UNITED STATES DEPARTMENT OF ENERGY SAVANNAH RIVER SITE	Document Review Record SRR-CWDA-2009-00010	
Document No./Title: **SRNS-STI-2008-00050, Evaluation of Sulfate Attack on Saltstone Vault Concrete and Saltstone, Part I: Final Report**	Rev. No.: 0	Doc. Date: 8/19/08
Reference: 3/25/09 – 3/26/09 NRC Onsite Observation Report for Saltstone (NRC Document No. ML091320439)		

No.	Comments	Comment Resolution
	SRNS-STI-2008-00050, Evaluation of Sulfate Attack on Saltstone Vault Concrete and Saltstone, Part I: Final Report	
ML091320439 #15	Evaluate the sensitivity of grid spacing to predicted front propagation in the sulfate attack evaluation.	SRS does not have direct access to the STADIUM software code of SIMCO Technologies. However, SRS has discussed the sensitivity of grid spacing (mesh) with SIMCO and the following response is provided: *The mesh used to perform the simulations is a lot denser than what is actually needed to solve the mass transport equations. However, using less elements would result in mineral dissolution/precipitation fronts that are less sharp. In other words, increasing the mesh density would not improve significantly the numerical solution already provided*. After consultation with the vendor, SRR believes that a reasonable and appropriate grid spacing was used for this approach.
ML091320439 #16	Explain how spatial representation in the numerical experiments of sulfate attack will be translated into a PA model, since the geometries of the real system will be much more complex (e.g., a random collection of different size blocks determined by crack distributions) than those considered in the numerical experiments.	Section 4.2.3.2.4 of the recently revised Saltstone Disposal Facility (SDF) Performance Assessment (PA) (SRR-CWDA-2009-00017) and supporting PORFLOW modeling report (SRNL-STI-2009-00115, Rev 1) describe how the 1D localized sulfate attack simulations using STADIUM are implemented in the larger scale vadose zone / disposal cell model.

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ML091320439 #17	Explain how cracks are incorporated into the sulfate attack representation in the PA model, since cracks could significantly impact the degradation assessment (page 15). Explain assumption "I" that the transport rate through damaged concrete of sulfate ions is not different from undamaged concrete (page 21).	In the STADIUM model, cracking from sulfate attack is not considered. This assumption may be reasonable under unsaturated conditions such that fractures are largely dewatered. The base case sulfate attack from the revised SDF PA (SRR-CWDA-2009-00017) adopts this assumption. In an abstraction of STADIUM that is used for a sensitivity case in the revised PA, a 10x higher diffusion coefficient is postulated to occur as a result of cracking behind the ettringite front. This sensitivity case is pessimistic compared to the base case. In the PORFLOW vadose zone / disposal cell model for the above two cases, cracking is assumed to occur behind the ettringite front and lead to degraded effective hydraulic properties for the overall disposal cell concrete thicknesses (roof, wall, floor). Section 5.6.6.3 of the revised SDF PA and supporting PORFLOW modeling report (SRNL-STI-2009-00115 Rev 1) provide more complete information. Vaults 1 and 4 contain existing macrocracks. In the revised model, the initial hydraulic conductivity assigned to the walls reflects significant through-cracking, such that the vault wall is not a hydraulic barrier when the cover system degrades and infiltration increases. That is, the Vault 1 and 4 walls are modeled as degraded from time zero, irrespective of sulfate attack.
ML091320439 #18	Clarify the conceptual model for sulfate attack. For example, does sulfate attack proceed along a front, or is it a generalized mechanism	In the revised SDF PA, the conceptual model assumes that ettringite forms along an advancing front that causes physical damage to the material. Material behind the front remains degraded.

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ML091320439 #19	Clarify the conceptual model represented by case 2 (page 6). If the concentration was diluted by diffusion, then what is the fate of diffused species? If species are diffusing through the vault wall, then why isn't the vault wall degraded.	As dissolved species diffuse from saltstone into adjoining concrete (degrading the concrete), concentrations of the dissolved species at the saltstone-concrete interface will decline through time. Some species will diffuse through concrete barriers, while others react with the concrete matrix. At later times, concentrations at the saltstone-concrete interface will be fractions of their original values.
ML091320439 #20	Explain why it is appropriate to neglect minor species (page A2-14).	Minor species are not expected to significantly influence sulfate attack in particular and the evolution of the concrete matrix in general. SRS does not have direct access to the STADIUM, proprietary software of SIMCO Technologies. However, after consultation with SIMCO, minor species are addressed as follows: *Components such as calcium or silica, when dissolved in solution, form different species. In the case of silica, species such as H2SiO4_2-, H3SiO4_1- and H4SiO4_0 are present in solution. The relative proportions of these species depends mainly on the pH of the solution. As illustrated in the figure below, some species are dominant in low pH conditions and become negligible at high pH. Cementitious materials contain a high pH pore solution. Accordingly, the species selected for the calculations corresponds to the species showing the highest concentration at high pH. Referring to the figure, H2SiO4_2- was selected over H3SiO4_1- and H4SiO4_0. Similarly, Ca2+ was favored over CaOH+ in the case of calcium. Once the main species are selected, the dissolution/precipitation reactions of the minerals considered in the calculations are expressed as a function of those species.*

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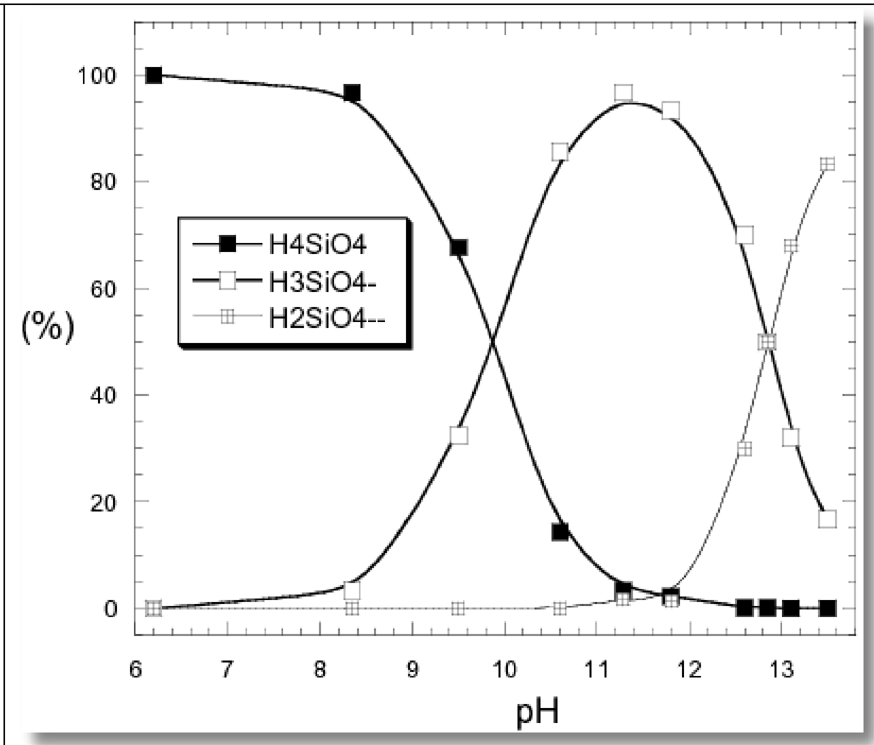
ML091320439 #20 (Cont'd)		

TECHNICAL REVIEW COMMENT SHEET
Salt Waste Disposal

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ML091320439 #21	Justify the use of Berner's approach for these materials and solutions (page A2-15).	SIMCO has validated the use of Berner's approach in high alkaline/high pH conditions (P. Henocq, E. Samson, J. Marchand, Infuence of alkali chloride on surface properties and solubility of C-S-H, in: J. J. Beaudoin, J. M. Makar, L. Raki (Eds.), 12th International Congress on the Chemistry of Cement, Cement Association of Canada, Montreal, Canada, 2007). The referenced work can be found at: http://cement.sinoepsourcing.com/downLoadServlet?fileUrl=/upload/tech/SEPS_1_5_10168.pdf