December 8, 2006

Mr. Karl E. Singer
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 1 - REVIEW OF LICENSEE RESPONSE TO NRC GENERIC LETTER 87-02, SUPPLEMENT 1 THAT TRANSMITS SUPPLEMENTAL SAFETY EVALUATION REPORT NO. 2 ON SQUG GENERIC IMPLEMENTATION PROCEDURE, REVISION 2, AS CORRECTED ON FEBRUARY 14, 1992

Dear Mr. Singer:

By letter dated October 7, 2004 (Agencywide Documents Access and Management System [ADAMS] Accession Number ML042890078), as supplemented August 29, 2006 (ADAMS Accession Number ML062420099), Tennessee Valley Authority (TVA) provided an updated response to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment In Operating Reactors (USI [Unresolved Safety Issue] A-46)." Supplement 1 to GL 87-02 transmits Supplemental Safety Evaluation Report No. 2 on SQUG [Seismic Qualification Utility Group] Generic Implementation Procedure, Revision 2, as corrected February 14, 1992 (GIP-2) for Browns Ferry Nuclear Plant (BFN), Unit 1.

The staff has reviewed TVA's response to GL 87-02, Supplement 1 for BFN Unit 1. As discussed in our enclosed safety evaluation, the NRC staff has determined that the A-46 implementation program has, in general, met the purpose and intent of the criteria and procedures provided in GIP-2 and the staff's Supplemental Safety Evaluation Report No. 2 for BFN Unit 1. Completion of the remaining implementing activities are subject to NRC inspection.

If you have any questions, please contact me at (301) 415-4041.

Sincerely,

/RA/

Margaret H. Chernoff, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-259

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO USI A-46 PROGRAM IMPLEMENTATION

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-259

1.0 BACKGROUND

On February 19, 1987, the U.S. Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46." The GL encouraged licensees to participate in a generic program to resolve the seismic verification issues associated with USI A-46. As a result, the Seismic Qualification Utility Group (SQUG) developed the "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 2 (GIP-2) (Reference 1).

On May 22, 1992, the NRC issued Supplement 1 to GL 87-02 including the staff's Supplemental Safety Evaluation Report No. 2 (SSER No. 2) (Reference 2). SSER No. 2 approved, with certain conditions and exceptions, use of GIP-2 as an acceptable methodology for the resolution of NRC USI A-46.

By letters dated October 7, 2004, the Tennessee Valley Authority (TVA), the licensee for Browns Ferry Nuclear Plant (BFN) Unit 1, responded to Supplement 1 of GL 87-02 by submitting the results of BFN Unit 1 USI A-46 seismic verification activities (Reference 3).

The staff has completed its review of TVA's seismic implementation program for BFN Unit 1. This safety evaluation provides the staff evaluation of TVA's USI A-46 implementation program at BFN Unit 1.

2.0 DISCUSSION AND EVALUATION

In its October 7, 2004, letter, TVA provided four enclosures:

- Enclosure 1 provides an introduction, background, and summary of the USI A-46 evaluation performed for BFN Unit 1, and identifies remaining activities.

- Enclosures 2 and 3 provide a description of the BFN Unit 1 seismic evaluation and relay evaluation performed, the results of those evaluations, and the planned resolution of outliers identified. The licensee stated that TVA will resolve all identified outliers prior to the restart of BFN Unit 1.

- Enclosure 4 contains two new regulatory commitments associated with TVA's USI A-46 implementation program for BFN Unit 1:

  (1) BFN Unit 1 USI A-46 outliers will be resolved prior to restart of BFN Unit 1.

  (2) TVA will complete the Operations review of the BFN Unit 1 USI A-46 verification following approval of BFN Unit 1 procedures, and notify the NRC of the results of that review prior to restart of BFN Unit 1.

In Enclosure 1, the licensee stated that TVA's approach taken for the resolution of USI A-46 for BFN Unit 1 is consistent with the approach taken for resolution of this issue with BFN Units 2 and 3. This enclosure provides a brief background of prior communications between TVA and the NRC concerning resolution of USI A-46 for BFN, and identifies the activities remaining.

By letter dated March 21, 2000 (Reference 4), the NRC issued its final safety evaluation, closed USI A-46 for BFN Units 2 and 3, and indicated that it would re-visit the issue for BFN Unit 1 should TVA decide to restart that unit.

In its October 7, 2004, letter, TVA stated that BFN Unit 1 seismic verification was performed in accordance with the SQUG Generic Implementation Procedure for Seismic Verification of Nuclear Power Plant Equipment, Revision 2A (GIP-2A) (Reference 5). TVA also stated that GIP-2A consists of GIP-2 revised to incorporate the NRC staff's clarifications, interpretations, exceptions, and positions identified in SSER No. 2.

The use of GIP-2A alone for the implementation of the resolution of USI A-46 program at BFN Unit 1 is not acceptable to the staff because, as indicated in the NRC letter to SQUG, dated May 24, 1993 (Reference 6), GIP-2A appeared to represent a SQUG effort to combine GIP-2 with rewritten excerpts from SSER No. 2 on GIP-2. The staff did not review and approve GIP-2A for the implementation of the resolution of USI A-46 at the effected facilities. The staff considers the SSER No. 2 to be its position for supplementing the SQUG GIP-2. The staff believes that these two documents (SSER No. 2 and GIP-2) are sufficient to implement the resolution of USI A-46 at the effected facilities, and these are the documents against which the staff will judge the acceptability of the implemented program. Therefore, if TVA's implementation of USI A-46 program at BFN Unit 1 does not deviate from the criteria and procedures delineated in SSER No. 2 and GIP-2, the results will be acceptable.

The staff's approval of the implementation of the resolution of USI A-46 for BFN Unit 1 does not imply the approval of the SQUG GIP-2A.

2.1 Safe-Shutdown Path

GL 87-02 specifies that licensees should be able to bring the plant to, and maintain it in a hot shutdown condition during the first 72 hours following a safe shutdown earthquake (SSE). To meet this provision, in its submittal of October 7, 2004, the licensee addressed the following plant safety functions: reactor reactivity control, pressure control, inventory control, and decay heat removal. Primary and alternate safe shutdown success paths, including their support systems and instrumentation, were identified for each of these safety functions to ensure that the plant is capable of being brought to, and maintained in a hot shutdown condition for 72 hours following an SSE. Appendix C to Enclosure 2 of Reference 3 provides the seismic review Safe Shutdown Equipment List (SSEL).

The reactor decay heat removal function is accomplished by relieving steam from the reactor through the main steam safety/relief valves (SRVs) to the suppression pool. The SRVs could be allowed to operate automatically at their respective setpoints or be manually operated by the control room operator to lower reactor pressure so that the low pressure coolant injection (LPCI) mode of residual heat removal (RHR) could be initiated for reactor coolant inventory control. In this mode, the LPCI takes suction from the suppression pool. Decay heat removal would be achieved by placing the RHR system in the suppression pool cooling (SPC) mode of operation. During the SPC mode of RHR, the RHR pump takes suction from and discharges to the suppression pool via the RHR heat exchangers. The service water system would provide the capability to transfer the decay heat from the RHR system to the ultimate heat sink.

In its letter dated October 7, 2004, TVA stated that it will complete the operations review of the BFN Unit 1 USI A-46 verification of SSEL following approval of BFN Unit 1 operations procedures, and notify the NRC of the results of that review prior to BFN Unit 1 restart. In a Request for Additional Information, dated July 27, 2006, TVA was requested to provide the status and the schedule for completion of the verification of the SSEL. In its response, dated August 29, 2006, the licensee said that, as stated in Enclosure 2 of TVA's response to NRC GL 87-02 Supplement 1:

> The BFN-1 Operations Department review of the SSEL against plant operating procedures will be completed after:
> - Major plant modifications are complete
> - Operating procedures for BFN Unit 1 are completed.

The licensee further stated that, based on review of the items on the punch list, the latest systems requiring maintenance and modification work that appear on this list are the Main steam and Feedwater systems. The work on these systems is currently on schedule to be completed prior to their System Preoperability Checklist (SPOC) Phase 2 dates, both scheduled for early January 2007. This SPOC process is a comprehensive system by system review to determine if the physical work and testing have been completed and to verify that the system is capable of being operable by reviewing the affected Problem Evaluation Reports, Design Changes Notices, and Work Orders, as well as performing a system walkdown. Based on the scheduled dates for completing the major modifications and the affected operating procedures, TVA plans to complete

its USI A-46 SSEL consistency review for BFN Unit 1 during the last month before restart.

The staff concludes that the approach to achieve and maintain safe shutdown for 72 hours following a seismic event meets the criteria of GIP-2 and is, therefore, acceptable. The results of the licensee's consistency review will be confirmed by the NRC Region II staff before the BFN Unit 1 restart.

2.2 Safe Shutdown Earthquake and In-structure Response Spectra

The BFN licensing-basis design basis earthquake (DBE) ground motion acceleration response spectrum is defined in Sections 2.5.4 and 12.2 of the BFN Final Safety Analysis Report. The horizontal peak ground acceleration (PGA) corresponding to the DBE is 0.20g, defined at the top of sound rock. Vertical ground motion is two-thirds of the horizontal motion. The site DBE design ground motion is that of a Housner-shaped spectrum anchored to 0.20g PGA.

The licensee stated that BFN Unit 1 SSEL equipment is located in the Reactor and Turbine Buildings. Effective grade elevations for these structures were determined by the licensee in accordance with Part II, Section 4.2 of the SQUG GIP-2, and they are: 561 feet for the Reactor Building and 565 feet for the Turbine Building. The licensee stated that the 5 percent damped BFN DBE ground motion response spectrum is fully enveloped by the SQUG Bounding Spectrum.

The licensee also stated that the 5-percent damped BFN Unit 1 Reactor Building DBE horizontal in-structure response spectra (IRS) are compared with the SQUG Reference Spectrum, and the results indicated that (1) at elevations 519 feet and 565 feet, the IRS are fully enveloped by the Reference Spectrum, and (2) at elevations 593 feet, 621.25 feet, and 639 feet, the IRS are partially enveloped by the Reference Spectrum.

The staff finds that the seismic demands used in the implementation of the USI A-46 program at BFN Unit 1 meet the GIP-2 criteria and are acceptable.

2.3 Seismic Evaluation Personnel

In Appendix A to the Seismic Evaluation Report (Enclosure 2 of Reference 3), the licensee included the resumes of selected seismic capability engineers (SCEs) who participated in the implementation of the USI A-46 resolution program at BFN Unit 1. All SCEs have taken the SQUG Walkdown Screening & Seismic Evaluation Training Course, and all the relay reviewers have taken the SQUG Relay Seismic Functionality Evaluation Training Course, in accordance with the GIP-2 procedures. The third-party audits were performed at various stages of the USI A-46 program implementation at BFN Unit 1 in accordance with Part I, Section 2.2.7 of GIP-2. The resume of the independent third-party reviewer is provided in Appendix G to the Seismic Evaluation Report.

The staff finds that TVA's seismic evaluation personnel qualifications meet the provisions of GIP-2 and the staff's SSER No. 2, and are, therefore, acceptable.

2.4 Seismic Adequacy of Mechanical and Electrical Equipment and Exceptions to the GIP

Capacity Versus Demand

The licensee stated that there were 81 instances where the seismic demand in-structure response spectrum for the floor elevation for SSEL items was not fully enveloped by the capacity spectrum that was used to define the seismic capacity of the item of equipment. The staff did not review the details of each case. However, the licensee stated that, in each of these 81 cases, the evaluation utilizing the estimated lowest natural frequency of the equipment component was performed to verify that the seismic capacity of the item exceeds its seismic demand. The staff finds that the approach used by the licensee meets the GIP-2 criteria and is acceptable.

Caveats, Anchorage, Interaction, and Tanks and Heat Exchangers

The licensee stated that, in all cases where the item of equipment was determined to be acceptable, the specific wording of the applicable caveat rule, anchorage rule, seismic interaction rule, and tank and/or heat exchanger rule as delineated in SQUG GIP-2 was met. The staff finds that the approach used by the licensee is acceptable. The details of the licensee's evaluation are subject to NRC staff inspection.

Cable and Conduit Raceways

The results of the cable tray and conduit raceway review is described in Appendix E of the Seismic Evaluation Report (Enclosure 2 of Reference 3). The licensee stated that the scope of the review covers all the electrical raceway systems at BFN Unit 1 not previously covered in the BFN Units 2 and 3 USI A-46 program. All common areas between Units 1, 2 and 3, as well as some areas in Unit 1, were evaluated in the BFN Units 2 and 3 USI A-46 program.

The licensee also stated that the BFN Unit 1 USI A-46 evaluations were performed per the requirements of the GIP-2. All analytical evaluations performed to resolve the outliers and the limited analytical reviews were performed using a 100-percent fill for the cable trays and conduits. Therefore, addition of cables to existing systems is acceptable as long as the raceways are not overfilled beyond their physical capacity. The licensee further stated that the results of the review showed that there are no indications of any generic seismic concerns with the cable tray and conduit systems at BFN Unit 1.

However, the licensee pointed out that, in the BFN Unit 1 Reactor Building, a unique anchorage device termed as "loop insert" is used as a typical anchorage for overhead cable tray supports. The loop insert is a cast-in-place device, with reinforcing steel passing through the embedded loop. The licensee stated that engineering evaluations of manufacturers data determined that the pullout resistance and shear capacity of the loop insert is significantly larger than that of a comparable size expansion anchor. Therefore, the licensee concluded that the BFN Unit 1 USI A-46 cable and conduit raceway reviews using the expansion anchor capacities from the SQUG GIP-2 to verify seismic adequacy was conservative.

Based on its review, the staff finds that the approach used by the licensee for the evaluation of the BFN Unit 1 USI A-46 cable trays and conduit raceways is acceptable.

Relay Functionality Review

Enclosure 3 of the licensee's October 7, 2004, submittal provides TVA's USI A-46/seismic portion of Individual Plant Examination for External Events (IPEEE) relay evaluation for BFN Unit 1. Review of the IPEEE for BFN Unit 1 is in progress. The results will be documented in a separate safety evaluation. The licensee stated that the BFN Unit 1 relay evaluation for USI A-46 and the seismic portion of IPEEE was performed in accordance with the appropriate industry guidance documents developed by the SQUG and the Electric Power Research Institute, and approved by the NRC. The relay evaluation for BFN Unit 1 also utilized results of the similar relay evaluations for BFN Units 2 and 3 .

The licensee summarized its findings for the relay evaluation for BFN Unit 1 as follows:

(1) Inherent ruggedness of contact devices, chatter acceptability, and seismic adequacy were sufficient to satisfactorily resolve the seismic acceptability of contact devices affecting the USI A-46 SSEL components.

(2) No outliers were identified in the evaluation.

(3) No low ruggedness (bad actor) relays were found to be essential relays.

(4) No operator actions were identified in the evaluation as necessary to correct relay-chatter-caused malfunctions, with the exception of some operator actions for equipment common to Units 1, 2, and 3, which were found to be acceptable by the Units 2 & 3 SE.

(5) Essential relays and the cabinets housing those essential relays were identified for the seismic capability engineers performing the seismic verification walkdowns and evaluations.

The licensee concluded that, in all cases where the relay was determined to be acceptable, the specific wording of the applicable SQUG GIP-2 relay review rule was met.

Based on its review, the staff found that the approach used by the licensee for the evaluation of the BFN Unit 1 USI A-46 relay functionality review meets the GIP-2 guidelines, and is acceptable.

2.5 Outlier Identification and Resolutions

In Section 5 of the Seismic Evaluation Report (Enclosure 2 of Reference 3), the licensee stated that a total of 84 individual items of mechanical and electrical equipment on the SSEL were identified as outliers, and the types of outliers are, in general, the major concerns related to the seismic interactions, anchorage, caveats, and the equipment capacity versus demand, etc. In the tank and heat exchanger area, four RHR heat exchangers and two control rod drive Scram Instrument Volume tanks were identified as outliers because their vertical configuration falls outside of the acceptability of the SQUG GIP-2 screening criteria. In the cable tray and conduit raceway area, the licensee identified 14 outliers. The details are described in Appendix E to the Seismic Evaluation Report. The licensee identified no outliers in the relay functionality reviews.

The licensee's methods of accomplishing resolution for the outliers described above are, in general, the use of (1) plant modification implemented through the Design Change Notice process, (2) procedure revision to eliminate seismic interaction concerns, (3) further evaluation, or (4) maintenance activity through the Work Order process.

Enclosure 2 to TVA submittal dated October 7, 2004, provides the BFN Unit 1 USI A-46 Seismic Evaluation Report. Chapter 5 of that report indicated that a total of 84 individual items of mechanical and electrical equipment on the SSEL were identified as outliers. The report indicated that designs had been completed to resolve the outliers where the resolution method was plant modification. The licensee stated that follow-up verification of each outlier that is resolved by work order or design change will be performed during plant area turnover walkdowns as described in Appendix H of the report. Appendix H contains a punch list of 139 SSEL equipment items requiring verification of the final configuration for outlier resolution prior to plant restart. By the NRC request for additional information, dated July 27, 2006, TVA was requested to provide the status and specific schedule for completion of the implementation of outlier resolution as delineated in Table 5-1 and Appendix H of the USI A-46 Seismic Evaluation Report.

In its response, dated August 29, 2006, to the NRC request for additional information, the licensee stated that, following the SPOC Phase 2 system-by-system review process to verify that a system is capable of being operable, TVA performs Area Turnover walkdowns. As part of these Area Turnover walkdowns, TVA will perform the verification of the 139 items, made up of unresolved "outliers" delineated in Table 5-1 and items that could not previously be walked down to verify each item's final configuration. The licensee further stated that the current schedule has all of the Area Turnovers completed in early February 2007.

The staff's review of the licensee's action regarding outliers resolution indicates that identified outliers have been or will be resolved by analysis or corrective actions. The staff finds the licensee's actions reasonable since they meet the provisions of GIP-2. The NRC staff notes that TVA has a process in place to verify the final configuration of the "outliers" delineated in the Table 5-1 and TVA has stated that this will be completed prior to restart of BFN Unit 1.

3.0 SUMMARY OF MAJOR FINDINGS

The staff's review of the licensee's USI A-46 implementation program, as provided for each area discussed above, did not identify any significant or programmatic deviation from GIP-2 and staff's SSER No. 2 regarding the walkdown and the seismic adequacy evaluation at BFN Unit 1.

4.0 CONCLUSION

TVA's USI A-46 program at BFN Unit 1 was established in response to Supplement 1 to GL 87-02 through a 10 CFR 50.54(f) letter. TVA conducted the USI A-46 implementation in accordance with GIP-2A (refer to Section 2.0 of this SER for clarification). TVA identified approximately 84 components as outliers and stated that designs have been completed to resolve the outliers where the resolution method will be plant modification. TVA further stated, in its response, dated August 29, 2006, to NRC's request for additional information, that verification of final configuration for outlier resolution will be completed in early February 2007. These remaining actions, when completed, will be subject to inspection by the NRC staff. TVA's summary report did not identify any instance where the operability of a particular system or component was questionable.

The staff concludes that TVA's USI A-46 implementation program at BFN Unit 1 has, in general, met the purpose and intent of the criteria in GIP-2 and the staff's SSER No. 2 on GIP-2 for the resolution of USI A-46. The staff has determined that TVA's corrective actions and physical modifications for resolution of outliers, when complete, will result in safety enhancements, in certain aspects, that are beyond the original licensing basis. As a result, TVA's actions provide sufficient basis to close the USI A-46 review at the BFN Unit 1 facility. The staff, also concludes that its findings regarding the licensee's implementation of USI A-46 at BFN Unit 1 do not warrant any further regulatory action under the provisions of 10 CFR 50.54(f). Licensee activities related to the USI A-46 implementation at BFN Unit 1 are subject to NRC inspection.

Regarding future use of GIP-2 in licensed activities, TVA may revise its licensing basis in accordance with the guidance in Section I.2.3 of the staff's SSER No. 2 on GIP-2 (Reference 2) and the staff's June 19, 1998, letter to SQUG's Chairman. Where plants have specific commitments in the licensing basis with respect to seismic qualification, these commitments should be carefully considered. The overall cumulative effect of the incorporation of the GIP-2 methodology coupled with the staff's SSER No. 2, considered as a whole, should be assessed in making a determination under 10 CFR 50.59. An overall conclusion that no unresolved safety question (USQ) is involved is acceptable so long as any changes in specific commitments in the licensing basis have been thoroughly evaluated in reaching the overall conclusion. If the overall cumulative assessment leads a licensee to conclude that a USQ is involved, incorporation of the GIP-2 methodology into the licensing basis would require the licensee to seek an amendment under the provisions of 10 CFR 50.90.

5.0 REFERENCES

1. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment," Revision 2, corrected February 14, 1992, Seismic Qualification Utility Group.

2. NRC "Supplement No. 1 to Generic Letter 87-02 that Transmits Supplemental Safety Evaluation Report No. 2 (SSER No. 2) on SQUG Generic Implementation Procedure, Revision 2, as corrected on February 14, 1992," dated May 22, 1992. ADAMS Accession No. ML031140292.

3. Letter, TVA to NRC, "Browns Ferry Nuclear Plant (BFN) Unit 1 - Response to NRC Generic Letter (GL) 87-02, Supplement 1 that Transmits Supplemental Safety Evaluation Report No. 2 (SSER No. 2) on SQUG Generic Implementation Procedure, Revision 2, as Corrected on February 14, 1992 (GIP-2)," dated October 7, 2004. ADAMS Accession No. ML042890078.

4. Letter, NRC (W. O. Long) to TVA (J. A. Scalice), "Browns Ferry, Units 1, 2 and 3, Re: Completion of Licensing Action for Generic Letter 87-02 (TAC NOS. M69430, M69431 and M69432)," dated March 21, 2000. ADAMS Accession No. ML003691720.

5. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Seismic Qualification Utility Group (SQUG), Revision 2A, dated March 1993.

6. Letter, NRC (Walter R. Butler) to SQUG (Neil P. Smith), "NRC Response to Seismic Qualification Utility Group (SQUG) Letter Dated March 26, 1993 (TAC M84091)," dated May 24, 1993.

7. Letter, NRC (Margaret Chernoff) to TVA (Karl W. Singer), "Browns Ferry Nuclear Plant, Unit 1 - Request for Additional Information for Response to Generic Letter 87-02, Supplement 1 (TAC No. MC4796)," dated July 27, 2006. ADAMS Accession No. ML062080577.

8. Letter, TVA (William D. Crouch) to NRC, "Browns Ferry Nuclear Plant (BFN) - Unit 1 - Request for Additional Information (RAI) for Response to Generic Letter (GL) 87-02, Supplement 1 (S1) (TAC No. MC4796)," dated August 29, 2006. ADAMS Accession No. ML062420099.

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