APR

MEMORANDUM FOR: Commissioner Gilinsky

THRU: Executive Director for Operations

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: BEAVER VALLEY WATER HAMMER AND PIPE VIBRATION PROBLEMS

Enclosed is a discussion of the history of pipe vibration problems at Beaver Valley in response to your March 14, 1979 request.

Original Signed By
E. G. Case

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosure:
Vibration History at
Beaver Valley Unit 1

cc w/enclosure:
Chairman Hendrie
Commissioner Kennedy
Commissioner Bradford
Commissioner Ahearne
S. Chilk, SECY
Policy Evaluation
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RESPONSE TO COMMISSIONER GILINSKY ON VIBRATION HISTORY AT THE BEAVER VALLEY UNIT 1 NUCLEAR POWER STATION

During November 1976 through January 1977, the feedwater pipe system (the secondary side) of the Beaver Valley Nuclear Plant experienced large vibratory loads (approximate pressure oscillation 400 psi at 17HZ) on three occasions (November 5, December 27, 1976 and January 5, 1977). These vibratory loads were not due to water hammer caused by two phase flow instability at the steam generator feed ring but were generated by hydraulic instability due to unstable feedwater flow control during power changes. The feedwater pipes did not fail during these incidents but damage to two snubbers, some pipe supports and instrumentation tubing lines was sustained.

Hydraulic instability was caused by an inadequate design of the internals of the feedwater flow control valves and these vibrations were not related to the errors in the design stemming from incorrect pipe stress calculations. The problem of hydraulic instability was resolved by changing the valve internals. Actual vibratory test data made available to the staff substantiated resolution of the problem.

Examination

A stress analysis based on these vibratory loads was performed on the affected pipes. The affected pipes were located both inside and outside containment. From the stress analysis the magnitude and

the location (on the pipes) of the three highest stressed areas were identified. These highest stress areas were radiographed for the pipes inside containment while the pipes outside containment were magnetic partical and liquid penetrant inspected. This examination showed no indication of damage.

As a result of the vibrations, the integrity of the piping system supports was questioned. Based on the original stress analysis performed when plant was being designed by Stone and Webster, the Architect Engineer (AE), a quality assurance check was made of the support of the main feedwater line. This quality assurance check revealed that six hydraulic shock suppressors were undersized with respect to seismic load requirements established by the original pipe stress analysis. The results of the original pipe stress analysis were not compared with the stress analysis performed at the time of the events (1977) because the dynamic loads used in the original stress analysis considered seismic loads while the latter considered loads due to hydraulic instability that occurred during the event. As a result of the anomalies found in the pipe supports of the main feedwater line, the licensee and AE expanded the review to cover 2,000 support points throughout other category I pipe systems. Of these 2,000 supports, a total of 29 could not be accepted based on the original stress analysis and the restraints at these points were either replaced or

modified in early 1977. Other supports, not on safety systems, were also examined at that time and found acceptable on the same basis.

All failed (resulting from the event) or undersized pipe supports and snubbers were replaced or repaired.