Performance Assessment for the F-Tank Farm at Savannah River Site - 9462

K. H. Rosenberger
Savannah River Nuclear Solutions
Building 705-1C, Aiken, SC 29808

ABSTRACT

The Savannah River Site (SRS) has completed a Performance Assessment for the F-Tank Farm (FTF) to support the closure documentation process [1]. The FTF is one of two liquid radioactive waste storage areas at the SRS and the location of the first two tanks closed in the Department of Energy (DOE) complex in the late 1990's. SRS plans to close the next two tanks in FTF prior to the Federal Facility Agreement (FFA) deadline of 2012. In order to commence tank grouting for final closure, several closure documents are necessary including a Section 3116 Waste Determination and South Carolina permit closure documents. The FTF Performance Assessment was written with consideration of the various documents necessary for final closure and the information necessary to inform the document conclusions.

INTRODUCTION

The SRS is a DOE facility located in south-central South Carolina, approximately 161 kilometers (100 miles) from the Atlantic Coast. The major physical feature at SRS is the Savannah River, approximately 32 kilometers (20 miles) of which serves as the southwestern boundary of the site and the South Carolina-Georgia border. The SRS includes portions of Aiken, Barnwell, and Allendale Counties in South Carolina. The SRS occupies an almost circular area of approximately 803 square kilometers (310 square miles) and contains production, service, and research and development areas.

The F-Area is in the north-central portion of the SRS and occupies approximately 1.5 square kilometers (364 acres). The FTF is an active liquid waste storage facility consisting of 22 underground carbon steel waste tanks that store, or once stored liquid radioactive waste generated primarily from chemical separations processes. There are four tank designs in FTF (Types I, III, IIIA and IV) which have unique design features that impact the PA results. Tank 17 and Tank 20 have already been filled with grout and closed via a South Carolina and Environmental Protection Agency (EPA) reviewed and approved Closure Plan and Closure Modules. The FTF also includes various equipment used to facilitate liquid transfers and evaporation operations. Figure 1 presents the general layout of FTF including the storage tanks and principal ancillary equipment.

The PA was prepared to support the eventual closure of the FTF underground radioactive waste tanks and ancillary equipment. The PA provides the technical basis and results to be used in subsequent documents to demonstrate compliance with the pertinent requirements identified for final closure of FTF including those in DOE Order 435.1 [2], the *Ronald W. Reagan National Defense Authorization Act (NDAA) for Fiscal Year 2005* Section 3116 [3], and South Carolina Department of Health and Environmental Control (SCDHEC) industrial wastewater regulations.

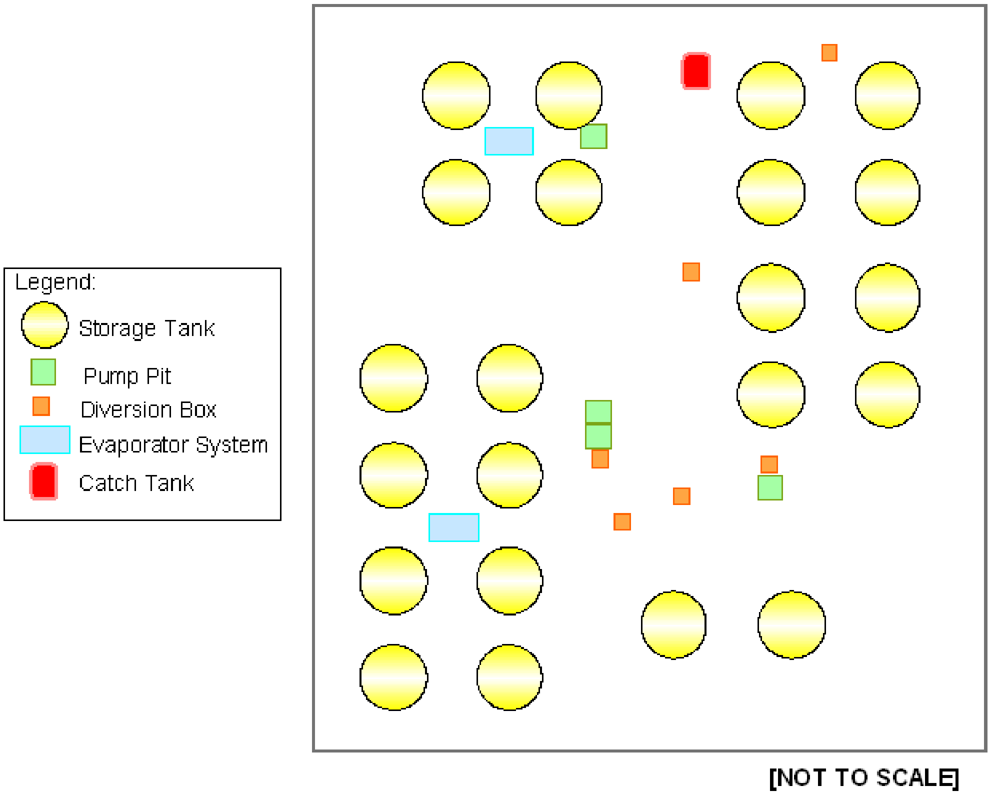

Fig. 1. General Layout of F-Tank Farm.

FTF PERFORMANCE ASSESSMENT

Input Scoping Meetings

In order to complete closure activities in a timely manner for meeting commitments, it was desired to reduce the comment resolution schedule durations and potential remodeling resulting from reviews of the PA after completion. It was therefore prudent to have scoping meetings during PA input data development to obtain up-front input understanding and assess the reasonableness of assumptions to minimize downstream rework and remodeling. The purpose of the scoping meetings was to facilitate candid technical discussion on input parameters related to the tank farm-specific PA modeling. To accomplish this goal, a series of meetings were held to discuss and review individual input packages with representatives from the DOE, SCDHEC, EPA and the Nuclear Regulatory Commission (NRC).

Modeling Approach

To prepare for modeling of FTF, SRS conducted several new testing and computational activities. The physical and chemical properties were determined via analytical testing for the cementitious materials in the closed tank system including the reducing fill grout and concrete walls and basemat. Key properties included the hydraulic conductivity, porosity, and distribution coefficients for numerous radionuclides. Computational work included determining solubility values for various radionuclides, closure cap design and infiltration estimates, steel liner life estimates, updated bioaccumulation factors and consumption rates for SRS and residual inventory estimates.

The PA for FTF employed a hybrid modeling approach. A deterministic evaluation was used to assess the base case and perform single parameter sensitivity analyses and utilized the PORFLOW computer code. The base case evaluation yielded a single result utilizing best estimate input parameters. A stochastic evaluation was used for the uncertainty analyses and sensitivity analyses and utilized the GoldSim platform with distributions for a large number of input parameters. The deterministic evaluation modeled flow and transport in both the near field and far field and the flow parameters were utilized in a more simplified analytical model for stochastic evaluation. The deterministic model results were benchmarked against the stochastic model to ensure consistency in model behavior. The stochastic evaluation modeled transport in both the near field and far field. The stochastic evaluation ensured that collective impacts were evaluated in the uncertainty analysis and sensitive parameters were identified in the sensitivity analysis. Figure 2 presents a graphical depiction of the modeling parameters for the deterministic and stochastic models.

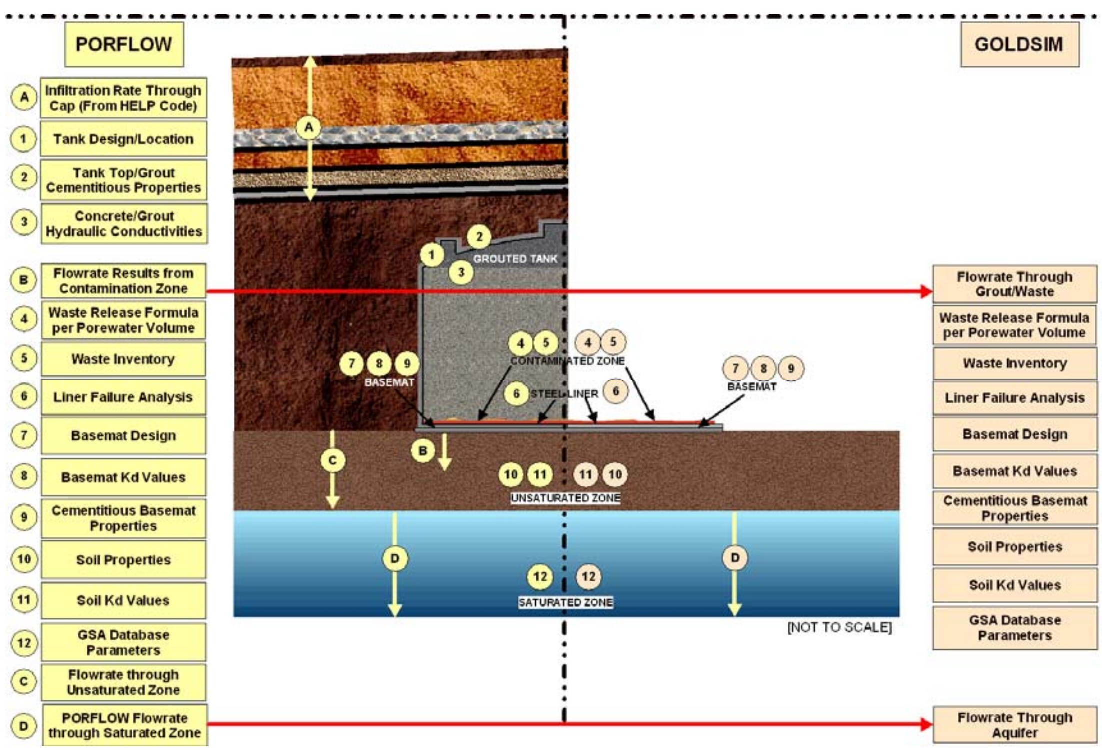

Fig. 2. Depiction of FTF Modeling Approach.

Modeling Results

The FTF sits on a groundwater divide and therefore future releases will flow along various flow paths. Figure 3 presents the flow path centerlines from analytical tracer particles released from the centerline of each tank and illustrates the diverse flow directions which terminate at the streams. The PA calculates of the following: potential radiological doses to a hypothetical member of the public (MOP) at 100 meters and at the streams; potential radiological doses to a hypothetical inadvertent intruder; radiological dose to a human receptor via the air pathway, radon flux, and water concentrations. All of these calculations were performed to provide results over a minimum of 10,000 years. The water concentrations were calculated for both radioactive and non-radioactive contaminants at multiple locations outside FTF which will be used by future closure documents.

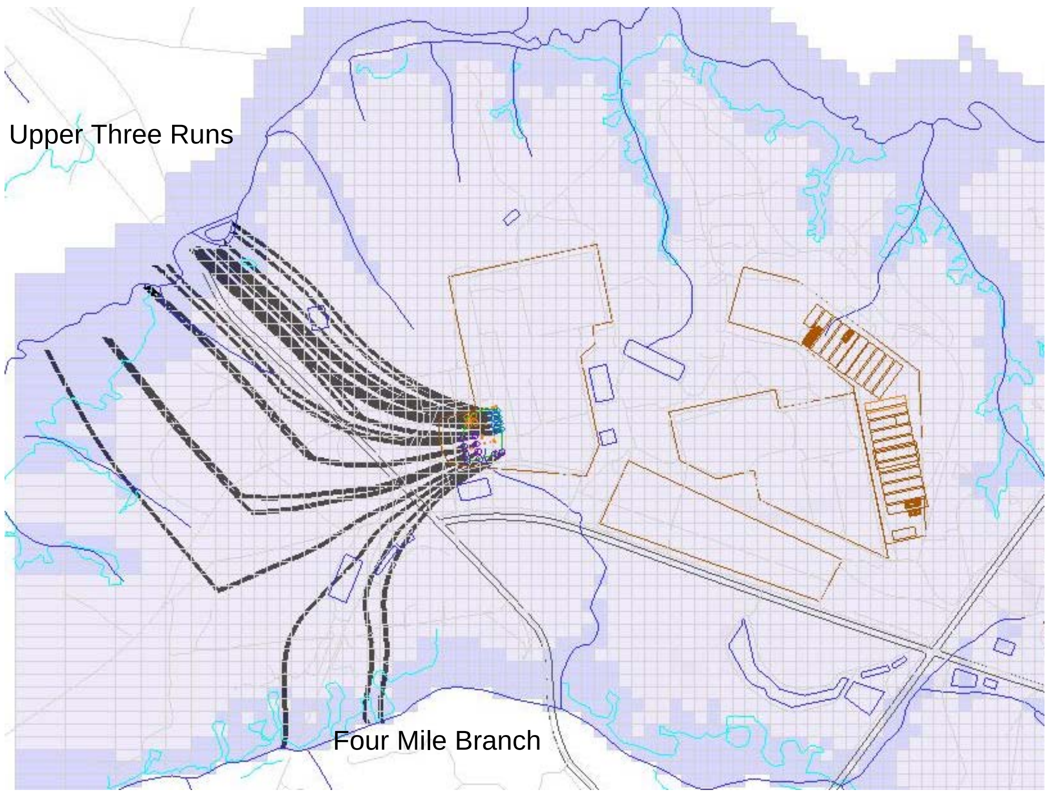

Fig. 3. FTF tank flow paths.

A key radiological dose result in the PA is the dose to the hypothetical MOP at a distance of 100 meters from the edge of FTF. The peak dose from all evaluated exposure pathways at 100 meters is approximately 14 microSv/year (1.4 mrem/year) at 10,000 years following facility closure with the principal radionuclides at the peak dose time period being Ra-226, U-233 and U-234. Figure 4 presents the peak dose over the 10,000 year compliance period.

The peak doses to a hypothetical inadvertent intruder are approximately 16 microSv (1.6 mrem) for an acute intruder and 730 microSv /year (73 mrem/year) for a chronic intruder. Peak doses for both scenarios occur at 100 years after facility closure as the doses are driven by short-lived radionuclides Cs-137/Ba-137m for the acute intruder and Cs-137/Ba-137m and Sr-90/Y-90 for the chronic intruder.

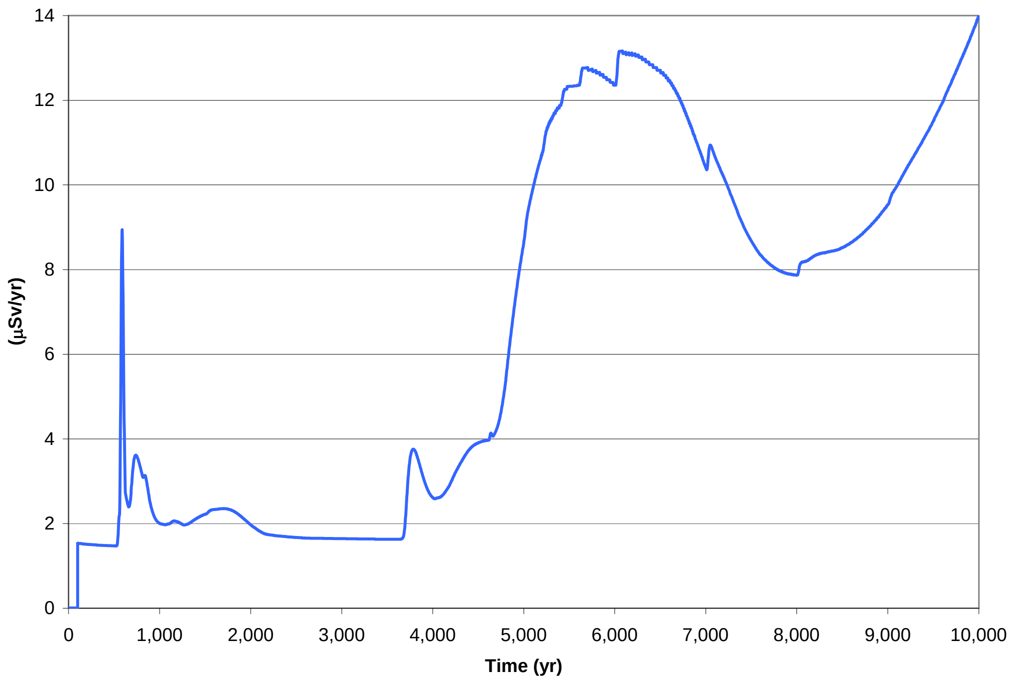

Fig. 4. Peak FTF all-pathways 100 meter dose.

CONCLUSION

The FTF PA contains results for future comparison to all performance measures for the regulatory time-frame of interest. The FTF PA provides documentation of the bases and methodology leading to the results and includes the necessary information for the development of future closure documents to support stakeholder closure decisions. The FTF PA has undergone Department of Energy review and is currently under review by SCDHEC, the EPA and the NRC.

REFERENCES

1. “Performance Assessment for the F-Tank Farm at the Savannah River Site”, SRS-REG-2007-00002, Revision 0, Washington Savannah River Company (2008).

2. “Radioactive Waste Management”, DOE O 435.1, Chg. 1, U.S. Department of Energy, (2001).

3. “Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005”, Public Law 108-375, “Defense Site Acceleration Completion”, Section 3116, (2004).