November 3, 2000

Mr. David A Christian
Senior Vice President - Nuclear
Virginia Electric and Power Company
5000 Dominion Blvd.
Glen Allen, Virginia 23060

SUBJECT: NORTH ANNA POWER STATION, UNITS 1 AND 2, RE: GENERIC LETTER (GL) 87-02, PLANT-SPECIFIC SAFETY EVALUATION FOR UNRESOLVED SAFETY ISSUE (USI) A-46 PROGRAM IMPLEMENTATION (TAC NOS. M69462 AND M69463)

Dear Mr. Christian:

Virginia Electric and Power Company's (VEPCO's) USI A-46 program at the North Anna Power Station was established in response to Supplement 1 of GL 87-02, through a 10 CFR 50.54(f) letter. Enclosed is the staff's Safety Evaluation of the USI A-46 program as described in the submittals.

Based upon the information provided, the staff has concluded that VEPCO's USI A-46 implementation program at North Anna has met the purpose and intent of the criteria in the Generic Implementation Procedure, Revision 2 (GIP-2), and the staff's Supplemental Safety Evaluation Report Number 2 on GIP-2 for the resolution of USI A-46. The staff has determined that 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 of the facility. The staff has also concluded that VEPCO's implementation program to resolve USI A-46 at North Anna has adequately addressed the purpose of the 10 CFR 50.54(f) request. Any additional activities conducted by VEPCO that are related to the USI A-46 implementation may be subject to staff inspection.

This concludes our efforts on this issue; therefore, we are closing out TAC Nos. M69462 and M69463.

Sincerely,

/RA/

Stephen R. Monarque, Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR USI A-46 PROGRAM IMPLEMENTATION

AT NORTH ANNA POWER STATION, UNITS 1 AND 2

OPERATING LICENSE NOS. NPF-4 AND NPF-7

DOCKET NOS. 50-338 AND 50-339

1.0 BACKGROUND

On February 19, 1987, the 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." In GL 87-02, the staff described the process for resolving USI A-46, and encouraged the affected 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, along with the staff's Supplemental Safety Evaluation Report No. 2 (SSER-2, Reference 2), pursuant to the provisions of 10 CFR 50.54(f), which required that all addressees submit either: (1) a commitment to use both the SQUG commitments and the implementation guidance described in GIP-2, as supplemented by SSER-2; or (2) an alternate method for responding to GL 87-02. The supplement also required that those addressees committed to implement GIP-2 submit an implementation schedule and detailed information on the procedures and criteria that will be used to generate the in-structure response spectra (IRS) for USI A-46.

By letter dated September 18, 1992 (Reference 3), Virginia Electric and Power Company (VEPCO), the licensee, responded to Supplement 1 to GL 87-02 for the North Anna Power Station Units 1 and 2 (NAPS). In this letter, VEPCO committed to abide by the commitments made by SQUG in GIP-2, including the clarifications, interpretations, and exceptions in SSER-2. The staff indicated its acceptance of VEPCO's response by letter on November 20, 1992 (Reference 4).

By letter dated May 27, 1997 (Reference 5), VEPCO submitted a summary report containing the results of the USI A-46 program implementation at NAPS. By letters dated April 1, 1999 (Reference 6), and June 1, 1999 (Reference 7), VEPCO provided supplemental information in response to the staff's requests for additional information (RAIs) on January 6, 1999 (Reference 8), and February 16, 1999 (Reference 9). The staff's review of VEPCO's responses indicated that further additional information for resolution of certain outliers was required with regard to the use of "Method A" of GIP-2, justification for the spacial interaction of cable trays,

Enclosure

and the evaluations for emergency condensate storage tanks (CSTs) and refueling water storage tanks (RWSTs). The staff concerns were then discussed during telephone conference calls with VEPCO. By letter dated October 18, 1999 (Reference 10), VEPCO provided further additional information, including drawings of the CST top support, which were not accounted for in the A-46 evaluation submitted earlier for staff review.

This report presents the staff's evaluation of VEPCO's USI A-46 implementation program. The evaluation is based on the staff's review of the summary report and of the supplemental information, clarifications, and documentation submitted by VEPCO in response to the staff's RAIs.

2.0 DISCUSSION AND EVALUATION

The summary report (Reference 5) discusses the results of VEPCO's implementation of the USI A-46 program at NAPS. The report discusses a safe shutdown equipment list (SSEL), and this report documents the screening verification and walkdown of mechanical and electrical equipment and the relay evaluation. The report also: (1) documents the evaluation of the seismic adequacy of tanks, heat exchangers, cable, and conduit raceways; (2) identifies outliers; and (3) proposes resolution of outliers, including projected schedules.

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

The design basis earthquake ground response spectra (GRS) are Newmark-type design spectra. For structures founded on rock, the horizontal component's peak ground acceleration (PGA) is 0.12g, and the vertical component's PGA is 0.08g. For structures founded on soil, the horizontal component's peak ground acceleration (PGA) is 0.18g and the vertical component's PGA is 0.12g.

New IRS were developed using lumped-mass models consisting of beams and stiffness matrix elements with six degrees of freedom at each node. Artificial times-histories whose spectra envelope the soil and rock GRS were developed for the analysis of the structures. The three time histories, one for each orthogonal direction, were statistically independent. For structures founded on soil, except for the auxiliary building (AB), soil structure interaction (SSI) analyses were performed using the lower bound, best estimate, and upper bound soil properties. The spectra from these three SSI analyses at each nodal point were enveloped. For the AB, the soil foundation was represented by three translational and three rotational soil springs in accordance with the previously existing design basis calculations. The IRS were peak broadened +15 and -15 percent to account for uncertainties and variables in the structures.

The staff finds VEPCO's approach for determining the seismic demand consistent with the provisions of GIP-2; therefore, it is acceptable for use in the USI A-46 program at NAPS.

2.2 Seismic Evaluation Personnel

The NAPS seismic evaluation was conducted by the seismic review team, which consisted of two seismic capacity engineers (SCEs), and included at least one licensed professional engineer. SCEs included members of VEPCO's staff and engineers from the consulting firms of EQE International and MPR Associates. The resumes of the SCEs and three third-party reviewers are included in Appendix E (Reference 5). They have completed SQUG training in their areas of involvement.

VEPCO also indicated that personnel in the NAPS operations department reviewed the items on the SSEL to ensure they are compatible with the normal, abnormal and emergency operating procedures used for NAPS. The resume of system engineers who prepared the SSEL report (Reference 11) is provided in Attachment A of Reference 6. The relays associated with items on the SSEL were evaluated by a lead relay/electrical engineer, whose resume is in Appendix I (Reference 12).

The staff finds that the qualifications of the VEPCO's seismic evaluation personnel meet the provisions of GIP-2 and the staff's SSER-2; therefore, they are acceptable for the USI A-46 program at NAPS.

2.3 Safe-Shutdown Path

GL 87-02 specifies that the 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 May 27, 1997, VEPCO addressed the following plant safety functions: reactor reactivity control, pressure control, inventory control, and decay heat removal. VEPCO identified the primary and alternate safe shutdown success paths with their support systems and instrumentation 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 I provides the SSEL.

The decay heat removal function is accomplished in two stages by secondary heat removal. The first stage of secondary heat removal will be achieved by the main steam power-operated relief valves (PORVs) until the decay heat rate decreases to the point where atmospheric dump valves can be used. Makeup water to the steam generators will be supplied by the auxiliary feedwater system, which takes suction from the emergency condensate storage tank (CST) and then from the CST. The second stage of secondary heat removal will be accomplished by the operation of the residual heat removal (RHR) system when the reactor coolant system (RCS) pressure and temperature are below the RHR entry limits. In this method, decay heat is removed from the RCS to the component cooling water (CCW) system via the RHR heat exchangers. The heat from the CCW is then transferred to the service water system via the CCW heat exchangers.

The plant operations department reviewed the equipment listed in Appendix I 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 a safe shutdown for 72 hours following a seismic event is acceptable for the USI A-46 program at NAPS as it meets the provisions of GIP-2.

2.4 Seismic Screening Verification and Walkdown of Mechanical and Electrical Equipment

The seismic screening and walkdown included verification of more than 1000 equipment items, which are typical of those found in the SQUG experience database in the 20 classes of equipment covered in Appendix B of GIP-2 (Reference 1). The staff's evaluations of the tanks and heat exchangers are in Section 2.5 of this Safety Evaluation (SE).

2.4.1 Equipment Seismic Capacity Compared to Seismic Demand

GIP-2 requires a comparison of the seismic capacity of the electrical and mechanical equipment in the SSEL to the appropriate seismic demand. The seismic capacity is based on the SQUG earthquake experience data base as represented by the bounding spectrum (BS), the reference spectrum (defined as 1.5 times the BS), the generic seismic testing data as represented by the generic equipment ruggedness spectra (GERS), or the documented design information for the equipment item. The seismic demand is represented by the plant's SSE GRS and IRS. The IRS may be the conservative design spectra, or a more realistic, less conservative spectra approved by the staff. VEPCO used four methods for the comparison of the seismic capacity to the seismic demand. It used the documented design of the equipment and compared it to the appropriate demand spectra for some equipment items. It also used GIP-2 Method A.1, comparing the SQUG BS to the plant's safe shutdown GRS; Method B.1, comparing 1.5 times the BS to the conservative design IRS; and Method B.2, in which it compared the GERS to the conservative design IRS.

GIP-2 places limitations on the use of Method A.1. These limitations are that the SSE GRS can be used for comparison to the BS when the following items occur.

- The equipment is mounted in the nuclear plant at an elevation below about 40 feet above the effective grade.
- The equipment, including its supports, have a fundamental natural frequency greater than about 8 Hz.
- The amplification factor between the free-field GRS and the IRS is not more than about 1.5.

Methods B.1 and B.2 may be used for equipment at any elevation and for equipment with any natural frequency.

VEPCO used Method A.1 for the evaluation of SSEL items at seven elevations below 40 feet above the effective grade. These items were the Unit 1 main steam valve house (MSVH) elevations 306 feet, 285 feet, and 286 feet; the service building (SB) elevation 286 feet; the Unit 2 MSVH and the reactor containment internal structure (CIS) elevations 253 feet and 256 feet 4 inches. A comparison of the IRS at these elevations to the GRS indicated amplification factors higher than the 1.5 limitation specified in GIP-2 for the use of Method A.1. These amplification factors are shown in the table below.

Structure	Elev. (FT)	Comp.	Frequency Range (Hz)	Amplification IRS/GRS
MSVH Unit 1	306	EW	8.0 - 12.0	4.95
“	”	NS	5.2 - 7.0	7.35
“	285	EW	8.0 - 12.0	3.40
“	”	NS	5.2 - 7.0	3.81
“	277	EW	8.0 - 12.0	2.80
“	”	NS	5.2 - 7.0	2.64
SB	286	EW	5.0 - 7.0	2.34
“	”	“	9.7 - 14.0	3.94
“	”	NS	3.0 - 5.0	2.20
“	”	“	9.0 - 14.0	2.74
MSVH Unit 2	285	EW	5.7 - 7.2	3.32
“	”	NS	4.0 - 5.7	3.44
CIS Unit 1	253	EW	4.5 - 6.2	3.72
“	”	NS	“	”
CIS Unit 2	256.33	EW	“	3.9
“	”	NS	“	”

During a telephone conference between the staff and VEPCO, the staff requested that VEPCO provide a quantitative justification for the use of Method A.1 at locations where the amplification factor between the GRS and the IRS is greater than about 1.5. VEPCO responded to the staff’s request for additional information on October 18, 1999 (Reference 10). In this submittal, VEPCO provided the following information about the use of Method A.1 at NAPS.

Method A.1 was only utilized for line mounted equipment (valves, temperature sensors, etc.), and only for seven elevations located within four different structures. The structures in which Method A.1 was used to compare seismic capacity to seismic demand are typical nuclear power plant structures. VEPCO did not find any unusual or plant-specific situations that would cause the amplification factors for these buildings to be greater than those in typical nuclear power plant structures. All four structures are heavily reinforced concrete shear wall structures. The Unit 1 MSVH, the SB, and the CIS were all founded on rock. The Unit 2 MSVH was founded on a structural fill over Saprolite and sound rock with concrete backfill against the containment.

VEPCO stated that the IRS have high amplifications at some buildings and elevations within about 40 feet of the grade due to the conservatism in the design-basis IRS for NAPS and the methods used to develop them. VEPCO presented the following list, which identified the significant sources of conservatism in the development of the IRS:

- Location of input motion (variation from free field input location).
- GRS shape
- Ground motion incoherence
- Time history simulation
- Existence of narrow peaks
- Structural damping
- Frequency (structural modeling)
- Non-linear behavior (e.g., concrete cracking)
- Peak broadening and enveloping

VEPCO did not quantify the specifics for any of these parameters with respect to the NAPS IRS. The staff reviewed the qualitative assessments provided by VEPCO took into account those points found to be germane.

VEPCO submitted a study (Reference 10) performed by their consultant, EQE International, to further justify the use of Method A.1 at the locations where the amplification factor is larger than about 1.5. Reference 10 contains a comparison evaluation of overall margins between median-centered analysis and design-basis analysis for nuclear power plant structures at other facilities similar in construction, building frequency, and damping to those at NAPS.

The median-centered spectra and the conservative design spectra for five reinforced concrete buildings at four nuclear power plants were presented in VEPCO's submittal on October 18, 1999 (Reference 10). The reinforced concrete shear wall structures are two ABs, a reactor building (RB) interior structure, an RB exterior shell, and a containment interior structure, which are typical of those found at nuclear power plants. The ratios of the conservative design spectra to median-centered spectra were 2.53, 5.3, 3.3, 2.3, and 5.4. The staff considers the wide range of the ratios of the conservative design spectra to median center spectra to be due to the different methods and levels of conservatism used in the analyses of the structures rather than differences between structural configurations. The mean of the ratios is 3.77. VEPCO used this mean value to estimate the amplification factor for the NAPS structures. If median-centered spectra were developed for locations in NAPS where Method A.1 was used, the amplification factor would be about 1.5.

The staff considers the use of the above approximation for estimating the level of the median-centered IRS to be adequate to justify the use of GIP-2 Method A.1 for equipment in the USI A-46 SSEL. The staff's acceptance of this approximation was based primarily on the fact that the floor spectra for the building structures at NAPS are extremely conservative. The use of this approach is limited to the verification of seismic adequacy of mechanical and electrical equipment at NAPS for the USI A-46 resolution. The use of this approach for any other application will require staff review and approval.

2.4.2 Assessment of Equipment “Caveats”

VEPCO indicated in Reference 5 that the SCEs verified that the caveats listed in Appendix B of GIP-2 for each equipment class were met for NAPS. The caveats are the inclusion and exclusion rules, which specify characteristics and features particularly important for seismic adequacy of a specific class of equipment when the equipment’s seismic capacity is determined using the experience-based data. The phrase “meeting the intent of the caveats” applies to equipment that does not comply with the specific wording in certain caveats, but the equipment is deemed to be seismically adequate based on the judgment of the seismic review teams.

VEPCO documented the equipment items whose seismic adequacy was verified as meeting the intent of the caveats in Column 14 of the Screening Verification Data Sheets (SVDS) in Appendix D to the summary report (Reference 5). In many cases, VEPCO considered items of equipment that did not comply with the GIP-2 caveats to be outliers and documented the outliers in Section 11 of the NAPS summary report as needing resolution. In some cases, if an item of equipment was judged to comply with the intent of the caveats, VEPCO considered the item to meet the caveat rule in accordance with GIP-2. VEPCO documented equipment items that meet the intent rather than the specific wording of the caveats in the “notes” of the SVDS.

In its response dated April 1, 1999 (Reference 6), to the staff's RAI dated January 6, 1998, VEPCO presented supplemental information in Table 2 of Reference 6 for the equipment items where the intent of the caveat was relied upon. For each of the deviations from the GIP-2 caveats, the table provides the technical basis for the judgment VEPCO used in determining how the intent, if not the wording, of certain caveats was met. VEPCO also indicated that if a component did not meet the wording of a caveat, and was not found to be an outlier, the assessment and justification for meeting the intent of a caveat were noted on the screening and evaluation work sheets (SEWS).

The staff finds that VEPCO’s determination of the seismic adequacy for equipment identified in Appendix D to the NAPS summary report conforms with GIP-2 guidance on the caveats, and is acceptable in those instances in which the intent rather than the wording of the caveats was met for resolution of USI A-46 at NAPS.

2.4.3 Equipment Anchorage

VEPCO summarized the equipment anchorage verification in Section 6.4 of the summary report (Reference 5). To verify the adequacy of equipment anchorage, VEPCO performed field inspections and analytical calculations in accordance with GIP-2, Section II.4.4 and Appendix C. In addition, VEPCO indicated that a tightness check was performed by the Special Review Team (SRT) or the craftsmen for almost all accessible expansion anchor bolts. The anchor bolt checks are documented in the SEWS. VEPCO performed bounding calculations to verify equipment anchorage adequacy for the worst loading condition, and they identified items that did not meet the requirements as outliers. Resolutions of the outliers are discussed in Section 11, Table 11.2-1 of the summary report.

VEPCO evaluated the anchor bolts for the NAPS tanks and cable tray supports in accordance with the GIP-2 guidance Sections II.7 and II.8, respectively. Most of the outliers were minor in nature and were corrected by physical modifications. In Reference 15, VEPCO indicated these items were resolved during the month of March 2000.

The staff concludes that VEPCO's evaluation of the equipment anchorages conforms with GIP-2 guidance and is acceptable for the NAPS USI A-46 resolution.

2.4.4 Seismic Spatial Interaction Evaluation

VEPCO's equipment screening evaluation included evaluation for potential seismic interaction concerns following the requirements of GIP-2 (Section II.4.5 and Appendix D). VEPCO screened enclosures containing essential relays for interaction concerns that might cause relay chatter (e.g., adjacent panels not bolted together), and they identified those items that did not meet GIP-2 interaction requirements as interaction outliers, which are discussed in Section 11 of the summary report (Reference 5). In Table 11.1-1 of the summary report, VEPCO lists the spatial interaction outliers, their descriptions, and resolutions. The interaction concerns were associated with the potential for side-to-side or front-to-back impact of cabinets containing essential relays, loose equipment mounting nuts, movable fire extinguishers, carts on wheels, and unanchored tables, and the potential for ceiling panels falling on control room cabinets. VEPCO resolved these outliers by modifications, analysis, maintenance actions, and the removal of unsecured items from the area containing the items on the SSEL. VEPCO provided the evaluation and resolution for the interaction outliers in Tables 11.1-1 and 11.2-1 of the summary report.

In Reference 6, VEPCO provided a revision to Table 11.1-1 of the summary report correcting typographical errors, and an updated Table 11.2-1 regarding the status of outstanding mechanical and electrical equipment outliers. In Reference 15, VEPCO indicated the items listed in Table 11.2-1 were resolved during the month of March 2000.

During a telephone conference between the NRC and VEPCO, the staff requested a clarification and technical justification for the method of calculating the maximum displacement of the cable tray for Example 10, provided in Appendix C of Reference 6. Subsequent to the telephone conference, VEPCO provided a further clarification in Reference 10 that the deflection calculated did not actually represent the end displacement and was not used for evaluating the spatial interaction of the multi-tier cable tray during a seismic event. VEPCO indicated that the spatial interaction for the cable tray system was verified during the USI A-46 walkdown. In addition, the SCEs performed tug tests to assess the displacement of the cable trays. As stated by VEPCO, there were more than adequate clearances between the cable trays and the nearest commodities, such as piping, equipment, components, and structures.

The staff finds that the spatial interaction evaluation is consistent with GIP-2 and is adequate for the resolution of USI A-46 at NAPS.

2.5 Tanks and Heat Exchangers

VEPCO stated in Reference 5 that the adequacy of SSEL tanks and heat exchangers were evaluated against the requirements of Chapter 7 of the GIP-2 methodology. VEPCO reviewed a total of 110 tanks and heat exchangers and 22 were identified as outliers. VEPCO indicated that all tank and heat exchanger outliers have been resolved via modification or analysis.

The emergency CST and the RWSTs are large vertical flat-bottom tanks that failed to satisfy the GIP-2 criteria. In its January 6, 1999, response (Reference 6) to the staff's RAI, VEPCO provided the USI A-46 calculations for these tanks. Analysis for evaluation of the RWST was performed to evaluate the tank wall stability, bolt strength, and anchor chair capacity. Analysis for the CST, assuming it is free-standing, was performed to evaluate the tank wall stability, overturning moment and shear capacity, and the freeboard clearance against the seismic demand at NAPS. VEPCO concluded that both tanks have capacities that exceed the seismic demand. The staff's review indicated that the evaluation of the unanchored CST did not satisfy the acceptance criteria in GIP-2 due to the lifting of the base even with consideration of the water hold-down force. In Reference 10, VEPCO stated that the CST is completely enclosed in a 2-foot-thick reinforced missile shield concrete jacket wall. As shown in the drawings provided in Reference 10, the CST is laterally braced by structural angles welded to the CST wall and connected to the concrete enclosure. The staff concludes that the lateral restraint at the top of the CST is adequate to prevent any significant overturning and sliding during an SSE and is, therefore, acceptable.

The staff finds the VEPCO's evaluation of the tanks and heat exchangers adequate for the resolution of USI A-46 at NAPS.

2.6 Cable and Conduit Raceways

VEPCO stated that the raceway review was performed as specified in GIP-2, Section 8. The review included walkdown and limited analytical review of representative worst-case raceways, as well as examination of seismic spatial interaction with adjacent equipment and structures. Seismic spatial interaction is discussed in Section 2.4.4 of this SE. The analysis was based on as-built dimensions. Review of VEPCO's sample calculation (Reference 2) for the limited analytical review indicated that VEPCO satisfactorily followed the GIP's guideline.

There were several outliers in the VEPCO evaluation, and they are listed in Table 7-1 of the summary report. VEPCO listed all the outliers that were resolved. In addition, VEPCO also stated that review of the list indicated that these outliers do not compromise the structural integrity of the raceway system or impact other safety-related items function during a seismic event. The staff found the outliers' resolutions acceptable.

The staff concludes that VEPCO's evaluation of the cable and conduit raceways followed GIP-2 criteria and is acceptable for the resolution of USI A-46 at NAPS.

2.7 Essential Relays

In Appendix E (Reference 12), VEPCO identified and listed essential relays that may be associated with one or more SSEL components. VEPCO indicated that the relay evaluation was performed in accordance with GIP-2 (Reference 1) and Electric Power Research Institute (EPRI) report NP-7148-SL (Reference 13). This relay evaluation report (Reference 12) contains the description and results of the relay functionality review and identifies the cabinets that house essential relays.

VEPCO indicated that relay spot checks were performed by the SRTs during the equipment walkdown and during the separate relay evaluation walkdown. According to the GIP-2 procedure, the purpose of spot checks is to verify the relay mounting, orientation, model number, load path, possible interaction, and cable slack. Accordingly, the SRT checked essential relays to confirm that they were mounted as recommended by the manufacturer and to identify any abnormal or atypical relay mounting configurations. VEPCO visually inspected mounting bolts to ensure that the relays were well secured and checked relay model, manufacturer, and equipment numbers against the designations listed on the electrical schematic drawings. VEPCO indicated that no abnormal mountings or damaged relays were found and that the relay mountings are standard and adequate. VEPCO found the relay types to be consistent with the electrical drawings.

In Section 2.3 of Reference 12, VEPCO concluded that all relays were satisfactorily screened and, accordingly, there are no open issues as a result of the relay evaluation. Furthermore, VEPCO did not find any essential relays to be of a type designated as low ruggedness as defined in Reference 13, which would automatically require replacement or case-specific evaluation.

The staff finds that VEPCO's seismic relay evaluation meets the provisions of GIP-2 and is, therefore, acceptable for the USI A-46 resolution at NAPS.

2.8 Human Factors Aspect

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 that operators should be trained in their use. It is not necessary to develop new procedures specifically for compliance with the USI A-46 program.

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. VEPCO had 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 walk-down 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 11.3 of the staff's SSER on GIP-2. The evaluation concluded that SQUG's approach was acceptable.

The staff's review of VEPCO’s summary report focused on verifying that VEPCO 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).

VEPCO provided information which outlined the use of the "desk-top" and “walkdown” evaluation methods 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. VEPCO 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 safe shutdown condition. The shutdown paths selected were reviewed by the North Anna operations staff who determined that the procedures would provide adequate guidance to the operators in response to a seismic event. VEPCO provided assurance that ample time existed for operators to take the required actions to safely shut down the plant. This was accomplished during the validation of the pertinent plant operating procedures related to VEPCO’s A-46 program review. Additionally, VEPCO stated that the potential for loss of instrument air, heating, ventilation and air conditioning (HVAC), and electrical loads (such as lighting) were anticipated, and a path/process for shutdown was selected that would work for such contingencies. The Appendix R report (fire protection) was reviewed as part of the process of developing the SSEL, since it was recognized that many of the same operational limitations may be present following a seismic event.

The staff verified that VEPCO had considered its operator training programs and verified that the 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 shut down the plant were included in existing normal, abnormal, and emergency operating procedures. VEPCO verified that no additional operator actions, beyond those associated with the safe shutdown paths, must be performed to bring the plant from a normal operating mode to a safe shutdown condition.

In addition, the staff requested verification that VEPCO 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. VEPCO provided information to substantiate that potential challenges to the operator were explicitly reviewed as part of the A-46 validation effort. The review determined that there were three newly required operator actions introduced as a result of a postulated seismic event-induced relay contact chatter. These three actions are necessary to manually restart the boric acid tank heater units following restoration of the vital emergency bus powering the heaters. These three actions require the operator to use a pushbutton located in the electrical penetration area, to manually restart the control room/relay room chiller units via closure of a local switch located in the chiller unit room, and to manually reset the control room air conditioners via closure of a local switch in the HVAC room. For each of the three manual actions, VEPCO conducted an evaluation and verified that the control room indications of conditions are provided sufficiently. Hospitable ingress/egress paths to the equipment would be available and sufficient time exists to permit the operators to access the equipment areas.

In addition, VEPCO explicitly evaluated the potential for local failure of architectural features and the potential for adverse spacial interactions in the vicinity of safe shutdown equipment, where local operator action may be required as part of the GIP-2 process. As a result of the review, VEPCO identified two potential control room interaction sources due to non-restrained equipment (e.g., a few essential relay cabinets not being adjacently bolted together, and diffuser panels on the control room ceiling creating a potential hazard if they should fall). In Reference 15, VEPCO indicated that these items were resolved during the month of March 2000. Additionally, VEPCO is preparing an administrative procedure to address future housekeeping concerns in safety-significant areas of the plant. VEPCO performed seismic interaction reviews that eliminated any concerns with the plant components and structures located in the immediate vicinity of the components that had to be manipulated. Therefore, the potential for physical barriers resulting from equipment or structural earthquake damage that could inhibit operator ability to access plant equipment was considered and eliminated as a potential barrier to successful operator performance.

VEPCO has provided the staff with sufficient information to demonstrate conformance with the NRC-approved review methodology outlined in GIP-2 and it is, therefore, acceptable for resolution of USI A-46 at NAPS.

2.9 Outlier Identification and Resolution

No outliers resulted from the essential relay review as discussed in detail in Section 2.7 of this SE. The staff discussed the significant outliers associated with the anchorage, tanks, heat exchangers, cable tray, and conduit raceway supports in Sections and 2.4.3, 2.5 and 2.6 of this SE.

Items of equipment were identified as outliers for three reasons: equipment class caveats, anchorage adequacy, and seismic interactions. Table 11.2-1 of Reference 5 listed outstanding equipment outliers and issues that remained open at the time of the May 27, 1997, submittal. In its response to the staff’s RAI (Reference 6), VEPCO provided an update for the status of outstanding outliers. Of the nine issues listed in Table 11.2-1 (related to housekeeping, control room ceiling concern, and 23 components), three have been completely resolved, five are in progress, and one remains to be addressed. In Reference 15, VEPCO indicated the eight remaining items were resolved during the month of March 2000.

The staff concludes that VEPCO’s outliers resolution is acceptable.

3.0 <u>SUMMARY OF STAFF FINDINGS</u>

The staff's review of VEPCO's USI A-46 implementation program, as discussed above, did not identify any significant or programmatic deviation from GIP-2 regarding the walkdown and the seismic adequacy evaluations at NAPS.

4.0 CONCLUSION

VEPCO's USI A-46 program at NAPS was established in response to Supplement 1 to GL 87-02 through a 10 CFR 50.54(f) letter, and as such, VEPCO conducted the USI A-46 implementation in accordance with GIP-2. A review of VEPCO's USI A-46 implementation submittal indicated that the SSEL contained more than 1000 equipment items that were assessed during the walkdown to verify their seismic adequacy, of which 180 were identified as outliers. In its May 27, 1997 submittal, VEPCO stated it planned to complete the resolution of the unresolved outliers by the end of refueling outage 14, which commenced in March 2000. Furthermore, VEPCO's implementation report did not identify any instance in which the operability of a particular system or component was questionable. In a letter dated May 26, 2000, VEPCO stated that resolution of these remaining outliers was completed. As described in Section 3.0, the staff's review did not identify areas where the VEPCO's program deviated from GIP-2 and the staff's SSER-2 on SQUG/GIP-2 issued in 1992.

The staff concludes that VEPCO'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-2 for the resolution of USI A-46. The staff has determined that VEPCO's completed actions have resulted in safety enhancements, in certain aspects, that are beyond the original licensing basis. Accordingly, VEPCO's actions provide sufficient basis to close the USI A-46 review at the facility. The staff also concludes that VEPCO's implementation program to resolve USI A-46 at the facility has adequately addressed the purpose of the 10 CFR 50.54(f) request. Any additional activities conducted by VEPCO that are related to the USI A-46 implementation may be subject to NRC inspection.

Regarding future use of GIP-2 in licensed activities, VEPCO may revise its licensing basis in accordance with the guidance in Section I.2.3 of the staff's SSER-2 on SQUG/GIP-2 (Reference 2) and the staff's letter to SQUG's Chairman, Mr. Neil Smith, on June 19, 1998 (Reference 14). Where plants have made specific commitments to the licensing basis with respect to seismic qualification, those 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 there are no unresolved safety questions is acceptable as 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 VEPCO to conclude an unresolved safety question is involved, then incorporation of the GIP-2 methodology into the licensing basis would require VEPCO to seek an amendment according to the provisions of 10 CFR 50.90.

5.0 REFERENCES

1. Seismic Qualification Utility Group, “Supplemental Safety Evaluation Report No. 2 on Seismic Qualification Utility Group’s, Generic Implementation Procedure, Revision 2, Corrected February 14, 1992 for Implementation of GL 87-02, USI A-46 Program, Verification of Nuclear Power Plant Equipment”

2. USNRC, “Supplement NO. 1 To Generic Letter (GL) 87-02 That Transmits Supplemental Safety Evaluation Report No. 2 (SSER No. 2) on SQUG Generic Implementation Procedure, Revision 2, as Corrected February 14, 1992,” May 22, 1992

3. Virginia Electric and Power Company letter to USNRC Document Control Desk, “Virginia Electric and Power Company Surry Power Station Units 1 and 2 North Anna Power Station Units 1 and 2 Response to Supplement 1 to Generic Letter 87-02 Supplement No.1 on SQUG Resolution of Unresolved Safety Issue A-46,” September 18, 1992

4. USNRC letter to VEPCO, “Safety Evaluation of North Anna Power Station, Units 1 and 2, Surry Power Station, Units 1 and 2, 120 Day Response to Supplement No. 1 to Generic Letter 87-02," November 20, 1992

5. VEPCO letter to USNRC Document Control Desk, “Virginia Electric and Power Company North Anna Power Station Units 1 and 2 Summary Report for Resolution of Unresolved Safety Issue (USI) A-46,” May 27, 1997

6. VEPCO letter to USNRC Document Control Desk, “Virginia Electric and Power Company North Anna Power Station Units 1 and 2 Request for Additional Information on Summary Report on USI A-46 Program,” April 1, 1999

7. VEPCO letter to USNRC Document Control Desk, “Virginia Electric and Power Company North Anna Power Station Units 1 and 2 Request for Additional Information on USI A-46 Program,” June 1, 1999

8. USNRC letter to VEPCO, “Request for Additional Information on the Resolution of Unresolved Safety Issue A-46 (USI A-46), - North Anna Power Station Units 1 and 2,” January 6, 1999

9. USNRC letter to VEPCO, “Request for Additional Information on the Resolution of Unresolved Safety Issue A-46 (USI A-46), - North Anna Power Station Units 1 and 2,” February 16, 1999

10. VEPCO letter to USNRC Document Control Desk, “Virginia Electric and Power Company North Anna Power Station Units 1 and 2 Request for Additional Information, Summary Report on USI A-46,” October 18, 1999

11. MPR Associates, Inc., MPR-1201, "North Anna Power Station, USI A-46 and IPEEE Safety Shutdown Equipment," Revision 1, March 1993 (Attachment A to the NAPS summary report for USI A-46 resolution)

12. MPR Associates, Inc., MPR-1392, "North Anna Power Station Units 1 and 2, USI A-46 Relay Evaluation," Revision 2, November 1995 (Attachment B to the NAPS summary report for USI A-46 resolution)

13. Electric Power Research Institute NP-7148-SL, “Procedure for Evaluating Nuclear Power Plant Relay Seismic Functionality,” December 1990

14. Letter from Brian W. Sheron, NRC, to Neil Smith, SQUG, dated June 19, 1998

15. VEPCO letter to USNRC Document Control Desk, “Virginia Electric and Power Company North Anna Units 1 and 2 Completion of Outlier Resolution - USI A-46 Program Generic Letter (GL) 87-02 - Verification of Seismic Adequacy of Mechanical and Electrical Equipment,” May 26, 2000

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