March 21, 2000

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

SUBJECT: BROWNS FERRY, UNITS 1, 2 AND 3 RE: COMPLETION OF LICENSING ACTION FOR GENERIC LETTER 87-02 (TAC NOS. M69430, M69431 AND M69432)

Dear Mr. Scalice;

Enclosed is the staff's safety evaluation of the Unresolved Safety Issue (USI) A-46 implementation program at Browns Ferry Nuclear Plant, Units 2 and 3. The USI A-46 program at BFN was established in response to Supplement 1 to Generic Letter 87-02 through a 10 CFR 50.54(f) letter. The staff has concluded that the Browns Ferry USI A-46 implementation program meets the purpose and intent of the criteria in the Generic Implementation Procedure, Revision 2 (GIP-2), and the staff's Supplemental Safety Evaluation Report No. 2 on GIP-2 for the resolution of USI A-46. The corrective actions and completed physical modifications for resolution of outliers will result in safety enhancements that, in certain aspects, are beyond the original licensing basis and, as a result, provide sufficient basis to close the USI A-46 review for the Browns Ferry Units 1 and 2 facilities. The staff has also concluded that its findings regarding the USI A-46 program do not warrant any further regulatory action under the provisions of 10 CFR 50.54(f). Activities related to the USI A-46 implementation are subject to NRC inspection.

This completes our efforts under the subject TACs. For Unit 1, this issue will be revisited in the event of restart. If you have any questions regarding this matter, please contact me at 301-415-3026.

Sincerely,

/RA/

William O. Long, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260 and 50-296

Enclosure: As stated

cc w/encl: See next page

Mr. J. A. Scalice

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

SUBJECT: BROWNS FERRY, UNITS 1, 2 AND 3 RE: COMPLETION OF LICENSING ACTION FOR GENERIC LETTER 87-02 (TAC NOS. M69430, M69431 AND M69432)

Dear Mr. Scalice;

Enclosed is the staff's safety evaluation of the Unresolved Safety Issue (USI) A-46 implementation program at Browns Ferry Nuclear Plant, Units 2 and 3. The USI A-46 program at BFN was established in response to Supplement 1 to Generic Letter 87-02 through a 10 CFR 50.54(f) letter. The staff has concluded that the Browns Ferry USI A-46 implementation program meets the purpose and intent of the criteria in the Generic Implementation Procedure, Revision 2 (GIP-2), and the staff's Supplemental Safety Evaluation Report No. 2 on GIP-2 for the resolution of USI A-46. The corrective actions and completed physical modifications for resolution of outliers will result in safety enhancements that, in certain aspects, are beyond the original licensing basis and, as a result, provide sufficient basis to close the USI A-46 review for the Browns Ferry Units 1 and 2 facilities. The staff has also concluded that its findings regarding the USI A-46 program do not warrant any further regulatory action under the provisions of 10 CFR 50.54(f). Activities related to the USI A-46 implementation are subject to NRC inspection.

This completes our efforts under the subject TACs. For Unit 1, this issue will be revisited in the event of restart. If you have any questions regarding this matter, please contact me at 301-415-3026.

Sincerely,

/RA/
William O. Long, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260 and 50-296

Enclosure: As stated

cc w/encl: See next page

DISTRIBUTION:

File Center	PUBLIC	OGC	BJain	BClayton
PD II-2 R/F	ACRS	RCorreia	PFredrickson, RII	WLong
KManoly	PYChen	RRothman		

DOCUMENT NAME: C:\a6943clo.wpd

TO RECEIVE A COPY, WRITE A "C" IN THE BOX.

OFFICE	PDII-2:PM	PDII-2:LA	PDII-2\SC		
NAME	WLong	BClayton	RCorreia		
DATE	3/14/00	3/14/00	3/16/00		

OFFICIAL RECORD COPY

Mr. J. A. Scalice
Tennessee Valley Authority

BROWNS FERRY NUCLEAR PLANT

cc:
Mr. Karl W. Singer, Senior Vice President
Nuclear Operations
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Jack A. Bailey, Vice President
Engineering & Technical Services
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. John T. Herron, Site Vice President
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

General Counsel
Tennessee Valley Authority
ET 10H
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. N. C. Kazanas, General Manager
Nuclear Assurance
Tennessee Valley Authority
5M Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Robert G. Jones, Plant Manager
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Mr. Mark J. Burzynski, Managar
Nuclear Licensing
Tennessee Valley Authority
4X Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Timothy E. Abney, Manager
Licensing and Industry Affairs
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Browns Ferry Nuclear Plant
l0833 Shaw Road
Athens, AL 35611

State Health Officer
Alabama Dept. of Public Health
RSA Tower - Administration
Suite 1552
P.O. Box 303017
Montgomery, AL 36130-3017

Chairman
Limestone County Commission
310 West Washington Street
Athens, AL 35611

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO USI A-46 PROGRAM IMPLEMENTATION

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 2 AND 3

DOCKET NOS. 50-260 AND 50-296

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-2, Reference 2), pursuant to the provisions of Title 10, Code of Federal Regulations (10 CFR) 50.54(f), which required that all addressees provide either (1) a commitment to use both the SQUG commitments and the implementation guidance described in GIP-2 as supplemented by the staff's SSER-2, or (2) an alternative method for responding to GL 87-02. The supplement also required that those addressees committing to implement GIP-2 provide an implementation schedule, as well as detailed information including the procedures and criteria used to generate the in-structure response spectra (IRS) to be used for USI A-46.

By letters dated September 21, 1992, (Reference 3) and January 19, 1993, (Reference 4), the Tennessee Valley Authority (TVA), the licensee for Browns Ferry Nuclear Plant, Units 2 and 3 (BFN) responded to Supplement 1 of GL 87-02. Its responses included a commitment to implement GIP-2, including the clarifications, interpretations, and exceptions in SSER-2, and to communicate to the staff, any significant or programmatic deviations from the GIP-2 guidance. The staff's evaluation of TVA's responses was issued in letters dated November 19, 1992, (Reference 5) and March 19, 1993, (Reference 6).

TVA conducted the implementation of the USI A-46 program and submitted a summary report on June 28, 1996, (Reference 7). The staff reviewed the summary report and issued requests for additional information (RAI) on March 20, 1998, (Reference 8) and July 13, 1998 (Reference 9). TVA responded to the staff's RAIs on June 11, 1998, (Reference 10), September 25, 1998 (Reference 11) and October 8, 1999 (Reference 12). The staff has

completed its review of TVA's responses. This report provides the staff evaluation of TVA's USI A-46 implementation program at BFN, based on the staff's review of TVA's summary report (Reference 7), and documentation provided by TVA in response to the staff's RAIs.

2.0 DISCUSSION AND EVALUATION

The summary report (Reference 7) provides TVA's implementation results of the USI A-46 program at BFN . The report contains safe shutdown equipment identification, seismic screening verification and walkdown of mechanical and electrical equipment, seismic adequacy of tanks and heat exchangers, seismic adequacy of cable and conduit raceways, relay seismic functionality review, and outlier identification and resolutions.

2.1 Seismic Demand Determination (Ground Spectra and In-structure Response Spectra)

The design basis safe shutdown earthquake (SSE) ground response spectra (GRS) for BFN are Housner spectra with a peak ground acceleration of 0.2g. Initially TVA utilized the N-S component of the El Centro recording of the 1940 Imperial Valley earthquake normalized to a peak ground acceleration of 0.2g as input motion for development of the in-structure response spectra (IRS) of the Category I structures. TVA also utilized an artificial time history with a peak ground acceleration of 0.2g as an alternative input motion for development of the IRS for the subsystems (i.e., structural elements, piping, and components) housed in Category I structures. This approach was accepted by the NRC as described in the safety evaluation report NUREG-1232, Volume 3, Supplements 1 and 2 (Reference 13). TVA showed that the GRS obtained from both time histories envelope the licensing basis GRS.

For structures founded on rock, TVA applied the input motion at the base of the structures for the development of the IRS for equipment. For structures founded on soil, TVA used soil amplification factors to account for the effects of soil-structure interaction. The methods for calculating the horizontal and vertical soil amplification factors and development of the IRS were reviewed and accepted by NRC as described in Reference 13. The staff has determine that the seismic demands used in the implementation of the USI A-46 program at BFN meet the GIP-2 criteria and are acceptable.

2.2 Seismic Evaluation Personnel

In Reference 7, the licensee stated that the USI A-46 resolution program at BFN was accomplished using multi-discipline teams, which compromised both TVA and EQE International engineers. TVA provided overall project management of the USI A-46 effort, as well as engineering support in the structural, mechanical, electrical, and instrumentation & controls disciplines. Operations, licensing, and quality assurance representatives were also involved in the program.

The licensee indicated that the seismic capability engineers (SCEs) consisted of highly-qualified staff from both TVA and EQE organizations. The engineers who participated in the screening evaluation walkdown are listed in Section 2 of Reference 7, together with their background and experience. Resumes of selected SCEs are contained in Appendix A of Reference 7. The third-party audits were performed at various stages of the USI A-46 program implementation at BFN in accordance with Part I, Section 2.2.7 of GIP-2. Two members of EQE International performed an initial peer review on August 23-26, 1994, to address specific procedural and

programmatic issues relevant to BFN USI A-46 resolution, as well as to conduct a third-party audit for the Unit 3 raceway evaluation performed by TVA. Subsequently, during the period March 22-24, 1995, a member of VECTRA Technologies, performed a peer review of the Unit 2 safe shutdown equipment list (SSEL). A final third-party audit was performed using a joint team consisting of a licensee representative and a member of EQE International during the period January 9-11, 1996, to review the overall USI A-46 program resolution at BFN. None of the above individuals was part of the BFN seismic review teams (SRT) at the time the reviews were performed. Their resumes are presented in Appendix A of Reference 7.

The staff finds that TVA's seismic evaluation personnel qualifications meet the provisions of GIP-2 and the staff's SSER-2, and are, therefore, acceptable.

2.3 Safe-Shutdown Path

GL 87-02 specifies that licensees should be able to bring the plant to, and maintain in a hot shutdown condition during the first 72 hours following an SSE. To meet this provision, in its submittal of June 28, 1996 (Reference 7), the licensee addressed the following plant safety functions: reactor reactivity control, pressure control, inventory control, and decay heat removal. A primary and an 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 in Reference 7 provides the SSEL.

The reactor decay heat removal function is accomplished by relieving steam from the reactor via the lifting of the main steam safety/relief valves (SRVs) at their respective set points into the suppression pool. The SRVs could 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. The 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.

The plant operations personnel reviewed the equipment listed in Appendix C against the plant operating procedures and operator training and concluded that the plant operating procedures and operator training were adequate to establish and maintain the plant in a safe shutdown condition following an SSE.

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.

2.4 Seismic Screening Verification and Walkdown of Mechanical and Electrical Equipment

The licensee states, in Reference 7, that each seismic review SSEL equipment was evaluated by an SRT compromising a minimum of two SCEs, one of the SCEs was a registered Professional Engineer. In general, the walkdown evaluations were conducted either on an area-by-area basis within a given unit of the plant, or by equipment class basis. The walkdowns were coordinated with plant outages, BFN's radiation protection ALARA program, and

equipment operational status to minimize disruption to the plant, reduce SRT exposure, and maximize walkdown effectiveness. Craft assistance was also utilized to provide access to various equipment for internal inspection as well as to perform anchor bolt tightness checks.

The results of the evaluations were documented on the respective screening evaluation worksheets (SEWs) and are tabulated on the screening verification data sheets (SVDS), which are contained in Appendix D of Reference 7 along with the SVDS certification.

2.4.1 Equipment Seismic Capacity Compared to Seismic Demand

GIP-2 provides the methods for comparing equipment seismic capacity to seismic demand. Method A uses comparisons of the SSE GRS with the GIP-2 Bounding Spectrum or with the Generic Equipment Ruggedness Spectra (GERS). Method B uses comparisons of the conservative design or median-centered in-structure response spectra with 1.5 times the Bounding Spectrum or with the GERS for the equipment. The criteria and limitations for use of Method A are that: the equipment should be mounted within about 40-feet above the effective plant grade, the equipment's natural frequency should be greater than 8 Hz, and the amplification factor between free-field response spectra and the IRS at the equipment's location should not be more than about 1.5. Method B may be used for equipment at any elevation and for equipment with any natural frequency.

TVA states in the summary report (Reference 7) that the SSE GRS was used as a seismic demand and compared to the seismic capacities described in the GIP-2 by the bounding spectrum (BS) (Method A.1) for equipment with natural frequencies greater than about 8 Hz and located within about 40-feet above the effective grade. In reviewing References 7 and 11 the staff found that the ratios of the IRS to the GRS for equipment in the reactor building (RB), the intake pumping station (IPS) and diesel generator building (DGB) at elevations within about 40 feet above the effective grade, at frequencies greater than 8 Hz are larger than 1.5. The staff questioned the applicability of Method A.1 at these locations during a telephone conference call with TVA on August 4, 1999. NRC asked TVA to provide a building specific justification for the use of Method A.1 at the locations where the amplification factor significantly exceeds 1.5.

TVA responded with Reference 12 in which the building specific justification for the use of Method A.1 was provided. TVA states that Method A was used in the diesel generator building (DGB), the IPS and the reactor building (RB) for part of the USI A-46 program. The licensee states that the highest elevations at which Method A.1 was used are 583 feet in the DGB, 593 feet in the RB, and 565 feet in the IPS. The maximum amplification factors (IRS/GRS) at these elevations are 6.3 for the DGB, 5.0 for the RB, and 4.8 for the IPS. The licensee asserted that the amplifications that are more than about 1.5 are due to conservatisms associated with the analytical procedures used in the development of the IRS.

Reference 15 presents information developed by SQUG to demonstrate the factors of conservatism between median centered and design IRS in nuclear power plants. The structures discussed in Reference 16 are reinforced concrete shear wall structures. The licensee states that the BFN structures in question are fundamentally reinforced concrete shear wall structures for which the results of Reference 15 are applicable. The ratios of the conservative design spectra to median-centered spectra for the five structures presented in Reference 15 are 2.53, 5.3, 3.3, 2.3, and 5.4. The mean of the ratios is 3.77. The NRC staff

had previously used this mean value to estimate what the amplification factor would be in the R. E. Ginna Nuclear Power Plant structures if median-centered spectra were developed for locations in Ginna where Method A.1 was used.

TVA followed a procedure, similar to the procedure used for Ginna, to estimate building specific amplification factors for BFN. The licensee estimated building specific amplification factors, expressed as the ratio of median-centered IRS to the GRS for each the three BFN buildings applying the 3.77 mean factor of conservatism to the amplifications for the conservative design spectra . This approach resulted in the revision of the amplification factor estimates to the magnitudes: 1.67 for the DGB, 1.33 for the RB, and 1.27 for the IPS. The licensee postulated, that if there were median-centered IRS developed for the structures, the amplification factors for the IRS over the GRS, at frequencies above 8 Hz, would be about 1.5 for the elevations where GIP-2 Method A.1 was used. Based on the above, the staff considers the use of Method A.1 acceptable at those locations to verify the adequacy of SSEL components for USI A-46.

For equipment with natural frequency less than about 8 Hz and located within 40-feet above the effective grade or for equipment located 40-feet above the effective grade, TVA used GIP-2 Method B where1.5 times the BS was compared to the IRS. TVA stated that in some instances GERS were also used for the capacity of the equipment items. The staff concludes that the equipment seismic capacity to seismic demand comparison is acceptable for the USI A-46 program at BFN.

2.4.2 Assessment of Equipment “Caveats”

In order to apply the experience-based approach and to use the equipment seismic capacity defined in GIP-2, the plant-specific equipment must meet some restrictions or caveats described in GIP-2. GIP-2 also allows engineers to verify whether equipment items satisfy the caveats specified for a particular equipment class by judging whether these items meet the "intent of the caveats" although they do not necessarily meet the exact words of the caveats.

The licensee stated in Reference 7 that, during the screening walkdown of the SSEL equipment, there were instances where the letter of a caveat was not met. The licensee identified fifteen instances in which the intent of a caveat is met without meeting the specific wording of the caveat, and these instances are described in Appendix F of Reference 7. The staff finds TVA's approach for assessing the equipment caveats consistent with the criteria of GIP-2, and is, therefore, acceptable for the resolution of USI A-46 at BFN.

2.4.3 Equipment Anchorage

TVA stated in the summary report (Reference 7) that the seismic adequacy of equipment anchorages was verified in accordance with the GIP-2 guidelines. During the walkdowns, the SRT inspected the seismic adequacy of anchorage installation and its connection to the base of the equipment and determined the allowable capacity of the anchorage used to secure the equipment. The inspection consisted of visual checks, measurements review of plant documentation and drawings, and anchor bolt tightness and embedment checks for concrete expansion anchors.

The licensee stated in Reference 7 that the screening approach for verifying the seismic adequacy of equipment anchorage is based on a combination of field inspections, analytical

calculations, and engineering judgments. SCEs considered the various design attributes and equipment characteristics when evaluating the equipment anchorage. The SRT reviewed existing anchorage calculations and/or other plant documentation, when available, for applicability and seismic adequacy. In cases where the SRT could verify the as-installed anchorage configuration against available plant documentation, it noted the anchorage caveat as being seismically adequate. If no plant documentation was available, but the SRT was able to specifically identify and accept the as-built anchorage attributes, it used engineering judgment. In cases where the SRT was unable to clearly identify and evaluate all attributes of the anchorage to allow use of engineering judgment, it identified the component anchorage as requiring analytical calculations to verify its seismic adequacy. It performed worst-case bounding anchorage calculations to address the seismic adequacy of similar configurations.

Most of the anchorages the SRT observed during the screening walkdown were expansion anchors typically of Phillips Redhead self-drilling type, cast-in-place headed studs and J-bolts, and welded or bolted connections to embedded channels and plates. Based on a review of the applicable plant drawings, the SRT found that the embedded channels and plates are typically anchored to the concrete with Nelson-type welded studs.

The SRT determined the seismic demand imposed on the equipment, and identified outliers for the anchorages that did not have enough capacity compared to the demand. It determined that most components have adequate capacity based on a combination of field inspection, analytical calculation, and engineering judgment. It identified any components whose anchorage capacity could not be verified using these methods as outliers, and resolved them accordingly. Section 5.3 and Appendix G of the summary report (Reference 7) discuss the equipment anchorage outliers identified during the walkdowns and the resolution methods for the outliers at BFN. TVA resolved the outlier issues by tightening anchor bolts, confirming capacity of anchorages and performing detailed calculations. With respect to the calculations to resolve the outlier issues, TVA used Appendix C of GIP-2 for determining a capacity of the anchors.

TVA modified or replaced the anchorage outliers and completely resolved all of the anchorage outlier issues (References 4). This is adequate to verify the adequacy of the equipment anchorages for the BFN USI A-46 program as it meets the GIP-2 provisions.

2.4.4 Seismic Spatial Interaction Evaluation

The licensee stated in the summary report that, during the equipment walkdowns, it made evaluations of potential seismic interaction concerns, including (1) proximity effects, (2) structural failure and falling, (3) flexibility of attached lines and cables, and (4) any other possible interactions. The SRT evaluated credible and significant interaction hazards for all the SSEL equipment items and components, and documented them on the SEWS. The teams utilized training, judgment, and past earthquake experience to differentiate between likely and unlikely interactions. The SRT followed the guidelines presented in GIP-2 (Part II, Section 4.5 and Appendix D of GIP-2) during the screening walkdown and evaluation process. It identified and documented seismic interaction concerns as outliers and resolved them accordingly. Therefore, the staff finds TVA's seismic spatial interaction evaluation acceptable for the resolution of the USI A-46 program at BFN.

2.5 Tanks and Heat Exchangers

TVA stated in Reference 7 that it reviewed the tanks and heat exchangers at BFN in accordance with the rules and procedures described in Section 7 of GIP-2. TVA identified eight (8) heat exchangers as outliers since they are not specifically covered by GIP-2.

Appendix H-2 to the Summary Report (Reference 7) contains the outlier description and resolution summary. TVA resolved all the heat exchangers outlier issues by performing calculations. The staff finds TVA's evaluation of tanks and heat exchangers acceptable for the resolution of USI A-46 at BFN.

2.6 Cable and Conduit Raceway Supports

TVA stated in the summary report (Reference 7) that its cable and conduit raceway supports evaluation had followed the guidelines and inclusion rules provided in Section 8 of GIP-2. Based on its walkdown results, TVA identified a total of 120 cable and conduit raceway support outliers. The outlier issues were mainly with anchorage support systems, and were resolved by further evaluations and/or analytical reviews. Among the 120 outliers, 16 outliers had to be modified. Appendix I-2 of the Summary Report (Reference 7) shows the outlier description and resolution summary. In Reference 15, TVA stated that it has completely resolved all the outlier issues. The staff finds that TVA's approach in verifying seismic adequacy of cable and conduit raceway systems is adequate and acceptable for the resolution of USI A-46 at BFN as it meets the criteria of GIP-2.

2.7 Essential Relays

The licensee stated in Reference 7 that the review of the relays associated with the USI A-46 SSE for BFN was performed and documented in accordance with the requirements of GIP-2, the NRC SSER for GIP-2, and EPRI Report NP-7148-SL. Since relays are subcomponents mounted on or within electrical panels, the adequacy of the panel structure and anchorage was addressed by a separate evaluation of the panel as an SSEL equipment item. This relay evaluation assumes that all panel configurations, anchorage, and interaction issues are resolved for the panel as separate SSEL equipment components.

The licensee also stated that the direct mounting of relays to a panel was addressed during the walkdown evaluation of the panel. The licensee noted missing mounting hardware or loose relay mounting conditions on the panel SEWS. It addressed these findings by issuing maintenance requests for any mounting conditions noted during walkdown. For this evaluation the licensee assumes that all relays are properly mounted in accordance with the manufacturer's recommendations or in accordance with plant specifications. Its objective in making the spot checks during the relay walkdown was to confirm these assumptions on a sample basis. SCEs collected the information needed for cabinet evaluations used in seismic screening of relays and to verify the seismic adequacy of the cabinets and enclosures which support essential relays during other plant walkdowns.

TVA has identified 84 circuits with relays and associated contacts that do not meet the GIP-2 criteria. By letters dated April 11, 1997 (Reference 14), and November 18, 1997 (Reference 15), the licensee notified the NRC that TVA had completed the resolution of equipment outliers identified for BFN, including relays, by engineering evaluation, plant modification, or maintenance work order during the Cycle 7 and 9 refueling outages.

The staff finds TVA's approach in verifying the seismic adequacy of essential relays at BFN acceptable for the resolution of USI A-46 since it meets the provisions of GIP-2.

2.8 Human Factors Aspects

GIP-2 describes the use of operator action as a means of accomplishing those activities required to achieve safe shutdown. Section 3.2.7, "Operator Action Permitted," states, in part, that timely operator action is permitted as a means of achieving and maintaining a safe shutdown condition provided procedures are available and the operators are trained in their use. Additionally, Section 3.2.6, "Single Equipment Failure," states that manual operator action of equipment which is normally power operated is permitted as a backup operation provided that sufficient manpower, time, and procedures are available. Section 3.2.8, "Procedures," states, in part, that procedures should be in place for operating the selected equipment for safe shutdown and operators should be trained in their use. It is not necessary to develop new procedures specifically for compliance with USI A-46.

In Section 3.7, "Operations Department Review of SSEL," of GIP-2, SQUG also described three methods for accomplishing the operations department reviews of the SSEL against the plant operating procedures. Licensees were to decide which method or combination of methods were to be used for their plant-specific reviews. These methods included:

(1) A desk-top review of applicable normal and emergency operating procedures.

(2) Use of a simulator to model the expected transient.

(3) Performing a limited control room and local in-plant walkdown of actions required by plant procedures.

The staff's evaluation of SQUG's approach for the identification and evaluation of the SSEL, including the use of operator actions, was provided in Section II.3 of the staff's SSER-2 on GIP-2. The evaluation concluded that SQUG's approach was acceptable.

The staff's review focused on verifying that the licensee had used one or more of GIP-2 methods for conducting the operations department review of the SSEL, and had considered aspects of human performance in determining what operator actions could be used to achieve and maintain safe shutdown (e.g., resetting relays, manual operation of plant equipment). A staff RAI was issued to the licensee dated March 20, 1998 (Reference 8). The licensee responded to the RAI on June 11, 1998 (Reference 10).

The licensee provided information which outlined the use of the "desk-top" review method by the Operations Department to verify that existing normal, abnormal and emergency operating procedures were adequate to mitigate the postulated transient and that operators could place and maintain the plant in a safe shutdown condition. The licensee determined that the systems and equipment selected for seismic review in the USI A-46 program are those for which normal, abnormal, and emergency operating procedures are available to bring the plant from a normal operating mode to a hot shutdown condition. The shutdown paths selected were reviewed by the BFN Operations staff and as a result the existing abnormal operating procedure 0-AO1-100-5, “Earthquake," was revised to enhance the operator guidance necessary to verify and ensure diesel generator and remote motor operated valve (RMOV) board operation, as well as

identify specific instrumentation with the highest reliability following a seismic event. With respect to ensuring the diesel generator operability, the licensee is adding additional procedural details for resetting the 86G lockout relays and verifying the associated diesel exciter field breaker is closed. Based on these enhancements the Operations Department determined that the procedures would provide adequate guidance to the operators in response to a seismic event. The licensee provided assurance that ample time existed for operators to take the required actions to safely shut down the plant. This had been accomplished during validation of the pertinent plant operating procedures related to the licensee's UFSAR, Chapter 15, Accident Analysis for the Loss of Offsite Power (LOOP) transient and for the Appendix R fire protection evaluation which preceded the A-46 program review. Since these plant procedures and associated operator actions had already been validated to ensure that adequate time and resources are available for operators to respond to a LOOP and an Appendix R event, it was considered not to be necessary to re-validate these procedures for the USI A-46 program.

The staff verified that the licensee had considered its operator training programs and verified that its training was sufficient to ensure that those actions specified in the procedures could be accomplished by the operating crews. The Operations Department verified that all actions necessary to safely shutdown the plant were included in existing normal, abnormal, and emergency operating procedures, and identified several procedural modifications which were implemented to enhance the procedures as a result of the A-46 review. The licensee verified that the only additional operator actions, beyond those associated with the LOOP or Appendix R accident scenarios, which must be performed to bring the plant from a normal operating mode to a hot shutdown condition are those specifically associated with the vibratory motion of the SSE. The specific areas where operator actions would be required include:

(1) Operator action may be required to reset LPCI motor generator sets for the RMOV boards.

(2) Operator action may be required to restart and load the diesel generators.

In each case, operations personnel reviewed the specific actions required, during the relay screening process, to ensure that the actions could be performed in the required amount of time with normally available resources. The results of the review of these operator actions by the operation personnel verified that each of the actions was adequately covered by procedural guidance, and that adequate resources including time available to take such actions were available.

In addition, the staff requested verification that the licensee had adequately evaluated potential challenges to operators, such as lost or diminished lighting, harsh environmental conditions, potential for damaged equipment interfering with the operators tasks, and the potential for placing an operator in unfamiliar or inhospitable surroundings. The licensee provided information to substantiate that potential challenges to the operator were explicitly reviewed during validation of the pertinent plant operating procedures related to the licensee's UFSAR, Chapter 15, Accident Analysis for the LOOP transient and Appendix R evaluations which preceded the A-46 program review. In addition, the licensee explicitly evaluated the potential for local failure of architectural features and the potential for adverse special interactions in the vicinity of safe shutdown equipment, where local operator action may be required, as part of the GIP-2 process. The licensee did not identify any seismic or housekeeping issues affecting the control room. The licensee performed seismic interaction reviews which eliminated any

concerns with the plant components and structures located in the immediate vicinity of the components which had to be manipulated. Therefore the potential for physical barriers resulting from equipment or structural earthquake damage which could inhibit operator ability to access plant equipment was considered, and the potential barrier to successful operator performance was eliminated.

The licensee has provided the staff with sufficient information to demonstrate conformance with the NRC-approved review methodology outlined in GIP-2 and is, therefore, acceptable.

2.9 Outlier Resolution and Resolutions

The licensee stated in Reference 7 that a total of 130 outliers were identified, affecting 114 equipment items on the SSEL for BFN mechanical and electrical equipment. The types of outlier condition include anchorage, capacity compared with demand, caveats, seismic spatial interactions including proximity and housekeeping items, and other outliers such as equipment not represented in the earthquake experience database. Several equipment have multiple outliers associated with them. The licensee listed the outliers and provided the resolution methods in Appendix G of Reference 7.

By letters dated April 11, 1997 (Reference 14), and November 18, 1997 (Reference 15), TVA informed the staff that it had completed the resolution of equipment outliers identified for BFN by engineering evaluation, plant modification, or maintenance work during the Cycle 7 and 9 refueling outages.

The staff's review of the licensee's action regarding outliers indicates that identified outliers have been resolved by analysis or corrective actions. The staff finds the licensee's actions reasonable since they meet the provisions of GIP-2.

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 regarding the walkdown and the seismic adequacy evaluation at BFN .

4.0 CONCLUSION

TVA's USI A-46 program at BFN 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-2 and the staff's SSER No. 2. TVA identified approximately 117 components as outliers. By letters dated April 11, 1997 (Reference 14), and November 18, 1997 (Reference 15), TVA stated that necessary actions to resolve the outliers have been completed. 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 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 completed physical modifications for resolution of outliers 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 facility. The staff, also concludes that its findings regarding the licensee's implementation of USI A-46 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 may be 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 SQUG/GIP-2 (Reference 2), and the staff's letter to SQUG's Chairman, Mr. Neil Smith on June 19, 1998. 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, 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.

Principal Contributor: P. Y. Chen, NRR/EMEB
R. Rothman, NRR/EMEB

Date: March 21, 2000

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 Including Supplemental Safety Evaluation Report No. 2 on Seismic Qualification Utility Group's Generic Implementation Procedure, Revision 2, corrected February 14, 1992," dated May 22, 1992.

(3) Letter, TVA to NRC, "Browns Ferry Nuclear Plant - Supplement 1 to Generic Letter 87-2, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 and Supplement 4 to Generic Letter 88-20, Individual Plant Examination of External Events for Service Accident Vulnerabilities," dated September 21, 1992.

(4) Letter, NRC to TVA, "Generic Letter 87-02, Supplement 1 Response - Browns Ferry Nuclear Plant (TAC NOS. M69430, M69431 and M69432)," dated November 19, 1992.

(5) Letter, TVA to NRC, "Browns Ferry Nuclear Plant - Units 2 & 3 - Generic Letter 87-02, Supplement 1, 120-day Response, Request for Additional Information," dated January 19, 1993.

(6) Letter, NRC to TVA, "Generic Letter 87-02, Supplement 1 Response - Browns Ferry Nuclear Plant (TAC NOS. M69430, M69431 and M69432)," dated March 19, 1993.

(7) Letter, TVA to NRC "Browns Ferry Nuclear Plant - Units 2 & 3 - Generic Letter 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 and Generic Letter 88-20, Supplement 4, Individual Plant Examination of External Events for Service Accident Vulnerabilities - Submittal of Seismic Evaluation Reports," dated June 28, 1996.

(8) Letter, NRC to TVA "Request for Additional Information Regarding Seismic Evaluation Reports submitted for BFN Units 2 and 3," dated March 20, 1998.

(9) Letter, NRC to TVA "Request for Additional Information Regarding Seismic Evaluation Reports submitted for BFN Units 2 and 3," dated July 13, 1998.

(10) Letter, TVA to NRC "Browns Ferry Nuclear Plant - Units 2 & 3 - Generic Letter 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 - Response to Request for Additional Information (TAC Nos. M69431 and M69432)," dated June 11, 1998.

(11) Letter, TVA to NRC "Browns Ferry Nuclear Plant - Units 2 & 3 - Generic Letter 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 - Response to Request for Additional Information (TAC NOS. M69431 and M69432)," dated September 25, 1998.

(12) Letter, TVA to NRC "Browns Ferry Nuclear Plant (BFN) - Units 2 & 3 - Generic Letter (GL) 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 -

Supplemental Response to NRC Request for Additional Information (TAC Nos. M69431 and M69432)," dated October 8,1999.

(13) NUREG-1232, Volume 3, Supplements 1 & 2, "Safety Evaluation Report on Tennessee Valley Authority: Browns Ferry Nuclear Performance Plan," dated January 1991.

(14) Letter, TVA to NRC "Browns Ferry Nuclear Plant - Unit 2 - Generic Letter 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 and Generic Letter 88-20, Supplement 4, Individual Plant Examination of External Events for Service Accident Vulnerabilities - Notification of Completion of Outlier Resolution," dated April 11, 1997.

(15) Letter, TVA to NRC, "Browns Ferry Nuclear Plant - Unit 2 - Generic Letter 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46 and Generic Letter 88-20, Supplement 4, Individual Plant Examination of External Events for Service Accident Vulnerabilities - Notification of Completion of Outlier Resolution," dated November 18, 1997.

(16) Letter, RG&E to NRC Document Control Desk, "Additional Information on Use of GIP Method A, R. E. Ginna Nuclear Power Plant," Docket No. 50-244, dated May 25, 1999.