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

ENCLOSURE 2

SAFETY EVALUATION BY THE OFFICE OF SPECIAL PROJECTS

RELATING TO SEQUOYAH FIRE PROTECTION ISSUES AND

THE NON-NUCLEAR HEATUP PRIOR TO RESTART

TENNESSEE VALLEY AUTHORITY

SEQUOYAH UNIT 2

DOCKET NOS. 50-328

1.0 INTRODUCTION

On Thursday, February 4, 1988, NRC received a phone call from Mr. Richard H. King who had Mr. Andrew Bartlik in his offices. The NRC personnel involved in the phone conversation were Jane A. Axelrad, Deputy Director, Office of Special Projects, Hukam C. Garg, Senior Electrical Engineer. and Robert C. Pierson, Chief, Plant Systems Branch. Mr. Bartlik was concerned that heat-up was taking place at Sequoyah despite concerns he had raised with NRC personnel during a meeting on Wednesday, February 3, 1988. The phone discussion involved three concerns of Mr. Bartlik and his opinion that heat-up should be precluded until these issues were resolved.

2.0 EVALUATION

2.1 First Issue

The first issue involved a scenario whereby the Pressure Operated Relief Valve (PORV) is opened spuriously with the pressurizer block valve open. The same initiating event could result in the spurious closure of the valves FCV-62-132 and 63-133 and the loss of suction to the operating Centrifugal Charging Pump (CCP). The other CCP could be damaged in the fire and is, therefore, assumed to be lost. The Residual Heat Removal (RHR) pumps subsequently become unavailable through inability to line up the RHR supply line. As a result, reactor coolant inventory is lost through the PORV and a source of Emergency Core Cooling System (ECCS) is not available. This analysis does not take credit for the Safety Injection pumps.

The fuel in the core has a low decay heat because the fuel has decayed since plant shutdown in August 1985. This was evaluated by TVA in its submittal dated October 12, 1987 on repairs to the RHR suction valve 2-FCV-74-2. A test conducted by TVA on October 3, 1987 indicated a reactor coolant heat-up rate of 1.5°F/hour. TVA calculated a heat-up rate of 3.6°F/hour based on a conservative decay heat release rate of 2.42×10^6 BTU/hr. The staff Safety Evaluation for the repair of 2-FCV-74-2 was dated October 10, 1987.

As a result of the heat-up rate, the response time to provide cooling for the core is a matter of hours rather than seconds as measured under FSAR analyzed conditions. Assuming this event is initiated from normal operating pressure and temperature attained through a non-nuclear heat-up, the initial event would cause a loss of reactor coolant system inventory through the open block valve and PORV until the reactor coolant system depressurized to atmospheric pressure and approximately 212°F. The core would remain covered. The inventory of the reactor coolant system (assuming all coolant inventory in the pressurizer is lost) is approximately 10,000 cubic feet of water. In addition, there is upper head injection (UHI) available with approximately 1800 cubic feet of water . Using a decay heat release rate of 2.42×10^6 BTU/HR divided by a phase change enthalpy (water to steam at 1 atmosphere and 212°F) of 970 Btu/lbm results in the following:

2.42×10^6 BTU/HR / 970 BTU/lbm = 2495 lbm/hr reactor coolant system water removed due to decay heat through boiling

Thus, the required make-up for the reactor coolant system water loss due to boiling from the decay heat is 2495 lbm/hr or 5.2 gallons/min. The UHI alone will provide adequate make-up for more than 40 hours. This is adequate time for TVA to take the necessary action to restore reactor core cooling.

2.2 Second Issue

The second issue involved spurious actuation preventing safe shutdown of the reactor. These could occur through several mechanisms including a cable to cable short. Associated circuits and spurious signal protection concerns were discussed in Section 5.b of the NRC Inspection Report 50-327/85-01 dated March 29, 1985. In regard to spurious signals the report states:

> "A review of the licensee's spurious signal analysis was conducted to determine if the following conditions had been considered:
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> > The false motor, control and instrument readings such as what occurred at the 1975 Browns Ferry Fire. These could be caused by fire initiated grounds, shorts or open circuits.
> >
> > Spurious operation of safety-related or non-safety-related components that would adversely affect shutdown capability (e.g., RHR/RCS Isolation Valves).

> The licensee's method for evaluation of fire induced spurious signals that could affect the circuits required to bring the plant to hot shutdown was reviewed. The licensee has treated the spurious signal-affected circuits and circuits that could affect the shutdown logic path through spurious actuation due to fire damage as shutdown circuits. Therefore, these circuits were evaluated for interaction between redundant shutdown paths. The circuits analyzed were control circuits that are powered from ungrounded AC or DC power sources.
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> The licensee intends to remove power and control voltages from several valves that could affect safe shutdown of a unit should they operate due to a fire induced spurious signal. The impact of this action in relation to the operability of the unit has been assessed by the licensee and submitted to NRC. The licensee's reevaluation and corrective action appears to adequately address the spurious signal concerns."

The Inspection Report also stated:

> "Appendix R, Section III.G.2, requires that where cables or equipment including associated nonsafety circuits that could prevent operation or cause the maloperation due to hot shorts, open circuits or shorts to ground of redundant trains of systems necessary to achieve and maintain hot shutdown conditions, shall be protected in accordance with either paragraph III.G.2.a., III.G.2.b., or III.G.2.c.
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> Based on the licensee's December 21, 1984, Appendix R reevaluation, 295 circuits were identified as having a common power source with shutdown equipment and the power source was not properly electrically protected from the circuit of concern or protected in accordance with Appendix R, Section III.G.2. On August 10, 1984, these conditions did not meet the requirements of Appendix R and are identified as Violation Item (50-327, 328/85-01-02), Failure to provide adequate breaker/fuse protection for equipment required for hot standby."

The open item was closed in Inspection Report 50-327, 328/87-41 dated August 7, 1987. In the inspection report, the NRC stated that TVA's submittal dated December 21, 1984 identified the 295 circuits that required modifications to meet Appendix R, Section III.G.2. TVA replaced fuses and breakers, reset breakers/relay trip settings, changed loads to different circuits, wrapped cables with a fire resistant material, replaced cable and rerouted cable.

2.3 Third Issue

The third issue involved the potential of the reactor core becoming critical in an Appendix R event.

Mr. Bartlik subsequently proposed that a hypothetical Appendix R event could cause an unmitigated multiple steam generator blowdown which would result in reactor criticality due to the cooling of the reactor coolant system. He further stated that the classical analysis is from zero power and, when TVA goes to a non-nuclear heatup on Sequoyah, that will be the condition of the plant. He also stated that during this non-nuclear heatup a steam generator blowdown could cause the core to go to criticality.

The reactor will not be taken critical during this non-nuclear heatup. TVA committed to maintain the boron concentration of the reactor coolant above the cold plant shutdown concentrations until the staff approves the entry of Unit 2 into Mode 2. Boron is a neutron absorber and is used to provide plant shutdown margin. As a result, the cooling effect of the postulated blow down of the steam generator will not make the reactor go critical. The classical analysis from zero power does not assume that the reactor coolant concentration of boron is at or above a cold shutdown concentration level.

3.0 CONCLUSION

Based on the NRC inspection effort to date, the low decay heat release rate in the core as discussed above under the first issue and the TVA commitment concerning the boron concentration discussed under the third issue, the staff concludes that it is safe for Sequoyah Unit 2 to heat up (i.e., enter Modes 4 and 3). This conclusion applies only to this heatup prior to the restart of Unit 2. It does not apply to the restart of Unit 2.

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Dated: February 17, 1988