TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

July 16, 1981

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Denton:

In the Matter of the	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

Enclosed are our positions for Browns Ferry Nuclear Plant on the following NUREG-0737 items.

II.E.4.1 Dedicated Hydrogen Penetrations

II.K.3.13 Separation of High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) System Initiation Levels Analysis and Implementation

II.K.3.15 Modify Break Detection Logic To Prevent Spurious Isolation of High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC)

II.K.3.25 Effect of Loss of Alternative Current Power on Pump Seals

We will continue to be as responsive as possible, however, we are continuing to incur difficulties regarding overall work load and qualified equipment procurement.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Regulation and Safety

Subscribed and sworn to before
me this 16th day of July 1981.

Bryant M. Lowery
Notary Public

My Commission Expires 4/4/82

Enclosures

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ENCLOSURE
BROWNS FERRY NUCLEAR PLANT
NUREG-0737 ITEMS

II.E.4.1 - Dedicated Hydrogen Penetrations

TVA Response:

As committed to in our December 23, 1980 response from L. M. Mills to H. R. Denton, TVA has completed the full evaluation of the purge system according to NRC's October 31, 1980 clarifications of post-TMI requirements. This was done since Browns Ferry Nuclear Plant does not use dedicated penetrations but rather shares some piping with the containment purge system.

Our review has indicated that some modifications will be required to bring the vent side of the system into strict conformance with single failure criteria. We have analyzed the existing configuration; and, although we find it acceptable for safety considerations, we have developed a preliminary design for making the system strictly single failure proof in accordance with the NRC clarifications. We will notify NRC concerning the modification schedule as soon as equipment procurement dates are arranged.

II.K.3.13 - Separation of High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) System Initiation Levels Analysis and Implementation

TVA Response:

As stated in our December 23, 1980 L. M. Mills to H. R. Denton letter, TVA committed to the auto restart of RCIC modification. We have proceeded with the design and procurement of qualified equipment to meet the requirements of this position. Based on the present vendor estimate of equipment delivery dates, we can tentatively commit to the following scheduled outages:

U 1 - March 1983

U 2 - March 1982

U 3 - September 1981

II.K.3.15 - Modify Break Detection Logic to Prevent Spurious Isolation of High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC)

TVA Response:

This modification involves adding a timer to the break detection logic to prevent spurious isolation. The modification on HPCI is complete. The design and procurement for the RCIC modification is proceeding; and, based upon the latest qualified equipment delivery dates, TVA has scheduled the implementation of these modifications during the next scheduled refueling outages as follows:

U 1 - March 1983

U 2 - March 1982

U 3 - September 1981

II.K.3.25 - Effect of Loss of Alternative Current Power on Pump Seals

TVA Summary:

Two independent systems provide cooling water to the recirculation pump seals: (1) the reactor building closed cooling water (RBCCW) system, and (2) the recirculation pump seal purge portion of the control rod drive (CRD).

The RBCCW pumps have automatic restart logic on loss of offsite ac power and are powered from the 480-V shutdown boards. The CRD pumps do not automatically restart, but the 1B CRD pump on units 1 and 2 and the 3B CRD pump on unit 3 have emergency power and can be manually restarted if required. Therefore, both systems are available to maintain the temperature of the recirculation pump seals below 250°F.

Total failure of both recirculation pump seal cooling water systems will not result in a safety problem. Even in the case of both systems failing followed by extreme degradation of the pump seals, the primary coolant loss, analyzed to be less than 70 gallons a minute, will be compensated for by normal or emergency water level controls. Consequently, no hazard to the health and safety of the public will result from total loss of recirculation pump seal cooling water.

INTRODUCTION

This has been prepared in response to item II.K.3.25 of NUREG-0737 entitled, "Effect of Loss of Alternative Current Power on Pump Seals." This item states, "The licensees should determine, on a plant-specific basis, by analysis or experiment, the consequences of loss of cooling water to the reactor recirculation pump seal coolers. The pump seals should be designed to withstand a complete loss of alternating current (ac) power for at least two hours. Adequacy of the design should be demonstrated." NRC has clarified the phrase "complete loss of alternating current (ac) power" to mean only loss of offsite power.

Investigation of loss of offsite ac power indicates that there will be no effect on the cooling water except for a 40-second loss of flow between the time the RBCCW pumps lose normal power and the "A" RBCCW pump restarts on emergency power. The investigation has also led to the conclusion that the loss of pump seal cooling is not a safety problem, but may require seal repairs prior to resuming operation.

This evaluation presents a description of the seal cooling systems, an evaluation of seal performance under loss of offsite ac power conditions, and the results of a seal leakage analysis for extremely deteriorated seals.

GENERAL DESCRIPTION

The BWR recirculation pump design incorporates a dual mechanical shaft seal assembly to control leakage around the rotating shaft of the recirculation pump. Each assembly consists of two seals built into a cartridge that can be replaced without removing the motor from the pump. Each individual seal in the cartridge is designed for full pump design pressure and can adequately limit leakage in the event that the other seal should fail.

During normal operation, the recirculation pump seals require forced cooling due to the temperature of the primary reactor water and due to the friction heat generated in the sealing surfaces. For most BWR's, two systems accomplish this forced cooling: the RBCCW system and the seal purge system. Cooling water, provided by the RBCCW system, flows through a heat exchanger around the seal assembly. This RBCCW flow cools primary reactor water which flows to the lower seal cavity, thereby maintaining the seals at the correct operating temperature. The seal purge system injects clean, cool water for the CRD system into the lower seal cavity. This seal purge flow also provides efficient cooling for the seals.

On loss of offsite ac power, the RBCCW pumps will trip. If no accident signal is present, the "A" and "B" RBCCW pumps restart immediately on emergency power and continue to supply cooling water to the pump seal heat exchangers. In the event of a coincident accident signal, the "A" RBCCW pump will automatically restart after 40 seconds. If the "A" RBCCW pump fails to start; the "B" RBCCW pump will automatically start 3 seconds after the "A" RBCCW pump fails to start. Therefore, RBCCW pumps will provide cooling water to essential loads, including recirculation pump seal heat exchangers, preventing any damage to the recirculation pump seals on loss of offsite ac power. The control rod drive (CRD) system pumps can also be powered from emergency buses and provide additional protection to the pump seals.

SEAL PERFORMANCE AND EVALUATION

Under normal conditions with the primary reactor system at or near rated temperature and pressure and the recirculation pumps either operating or secured, both RBCCW and seal purge are operating. These two systems maintain the seal temperatures at approximately 120°F.

Recirculation pump vendor test data shows that the pump seals may begin to deteriorate when seal temperature exceeds 250°F. If an event occurs where both closed cooling water to the pump seal heat exchanger and control rod drive seal purge flow are totally lost, the recirculation pump seals will heat up. This will occur whether or not the pump is running. Vendor test data, taken while operating at approximately 530°F/1040 psia, indicates that the seals will heat up, reaching 250°F approximately 7 minutes after a total loss of cooling. Similar test data indicates that if either one of the seal cooling systems is in operation, the seal temperatures remain well below 250°F and no seal deterioration occurs.

If both closed cooling water and seal purge are totally lost and if the seal temperatures exceed 250°F, seal deterioration may occur resulting in primary coolant leakage to the drywell. An analysis of fluid loss through a degraded seal modeled the fluid leakage path as a series of fluid volumes with interconnecting junctions each having appropriate initial conditions(1). The model assumed gross degradation of the mechanical seals. Gross failure of these seals encompasses warpage, fractures, and grooving of the seal faces due to excessive thermal gradients and dirt.

[1] NEDO-24083, "Recirculation Pump Shaft Seal Leakage Analysis," November 1978. (Licensing Topical Report)

The results of this seal leakage analysis show that, even with gross degradation of the seals, the leakage would be less than 70 gpm. This amount of leakage is within the capacity of normal or redundant emergency vessel water level control systems. A leakage of 70 gpm is equivalent to a liquid leak of 0.001 ft^2 flow cross sectional area. Even if the seals on both recirculation pumps fail, the effects of such leakage do not influence the results of loss-of-coolant accident analyses. It is emphasized that the seal leakage analysis is extremely conservative, and a leakage rate of 70 gpm is not expected upon seal failure.

OPERATIONAL CONSIDERATIONS

If an event occurred which led to seal degradation and subsequent leakage, the operator could isolate the pump by closing both the recirculation suction and discharge valves. Following an event where the seal temperatures exceeded 250°F, the utility would have to determine whether to directly return to power operation or to replace the pump seals. Factors influencing this decision would include the seal's operating history, the amount of time without cooling, and peak seal temperature. It is stressed that, even if the seal is grossly degraded, no safety problem will exist because the maximum leakage is small.

CONCLUSIONS

Two systems provide cooling to the recirculation pump seals. If either one of these systems is operating, recirculation pump operation without the second cooling system may continue with no harm to the seals. If both seal cooling systems are inoperable, the pump seals will overheat approximately 7 minutes after the total loss of cooling and seal deterioration may begin.

Based on fluid loss analysis of extremely degraded seals, the leakage is less than 70 gpm. This amount of leakage will not lead to a safety concern but may degrade the seals such that they would have to be repaired prior to resuming operation. Consequently, no change in design is necessary.