Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

APR 30 1991

WBRD-50-390/90-11
WBRD-50-391/90-11

10 CFR 50.55(e)

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - POTENTIAL FOR GAS ACCUMULATION IN EMERGENCY CORE COOLING SYSTEM PIPING - WBRD-50-390/90-11 AND WBRD-50-391/90-11 - FINAL REPORT

The subject deficiency was initially reported to NRC Region II on January 8, 1991, in accordance with 10 CFR 50.55(e) as Condition Adverse to Quality Report WBP 900556 (presently Significant Corrective Action Report WBP 900556SCA). The first interim report was issued February 20, 1991. Enclosed is TVA's final report.

If there are any questions, please telephone P. L. Pace at (615) 365-1824.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

Mark Burzynski for

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Enclosures
cc: See page 2

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U.S. Nuclear Regulatory Commission

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ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN)
POTENTIAL FOR GAS ACCUMULATION
IN THE
EMERGENCY CORE COOLING SYSTEM (ECCS) PIPING
SCAR WBP 900556
WBRD-50-390, 391/90-11
10 CFR 50.55(e)
FINAL REPORT

DESCRIPTION OF DEFICIENCY:

Gas accumulation in the centifugal charging pump (CCP) piping that exceeded the maximum allowed gas volume occurred at TVA's Sequoyah Nuclear Plant (SQN) on August 22, 1990. Because WBN is similar in design to SQN, the WBN ECCS design could also allow entrained gases to be removed from solution and to accumulate in the CCP suction piping. This gas accumulation has the potential for common-mode failure of the CCPs during a loss of coolant accident (LOCA) due to gas binding. The root cause for this condition was that the design of the Chemical Volume Control System and the Emergency Core Cooling System piping configuration downstream of the volume control tank as specified on the physical piping drawings did not anticipate gas desorption and accumulation at system high points.

SAFETY IMPLICATIONS

Gas binding of the CCPs has not been experienced at WBN during testing. However, the WBN ECCS piping configuration may have the potential for gases to accumulate in the suction piping to the charging pumps. Based on the potentially affected piping and the respective volume for entrainment, the operation of one CCP could be impacted at WBN.

The Westinghouse Auxiliary Equipment Engineering and Dresser Pump Division analysis for the SQN event identified several concerns with passing entrained gas through the charging pumps. The consequences on the pumps are highly dependent on how the gas is mixed with the fluid before entering the pump. If the gas is not mixed and passes as a slug, a pump could experience a period of time during which no water is available for pump lubrication. Given this worst-case scenario, the pump vibration could significantly increase and cause rotating element internal rubbing and possibly seizure or shaft breakage. Westinghouse, however, believes this scenario is very improbable since gases would normally be expected to mix with the water before reaching pump suction. Such mixing would be created by the elbows and tees before the mixed flow enters the CCP impellers.

With partial mixing, enough lubrication should be provided to prevent prompt pump failure. Any appreciable amount of gas in solution (greater than 5 percent) may result in a temporary imbalance in the loads in the rotating element and could be severe enough to cause pump shaft bending and shaft crack initiation. If this situation occurs, the Westinghouse evaluation indicates that the pump could continue to run for several days following a LOCA before shaft failure. By that time, the system would be depressurized and the low-head safety injection pumps would provide adequate core cooling.

Another consequence is that pump hydraulic performance will degrade during the time a mixture of gas and water passes through a pump. Once all the gas is purged, pump performance will recover. The Westinghouse evaluation determined that this is acceptable since pump performance requirements are less stringent during recirculation than during injection. Therefore, a slight degradation of charging pump flow for a short period of time at the initiation of recirculation would be acceptable.

The Westinghouse evaluation for SQN that is also applicable to WBN concluded that the CCPs would operate with up to six cubic feet of gas in the suction lines. The six cubic foot limit was based on engineering judgement from the results of more detailed analyses done for Farley and Beaver Valley Nuclear Plants. The analyses included scale models of the physical piping for those plants and a significant amount of testing. While Westinghouse had reasonable confidence that SQN was bounded by the results of these tests, they could not say definitely what would have happened for any amount over six cubic feet.

Corrective Actions

1. Although gas accumulation is difficult to predict, the physical phenomenon causing gases to come out of solution is suspected to be primarily gas stripping at the charging pump miniflow line flow restricting orifices. TVA will modify the system to add a loop seal in the 3-inch emergency boration line and the 8-inch line downstream of FCV-63-8 to prevent gas from trapping in these lines.

2. TVA will add a vent valve to the high point of the emergency boration line in order to provide proper system venting. This corrective action will assure that the CCPs will function as designed.

3. A system engineering review of system interfaces, piping configurations, and probable gas generation mechanisms has determined that there are not other accumulations in primary safety systems that could prevent the proper operation of those systems.

Actions 1 and 2 will be completed by TVA before system completion for turnover to prestart testing.

ENCLOSURE 2

LIST OF COMMITMENTS

1. TVA will modify the system to add a loop seal in the 3-inch emergency boration line and the 8-inch line downstream of FCV-63-8 to prevent gas from trapping in these lines.

2. TVA will add a vent valve to the high point of the emergency boration line in order to provide proper system venting.

Actions 1 and 2 will be completed by TVA before system completion for turnover to prestart testing.