1.0 RESULTS AND CONCLUSIONS
Willbros Government Services, LLC
Tulsa, OK
Tank #5

INTRODUCTION

An NDT inspection was conducted on Tank #5 at Red Hill in Honolulu, HI on August 18th – September 24th, 2010. 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). 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 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. The results of this inspection are detailed in the following report.

RESULTS

It is to be noted that work for this tank took place in 5 day work weeks. The work in all other previously inspected tanks (15, 16, 6, 2, and 20) consisted of 4 day work weeks.

In beginning of this inspection (August 18, 2010), TesTex started scanning the floor plates (6 plates totaling 25 ft. in diameter) of tank #5. By end of the first day, surface area scanning was complete on the floor (491 sq ft), and scanning started on course 1 of the lower dome. Day 2 saw the completion of the surface area scanning of course 1 (2,695 sq ft) and the first 3-foot of course 2. Day 3 consisted of scanning of the welds using the Hawkeye on the floor (and around all pipe entry points), course 1, and the first 3 foot of course 2. The first week came to a close with the completion of the floor, course 1 and the beginning of course 2. It is to be mentioned that all scanning to this point could be reached from standing on either the floor or course 1 of the lower dome. In the beginning of the second week (August 23rd, 2010), both teams had to set up the boomed baskets with the equipment for both types of scanning (LFET for liner plates and BFET for welds), since accessibility was no longer available from standing on the floor or course 1. Once the setup was complete, work continued on course 2 and was finished in the morning of day 2 (4,573 sq ft). Course 3 (5,797 sq ft) was then started and was finished using both baskets by the morning of day 4. The rest of day 4 was spent scanning course 4. Day 5 ended the week and saw the completion of course 4 (5,634 sq ft) and the lower dome and the beginning of Barrel scanning. The third week (August 30th, 2010) picked back up with barrel scanning. The scans in this section of the tank consisted of 8 ft. wide (the width of the basket) drops from the extension/barrel interface down to the lower dome/barrel interface. Each team averages about 2 drops per day. By the end of the week, approximately 50% of the barrel was completed. The fourth week (September 6th, 2010) started off with a holiday and no work for day one. Barrel scanning continued on day 2 and by the end of the week, scanning from the two main boomed baskets was finished. This brought the total finished barrel percentage to approximately 95%. The fifth week (September 13th, 2010) would begin with scanning the Barrel

section under the Catwalk. One crew scanned this section while the other went up to the gallery to scan course F of the upper dome. The end of day 2 saw the completion of the section under the catwalk and thus the completion of barrel scanning (41,598 sq ft). It also saw the completion of course F (491 sq ft). The extension area (4,712 sq ft) was scanned in its entirety on the third day. Day 4 of that week started course A scanning. The morning of the last day of the week was lost due to a need for additional paperwork to be handled at Pass and I.D. Work resumed in the afternoon and saw the completion of Course A (4,437 sq ft) of the upper dome. In week six, the final week (September 20th, 2010), course B (4,082 sq ft) was scanned on day 1, course C (3,458 sq ft) was scanned on day 2, course D (2,632 sq ft) was scanned on day 3, and course E (1,664 sq ft) was scanned on day 4. In that final week, the second day marked the arrival of an ultrasonic technician. The ultrasonic technician began using magnetic particle technology on the welds of the lower dome/floor interface (this was done in place of Shear wave Technique because the intersection welds were concealed by cover plates) and was finished that same day. Shear wave ultrasonics was, however, applied to the first 6 inches of intersection weld between the plates of course 1, just above the cover plates (intersecting the Floor and Course 1). All other possible weld defect locations found in the tank, using the Hawkeye BFET system, were also backed up with the shear wave technique by the ultrasonic technician. This occurred on the last two days of the final week (September 23rd and September 24th) along with the final verification of all defect locations found in the tank. From there, all of the gathered data was examined over the weekend, and a preliminary report was given on Sunday September 26th, which outlined all defects found in the tank. This report characterized type, size, location, etc. for each. In addition to the above-mentioned scanning, all channels (weld covers) associated welds in the upper dome were scanned using the Hawkeye BFET system. Work was also performed in the lower tunnel on U.T. spot checks inside of the 32-inch and 18-inch lines. These spot checks were done on the 32-inch line from the inside and consisted of a group of 8 circumferential readings taken every 3-foot across the approximate 40-foot span. The 18-inch line was too small to access internally, so readings could only be taken at 8 and 18 inches from the end. Also, the inside of the manway and manway cover were scanned using the LFET scanner. It is to be noted that, when it came to scanning course E and F in the upper dome, ultrasonic trolleys had to be used instead of the LFET scanners since the booms could not place the baskets close enough to the walls for safe access.

CONCLUSIONS

As a result of this inspection, TesTex found 404 flaw indications most of which were either proved up with ultrasonic thickness measurements or sized using Ultrasonic Shear Wave Technique. All defects including their respective depth or other flaw characterization may be found in Section **4.0, PLATE TEST SUMMARY**.

Section **3.0** is **TANK MAPS,** which clarifies the numbering system and tank layout. Section **5.0** shows **typical waveforms** collected from these sections. Printouts of waveforms collected from this unit are included in **APPENDIX A** and are correlated to each plate where the original flaw indication(s) was observed.

2.0 UNIT DETAILS
Willbros Government Services, LLC
Tulsa, OK
Tank #5

	Totals
Orientation	**Vertical**
Plate Thickness	
Upper Dome	**0.250"**
Lower Dome	**0.250"**
Barrel	**0.250"**
Floor	**0.500"**
Plate Material	**Carbon Steel**
Total Surface Area of Tank #5	**≈ 84,333 sq ft (plates)**
Upper Dome	**≈ 16,763 sq ft (plates)**
Extension	**≈ 4,712 sq ft (plates)**
Barrel	**≈ 43,668 sq ft (plates)**
Lower Dome	**≈ 19,190 sq ft (plates)**
Total Surface Area and Welds Scanned by TesTex	**≈ 84,333 sq ft (plates)**
	≈ 23,978 linear ft (welds)
Upper Dome	**≈ 16,277 sq ft (plates)**
	≈ 5,579 linear ft (welds)
course A	**≈ 4,437 sq ft (plates)**
	≈ 1,394 linear ft (welds)
course B	**≈ 4,082 sq ft (plates)**
	≈ 1,378 linear ft (welds)
course C	**≈ 3,458 sq ft (plates)**
	≈ 985 linear ft (welds)
course D	**≈ 2,632 sq ft (plates)**
	≈ 932 linear ft (welds)
course E	**≈ 1,664 sq ft (plates)**
	≈ 590 linear ft (welds)
course F	**≈ 491 sq ft (plates)**
	≈ 300 linear ft (welds)
Extension	**≈ 4,712 sq ft (plates)**
	≈ 2,094 linear ft (welds)
Barrel	**≈ 43,668 sq ft (plates)**
	≈ 11,346 linear ft (welds)
Lower Dome	**≈ 19,190 sq ft (plates)**
	≈ 4,959 linear ft (welds)
course 4	**≈ 5,634 sq ft (plates)**
	≈ 1,569 linear ft (welds)

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course 3	≈ **5,797 sq ft (plates)**
	≈ **1,208 linear ft (welds)**
course 2	≈ **4,573 sq ft (plates)**
	≈ **1,135 linear ft (welds)**
course 1	≈ **2,695 sq ft (plates)**
	≈ **1,047 linear ft (welds)**
base:	≈ **491 sq ft (plates)**
	≈ **169 linear ft (welds)**

Percent surface area of Tank #5 inspected	≈ **100%**
Surface area of Upper Dome inspected	≈ **100%**
Surface area of Barrel inspected	≈ **100%**
Surface area of Lower Dome inspected	≈ **100%**

Tank Numbering System See **3.0 TANK MAP**

	Totals
Defect distribution	
Tank #5	404
Area	
Upper Dome	110
Extension	30
Barrel	205
Lower Dome	57
Floor	2
Type	
Underside corrosion (WL)	153
Underside corrosion around patch plates/anchors [WL (APP)]	50
Underside corrosion on patch plates/anchors [WL (OPP)]	46
Through holes	0
Topside (pits (SP), gouges (G), tack welds (TW))	36
Dents (D)/bulges	20
Weld (WD): LOF/IP/Porosity/Undercutting	40
Weld: Cracking	1
Grout Nozzles (GN)	48
No Reportable Indication (NRI)	10

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Test Equipment:

Electronics:
TS-2000, 8 Channel Plate Scanner
Hawkeye, Single Channel Pencil Probe Weld Scanner

Hardware:
U.T. Viper (Magnetic manual Crawler)

Ultrasonic Thickness Meter:
DMS-2 Krautkramer (with A-Scan Display)