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5. ESTIMATED TANK LIFE

Contrary to popular belief, the "design life" of the tanks has not been exceeded. Actually, there is no design life specified for the tanks in the design documentation. In fact, a FLUOR Corporation report (Reference 14) states: "The objective of this study is to determine the most economical method of storing the waste products from processing zirconium-uranium alloy fuel elements. The waste must be stored for 300-400 years; however, individual tanks must serve for at least 50 years without leakage". This indicates the thinking in 1959 was that the tanks planned for storing zirconium type wastes should be designed so that they could serve reliably for at least 50 years, when storing this relatively corrosive waste.

Since there is no specified design life, one way to calculate a reasonable tank life is to determine the corrosion rate for the tank material under actual operating conditions. As described earlier, corrosion coupons have been installed in the tanks during their operating lifetimes. These coupons have been pulled from the tanks and analyzed on approximately ten-year intervals. The results have been routinely reported (References 1-4). Reference 1 provides an excellent overview of the corrosion status of all eleven tanks in 1988. It's abstract states:

> "Corrosion test coupons removed from the high level liquid waste (HLLW) tanks at the Idaho Chemical Processing Plant (ICPP) during a 1987-1988 coupon recovery operation have been evaluated. The data indicate that the fluoride-containing first-cycle raffinates (zirconium waste) are the most corrosive solutions with an average general corrosion rate of 2.9×10^{-2} mil per year. The average general corrosion rate for non-zirconium first-cycle waste solution is 1.3×10^{-2} mil per year. Sodium bearing wastes (principally PEW Evaporator bottoms) are much less corrosive with an average general corrosion rate of 6.6×10^{-4} mil per year. These corrosion rates indicate very low general corrosion rate for the internal surfaces of the austenitic stainless steel tanks. The corrosion test coupons in the HLLW vessels at this time do not indicate any localized corrosion such as pitting or heat affected weld zone attack. New coupon assemblies were installed in the waste tanks which will be exposed on the bottom of most tanks."

The 300,000-gallon waste tanks were constructed from 1951 to 1964 and were put into radioactive service from 1953 to 1966. The latest study (Reference 1), conducted in 1989 using data from corrosion coupons retrieved in 1987-88, shows that the tank which has been in the most corrosive service[30] has lost a total of 1.2 mils of metal over 23.3 years of service. The tanks were designed with a corrosion allowance[31] of 125 mils. If the corrosion data were extrapolated based on this worst case corrosion rate, the tank life would be approximately 2400 years. It is

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[30] This is Tank WM-188 which was examined by the Light Duty Utility Arm (LDUA) in 1999.

[31] Corrosion allowance is the thickness of metal that can be lost from the tank wall and still meet structural and operating requirements.

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stress-corrosion cracking, crevice corrosion, and preferential weld attack, are characterized by the appearance of the metal surfaces in microscopic examination and from various techniques of metallographic analysis.

Minor localized pitting was identified on some of the corrosion coupons retrieved during 1999 through 2002 from Tanks WM-182, WM-183, WM-187, WM-188, and WM-189.[24–27] To evaluate the impact of this pitting, a fitness-for-service evaluation was performed, as discussed in the next section.

Coupons have been retrieved from the tanks and analyzed in 1962, 1976, 1983, 1988, and from 1999 through 2002.[18,19,24–29] The results of these analyses are shown in Table 1, and are discussed in Appendix C.

3.1.5 Tank Life Projection

The most unfavorable effect of degradation would be leakage of the contents of a tank to the outside environment. If this were to occur, the tank could either be repaired or taken out of service. However, because of the highly radioactive nature of TFF solutions, the radiation exposure associated with repairing tanks probably would be unacceptable. Therefore, the preferred option is to, maintain the tanks in a fit for service condition for their operating life. The effects of degradation can be quantified by estimating the service life of a tank.

The American Society of Mechanical Engineers and American Petroleum Institute (API) design codes and standards for pressurized equipment provide rules for the design, fabrication, inspection, and testing of new pressure vessels, piping systems, and storage tanks. These codes do not address degradation of equipment while it is in service or deficiencies caused by degradation or the original fabrication that may be found during subsequent inspections. Fitness-for-service assessments are quantitative engineering evaluations that are performed to demonstrate the structural integrity of an in-service component containing a flaw or damage. Guidance for conducting fitness-for-service assessments is provided in API Recommended Practice (RP) 579, "Fitness-for-Service."[30]

A fitness-for-service assessment for the tanks that will remain in service over the next decade was conducted by CC Technologies in 2002.[31] An engineering, research, and testing firm, CC Technologies specializes in corrosion control, fitness-for-service, pipeline and plant integrity analysis, corrosion monitoring, materials evaluation and selection, and the design and development of instrumentation and software. The fitness-for-service and remaining life of Tanks WM-180, WM-187, WM-188, and WM-189, which continue to be used for storing SBW, were assessed using the accepted industry practice methods of API RP 579.

Based on the worst pit observed on the coupons, fitness for service and the remaining life of the tanks were evaluated by Level 1 and Level 2 methods of API RP 579. Level 1 methods are the most conservative, with the analysis accuracy increasing and the degree of conservatism decreasing from Level 1 to Level 3. Both the Level 1 and 2 analyses indicated that the tanks are fit for continued service even if they contain the worst amount of pitting observed in the corrosion coupons at the location of highest stress. For Level 1 analysis, the minimum remaining life was computed to be 48 years. For Level 2 analysis, the minimum remaining life was computed to be 90 years.[31] CC Technologies also recommended increasing the frequency of corrosion coupon examinations to approximately once every 5 years, along with use of electrochemical noise monitoring.[31]