APPENDIX 2Q EAB AND LPZ SHORT TERM ACCIDENT DIFFUSION ESTIMATES FOR AST

2Q.1 OBJECTIVE

Conservative values of atmospheric diffusion at the site boundary (EAB) and the low population zone (LPZ) were calculated for appropriate time periods using meteorological data collected onsite during the time period 1998 through 2002.

2Q.2 METHODOLOGY

The methodology used for this calculation is consistent with Regulatory Guide 1.145 as implemented by the PAVAN computer code (Reference 2). Using joint frequency distributions of wind direction and wind speed by atmospheric stability, the PAVAN computer code provides relative air concentration (CHI/Q) values as functions of direction for various time periods at the site boundary and LPZ. Three procedures for calculation of CHI/Qs are utilized for the site boundary and LPZ; a direction-dependent approach, a direction-independent approach, and an overall site CHI/Q approach. The CHI/Q calculations are based on the theory that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. A straight-line trajectory is assumed between the point of release and all distances for which CHI/Q values are calculated.

The theory and implementing equations employed by the PAVAN computer code are documented in Reference 2.

2Q.3 CALCULATIONS/PAVAN COMPUTER CODE INPUT DATA

The boundary distance used in each of the 16 downwind directions from the site was set to 914 m. The LPZ boundary distance was set to 2,011 m.

All of the releases were considered ground level releases because the highest possible release elevation is from the plant stack at 185 ft above plant grade. From Section 1.3.2 to Reference 1, a release is only considered a stack release if the release point is at a level higher than two and one-half times the height of adjacent solid structures. For the Seabrook plant, the elevation of the top of the containment is 199.25 ft. Therefore, the highest possible release point is not 2.5 times higher than the adjacent containment buildings, and thus all releases were considered ground level releases. As such, the release height was set equal to 10.0 meters as required by Table 3.1 of Reference 2. The building area used for the building wake term was 2,416 m^2.

The tower height at which the wind speeds were measured is 10.05 m above plant grade. The windspeed units are given in miles per hour, therefore the PAVAN variable UCOR was set equal to 101 to convert the windspeeds to meters per second as described in Table 3.1 of Reference 2. The maximum windspeed in each windspeed category was chosen to match the raw joint frequency distribution data, which conforms to the windspeed bins in Table 1 of Reference 3.

2Q.4 RESULTS

PAVAN computer runs for the EAB and LPZ boundary distances were performed using the data discussed previously. Per Section 4 of Reference 1, the maximum CHI/Q for each distance was determined and compared to the 5% overall site value for the boundary under consideration. For dose calculations, the most limiting 2 hour CHI/Qs were combined with the worst 2 hour EAB doses to maximize calculated EAB doses (conservative approach).

The maximum EAB and LPZ CHI/Qs that resulted from this comparison are provided in the table below:

Offsite Boundary χ/Q Factors for Analysis Events		
Time Period	EAB χ/Q (sec/m^3)	LPZ χ/Q (sec/m^3)
0-2 hours	3.17E-04	1.54E-04
0-8 hours	2.08E-04	8.63E-05
8-24 hours	1.68E-04	6.46E-05
1-4 days	1.06E-04	3.45E-05
4-30 days	5.51E-05	1.40E-05

2Q.5 REFERENCES

1. USNRC Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982, (Reissued February 1983 to correct page 1.145-7).

2. NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations," November 1982.

3. Safety Guide 23, "Onside Meteorological Programs," February 17, 1972.

APPENDIX 2R SHORT-TERM (ACCIDENT) DIFFUSION FOR THE CONTROL ROOM

2R.1 OBJECTIVE

Conservative values of atmospheric diffusion to the Control Room were calculated for appropriate time periods using meteorological data collected onsite during the time period 1998 through 2002.

2R.2 METHODOLOGY

The ARCON96 computer code is used by the USNRC staff to review licensee submittals relating to control room habitability (Reference 1). Therefore, the ARCON96 computer code was used to determine the relative concentrations (CHI/Qs) for the control room air intakes and inleakage locations.

The ARCON96 computer code uses hourly meteorological data for estimating dispersion in the vicinity of buildings to calculate relative concentrations at control room air intakes that would be exceeded no more than five percent of the time. These concentrations are calculated for averaging periods ranging from one hour to 30 days in duration.

The theory and implementing equations employed by the ARCON96 computer code are documented in Reference 1.

2R.3 CALCULATIONS/ARCON COMPUTER CODE INPUT DATA

Five years of meteorological data (1998-2002) were used for the ARCON96 computer code runs. The percentage of valid data over this time period was 98.8% which exceeds the minimum value of 90% data recovery specified in Reference 2.

A number of various release-receptor combinations were considered for the control room CHI/Qs. These different cases were considered to determine the limiting release-receptor combinations for the various events. The case matrix for these combinations is provided in Table 2R-2.

The distance and direction inputs for the ARCON96 runs may be found in Table 2R-1. The distances were converted from feet to meters with a factor of 0.3048 m/ft. The distances in meters were then rounded down to the nearest tenth for conservatism. The elevation difference term was set equal to zero for each case since all elevation points are taken with respect to the same datum.

The lower and upper measurement heights for the meteorological data were entered as 10.05 m and 60.66 m, respectively, for each case. The mph option was selected for the windspeed units.

A ground level release was chosen for each scenario since none of the release points are 2.5 times taller than the closest solid structure as called out in Section 3.2.2 of Reference 3 for stack releases. The top of the containment structure is at an elevation of 199.25 ft. The highest release point is from the top of the plant stack at an elevation of 185 ft., which is not 2.5 times higher than the nearby containment structure. The vertical velocity, stack flow, and stack radius terms were all set equal to zero since each case is a ground level release. The vent release option was not selected for any of the scenarios.

The actual release height was used in the cases. No credit was taken for effective release height due to plume rise; therefore, for the releases from the stacks, the release elevations were set equal to the stack top elevation. The release heights were taken as the release elevations less the plant grade elevation of 19 ft.

The only cases in this analysis that take credit for the building wake effect are the scenarios where the release is from the containment building, the tank farm, or the waste processing building. Some of the other scenarios have buildings between the release and receptor points, but for these cases the building wake was not credited for the sake of conservatism. Not crediting wakes was accomplished by setting the building area term equal to 0.01 m^2 as stated in Table A-2 of Reference 3. The first building area used is a conservatively determined containment cross sectional area. The area is calculated as the sum of the cross sectional areas created by the cylindrical portion of the containment structure above the highest nearby roof and the hemispherical area of the dome. The width used is equal to the diameter of the containment structure. The height of the cylindrical portion is taken as the distance between the top of the cylinder portion of the containment structure (represented by the spring line elevation) and the primary auxiliary building roof elevation. The radius of the hemispherical dome is taken as one half of the calculated diameter. The containment area was determined to be 1,506 m^2. The second building area is calculated as the product of the minimum roof height of the waste processing building and tank farm and one half the width of the waste processing building and tank farm. The minimum roof height and one half of the width are used for conservatism. This building area was determined to be 337 m^2.

All of the default values in the ARCON96 code were unchanged from the code default values with the following exceptions. Table A-2 of Reference 3 suggests use of a value of 0.2 for the Surface Roughness Length, and use of a value of 4.3 for the Averaging Sector Width Constant. These two changes were made for each case. The minimum wind speed was left at 0.5 m/s per the guidance instruction in Table A-2 of Reference 3.

2R.4 RESULTS

ARCON96 computer runs for the various release points and control room intake locations were performed using the data discussed previously. Per Reference 3, the 95th percentile CHI/Q values were determined. The resulting CHI/Qs are listed in Table 2R-2.

2R.5 REFERENCES

1. NUREG/CR-6331 PNL-10521, "Atmospheric Relative Concentrations in Building Wakes," May 1995, with Errata dated July 1997.

2. Safety Guide 23, "Onside Meteorological Programs," February 17, 1972.

3. USNRC Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," June 2003.