AIR MODELING PROTOCOL FOR THIS REPORT

We utilized the US Environmental Protection Agency's SCREEN3 Model in our calculations. The model estimates pollution concentrations from air pollution sources under a wide range of meteorological conditions. SCREEN is a Gaussian plume dispersion model which takes into account the physical factors of each particular air pollution source including emission rate, stack height and diameter, and gas exit velocity and temperature. The model can calculate pollution concentrations from a particular source at discrete distances downwind from an emission point.

The EPA Technology Transfer Network Support Center for Regulatory Atmospheric Modeling states:

> Dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source. Based on emissions and meteorological inputs, a dispersion model can be used to predict concentrations at selected downwind receptor locations. These air quality models are used to determine compliance with National Ambient Air Quality Standards (NAAQS), and other regulatory requirements such as New Source Review (NSR) and Prevention of Significant Deterioration (PSD) regulations. These models are addressed in Appendix A of EPA's *Guideline on Air Quality Models* (also published as Appendix W of 40 CFR Part 51), which was originally published in April 1978 to provide consistency and equity in the use of modeling within the U.S. air quality management system.

The SCREEN3 equation for determining ground-level pollution concentration is:

$$X = Q/(2u_s yz)\ \{\exp[-½\,((z_r - h_e)/z)^2] + \exp[-½\,((z_r + h_e)/z)^2]$$

$$+ \sum_{N=1}^{k} [\exp[-½\,((z_r - h_e - 2Nz_i)/z)^2]$$

$$+ \exp[-½\,((z_r + h_e - 2Nz_i)/z)^2]$$

$$+ \exp[-½\,((z_r - h_e + 2Nz_i)/z)^2]$$

$$+ \exp[-½\,((z_r + h_e + 2Nz_i)/z)^2]\ ]\ \}$$

Where:

X = concentration
Q = emission rate
u_s = wind speed at stack height
y = lateral dispersion parameter
z = vertical dispersion parameter
z_r = receptor height
h_e = height of plume centerline above ground
z_i = mixing height
k = summation level for multiple reflections of plume off of the ground and elevated inversion, usually ?4.

Wind speed in the Aiken-Augusta area averages from 5 to 8 miles per hour, with the high occurring in early Spring and the low in late Summer. A wind rose and wind-speed graph are included on pages 22 and 23 of the report. SCREEN3 uses all stabilities and wind speeds in an iterative process to determine a range of ambient pollution levels downwind of an air emission point.

We have largely adopted a regulatory agency methodology (ref: North Carolina DENR Air Quality Analysis Branch) in developing the protocol used for our assessment.

SCREEN3 inputs are specific for each stack and site location. Most are simple parameters based on physical measurements: source type, stack height and inside diameter, etc. Also, the model asks the user to enter a value for the emission rate in grams per second. For this report, we used the value of 0.126 g/s which corresponds to 1 pound per hour. With this value entered, the SCREEN3 calculates a *generic concentration factor* for each stack which facilitates the use of the pounds per hour data for each air pollutant reported by WSRC. This calculation is explained further below.

There are user options which allow SCREEN3 to adjust to local conditions. Model options selected for this investigation are:

Stack exit velocity: For vertical stacks, the exit velocity is entered. For horizontal stacks or those with rain caps or other deflectors, the formula is $v_i = v_r \sin(\alpha)$ where v_i is velocity to input into the model, v_r is the reported exit velocity, and α is the angle of the stack from horizontal. The minimum recommended input value is 0.01 meters/second.

Ambient air temperature: We used the regulatory default of 293 degrees-K, which is 68 degrees-F.

Receptor height: We used 0 meters to determine ambient pollution at ground level. This is a conservative measure; a receptor height of 1 or 2 meters would gauge pollution concentrations at nose level for children and adults, but we selected zero to rule out local turbulence or other factors.

Urban/rural option: Rural option selected throughout based on land use and population density within SRS and the surrounding areas.

Complex terrain analysis: This option is required when the local topography rises above the top of a 50 meter stack within 20 kilometers. H Canyon and F Canyon are at an elevation of approximately 95 meters ASL and have stacks exceeding 60 meters tall. The DWPF stack in S Area is 45 meters tall and is at an elevation of 86 meters ASL. All three areas are less than 30 kilometers from Aiken, SC: elevation, 160 meters. The complex terrain option is also required for shorter stacks where the terrain exceeds stack height within 5 kilometers. M Area is within one kilometer of SRS boundary and terrain elevation approaches stack height within 6 km. Therefore, the complex terrain analysis was selected and run for these stacks.

Building downwash: Used to determine cavitation effects, elevated pollution concentrations caused by structures downwind of stack emissions. Not enough information was available regarding height, width and orientation of local structures to allow us to make determinations for building downwash. The most severe impacts of building downwash pollution would be on receptors within SRS; i.e., employees and visitors. Subsequent studies will be necessary to measure these impacts.

Using the SCREEN3 model (Version 95250), we calculated a *generic concentration factor* (C_g) at the SRS property line and/or in nearby population centers for each air pollution source. Next, we multiplied the generic concentration factor by the source's *pollutant emission rate* (E_p) to find the *modeled pollutant concentration* (C_m) for each toxic chemical at the property boundary line of SRS.

The formula for the modeled pollutant concentration at SRS is:

$$C_g \times E_p = C_m$$

Where:

C_g = generic concentration factor (μg/m3/lb/hr)
E_p = pollutant emission rate (lb./hour)
C_m = modeled pollutant concentration (μg/m3)

The following conversion factors are used as needed:

Hourly concentration = C_m x 1.0
24-hour concentration = C_m x .4
Annual concentration = C_m x 0.08

The generic concentration factor was computed for each air pollution source for which we could obtain stack parameters. These parameters were found in the Title V Air Permit application submitted to South Carolina DHEC by Westinghouse Savannah River Company. We also obtained sources' pollutant emission rates from the WSRC Title V permit application. This document is on file at the SC DHEC Bureau of Air Quality in Columbia.

The last step in our protocol was to compare the computer modeled pollutant concentrations to the actual ambient air pollution concentrations obtained from EPA-certified laboratory tests of grab-samples gathered at the SRS plant boundary in 2004 and 2005.