



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 4 1982

MEMORANDUM FOR: Robert L. Tedesco, Assistant Director
for Licensing, DL

Gus C. Lainas, Assistant Director
for Safety Assessment, DL

FROM: James P. Knight, Assistant Director
for Components & Structures Engineering, DE

SUBJECT: IP REQUEST FOR EXPERT REVIEW OF KRSKO S/G CHANGES

The Mechanical Engineering Branch has reviewed the information regarding the proposed fix to the Krsko Nuclear Power Plant Type D-4 S/G. Our initial comments regarding the overall proposed fix and request for additional information needed to complete the review are enclosed herein.

James P. Knight, Assistant Director
for Components & Structures Engineering
Division of Engineering

cc: R. Vollmer
R. Bosnak
H. Brammer
W. Kane
J. Rajan

The proposed 70/30 split feed system and the auxiliary feed system modifications appear to be an acceptable method to mitigate the tube vibration and wear in the Model D4 steam generators at KRSKO. The following concerns, however, need to be addressed in order to complete the review.

1. In the generic program for mitigation of the tube vibration problem for the Model D4 steam generators, Westinghouse had proposed a number of mechanical design modification concepts. These included (1) impingement plate ribs with flow slots, (2) flow diverters, (3) center channel flow restrictor, (4) expand tubes at support plates, (5) sleeved tubes, (6) bypass flow through "B" plate and/or inlet box cap plate, (7) modifications of flow limiter. These mechanical modifications were being considered in conjunction with the auxiliary/main feed split flow system. However, for the KRSKO steam generators, it is understood that only the split feed system modification is being proposed as the sole remedial measure. Based on the available information, the ~~staff is~~ ^{we are} unable to decide whether or not the proposed split flow modification design, in itself, will be adequate in eliminating the tube vibration problem at all power levels.
2. The split feed system concept is based on the assumption that no damaging tube vibrations occur at power levels up to 70 percent in the Model D-4 steam generator. ~~The staff needs to review~~ ^{We have not seen} the data and other pertinent information which form the basis of this conclusion. Westinghouse has concluded that turbulent buffeting is the dominant mechanism causing the excessive tube vibrations in Models D2/D3. If this is true for the Model D4, this excitation mechanism should give rise to a broad band

frequency force and it can be expected to excite a range of coupled frequencies. For example, a comparison of the frequency range excited by turbulent buffeting in Argonne National Lab tests of an industrial size heat exchanger agreed well with the predicted bounds on coupled mode frequencies. It would be of interest to compare calculated frequency bands with frequencies present in KRSKO power spectral densities.

3. The flow in the inlet plenum of the Model D4 steam generator is of a counter flow type, the outer row tubes in these steam generators are shielded from the impingement effects of the main feed flow and as such are not exposed to turbulent buffeting as in Models D2/D3. Yet data from KRSKO indicates that excessive tube vibrations occur in these tubes. This suggests that the dominant mechanism in Model D4 steam generators may be a threshold type resulting from fluid elastic instability. If this is the case then the split feed system modification may not be a totally adequate solution.
4. Additional information is needed on the flow distribution in the Model D4 steam generator tube bundle. It is not clear how the flow from the auxiliary feedline affects the main feed flow and how it is distributed at different power levels.