Entergy Nuclear Vermont Yankee, LLC
Entergy Nuclear Operations, Inc.
Docket No. 6812
New England Coalition Ninth Set of Information Requests
December 23, 2003
Witness: Dan Yasi/George Thomas

Q3. Please provide documentation of the drift deposit pattern from Vermont Yankee Nuclear Power Station's cooling towers under varying controlling conditions.

a. Please explain how internal cooling tower conditions affect drift.

b. Please explain how external conditions (wind speed and direction) affect drift.

c. Please identify best case and worst-case drift emission, travel and deposit.

d. Please identify any occasions during the last five years in which drift emissions, travel, and deposition has been quantified.

e. If this information has been shared with any governmental entity, please document.

Response: (by counsel) Entergy VY objects to this request as out of time, as it neither addresses changes in Entergy VY's petition nor arises from recently submitted discovery, as required by the Board's October 10, 2003 Order on Sanctions and Schedule. Without waiving the objection, Entergy VY responds as follows:

(parts a. b. and c. by Mr.Yasi; parts d. and e. by Mr. Thomas)

In response to this information request, the water drift deposition pattern from the VY cooling towers has been quantified using the SACTIP model, incorporating the drift rate from the cooling towers (i.e., 183 gallons per minute) and the total dissolved solids concentration in the drift as input parameter. Using the 5-year Albany, NY meteorological database and the cooling tower EPU operating parameters under the current NPDES permit conditions and lower bounding air flow rate, the water drift deposition rate as a function of downwind distance and direction from the cooling towers has been estimated. This operating condition was selected since it reflects a high heat rejection rate and low air mass flow rate, which tends to produce the highest offsite drift deposition results. The SACTIP results for the spring season were selected for this response since water deposition rate estimates during this season are slightly higher than the summer and fall seasons. The winter season was not considered as the towers are expected to operate infrequently and at much lower heat loads during the winter. The drift deposition estimates are based on the conservative assumption that the cooling towers operate continuously over the period of a month.

The water drift deposition pattern estimated by SACTIP indicates that the average water deposition rate over all directions drops off rapidly with distance from the cooling towers. The highest predicted offsite water deposition rate over land is approximately 0.10 inch per month compared to the lowest long-term average monthly precipitation amount at Albany during the spring months of 2.39 inches. The water drift deposition rate drops off to 0.04 inch per month at 500 meters and to below 0.01 inch per month at 900 meters downwind of the cooling towers on average.

a. Cooling Tower drift is the circulating water lost from the tower in the form of fine droplets entrained in the exhaust air. Various internal cooling tower conditions can affect drift. To minimize the drift, drift eliminators have been installed. These are a type of closely spaced blades that act as a separator forcing the two-phase exhaust flow to abruptly change direction. The inertia of the relatively large, heavy drift droplets cause them hit the drift eliminator blade walls, agglomerate and collect, and fall back down by gravity inside the cooling tower to the cold water basin. The effectiveness of the drift eliminators depends on a number of factors including proximity of the fill to the eliminator plane, water loading and chemistry, and eliminator design, but most importantly, droplet size and air approach velocity. As stated in response to question 9 of NEC's 3rd Set of Interrogatories, the change in quantity of drift is small between the present condition and the uprate conditions.

b. Wind speed and direction have essentially no meaningful effect on the drift rate from the towers. Relative to drift dispersion and deposition, higher wind speeds result in greater mixing and dilution of the cooling tower plume resulting in lower drift deposition rates. Higher wind speeds also cause the cooling tower plumes to bend over faster (i.e., less plume rise) and decrease the height of the plumes compared to lighter wind speeds. The lower plume rise results in drift droplets reaching the ground a little sooner resulting in higher deposition rates. Therefore, these two effects offset each other relative to drift deposition, which are accounted for in the SACTIP model. Wind direction primarily affects the spatial distribution of the drift deposition and the effect of the tower structure in terms of aerodynamic downwash. Lastly, the higher the humidity, the higher the drift deposition rate as the drift droplets evaporate less and remain larger.

c. The drift emission rate from the towers is essentially a constant. The SACTIP analysis of drift deposition rate involves five years of meteorological data that encompass a full range of meteorological conditions that may be encountered during tower operation. Therefore, best and worst case conditions relative to the travel and deposit of drift are included embedded within in the seasonal analysis. As noted earlier, the worst case drift deposition occurs very close to the towers on plant property and drops off quickly within the first few hundred meters of downwind distance. The average deposition rate drops off to below 0.01 inch per month at 900 meters from the cooling tower.

d. Other than the analysis described above, Cooling Tower drift emissions, travel, and deposition have not been quantified during the last five years.

e. The analysis described above has not been shared with other government entities. During the original licensing of Vermont Yankee a cooling tower plume study was performed and included as Appendix A to the VY Supplement to the Environmental Report submitted to NRC by letter dated 12/21/71. This report did not quantify the drift, but did qualitatively assess drift impacts in regard to local icing.