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New Meteorological Data for VENTSAR XL©

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INTRODUCTION

Every five years Savannah River National Laboratory (SRNL) generates an updated meteorological database to facilitate dosimetric calculations of accident and routine release scenarios for onsite and offsite populations. This information becomes the input of various environmental dosimetry codes run by the Environmental Dosimetry Group (EDG) at SRNL. The three most recent databases prior to the current one were completed for the time periods 1987-1991, 1992-1996, and 1997-2001. The current database covers the period 2002-2006.[1] This study represents a portion of a larger study to compare the meteorological data among these four five-year periods and focuses on updating VENTSAR XL© for the current meteorological database. The updated meteorological data are also applied in other dosimetry models approved for risk and dose assessment at Savannah River Site (SRS).

VENTSAR XL© is a Gaussian Plume model that includes building effects and plume rise. The typical input involves the location of the release, building dimensions, distance to the building, release height, vent diameter, vent gas temperature, gas molecular weight, ambient air temperature, breathing rate, meteorological conditions, radionuclides and their amount released. The output is easily converted into tables and graphs for further analysis and shows the concentrations and pathway doses for each of the incremental downwind distances. [2, 3] VENTSAR XL© has been used at SRS to investigate building effects such as reactor cooling towers in support of safety analyses. VENTSAR XL© has also been applied to Good Engineering Practice (GEP) stack height evaluations for various projects at SRS.

In accordance with the Clean Air Act Amendments of 1977, GEP must be used in determining the height of any stack that will be used to disperse routine emissions. [4, 5] With respect to stack heights, the GEP height is "the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies and wakes which may be created by the source itself, nearby structures or nearby terrain obstacles."[1] The EPA has set specific criteria to determine if a stack is of the acceptable height. These criteria have been used to determine a GEP stack height for several emission assessments at SRS.

The EPA documents contain detailed information on how the height of a stack is determined. [4, 5] The general rule for stack height determination is to make the stack at least 2½ times the height of nearby buildings. This estimated height can be increased or decreased based on other factors such as plume rise, downwash, and building wake effects.

DESCRIPTION OF THE ACTUAL WORK

VENTSAR XL© test cases are executed each time for a new set of meteorological data by the EDG. This was completed for the new metrological period 2002-2006. The previous three time periods are shown for comparison in Figs 1 and 2.

Table 1. Input parameters for Test Case 1 and Test Case 2

Parameter	Case 1	Case 2
Building Height (m)	10	0
Building Width (m)	20	0
Building Length (m)	30	0
Penthouse Height (m)	1	0
Penthouse Width (m)	2	0
Penthouse Length (m)	3	0
Bldg. to Penthouse (m)	5	0
Min. Vent to Receptor (m)	10	10
Max. Vent to Receptor (m)	1000	1000
Compass Sector	NNW	S
Vent to Roof Edge (m)	-500	0
Vent Height (m)	50	25
Pollutant Mole Fraction	0.000001	0.000001
Vent-Gas Flow Rate ($m^3 s^{-1}$)	500	750
Meteorological Averaging?	YES	YES
Probability Level	0.005	0.005
Vent Diameter (m)	3	2
Vent-Gas Molecular Weight	210	200
Vent-Gas Temp(^{o}C)	20	17
Ambient Air Temp(^{o}C)	15	17
Radionuclide, Source Term	^{3}H, 0.11 TBq	^{3}H, 0.11 TBq
	^{137}Cs, 74 GBq	^{137}Cs, 74 GBq
	^{137m}Ba, 74 GBq	^{137m}Ba,74 GBq

The results from the code are compared to ensure that there are no abnormalities in the new meteorological data. Executing the test cases also provides the means to verify that these changes have been properly made. Some of the input parameters for Test Cases 1 and 2 are shown in Table 1. A building is included in the concentration calculation in Test Case 1, while no buildings are considered in Test Case 2.

RESULTS AND CONCLUSIONS

Results from two of the test cases are plotted in Figures 1 and 2. The differences observed for these cases are caused only by changes in the meteorological data. The curves for these cases follow a similar trend with various peaks. The main sections of interest on these plots are the maximum values. The annual average air concentrations (s m^{-3}) versus downwind distances are plotted from the VENTSAR XL© output. The maximum concentrations are easily determined from these plots as shown. The results of this study indicate expected variations in the meteorological data among these four time periods.

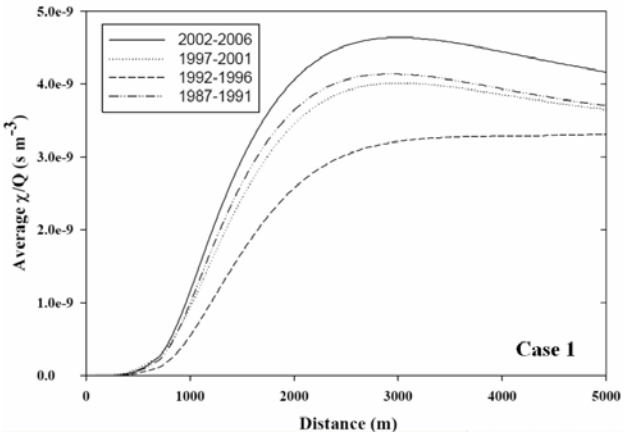

Fig. 1. Test Case 1.

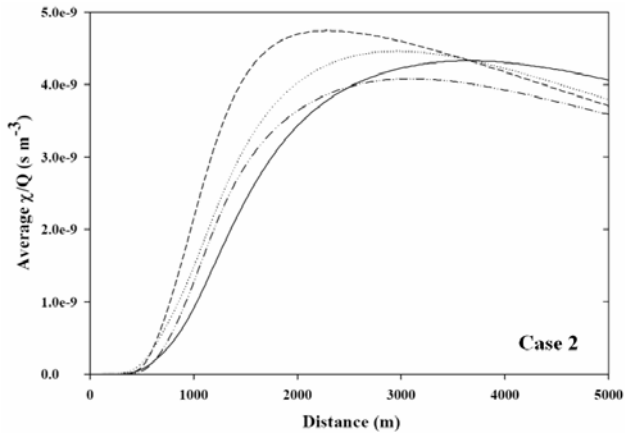

Fig. 2. Test Case 2.

NOMENCLATURE

EDG	Environmental Dosimetry Group
GEP	Good Engineering Practice
SRNL	Savannah River National Laboratory
SRS	Savannah River Site

REFERENCES

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