Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

To: NSRPD Staff Date: July 25, 1997

From: Dom Ruggeri, Team Leader
Air Dispersion Modeling Team

Subject: Modeling Fugitive Emissions as Pseudo-Point Sources

Procedure

As part of our modeling technique refinement process, we have developed a new procedure for modeling fugitive emissions as pseudo-point sources to correct for the models' application of stack-tip downwash. Use the following parameters with both the SCREEN and ISC models, as applicable:

Stack Gas Exit Temperature: For SCREEN, set the exit temperature equal to the ambient temperature. The default ambient temperature is usually set at 293 K. For ISC, set the temperature to 0 K. This causes the model to set the exit temperature equal to the ambient temperature. These temperatures are the same as those used currently.

Stack Diameter: For both SCREEN and ISC, set the diameter to 0.001 meters. This diameter causes the models to ignore stack-tip downwash. This diameter is a change from the one used currently.

Stack Velocity: For both SCREEN and ISC, set the velocity to 0.001 meters/second. This velocity is the same as the one used currently.

Background

Why did we make the change? The old procedure caused the SCREEN and ISC models to over predict concentrations.

What feature caused the models to over predict? The feature is stack-tip downwash. The models compare the stack gas exit velocity (vs) to the wind speed at stack height (us) to determine the potential for stack-tip downwash. That is, the potential for the plume rise to be limited by the turbulent effect of the wind as it passes the stack of any diameter (ds). The models account for stack-tip downwash by modifying the physical height of the stack (hs). If the exit velocity is less than 1.5 us, the model calculates a modified stack height (hs') using the following equation:

$$hs' = hs + 2ds[vs/us - 1.5]$$

This modified stack height replaces the physical stack height and is used for all plume height calculations.

How does the over prediction occur? The procedure to model fugitive emissions as pseudo-point sources requires stack parameters that cause the SCREEN and ISC models to calculate no plume rise. If an exit velocity of 0.001 m/s is used, the exit velocity will always be less than the threshold of 1.5 us (the minimum value for us is 1 m/s in the SCREEN model), so the model will calculate a modified stack height. The stack diameter is then the controlling parameter, and with a default diameter of one meter, the modified stack height will always be about three meters lower than the physical stack height. For fugitive releases, the effect of the lower "stack" height is a lower plume height lower by three meters, or lowered to zero if the source is at three meters or less. These lower plume heights can result in significant over predictions depending on the source height and the source distance from the property line and downwind receptors.

How did we fix this shortfall? By choosing a stack diameter of 0.001 meters we have ensured that the model will not modify the stack height.

Does building downwash override stack-tip downwash? Not necessarily. The models may calculate stack-tip downwash if a point source is affected by building downwash. The models have two downwash algorithms: Schulman-Scire (SS) and Huber-Snyder (HS). The SS algorithms do not consider stack-tip downwash but the HS algorithms do. The HS algorithm applies the stack-tip downwash correction after the model determines whether the source should be affected by building downwash.

Does stack-tip downwash apply to volume sources? No. The models do not consider stack-tip downwash for volume sources. Therefore, the release height and the plume height will be the same.

What will the difference in concentration be between the old procedure and the new procedure? The concentrations will be lower. The centerline of the plume may be as much as three meters higher using the new procedure, thereby reducing the ground-level concentration to a more representative value.