Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

December 1, 1999

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

Gentlemen:

In the Matter of	)	Docket No. 50-260
Tennessee Valley Authority	)	50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 2 AND 3, CORRECTED INFORMATION FOR TECHNICAL SPECIFICATION CHANGE REQUEST TS-384, POWER UPRATE - (TAC NOS. M99711 AND M99712)

In a letter dated October 1, 1997 (Reference 1), TVA provided a proposed Technical Specification change that would allow BFN Units 2 and 3 to operate at an uprated power of 3458 megawatts thermal. In a September 8, 1998 letter (Reference 2), NRC issued license amendments 254 and 214 approving TVA's request for uprated power operation, for Units 2 and 3 respectively.

TVA's October 1, 1997 letter, contains information which TVA has determined to be inaccurate. In Enclosure 5, Section 4.1.1.1 b of General Electric (GE) NEDC 32751P - "Power Uprate Safety Analysis For Browns Ferry Nuclear Plant Units 2 and 3", TVA stated that the main steam relief valve (MSRV) T-Quenchers are located above the elevation of the emergency core cooling systems (ECCS) torus suction while in fact the T-Quenchers are located below the ECCS torus suction. The relative location of the two points (MSRV T-Quencher versus ECCS suction) formed the basis of TVA's conclusion that an evaluation of local suppression pool temperature was not required for power uprate.

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TVA's evaluation of local suppression pool temperature is provided below:

Background

On October 1, 1981, NRC published NUREG-0783, "Suppression Pool Temperature Limits For Boiling Water Reactor (BWR) Containments (Reference 3)." The NUREG established local temperature limits for BWR suppression pools during MSRV discharge. The primary plant transient of interest was an extended MSRV discharge such as a single stuck open MSRV which would produce high localized pool temperatures in one suppression pool bay. NRC's concern was that high localized suppression pool temperatures could result in unstable condensation of the steam bubbles thus inducing excessive loads on the suppression chamber internal structures. In response to NUREG-0783, each plant was required to prepare a localized pool temperature analysis. For BFN, a local suppression pool temperature analysis was documented by GE report NEDC-22004, issued October 1981, "Browns Ferry Nuclear Power Plant Units 1, 2, and 3 Suppression Pool Temperature Response."

GE report NEDO-30832, "Elimination of Limit on BWR Suppression Pool Temperature for SRV Discharge with Quenchers", approved in a Safety Evaluation Report (SER) on August 29, 1994 (Reference 4), generically analyzed the issue using revised techniques. The report concludes that for plants employing T-Quenchers, the condensation loads over the full range of pool temperatures up to the saturation temperature are low compared to loads from MSRV discharge line air clearing and the Loss of Coolant Accidents (LOCA). The GE report concludes that the NUREG-0783 limit on the suppression pool temperature for MSRV discharge through T-Quenchers is unnecessary and associated plant operating limits may be replaced by limits based on other considerations.

A Brookhaven National Laboratory Report, prepared for the staff to assist them in the review of NEDO-30832, supports the NRC SER for NEDO-30832, concurring with the GE findings regarding structural loads. Additionally, the report discussed steam ingestion by the ECCS pumps resulting in the potential for pump cavitation or condensation induced water hammer in the suction piping following collapse of the steam bubbles or plume.

Based on information received from the Massachusetts Institute of Technology (MIT), the Brookhaven report concluded that the maximum extent of any steam plume formed when saturated conditions exist in the vicinity of a T-Quencher device will be no greater than approximately 1.5 meters (4.92 feet). Thus, the Brookhaven report concluded that if the ECCS suction is horizontally separated from the T-Quencher by at least 1.5 meters (4.92 feet) (irrespective of the vertical relationship of the two points), the plume/bubbles would not be ingested by the ECCS suction.

The NRC agreed with GE report NEDO-30832 concerning loads on the suppression chamber internal structures. However, the NRC disregarded Brookhaven's 1.5 meter separation criteria for ECCS suction separation and instead, stipulated in the 1994 NRC SER for NEDO-30832 that the local suppression pool temperature limit can be eliminated if the pump inlet for the ECCS pumps is below the elevation of the MSRV T-Quenchers. This was intended to geometrically preclude the ingestion of a thermal/steam plume and thus its potential impact on both the net positive suction head (NPSH) of the ECCS pumps and water hammer loads on the piping.

The October 1, 1997, BFN Power Uprate submittal stated that the evaluation of local pool temperature limit is not necessary in accordance with NEDO-30832 since the T-Quenchers are above the RHR suction elevation. It has subsequently been determined that the T-Quenchers are located below the ECCS torus suction strainers.

Evaluation

Because of the discrepancy identified in the October 1, 1997 letter, TVA re-evaluated the impact on local suppression pool temperatures resulting from the five percent power uprate.

The local suppression pool temperature analysis for Browns Ferry provided in GE report NEDC-22004-P, was reevaluated. The results of the re-evaluation show that the local pool temperature is not sensitive to the small (5 percent) change in the initial reactor thermal power due to power uprate. The report contains a case for a stuck open relief valve (SORV) at both hot shutdown and full power conditions with the same assumptions regarding RHR cooling. The difference in suppression pool local temperature for these two cases is only 9 degrees F. Assuming a linear relationship to power, a five percent increase in power would result in less than 0.5 degrees F additional temperature at the uprated condition. The highest temperature for any case in GE report NEDC-22004-P is 198 degrees F. Even with an additional 0.5 degrees F, the report's conclusion that the local suppression pool temperature remains below the 200 degrees F limit remains valid.

In order to further address ECCS suction separation, TVA has evaluated the physical configuration of the suppression pool, MSRV T-Quenchers, and ECCS suction strainers utilizing the information contained in NEDO-30832, the NRC SER and the associated Brookhaven report.

The ECCS system pumps take suction from the suppression pool through an ECCS ring header by way of four strainers connected in parallel. The strainers inside the suppression chamber are GE stacked disk design, with a very large external open flow area. The main steam relief valves discharge though T-Quenchers located on the opposite side of the suppression chamber centerline from the ECCS strainers.

At the closest point between the ECCS strainers and the T-Quenchers, the T-Quencher outer edge is approximately 2.3 meters (7.54 feet) horizontal distance from the strainer outer edge, substantially exceeding the criteria provided by the Brookhaven report. This point on the ECCS strainers is at approximately 528 feet 10 inches elevation. The centerline of the MSRV T-Quenchers is at elevation 526 feet 6 inches.

The Brookhaven 4.92 feet criteria is based on the horizontal distance from the T-Quencher to the outer edge of the steam plume at the surface of the pool. The horizontal extent of the steam plume is greatest at the pool surface since the horizontal size of the steam plume would increase from the T-Quencher up to the surface due to the steam plume mixing horizontally (i.e., expanding) as it rises through the pool. The steam plume should be even smaller than 4.92 feet near the elevation of the T-Quenchers which further increases the separation between the steam plume and the strainers.

In the event of one stuck open MSRV at high reactor pressure, the ECCS systems would not operate at their full flow capacity. In the initial phase of the event, reactor vessel makeup would be accomplished via the normal feedwater system. If it became necessary to initiate ECCS makeup, the reactor core isolation cooling (RCIC) system at 600 gallons per minute (gpm) and/or the high pressure coolant injection system at 5000 gpm would be initiated. Normal suction for these two systems is the condensate storage tanks. However, these pumps can be aligned to the suppression pool and, therefore, were considered for evaluation.

Due to the initiation of the RCIC and/or HPCI or due to high suppression pool temperatures, both loops of the residual heat removal (RHR) system in the suppression pool cooling mode at 13000 gpm per loop would be initiated. If necessary, the operator could also initiate two loops of Core Spray on their minimum flow paths at 620 gpm each loop. With a total flow of 32840 gpm through the four strainers, TVA estimates that the approach velocity to each strainer would be approximately 0.06 feet per second.

In the event of one stuck open MSRV at a reactor pressure below the shutoff head of the low pressure ECCS pumps, the ECCS systems would operate at their full flow capacity; however, the size of the steam/bubble plume would be significantly smaller due to the lower reactor pressure and thus the separation criteria would be conservative.

The 7.54 feet of horizontal separation provided in the BFN suppression chamber would prevent the steam plume/bubbles from reaching the ECCS suction strainers. Also, because the ECCS suction strainers have a very large external open flow area, they have a low approach velocity. The low approach velocity would reasonably be expected to prevent the ECCS suction from hydraulically distorting the steam plume (i.e., drawing the plume nearer to the strainer) and thus, further minimizes the potential for ingesting the plume/bubbles into the strainer. Based on the Brookhaven criteria, the 7.54 feet of horizontal separation at BFN would prevent the steam plume/bubbles from reaching the ECCS suction strainers. However, even if the plume were to extend to a small portion of the strainer, the large size of the strainer would result in the majority of the flow being drawn from the cooler pool water outside of the plume. The cool water would mix with the thermal plume inside the strainer and form a mixture of water substantially below the plume temperature before being sent to the ECCS pumps.

As previously noted, the ECCS system pumps take suction through a ECCS ring header by way of four strainers connected in parallel. The strainers are at four nearly equal distant locations separated by approximately 25 percent of the circumference of the ring header. Since the extended MSRV actuation discussed in this letter involves only one MSRV, the transient can potentially interact with only one ECCS suction strainer. The ring header design ensures that the flow to a specific pump is not from a single strainer but is instead a mixture of flow from the widely separated strainers.

Conclusion

The geometry of the torus and ECCS piping coupled with the thermal-hydraulic conditions discussed above will ensure that: 1) the local suppression pool temperature will remain below the 200 degrees F limit for structural loads, 2) the ECCS suction piping would not ingest steam bubbles which could later collapse and induce water hammer loads, and 3) the ECCS pumps and their associated NPSH will not be subjected to elevated temperature suction flows. Therefore, the ECCS systems are fully capable of performing their design and licensing basis functions and thus there is no impact on the operability of the systems. Hence, the staff's conclusions published in NRC's September 8, 1998, Safety Evaluation regarding the acceptability of Browns Ferry's power uprate remain valid.

There are no commitments contained in this letter. If you have any questions, please contact me at (256) 729-2636.

Sincerely,

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Manager of Licensing
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cc: See Page 8

REFERENCES

1. TVA Letter to NRC dated October 1, 1997, Browns Ferry Nuclear Plant (BFN) Units 2 and 3 - Technical Specification (TS) CHANGE TS-384 - Request For Power Uprate Operation

2. NRC Letter to TVA dated September 8, 1998, Issuance of Amendments Regarding: Power Uprate - Browns Ferry Nuclear Plant Units 2 and 3 (TAC NOS. M99711 and M99712)

3. NUREG 0783, Suppression Pool Temperature Limits For Boiling Water Reactor (BWR) Containments, published October 1, 1981

4. August 29, 1994, Safety Evaluation of General Electric Co. Topical Reports; NEDO-30832 Entitled, Elimination of Limit on BWR Suppression Pool Temperature For Steam Relief Valve Discharge With Quenchers and NEDO-31695 Entitled, BWR Suppression Pool Temperature Technical Specification Limits

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