Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
1	2005 Special Analysis Base Case	N/A – Base Case	N/A – Base Case	4.8E-02	N/A – Base Case
2	Optimistic Cover Degradation	Peak Infiltration from 14 in/year to 7 in/year.	Addresses sensitivity of varying cap degradation	2.0E-02	Results suggest that varying cap behavior among reasonable values has minor impact on dose result.
3	Pessimistic Cover Degradation	Peak Infiltration from 14 in/year to 21 in/year.		2.7E-01	
4	Optimistic Vault Degradation	Saturated hydraulic conductivity of the vault goes from 1E-12 to 1E-10 cm/sec over 10,000 years.	Addresses sensitivity of varying vault degradation behavior	3.1E-02	Results suggest that varying conductivity by 4 orders of magnitude has negligible impact on dose result.
5	Pessimistic Vault Degradation	Saturated hydraulic conductivity of the vault goes from 1E-12 to 1E-8 cm/sec over 10,000 years.		5.1E-02	
6	Optimistic Initial Vault Conductivity	Initial saturated hydraulic conductivity of the vault set at 1E-13 cm/sec	Addresses sensitivity of initial vault saturated hydraulic conductivity.	3.2E-02	2 orders of magnitude has little impact on dose result
7	Pessimistic Initial Vault Conductivity	Initial saturated hydraulic conductivity of the vault set at 1E-11 cm/sec		5.1E-02	
8	Optimistic Saltstone Degradation	Saturated hydraulic conductivity of Saltstone goes from 1E-11 to 1E-10 cm/sec	Addresses sensitivity to Saltstone degradation rate	3.7E-02	3x change in rate of degradation has little impact on dose result
9	Pessimistic Saltstone Degradation	Saturated hydraulic conductivity of Saltstone goes from 1E-11 to 1E-8 cm/sec over 10,000 years.		2.3E-01	
10	Optimistic Initial Saltstone Conductivity	Initial saturated hydraulic conductivity of Saltstone set at 1E-12 cm/sec	Addresses sensitivity to initial Saltstone saturated hydraulic conductivity	3.8E-02	1 order of magnitude increase in conductivity

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
11	Pessimistic Initial Saltstone Conductivity	Initial saturated hydraulic conductivity of Saltstone set at 1E-10 cm/sec		2.4E-01	increases dose 5x
12	Pessimistic Cover Degradation and Pessimistic Vault and Saltstone Degradation – Combination of Runs 3, 5 and 9	Peak Infiltration from 14 in/year to 21 in/year. Saturated hydraulic conductivity of the vault goes from 1E-12 to 1E-8 cm/sec over 10,000 years. Saturated hydraulic conductivity of Saltstone goes from 1E-11 to 1E-8 cm/sec over 10,000 years.	Addresses combined effect of pessimistic cover degradation, pessimistic vault and saltstone conductivity.	4.0E+00	Significant (82x) increase in dose, but still < 25 mrem/year
13	Vault and Saltstone Saturated for Entire Run	Relative hydraulic conductivity set to 1 for both the vault and Saltstone.	Addresses impact of saturation	1.8E-01	Relatively small (4x) increase in dose
14	Optimistic Vault Diffusion	Vault diffusion coefficient set to 1E-9 cm^2/sec	Assesses sensitivity to vault diffusion coefficient	3.5E-02	2 orders of magnitude changes dose ~5x
15	Pessimistic Vault Diffusion	Vault diffusion coefficient set to 1E-7 cm^2/sec		1.7E-01	
16	Optimistic Saltstone Diffusion	Saltstone diffusion coefficient set to 5E-10 cm^2/sec	Assesses sensitivity to Saltstone diffusion coefficient	3.9E-02	2 orders of magnitude changes dose ~2x
17	Pessimistic Saltstone Diffusion	Saltstone diffusion coefficient set to 5E-8 cm^2/sec		6.4E-02	
18	Pessimistic Vault and Saltstone Diffusion – Combination of Runs 15 and 17	Vault diffusion coefficient set to 1E-7 cm^2/sec Saltstone diffusion coefficient set to 5E-8 cm^2/sec	Assesses sensitivity to combined vault and saltstone diffusion coefficient	6.8E-01	1 order of magnitude increase for vault & saltstone increases dose 14x

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
19	Pessimistic Partition Coefficients	Partition coefficients for C-14, Se-79 and I-129 set to 0 mL/g	Assesses sensitivity to K_d	3.6E+01	Dose increases 740x; dose > 25
20	Reducing Conditions in Vault at all times	Technetium Partition Coefficient set to 1000 mL/g.	N/A – Base Case for technetium	1.6E-13	N/A – Base Case Tc-99 dose
21	Oxidizing Conditions in Vault at all times	Technetium partition coefficient set to 1 mL/g.	Assesses sensitivity to redox state of vault and Saltstone	3.2E+00	3 orders of magnitude reduction in K_d results in 13 orders of magnitude increase in technetium dose; dose still < 25
22	Oxidizing Conditions in Vault at all times with pessimistic technetium behavior	Technetium partition coefficient set to 0 mL/g.	Assesses sensitivity to redox state of vault and saltstone, using pessimistic technetium partition coefficient.	9.0E+01	Reducing Kd from 1 to 0 results in 1.5 orders of magnitude increase in technetium dose; dose > 25

New Cases

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
23	RAI# 32. Increase the final saturated hydraulic conductivity of degraded vault and Saltstone to 1E-6 cm/sec at 10,000 years	Concrete K_s increases from 10^{-12} to 10^{-6} cm/s with a degradation rate constant, $\alpha = 3$ Saltstone K_s increases from 10^{-11} to 10^{-6} cm/s with a degradation rate constant, $\alpha = 2.5$ Degradation Equation: $\log_{10}(k/k_o) = \alpha \log_{10}(t/t_o)$ where k = saturated hydraulic conductivity at time t, cm/s; k_o = saturated hydraulic conductivity at t_o = 100 years, cm/s Radionuclides Analyzed: H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	A saturated hydraulic conductivity of 1E-6 cm/s is two orders of magnitude greater than the upper range of standard concrete (i.e. 1E-8 cm/s (Ramachandran and Beaudoin 2001)) and within the range of soil saturated hydraulic conductivities at SRS. Addresses more pessimistic values for saturated hydraulic conductivity of the vault and Saltstone final degraded state.		
24	RAI# 20. Increase precipitation and assess consequent increased infiltration.	Increase the average precipitation utilized within the base case (i.e. 48.9 in/yr) by 25%. Radionuclides Analyzed: H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	In a publication of the U.S. Global Change Research Program (The Potential Consequences of Climate Variability and Change Overview Southeast (www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewsoutheast.htm)), results from the two principal models used to assess climate change, due to CO_2 induced global warming, show increases in annual precipitation of no more than 25% across the Southeast U.S through year 2100. Further a report from the Intergovenrmental Panel on Climate Change (Climate Change 2001: Synthesis Report (www.ipcc.ch/pub/un/syreng/spm.pdf)), project that atmospheric CO_2 levels and hence, average temperature, will stabilize over the 22nd century. Addresses an increased average precipitation to explore the potential effect of climate change on the infiltration through the closure cap.		.

New Cases

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
25	RAI# 19. Combine increased precipitation with pessimistic vault and Saltstone degradation	Sensitivity cases 5, 9, and 24 are combined. Cases 5 and 9 increase the final saturated hydraulic conductivity of the degraded vault and saltstone at year 10,000 to 1E-8 cm/s. Case 24 increased the average precipitation by 25%. Radionuclides Analyzed: H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	A saturated hydraulic conductivity of 1E-8 cm/s is at the upper range of concrete saturated hydraulic conductivity (Ramachandran and Beaudoin 2001). See case 24 for a discussion of the rationale for a 25% increase in average precipitation. Addresses the coupled effect of increased infiltration and increased degradation of the vault and saltstone.		
26	RAI# 19. Decrease K_ds in all media by 10x and add additional radionuclides.	The K_ds for the radionuclides in all media are reduced by a factor of 10 from the values presented in Table A-8 of Cook et al. 2005. Radionuclides Analyzed: C-14, Se-79, Sr-90, Tc-99, I-129, Cs-137, U-238, Np-237, Pu-238 and Pu-239.	Additional strongly sorbed radionuclides have been added to the analysis. These radionuclides represent the most abundant, strongly sorbed radionuclides with both short and long half-lives and those with a high dose conversion factor. Addresses the impact of increased radionuclide mobility.		
27	RAI# 19. Combine pessimistic initial Saltstone conductivity and pessimistic Saltstone degradation.	Sensitivity cases 9 and 11 are combined. Saltstone K_s decreases from 10^{-10} to 10^{-7} cm/s with a degradation rate constant, $\alpha = 1.5$ Degradation Equation: $\log_{10}(k/k_o) = \alpha \log_{10}(t/t_o)$ where k = saturated hydraulic conductivity at time t, cm/s; k_o = saturated hydraulic conductivity at t_o = 100 years, cm/s Radionuclides Analyzed: H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	Addresses the coupled effect of a higher initial Saltstone saturated hydraulic conductivity and an increased Saltstone degradation rate.		

New Cases

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
28	RAI# 19. Pessimistic initial vault saturated hydraulic conductivity of 1E-8 cm/s.	Concrete K_s decreases from 10^{-8} to 10^{-6} cm/s with a degradation rate constant, α = 1.0 Degradation Equation: $\log_{10}(k/k_o) = \alpha \log_{10}(t/t_o)$ where k = saturated hydraulic conductivity at time t, cm/s; k_o = saturated hydraulic conductivity at t_o = 100 years, cm/s Radionuclides Analyzed: H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	A saturated hydraulic conductivity of 1E-8 cm/s is at the upper range of concrete saturated hydraulic conductivity (Ramachandran and Beaudoin 2001). This will assess a higher initial vault saturated hydraulic conductivity.		
29	RAI# 19, 41, and 55. Simulate loss of reducing property in Saltstone and vault by reducing the K_d for those radionuclides affected by the change from reducing to oxidizing conditions.	The following two ends in the oxidation/reduction continuum in the Saltstone and vault are analyzed: Oxidizing K_ds for Tc-99 and the uranium isotopes taken from Bradbury and Sarott (1995). Reducing K_ds for Tc-99 and the uranium isotopes taken from Bradbury and Sarott (1995). Radionuclides analyzed: Tc-99 and U-238	Radionuclides, whose K_ds are redox sensitive, are considered. This includes the uranium isotopes (U-232, U-233, U-234, U-235, U-236, and U-238) in addition to Tc-99 (by agreement with the NRC, only U-238 was analyzed in addition to Tc-99). The response to NRC RAI Comment #41 showed a 3 percent reduction in reducing potential after 10,000 years. A subsequent analysis showed a 5 percent reduction in reducing potential after 10,000 years with the presence of cracks due to seismic activity. This will assess both complete oxidation and complete reduction.		

New Cases

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
30	RAI# 19, 41, and 55. Combine oxidizing Saltstone & vault with increased infiltration and pessimistic vault and saltstone degradation.	Sensitivity cases 25 and 29-oxidized are combined (increased degradation of the vault and Saltstone, increased infiltration, and oxidized condition of Saltstone and vault). Radionuclides Analyzed: Tc-99, U-238	See cases 25 and 29 for a discussion of the rationale. Addresses the combined effects of oxidized Saltstone and vault, increased infiltration, and increased degradation of the vault and Saltstone.		
31	RAI# 19. Assume saturation of the vault and Saltstone to assess flow through cracks.	Assume vault and Saltstone exhibit large-scale cracking at a 30 ft nominal spacing. Assume vault, Saltstone and cracks are fully saturated. Implemented by redefining the water retention and relative permeability curves, such that both are 1.0 regardless of suction head. Radionuclides Analyzed: H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	The cracking is based upon modeling of potential impacts from large-scale seismic events and differential settlement as documented within Peregoy 2003. Cracks become active in the radionuclide transport process if they are completely water saturated. Addresses the effect of flow through cracks if the vault and Saltstone were to be saturated in the first 10,000 years.		
32	RAI# 19. Assume saturation of the vault and Saltstone to assess flow through cracks with oxidizing conditions	Assume vault and Saltstone exhibit large-scale cracking at a 30 ft nominal spacing. Assume vault, Saltstone and cracks are fully saturated. Implemented by redefining the water retention and relative permeability curves, such that both are 1.0 regardless of suction head. Oxidizing Kds used for Tc-99 Radionuclides Analyzed: : H-3, C-14, Se-79, Tc-99, I-129 and Np-237.	The cracking is based upon modeling of potential impacts from large-scale seismic events and differential settlement as documented within Peregoy 2003. Cracks become active in the radionuclide transport process if they are completely water saturated. Addresses the effect of flow through cracks if the vault and Saltstone were to be saturated in the first 10,000 years in combination with oxidized conditions.		

New Cases

Run	Sensitivity Cases Description	Variables Altered	Discussion	Dose Result[a] (mrem/year)	Results Discussion
33	RAI# 19. Assumes greatly increased infiltration, hydraulic conductivity and diffusivity (vault and Saltstone), and oxidation.	Infiltration to the vault is 25 cm/yr throughout the simulation and the closure cap drains silted to allow infiltration to go to Saltstone. Hydraulic Conductivity of Vault and Saltstone are set to 5E-7 cm/sec throughout the simulation. Effective diffusivity for the Vault and Saltstone are increased by a factor of 10. Vault will be 1E-7 cm^2/sec (vs 1E-8 in base case) and Saltstone 5E-8cm^2/sec (vs 5E-9 in base case). Modeled oxidation of Saltstone as 0 and 100% and interpolated to get to 5-30% oxidation. Radionuclides Analyzed: Tc-99, Np-237, U-238, H-3, C-14, Se-79, and I-129.	The NRC requested this sensitivity case to consider a very degraded state throughout the simulation (closure cap, vault, Saltstone, oxidation) that combines a number of variables.		

a. Using the revised inventory for Vault 4 from RAI 62