



Prepared for

**NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING SERVICE CENTER**

Port Hueneme, California

Technical Submittal for Project:

Project Title: CLEAN, INSPECT, AND REPAIR STORAGE TANKS 5 & 17
Location: PEARL NAVAL BASE – REDHILL COMPLEX, Pearl Harbor, HI
Task Order No.: N62583-09-D-0132/0003
WGS Project Number: 54118
Date: 18 Nov, 2010

**TANK 5 & 17 CLEANING, INSPECTION
AND REPAIRS PROJECT**

TANK 5 INSPECTION REPORT

Submitted By:

Willbros Government Services, LLC
2087 E. 71st Street
Tulsa, OK 74136

Rev	Date	Description	Reviewed	Approved
A	11/22/10	Issue Draft Report & Data for Info	RC	TDA
B	4/2/11	Issue for Review & Approval	JS / DB	TDA
C	5/23/11	Issue for Review & Approval	JS / DB	TDA
D	6/02/2011	Issue for Review & Approval	JS / DB	TDA
E	8/09/2011	Issue for Review & Approval	JS / DB	TDA

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WILLBROS GOVERNMENT SERVICES (U.S.), LLC

A WILLBROS COMPANY

Project Client:
**NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING SERVICE CENTER**
Port Hueneme, California



Technical Data & Submittal for Project:
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**FINAL DRAFT TANK INSPECTION
& INTEGRITY REPORT**

REDHILL COMPLEX TANK 5

Submitted By:
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Rev	Date	Description	Reviewed	Approved
A	11/22/10	Issue Draft Report & Data for Info	RC	TDA
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Distribution is limited to US Government agencies and their contractors; administrative/operational use within the context of this project or specific equipment. Other request shall be referred to the Naval Facilities Engineering Service Center for information needed. This report is confidential and shall be maintained to this extent.



Statement of Compliance

All work performed on this tank under this contract have been performed within the required project scope of work, specifications and regulations. All data provided has been obtained during the inspection, reviewed and verified to determine the existing condition of each item or component. Within the limits stated in this report to the extent visible, accessible or able to evaluate from the activities performed.

NDE Inspection & Testing performed by:

**TESTEX, INC. & AES
NDE / INSPECTION SERVICES**

Performed / Reviewed By	Date
Tim Anderson	
API653 Tank Inspector - #494, API570 / API510 Insp.	11/22/2010
Doug Bayles - Approval on File	
Tank Expert/Engineer - Doug Bayles, P.E. HI#11128-C, API653 Insp.	11/22/2010
Tim Anderson - Approval on File	
Project Manager - Tim Anderson, API 653 / API570 / API510 Insp.	11/22/2010



General Statement and Conditions

The information referenced in this inspection and engineering report is based solely upon the area or areas agreed upon and contracted for inspection; on the date of the inspection and under those present, known, same, accessible and current conditions. This report was prepared using retrievable data from those areas that were properly cleaned and prepared and made available and accessible during the inspection. Areas outside the scope of work which was not contracted for inspection and areas that were not cleaned and made available and / or accessible are not included in this report.

The methods, standards and regulations used by Willbros Government Services, LLC (Willbros) during the inspection and in preparing this engineering report comply with the most current and widely accepted industry standards and regulations, in which these standards and regulations make no representation, warranty or guarantee. The professional opinions and recommendations stated in this report, including predictability of life, maximum length of time for re-inspection, suitability for product storage, and safe fill height are conclusive approximations and are intended to serve mainly as guidelines in accordance with industry codes, standards and / or practices for obtaining the utmost in spill prevention and environmental protection. The listed recommendations may not necessarily be mandatory actions, but corrective actions that Willbros suggests would better preserve the owners'/operators' facility components and may contribute to a safer and more convenient operation. Failure to comply with these could result in, but may not be limited to, reduction of service life, tank operational mishap, legal consequences and/or fines for owners/operators. It is best advised that the recommended repairs, corrective actions and procedures be fully and accurately reviewed and complied with in order to meet the required and applicable federal, state and local regulations, and to have the necessary repairs and up-grades performed prior to making any change in service, product and/or current conditions.

Some recommendations and requirements are necessary to bring the component(s) into compliance with federal, state, and local regulations. Willbros recommends re-inspection after any corrective action, repair or review when there is a change in service. Any change in facility conditions that are applicable to this inspection report, such as, but not limited to, environmental anomalies or conditions, a change in service or usage could result in outdating this report. The predictability of any component in this report is a result of following the procedures in the applicable industry standard. Willbros accepts absolutely no responsibility or liability for any mishap or failure, including any subsequent clean-up costs or legal ramifications, resulting from owners'/operators' failure to perform the required repairs, inspections and re-inspections, as applicable.



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LIST OF ACRONYMS AND ABBREVIATIONS

API	American Petroleum Institute
ASME-BPV	American Society of Mechanical Engineers – Boiler & Pressure Vessel Code
ASNT	American Society of Non-Destructive Testing
AWS	American Welding Society
BMP	Best Management Practice
CO	Contracting Officer
CP	Cathodic Protection
DBB	Double Block and Bleed Valve
DO	Delivery Order
DOT	Department of Transportation
EPP	Environmental Protection Plan
FFD	Federal / Naval Fire Department
F-76	Diesel Fuel Marine
FHWA	Federal Highway Administration
FISC	Fleet and Industrial Supply Center
FLD	Field Operating Procedure
FORFAC	Fuel Oil Reclamation Facility
HSA	Health and Safety Officer
HASP	Health and Safety Plan
HPV	High Point Vent
JP-5	Jet Propellant Grade 5
JP-8	Jet Propellant Grade 8
LOTO	Lockout Tagout
LPD	Low Point Drain
NAVFAC	Naval Facilities Engineering Command
NAVFAC ESC	Naval Facilities Engineering Service Center
NAVSTA	Naval Station
NDE	Non-Destructive Examination
NPDES	National Pollution Discharge Elimination System
NTR	Navy Technical Representative
PM	Project Manager
POC	Point of Contact
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
SSHEP	Site Specific Health & Environmental Plan
SM	Site Manager
SOW	Statement or Scope of Work
TO	Task Order
USACE	U.S. Army Corp of Engineers
USN	U.S. Navy
UST	Underground Storage Tank
VS	Valve Station
WDP	Waste Disposal Plan
WP	Work Plan



Section 1.0 – Executive Summary

Willbros Government Services (Willbros) completed the modified API 653 inspection of the Tank 5 (TK5) on November 16, 2010 to verify the tank's current condition; integral and structural components; and coating integrity. Tank 5 (TK 5) is a vertical underground storage tank (UST) located in the Redhill Complex of the Pearl Harbor Naval Station, Oahu HI. Tank 5 is 100 ft. dia. x 250 ft. high; upper and lower dome sections (50 ft. radius each), carbon steel tank which has been externally reinforced during construction by a concrete / gunite lining.

Willbros performed all preliminary activities required to perform the SOW including (LOTO) Lock-Out & Tag Out on the tank and ancillary piping systems. Willbros removed the tank's isolation skin valves and installed mechanical blinds. Willbros cleaned the tank by high pressure washing all internal surfaces. Residual fuel was transferred to FISC operations; unusable fuel and wash rinsate were transported to a regulated waste disposal site for processing and disposal.

Testex, Inc. performed (NDE) non-destructive examination and testing inspection on 100% of the tank's welds, shell, upper and lower dome surfaces to determine the remaining wall thickness and condition of each section or component. During the NDE examinations and inspection all relevant indications observed were identified, recorded and photographed as necessary to document the condition of each relevant indication in the tank. These areas were inspected by certified ASNT Level II NDE Inspection Technicians.

Willbros performed hydrostatic pressure testing on the tank's nozzles and ancillary piping to the first isolation flange on the tank. Willbros performed a visual inspection of the tank's welds, shell, upper and lower dome, nozzles and structural surfaces to determine the actual condition and integrity of each section or component. During the visual inspection all relevant indications observed were identified, recorded and photographed as necessary to document the condition of each relevant indication in the tank. These areas were inspected by a certified API 653 Tank Inspector and ASNT Level II NDE Inspection Technician.

1.1 Summary of Inspection Findings

Willbros and Testex performed a thorough API 653 modified inspection and NDE examination of Tank 5 surfaces and components. During the inspection there were over (800+) various types of indications and flaws found throughout the tank. These indications varied in type, cause and severity. The following indications or flaws were found in various locations in the tank. The repair indications or flaws are identified in the Table 7-1 of this report. Repair considerations and recommendations for each relevant indications or flaws has been reviewed and listed in Table 7-1 for each repair type, size and classification for mandatory, short term and long term intervals.

1.1.1 Summary of Indications and Flaws

- Gouges – Ranging in various depths and sizes. Typical depths ranged from 0.020" to 0.190" in depth, with various diameters and configurations.
- Corrosion Areas and Pits – Ranging in various depths and sizes. Typical depths ranged from 0.015" to 0.195" in depth, with various diameters and configurations.
- Holes – Two (2) holes were found, (1) in the shell extension and (1) in the upper dome.
- Weld Discontinuities and Defects
 - Porosity – Ranging in various sizes. Typical sizes ranged from 0.020" to 0.188" in diameter.
 - Undercut – Ranging in various depths and sizes. Typical depths ranged from 0.015" to 0.240" in typically a 0.250" original plate thickness.
 - Lack of Fusion and Cold Lap - Ranging in various sizes. Typical sizes ranged from 0.25" to 1.5" in length.
 - Slag Inclusions - Ranging in various sizes. Typical sizes ranged from 0.125" to 0.375" in length.



- Underfill – Areas were observed in the vertical and horizontal welds where the weld reinforcement was less than base metal thickness.
- Excess Weld Reinforcement - Areas were observed in the vertical and horizontal welds where the weld reinforcement was more than allowed per code from base metal surface to the top of the weld.
- Weld Sizes - Areas were observed in the vertical and horizontal welds where the weld pass size and reinforcement exceeded the weld widths, configurations and sizes relative to the base metal thickness.
- Weld Arc Gouges – Arc pull or wash outs, ranging in various depths and sizes. Typical depths ranged from 0.025" to 0.125" in depth, with various diameters and configurations.
- Torch Gouges – One area was found where a torch gouged or cut thru the weld seam and exposed the open joint seam connection completely for approximately 3/8" in length. This is a complete thru wall opening, leak or equivalent hole in the upper dome.
- Leak – One area was observed leaking in the telltale system. The weld in this area has failed and leaking product in the upper dome.
- Un-welded Seams – One seal plate (2"W x 8"L) and one 2" diameter nozzle was found tacked, but not welded in the upper dome.
- Dents & Bulges – Dents were observed ranging in various depths and sizes. Typical depths ranged from 0.125" to 0.5" in depth, with various diameters and configurations. Bulges were observed throughout the tank's internal plate surfaces.
- 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.
- Bolts – Were found missing or in correct length, (52) missing bolts were replaced in the tower and catwalk structures.
- Coating – The overall coating is in poor condition. The coating has disbanded, flaked or deteriorated over 80% of all internal surface areas.
- Detailed list of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 thru 6-4 and 7-1.

1.2 Summary of Recommendations

Willbros and Testex found over (800+) various indications and flaws during the API 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 thru wall holes.
- Repair weld where torch gouged thru 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 of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 thru 6-4 and 7-1.

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 (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 of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 thru 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 (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 of indications and repairs are provided for each component in the appropriate section listed in Tables 6-1 thru 6-4 and 7-1.



Section 2.0 – Suitability for Service Statement

Suitability for Service Statement **For Redhill Complex UST Tank 5 – Pearl Harbor, HI**

Tank 5 integral structural and component integrity is not satisfactory for continued service and cannot be placed back in normal operation. The repairs will need to include the mandatory repairs and the repairs required for the next desired operational interval. After the repairs are completed, the repairs will need to be re-inspected and tested for compliance. Once all repairs are completed, inspected and approved; then the next inspection intervals can be determined.

The next API-653 internal inspection should be conducted in xxxx (0) years, or by xxxxxx [1/2 of the shell life based on the tank having greater than 0 years remaining shell life]. The bottom life calculations give the tank bottom greater than xxxx (0) years of remaining operation. A visual inspection of UST internal coatings should be conducted in ten years.

API-653 Inspector:

Tim D. Anderson; API-653 # 494

Professional Engineer's Review:

Douglas J. Bayles, P.E. – Hawaii P.E. Registration Number 11128-C



Section 3.0 – Project References and Specifications

Willbros reviewed the project SOW and listed the applicable requirements for reference and utilization in the development and execution of the project activities to ensure compliance with all relevant regulations, project requirements including the following codes and specifications:

3.1 American Petroleum Institute (API)

- 3.1.1 API Recommended Practice 574, *Inspection Practices for Piping System Components*, Latest Edition.
- 3.1.2 API Recommended Practice 575, *Inspection of Atmospheric and Low-Pressure Storage Tanks*, Latest Edition.
- 3.1.3 API Standard 650, *Welded Steel Tanks for Oil Storage*, Latest Edition.
- 3.1.4 API Recommended Practice 651, *Cathodic Protection of Aboveground Petroleum Storage Tanks*, Latest Edition.
- 3.1.5 API Recommended Practice 652, *Lining of Aboveground Petroleum Storage Tanks*, Latest Edition.
- 3.1.6 API Standard 653, *Tank Inspection, Repair, Alteration and Reconstruction*, Latest Edition.
- 3.1.7 API/ANSI Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*
- 3.1.8 API/ANSI RP 2016 *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks*
- 3.1.9 API Standard 2550, *Measurement and Calibration of Upright Cylindrical Tanks*

3.2 American Society of Mechanical Engineers (ASME)

- 3.2.1 ASME B31.3, *Process Piping*, Latest Edition.
- 3.2.2 ASME B31.4, *Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids*, Latest Edition.
- 3.2.3 ASME VII Non-Destructive Examination, Latest Edition.
- 3.2.4 ASME IX Welding and Brazing, Latest Edition.

3.3 Code of Federal Regulations (CFR)

- 3.3.1 29 CFR 1910, *Permit-Required Confined Spaces for General Industry*.
- 3.3.2 40 CFR 112, *Oil Pollution Prevention*.

3.4 Military Handbooks (MIL-HDBK)

- 3.4.1 MIL-HDBK 1022A, *Department of Defense Handbook: Petroleum Fuel Facilities*, 01 November 1999.
- 3.4.2 MIL-HDBK 201B, *Military Standardization Handbook: Petroleum Operations*.

3.5 National Association of Corrosion Engineers (NACE)

- 3.5.1 NACE Recommended Practice, RP0184-97, *Repair of Lining Systems*.
- 3.5.2 NACE Recommended Practice, RP0193, *External Cathodic Protection of On-Grade Metallic Storage Tank Bottoms*.
- 3.5.3 NACE Recommended Practice, RP0288-94, *Inspection of Linings on Steel and Concrete*.

3.6 National Fire Protection Association (NFPA)

- 3.6.1 NFPA-30, *Flammable and Combustible Liquids Code*.

3.7 Steel Tank Institute (STI)

- 3.7.1 STI SP001, *Standard for the Inspection of Aboveground Storage Tanks*.

3.8 Safety

- 3.8.1 EM 385-1-1, *U.S. Army Corps of Engineers Safety and Health Requirement, Appendix A Minimum Basic Outline for Accident Prevention, and sections*.



3.9 Unified Facilities Criteria (UFC)

3.9.1 UFC 3-460-01, *Petroleum Fuel Facilities*.

3.10 Unified Facilities Guide Specification (UFGS)

3.10.1 UFGS 09970, Epoxy/Fluoropolyurethane Interior Coating Of Welded Steel Petroleum Fuel Tank

3.10.2 UFGS 09971, Exterior Coating System for Welded Steel Petroleum Storage Tanks

3.10.3 UFGS 09973, Interior Coating System for Welded Steel Petroleum Storage Tanks

3.10.4 UFGS 01351, Safety, Health, and Emergency Response

3.10.5 UFGS 13205, Steel Tanks with Fixed Roofs