

November 12, 2009

MEMORANDUM TO: Gregory Suber, Chief
Low-Level Waste Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

THRU: Christopher McKenney, Chief */RA/*
Performance Assessment Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

FROM: David Esh, Senior Systems Performance Analyst */RA/*
Performance Assessment Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

SUBJECT: TECHNICAL REVIEW: SALTSTONE VAULT #2 INTERIOR
LINING REVIEW

On November 25, 2008, the U.S. Department of Energy (DOE), Savannah River Operations Office, provided the subject report for review by the U.S. Nuclear Regulatory Commission (NRC) staff pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005. The subject report is available on NRC's Agencywide Documents Access and Management System at accession number ML083400060. This report was reviewed in accordance with monitoring activities described in "NRC Plan for Monitoring the DOE Salt Waste Disposal at the Savannah River Site in Accordance with the

G. Suber

2

National Defense Authorization Act for Fiscal Year 2005" (ML070730363). The staff's technical review summary is enclosed for your use.

Docket No.: PROJ0734

Enclosure: Technical Review Summary

G. Suber

2

National Defense Authorization Act for Fiscal Year 2005" (ML070730363). The staff's technical review summary is enclosed for your use.

Docket No.: PROJ0734

Enclosure: Technical Review Summary

DISTRIBUTION:

KPinkston GAlexander ARidge CGrossman LHoward/CNWRA

ML093100197

OFC	DWMEP	DWMEP	DWMEP	DWMEP:BC
NAME	DEsh	NDevaser	AWalker-Smith	CMcKenney
DATE	11/12/09	11/12/09	11/12/09	11/12/09

OFFICIAL RECORD COPY

Technical Review Summary
SALTSTONE VAULT #2 INTERIOR LINING REVIEW

Review Completed: November 2009

Reviewer(s): D. Esh

Document(s): T.E. Skidmore, and K.D. Billings, *Saltstone Vault #2 Interior Lining Review*, WSRC-TR-2008-00090, Rev. 0, Savannah River National Laboratory. May, 2008. ADAMS Accession # ML083400060

Evaluation

The subject report provided a review of lining options for the interior of the new Saltstone Vault #2 design. The objectives for the lining materials are to improve the probability that the new vault design will meet long-term performance goals in a 10,000 year performance period by protecting the concrete vault from sulfate attack and other degradation mechanisms associated primarily with the initial interaction of the vault concrete with the saltstone wastefrom. The desired service life of the materials selected is 100 years, because current DOE analysis suggests the impact of sulfate-containing bleedwater decreases as the bleedwater is removed from the system as the saltstone cures.

The report provides an overview of the vault lining requirements and saltstone characteristics. The primary function of the lining materials is mitigation of sulfate attack from short-term saltstone bleedwater (10,900 mg/L SO_4^-) penetration through surface cracks and by capillary suction, and diffusion of sulfate from the pore fluid of the cured saltstone. The coating must be resistant to chemical and radiation damage at elevated temperatures. In addition, the coating should exhibit a minimum elongation value of 2%, provide a long-term barrier for diffusion, be easily applied to joints and penetrations, and generate limited amounts of flammable gases. The report provides physical characteristics of saltstone, referencing the 1992 performance assessment. More recent data is acknowledged, though a reference is not provided. Although the physical characteristics of saltstone are not essential to the content of this report, they may influence the preliminary assessment performed in 2007 (reference 1 in the document) which identified the desired service life. If this report were to be revised, U.S. Nuclear Regulatory Commission (NRC) staff recommends that more recent information for the physical characteristics of saltstone be provided and that the assessment of the impact of liner coatings on preventing, mitigating, or delaying sulfate attack of concrete be reevaluated.

The impact of radiation on different liner materials was evaluated. Cs-137 was the primary contributor to the total dose rate from all radionuclides. The Cs-137/Ba-137m concentration was assumed to be 0.1 Ci/gal. From review of saltstone inventory reports, NRC staff concludes that the assumption of 0.1 Ci/gal may not be realistic or sufficiently conservative. Review of the saltstone inventory reports show that quarterly averaged concentrations of saltstone can exceed 0.15 Ci/gal. In addition, batch to batch variability would likely result in locally higher concentrations. NRC staff recommends that the assessment of radiation damage should consider variability in the source concentrations of saltstone. NRC staff agrees that the

ARP/MCU and SWPF waste streams are projected to have concentration less than 0.1 Ci/gal; however, DOE should evaluate the fraction of waste that may be above 0.1 Ci/gal.

Mat-reinforced epoxy-novolac thermosetting linings were recommended based on the assessment of experience with different lining materials, comparison of the materials to the design requirements, and recommendations from vendors, among other factors. The report recommends mat-reinforced epoxy-novolac thermosetting linings, but acknowledges that service life prediction is complex, long-term performance data are limited, and that performance is based on several assumptions that would require verification. These assumptions include: limited oxidation, gradual temperature decline, tolerable radiation dose with minimal dose rate effects, minimal differential settlement and proper installation. Numerous vendors were contacted by DOE for recommendations of coating systems given the design parameters. Throughout section 5.4 of the subject report is a discussion of lining degradation mechanisms and in particular dose rate effects. Processes that are rate-limited have the potential to not be identified in testing or from examination of performance data of a period of time that is shorter than the anticipated service life. In addition, the materials may exhibit cliff response where performance is relatively stable until a condition is achieved, where performance deteriorates relatively quickly. An example would be depletion of antioxidants in a polymer.

Teleconferences and Meetings

This report has not yet been discussed in a teleconference or meeting.

Open Issues

No open issues were identified as part of this review.

Conclusion

The NRC staff believes that this report was a sufficient assessment of lining systems that could be used to reduce the impact of sulfate attack on saltstone vault concrete. NRC staff concludes the primary vault lining requirements have been appropriately identified. The report adequately discussed lining degradation mechanisms, factors that could affect performance and key assumptions.

NRC staff would note that while the report did a good job of assessing different lining materials and evaluating their potential performance given the design goals and expected service environment, the actual performance of thermosetting lining materials would need to be verified for this particular application. If credit is taken for the thermosetting lining performance in the performance assessment the NRC staff recommends:

- 1) Performance of additional testing and research. The testing and research should consider how dose rate effects could be addressed.
- 2) Providing conceptual diagrams of the systems and conditions, including a description of how the system would avoid osmotic blistering and moisture vapor transmission.

- 3) Completion of the accelerated-aging test program noted in the report to validate conclusions and provide a model for lining service life prediction for this application.
- 4) Providing a more detailed description of the quality assurance (QA) processes, procedures, and controls for the lining systems selected for use in this application.
- 5) Evaluating the potential for waste to exceed 0.1 Ci/gal, and if necessary revise the lining assessment and selection process and associated testing.

References

WSRC. *Radiological Performance assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Westinghouse Savannah River Company. 1992,