5.2, Red Hill Facility Corrosion and Metal Fatigue Practices Report.

The Navy is continually evaluating variations and refinements on UT and electromagnetic technologies, as well as alternative inspection methods. Technologies in use in the industry have and will continue to be considered. Validation of the suitability of emerging technologies will take place at non-Red Hill locations until such time as they are found to be mature and reliable enough for testing inside the facility. One technology in use in industry which is believed to be ready for testing inside the facility is SLOFEC.

17-2.2.2 SLOFEC is saturated low frequency eddy current technology. The technique uses the eddy current principle in combination with a magnetic field. Changes in eddy current field lines are measured and analyzed to compare difference in signal amplitude, phase, shape, and calibration data. The result is an instrument sensitive to and able to differentiate between product and backside indications, is able to quickly screen surfaces, and is claimed to be capable of quantifying defects. Advantages of SLOFEC are the speed of use, real-time data acquisition and review, and the capability to both detect and quantify indications. SLOFEC is used in the storage tank inspection industry for use on tank bottoms. Once detection reliability has been quantified, SLOFEC is recommended to be used on a trial basis at Red Hill.

17-2.2.3 API Std 653 provides a method for calculating the minimum acceptable thickness for a tank bottom. The method calculates the minimum thickness at the end of a service interval based on measurements and the corrosion rate. For inspection and calculation purposes, the modified API Std 653 approach at Red Hill considers all tank hydraulic surfaces to be a tank bottom. Since corrosion rate data are incomplete at Red Hill, the Navy is implementing a more conservative engineered approach derived from the API Std 653 and API 570 standards. For purposes of determining minimum plate thickness at the end of a service interval, a factor of safety of two will be applied. The goal of the approach is that plate thickness will be no less than 0.100 inch at the end of a 20-year interval.

17-2.2.4 High confidence in locating pits and corrosion using available methods: Current industry practice to detect and size backside corrosion is with electromagnetic methods backed up with ultrasonic methods. Nondestructive examination companies routinely qualify examiners and methods. At least one firm qualifies examiners on test plates which came from a Red Hill tank.

As mentioned in Chapter 4, the reliability of LFET has previously been quantified on a pipeline on the Alaska. However, quantifying reliability of detection method has not been done at Red Hill. The Navy is developing procedures to establish the reliability of the detection methods with a POD examination of methods and operators. Attachment BD has requirements for the examination. The Navy will evaluate the means and methods required to perform POD examinations and investigate changes in the requirements as-necessary to improve results.

17-2.2.5 The following is a narrative regarding the potential of corrosion when dissimilar metals are welded together (ie: new plate to old plate).

Corrosion failures of welds may occur although the proper base metal and filler metal have been selected, industry codes and standards have been followed, and good quality, full penetration welds have been made with the proper shape and contour. Although the wrought form of a metal or alloy may be resistant to corrosion in a particular environment, the welded product may not. Also welds can be made using a filler metal or can be made autogenously (without filler metal).

a. Factors Influencing Corrosion of Weldments:
   It is not always possible to determine why welds corrode; however, the failure is often due to one or a combination of the following factors [2]:
   1) Weldment design
   2) Fabrication technique
   3) Welding practices
   4) Moisture contamination
   5) Organic or inorganic chemical species
   6) Oxide film and scale
   7) Weld slag and spatter
   8) Incomplete weld penetration or fusion
   9) Porosity
   10) Cracks (crevices)
   11) Improper choice of filler metal
   12) Final surface finish

Corrosion resistance can usually be maintained in the welded product by balancing alloy compositions, by shielding molten and hot metal surfaces from reactive gases in the weld environment, and by choosing the proper welding parameters.

b. Dissimilar (Galvanic) Metal Couples

Although some alloys can be autogenously welded, filler metals are more commonly used. The use of filler metals with compositions different from the base material may produce an electrochemical potential difference that makes some regions of the weldment more active. For example, the E6013 welding electrode is known to be highly anodic to A285 base metal in a seawater environment. It is important to select a suitable filler metal when an application involves a harsh environment. Other causes of galvanic corrosion include:

1) Different composition of metal plates being welded together. One material may be anodic to the other.
2) New steel being welded to old steel. New steel is typically anodic to old steel and may corrode at a higher rate than the existing old steel.
3) A mechanical defect in the metal (a gouge or scrape may be anodic to the surrounding parent metal).

The simple presence of a galvanic couple does not mean that galvanic corrosion will necessarily occur. The galvanic couple must create a corrosion cell in order for the corrosion process to occur. The four components of a corrosion cell must be present for corrosion to occur:

1) Anode (anodic material)
2) Cathode (cathodic or more noble material)
3) Metallic connection (welded joint)
4) Electrolyte (moisture, soil, chloride contaminated concrete – fuel is not an electrolyte)

The severity of corrosion will depend upon the potential difference between the differing metals, the relative difference in size between the anodic and cathodic materials, and the aggressiveness of the environment.

c. Coating

In the case of the Red Hill storage tanks, the application of a protective coating to the welded steel surfaces will remove the electrolyte and effectively mitigate corrosion. Corrosion may still occur at any coating defects. The concrete on the exterior side of the steel plates, if dry and not contaminated with chlorides, is not a corrosive electrolyte, and the concrete’s high pH will passivate the steel. Corrosion will occur when water containing salts infiltrates between the concrete and steel, and provides a significantly conductive electrolyte to complete the corrosion cell.

Corrosion can be detected by non-destructive testing, confirmed by the destructive testing/inspection of steel plates during normal tank integrity testing inspection and resulting repairs. Although corrosion may be found, it may not be possible to absolutely ascertain that the corrosion was caused by a galvanic couple.

d. Welding Practice to Minimize Corrosion

Several methods are available to minimize corrosion in weldments.

1) Properly select materials and welding consumables to reduce the macro- and micro-compositional differences across the weldment and thus reduce the galvanic effects.
2) Properly specify a cleaning process that can reduce defects that may become sites for corrosive attack in an aggressive environment. The surface preparation and cleaning process can also create a corrosion problem. A mechanically cleaned surface (i.e., cleaned by sand blasting or grinding) can leave impurities on the surface. The type of wire brush used can also be an important consideration. Generally, specify stainless steel brushes as they do not form corrosion products capable of holding moisture.
3) Specify a weld design with relatively flat beads with low profiles and minimal slag entrapment. A poor design can generate crevices that trap stagnant solutions, leading to pitting and crevice corrosion.
4) Complete penetration is essential for avoiding under-bead gaps. Remove slag after each pass with a power grinder or power chipping tool. If the welding method uses flux, thoroughly remove the flux because many flux residues are hydrophilic and corrosive.
5) Visually inspect the weld immediately after welding. Maximum corrosion resistance usually requires a smooth uniformly oxidized surface that is free from foreign particles and irregularities. Deposits normally vary in roughness and in degree of weld spatter, a concern that can be minimized by grinding. For smooth weld deposits, wire brushing may be sufficient.
6) When a variation in composition across the weld metal can cause localized attack, consider specifying the use of protective coatings. The coating needs to cover both the weldment and the parent metal, and it too requires special surface preparation before coating application.

7) Proper selection and specification of welding consumables, proper welding practice, and thorough slag removal to help minimize crevice corrosion damage. Slag that is still adhering to the weld deposit and defects such as lack of penetration and micro-fissures can result in crevices that can promote a localized concentration cell, resulting in crevice corrosion.

17-2.2.6 Destructive testing is planned during the tank inspections. The intent is to establish the pedigree of the steel plates, document material variability within and amongst the tanks, confirm backside corrosion NDE results, and confirm weldability.

To establish pedigree, chemical, mechanical, macrographic, and metallographic analysis will be performed in laboratory testing of coupons. Attachment BD and the AOC SOW, Section 5.2 Corrosion and Metal Fatigue Practices Report provide more information. Weldability of the base metal will be confirmed by qualifying fillet and butt joint weld procedure(s) on a test coupon as required in Attachment BE during the repair phase.

17-3 DEVELOPMENT OF A NEW SPECIFICATION FOR TANK REPAIR

17-3.1 Attachment BE is the Draft Specification for the Red Hill Tank Repair.

17-3.1.1 Part 1 provides:

a. List of applicable References.
b. Definitions of the personnel associated with the design of repairs and repair of tanks.
c. Submittals requirements for preconstruction, shop drawings, product data, design, test reports, certificates, field reports, and close out.
d. General Requirements for Welding, Weld Inspection, and Nondestructive Examination.
e. Administrative Requirements which covers meetings, sequencing and scheduling of tank repairs, and QC meetings.
f. Design requirements for the repairs to the tank, tower, bridge, catwalk, sample lines, drain line, and nozzles. The design will include engineered plans for tank plate access, ventilation, welding, piping hydrostatic testing following repairs, non-destructive testing of the welds, safety, and marine chemist.

g. Quality Control Documentation requirements during tank repair including a data management system, repair log, weld tracking log, shop drawings, Weld Inspections, NDE Procedures, and tank repair inspection.
h. Qualification and Certification of weld procedures and personnel, Welding Procedure Specification, Procedure Qualification Record, Welding personnel performance, Weld Inspector, NDE Examiner, Tank Engineer, Tank Inspector of Record, Independent Tank Inspector, Independent Testing Organization, and Marine Chemist.
i. Delivery, Storage, and handling of materials.

17-3.1.2 Part 2 states the requirements for:

a. Materials including steel plates, gaskets, fasteners, carbon steel pipe, structural steel shapes, flanges, valves, welding materials, and mortar.
b. Steel plates for fillet welded patch plates, and insert and Replacement plates.
c. Materials for the catwalk repairs.
d. Materials for the sample lines repairs.

17-3.1.3 Part 3 states the requirements for:

a. Safety.
    - Control of Hazardous Energy
    - Tank Plate Access
    - Preparation for Entry
    - Gas-free environment
    - Gas test hole installation
b. Welding Operations.
    - Identification
    - Weld Joint Fit-Up
    - Preheat and Interpass Temperatures
    - Welding
c. Tank Repairs.
    - Grinding
    - Cutting
    - Marking
    - Installation
    - Substrate
    - Shell Plate
    - Gas Test Hole Repair
    - Weld Repair
    - Nozzles, Flanges, and Manway

- Barrel to Lower Dome Joint
- Barrel to Upper Dome Joint (adjustment plate)
- Expansion Ring Joint
- Strain Gauge Pipe
- Grout and Grout Relief piping
- Drain Line
- Sample Lines
- Interior Piping and Supports
- Tank Appurtenances and Attachments
- Tower, Bridge, and Catwalk
- Coating System
- Tank Calibration Table

d. Valve Repair.

e. Inspection, Examination, and Testing.
- Inspection of Repairs
- Weld Inspection
- NDE
- Pneumatic Pressure Test
- Hydrostatic Testing (on nozzles)
- Inspection and Tests by the Government

f. Correction and Rework.
- Damage
- Rework
- Inspection and NDE of Rework

g. Data Management.

h. Closeout Activities.
- Cleaning Interior Surfaces
- Inspection During Tank Filling
- Completion Report, including as-built drawings
- Tank Return To Service Documentation

17-4 COMPARISON OF EQUIPMENT USED OVER THE YEARS FOR PERSONNEL ACCESS TO THE TANK SHELL IN THE UPPER DOME, BARREL, AND LOWER DOME

17-4.1 1940 - 1943 Original Tank Construction

a. A circular metal framed wooden platform was installed around the entire tank perimeter. The platform was raised and lowered by hand operated winches. Also, steel and wood plank scaffolding welded to tank shell was used.

b. Water staging was used during the final leak test/leak repair work in each tank. The water level in a tank was gradually increased as air was pumped behind the shell plates via the tell-tale pipes under low pressure. Leaks through the shell plates and welds showed up as bubbles in the tank. Welders working in small boats applied patches and repaired welds to stop the leaks.

17-4.2 1960 - 1962 Clean, Repair, Modify, and Coat Tanks 17-20

Tanks were filled with fuel in the leak search phase. New upgraded tell-tales helped to locate the general area of the leaks. Tanks were filled with water in the leak repair phase and the tell-tales were used to inject air behind shell plates to pinpoint the leaks. Welders worked from water staging (rafts/boats) to repair the leaks.

17-4.3 1970 – 1972 Clean, Repair, and Modify Tanks 5, 6, and 12

Water staging was used in this project. However the project was limited to use of one full tank of water (approximately 12,000,000 gallons) that was rotated among the three tanks due to the fact that Hawaii was in a severe drought condition at the time. The project included a water piping and pumping system that allowed the water to be easily transferred from tank to tank.

17-4.4 1978 - 1985 Clean, Repair, Modify, and Coat Tanks 1-16

The work was executed under FY-78 MILCON Project No. P-060. The Prime Contractor was Hawaiian Dredging and Construction. For the initial major repairs two separate scaffold systems were installed in each tank. For the follow-on re-entry into a tank for leak search and repair, a different scaffold system was used. All scaffold systems were driven by hydraulic or compressed air powered motors.

a. Major repair work.

(1) Upper Dome. First, structural members were added to the top of the center tower to strengthen and stiffen it. (The added structural members were never removed.) Next, three guy wires on each tower leg, one each at the Upper Spring Line midpoint and Lower Spring Line (twelve wires total) connecting the tower leg to points opposite on the tank shell were removed. Then two box-shaped steel rings were

installed horizontally around the outside of the center tower, one near the top of the tower and another on the tower 10’-15’ above the catwalk. Next a truss matching the curvature of the Upper Dome was attached to the two rings on the tower. The truss rotated on the ring 360 degrees around the tower. Three man-baskets capable of moving independently up and down the topside of the truss were installed. This was the dome truss rotating scaffold and it provided access to all points on the Upper Dome. See Attachment B for photos of the Dome Truss Scaffolding. This scaffolding is still on-site but its suitability for service is unknown. In addition, drawings for this scaffolding are available.

(2) Barrel and upper (steep) section of Lower Dome. Just above the spring line near the bottom of the Lower Dome, a trolley rail was installed around the perimeter of the tank. The trolley rail supported two hanging scaffold platforms (similar to window washing scaffolds) to provide access to the Barrel and upper sections of the Lower Dome. See Attachment C for photos of the monorail scaffolding.

b. Follow-on tank re-entry for leak search and repair.

Upper Dome, Barrel, and upper (steep) section of Lower Dome. Two telescoping box booms are attached to opposite legs of the center tower. The attachment/pivot point on the tower leg for the inner end of the boom is approximately 3-feet above the catwalk level. The outer end of the boom is raised and lowered by a cable that runs over a sheave attached to the same tower leg near the top of the tower. A cable hangs from the outer end of the boom on which an industrial man-basket climbs up and down to access the tank shell. From the pivot point each boom rotates horizontally 180-degrees to cover half of the tank Barrel and vertically 90-degrees to cover half of the Upper Dome. The boom and man-basket are moved by hydraulic and air-driven motors and winches. The man-basket is able to access most, but not all areas of the tank shell (Attachment D).

c. Dome truss and trolley rail with hanging platforms vs. telescoping box booms with man-baskets.

(1) Advantages - Dome truss and trolley with hanging platforms

- Five work platforms can support five teams working simultaneously.

- Separate scaffold systems support simultaneous work in Upper Dome and Barrel/Lower Dome.
- Dome truss scaffold provides rapid access to all points on Upper Dome.
- Hanging work platforms travel rapidly on trolley rail to expedite plate scanning in horizontal direction.
- Hanging work platforms are 14-foot long.
- 14-foot long work platform with rapid horizontal travel enables scan of an entire 20-foot long x 5-foot high plate in Barrel section at once.
- Provides two work platforms each in Upper Dome and Barrel to support large shell plate repairs.

(2) Disadvantages - Dome truss and trolley with hanging platforms

- Requires a long time to install and remove from tank (estimate 2-3 weeks each) due to heavy weight and more parts to assemble.
- Requires complicated and difficult rigging.
- Condition and suitability for use of vintage components is unknown.
- Examination and re-engineering by a licensed engineer is required to ensure current safety standards are met.
- Unclear whether vintage system is complete.
- Heavy system difficult to handle and transport through tunnel and tank manway.

(3) Advantages - Two telescoping box booms each with a man-basket

- Requires a shorter time to install and remove from tank (estimate 3-5 days each) due to relatively lighter weight and fewer parts to assemble.
- Light weight system easier to handle and transport through tunnel and tank manway.
- Can access most of upper dome, barrel, and lower dome with one system.

(4) Disadvantages - Two telescoping box booms each with a man-basket

- Maximum of two work platforms.
- Limited boom lift capacity which must be strictly adhered to.
- Low boom lift capacity limits size of man-basket, number of personnel, and amount of portable equipment in basket. Man-basket approximately 8-feet by 3-feet.

- 8-foot long man-basket requires more vertical “drops” to cover tank shell.
- Vertical “drops” and horizontal travel are overly time consuming – scanning stops, boom telescopes in, man-basket travels vertically and/or horizontally, boom telescopes back out to tank shell, scanning starts again.
- Cannot scan complete 20-foot long x 5-foot high shell plate in one drop. Scan limited to 8-foot length of man-basket.
- Limited access to Courses E and F in Upper Dome.
- Limited access to shell plates in barrel directly beneath catwalk.

17-5 OTHER METHODS OF ACCESS FOR INSPECTION AND REPAIR

17-5.1 Scaffolding

Multi-tiered modular platform scaffold is a traditional type of approach to providing worker access to a workspace. Fixed platform scaffold provides workers with a stable working surface, safety rails, and fall protection anchorages. Fixed platform access allows better illumination and the capability for simultaneous work in different areas. Fixed tier scaffolding of an entire Red Hill tank has never been accomplished.

17-5.1.1 Advantages for Scaffolding

a. Can have multiple people working concurrently throughout the tank.
b. May get better inspections since they will be able to inspect one plate at a time.
c. May get better QC/QA since because the work can be inspected when it is being done.

17-5.1.2 Disadvantages for Scaffolding

a. Time for assembly/disassembly of each massive scaffold structure (approximately 3 months to erect).
b. All scaffold components must be manually transported through the single tank manway.
c. Availability of that much scaffolding for three tanks simultaneously.
d. Availability of personnel to erect the scaffolding (25 or so for each tank).
e. Extensive rigging required for assembly and dismantlement.
f. Design of scaffolding – will need to be engineered, supported, and braced properly and independent of the tank shell. This will require installation of numerous anchorages through the tank shell and into the tank concrete substrate at various heights.

g. Availability of qualified inspectors to warrant the cost and time (will it take just as long to inspect with the scaffolding than with just the baskets due to limited number of inspectors).
h. The entire scaffold system must be inspected every day prior to the work shift.
i. Access to the upper dome will require a scaffold bridge structure.
j. Stairways required for scaffold access.
k. Area on a scaffold tier must be safeguarded from worker access during work on a tier above.
l. Scaffold must be removed prior to coating of the lower dome – so a different access system will be required to access the top part of the lower dome.
m. Availability of qualified welders to warrant the cost and time (will it take just as long to weld with the scaffolding than with just the baskets due to limited number of welders).
n. Safety.

17-6 COATINGS

17-6.1 Coating History

17-6.1.1 1962 – Tanks 17-20

The entire tank shell was coated with a thin film polyurethane coating system formulated by Naval Research Laboratory.

From the WGS coating inspection in Tank 17 (then in place for 50 years) during October 2012:

> "The overall coating is in fair condition. The coating has small areas that have disbonded, flaked, or deteriorated over the majority of the internal surfaces. The Lower Dome and floor are in poor condition."

From the Shaw Environmental coating inspection in Tank 20 (then in place for 48 years) in October 2008:

> "The area referenced as the Lower Dome has approximately 40% coating failure with exposure of the tank steel liner. The area known as the tank Barrel section was noted to have smaller areas of coating failure. The tank Upper Dome was noted to have the best areas of coating with only minimal failure."

17-6.1.2 1982 – Tanks 1-16

The entire tank shell was coated with a thin film polyurethane coating system re-formulated by Naval Research Laboratory. Differences from the 1962 formulation include an acid wash primer applied to the steel after sandblasting to remove any rust remaining in the pores of the steel, and the application of flame sprayed aluminum to the circular flat bottom and a few feet up the first sloping plates prior to applying the polyurethane coating system. It was thought that the polyurethane would adhere better to the more porous aluminum. Upon inspection in later years, it was found that over time the aluminum sacrificed itself to the steel, forming aluminum oxide. With no aluminum to adhere to, the polyurethane coating disbonded from the tank bottom.

17-6.1.3 1994 to Present

Tanks 2, 4, 5, 6, 7, 8, 10, 14, 15, 16, 17, and 20 have been cleaned, inspected, and repaired. In each tank the coating covering the flame sprayed aluminum on the tank bottom was removed along with any remaining aluminum, and the area was recoated. In some cases the entire Lower Dome was sandblasted to bare metal and recoated. The 1982-vintage polyurethane coating in the Barrel and Upper Dome is generally in good condition and remains in place in most, if not all, tanks. Starting in 1998, the sandblasted steel was checked for soluble salts (chlorides, sulfates, and nitrates) prior to recoating and cleaned as required.

17-6.2 Low VOC Polysulfide Interior Coating Of Welded Steel Petroleum Fuel Tanks (UFGS Section 09 97 13.15)

17-6.2.1 Background

The polyurethane over epoxy coating system that was developed by the Navy Research Laboratory was applied to these tanks over 50 years ago, and the coating is still in good (not great) condition. The issue with this coating system is that it was very expensive and took skill and experience to apply. Due to this issue, this system was not used frequently within the DoD, but instead, the 3-coat epoxy which was the normal specification (UFGS Section 09 97.13.17 Three Coat Epoxy Interior Coating of Welded Steel Petroleum Fuel Tanks).

Knowing that the 3-coat epoxy system was only lasting maybe 20 years, the Navy recently developed and published a new specification. This new coating specification is for a Low volatile organic compound (VOC)

Polysulfide Epoxy Coating system. This system is expected to exceed 50 years without any failure.

17-6.2.2 Performance

The Low VOC Polysulfide Epoxy Coating System cost approximately 30% more than the 3-coat epoxy system, but it will last 2-3 times as long. The dry film thickness is 24 to 30 mils. The new system has the following advantages:

a. Adhesion is around 2x greater (+2000 psi vs 800 to 1000 psi) helps reduce impact of under film corrosion.
b. Better chemical / fuel resistance - novolac epoxy vs standard epoxy
c. Greater impact resistance.
d. Greater abrasion resistance which will better resist erosion due to fuel movement and any debris that may get through.
e. Greater elongation (50% vs 10%) which will make it more adaptable to temperature extremes, hold on to edges, corners, weld seams.
f. Greater flexibility which will help it retain shape over longer periods of time.
g. Higher solids (100% vs 60%) so number of gallons used to achieve the dry film thickness (DFT) is less and thinning or pulling at edges and corners is eliminated.
h. Higher contact angle (slicker) approaching "Teflon" which will allow it to shed water more easily, important to keeping water off the bottom which can lead to corrosion of tank bottoms and easier to clean and inspect tanks holding heavier fuels.
i. Lower porosity thereby reducing effects of moisture on steel substrates (corrosion of tank bottoms).
j. The DFT is about twice that of the old system on top of all the improved qualities.
k. A previous generation system was applied to a steel tank in 1998 and inspected in 2008. No signs of any type of deterioration were evident. There were no striations at fuel inlet or outlet, no checking (minor cracks), no apparent loss in gloss, no edge cracks or corrosion marks of any type.

17-6.2.3 Quality Control

a. QA / QC updates in the new UFGS have been added to the two coat specification that makes it more robust in the coating application and contractor oversight.
b. Holiday testing - check for pinholes in the coating - is done after the first coat of the coating is applied. If any holidays are found they are fixed and

retested. The second coat is then applied providing greater insurance of an intact and continuous system. The 3-coat system is checked after fully applied and holidays fixed. This should not be a problem but it is not a truly continuous film.

c. While the system requires heated hoses during application, other environmental conditions are similar but the system is more tolerant of hotter substrate temperatures offering a greater range of application conditions and potential reduction in required environmental controls such as dehumidification.

17-6.2.4 Environmental Regulations

a. Many States are now requiring coating systems to have Low VOC's.
b. The Low VOC (0%) Modified Epoxy Polysulfide meets the States' newer environmental regulations.
c. The three coat Epoxy System does NOT meet the States' newer environmental regulations.

17-6.2.5 Long Term Repair

a. The system is easily repaired as it easily adheres to itself.
b. This is useful when tanks are modified and coating is damaged.
c. The 3 coat epoxy system embrittles with time as it continues to cross link with time (slowly) and requires greater care to repair.
d. The new system is not expected to embrittle since full cure is set and completed during application.

17-7 TELL-TALE LEAK DETECTION SYSTEM

Refer to the AOC SOW, Section 3, Tank Upgrade Alternatives, for additional discussions for the best available practicable technology concerning the tell-tale leak detection system.

17-7.1 Background

Attachment BF provides a narrative of the installation of the tell-tale leak detection system. The original 1942 vintage tell-tales were removed and replaced with upgraded tell-tales in Tanks 17 through 20 in 1960 to 1962 and in Tanks 5, 6, and 12 in 1970-1972. Attachment BF contains isometric sketches of the changes made. The original and upgraded tell-tales were completely removed from Tanks 1-16 in 1978-1982, and from Tanks 20 and 17 in recent years. Attachment BF includes a memorandum from March 1972 which describes the telltale system, identifies reasons for its installation, and makes a case for the system to be kept functional. The author of the memorandum was an engineer who, at the time of the memo, had in-depth involvement at Red Hill for thirty years (including its original construction).

17-7.2 Advantages of the Tell-Tale Leak Detection System

a. The tell-tale leak detection system provides a real-time, analog tool for identifying potential releases, collects product trapped in the reinforced concrete shell to steel liner interstice, and provide a pathway to relieve product from the interstice.
b. Should a positive indication be received, the system will provide information about the region, height, and azimuth of the possible release point.
c. Each tell-tale will relieve water which might have percolated into the interstice between the back side of the steel shell plates and the inner side of the concrete wall.
d. The tell-tale system relieves hydrostatic pressure outside the tank shell and provides piping to relieve product from the interstice.
e. Prior to placing the tank back into service, the tell-tale system can be used to perform leak testing by injecting tracer gas at the bottom of the tell-tale and sensing to detect the tracer gas inside the tank. Tracer gas technology can be used to detect and locate holes through the tank shell plates and shell plate welds regardless of whether the holes are due to corrosion or stress cracking. This will complement the electronic methods used to find flaws in the shell plate and shell plate welds and will increase the confidence in the overall POD.

17-7.3 Disadvantages of the Tell-Tale Leak Detection System

a. To reinstall the tell-tales will require the removal of 550 patch plates in each tank, and the welding of pipe to the tank shell at each location. This will require design, seal welding, quality control and testing, and quality assurance.
b. The tell-tales could possibly hinder future inspections since the scanning equipment cannot fit between the tell-tale pipe and the tank shell.

17-7.4 Improvements to the Tell-Tale Leak Detection System

a. The original design can be modified to incorporate the following improvements:
    - Increasing the pipe diameter from ¾” to 1½” to prevent clogging.
    - Increasing the wall thickness from standard to extra heavy to provide corrosion allowance.

- Extending the pipes up into the Gauging Gallery at the top of the tank where they could be readily accessed for flushing and cleaning.
- Relocating the point at which the tell-tale pipes exit the tank to well above the tank bottom so the pipes would not be exposed to the corrosive effect of tank bottom water.

b. These improvements will need to be investigated to insure that the tank structure can support the weight of the tell-tale pipe.

c. As an alternative to carbon steel pipe, the use of a flexible pipe which is currently being used in the oil and gas industry can be investigated. This pipe was recently approved by the DoD via third party testing to be compatible with Jet Fuel (with the DoD additives) on the inside and outside of the pipe. There are issues associated with this pipe including the ability to support itself, its bend radius, and the smallest available size is four-inches (4”).

17-8 TANK HYDROTESTING WITH WATER

17-8.1 Background

The tanks were hydrotested with water when they were originally constructed as means of tightness testing. The water was transferred from tank to tank during the progression of the construction.

17-8.2 Concept of Hydrostatically Testing the Tanks

a. Filling, gauging, and emptying.

A Red Hill tank can be filled by gravity flow from the NAVFACHI water tank. A tank can be splash filled in stages up to the level of the 5-foot diameter cylindrical section at the top of the tank where a liquid level change of 1/8-inch equals 1.53 gallons. In order for hand gauging be as accurate as possible, the tank is to be splash filled first through the 8-foot dia. entry tube at the upper access tunnel (UAT) level, and then topped off by filling from the Gauging Gallery at the top of the tank. This will allow the gauger to be as close as possible to the free surface when gauging the tank, thereby increasing the accuracy of the gauge. In order that the gaugers can enter the tank to take manual gauges, forced air ventilation of the tank via the 20” dia. manway at the UAT level and the 30” dia. manway at the top of the tank is to be maintained along with some lighting while the tank is filled to the catwalk level. When the leak test is complete, nearly all of the water could be transferred to Tank 1 for temporary storage for future leak testing, with the remaining water transferred via the existing oily waste discharge line from the sump near Tank 1 to the lower tunnel access point. Disposition of the test water would depend on its quality and requirements in a permit to be received from the State Department of Health pursuant to Hawaii Administrative Rules 11-55 National Pollutant Discharge Elimination System (NPDES) General Permit Authorizing Discharges of Hydrotesting Waters. It will take approximately up to 12,700,000 gallons to fill a tank. The capacity of Tank 1 is 12,000,000 gallons. Therefore, it is possible that 700,000 gallons of water would need to be discharged pursuant to requirements in the NPDES permit.

b. Existing water transfer piping. The existing 6” diameter water lines in the Upper and Lower Access Tunnels are believed to be from the original 1940-1943 construction and should not be used to transport the high volume of water needed to fill a tank.

c. New water transfer piping. In order to fill a tank with water for hydrotesting as a means of leak testing, and due to the age of existing piping, new or temporary sections of water line in the adits and tunnels will need to be installed. The piping, valves, and hoses to be temporarily installed for filling and draining would be Class 150 groove-coupled pipe, Class 150 gate and ball valves, and light weight spiral wound flexible suction hose with cam-lock connections.

   (1) Filling pipe and hoses: In the upper access tunnel, thousands of feet of piping of pipe would need to be installed to connect the end of the existing water line to the manway of a tank. The end of the pipe would need an isolation valve and a cam-lock connector. Tanks would be filled through the manway and then through the gauger station.

   (2) Drain pipe and hoses: In the lower access tunnel thousands of feet of piping would need to be installed from the tank bottom to the slop line connection. The end of the pipe would need an isolation valve and a cam-lock connector. A centrifugal pump would need to be operated in a cross tunnel to lift water into Tank 1 after transfer by gravity has equalized. Water which cannot be stored in Tank 1 would need to be piped to the existing slop line connection to transfer to outside of the Red Hill tank facility.

   (3) Piping and/or hose would need to be installed from the point outside of the Red Hill tank facility to the point of collection or discharge, depending on the NPDES permit requirements.

17-8.3 Advantages to Performing a Hydrostatic Test

a. The tank will be filled using a method that will ensure the integrity of the tank without a risk to the environment.

b. The water will be available for the following tanks, after rerouting the water piping in the tunnel and installing pumps. If a tank is filled with water after an upgraded tell-tale system is installed and the water is dosed with a tracer chemical, the tell-tale system could be used to detect leaks and determine the general area of the leaks.

17-8.4 Disadvantages to Performing a Hydrostatic Test as Means to Determining Tightness

a. The cost is very high. The Government will have to purchase the water, install the piping and pumps.
b. The Government will need to maintain the quality of the water to prevent biological growth corrosion on the tank bottoms.
c. The schedule to install the piping and to fill the tank can take over a year.
d. If Tank 1 was designated to receive and/or store test water, it would need to be inspected, repaired, and coated before receipt.
e. This type of test is a last resort because of the lack of information and the shell stress it produces. It is a gross test only, and provides little to no information as to the location of a possible release point.

17-9 TANK COMMISSIONING

17-9.1 Tank Out-of-Service

a. The goal in filling a Red Hill tank is to do it in such a way that the integrity of the tank can be determined by the operator monitoring the tank during stop and hold points. Fuel expansion due to temperature increase can mask a loss of fuel from the tank. On the other side, fuel shrinkage due to temperature decrease can give a false impression that the tank is leaking when it is not. Historically, the temperature of fuel in long term storage at Red Hill is 80 degrees F plus or minus one (1) degree. The key to a successful leak test is to minimize the time for the fuel to reach thermal equilibrium with the tank shell by:
    - Controlling tank ventilation to bring the temperature of the tank shell as close as possible to 80 degrees F, and
    - Refilling the tank from Red Hill tank(s) and upper tank farm tank(s) with fuel that has been in long term storage so that the temperature in the tanks have stabilized.
b. When a Red Hill tank is taken out-of-service for cleaning and repair, on average it remains empty for three years. Now that the tunnels have a balanced ventilation system, the air supply into the tank will be from outside of the tunnel, and the exhaust air will be vented outside of the

tunnel. In the month preceding refill of the tank there should not be any added heat in the form of hot work or lights in the tank, so the temperature of the steel tank shell can be expected to assume the average temperature of the ventilation air. The temperature of the reinforced concrete shell behind the inner steel shell is less likely to be effected by the ventilation air.

17-9.2 Prepare Tank for Refilling

a. Measure the temperature of the steel tank shell several weeks prior to refilling the tank.
   - If the average shell temperature is less than 80 degrees F, continue ventilating with warmer daytime air only.
   - If the average shell temperature is greater than 80 degrees F, continue ventilating with cooler night air only.
b. Check the tank and nozzle pipes for cleanliness and remove all dirt and debris, especially:
   - Anything that could get caught in a valve and cause it to leak, and
   - Check all horizontal surfaces that could hold dirt and debris at the upper and lower spring lines, on the catwalk, center tower, and tank bottom.
c. Check the operation of tank valves and check that all flanges are properly tightened.
d. Lower AFHE probe and reseat in place. Verify the operation of the high level switch and its interface with the skin valve and associated time delay relay.
e. Just prior to closing the tank's manway, measure the temperature of the tank shell to know whether to expect the fuel to expand or shrink.

17-9.3 Refilling the Tank

Transfer the test fuel from a single full Red Hill tank with temperature stable fuel that has been in long term storage.

a. Slowly allow fuel from one Red Hill tank to transfer to the tank to be filled. Ensure the flow rate in the receipt pipe is less than three-feet (3') per minute until the fuel nozzle is covered by at least three (3) feet of fuel as required by the MIL-STD 3004 (Series) to minimize turbulence, splashing and static build up.
b. The level in both tanks should equalize at about half full.
c. Tank fill stop points will be determined by several factors including amount and location of repairs and height of the courses.

d. Hold the tanks at the predetermined stop points for a minimum of 24 hours and constantly monitor the AFHE for any unexplained drop in tank level indicating a loss of fuel.
e. If there is no indication of fuel loss, continue filling the tank in stages, stopping at the stop points, as determined in step d above, and the following:
   - One-foot (1') below each expansion joint.
   - Maximum fill level height (Safe Fill Level) is based on the high operating limit for each tank.

17-9.4 Monitor the Skin Valves for By-Pass Leakage

During the tank filling process at 50% and 100% heights, check the skin valve body cavities for by-pass leakage.

17-9.5 Monitor the Casing Pipes for the Sample Lines and the Slop Line (If Slip-Lined) for Leakage.

Note that each Red Hill Tank is configured differently for the sample line and slop lines under the tank bottom. If applicable, the following checks will confirm if there is any leakage from the sample lines into the casing pipe.

a. Attach a double block and bleed valve to the drain port on each casing pipe.
b. Using the body cavity drain of the valve, monitor and measure the quantity of any fuel that leaks into the casing pipe.

17-9.6 Monitor the Tank Level

a. During the "hold" period after each stage of filling, record the time and level for each change of the AFHE reading.
b. Plot the AFHE reading (y-axis) versus time (x-axis) on a graph.
   (1) A straight line plot on the graph, i.e., a constant level drop with time most likely indicates a leak from either a hole(s) in the tank shell or leakage through a skin valve.
   (2) A curved line plot asymptotic to the x-axis most likely indicates fuel shrinkage/expansion over time due to a decrease/increase in fuel temperature.

17-10 DESIGN TO DOCUMENT TANK CONDITIONS

Each Red Hill tank has unique conditions and repairs, many of which are sparsely documented. In order to reduce variability and increase the quality of designs, NAVFAC EXWC can document the known history, repairs, and conditions of each Red Hill tank into a set of design documents. The designs would be used by the various engineering firms in performing the tank inspection and repair. The design documents would accompany new inspection and repair specifications.

17-11 REMOVE UPPER DOME COVER CHANNELS

Currently upper dome plate welds are encapsulated by cover channels. However tank filling into the upper dome is not currently being done. Numerous repairs on the seal welds on the cover channels have been performed over the years to make the cover plates tight. In order to fill the tanks to the designed heights and recover lost capacity, the cover channels can be removed. After removal, the shell plate welds would be tested and all necessary repairs performed to ensure the welds were tight.

17-12 STILLING WELLS

Current DLA Policy on ATG stilling wells (Attachment BG) is not being implemented in the Red Hill tanks. The policy specifies sizes and numbers of gauge tubes, along with details on how the tubes should be slotted. This will help ensure maximum accuracy of the tank gauging system.

17-13 COST BENEFIT MATRIX

IMPROVEMENT	COST	BENEFIT
INSPECTION SPECIFICATION	$	★★★
REPAIR SPECIFICATION	$	★★★
TANK ACCESS	$$	
COATING	$$$	★★★
REINSTALL TELL-TALES	✦	✦
PERFORM A TANK HYDROSTATIC TEST FOLLOWING REPAIRS	$$$$$$	★★
COMMISSIONING	$	★★★
DESIGN TO DOCUMENT TANK CONDITIONS	$$	★★★

REMOVE UPPER DOME COVER CHANNELS	$$$$$$	★
REPLACE STILLING WELLS	$$	★★★

✦ Refer to the AOC SOW, Section 3, Tank Upgrade Alternatives, for additional discussions for the best available practicable technology concerning the tell-tale leak detection system.

17-14 FEASIBILITY AND RELIABILITY MATRIX

IMPROVEMENT	FEASIBILITY	RELIABILITY
INSPECTION SPECIFICATION	High	High
REPAIR SPECIFICATION	High	High
TANK ACCESS	Medium	Medium
COATING	High	High
REINSTALL TELL-TALES	✦	✦
PERFORM A TANK HYDROSTATIC TEST FOLLOWING REPAIRS	Medium-high	Medium-high
COMMISSIONING	High	High
DESIGN TO DOCUMENT TANK CONDITIONS	High	High
REMOVE UPPER DOME COVER CHANNELS	Medium	Medium
REPLACE STILLING WELLS	High	High

✦ Refer to the AOC SOW, Section 3, Tank Upgrade Alternatives, for additional discussions for the best available practicable technology concerning the tell-tale leak detection system.

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CHAPTER 18- DESTRUCTIVE TESTING

18-1 INTRODUCTION

NAVFAC EXWC is planning to perform destructive testing for plates that have been cut out of the shells of one of the Red Hill tanks. The plan to perform this work will be provided per the AOC SOW, Section 5.3 Destructive Testing Scope of Work. This Chapter discusses past destructive testing related to Red Hill tanks, methods for positive material identification (PMI), and specifications and recommendations for producing and testing coupons cut out of a tank.

18-2 DESTRUCTIVE TESTING

No specific destructive testing was performed on Tank 5.

A section of shell plate that was removed from Tank 16 in May 2006 by Dunkin and Bush resides in Pittsburgh with TesTex and has been used by them to test and calibrate their LFET equipment. The plate section was removed because it was covered with backside corrosion. The average remaining thickness was 0.153-inch and ranged from 0.000-inch (two holes) to 0.200-inch. Dimensions of the plate were 10-feet high by 4 to 7-feet wide. Attachment J is the report on Tank 16 by Weston Solutions which includes photos of this plate.

18-3 MATERIAL VERIFICATION

18-3.1 Positive Material Identification (PMI)

18-3.1.1 X-ray Fluorescence (XRF)

Description: XRF analyzers can quickly and easily help verify the composition of metal alloys. A portable device transmits X-rays on the surface of a sample under analysis. In response to the energy from these X-rays, the atoms in the sample fluoresce and emit signals that the analyzer detects. Atoms of different elements respond differently to X-rays. [1] [2] Hence, one can determine the percent composition of elements in a material [1] [2], as long as the elements are magnesium or heavier (and not noble gases) [3].

Advantages: XRF analyzers do not affect the chemistry of the elements they impact. Therefore, one can determine the composition of a piece of equipment without causing it to go into downtime. [1] Each element has a limit of detection that may be as low as 0.002% by weight within a material, so XRF analyzers can distinguish between two similar metal alloys. Also, because testing a sample is fast and easy, the cost of the analyzer makes up the bulk of the total cost of analysis. [3]

Disadvantages:
a. Because XRF analyzers cannot detect carbon [2] [3], they may not be able to distinguish between metal alloys containing similar fractions of elements that are magnesium or heavier but differing percentages of carbon. In addition, even with advances in XRF technology since 1980, the limits of detection are relatively high for light elements like silicon (0.050%) and sulfur (0.01%) (compared to 0.002% for heavier elements like molybdenum). [3]
b. NAVFAC has developed a Safety program that oversees the use of Radiological equipment on Naval Facilities. This safety program requires the construction contract include UFGS Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS [4] which contains the Radiological Safety Requirements if any radiological source is required for the project. These requirements are very strict, and can be a show-stopper for all but mandatory radiological testing. If possible, most of the x-ray required is performed off-base and welded pipe is brought on-base and installed. Attachments BH and BI provide the NAVSEASYSCOM and NAVFACENGCOM's instructions concerning the use of radiographic sources on Naval Facilities.

18-3.1.2 Optical Emission Spectroscopy (OES)

Description: An OES analyzer works by emitting an electric arc onto a sample, whose atoms transmit an elemental signature of light to the analyzer. The analyzer then processes the incoming light signals to determine the elemental composition of the sample. [2]

Two groups of portable OES analyzers exist:

a. Devices that can process a large number of elements and offer laboratory-grade analysis, with little input required from the operator, while weighing as little as 33 lbs.
b. Devices that are even lighter than 33 lbs but can detect up to 16 elements only and require significant skill from the operator [2].

Advantages: Like XRF analyzers, OES analyzers are NDT devices, so a metal sample in an industrial system would not need to be removed from that system and brought into a laboratory for analysis. OES analyzers come in cordless, portable forms. [4] [5] Some have lightweight, interchangeable probes: arc, spark, ultraviolet, and combination. [4] Unlike XRF analyzers, OES analyzers can detect light elements like carbon and nitrogen. [2] One analyzer adjusts the air between the analyzer and the sample to maximize the precision of detecting carbon in iron. [6] Current systems are automatically equipped with immense databases detailing over 300,000 materials, so an operator can quickly determine, on site, the material of a sample. [4]

Disadvantages: The arcs that an OES analyzer emits can cause surrounding substances to ignite, so permits for hot work and for gas testing in the sample location may be required before OES analysis can take place. [2] In a fuel environment, OES analysis would have to be performed with extreme care because it may generate flames. However, one vendor of portable OES devices states that its products have been used in petrochemical plants and oil refineries, suggesting that OES can be operated safely around POL equipment. [4]

18-3.2 Chemical Methods of Metal Alloy Identification

18-3.2.1 Resistivity Testing

An unknown metal is placed in contact with a 300ºF (150ºC) probe of a different metal, creating a potential difference that reflects the atomic structure and chemical composition of the unknown metal. This voltage will be the same for every metal and every alloy that has the same crystalline structure, in accordance with the thermoelectric principle, also known as the Seebeck Effect. Materials both ferrous and nonferrous can be distinguished using this method, but austenitic stainless steels and alloys with less than 5% chromium are not always distinguishable. [2]

18-3.2.2 Chemical Spot Testing

A small piece of a metal is laid on top of filter paper, and a chemical is placed on that metal piece. The chemical reacts in contact with the metal and changes color differently depending on the metal’s composition, allowing an observer to determine what alloy an unknown metal is. [2] One company sells spot-test kits with reactants that are each suited for distinguishing specific pairs of metals [7]: for example, one kit can be used to test 304 vs. 316 stainless steel. [8]

This method is inexpensive and portable, and it requires very little training. [8] However, it is subjective, non-quantitative, and slow. [2]

18-4 PATCH PLATES

The Report on the Trip to Pacific Division Naval Facilities Command in 1981 (Attachment BJ) contains recommendations on welding plates on Red Hill tanks. In particular, this report states on p. 3:

> Magnetic particle inspection (M.T.) is done on ground potential weld repair areas in the barrel and bottom dome sections of the tanks (i.e. the upper dome welds are encapsulated and M.T. is not done). The M.T. is done with the AC yoke method using red or grey powder. Under the tank interior lighting conditions yellow or white M.T. powder might be more visible making rejectable linear indications more readily discernable.

The same report describes, on p. 5:

> Magnetic Particle Inspection (M.T.). The purpose of the M.T. inspection is not apparent. If there is an indication, the presence of a leak is verified by vacuum box testing. Repair is accomplished with a doubler patch plate. It is suggested that the purpose served by the M.T. inspection be reevaluated. If it is considered that a purpose is served it is suggested that yellow or white M.T. powder be used. The lighter colors would provide improved availability to detect flaws under the tank interior lighting/background conditions.

The focus of the 1981 report was to reform welding procedures on Red Hill metal plates; it does not discuss which plate materials are weldable and which are not. According to the report, if welding processes were revised and followed, future welds would no longer be defective and leaks would not be appearing. Therefore, presumably, the tank-wall materials had already weldable prior to the 1981 report. Moreover, hundreds of patch plates had been welded on the tanks without any known weldability issues.

The patch plates are connected by fillet welds on the tank walls. These welds are not structural welds, as they are not holding any structural loads.

Refer to Chapter 5 of this report for further details.

18-5 RECOMMENDATION

UFGS Section 33 56 17.00 20 (Attachment BD), paragraph 3.12 specifies the method to perform Destructive Testing. This UFGS Section states the following must be adhered to during coupon removal:

a. Five 8” x 4” coupons cut from the tank shell without distortions and with straight edges. The selection of areas from which the coupons are cut must represent each of the tank’s areas.
b. Photographs must be taken of the coupons to be tested. Testing must be performed on these coupons and must take place in an accredited laboratory (either in-house or contracted out), not in situ.
c. Types of testing to be conducted are macrographic, metallographic, mechanical, and chemical. Testing will investigate the following properties: tensile strength, yield stress, microhardness, microstructure, ductility, and carbon-equivalent limits. It will also ascertain the chemical composition of the test coupons to determine the P-number of the coupon material for welding purposes.
d. Test results are to be compared and contrasted to specifications for plate materials from the ASTM. Material characteristics must be recorded in accordance with API Std 650 Section 4 [9]. Permissible stresses for the product and for hydrostatic testing should be set according to API Std 653 Table 4.1 [10] so minimum wall thickness can be determined. The Pedigree Report (refer to UFGS Section 01 33 00.05 20 Design Submittal Procedures [11]) should contain and discuss these test results.

18-6 SOLUTION RATIONALE DISCUSSION

The overall metallurgy will be determined by the destructive testing. This destructive testing will give us the pedigree of the original steel. It will allow us to optimize the weld specification in the future for each tank.

Using the OES and XRF are field verification of the constituent components of the steel. This will allow the validation of the welding to the metal, where ever it is in the tank.

If there is any major variance, additional destructive testing will be performed, to determine if there is any change in the pedigree of the steel so that it will affect the weld specification.

It will be a learning curve to determine the maximum allowable variance between the pedigree of the steel and the OES or XRF that will change the welding specification. The more information that we have on this variance the more assurance there is on the weld procedures being used.

A database will be developed to record the results of the metallurgy of the tank, OES, XRF, and weld specifications during the TIRM of all of the tanks.

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CHAPTER 19- SCHEDULE/ FREQUENCY OF MODIFIED API STD 653 TIRM

19-1 INTRODUCTION

This Chapter addresses the schedule/frequency of API Std 653 tank inspections and performing API RP 580 Risk based inspections. This section will also discuss specific scheduling requirements and constraints in executing individual contract actions.

19-2 API STD 653 INSPECTIONS

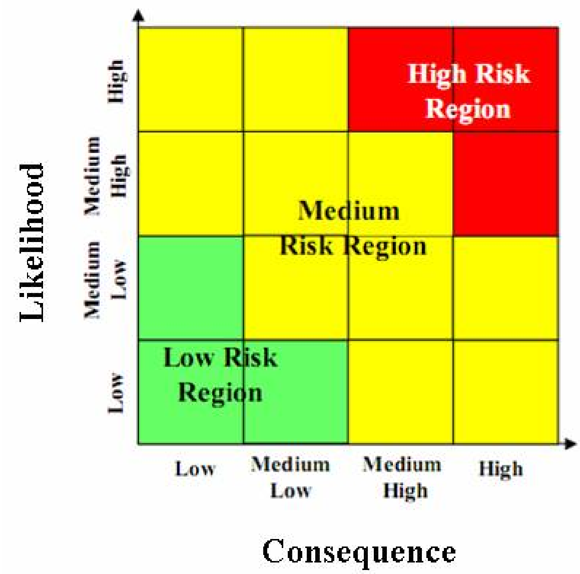
19-2.1 Section 1 of API Std 653 states the scope of the document. This document "provides minimum requirements for maintaining the integrity of such tanks [API Std 650 and API Std 12C] after they have been placed in service and addresses inspection, repair, alteration, relocation, and reconstruction." This section allows the owner/operator to "apply this standard to any steel tank constructed in accordance with a tank specification." Therefore, the Navy/DLA (owner/operator) was able to apply the API Std 653 principles on the Red Hill tanks, but "modified" the inspection techniques since the exterior of the tanks are not accessible to the inspector.

19-2.2 API Std 653, Section 6 provides the requirements for the frequency of inspection of above ground fuel storage tanks:

a. Initial Inspection - The initial internal inspection interval is stated to be 10 years, but years can be added onto this if the tank has safeguards such as a coating system, release prevention barrier, cathodic protection, or a high corrosion allowance. Therefore, the initial inspection of a new tank can be as long as 27 to 30 years after the tank was placed into service.
b. Subsequent Internal Inspection Interval – The subsequent internal inspection interval is based on:
   - Measured corrosion rate and the minimum remaining thickness (as determined in API Std 653, paragraph 4.4.5), and
   - Not to exceed 20 years for tank without a release prevention barrier.
c. API Std 653 also provides the owner/operator to "establish subsequent internal inspection intervals using risk based inspection (RBI) procedures in accordance with API RP 580 and the additional requirements of this section."

19-3 API RP 580 RISK-BASED INSPECTION, DOWNSTREAM SEGMENT

19-3.1 API RP 580 was first published in 2002 and provides a method to determine the frequency of inspection based on the probability of failure verses consequence of failure.



API RP 580 was developed to provide specific guidelines to use in performing a risk-based analysis for tanks, pressure vessels, piping, etc. The document first describes risk assessments. The risks are first identified, and then a determination is made on how to reduce or manage the risk. The document further states that there can never be zero risk based on inspection alone, since there are residual risks due to outside influences such as human error, natural disasters, external events, etc.

API RP 580 discusses how to "determine what incident could occur (consequence)" and "how likely (probability) is that the incident could happen." This exercise is performed and documented for a variety of events. The document describes the qualitative, quantitative, and semi-quantitative approaches, and then provides the process in combining the approaches for defining probability and consequences.

The document describes risk management through various tools such as inspection, inspection plan, and prioritization for implementing the plan. It further provides information on conducting Fitness for Service analysis, and other types of risk management tools.

The inspection plan and the inspection reduces risks by mitigating potential incidents that were determined to result in a high probability of consequence, or a high probability of failure. If there is a possible incident that does not lead to a high probability of failure or consequence, then mitigation of the incident does not need to be prioritized.

API RP 580 categorizes consequences as: safety and health impacts, environmental impacts, and economic impacts. The document further provides the level of consequence for each of these items, such as number of deaths, duration of environmental impacts, and costs to remediate.

The document discusses the determination of what is an acceptable risk. A method that is used is a cost-benefit analysis. This analysis provides the value of each risk reduction mitigation action, and the value of a failure that occurs if no mitigation action is taken.

In summary, the risk based inspection process is "the determination of what to inspect, how to inspect (technique), where to inspect (location), how much to inspect (coverage), and when to inspect. This determination is based on the Probability of Failure, Consequence of Failure, and the acceptance of the resulting risk. There are many factors that contribute to the acceptance of the resulting risk such as life-cycle cost analysis, changes to the system/process resulting from Fitness-for-Service analysis, redesign, rerating, and reducing the inventory.

19-3.2 Navy/DLA review of the API RP 580

The Navy/DLA investigated incorporating the API RP 580 principles in the scheduling of the CIR fuel storage tanks. The theory outlined in the document in API RP 580, paragraphs 1 through 9 can easily be applied to DoD tanks. The Navy/DLA has different Consequences of Failure than stated in paragraph 10, as outlined below. In addition, in order to be able to consistently program and plan for the TIRM of the thousands of fuel storage tanks that are owned by DoD, a constant inspection interval was determined to be required.

19-3.2.1 Current Scheduling of Tanks

In 2007, Navy/DLA initiated the CIR tank program with the objective of inspecting every tank every ten (10) years. In 2016, Navy/DLA recognized that there are too many constraints that are preventing this schedule for the overall program to be realized. Constraints include the time it takes to contract each task order, time it takes to modify each task order for additional repairs found during the inspection, resources needed to perform the contracting, and finally, the resources available to perform the actual cleaning, inspecting, and repairing of the tanks. In addition, the mission of providing fuel to the forces was being compromised due to the number and duration of the tanks that were being taken out of service and being kept out of service pending required additional repairs. Funding to perform the Navy/DLA CIR tank projects is not a constraint and is not a factor in the scheduling and programming, unlike the oil industry in which cost and profit are factors to be considered as discussed in API RP 580.

19-3.2.2 Risk-Based Inspection Investigation

In 2015, a Business Case Analysis (BCA) to determine the best inspection process to implement for all of DLA's fuel storage tanks was performed. [1] The BCA compared the following scenarios:

Alternative 1: Current Guidance (Status Quo): API Internal and Modified Inspections = Every 10 years (initial and subsequent)

Alternative 2: Extend Subsequent Inspection to Max Interval (based on Corrosion Rate Procedures = API Internal and Modified Inspections: 10 years for initial; 20 years for subsequent inspections

Alternative 3: Extend all Inspection Intervals (based on Corrosion Rate Procedures) = API Internal and Modified Inspections: 12-20 years for initial; 20 years for subsequent

Alternative 4: Extend all Inspection Intervals (based on performing RBI Assessments) = API Internal and Modified Inspections: 12-25 years for initial; 25 or 30 years for subsequent inspections.

Results from this investigation showed:

a. Alternatives 2, 3, and 4 provide the opportunity for a significant reduction in OOS instances relative to Alternative 1.
b. Alternative 3 offers a greater reduction in OOS instances over Alternative 2 due to improved optimization of API inspection schedules.
c. Alternative 4 provides the greatest reduction in OOS instances due to overall decreased inspection frequencies from risk-based inspections.
d. Alternative 4 provides SRM the greatest reduction in OOS instances, while Alternative 2 and 3 provide the greatest inspection cost savings.
e. Alternatives 2, 3, and 4 require additional implementation effort relative to the current state. Alternative 4 is significantly more complex to implement.

19-3.2.3 The BCA did not address the difference Consequence of Failure modes between the standard industry practices as stated in API RP 580 and the

Government practices. Below is a comparison between the Industry and the Government's concerns:

Government	Oil Industry Company
INSURANCE	
Self-insured - The Government pays for all inspection and repairs. - The Government pays for all environmental remediation.	Insurance - The Insurance Company pays for the environmental remediation. - The Company pays for the insurance and deductibles. - Factory Mutual Engineering Corporation also has requirements for Tank inspection intervals. Normally the Company has to adhere to these requirements in order to obtain the insurance, or to have a good insurance policy.
COSTS	
Mission - If a tank leaks and is out of service for 1-2 years, what is the cost to the Government to maintain its mission? - The fuel is required for the Government to maintain its mission in defending the Country.	Profit - The Company will perform the required preventive maintenance to maintain its insurance. - The Company may rather have a small release that may/may not be contained than to have to take a tank out of service to clean and inspect. This OOS time affects their profit, especially if nothing was wrong with the tank. The tank cleaning, inspection and profit loss may cost more than remediation.
FEDERAL ACQUISITION REGULATIONS	
- There is considerable amount of time involved (months to years) for the acquisition, inspection, repair, and remediation up spills due to the Government's acquisition regulations and post-award processes. - There are also additional costs involved (see #1 above)	- Companies normally have a contractor on a retainer so that they can have the clean-up and repair done immediately.
PUBLIC OPINION	
- The Government cannot risk being forced to close down or relocate. - Costs and Time associated with responding to queries and other public notices. - There are very few organizations	- The Shareholders of the Company's stocks are involved in responding to the public opinion. Therefore, the large companies pay a fine, repair the facility, and start working again.

that will participate in defending the Government.	

19-3.2.4 In 2016, the UFC 3-460-03, Maintenance of Fuel Facilities was rewritten. (This document cannot be released to the Public until it has received all approving signatures and is published on the Whole Building Design Guide.) The following is an excerpt from the document:

> Perform an out-of-service API Std 653 or STI SP001 inspection to evaluate the tank for conditions which may affect the operational integrity of the tank floor, shell, roof and floating roof or pan. API Std 653 or STI SP001 provides a checklist to be used as part of the assessment. This inspection must be performed by an appropriately certified API Std 653 or STI SP001 inspector. Inspection shall include all components and equipment located inside the tank containment area such as piping, pipe supports, containment valves, and product saver tanks.
> **Frequency: Every ten years or as recommended by an appropriately certified tank inspector in the previous API Std 653 or STI SP001 inspection report**."

This allows the Government to schedule the next tank inspection as recommended by the API Std 653 Inspector. Therefore, the next inspection should be in ten (10) years, unless the corrosion rate is such that it can be inspected later (ie: 20 years) as recommended by the API Std 653 Inspector. The current Navy/DLA's repair program is to repair all corrosion areas while the tank is out of service, so that the corrosion rate on non-repaired corrosion areas will allow the next inspection to be in twenty (20) years.

Draft UFGS Section 33 56 17.00 20 paragraph 1.6.5.3 (Attachment BD) provides the criteria for the calculation of corrosion rates for the Red Hill Tanks. Refer to Chapter 17-2.2.3 for additional information on the development of this criteria.

19-4 CONSTRAINTS FOR SCHEDULING THE CLEAN, INSPECT, AND REPAIR OF THE TANKS

19-4.1 Operations

The following are the operational constraints.

a. No more than one (1) JP-8 tank empty and out of service at a time.
b. No more than one (1) F-76 tank empty and out of service at a time.
c. Two (2) JP-5 tanks can be empty and out of service at one time.

d. Only three (3) tanks after tank 13 can be empty and out of service.
   - Four tanks will be out of service until October 2018.

e. Only two tanks will be issued on each task order.
   - This lowers the risk of schedule slippage if the Contractor does not perform well.

f. Adjacent tanks should be on one (1) contract, but not mandatory.

19-4.2 Physical Limitations
The physical limitations are discussed in Chapter 2.

19-4.3 Security Limitations
The security limitations are discussed in Chapter 2.

19-4.4 Qualified Personnel
The qualified personnel limitations are discussed in Chapter 2.

19-5 ACQUISITION TIMELINE

19-5.1 Attachment BK provides the timeline to procure a task order on the POL MACC contract. As shown in this attachment, approximately six (6) months are required from the time of notification of need until the contract is awarded.

19-5.2 Attachment BL provides a typical timeline for a contractor to clean, inspect, and repair a Red Hill fuel storage tanks. In general, the first six months will be spent obtaining security clearances to enter the Red Hill facility and to prepare and obtain approval of the pre-construction submittals. The second six months are for preparing the tank for inspection. The second year consists of inspecting the tank (6 months), repairing the tank (3 months), and preparing the tank to return to service (3 months).

19-5.3 Attachment BM provides the overall timeline to clean, inspect, and repair all of the Red Hill fuel storage tanks. Note that this timeline does not include additional time required for any additional inspection or repair requirements that are listed in Chapter 17. This timeline takes into consideration the constraints provided in paragraph 19-4 above.

19-6 DETERMINATION OF ORDER OF TANKS

19-6.1 The order of tanks to be inspected is based on the last date in which the tank was inspected and operational requirements. Currently, Navy/DLA requires tanks 13 and 14 to be converted from F-76 to JP-5. Therefore, these tanks need to be cleaned in order to make this conversion. While the tank is out-of-service and cleaned, Navy/DLA determined that it would be prudent to also inspect and repair them.

19-6.2 Table 19-1 provides the list of tanks, their product, and when they are currently scheduled to be inspected. These dates are subject to change depending on the velocity of the pre-award phase, the contractor's work progress, more repairs than anticipated (based on previous work), Acts of God, and mission requirements.

Table 19-1 – Tank Inspection Schedule

Tank	Product	Last Inspected	Next Inspection due	Next Inspection Scheduled	delta
13	F-76/JP5	1995	2015	2017	**-2**
14	F-76/JP5	Inspected previous to 1994 (1982)		2017	
15	F-76	Aug-05	2025	2023	2
16	F-76	Jan-06	2026	2024	2
17	JP-5	Nov-12	2017	2017	0
18	JP-5	Inspected previous to 1994 (1960)		2018	
11	JP-5	Inspected previous to 1994 (1981)		2020	
12	JP-5	1995	2015	2020	**-5**
8	JP-5	1998	2018	2021	**-3**
9	JP-5	1995	2015	2021	**-6**
7	JP-5	Apr-98	2018	2023	**-5**
10	JP-5	1998	2018	2023	**-5**
20	JP-5	Oct-08	2028	2026	2
5	JP-8	In progress		2017	
4	JP-8	Inspected previous to 1994 (1983)		2018	

3	JP-8	Inspected previous to 1994 (1983)		2019	
2	JP-8	Apr-08	2028	2024	4
6	JP-8	May-06	2026	2024	2
1	n/a	n/a	n/a	n/a	
19	n/a	n/a	n/a	n/a	

19-7 PREVIOUS HISTORY

This paragraph provides background information on the timelines that it has taken to perform the previous contracts.

19-7.1 In 1978 through 1985, the tanks were cleaned, inspected (not considered as "API Std 653"), and repaired. This work was a MILCON project, designated as FY78 P-060. Since this was a MILCON project, the duration for planning and funding started in 1973. All work was performed by a single Prime Contractor. Refer to Attachment AF.

Tank	Start	End	Duration (days)
1	10/23/1981	4/19/1983	543
2	12/29/1981	3/15/1983	441
3	3/5/1982	4/19/1983	410
4	4/22/1982	2/24/1983	308
5	8/26/1981	5/31/1984	1009
6	6/30/1981	1/31/1985	1311
7	10/24/1978	12/12/1982	1510
8	4/18/1981	6/6/1983	779
9	7/25/1978	6/9/1981	1050
10	10/24/1978	4/18/1984	2003
11	7/10/1978	1/27/1981	932
12	2/27/1980	10/15/1982	961
13	5/30/1980	4/19/1982	689
14	4/17/1980	5/18/1982	761

15	8/4/1980	5/18/1982	652
16	2/12/1981	2/12/1982	365
		Average	858

The total number of days from the start of the work to the last tank in service was 1,800 days.

19-7.2 Between 1994 and 1996, tanks 6, 7, 8, 9, 10, 12, 13, 14, and 16 were cleaned and visually inspected. Tanks 6, 9, 12, 13, and 14 were abrasive blasted, inspected by Conam MMP Inspections, Inc, and repaired in accordance with API Std 653. Specific information, including the durations, is not available for this contract.

19-7.3 In 2006, Tanks 15, 16, and 6 were cleaned, inspected, and repaired by two Contractors. They were inspected by Weston Solutions under contract FA8903-04-D-8681, Task Order 0176 (Attachment I), and cleaned and repaired by Dunkin and Bush under contract N62742-03-C-1402 (Attachment BA).

Contract #	Award Date	Completion Date	Duration (days)	Average per tank
FA8903-04-D-8681	6/14/2005	1/31/2007	596	199
N62742-03-C-1402	4/23/2004	9/9/2008	1,600	533

19-7.4 In 2008, Tanks 2 and 20 were cleaned, inspected, and repaired by Shaw Environmental and Infrastructure, Inc., under contract N47408-04-D-8503, Task Order 0031 (Attachment M). The following is the schedule for this task order:

Contract #	Award Date	Completion Date	Duration (days)	Average per tank
N47408-04-D-8503, Task Order 0031	8/31/2007	4/30/2010	973	486

19-7.5 In 2011, Tanks 5, and 17 were cleaned and inspected by WGS. The API Std 653 inspector was Tim D. Anderson, Certification No. 37258, under (Attachment P). The following is the schedule for this contract.

Contract #	Award Date	Completion Date	Duration (days)	Average per tank
N62583-09-D-0132, TO#3	1/13/2010	9/30/2014	1,721	860

The following is additional schedule information for this task order.
Tank #17 – Inspection completed on 2/28/2012
Tank #5 – Inspection completed on 11/16/2010

19-8 OTHER RELEVANT TIRM NOT REQUIRING EMPTY TANKS

Refer to Chapter 8 for re-occurring maintenance of the Red Hill Tanks.

19-9 RELATIONSHIP TO CHAPTER 4 CORROSION RATES

Currently the scheduling of the tanks is being prioritized by inspecting the tanks that have not been inspected in the past 20 years first, and then scheduling the tanks that have recently been inspected (ie: 20, 5, 4, 3, 2, and 6) per a 20 year schedule. Repairs made to these tanks following the last inspection provided at least a 20 year service interval based on the corrosion rate analysis.

BIBLIOGRAPHY

[1] Deloitte Development LLC, "Tank Inspection Interval Business Case Analysis I," Deloitte, 2015.

CHAPTER 20 - PLANNED ACTIONS UNDERWAY INDEPENDENT OF TANK UPGRADE

20-1 INTRODUCTION

This Chapter addresses the actions that are currently being or planned to be taken throughout the Red Hill Tank area, as soon as practicable, to reduce risk of release that can be implemented independent of tank upgrades.

20-2 REINSPECT TANK 5

a. Due to issues resulting from the WGS warranty repairs as discussed in Chapter 6, the Navy/DLA is planning to perform another API Std 653 inspection. This inspection will be performed by an A-E. Full scanning of the tank shell and welds, as was done by WGS in 2010, is planned. The inspection will ensure that all gas test holes have been welded closed and all patch plates have been properly welded. In addition, a new corrosion rate will established based on the difference of any backside corrosion found during the 2010 and 2017 inspections.
b. Navy/DLA is planning to place Tank 5 back into service per the NAVSUP instruction and improved procedures.
c. Currently, as long as no repairs are required by the API Std 653 inspection, Tank 5 should return to service late 2017.

20-3 CONTINUE CIR OF RED HILL TANKS

a. A contract to clean, inspect, and repair Tanks 14 and 17 simultaneously, and then tank 18 after Tank 14 is placed back into service for tanks (Attachment BN) was awarded on 31 August 2016.
b. A contract to clean, inspect, and repair Tank 13 and then Tank 4 after Tank 5 is placed back into service (Attachment BO) was awarded on 31 August 2016.
c. These contracts were awarded on the GPOL MACC contract, which is discussed in Chapter 10. These contracts included most of the lessons learned, except they do not include UFGS specifications for Tank Inspection or Tank Repair. They do include most of the requirements of these UFGS's, but in the "Scope of Work" section of the contract.
d. The overall schedule of these contracts is provided in Chapter 19.

20-4 ADOPT NEW QC AND QA PROCESSES

a. The new specifications for the Tank Repair (Attachment BE) and Tank Inspection (Attachment BD) as discussed in Chapter 17 are planned to be part of the next new contract planned for October 2018.
b. The Government Quality Assurance plan during design and on-site surveillance as discussed in Chapter 16-4.1 and 16-4.2 is being implemented for the two new contracts that were awarded in August 2016.
c. The Contractor Quality Control plan as discussed in Chapter 16-5 has been implemented in the two new contracts that were awarded in August 2016.
d. The Government Quality Assurance Surveillance plan as discussed in Chapter 16-6 will be tailored to the individual task orders and implemented for the two new contracts that were awarded in August 2016.
e. Third Party oversight, provided by the Contractor's independent first tier subcontractor, as discussed in Chapter 16-7, is included in the two new contracts that were awarded in August 2016.
f. Third Party oversight, provided by the Government, as discussed in Chapter 16-7, is not anticipated at this time, but will be considered if necessary.

20-5 INSTALL FIRE SUPPRESSION SYSTEM AND OIL TIGHT DOORS

The scope of the current MILCON P-1551 includes installation of a new fire suppression system, one oil tight door, and six (6) fire tight doors. The oil tight door will be located just downhill of tanks 1 and 2. This project is also repairing the narrow-gauge rail tracks. This project is anticipated to be completed in March 2017.

20-6 INCREASE FREQUENCY OF TANK TIGHTNESS TESTING

The frequency of tightness testing the tanks has been changed from biennial to annual. Refer to the AOC SOW, Section 4.3, Red Hill Facility, Current Fuel Release Monitoring Systems Report, for additional information on the Leak Detection System.

20-7 UPDATE AND/OR VALIDATE EXISTING LEAK DETECTION SYSTEMS

a. Navy/DLA is currently investigating the capabilities of the Low Range Differential Pressure Leak Detection System (LRDP). This system was developed in 1999 by Vista Research, Inc. and NFESC. The LRDP obtained third party certification by Ken Wilcox Associates (KWA) and is listed on the National Work Group of Leak Detection Evaluations (NWGLDE). This system is installed in Red Hill Tanks 9 and 16 but has not been in use since 2001. The system installed in Tank 9 appears to still be operational. The system in Tank 16 appears to be only partially functional and will likely require maintenance before it can be fully tested. The Navy/DLA is currently planning to reactivate the LRDP in Tank 9 and evaluate its capabilities and compare it to the current Mass Technology system that is used for the annual tank tightness test requirement.

b. The Navy requires additional testing of the LRDP system beyond that of the current investigation. Since this is a permanently installed system, unlike the Mass Technology system which is a temporary installation, a long term analysis over a period of at least three months is desired. Additionally, short term tests in a dynamic scenario should also be investigated to verify level of performance after a transfer has been completed and the tank is returned to a static condition. The investigation will include the feasibility of integrating the communication system into the existing and/or planned communications upgrades to collect data in a central location under the purview of FLCPH. In addition, an overall comparison/analysis of the LRDP to the AFHE system and the Mass Technology System is planned to determine the complimentary and redundancy of each system, and also to compare its capabilities to other potential systems.
c. Refer to the AOC SOW, Section 4.3, Red Hill Facility, Current Fuel Release Monitoring Systems Report, for additional information on the Leak Detection System.

20-8 INCORPORATE FINDINGS FROM CORROSION AND METAL FATIGUE PRACTICES REPORT

a. The AOC SOW, Section 5.2, Red Hill Facility Corrosion and Metal Fatigue Practices Report submitted April 2016 discussed cathodic protection, coatings, tank assessments, and fatigue considerations.
b. The following table lists the findings in the Corrosion and Metal Fatigue Practices Report and how they were incorporated into this TIRM report.

Corrosion and Metal Fatigue Report Findings	Incorporation into the TIRM Report
Cathodic Protection: The application of CP to control	The new tank repair specification will require coupons to be removed

corrosion is not viable.	from the tank. When these coupons are removed, the pH of the concrete will be measured.
Internal Protective Coating: The tank internal protective coating is assessed during routine tank integrity inspection assessments.	A tank internal protective coating will be assessed during routine tank integrity inspection assessments. The tank cleaning specification will be updated so that the coating will not be removed during cleaning. The bottom of the tank will be recoated, and any coating failure in the barrel and upper dome will be assessed and a determination will be made if any areas need to be recoated.
Tank assessments	The tank assessment procedure in the report has been incorporated into the tank inspection specification.
Fatigue Design Considerations: Static fuel levels in the Red Hill tanks limit susceptibility to fatigue issues that may be experienced by smaller tanks with fluctuating fuel levels.	No action required.

20-9 INCREASE FACILITY POWER CAPABILITY

NAVY/DLA is currently planning a project to update the electrical power capability in the tunnel, so that power can be available for tank inspection, repair, and maintenance contractors to use during construction. The project is programmed to start in FY2018.

Contractors will be required to provide temporary electrical power to support contract work until the power capability is upgraded.

20-10 REPAIR ROAD TO ACCESS UPPER TUNNEL ACCESS POINTS

Navy is currently planning a project to correct the erosion in the Red Hill complex. Part of this project is to repair the road to access the upper tunnel access points. This project is programmed to start in FY2021.

20-11 INSPECT TANK VENT SYSTEM

An internal inspection of all the tank vents for the Red Hill Fuel Complex is planned to be conducted in 2017.

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PART E – TIRM RECOMMENDATIONS SUMMARY

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CHAPTER 21 – EVALUATION AND PRESENTATION OF OPTIONS FOR TIRM RECOMMENDATIONS

21-1 INTRODUCTION

Options for improving the TIRM procedure are presented in Chapter 17. The Navy has adopted some of the options as best practice and they already are, or are in the process of being implemented.

21-2 TIRM IMPROVEMENTS BEING IMPLEMENTED

Improvements to the TIRM which are already in place or are currently being implemented are shown in Table 21-1.

21-1 TIRM Improvements Being Implemented

Improvement	Benefit
Specification for tank inspection	Standardize a Red Hill tank inspection
	Reduce variability in inspection results
	Provide the basis for substantive reports
	Establish qualification requirements for personnel
	Quantify NDE reliability
	Provide for destructive testing in order to perform metallurgical, mechanical, and weldability testing; evaluate reliability of NDE backside corrosion data
	Require establishment of a professional data management system
	Require management of gas test holes
	Inspection to take place before and during tank cleaning
	Include detailed submittal requirements such as the certification of inspectors and NDE technicians
Specification for tank repair	Standardize many aspects of repair
	Reduce variability in performance
	Provide the basis for record drawings documenting conditions to and changes made to a tank
	Establish minimum qualification requirements for key personnel (welder, weld inspector, NDE technicians)
	Establish weld inspection and NDE frequency
	Establish weld and NDE acceptance criteria
	State minimum repair design requirements
	Establish repair requirements for gas test holes

	Require tank inspection and validation of predictive repairs to occur during the design phase
	Specify standards for materials used in repair
	Require in-progress review of repairs by API 653 inspector
NAVFAC QA design, construction, and project management roles distributed across separate individuals	Work load spread more evenly; leverages expertise of various NAVFAC communities instead of relying on one individual who was in charge of multiple projects simultaneously
NAVFAC locating construction management and QA oversight at the local component	Construction management role will be located at JBPHH
NAVFAC use of standard design build contract specific to POL work	Standardize general requirements; specifies adherence to P-445; will require QCM role to be independent of production, safety, or project management
Frequency of tightness testing increased from biennial to annual	Better monitoring of tank integrity and complies with 40 CFR 280
New filling and return to service instruction	Standardize the filling and return to service process for a storage tank
	Mandates receipt of suitability for service statement prior to refilling
	Documents that all repairs have been completed; compares with inspection report to ensure all repairs have been completed prior to refilling
	Receipt of final inspection report prior to refilling
	Receipt of proper turnover documentation from NAVFAC prior to refilling
	Prior to return to service, development of a specific procedure for filling the tank being returned to service
	Approval of a tank specific operations order by the FLCPH commanding officer prior to refilling the tank
Reactivation of existing mass-based low range differential pressure precision tightness apparatus	Will provide enhanced tightness testing capabilities for Tank 9
Update UFGS Section 33 65 00 Cleaning Petroleum Storage Tanks	Update to existing specification to avoid damage to coating during cleaning and to account for pressure and temperature of power wash. Update the

	specification to provide test patch of the power wash technique.

21-3 OPTIONAL TIRM IMPROVEMENTS

Options for improving the TIRM and NAVFAC recommendations are shown in Table 21-2.

21-2 Options for Improving the TIRM

Improvement	Recommended
Coat lower dome and barrel to the top of the barrel region	No
Coat entirety of tank	No
Coat lower dome, spot coat disbonded areas, coat patch plates	Yes
Install tell-tale leak detection/collection system	See Note
Perform leak testing during the repair phase utilizing the tell-tale system and tracer gas	See Note
Hydrotest tank as a means to determine tightness	No
Investigate capabilities of LRDP; Perform additional testing to analyze benefits of real-time monitoring, the possibility of dynamic analysis, and direct communication with FLCPH control operator	See Note
Install multi-tiered fixed platform scaffold as a means to access tank shell	No
Install dome truss, monorail, suspended platform scaffold, and telescoping box booms or similar means to access tank shell	TBD
Perform enhanced tank commissioning	Yes
Update storage tank cleaning specification to account for pressure and temperature of power wash; provide test patch of the power wash technique	Yes
Provide ATG slotted tubes to provide compliance with DLA ATG Policy Letter	Yes
Design To Document Tank Conditions	Yes
Remove Upper Dome Cover Channels	No

Note - TIRM improvements are subject to change depending on the results of the AOC In the Matter of Red Hill Bulk Fuel Storage Facility, Attachment A, Statement of Work, Section 3, Tank Upgrade Alternatives report and Section 4, Release Detection/Tank Tightness Testing.

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