STUDENT SUMMER INTERNSHIP TECHNICAL REPORT

Double Shelled Tank Visual Inspections

DOE-FIU SCIENCE & TECHNOLOGY
WORKFORCE DEVELOPMENT PROGRAM

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ABSTRACT

The Department of Energy's Hanford Site is the resting place of 149 single-shelled and 28 double-shelled (DST) underground nuclear tanks containing nuclear waste from the end of WW2 and Cold War. Although having been decommissioned for many years the site is still active today due to federal and state efforts to safely and properly dispose of the nuclear waste byproduct through the process of vitrification and storage. [1] Of the few contracted companies working on the Hanford, WRPS (Washington River Protection Solution) oversees the tank farms storage efforts within Hanford. Within WRPS, the Tank and Pipeline Integrity and Tank Monitoring teams monitor the health of the aging tanks and are responsible for discovering and assessing areas of concern for tank leakage. Apart from studying waste level, seeking solutions against corrosion and gathering tank structure data, the teams also conduct visual inspections of the tanks. These visual inspections are vital for the company as it provides an easily accessible form of tank health monitoring. Every 3 years every DST must be visually inspected with the use of a camera system inserted into the risers (access pipes) located at the top of the tanks. Moreover, even greater emphasis has been placed on the visual inspection program since the primary shell leak of double shell tank AY-102 in 2012, hence ongoing improvements to the visual inspection program to help insure leak integrity of the remaining 27 double shelled tanks (DST). [2][3] Apart from the primary camera-riser system used, other methods of visual inspection are being developed to investigate underneath the primary shells of the DSTs. Such methods include a marsupial crawler robot, developed by WRPS subcontractors, which pushes a snake-like camera into the DST refractory pad air slots. [4] Ultimately, all inspection efforts focus on one goal in mind, to support extended service lives of the DSTs.

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1. INTRODUCTION

This paper will describe the internship experience of Patrick Uriarte at the Washington River Protection Solutions. His main task was to assist the Tank and Pipeline Integrity (TAPI) Engineers by preparing panorama images of Double Shelled Tanks which would later be used as inspection tools for the Tank and Pipeline Integrity Team. The panoramas would also be included in visual inspection reports for review by the Department of Energy and State officials. The visual inspection process encompasses all the site's Double Shelled Tanks and repeats every 3 years. Upon creation each tank was given inspection pipes known as risers. Although varying in size, a select number of risers have been repeatedly chosen as locations of deployment for the visual inspection camera. Apart from his primary objective, Patrick also aided the Tank Monitoring team with seeking and compiling legacy documents and images for easier future access.

2. EXECUTIVE SUMMARY

This research work has been supported by the DOE-FIU Science & Technology Workforce Initiative, an innovative program developed by the US Department of Energy's Environmental Management (DOE-EM) and Florida International University's Applied Research Center (FIU-ARC). During the summer of 2019, DOE Fellow intern Patrick Uriarte spent 10 weeks doing a summer internship at Washington River Protection Solutions, Richland Washington under the supervision and guidance of Ruben Mendoza, Tank and Pipeline Integrity Manager. The intern's project was initiated on June 3, 2019 and continued through August 8, 2019 with the objective of assisting the TAPI team construct panorama images for the visual inspection reports of the double shelled tanks.

3. RESEARCH DESCRIPTION

Visual Inspection Reports

Every 3 years, visual inspections of the Double Shelled Tanks are conducted. A camera is lowered into the annulus space of the double shelled tanks. Operators carefully scan over 95 % of the DST's primary shell walls.

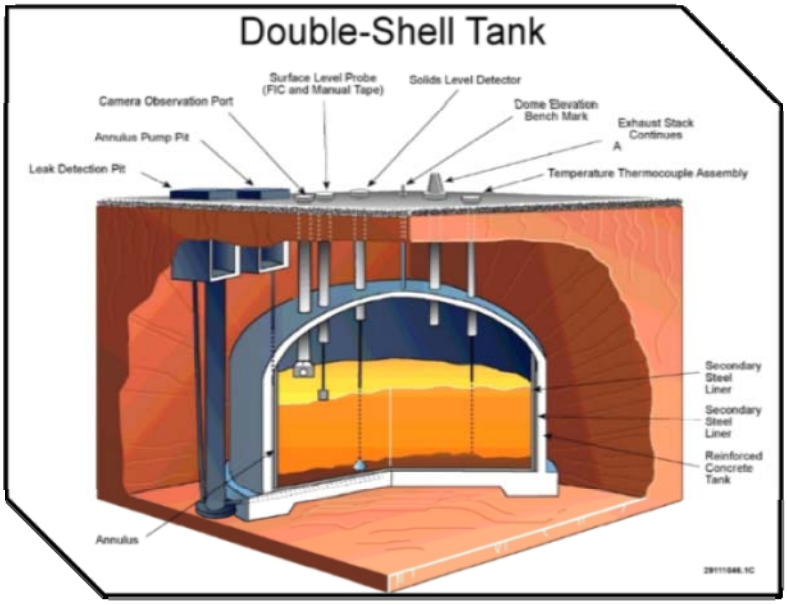

Figure 1: Diagram of Hanford Site's Double Shell Tanks

Some of the Hanford Site's Double Shelled Tanks are past their designed life timeline, therefore more careful inspection of the tanks and their corresponding pipelines is vital in mitigating the threat to the environment. Visual Inspections are required as they provide a easily consumable form of data for the Tank and Pipeline Integrity Engineers. Moreover, a common form of visual inspection is through the usage of panorama images stitched together by software.

Panorama Construction: The Tank & Pipeline Integrity team has been utilizing "AutoPano" software to construct panorama images to help with visual inspections. Upon Patrick's arrival to the internship, AutoPano was being replaced with newer software, PTGUI.

Throughout the internship Patrick was solely responsible for teaching his colleagues how to utilize the new software effectively.

Goals: Visual inspection Reports are submitted every 3 years at WRPS. The latest report was to be sent in Mid-September therefore as the only team member working on the tasks Patrick had to establish goals for each week. This included setting an amount of visual inspection panoramas to be completed per day.

Tank Monitoring Support Work

Due to a change in the company's data storage, apart from the Visual Inspections Patrick was given the task to create back-ups and compilations of legacy Hanford Site documents. This required scouring through Hanford document data and documents and populating a digital notebook.

4. RESULTS AND ANALYSIS

Through meticulous tracking Patrick was able to split the panorama construction process into its multiple stages. The Panorama steps are as follows: Photo Organization, Controls Points, Clean Up and Gluing. Figure 2 demonstrates the time collection Excel sheet Patrick used to monitor his progress.

Riser #	Layer	Process	Date	Time In (hh:mm)	TimeOut (hh:mm)	Time Duration (hh:mm)	Total Time (hh:mm)
AN-106 Riser 45 2019	Layer 1	Photo Organization	16-Jul	6:38	6:42	0:04	
		Control Points		6:42	7:05	0:23	
		Clean Up		7:05	7:08	0:03	
		Glue		7:08	7:18	0:10	0:40
	Last Layer	Photo Organization	16-Jul	7:20	7:24	0:04	
		Control Points		7:24	7:31	0:07	
		Clean Up		7:31	7:36	0:05	0:16
AN-106 Riser 46 2019	Layer 1	Photo Organization	16-Jul	3:34	3:38	0:04	
		Control Points		3:38	3:50	0:12	
		Clean Up		3:50	3:53	0:03	
		Glue		3:53	3:55	0:02	0:21
	Last Layer Refract	Photo Organization	16-Jul	3:59	4:07	0:08	
		Control Points		4:07	4:20	0:13	
		Glue		4:20	4:30	0:10	
		Clean Up		6:32	6:37	0:05	0:36
AN-106 Riser 48 2019	Layer 1	Photo Organization	16-Jul	7:42	7:43	0:01	
		Control Points		7:43	7:52	0:09	
		Clean Up		7:52	7:53	0:01	
		Glue		7:53	8:01	0:08	0:19
	Last Layer	Photo Organization	16-Jul	8:00	8:04	0:04	
		Control Points		8:04	8:20	0:16	
		Clean Up		8:25	8:25	0:00	0:20
AN-106 Riser 49	Layer 1	Photo Organization	17-Jul	6:29	6:32	0:03	
		Control Points		6:32	6:55	0:23	
		Clean Up		6:55	6:56	0:01	
		Glue		6:56	6:59	0:03	0:34
	Last Layer Refract	Photo Organization	17-Jul	7:00	7:04	0:04	
		Control Points		7:04	7:54	0:50	
		Clean Up		7:54	7:55	0:01	0:55

Figure 2: Timekeeping Table of Panorama Construction

With the previous panorama construction time of ~60 minutes. Patrick used the time as a standard and aimed for dramatic decrease in time. By the end of the internship Patrick was averaging a construction time of 32.25 minutes. Figures 3-4 show two panoramas constructed for a couple of DSTs. The tank and pipeline integrity engineer will be able to inspect the condition of the Double Shelled Tanks through these panoramas. Areas of interest will be reviewed and any new areas of interest would be evaluated.

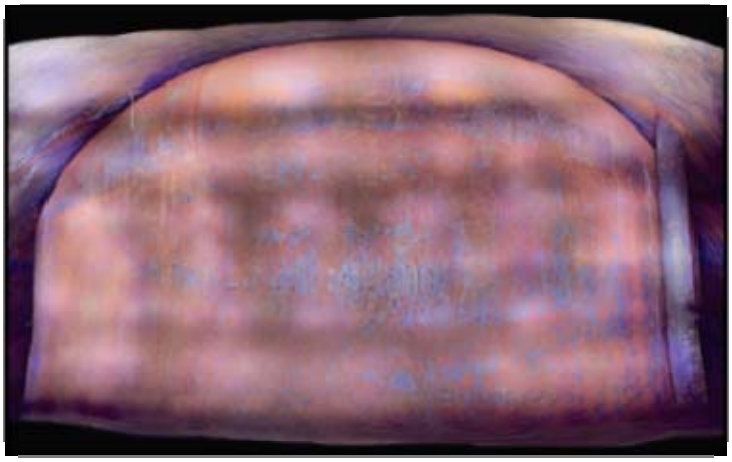

Figure 3: Panorama of DST's Primary Shell's Upper Knuckle

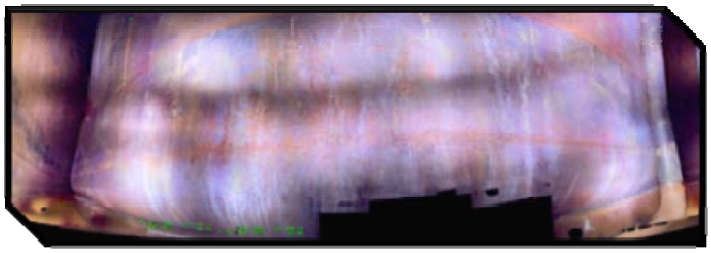

Figure 4: Panorama of DST's Primary Shell Lower Knuckle

The process of constructing panoramas like Figures 3 & 4 begins by automatically collecting images from the tank inspection videos. Once the images are collected Control Points are added between images to "link" the two together as shown in Figure 5.

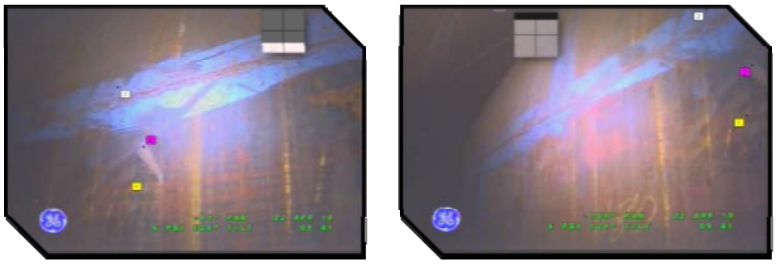

Figure 5: Application of Control Points to panorama images

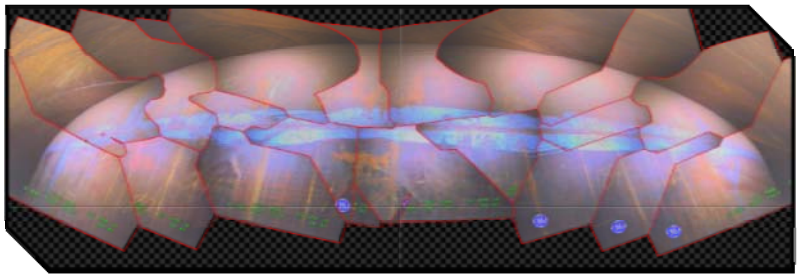

Figure 6: Stitched panorama images

Once all the images are correctly "linked" with control points, the PTGui software stitches the images together into a larger image as shown in Figure 6. This panorama construction process was completed for every panorama over the 2019 summer.

Apart from panorama construction Patrick also assisted with compilation and back up of legacy tank monitoring data. Figure 7 shows a sample of the types of images saved for back up. Every tank and its respective images are placed in their respective digital notebooks for easy access later.

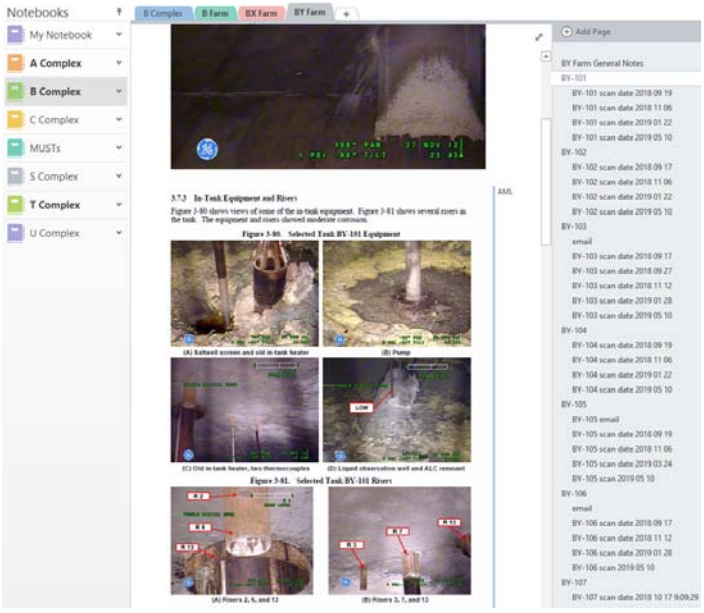

Figure 7: Compilation of Tank Waste images for Back Up

5. CONCLUSION

Patrick's work at Washington River Protection Solutions assisted the Tank & Pipeline Integrity team and Tank Monitoring team. Goals set at the beginning of the internship were met and the majority of the required visual inspection panoramas were completed in time for the delivery of the final visual inspection report due Mid-September 2019. His contributions to the compilation and back-up of legacy documents ensured the prevention of any data loss during the company's data storage transition period. Apart from his work, Patrick was also able to learn about the cleanup efforts and legacy of the Hanford Site. The great efforts put forward by the Department of Energy and Washington River Protection Solutions were prevalent throughout his time in Washington.

6. REFERENCES

[1] United States Department of Energy; “Tank Farms”; October 27, 2019

[2] “C. Girardot”; Washington River Protection Solutions; “Hanford Double-Shell Tank Visual Inspections”; ASNT Annual Conference 2015; October 26, 2015

[3] “C. Hanson”, “D.Greenwell”, “S. Guillot”, “J.Follett”; Washington River Protection Solutions; “ Hanford’s Double-Shell Tank AY-102 Recovery Project”; March 6, 2017

[4] Office of Environmental Management; “Robotic Crawlers Inspect Bottom of Hanford Double-Shell Tank”; November 20, 2018