ENCLOSURE

SEQUOYAH NUCLEAR PLANT UNIT 1
VIBRATION IN RHR PIPING
NCR CEB 79-4
10 CFR 50.55(e)
FINAL REPORT

Description of Deficiency

During the preoperational pipe vibration testing, several possibly nonconforming conditions were found to exist in the unit 1 RHR piping, downstream from the RHR heat exchangers. These problems are as follows:

1. Excessive vibration was identified in the vicinity of the air operated eight-inch butterfly valves. These valves are used for RHR flow control. The vibration levels were found to be acceptable on train A and unacceptable on train B, according to TVA Displacement Criteria for Vibration Qualification of Piping. The vibration appears to be partially caused by cavitation in the control valves in any position other than full open. There were also problems in adjusting the valves to maintain specific flow rates and in seating these valves.

2. Two variable spring supports, one on each train, were not installed in accordance with TVA drawing 47K432-50R3. These are dead weight supports that were specified by Westinghouse but were never installed.

3. The B train control valve was oriented in the piping system such that the end of the actuator could contact the wall when the system is hot or during a seismic event.

4. A distinctive clanging sound was emanating from the immediate vicinity of the train A flow control valve during a flow mode in which the valves were full open and there was no cavitation. The exact cause of this noise is not known but a Woodruff Key in the actuator linkage was later found to be broken. This could have allowed the disk to oscillate in the fluid stream, causing the noise.

Safety Implications

The conditions identified by this nonconformance represent significant deficiencies in the safety-related RHR system. A failure of the RHR flow control valves or the associated piping could reduce the system redundancy or prevent the RHR system from performing its intended safety function.

Corrective Actions

The variable spring supports have been added to the valve operators and a pipe support has been installed to alleviate the pipe vibration problem. Retesting of the system indicates that the pipe vibration problems have been resolved (even for operational modes where cavitation occurs).

The flow adjustment and valve seating problems were evidently related to partial or complete Woodruff Key failures Proper operation of these valves has been verified when good keys are installed. The clanging noise is also

eliminated when good keys are installed. To prevent further valve actuator key failures, high strength Woodruff Keys have been installed. The high strength keys are one of two types recommended on the manufacturer's (Fisher Control Co.) valve drawing.

The B train control valve has been rotated to avoid any potential physical interferences.

Cavitation across the throttling valves appears to have been the primary cause of the original pipe vibration and shear key failures. Additional resistance has been added to the RHR piping system, downstream of the throttling valves, as corrective action to NCR NEB 79-3. The additional resistance has significantly suppressed the cavitation by increasing the back pressure to the throttling valves. Post modification testing has confirmed that cavitation will not occur during normal use of the RHR system.

ECCS modes of operation do not use throttling. Since cavitation does not occur with the valves full open, the problem is avoided during ECCS operation.

These corrective actions will be considered for applicability to Sequoyah unit 2 and Watts Bar Nuclear Plant units 1 and 2.