**ADDITIONAL BACKGROUND FOR SRS QUESTIONS**
**(question numbers match those in enclosure to letter dtd 3/11/99)**

1&2 Neither the "Regulatory Basis for Incidental Waste Classification at the Savannah River Site High-Level Waste Tank Farm" (Regulatory Basis) nor the RAI responses provide specific information on radionuclide removal efficiencies for any of the bulk waste removal options. Measured or estimated radionuclide removal efficiencies for bulk waste removal, water washing and oxalic acid washing should be provided. Numbers for a sample tank cleaning, for example, Tank 16, would be sufficient to represent expected efficiencies, however, specific numerical percentages of curies removed for this example are requested. Specific cut-offs representing the limits of technical and economic feasibility should also be provided.

3. To better ascertain the potential effect of a fluctuating water table, detailed records of measurements of water table elevation at monitored wells in and around the F-Area tank farm should be presented. This should include a map of the monitoring well locations and graphs or tables of water level elevations. The measurement interval should be short enough to reflect seasonal variations. If the period of record is less than 20 years of seasonal well monitoring data, precipitation records of a longer duration would be useful to gain confidence in the range of fluctuations (i.e., A- and F-Area meteorological stations). Expanding the duration of records of precipitation by including data from multiple sites with similar expected precipitation characteristics would also be useful (i.e., Bush Field in Augusta). Presentation of longer records is encouraged as this will reduce uncertainty in the fluctuations. Without the supporting well monitoring and precipitation (if needed) data, the extreme case of tank submergence should be modeled.

   Only the extreme case of continuous submergence can be modeled by MEPAS. A fluctuating water table would require, at minimum, a numerical model with a succession of alternating steady state water table levels.

4. More information should be presented to show that the aquifers are not suitable for future use by an inadvertent intruder. A survey, a reference to a document, or state database on wells might be used to show typical sources of well water in the region; for example, information that wells are not constructed that utilize water from the upper 2 aquifers should be presented.

5. In order to evaluate the effect of climatic variations over the performance period, background information for the region should be presented on climate changes and associated probable hydrologic effects. This could be accomplished by a literature search for climate variations and determination of reasonable variations considered likely over a 10,000 year period. Anthropogenic effects on climate change need not be considered. An alternative approach could be to bound the potential rise in the water table caused by climate variations and evaluate the effect of progressively higher water tables up to that bound using additional MEPAS simulations. Tanks that could potentially be affected by a rising water table could be delineated and modeled using the alternative conceptualization of the tank bottom being submerged beneath the water table.

6. (No additional detail)

7. Need for additional performance assessment runs. The perspective taken here is that if the performance objectives are met for the reasonably bounding conceptualizations, then there is no need for more site-specific information, detailed process modeling, or addressing uncertainty through stochastic approaches.

   a. Sensitivity analyses

      i. To evaluate model uncertainty due to a fluctuating water table using MEPAS, the unsaturated layers should be eliminated. The upper two aquifers can be considered as one aquifer and the Congaree Aquifer can be eliminated. The bottom of the tanks considered to be potentially affected by a fluctuating water table should be submerged below the water table. The flux rate through the lower portion of the tanks is based on the flux rate in the aquifer. For tanks potentially affected by the water table rise under future climate conditions, but not under current conditions, two simulations should be run; one with the tank bottom submerged and one with an unsaturated column thickness equivalent to present-day conditions.

      ii. The basemat integrity will be an important barrier for release of radionuclides. Given that the concrete of the basemat does not meet the specifications for the concrete in the E-Area Vault (Cook and Hunt, 1994), a sensitivity analysis should be performed using a range of durations of basemat integrity from 0 to 500 years (0, 50, 100, 500 yrs). The value of a sensitivity analysis is illustrated by the cracking reported for some of the existing basemats.

         The length of time for the basemat integrity to remain as an effective engineered barrier should be evaluated for the tanks that were determined to be affected by water table fluctuations.

      iii. High conductivity zones

         Since the presence of narrow, high conductivity zones has been delineated by the tritium plumes in the H- and F-Area hillslopes, it should be presumed that radionuclides transported from the tanks will also move in these channelized zones. Ideally, the MEPAS/GTS construct should be calibrated to reproduce the tritium plumes, then the resulting parameter values could be considered reasonably representative. Although the entire hillslope is not comprised of high conductivity channels, a large proportion of the flow down the hillslope may be in the channelized zones.

         To test the effect of narrow, high conductivity zones, a fraction of a GTS should be treated as a high conductivity zone. This can be implemented by superimposing two MEPAS simulations: (i) using the typical hydraulic conductivity; and (ii) one with the higher conductivity and Darcy velocities representative of the zones delineated by the tritium plumes and the dispersivity being set to zero. Since MEPAS assumes infinite lateral dispersion, the reduction in dispersivity values would represent narrow channels. The fraction of flow (in essence, the

radionuclide source term from each grouping of tanks) assigned to the high conductivity channels should range from 0 to 80%. For this sensitivity analysis, the system may be simplified by combining the Water Table and Barnwell-McBean Aquifers and eliminating recharge to the Congaree Aquifer. A reasonable upper bound to use for the saturated hydraulic conductivity in the high conductivity streamtubes is 40 ft/d, based on pump tests reported in Flach (1993).

iv. Parameter Sensitivity: in the interest of streamlining the PA review process, the parameter sensitivity can be reduced in light of the more important questions addressing model uncertainty discussed in the sections on water table fluctuations and high conductivity zones. This reduced list of parameter sensitivity simulations includes water budget percentages, sorption coefficients, and dispersivity values; the order of listing does not infer importance. Parameter sensitivity can be determined by changing one parameter at a time, but the sensitivity analysis should also include changing all parameters concurrently. This sensitivity analysis should be performed for a base case from the approach described in Morrison (1997) and from a base case determined from the incorporation of a fluctuating water table, basemat integrity, and high conductivity zones as described in items 7a.(i-iii)

1. Water budget percentages: the simplified analytical approach used to estimate percentages of recharge (and hence radionuclides) apportioned to each aquifer immediately below the tank farm is highly sensitive to small changes in parameter inputs. Reasonable ranges for the parameters can significantly change the percentages of radionuclides distributed to each aquifer below the tank farm. Hence, a sensitivity analysis should include a range of 20% to 65% for flux across the Tan Clay layer; the latter being the current base case for the Barnwell-McBean Aquifer. The portion of radionuclides distributed to the Congaree Aquifer should be reduced from 4% to 0% for this sensitivity analysis.

2. Sorption coefficients (Kd): a sensitivity case should be performed with alternative Kd's for zones II and III as described in the FTM modeling report (Morrison 1997). For most radionuclides, the SRS base case uses values from Bradbury and Sarott (1995, see below) for sorption onto cementitious materials that have undergone minimal degradation (i.e., "Region I"). It would be reasonable, especially for the post-failure period, to use values from Bradbury & Sarott's "Region III" degradation level, i.e., more seriously degraded cementitious material. Because infiltration rises dramatically post-failure, it also would be conservative to use the Region III values for oxidizing conditions. Therefore, the sensitivity case should use Kd's for all radionuclides for Zones II and III from the "Region III Oxid." column in Table 4 of Bradbury and Sarott (1995).

   (Note: Among the radionuclides in Table 4 of the FTM report (Morrison 1997), Bradbury and Sarott Region III oxidizing values differ from reducing values only for Tc, U, and Np.)

   Both in combination with the above analysis and independent of it, the previous DOE sensitivity case involving using zero Kd's for C-14, Tc-99, and I-129 in the soil zone should be extended by assuming zero also for the clay layers.

Furthermore, Se-79 should be added to this list.

3. Dispersivity: a sensitivity analysis of dispersivity values should include an order of magnitude reduction in all values used for the base case based on modeling of the tritium plumes associated with the seepage basins (Flach, 1993). Simulations using zero for dispersivity values should also be run for comparison.

b. Sensitivity of dose to resident farmer intruder to institutional control

In order to evaluate the usefulness of extended institutional controls, traditional resident farmer intruder scenarios should be evaluated to show the impact of the 100 year active institutional control period specified in 10 CFR 61.59. For comparison to the intruder analysis already provided by DOE, two scenarios are recommended. First, 100 year active institutional controls (Part 61) with a resident farmer intruder immediately following cessation of controls (for comparison with intruder scenario already provided which has intruder at 100 years). Second, 100 year active institutional controls (Part 61) with a resident farmer intruder at 500 years (Part 61.7(b)(5)). Both scenarios should include drinking water dose from wells on the tank farm at specified distances from the source (tank or tank grouping) in the total intruder dose calculation.

Due to the complex source term for the tank farm, the groundwater drinking pathway for the intruder scenario involving drilling between the tanks, or immediately downgradient, is difficult to evaluate. The complexity is a result of the compositing of source areas by the grouping of tanks by tank type and by the separation of tank sources from ancillary structure sources. In addition, the analytical solution used by MEPAS may produce significant roundoff errors for cases involving short distances at long times. Direct evaluation within or near the tank farm is not possible unless the methodology is changed. An indication of the dose at decreasing distances to the tank farm may allow for an evaluation of the magnitude and uncertainty of dose for this intruder pathway. Since the distance from the tank farm at which the simplification of the source terms become less significant than the overprint of the transport processes is not known, a range of distances would help to ascertain the magnitude and uncertainty of dose close to the tank farms. Suggested distances at which to calculate total dose include 1, 25, 50, and 100 m. Results should include plots of the pulses from both the ancillary structure and the tank sources.

**References**

Bradbury M.H., and F. Sarott. 1995. *Sorption databases for the cementitious near-field of a L/ILW repository for performance assessment.* PSI Bericht Nr. 95-06. Switzerland: Paul Scherrer Institute.

Cook, J.R., and P.D. Hunt. 1994. *Radiological Performance Assessment for the E-Area Vaults Disposal Facility.* WSRC-RP-94-218. Aiken, SC: Westinghouse Savannah River Company.

Flach, G.P. 1993. *Groundwater Model Calibration and Review of Remedial Alternatives at the F&H Area Seepage Basins (U).* WSRC-TR-93-384. Aiken, SC: Westinghouse Savannah River Company.

Morrison, A.S. 1997. *Environmental Radiological Analysis: Fate and Transport Modeling of Residual Contaminants and Human Health Impacts from the F-Area High-Level Waste Tank Farm, Savannah River Site.* Aiken, SC: Halliburton NUS Corporation.