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North Anna 1&2 Turbine Missile Proceeding
Docket Nos. 50-338 OL & 50-339 OL
Additional Information on Flaw Coalescence

Gentlemen:

At the public hearing June 20 Dr. Buck asked Dr. Shaffer for additional information on flaw coalescence (Tr. 553). Dr. Shaffer has responded in the attached statement. Please let me know if this is not adequate.

Yours very truly,

James N. Christman

James N. Christman
Counsel for Virginia Electric
and Power Company

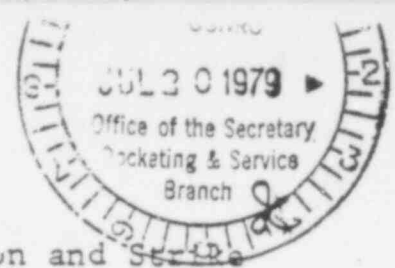
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Enclosure

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FLAW COALESCENCE

A partial objective of "Analysis of the Generation and ~~Stride~~ of Missiles from a Nuclear Turbine" issued March 1974, by the Westinghouse Steam Turbine Engineering Department, was to obtain an estimate of the probability of low pressure turbine disk rupture given a design overspeed incident. This work was based on an assumed crack in the disk that issued radially from one of the three keyways at the bore. No other crack in the disk was considered and the question of coalescence of smaller cracks in the vicinity of the bore was also not considered.

Numerous steps were taken throughout this work to insure conservatism in the estimate: i.e., that the estimated probability should overestimate the actual probability of disk rupture. We believe that there are three primary reasons why our treatment is conservative even without direct consideration of flaw coalescence:

1. The analysis of the crack at the keyway is handled in a conservative manner treating the keyway itself as an extension of the crack, thus overestimating the stresses causing crack growth.

2. Rupture under the stresses at design overspeed was evaluated only after subcritical crack growth for the expected lifetime of the turbine; bore stresses, above nominal, were assumed throughout the growth period.

3. The presence of a cluster of small flaws in the vicinity of the bore of the disk would lead to a relieving of the stress intensification in that region.

It should be noted that although non-destructive examination of structures can often detect flaw clusters, there is no satis-

factory methodology for treating them analytically in studies such as the one reported here. Hence, efforts were taken to make the study conservative while treating only a single flaw issuing radially from a keyway.

D.H. Shaffer
July 13, 1979