July 26, 2007

TVA-BFN-TS-461S1

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of)
Tennessee Valley Authority)

Docket No. 50-259

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 1 - TECHNICAL SPECIFICATIONS (TS) CHANGE TS-461S1 - MODIFICATION OF RESTART LARGE TRANSIENT TESTING LICENSE CONDITION 2.(G)2 - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) (TAC NO. MD5871)

On March 6, 2007 (ADAMS Accession No. ML063350404), NRC approved TVA's September 22, 2006 (ML062680459) Unit 1 license amendment request for a 5 percent increase in rated thermal power from the original licensed power of 3293 Megawatts thermal (MWt) to 3458 MWt. BFN Units 2 and 3 were previously licensed and each has operated for several years at this stretch power level of 3458 MWt.

The March 6, 2007, NRC approval added two license conditions, 2.G(1) and 2.G(2), on conducting transient tests. License condition 2.G(1) included a condensate pump trip, a condensate booster pump trip, and a main feedwater pump trip test from rated power. License condition 2.G(2) required the performance of a turbine generator load reject test and a main steam isolation valve (MSIV) closure test from rated power. The pump trip transient tests have been completed and the full power MSIV transient test was conducted on June 23, 2007. Additionally, on June 9, 2007,

Unit 1 experienced an unplanned turbine trip and scram from approximately 80 percent of rated power.

A scram analysis of the Unit 1 systems response during the June 9 turbine trip transient and the June 23 rated power MSIV closure transient test concluded that the plant safety and control systems responded well. In view of this favorable plant response during the two high power scrams and during the set of pump trip tests, TVA believes that that the objective of license conditions 2.G(1) and 2.G(2) to demonstrate integrated plant operation in response to transients has been satisfied. Consequently, TVA concluded the performance of another high power transient, i.e., the rated power turbine generator load reject test referenced in license condition 2.G(2), should not be necessary.

Accordingly, on June 25, 2007 (ML071790514), TVA submitted a request for an exigent license amendment (TS-461) to modify license condition 2.G(2) to postpone the performance of the load reject test into the Fall of 2007 so that the test could be performed when reserve margin on the TVA electrical grid was greater. NRC reviewed this request and determined that the circumstances did not warrant an exigent staff review and abbreviated public comment period. After further consultation with the NRC staff, TVA modified the TS-461 request to eliminate rather than postpone the load reject transient test. This revised application was submitted to NRC on July 3, 2007, as TS-461S1 (ML071870024). On July 16, 2007, TVA received an RAI on TS-461S1, which is answered in Enclosure 1. On July 25, 2007, an additional e-mail RAI request was received, which is also answered in Enclosure 1.

TVA has determined that this RAI response does not change the determination in the July 3, 2007, TS-461S1 submittal that there are no significant hazards considerations associated with the proposed change and that the change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter to the Alabama State Department of Public Health.

TVA is currently limiting Unit 1 power operation to 95 percent of rated to ensure continued compliance with license condition 2.G(2), which requires the turbine generator load reject be performed prior to exceeding 30 days of plant operation above 3293 MWt.

There are no new regulatory commitments associated with this submittal. If you have any questions about this submittal, please contact me at (256) 729-3046.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 26, 2007.

Original signed by:

R. G. Jones, General Manager,
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Enclosures:
1. Response to Request for Additional Information (RAI)
2. BOC7 MSIV Simulation

cc: See page 4

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s:lic/submit/Techspec/TS-461S1 - RAI response

Enclosure 1

Browns Ferry Nuclear Plant (BFN) Unit 1

Technical Specifications (TS) Change TS-461S1 Modification of Restart Large Transient Testing License Condition 2.G(2)

Response to Request for Additional Information (RAI)

NRC RAI 1

Identify the acceptance criteria (both primary and secondary) applicable to the generator load reject and main steam isolation valve (MSIV) closure tests. Explain (using major system component setpoints and time requirements) how the June 23rd MSIV isolation test satisfied the acceptance criteria and how the June 9th transient provides confidence based on modeling that the acceptance criteria would be satisfied for a generator load rejection from 105-percent original licensed thermal power.

TVA Response to RAI 1

The test criteria for the generator load reject and the MSIV isolation test are contained in plant Technical Instruction (TI), 1-TI-528, "Unit 1 Power Uprate Large Transient Test." The criteria are repeated below. Level 1 criteria are test acceptance criteria and Level 2 criteria are operational performance criteria.

TI-528 Acceptance Criteria for Generator Load Reject Test

In view of the favorable plant response during the two referenced high power scrams and to a set of condensate and feedwater pump trip tests from rated power, TS-461S1 is requesting the deletion of the license condition requirement to perform this turbine generator load reject test. However, as discussed below, Unit 1 testing and plant operating experience can be used to show that the load reject test, if it were performed, would meet the test acceptance criteria.

- (Level 1) - Reactor pressure shall be maintained below 1230 psig during the transient following closure of all valves

Analysis

On June 9, 2007, Unit 1 was operating at approximately 80% rated power and a reactor operating pressure of 1020 psig when an unplanned turbine trip and scram occurred. The turbine trip resulted in a brief pressure rise of 79 psig to 1099 psig. TVA's June 25 and July 3, 2007, submittals provided graphs of the plant response. Turbine trips and load rejects are quite similar in reactor pressurization rate since both turbine stop and control valves close very rapidly. Load rejects are analytically slightly more severe than turbine trips from the same power level. This is because the control valves close from an intermediate position rather than from full open.

In TVA's June 25, 2007, TS-461 submittal, TVA presented the results of an ODYN turbine trip simulation analysis at 80% rated power for comparison against the actual June 9 turbine trip. A separate ODYN turbine trip simulation at 100% rated power was performed to estimate the difference between the 80% and 100% rated power turbine trips for peak reactor pressure. The 80% ODYN case predicted a vessel pressure change of about 86 psig, while the plant recorded a pressure change of approximately 79 psig. Since the 80% ODYN simulation was shown to be conservative with respect to the peak reactor pressure observed during the June 9 turbine trip, the 100% power ODYN simulation provides a conservative estimate of the peak reactor pressure that would be observed during a turbine trip at 100% power.

The 100% ODYN turbine trip simulation calculated a peak predicted reactor pressure of 1152 psig. The nominal setpoints for the three groups of Main Steam Relief Valves (MSRVs) are 1135 psig, 1145 psig, and 1155 psig as shown as shown in TS 3.4.3, S/RVs. The ODYN 100% analysis results in MSRVs opening very briefly (approximately 2 seconds) after which the turbine bypass valves react to control reactor pressure. Since the 100% ODYN turbine trip analysis predicts a brief pressure peak at 1152 psig, even if a load reject was somewhat more severe, there would remain ample margin to the test criteria value of 1230 psig.

- (Level 1) - The Turbine Stop and Control Valves close no faster than times assumed in the U1 Core Operating Limits Report:

  - Turbine Control Valves - 150 milliseconds from full open
  - Turbine Stop Valves - 100 milliseconds

Analysis

The turbine control valve speed was measured by the process computer during the June 9, 2007, turbine trip from 80% power. At 80% rated power, the turbine control valves were approximately 33% full open and were measured to close in approximately 100 milliseconds. Since the closure rate of the turbine control valves is essentially linear, a simple extrapolation of the closure time from 33% open to a full open control valve position yields an approximate 300 millisecond stroke time. This satisfies the control valve timing acceptance criteria of 150 milliseconds by a factor of two. The turbine stop valve speeds were measured during the June 23, 2007, MSIV full closure transient test. The measured speed was approximately 300 milliseconds, which satisfies the turbine stop valve timing acceptance criteria of 100 milliseconds by a large margin.

- (Level 2) The pressure regulator must regain control before a low pressure reactor isolation

Analysis

During transients, it is desirable for the reactor pressure control system to maintain pressure above the main steam line low pressure setpoint to avoid MSIV isolations. The TS value for this main steam line low pressure isolation setpoint is 825 psig as shown in TS Table 3.3.6.1, Primary Containment Isolation Instrumentation, Function 1.b.

The TS-461 and TS-461S1 submittals provided a plot of key plant parameters measured during the June 9, 2007, turbine trip from 80% rated power. The plot shows a brief pressure peak and then a smooth return of reactor pressure to a steady turbine set pressure of about 960 psig, which is well above the main steam line low pressure isolation setpoint. A similar behavior would be expected during a full power load reject.

- (Level 2) The reactor scram must meet the Reactor Protection System (RPS) specification

Analysis

The post-trip evaluation of the June 9, 2007, turbine trip scram and the June 23, 2007, MSIV full closure scram, demonstrated that the RPS is responding as expected. All control rods fully inserted during both scrams and the scram signal was generated by the proper initiator.

During a load reject, the scram would be generated by the control valve fast closure low oil pressure switches (Function 9) in TS Table 3.3.1.1, Reactor Protection System Instrumentation. These switches are routinely tested in accordance with TS surveillance requirements and were also observed to trip during the June 9, 2007, turbine trip.

TI-528 Acceptance Criteria for MSIV Isolation Test

- (Level 1) MSIV stroke time will be between 3 and 5 seconds, exclusive of electrical delay time

Test Results

The measured MSIV stroke times for the eight MSIVs were between 3.46 seconds and 4.66 seconds. Therefore, the test criterion was satisfied.

- (Level 1) Reactor steam some pressure shall be maintained below 1230 psig during the transient following closure of all valves

Test Results

Peak reactor steam dome pressure during the MSIV isolation test was approximately 1072 psig. Therefore, the test criterion was satisfied.

NRC RAI 2

For the MSIV Closure test at 3456 Megawatt thermal (MWt) [99.9 percent rated current licensed thermal power (CLTP)], provide the following information:

a) Provide the high pressure coolant inject/reactor core isolation cooling injection water temperature;

b) Provide an estimate of the fraction of decay heat from the steady state value at the time of the test, and how that differs from the assumptions in the analysis of record.

TVA Response to RAI 2.a

The high pressure coolant injection (HPCI)/reactor core isolation cooling (RCIC) injection water temperature was approximately 97°F.

TVA Response to RAI 2.b

At the time of the MSIV transient test on June 23, Unit 1 had operated for approximately 11 days at rated power disregarding

short downpowers for other activities. In the Updated Final Safety Analysis Report (UFSAR) analysis of record, the conservative analysis assumption is that the core decay heat is at a long term operation equilibrium state.

For 11 days of operation, the core decay heat would be slightly lower than that assumed in the UFSAR calculation. The delta in decay heat between the June 23 MSIV test event and the UFSAR analysis of record, however, is comparatively a minor factor and is greatly outweighed by differences in the operating state of the reactor prior to the transient. In the response to RAI 4, an ODYN simulation of the June 23 MSIV test is compared to the UFSAR analysis. The simulation uses a core decay heat that is more representative of the core power history at the time of the test.

NRC RAI 3

Section 14.5.2.7.1 of the Updated Final Safety Analysis Report (UFSAR) provides the analysis of a MSIV closure test at 3458 MWt (100 percent CLTP) analysis. From that analysis, provide the peak pressure calculated by ODYN and how much higher it was from the peak pressure during the test.

TVA Response to RAI 3

Section 14.5.2.7.1 of the UFSAR presents an ODYN analysis of an MSIV full closure transient - direct position switch scram (MSIVD) at 102% of 3458 MWt. The peak calculated pressure is 1234 psia at vessel bottom as stated in the UFSAR. This is equivalent to a dome pressure of about 1190 psig. The peak pressure measured during the June 23, 2007, MSIV transient test was approximately 1072 psig. Therefore, the difference between the June 23, 2007, MSIV transient test and the UFSAR MSIVD transient case is about 120 psig.

NRC RAI 4

Additionally, Section 14.5.2.7 of the UFSAR indicated that the main steam relief valves (MSRVs) should lift momentarily during a MSIV closure. Address why the MSRVs did not lift, given that all 12 were predicted to be opened. Address the affect different initial conditions and operator action had on the observed results when compared to the expected.

TVA Response to RAI 4

As discussed above in RAI 3, the UFSAR MSIVD analysis results in a predicted peak dome pressure of about 1190 psig. The nominal setpoints of the three groups of MSRVs are 1135, 1145, and 1155

psig as shown in TS 3.4.3, S/RVs. So the UFSAR MSIVD analysis predicts the MSRVs would briefly open.

As discussed in UFSAR Section 14.5.2.7.1.2, the reactor statepoint for the MSIVD transient is at End-of-Cycle (EOC) exposure conditions at 102% of 3458 MWt. At the EOC statepoint, all control rods are withdrawn and a top peaked core power exists. With the top peak power shape and all rods out, the effectiveness of the scram reactivity insertion to reduce reactor power rapidly is greatly reduced. Additionally, the UFSAR analysis uses other conservative ODYN assumptions such as a 3 second MSIV closure time, which is faster than actual measured plant MSIV speeds.

The June 23, 2007, MSIV transient test was conducted very early in Cycle 7, so the reactor was at a near Beginning-of-Cycle (BOC) statepoint, where the core power shape is bottom peaked and some control rods were partially inserted. This enhances the ability of the scram to quickly reduce core power.

To analytically demonstrate the effects of the differences of the BOC and EOC statepoints on the transient response, General Electric performed an ODYN MSIVD transient simulation using similar initial conditions as those that existed on BFN Unit 1 when the June 23, 2007, transient test was performed. The plant initial parameters used in the ODYN simulation are shown in Table 1.

Table 1 Key Parameter Initial Conditions for ODYN MSIV Closure Simulation

Parameter	**ODYN Simulation**
Reactor Power (MWt)	3456
Reactor Power (% of Rated)	99.9
Core Flow (Mlbm/hr)	88.3
Core Flow (% of Rated)	86.1
Dome Pressure (psig)	1032
Feedwater Temperature (°F)	348.9

In addition, where practical, the ODYN code inputs were modified to better emulate the actual plant condition for a near-BOC statepoint. Table 2 provides a list of these ODYN inputs that were modified to better mimic the plant conditions. A bottom peaked power shape representative of a near-BOC condition was used.

Table 2 Key Inputs for ODYN Simulation

Parameter	Used In Analysis
Core Loading	As-Loaded
Core Exposure	500 MWD/ST
Assumed Rod Pattern	Same as plant
MSIV Closure Time	Measured Average (during test)[1] of 3.6 sec
Assumed SRV Setpoints	Nominal Setpoint
Assumed Scram Speed	Option B Scram Times[2]
Assumed Decay Heat	Best Estimate (Nominal)[3]
Initial Water Level (inches NR)	36.5

Notes:
1. Average performance for the four steam line isolation valves
2. Option B times are slightly slower than the average scram times, but faster than the TS.
3. A one term exponential decay model is used in the analysis, which captures a nominal decay heat for the short duration of the transient. Variation in decay heat models is not important for this short term simulation.

A figure showing the ODYN simulation results is provided in Enclosure 2. With these input changes, the ODYN MSIVD simulation predicts a pressure rise of about 90 psig to approximately 1120 psig, which is lower than the lowest set MSRV grouping of 1135 psig. During the actual MSIV test on June 23, 2007, the peak measured reactor pressure was approximately 1072 psig, which is an increase of about 40 psig. Since ODYN is a conservative licensing basis code, it will overpredict the pressure increase even with inputs modified to better mimic the plant. In addition, field settings in the plant, such as the MSIV position switch trips, are conservatively set to provide margin to TS values and to compensate for instrument uncertainties. This practice also results in the actual plant performance being milder than predicted by the ODYN simulation for the same initial conditions. Consequently, the plant performance during the June 23, 2007, transient test is reasonably bounded by the ODYN simulation and as expected, is milder than would be predicted by the ODYN simulation.

As shown in the UFSAR transient, the ODYN simulation, and the actual plant response graph provided in the July 3, 2007, submittal, the transient pressure peak occurs a few seconds into the event. There were no operator activities that affected this initial peak during the MSIV test.

HPCI and RCIC auto-initiated on low low water level at approximately 14 seconds into the test. As shown in the plant response plot in Enclosure 4 of the July 3 submittal, this is also the point at which the minimum vessel level of -46 inches from

reference zero was recorded. The ODYN simulation minimum level was -25 inches. HPCI and RCIC came to speed, recovered vessel level, and operated until tripping on reactor high water level at 160 seconds. At about 100 seconds, operators reduced reactor pressure by occasionally operating MSRVs in accordance with plant operating instructions. At 19 minutes, a steam line was reopened, which reestablished the condenser as the heat sink.

NRC July 25, 2007 e-mail RAI

For completeness, a discussion should be included addressing why the HPCI pump seal failure occurred during the MSIV closure test and explain why this is considered to be an isolated case that is not expected to occur during MSIV closure and load rejection transients and what (if any) impact this failure had on the peak reactor vessel dome pressure that was achieved.

TVA Response

As discussed in TVA's July 3, 2007, submittal, a failure of the upper gasket on the HPCI gland seal condenser was observed during the HPCI run. The gland seal condenser collects steam leakage from the HPCI turbine gland seals, and the HPCI turbine control and stop valve stems. It is in service whenever HPCI operates. The purpose of this condenser is to prevent the leakage of radioactive steam from the collection points into the reactor building atmosphere. The gland seal condenser has no affect on reactor pressure during a transient.

The upper and lower gaskets on gland seal condenser are held in place by a retaining band. The retaining band on the upper gasket had apparently shifted in place, which resulted in the gasket failing when HPCI started. A Problem Evaluation Report was initiated to document the problem. New gaskets and bands were installed, and the bands were verified to be snug tight. The condenser system was pressurized to 70 psig and no leakage was observed after 10 minutes. We expect no further problems.

Enclosure 2

Browns Ferry Nuclear Plant (BFN) Unit 1

Technical Specifications (TS) Change TS-461S1 Modification of Restart Large Transient Testing License Condition 2.G(2)

BOC7 MSIV Simulation