Omaha Public Power District

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September 1, 1982
LIC-82-315

Mr. Robert A. Clark, Chief
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Clark:

CE/BNL Fort Calhoun Reactor Vessel
Azimuthal Flux Calculations

In connection with pressurized thermal shock (PTS) evaluations by the Nuclear Regulatory Commission, Brookhaven National Laboratory (BNL), acting as consultant to the Commission, has reanalyzed the Fort Calhoun wall surveillance capsule and calculated the current peak vessel fluence, as well as a projected end of life value. The BNL peak fluence values exceeded those calculated by CE by nearly 10%. This was viewed as good agreement, in view of differences in calculational methodology and associated uncertainties. There was one significant difference in calculational results which impacts the PTS evaluation and that is the fluence at the 0^{o} weld which occurs not at the maximum but at a secondary peak in the azimuthal distribution. The normalized azimuthal distribution computed by BNL was 40% lower at the 0^{o} location.

At the Commission's request, a meeting was held in Windsor, Connecticut between CE, BNL, and NRC representatives to resolve the discrepancy in the two calculated azimuthal distributions. Differences in input and modeling were reviewed and, basically, two areas of concern were identified - the effect of certain geometric approximations of the core shroud in the CE calculation and a 3 cm underestimate of the core boundary in the vicinity of the 0^{o} axis in the BNL calculation. The impact of these concerns on the azimuthal fluence distribution was not readily apparent, so both organizations were requested by the Commission to recalculate the fluence distribution with modified models incorporating agreed upon power distribution data, core dimensions, and coolant temperature conditions.

The power distribution data represented the cumulative average power distribution from initial startup to the end of Cycle 3 on an assembly by assembly level of detail. The corresponding average power distribution for the end of Cycle 6 was determined to be essentially the same

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as that for the end of Cycle 3 when the assembly by assembly level of detail is considered. The dimension of the outer edge of the core along the principal axis from the core centerline through the core flat was agreed to be 135.43 centimeters. The coolant density was assumed to be 0.770 g/cc for the downcomer and core bypass regions in the calculational model.

A correction was made for the perturbation of the fast flux on the vessel wall due to the presence of the surveillance capsule in the model. This adjustment changed the flux at the 45^{o} position on the vessel wall by +3.8%.

The results of the new calculations by CE and BNL showed reasonable agreement; the revised BNL normalized azimuthal fluence distribution was lower than the CE result at 0^{o} by about 11%. This comparison essentially resolves the discrepancy leading to the July 15, 1982 meeting. The more detailed representation of the core and shroud in the CE calculation changed the CE result by less than 2%. These analyses do not result in an updated fluence result for PTS because they employed the BNL approach to modeling the core power distribution; namely, assembly average powers. CE analyses normally include a more detailed representation of the power distribution in each fuel assembly and CE analyses show that this increases the 0^{o} fluence by about 8%. In addition, CE evaluations of the contribution of continued operation from 1977, when the wall capsule was removed, through 1981 indicate a further increase in the 0^{o} fluence by about 6%, whereas the BNL modeling concludes essentially no difference. To resolve this problem, a more detailed vessel fluence calculation employing detailed pin-wise power histories from plant startup through 1981 would be required.

The net result of the calculations done to compare with the BNL calculations was a ratio (of fast neutron flux at the 0^{o} position to the peak flux) of 0.73. This compared well with the BNL result of 0.65. For consistency, the above ratios would be more applicable to the peak fluence derived from the BNL analysis, since it used the assembly averaged power distribution approach for the flux calculation.

Sincerely,

W. C. Jones

W. C. Jones
Division Manager
Production Operations

WCJ/TLP:jmm

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