Erosion & Corrosion Analysis of Waste Transfer Components in the POR104 Valve Box at Hanford

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Abstract

At the United States Department of Energy Hanford Site in Richland, Washington, waste is being transferred to storage tanks in preparation for treatment at the Waste Treatment and Immobilization Plant. Regulatory committees have concerns regarding the structural integrity of the waste transfer components being used. Washington River Protection Solutions (WRPS) has employed a Fitness-for-Service program, which is a multi-disciplinary engineering approach that is used to determine if equipment is fit to remain in operation for a specified projected period. An approach to monitor aging equipment is to take thickness measurements of components when feasible, to evaluate if there is any appreciable degradation in the integrity of the components. The thickness measurements can be used to determine if erosion or corrosion is occurring and predict the remaining lifespan of the components. These predictions can also be used to develop design modifications for new piping and pipe jumpers. Analysis of thickness measurements have been conducted on four floor nozzles in the POR104 valve box located in the C-Tank Farm at Hanford. The data for the floor nozzles of the valve box does not show signs of wear, but there are variations in thicknesses which are likely due to manufacturing processes.

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Background

- The U.S. Department of Energy's task at the Hanford Site is to safely store, retrieve, treat and dispose of approximately 54 million gallons of radioactive waste.
- Waste is transferred using a waste transfer system, which consists of a network of transfer lines and ancillary systems such as pits, vaults, and tanks.
- Regulatory committees are concerned for the structural integrity of waste transfer components being used.
- WRPS has implemented a Fitness-for-service program, which is a multi-disciplinary engineering approach that is used to determine if equipment is fit to continue operation for some desired future period.

Figure 1. Transport of nuclear waste tank

Objective

- The work scope for this research consists of determining wear rates to predict the existing system's remaining useful life. This will also be used to determine design allowances needed for new piping and pipe jumpers.
- Analysis will be conducted on data obtained from ultrasonic transducer thickness measurements of four 2-in Schedule 40 ASTM A312 TP 304L stainless steel floor nozzles in the POR104-WT-VP-001 (POR104) valve box at Hanford.
- Wall thickness measurements for floor nozzles B, C, E, and F contained within the POR104 were provided for analysis.

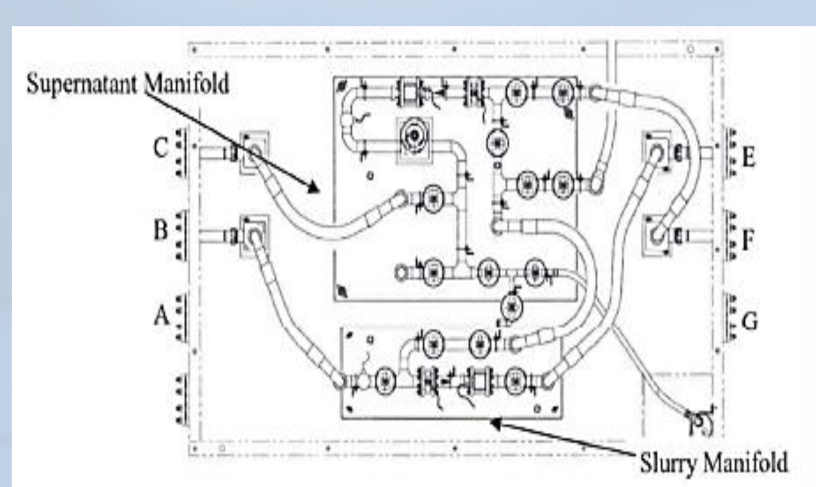

Figure 2. POR104 valve box

Data Analysis

Floor Nozzle B

Transferred 7.83 Mgal of slurry

Thickness measurements were obtained on three components for each floor nozzle: straight section, elbow, and a Purex nozzle

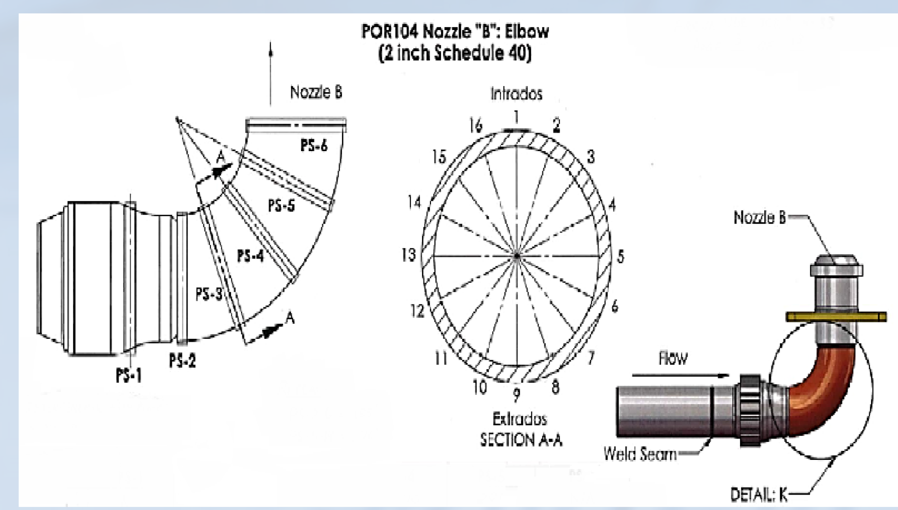

Figure 3. Positions for floor nozzle B elbow measurements

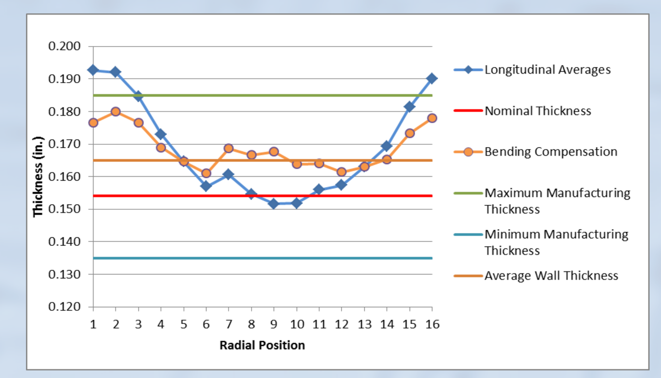

Figure 4. Average longitudinal measurements (elbow)

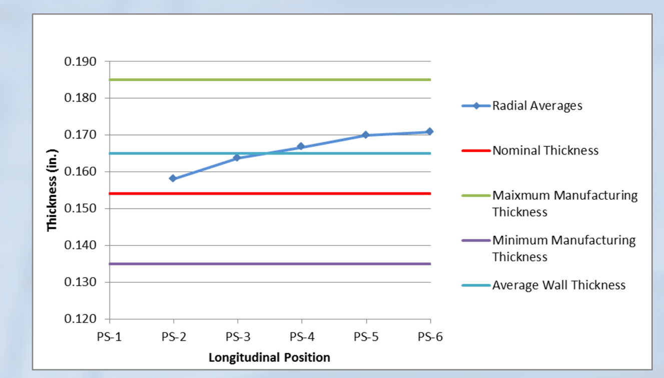

Figure 5. Average radial measurements (elbow)

- The average thickness measurements vary in an oscillatory manner around the circumference of the pipe. Thickness trends do not appear to be due to wear; rather from the manufacturing process for the pipe.

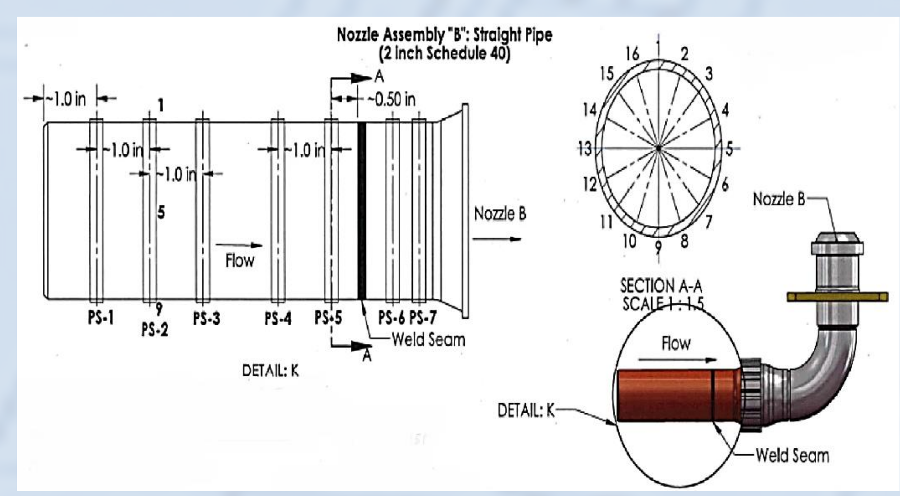

Figure 6. Positions for floor nozzle B straight section measurements

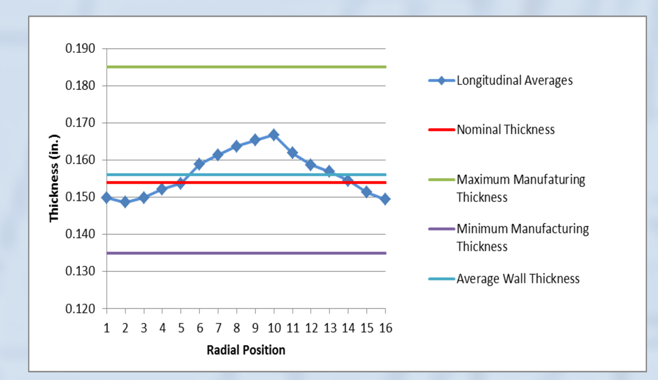

Figure 7. Average longitudinal measurements (straight)

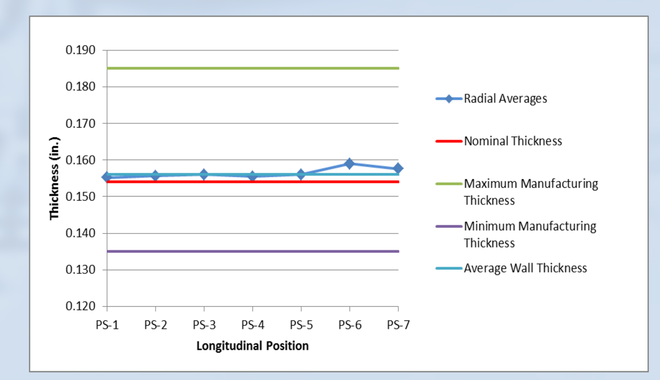

Figure 8. Average radial measurements (straight)

- Both the longitudinal and radial measurements fall between the minimum and maximum manufacturing allowances suggesting no signs of wear in the straight section

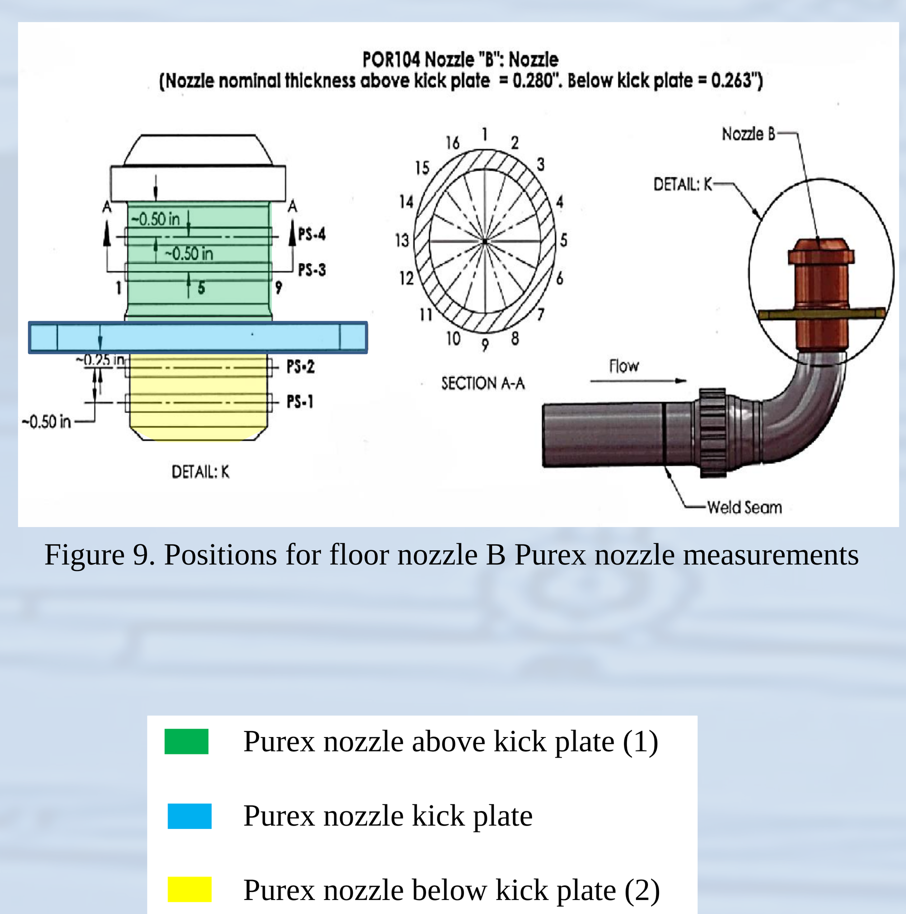

Figure 9. Positions for floor nozzle B Purex nozzle measurements

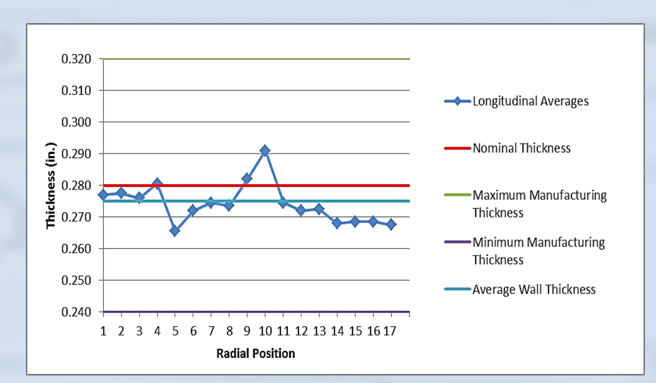

Figure 10. Average longitudinal measurements (1)

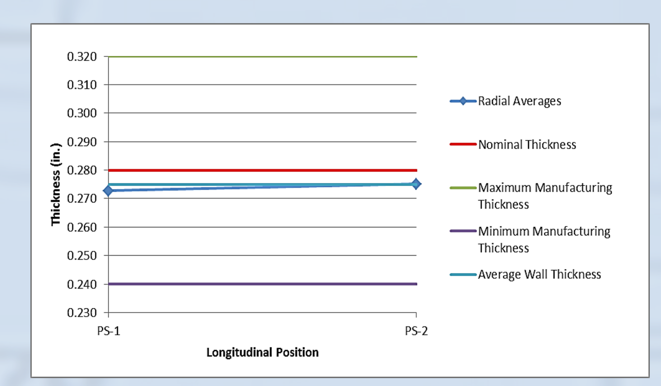

Figure 11. Average radial measurements (1)

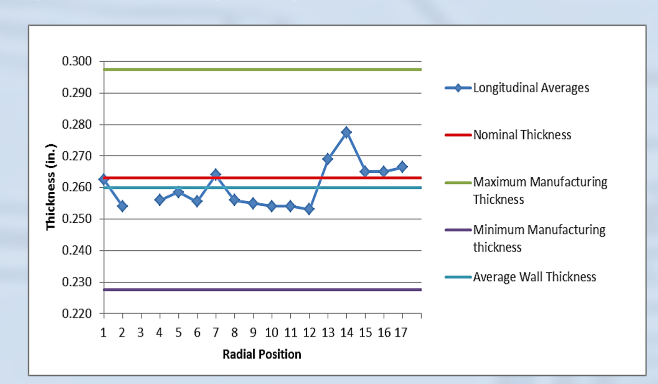

Figure 12. Average longitudinal measurements (2)

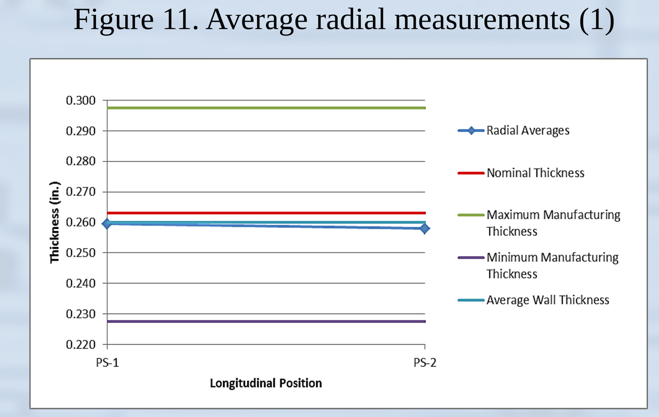

Figure 13. Average radial measurements (2)

- Radial measurements are between the minimum and maximum allowance (no signs of wear).
- The longitudinal measurements show negligible change in wall thicknesses.

Results

Floor Nozzle	Flow Type	Volume (Mgal)
B	Slurry	7.83
C	Supernatant	7.27
E	Slurry	7.83
F	Supernatant	7.27

Table 1. Summary of flow type and volume for POR104

Floor Nozzle	Section	Average Thickness (in)	Manufacturer's Nominal Thickness (in)	Minimum Manufacturing Thickness (in)
B	Elbow	0.169	0.154	0.135
	Straight	0.156	0.154	0.135
	Purex Nozzle (Above)	0.275	0.280	0.240
	Purex Nozzle (Below)	0.260	0.263	0.2275
C	Elbow	0.163	0.154	0.135
	Straight	0.157	0.154	0.135
	Purex Nozzle (Above)	0.271	0.280	0.240
	Purex Nozzle (Below)	0.261	0.263	0.2275
E	Elbow	0.165	0.154	0.135
	Straight	0.159	0.154	0.135
	Purex Nozzle (Above)	0.278	0.280	0.240
	Purex Nozzle (Below)	0.262	0.263	0.2275
F	Elbow	0.168	0.154	0.135
	Straight	0.160	0.154	0.135
	Purex Nozzle (Above)	0.277	0.280	0.240
	Purex Nozzle (Below)	0.259	0.263	0.2275

Table 2. Summary of wall thickness measurements for POR104

Conclusion

Thickness measurements were obtained for four floor nozzles pertaining to the POR104 valve box. The data suggests that there has been no substantial erosion or corrosion for these components.

Future Work

The future work of this project will consist of developing an alternative form of mounting ultrasonic transducers to receive more reliable measurements in real-time. Conceptual designs have been considered by WRPS, but a number of issues still remain.

Figure 14. Installed Pipe Wrap™

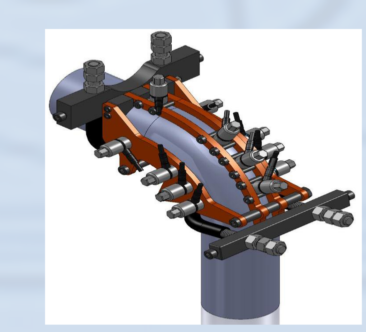

Figure 15. Conceptual Design

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