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November 9, 1988

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Byron Station Units 1 and 2
Braidwood Station Units 1 and 2
NRC Bulletin 88-08 Additional Information
NRC Docket Nos. 50-454/455 and 50-456/457

Dear Mr. Murley:

Telephonically, on November 1, 1988, a meeting was held between Commonwealth Edison and members of the NRC Staff. At that time, a request fo- additional information regarding clarification of the Westinghouse report MT-SME-427(88) Rev 1. relating to stratification and thermal cycling issues. A specific question about the assumptions and the values of U (net thermal resistance between fluid and ambient) and Keff (effective thermal conductivity) was asked. The enclosure to this letter contains the explaination of how these values were calculated and the intended purpose of the thermohydraulic calculations.

Please direct any further questions on this matter to this office.

Very truly yours,

R. Chrzanowski
Nuclear Licensing Administrator

/scl
5314K
Encl.
cc: Byron Resident Inspector
Braidwood Resident Inspector
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Attachment

For estimating temperature on unisolable pipe sections, Westinghouse constructed a graph titled "Effect of Molecular Conduction and Free Convection on Axial Temperature Distribution" (Figure 2-1 in the referenced report).

The methodology was developed by Westinghouse based on Heat and Mass Transfer by ERG Eckert, McGraw-Hill, 1959 Edition.

Calculations were performed for cylindrical fin models with water (at 2500 psig and 600°F). Schedule 160 pipe and 2-inch calcium silicate insulation (K = 0.025 Btu/hr-ft2°F) were assumed. The thermal resistance between insulation and air was 1 Btu/hr-ft^2·F. Based on these assumptions, U was calculated to be 0.13 Btu/hr-ft^2·F. As for Keff, calculation is presented as follows:

Keff = effective increase in normal molecular water thermal conductivity K to account for free convection currents based on experimental data.

Assume delta T = 300°F over 7 ft. of pipe
Grashoff number: Gr is approximately = to 1.7×10^{14}
Prandtl number: Pr is approximately = to 2.0
$Gr \times Pr = 3.4 \times 10^{14}$

From Figure 11-14 of Eckert (p. 331, 1959 ed.),

$\frac{Keff}{K}$ is approximately = to 250.

This is a typical number for the convection case. for the conduction case,

$\frac{Keff}{K}$ would be equal to 1.

The curve labeled "Conduction" can be applied to unisolable pipe sections where only conduction heat transfer is possible (e.g., vertical downward segments).

The curve labeled "Free Convection" is for pipe segments where convection heat transfer is possible (e.g., vertical upward pipe segments).

The purpose of the graph is to allow for qualitative assessment of temperature on unisolable pipe sections. These estimates are needed for two purposes:

i) To compare which location on the unisolable section has the highest pipe metal temperature. Since thermal stress is proportional to change in temperature over time, the location with the highest (relatively speaking) temperature will be subjected to the highest thermal stress should valve leakage occur. These locations are recommended for ISI and temperature monitoring.

ii) To provide an expected temperature range for guidance in temperature monitoring. Based on the temperature estimated at the monitoring locations, a ± 25°F range was given to allow for environmental uncertainties such as insulation misalignment, forced convection on the reactor coolant loop, etc.

Temperature estimations based on thermohydraulic calculations are inherently inaccurate. Westinghouse recognizes the limitations of such calculations and has only used them for estimation purposes.