From: <dggreen01@mchsi.com>
To: <tcj@nrc.gov>
Date: 6/2/05 6:29PM
Subject: Wording for NEF Natural Gas Pipeline Hazard Risk Determination

Tim,

I have attached, for your information, the wording that will be included in the NEF Natural Gas Pipeline Hazard Risk Determination. Based on this wording, "radiant heat incidence" in the SER should be "total heat exposure per unit surface area." The calculation with this wording will be submitted to you early next week.

If you have any questions, please do not hesitate to contact Rod Krich or myself.

Thanks,
Dan Green

CC: <rod.krich@exeloncorp.com>

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Subject:	Wording for NEF Natural Gas Pipeline Hazard Risk Determination
Creation Date:	6/2/05 6:28PM
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6.3 Probability of Thermal Hazard

The thermal radiation hazard depends on the gas release rate, subsequent motion of the vapor cloud, flame temperature, flame speed, flame emissivity, air transmissivity, and distance between the vapor cloud and the facility. The gas release rate and subsequent motion of the vapor cloud for the present analysis are bounded by a similar analysis involving a natural gas pipeline conducted by the Tennessee Valley Authority (TVA) at the Hartsville Nuclear Plants (Reference 9). The pipeline in the TVA analysis had a larger diameter (22 vs. 16 inches) and a higher operating pressure (560 vs. 50 psi). In addition, the TVA analysis used conservative values for flame temperature, flame speed, flame emissivity, and air transmissivity, all of which are applicable to the present evaluation. Lastly, although the distance to the pipeline for the NEF site is less than the TVA analysis (1800 ft vs. 2650 ft), considering other conservatisms as noted above, the TVA results for the heat exposure hazard ~~radiant heat flux~~ would bound those for a detailed analysis of the pipeline near the NEF.

~~The worst-case heat flux to critical plant structures in the TVA analysis was less than 800 Btu/ft^2 (page 2.2-12m, Attachment 9). Based on the above argument, the radiant heat flux to the proposed NEF is also expected to be less than 800 Btu/ft^2. This is substantially less than the heat flux expected to cause any damage to the concrete NEF structures. From Reference 9 (page 2.2-12l, Attachment 9), a heat flux of about 1750 Btu/ft^2 would be needed to cause spontaneous ignition of wood. The heat flux that would cause damage to concrete is expected to be much higher. Given the low gas pressure, any fireball would last a very short period of time before the flame front retreated back to the vicinity of the pipe, approximately 1800 ft from the NEF. Hence, there is no need to consider the hazard due to heat exposure from combustion of the gas/air mixture in the gas, resulting in a yearly probability of zero.~~

TVA used a model to determine the heat flux due to radiation from a burning gas cloud. The heat flux was determined by applying standard equations of radiation heat transfer between two surfaces, and is proportional to the emissivity of the burning area, the flame temperature to the fourth power, the projected area of the burning gas, and the duration of burning (Attachment 9, page 2.2-12g). Inclusion of the duration of burning in the calculation of heat flux (as defined in the TVA analysis) results in the determination of the total heat exposure per unit surface area. Therefore, the units for heat flux as defined in the TVA study are BTU/ft^2.

The worst-case heat flux (as defined in the TVA analysis and which also accounts for the duration of burning) was less than 800 Btu/ft^2. When TVA compared this value to that required for the spontaneous ignition of wood of approximately 1,750 Btu/ft^2 (the application of 2.94 Btu/ft^2-sec for about 10 minutes), it was concluded that the maximum heat flux (as defined in the TVA analysis) expected is well below that which would cause any damage because all of the critical plant surfaces exposed to the heat radiated from a burning gas cloud are concrete (see Attachment 9, pages 2.2-12l and 2.2-12m). As a result, TVA found that the probability of a heat exposure hazard under worst-case conditions to be negligible.

The TVA analysis used a value of approximately 1,750 Btu/ft^2 as the heat flux required for the spontaneous ignition of wood. TVA used Reference 11, page 6-7, as the source for this information. In Reference 11, the authors use the terminology of "energy flux" with units of Btu/ft^2 for the parameter for which TVA uses the term "heat flux." Reference 11 notes that this "energy flux" is based on a radiation flux of 2.94 Btu/ft^2-sec for about 10 minutes. This "energy flux" is actually the total heat exposure per unit surface area.

All NEF structures significant to safety will have concrete exterior walls. These walls will carry a minimum 1-hour fire resistive rating. The fire exposure necessary to achieve the 1-hour rating is substantially greater than the thermal exposure from a transient short-duration fireball. The

"energy flux" required to damage these concrete walls would be substantially higher than that required to spontaneously ignite wood.

Based on the above discussion, the total heat exposure per unit surface area (defined as heat flux in the TVA analysis) on the proposed NEF structures is expected to be less than 800 Btu/ft^2. This is substantially less than that expected to cause any damage to the concrete NEF structures. Given the low gas pressure, any fireball would last a very short period of time before the flame front retreated back to the vicinity of the pipe, approximately 1,800 ft from the NEF. Hence, there is no need to consider the hazard due to heat exposure from combustion of the gas/air mixture, resulting in a yearly probability of zero.