LEAKING TANK REPORT.

RPP-ASMT-53793
Revision 0

Tank 241-AY-102 Leak Assessment Report

J. K. Engeman
C. L. Girardot
D. G. Harlow
C. L. Rosenkrance
Washington River Protection Solutions

Date Published
October 2012

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800

washington river protection solutions

P.O. Box 850
Richland, Washington 99352

APPROVED
By Julia Raymer at 7:40 am, Nov 07, 2012

Release Approval Date

EXECUTIVE SUMMARY

Tank AY-102 was the first double-shell radioactive waste storage tank constructed at Hanford. The tank was completed in 1970, and entered service in 1971. It currently stores the Waste Treatment and Immobilization Plant hot commissioning feed.

In August 2012, an accumulation of material was discovered at two locations on the floor of the annulus that separates the primary tank from the secondary liner, and at a third location on the primary tank dome above the waterline. None of the material was present during inspections completed in December 2006 and January 2007.

A formal leak assessment team was established August 10, 2012, to review Tank AY-102 construction and operating histories, and determine whether the material found on the annulus floor resulted from a primary tank leak. The panel consisted of Engineering, Base Operations, and Environmental Protection individuals representing a broad cross-section of the company. The team met between August 28, 2012 and October 10, 2012, to gather and analyze information, formulate tank leak and non-leak hypotheses, and reach a consensus on the source of the floor material.

Tank AY-102 construction records detail a tank plagued by first-of-a-kind construction difficulties and trial-and-error repairs. The result was a tank whose as-constructed robustness was much lower than intended by the double-shell tank designers. For example:

- Bulges created in the secondary liner from welding the thin floor plates, and from reworking rejected welds, were eventually accepted so construction could proceed. The rigid insulating refractory cast on top of the secondary liner cracked as the bulges moved, leaving the pad bridged in places.
- The primary tank floor plate weld rejection rate was 36 percent. Weld maps show welds being reworked as many as four times before passing radiography examination.
- Rainwater saturated the insulating refractory pad in the weeks before the primary tank was scheduled for post-weld stress-relief. During stress relief, the tank bottom temperature could not be raised above 210°F for two days, while steam escaped from the water-soaked refractory. The tank temperature eventually reached the required annealing temperature and was held at temperature for the required time.
- After stress relief and the hydrostatic leak check, part of the insulating refractory pad was found to be too damaged to be used. The outside 21 in. of the refractory were excavated from beneath the primary tank and replaced with structural concrete. Pieces of Styrofoam were used to fill gaps between the primary tank bottom and the refractory surface further under the tank when they were found.

  The initial pours of the structural concrete filled the area under the primary tank knuckle, but did not flow to the back of the excavation. The slump was increased on later pours to ensure that the primary tank bottom was supported.

Between 1977 and 1984, the tank received a variety of supernatant wastes. A thin layer of sludge formed on the tank bottom during 1977 – 1979, and probably 1982 – 1984. The interstitial liquid associated with the sludge may have been mildly corrosive based on derivation of its composition from the limited number of sample analyses that are available. It is possible that the interstitial liquid began to incrementally corrode the tank bottom during this time.

In 1998 and 1999, high temperature sludge from Tank C-106 was transferred into Tank AY-102. The sludge formed a blanket over the existing sludge and increased its temperature dramatically. It is likely that the corrosion rate accelerated after the temperature increase.

In 2005, a segment of core sample drill string was dropped back into the tank during its removal; and in 2009, the tank bottom was repeatedly bumped during installation of a corrosion probe. Review of these events suggests that neither materially damaged the tank.

During September and October 2012, samples from both annulus floor locations were collected and analyzed. The material was radioactive and its composition was consistent with Tank AY-102 waste, including a high concentration of potassium. Potassium is a unique chemical marker because it is contained in only a few tanks.

There was consensus agreement among the leak assessment team members that the radioactive material on the annulus floor of Tank AY-102 was the result of waste leaking from a breach in the bottom of the primary tank. The probable leak cause was identified as corrosion at high temperatures in a tank whose waste containment margins had been reduced by construction difficulties. The impacts that the tank bottom may have received from the dropped core sample drill string or the corrosion probe installation were judged to have negligible effect.

The Tank AY-102 leak volume was estimated to be between 190 to 520 gal. A significant portion of the liquid has evaporated, leaving about 20 to 50 gal of drying waste.

The results of the leak assessment were presented to the Washington River Protection Solutions, LLC. Executive Safety Review Board on October 19, 2012, with a recommendation to change the Tank AY-102 leak integrity classification from "sound" to "assumed leaker." The Board concurred with the recommendation.

The leak assessment team considered the possibility that Tank AY-102 is an outlier among the Hanford double-shell tanks. Construction difficulties and trial-and-error repairs left the primary tank bottom with residual stresses that could not be foreseen by the designers. These provided a fertile incubator for sustained corrosion to take place. With the construction improvements already evident in Tank AY-101 as Tank AY-102 was being completed, and the design changes implemented in the second and subsequent generations of double-shell tanks, it seems unlikely that the other double-shell tanks in similar circumstances would have been similarly affected. Additional Extent of Condition inspections scheduled for the other double-shell tanks will determine the validity of the team's conclusion.

This report summarizes the forensic lines of inquiry prepared by the leak assessment team and supporting technical staff during the Tank AY-102 leak determination.