March 20, 2000

Mr. Samuel L. Newton
Vice President, Operations
Vermont Yankee Nuclear Power Corporation
185 Old Ferry Road
Brattleboro, VT 05301

SUBJECT: VERMONT YANKEE NUCLEAR POWER STATION - SAFETY EVALUATION REPORT FOR UNRESOLVED SAFETY ISSUE (USI) A-46 PROGRAM IMPLEMENTATION (TAC NO. M69490)

Dear Mr. Newton:

The Nuclear Regulatory Commission (NRC) staff issued Generic Letter (GL) 87-02 in February 1987 to provide guidance for the resolution of USI A-46. It concluded that the seismic adequacy of certain equipment in operating nuclear power plants should be reviewed against seismic criteria not in use when these plants were being constructed. In 1987, the Seismic Qualification Utility Group (SQUG), representing its member utilities, committed to develop a Generic Implementation Procedure (GIP) for implementing the resolution of USI A-46. On May 22, 1992, the staff issued Supplement No. 1 to GL 87-02 which transmitted its final SER (SSER No. 2) on the then final version of GIP (GIP-2). In the supplement to GL 87-02, the staff requested that USI A-46 licensees who are members of SQUG to either provide a commitment to use both the SQUG commitments and the implementation guidance described in GIP-2, as supplemented by the staff's SSER No. 2, or provide an alternative method for responding to GL 87-02. By letter dated September 18, 1992, you committed to the implementation of GIP-2 for resolving USI A-46 at the Vermont Yankee Nuclear Power Station (VY).

The USI A-46 program for VY was established in response to GL 87-02 through a 10 CFR 50.54(f) letter. We have concluded that your USI A-46 implementation program has, in general, met the purpose and intent of the criteria in GIP-2 and our SSER No. 2 for the resolution of USI A-46. We have determined that your corrective actions and completed physical modifications for resolution of outliers will result in safety enhancements and provide sufficient basis to close the USI A-46 review at VY. We have also concluded that your implementation program to

resolve USI A-46 at VY has adequately addressed the purpose of the 10 CFR 50.54(f) request. This completes our review of this issue and TAC No. M69490 is closed, however, activities related to the USI A-46 implementation are subject to NRC inspection.

Sincerely,

/RA/

Richard P. Croteau, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure: Safety Evaluation

cc w/encl: See next page

resolve USI A-46 at VY has adequately addressed the purpose of the 10 CFR 50.54(f) request. This completes our review of this issue and TAC No. M69490 is closed, however, activities related to the USI A-46 implementation are subject to NRC inspection.

Sincerely,

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Richard P. Croteau, Project Manager, Section 2
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cc w/encl: See next page

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Vermont Yankee Nuclear Power Station

cc:

Regional Administrator, Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. David R. Lewis
Shaw, Pittman, Potts & Trowbridge
2300 N Street, N.W.
Washington, DC 20037-1128

Mr. Richard P. Sedano, Commissioner
Vermont Department of Public Service
112 State Street
Montpelier, VT 05620-2601

Mr. Michael H. Dworkin, Chairman
Public Service Board
State of Vermont
112 State Street
Montpelier, VT 05620-2701

Chairman, Board of Selectmen
Town of Vernon
P.O. Box 116
Vernon, VT 05354-0116

Mr. Richard E. McCullough
Operating Experience Coordinator
Vermont Yankee Nuclear Power Station
P.O. Box 157
Governor Hunt Road
Vernon, VT 05354

G. Dana Bisbee, Esq.
Deputy Attorney General
33 Capitol Street
Concord, NH 03301-6937

Chief, Safety Unit
Office of the Attorney General
One Ashburton Place, 19th Floor
Boston, MA 02108

Ms. Deborah B. Katz
Box 83
Shelburne Falls, MA 01370

Mr. Raymond N. McCandless
Vermont Department of Health
Division of Occupational
and Radiological Health
108 Cherry Street
Burlington, VT 05402

Mr. Gautam Sen
Licensing Manager
Vermont Yankee Nuclear Power
Corporation
185 Old Ferry Road
Brattleboro, VT 05301

Resident Inspector
Vermont Yankee Nuclear Power Station
U. S. Nuclear Regulatory Commission
P.O. Box 176
Vernon, VT 05354

Director, Massachusetts Emergency
Management Agency
ATTN: James Muckerheide
400 Worcester Rd.
Framingham, MA 01702-5399

Jonathan M. Block, Esq.
Main Street
P. O. Box 566
Putney, VT 05346-0566

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EVALUATION OF VERMONT YANKEE NUCLEAR POWER CORPORATION

RESPONSE TO SUPPLEMENT NO. 1

TO GENERIC LETTER 87-02

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

1.0 BACKGROUND

In December 1980, the Nuclear Regulatory Commission (NRC) designated "Seismic Qualification of Equipment in Operating Plants" as Unresolved Safety Issue (USI) A-46. The safety issue of concern was that equipment in nuclear plants for which construction permit applications had been docketed before about 1972 had not been reviewed according to the 1980-81 licensing criteria for the seismic qualification of equipment, such as Regulatory Guide 1.100 (Reference 1), IEEE Standard 344-1975 (Reference 2), and Section 3.10 of the Standard Review Plan (NUREG 0800, July 1981) (Reference 3). To address USI A-46, affected utilities formed the Seismic Qualification Utility Group (SQUG) in 1982.

The NRC staff issued Generic Letter (GL) 87-02 in February 1987 (Reference 4) to provide guidance for the resolution of USI A-46. It concluded that the seismic adequacy of certain equipment in operating nuclear power plants should be reviewed against seismic criteria not in use when these plants were being constructed. In 1987, SQUG, representing its member utilities, committed to develop a Generic Implementation Procedure (GIP) for implementing the resolution of USI A-46. SQUG requested a deferment of the 60-day response period, as requested in GL 87-02, until after the NRC issues its final safety evaluation report (SER) on the final version of GIP.

On May 22, 1992, the staff issued Supplement No. 1 to GL 87-02 which transmitted its final SER (SSER No. 2, Reference 5) on the final version of GIP (GIP Revision 2, as corrected on February 14, 1992, or simply GIP-2, Reference 6). In the supplement to GL 87-02, the staff requested that USI A-46 licensees who are members of SQUG to either provide a commitment to use both the SQUG commitments and the implementation guidance described in GIP-2, as supplemented by the staff's SSER No. 2, or provide an alternative method for responding to GL 87-02. In its letter, dated September 18, 1992 (Reference 7), Vermont Yankee Nuclear Power Corporation (VYNPC), the licensee for Vermont Yankee Nuclear Power Station (VY) and a member of SQUG, committed to both the SQUG commmitments and the implementation of GIP-2 for resolving USI A-46 at VY plant. The NRC subsequently approved the licensee's approach and schedule in a letter dated November 12, 1992 (Reference 8).

By letter dated July 1, 1996 (Reference 9), the licensee submitted a report summarizing the results of its USI A-46 implementation program. The staff reviewed the report and issued a request for additional information (RAI) on January 29, 1998 (Reference 10). The licensee subsequently submitted its response to the RAI in a letter dated July 17, 1998 (Reference 11).

This report provides the staff evaluation of the licensee's USI A-46 implementation program based on the staff's review of the summary report, supplemental information and clarification provided by the licensee in response to the staff's RAI.

2.0 DISCUSSION AND EVALUATION

The staff's review of the Vermont Yankee USI A-46 summary report (Reference 9) consisted of a screening-level review of specific sections of the licensee's program, with emphasis placed on identification and resolution of outliers, i.e., equipment items which did not readily pass GIP-2 screening and evaluation criteria. The summary report identifies a safe shutdown equipment list (SSEL) and contains the screening verification and walkdown of mechanical and electrical equipment. The summary report also contains relay evaluations and the evaluation of the seismic adequacy for tanks and heat exchangers, cable and conduit raceways, and the identification and resolution of outliers, including the proposed resolution schedules.

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

The design ground response spectrum (GRS) for the site is a Housner spectrum. The horizontal components are normalized to a peak ground acceleration of 0.07g. This ground motion is defined as the design basis earthquake and is equivalent to the operating basis earthquake (OBE). The time history used to develop the spectrum is the N69W component of the Taft recording of the 1952 Kern County earthquake. The response spectra of the horizontal components of the maximum hypothetical earthquake, which is equivalent to the safe shutdown earthquake (SSE), are twice those of the OBE. The SSE has a peak ground acceleration of 0.14g. The vertical component of ground motion is two thirds of the horizontal component.

The criteria and the procedure used in the generation of the in-structure response spectra (IRS) are described in Section 2.2 of the Seismic Evaluation Report (Reference 9). These IRS are the licensing basis spectra and are the same spectra referenced in the licensee's 120-day response submitted to NRC dated September 18, 1992 (Reference 7). In generating the IRS for the reactor building (including the primary containment and reactor vessel), control building, turbine building, and intake structure, linear elastic lumped-mass models were developed. Lumped-mass points are generally located at major floor elevations and represent the weight distribution of the structure and its equipment. At the time of 120-day review, the staff accepted the licensee's determination that the IRS is "Conservative Design." The staff finds that the licensee's approach for determining equipment seismic demand for the USI A-46 program is consistent with GIP-2 and the staff's previously-approved IRS and is, therefore, acceptable for use in the resolution of USI A-46 at VY.

2.2 Seismic Evaluation Personnel

The screening verification, walkdown, and outlier identification were performed by a Seismic Review Team (SRT) comprising Seismic Capability Engineers as defined in GIP-2. GIP-2 describes the responsibilities and qualifications of the individuals who will implement this generic procedure. For a complete resolution of the USI A-46 issue, the seismic evaluation personnel should include individuals with sufficient expertise to identify the safe shutdown equipment, perform the plant walkdown, verify the seismic adequacy of equipment and cable/conduit raceway systems, and perform the relay screening and evaluation. This involves a number of plant and engineering disciplines including structural, mechanical, electrical, system, earthquake, and plant operations. Based on the information provided in Appendix A and Appendix D to the licensee's Seismic Evaluation Report, the staff concludes that the qualifications of the individuals responsible for implementing the resolution of USI A-46 at Vermont Yankee, including the third party reviewers, meet the criteria of GIP-2 and the staff's SSER No. 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 it in, a hot shutdown condition during the first 72 hours following an SSE. To meet this provision, in its submittal of July 1, 1996 (Reference 9), the licensee addressed the following plant safety functions: reactor reactivity control, pressure control, inventory control, and decay heat removal. The licensee identified 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 during the first 72 hours following an SSE. Appendix B to Reference 9 provides the SSEL.

The reactor decay heat removal function is accomplished by relieving steam from the reactor via the main steam safety relief valves (SRVs) at their respective set points into the suppression pool. During the early stages, the reactor inventory is controlled by the high pressure coolant injection (HPCI) which takes suction from the condensate storage tank and the suppression pool. The SRVs are designed to be capable of manual actuation to reduce reactor pressure to below the low pressure permissives of the residual heat removal (RHR) systems. The decay heat removal is achieved by placing the RHR system in the suppression pool cooling (SPC) mode of operation. During the SPC mode of RHR, the RHR system takes suction from the suppression pool, pumps it through the RHR heat exchangers and returns it to the suppression pool via the full flow test line. The service water system provides the capability to transfer the decay heat from the RHR system to the ultimate heat sink.

The plant operations department reviewed the equipment listed in Appendix B 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 during the first 72 hours following a seismic event is acceptable for the resolution of USI A-46 at VY because it meets GIP-2 provisions.

2.4 Seismic Screening Verification and Walkdown of Mechanical and Electrical Equipment

The staff's evaluation focused primarily on the licensee's identification and resolution of equipment outliers, i.e., equipment items which do not comply with all of the screening guidelines provided in GIP-2. GIP-2 screening guidelines are intended to be used as a generic basis for evaluating the seismic adequacy of equipment. If an item of equipment fails to pass these generic screens, it may still, however, be shown to be adequate by additional evaluations. The majority of screening verifications and walkdowns were performed prior to and during the spring 1995 refueling outage. The four basic screens used to evaluate each piece of equipment are described below.

2.4.1 Equipment Seismic Capacity Compared to Seismic Demand

As a first screening guideline, the licensee compared the seismic capacity and seismic demand for the equipment in the SSEL. In accordance with GIP-2 the seismic capacity is based on the SQUG earthquake experience data base as represented by the bounding spectrum (BS), 1.5 times the BS (Reference Spectrum), or the generic seismic testing data as represented by the generic equipment ruggedness spectra (GERS). The seismic demand is represented by the plant's SSE GRS and both the conservative design IRS and median-centered IRS. There are five GIP-2 methods for comparing equipment seismic capacity to the seismic demand. Method A.1 compares the SQUG BS to the SSE GRS. Method A.2 compares the GERS to 2.25 times the SSE GRS. Method B.1 compares 1.5 times the BS (Reference Spectrum) to the conservative design or to the median-centered SSE IRS. Method B.2 compares the GERS to conservative design SSE IRS. Method B.3 compares the GERS to 1.5 times the median-centered SSE IRS.

The licensee estimated the seismic capacity of safe shutdown equipment using: (1) earthquake experience data with capacity defined by the SQUG BS or 1.5 times the BS, (2) generic seismic test data which have been compiled into GERS, or (3) equipment-specific test and/or analysis data using seismic qualification techniques which are similar to those used in newer nuclear power plants.

GIP-2 places limitations on the use of Method A.1. These limitations are that the SSE ground response spectrum can be used for comparison to the Bounding Spectrum when: (1) the equipment is mounted in the nuclear plant at an elevation below about 40 feet above the effective grade, (2) the equipment, including its supports, has a fundamental natural frequency greater than about 8 Hz, and (3) the amplification factor between the free field ground response spectrum and the in-structure response spectra is not more than about 1.5. The NRC staff's review of the ratio of VY IRS to the ground response spectrum at locations where GIP-2 Method A.1 was used indicated that the amplification factors, above 8 Hz at some locations, appear to be significantly above the 1.5 limit set by GIP-2. In a telephone conference call, on August 11, 1999, the staff requested that the licensee provide a building specific justification for the use of Method A.1 at the locations where the amplification significantly exceeds the 1.5 limit above 8 Hz.

The licensee sent a letter to the NRC, dated October 29, 1999 (Reference 16), in response to the staff's request for information. In the letter the licensee stated that it used Method A.1 for determining seismic demand in the following locations: Reactor Building up to elevation 280

feet, Drywell up to elevation 269 feet, Turbine Building up to elevation 272 feet-6 inches, Intake Structure up to elevation 237 feet-6 inches, and Control Building up to elevation 272 feet-6 inches. The IRS for these buildings had been submitted to the NRC in Reference 17. Descriptions of the buildings and the methods used for computing the IRS were provided in References (7) and (17). These spectra and the method by which they had been developed had been reviewed and determined to be conservative design spectra by the NRC (Reference 8).

If the IRS provided by VY in Reference (11) at the elevations where Method A.1 was used are compared to the GRS at frequencies of 8 Hz and above, the following amplifications were noted:

Building	Elevation (feet)	Amplification Factor (IRS/GRS)
Reactor	280	4.6
Drywell	269	5.3
Turbine	272.5	3.7
Intake	237.5	5.6
Control	272.5	1.7

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 18 presents information developed by the SQUG to demonstrate the factors of conservatism between median centered and design IRS in nuclear power plants. The structures discussed in Reference 18 are reinforced concrete shear wall structures. The VY structures are also reinforced concrete shear wall structures. The ratios of the conservative design spectra to median-centered spectra in Reference 18 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 Ginna structures if median-centered spectra were developed for locations in Ginna where Method A.1 was used.

VY followed a procedure, similar to the procedure used for Ginna, to estimate building specific amplification factors. The licensee estimated building specific amplification factors, expressed as the ratio of median-centered IRS to the GRS for each VY building applying the 3.77 mean factor of conservatism to the amplifications in the above table for the Reactor, Drywell, Turbine and Intake structures. This yields the following:

Building	Elevation (feet)	Amplification
Reactor	280	1.2
Drywell	269	1.4
Turbine	272	1.0
Intake	237	1.5

The amplification factor for the Control Building design IRS over the GRS is about 1.5. The licensee was able to demonstrate that if there were median centered IRS developed for the other 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 findings, the staff considers the use of Method A.1 acceptable at those locations to verify the

adequacy of SSEL components for USI A-46. Therefore, the staff concludes that the equipment seismic capacity to seismic demand comparison for VY is acceptable for the USI A-46 program.

2.4.2 Assessment of Equipment Caveats

As a second screening guideline, the licensee verified the seismic adequacy of an item of mechanical or electrical equipment by determining that (1) the equipment characteristics are generally similar to the earthquake experience equipment class or generic seismic testing equipment class, and (2) the equipment meets the intent of the specific caveats for the equipment class, if the SQUG BS or GERS are used to specify the seismic capacity.

The “caveats” are defined as a set of inclusion and exclusion rules, which are established to represent specific characteristics and features particularly important for seismic adequacy of a particular class of equipment. Appendix B of GIP-2 contains a summary of the caveats for the earthquake experience equipment class and for the generic seismic testing equipment class.

Another aspect of verifying the seismic adequacy of equipment included within the scope of this procedure is explained by the "rule of the box." For the equipment included in either the earthquake experience or equipment testing class, all of the components mounted on or inside this equipment are considered to be part of that equipment and do not have to be evaluated separately.

The licensee has identified a few equipment items which have characteristics outside the bound of the above defined caveats. The licensee has identified these equipment items as outliers in Table 5-4 of its Seismic Evaluation Report.

When evaluating an equipment item, engineering judgment was often used to determine whether the specific seismic concern addressed by the caveat was met. Each item of equipment has been evaluated to determine whether it meets the specific wording of the applicable caveats or their intent. If an equipment item was judged to have met the intent, but not the specific wording of the caveats, that item would still be considered to have met the caveat.

At VY, a few interpretations were relied upon in situations where the intent of GIP-2 caveats was used. Those interpretations or measures taken to meet the intent of the caveat are provided by the licensee in Table 5-3 of the Seismic Evaluation Report. The staff has reviewed the information provided in the table and found the SRT’s interpretations and measures to meet the intent of GIP-2 caveats acceptable for USI A-46 implementation at VY.

2.4.3 Equipment Anchorages

As a third screening guideline, the licensee described in Section 5.3 of the Seismic Evaluation Report the procedure used for verifying the seismic adequacy of equipment anchorages. The licensee evaluated the anchor bolts for the VY tanks and heat exchangers as well as cable tray supports. The evaluations were performed in accordance with the GIP-2 guidelines provided in Sections 7 and 8, respectively. Most of the outliers are minor in nature and have been resolved by physical modifications. Resolution of others were deferred to a later date (see Section 2.8

below). The staff found that the licensee's method of evaluation for the anchor bolts are acceptable for USI A-46 implementation at VY because they were done in accordance with the GIP-2 provisions.

2.4.4 Seismic Spatial Interaction Evaluation

As a final screening for the seismic adequacy of mechanical or electrical equipment, the licensee addressed potential spatial interaction effects for the equipment in Section 5.4 of the Seismic Evaluation Report. This serves to ensure that there is no adverse seismic spatial interaction between the SSEL equipment under consideration and nearby equipment, systems, and structures which could cause the equipment to fail to perform its intended safe shutdown function. The interactions of concern are (1) proximity effects, (2) overhead or adjacent equipment failures, and (3) flexibility of attached lines or cables. Guidelines for judging potential interaction effects, when verifying the seismic adequacy of equipment, are presented in Appendix D of GIP-2.

During the plant walkdowns at VY, the SRT identified a few interaction concerns, primarily due to potential interactions with adjacent equipment components or piping. Potential interactions due to inadequate supports of steam heating units located above cabinets were also identified. In addition, some nitrogen cylinders were not adequately supported which posed an interaction concern to the attached manifold. These are included in Table 5-4 of the Seismic Evaluation Report as outliers. The resolution and schedule for outliers is discussed in Section 2.9 below.

2.5 Tanks and Heat Exchangers

Section 6 of the Seismic Evaluation Report contains the guidelines provided in Section 7.2 of GIP-2, for the evaluation of SSEL tanks and heat exchangers. The licensee stated that the only SSEL tanks or heat exchangers which were evaluated to the step-by-step methodology of GIP-2 are the Condensate Storage Tank (CST-TK-4-1A) and the Fuel Oil Storage Tank (FOST-TK-40-1A). Both have been found to be seismically adequate per the evaluation guideline of GIP-2. Evaluations of other tanks followed the general guidelines of GIP-2 and other engineering practice. The evaluation performed for each item included:

(1) Shell buckling potential.
(2) Anchorage adequacy.
(3) Load path and connection strength between either the tank or heat exchanger and its anchorage.
(4) The flexibility and applied loads of attached piping.
(5) Seismic interactions.

The step-by-step methodology employed in evaluating the two tanks noted above has been reviewed and approved by the staff. The rest of the evaluation methodology discussed above is also acceptable to the staff because it is also based on the GIP-2 guideline and they are commonly practiced in engineering evaluation.

Several outliers were identified in Table 5-4 of the Seismic Evaluation Report. The table includes two cases of seismic interaction. A total of six cases did not meet the GIP-2 anchorage criteria. Two Diesel Fuel Oil Tanks did not meet the AISC design criteria. The

resolution and schedule for outliers is discussed in Section 2.9 below. The staff finds the evaluation of the tanks and heat exchangers acceptable for the resolution of USI A-46 at VY.

2.6 Cable and Conduit Raceways

The safety class cable trays at VY are supported for dead weight using a variety of support geometries. The majority of the tray runs are supported from above using cantilever bracket type supports. Seismic supports were added to the cable tray runs in the Reactor Building. The seismic supports provide lateral support to long horizontal runs and are typically spaced 24 to 26 feet apart.

The licensee stated that the raceway review was performed as specified in Section 8 of GIP-2. The review included walkdowns, limited analytical reviews of the representative worst-case raceways as well as examinations of seismic spatial interaction with adjacent equipment and structures. The analysis was based on as-built dimensions. Review of the licensee sample calculations (Reference 12) for the limited analytical review as well as overall raceway evaluation indicated that the licensee followed the GIP-2 guidelines satisfactorily.

No outliers were found for the spacial interaction of the cable tray support system. However, there were several other types of outliers identified in the licensee's evaluation; and they are listed in Table 7-1 of the Seismic Evaluation Report (Reference 9). The resolution and schedule for these outliers is discussed in Section 2.9 below. The cable and conduit raceway's review followed the GIP-2 criteria and is acceptable for the resolution of USI A-46 at VY.

2.7 Essential Relays

A review of the relays associated with safe shutdown equipment is required as part of the resolution of the USI A-46 programs. The purpose of the relay review is to verify that safe shutdown systems would not be prevented from performing their safe shutdown functions because of relay (contact) chatter during the period of strong ground motion associated with an SSE.

The relay review methodology used at VY consists of a step-by-step procedure to screen and evaluate relays. Systems, associated circuits, and relays which must remain functional during and immediately after an earthquake were first identified. Relay functionality reviews were then performed for safe shutdown equipment to verify that safe shutdown systems would not be prevented from performing their safe shutdown functions as a result of relay (contact) chatter during the period of strong ground motion associated with an SSE. Those relays whose temporary malfunction (contact chatter or change of state) would not prevent safe shutdown of the plant were screened out, as non-essential relays, utilizing system and circuit evaluation techniques.

The scope of the relay functionality reviews included components which formed a subset of the SSEL. All equipment on the SSEL which could inadvertently change state, operate, or not operate due to relay chatter in the control circuits of the equipment were reviewed for acceptability. Appendix C of the Seismic Evaluation Report (Reference 9) includes a copy of the Relay Review Safe Shutdown List (Relay Review SSEL).

For VY, a basis was determined for each component on the Relay Review SSEL as to whether it was acceptable to inadvertently change state, operate or not operate. Based on this and the screening criteria described in GIP-2, a detailed circuit review for each component on the Relay Review SSEL was performed to obtain a list of essential relays.

Vulnerable relays, where it was determined that the results of contact chatter were unacceptable, were included on the essential relay list in Appendix C.

The SRT used the list of essential relays and associated data, identified in the above process, to compare the capacity of the relays to their seismic demand. Essential relays with no applicable GERS, for which the specific amplification factor had to be determined, or with capacity less than demand, were identified as relay outliers. These relay outliers are listed in Table 8-1 of the Seismic Evaluation Report.

The staff determined that the licensee's approach for the relay review has met the GIP-2 criteria and is, therefore, acceptable for resolution of USI A-46 at VY.

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 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, the 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 walk-down of actions required by plant procedures.

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).

The licensee provided information which outlined the use of the desk-top and simulator evaluation 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 safe shutdown condition. The shutdown paths selected were reviewed by the VY operations staff and determined that the procedures would provide adequate guidance to the operators in response to a seismic event. The licensee provided assurance that ample time would exist for operators to take the required actions to safely shut down the plant. This had been previously accomplished during validation of the pertinent plant operating procedures related to the licensee's Updated Final Safety Evaluation Report, Chapter 14, Accident Analysis for the Loss of Offsite Power transient. The licensee stated that since these plant procedures had already been validated to ensure adequate time and resources are available for operators to respond to the analyzed transients, it was not 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 and training department instructors verified that all actions necessary to safely shutdown the plant were included in existing normal, abnormal, and emergency operating procedures. The licensee 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 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 operator's 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 desktop and simulator evaluations and as part of the A-46 review. The review determined that there were no newly required local operator actions introduced as a result of the A-46 safe shutdown path selected.

In addition, the licensee explicitly evaluated the potential for local failure of architectural features and the potential for adverse spatial 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, a potential control room interaction source was identified associated with non-restrained equipment (e.g., overhead suspended ceiling, heating, ventilation, and air conditioning duct work, electrical conduit and cabling, file cabinets and bookcases, furniture and non-essential operator aids such as computer equipment). The licensee stated that these issues have been evaluated and corrected by relocating or removing the hazard, or upgrading the anchorage of the equipment to preclude any interaction. 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 eliminated as a potential barrier to successful operator performance.

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

2.9 Outlier Identification and Resolution

As stated previously, an outlier is defined as an item of equipment which does not meet GIP-2 screening guidelines. An outlier may be shown to be adequate for seismic loadings by performing an additional evaluation using alternate methods or seismic qualification techniques acceptable to the staff. Based on the screening criteria stated in Section 2.4, a number of equipment items were designated as outliers during the walkdowns by the SRT and are identified in Table 5-4 of the Seismic Evaluation Report. Tanks and heat exchangers which were designated as outliers are also included therein. In addition, a summary of the limited analytical reviews including identified outliers for conduit and cable tray is provided in Table 7-1 of the Seismic Evaluation Report. Conduit and cable tray outliers identified during the plant walkdowns are listed in Table 7-2 of the report.

As stated in the Seismic Evaluation Report, the licensee followed the guidelines provided in GIP-2 for outlier resolution. The licensee committed to complete resolution for all the A-46 outliers prior to the plant startup from the 1999 refueling outage. During a teleconference on July 26, 1999, the staff requested the licensee to provide a written summary, by equipment category, of the then current status of efforts to resolve the remaining A-46 outliers. By letter dated July 30, 1999 (Reference 13), the licensee provided the staff with the following updated information at the time.

Electric Equipment

For the physical modifications that would be made to electrical equipment, the majority of the design packages had been prepared, reviewed and approved by station management, and the installation and test procedures had been written.

Mechanical Equipment

Approximately 80% of the required physical modifications had been completed, and the remaining 20% were in the modification package development stage.

Cable Trays

The required physical modifications had been conceptually scoped and walkdowns had been completed. The modification packages were under development.

Tanks and Heat Exchangers

Physical modifications had been completed on two Diesel Fuel Oil Day Tanks, and remained to be done on the HPCI gland seal condenser and exchanger. The HPCI modification packages had been finalized, and the installation and test procedures were being prepared.

Refined analysis had been performed and was being checked for the RHR heat exchangers, RHR pumps, core spray pumps, and RHR service water pumps.

Relays

All but one (1) of the outlier relays had been resolved. The remaining outlier requires a physical modification. Conceptual scoping and walkdown for the modification had been completed, and the modification package was being developed.

The licensee reconfirmed in Reference 13 that these efforts were on track to be completed by the end of the Fall 1999 refueling outage, scheduled to begin on October 29, 1999.

By letter dated January 28, 2000 (Reference 19), the licensee confirmed that as of the December 3, 1999, plant startup date, VY had completed all physical modifications and analytical work necessary to resolve all the remaining outliers. This is acceptable to the staff.

The staff also reviewed the peer review report attached to the Seismic Evaluation Report. Based on their review, the peer reviewers concluded that the VY A-46 implementation has been done in accordance with GIP-2, and the walkdowns conducted have been thorough and well documented. This is acceptable to the staff.

In regard to the use of the Seismic Margin Assessment (SMA) methodology, described in EPRI Report NP-6041-SL (Reference 14), the staff indicated in its RAI of January 29, 1998 (Reference 10), that the conservatism of the SMA methodology is not certain at this time. Its application is, therefore, not endorsed by the NRC for the analysis of safety-related systems and components, including the resolution of mechanical, electrical, and structural component outliers in the USI A-46 program. The licensee was requested to reevaluate the portion of the A-46 program where the above methodology had been used. The licensee subsequently responded in its July 17, 1998 submittal (Reference 11), that VY had not used any analytical methods presented in EPRI NP-6041 to resolve outliers. This is acceptable to the staff.

In its July 17, 1998 submittal (Reference 11), the licensee also indicated that for those outliers which have not already been resolved, the resolution is scheduled for completion prior to startup from the 1999 refueling outage. The licensee further stated that all components classified as outliers were subject to additional screening to ensure operability and conformance with established seismic design and licensing bases. The licensee stated that the Seismic Capability Engineers (SCEs) that performed the walkdown inspections are knowledgeable and well-versed in plant specific licensing and design basis, Technical Specifications and operation requirements, and plant procedures. Any items of safety significance which were identified by the SCEs during the walkdowns were promptly entered into VY's corrective action process, assessed for immediate operability concerns, and dispositioned through this formal process. As an example, a number of Motor Control Centers

(MCCs) were found to have suspected anchorage features; and, as a result of the process discussed above, modifications were promptly designed and installed to resolve this concern. The staff found the above licensee's provision for assuring the operability of A-46 equipment components to be acceptable.

3.0 SUMMARY OF MAJOR STAFF FINDINGS

Based on the staff review of References 9, 11, 12 and 13, the staff found that the licensee's USI A-46 program has, in general, followed GIP-2 guidelines, and that no programmatic or significant deviations from the guidelines were made during the USI A-46 resolution process at VY. The staff found that the licensee's approach for determining equipment seismic demand is consistent with GIP-2 and the staff's previously approved IRS and is, therefore, acceptable.

4.0 CONCLUSIONS

In general, the licensee conducted the USI A-46 implementation in accordance with GIP-2. The licensee's USI A-46 implementation program did not identify any instance where the operability of a particular system or component was called into question. The staff's review of the licensee's implementation program did not reveal any significant findings that would suggest inadequacy of the licensee's USI A-46 program in light of the GIP-2 guidelines. According to the earlier licensee commitment, resolution of all outliers was projected to be completed prior to the plant startup from the 1999 refueling outage. By letter dated January 28, 2000 (Reference 19), the licensee confirmed that as of the December 3, 1999, plant startup date, VY had completed all physical modifications and analytical work necessary to resolve the remaining outliers.

The staff concludes that the licensee'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 for the resolution of USI A-46. The staff has determined that the licensee's already completed actions will result in safety enhancements which, in certain aspects, are beyond the original licensing basis. As a result, the licensee's actions provide sufficient basis to close the USI A-46 review at the facility. The staff also concludes that the licensee's implementation program to resolve USI A-46 at the facility has adequately addressed the purpose of the 10 CFR 50.54(f) request. Licensee activities related to the USI A-46 implementation may be subject to NRC inspection.

Regarding future use of GIP-2 in licensing activities, the licensee may revise its licensing basis in accordance with the guidance in Section 1.2.3 of the staff's SSER No. 2 on SQUG/GIP-2, and the staff's letter to SQUG's Chairman, Mr. Neil Smith on June 19, 1998 (Reference 15). 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 unreviewed 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. Regulatory Guide 1.100, “Seismic Qualification of Electric and mechanical Equipment for Nuclear Power Plants,” Revision 2, 1987.

2. IEEE Standard 344-1975, “IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations,” dated January 31, 1975.
3. NRC Standard Review Plan (NUREG-0800), Section 3.10, “Seismic and Dynamic Qualification of Mechanical and Electrical Equipment,” Revision 2, July 1981.

4. NRC Generic Letter GL 87-02, “Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46,” February 1987.

5. “Supplemental Safety Evaluation Report No. 2 on Seismic Qualification Utility Group’s Generic Implementation Procedure, Revision 2, corrected February 14, 1992.”

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

7. Letter, VYNPC to NRC Document Control Desk, “VYNPC Response to Supplement 1 to Generic Letter 87-02 on SQUG Resolution of USI A-46,” BVY 92-112 dated September 18, 1992.

8. Letter, NRC to VYNPC, “VYNPC Evaluation of 120-Day Response to Supplement 1 to Generic Letter 87-02,” dated November 12, 1992.

9. Letter, VYNPC to NRC Document Control Desk, “Vermont Yankee Summary Report for Resolution of USI A-46,” dated July 1, 1996.

10. Letter, NRC to VYNPC, “Request for Additional Information Regarding the Resolution of Unresolved Safety Issue A-46,” dated January 29, 1998.

11. Letter, VYNPC to NRC Document Control Desk, “VYNPC Response to Request for Additional Information Regarding the Resolution of Unresolved Safety Issue A-46,” dated July 17, 1998.

12. Letter, VYNPC to NRC Document Control Desk, “VYNPC Response to Request for Additional Information Regarding the Resolution of Unresolved Safety Issue A-46,” dated February 2, 1999.

13. Lettter, VYNPC to NRC Document Control Desk, “VYNPC Response to Request for Information Regarding the Status of Resolution for USI A-46 Outliers,” dated July 30, 1999.

14. EPRI Report NP-6041-SL, “A Methodology for Assessment of Nuclear Power Plant Seismic Margin (Revision 1),” dated August 1991.

15. Letter, NRC to Neil Smith, “Incorporation of the Generic Implementation Procedures into the Licensing Basis,” dated November 26, 1997.

16. Letter, VYNPC to NRC Document Control Desk, “VYNPC Response to Request for Information Regarding *Verification of Seismic \Adequacy of Mechanical and Electrical Equipment,” dated October 29, 1999.

17. Letter, VYNPC to NRC Document Control Desk, “Supplemental Information Regarding VYNPC Response to Generic Letter 87-02 Supplement 1 on SQUG Resolution of USI A-46,” BVY 92-113 dated September 18, 1992.

18. 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.

19. Letter, VYNPC to NRC Document Control Desk, “Closeout for Resolution of USI A-46 Outliers,” dated January 28, 2000.

Principal Contributors: A. J. Lee, DE/EMEB
S. Kim, DE/EMEB
R. Rothman, DE/EMEB

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