May 17, 2012

MEMORANDUM TO: Charles R. Ogle, Director
Division of Construction Inspection
Region II

FROM: Sher Bahadur, Deputy Director ***/RA/***
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: FINAL RESPONSE TO TASK INTERFACE AGREEMENT 2011-012, WATTS BAR, UNIT 2, SEISMIC QUALIFICATION OF HEINEMANN MOLDED CASE CIRCUIT BREAKERS

By letter dated August 19, 2011 (Agencywide Documents Access and Management System Accession No. ML11238A057), the U.S. Nuclear Regulatory Commission (NRC), Region II Office, requested technical assistance from the Office of Nuclear Reactor Regulation (NRR) to address the following questions about the seismic qualification of Heinemann Electric Canada, Co. Ltd., molded case circuit breakers (MCCBs) at Watts Bar Nuclear Plant, Unit 2. Region II requested NRR's technical assistance to address the above issue by providing answers to the following Task Interface Agreement (TIA) questions:

1. Has TVA [Tennessee Valley Authority] met or adequately evaluated the requirements in Section 6.4, "Device Testing," of Institute of Electrical and Electronics Engineers Standard 344-1975, "Recommended Practice for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations," for the 1992 seismic qualification of the MCCBs?

2. Has TVA adequately evaluated configuration and control issues and differences that would allow it to maintain the validity of the 1975 qualification testing? Is TVA's current configuration and justification adequate to meet its design and licensing basis?

3. Are the most limiting seismic responses on the panel required to be determined for future device testing of the MCCBs, and has TVA adequately determined them? (Discuss any regulations or standards that would require the most adverse conditions to be analyzed during testing.)

This TIA request is related to the adequacy of corrective actions associated with NRC Region II Notice of Violation 05000391/2010603-08 issued for failure of TVA to adequately evaluate and qualify the MCCBs. The NRR staff's assessment is documented in the enclosed evaluation.

Enclosure:
As stated

CONTACT: Holly D. Cruz, DPR/PLPB
(301) 415-1053

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TASK INTERFACE AGREEMENT 2011-012

WATTS BAR NUCLEAR PLANT, UNIT 2

SEISMIC QUALIFICATION OF HEINEMANN MOLDED CASE CIRCUIT BREAKERS

1.0 INTRODUCTION

By letter dated August 19, 2011 (Agencywide Documents Access and Management System Accession No. ML11238A057), the U.S. Nuclear Regulatory Commission (NRC), Region II Office, requested technical assistance from the Office of Nuclear Reactor Regulation (NRR) to address the following questions about the seismic qualification of Heinemann Electric Canada, Co. Ltd., molded case circuit breakers (MCCBs) at Watts Bar Nuclear Plant (WBN), Unit 2. Region II requested NRR's technical assistance to address the above issue by providing answers to the following Task interface Agreement (TIA) questions:

1. Has TVA [Tennessee Valley Authority] met or adequately evaluated the requirements in Section 6.4, "Device Testing," of Institute of Electrical and Electronics Engineers [(IEEE)] Standard 344-1975, "Recommended Practice for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations," for the 1992 seismic qualification of the MCCBs?

2. Has TVA adequately evaluated configuration and control issues and differences that would allow it to maintain the validity of the 1975 qualification testing? Is TVA's current configuration and justification adequate to meet its design and licensing basis?

3. Are the most limiting seismic responses on the panel required to be determined for future device testing of the MCCBs, and has TVA adequately determined them? (Discuss any regulations or standards that would require the most adverse conditions to be analyzed during testing.)

This TIA request is related to the adequacy of corrective actions associated with NRC Region II Notice of Violation (NOV) 05000391/2010603-08 issued for failure of TVA to adequately evaluate and qualify the MCCBs.

2.0 BACKGROUND

Region II is concerned that TVA's application of the IEEE standard during device testing does not adequately assess modifications to the mounting in the switchgear since its initial qualification in 1975. Specifically, Region II is concerned that the combination of the 1975 test and the 1992 test does not adequately evaluate the potential impact loads and accelerations on the MCCBs since their current configuration lacks rigidity within the switchgear. In the event of a design-basis earthquake, the shakes, rattles, and bangs (MCCBs against the front panel of the switchgear and rear angles) imparted by the inservice clamped hardware could induce impact forces to the MCCBs that are not accounted for in the 1975 configurations. Region II is concerned that, based on the required response spectrum (RRS), the expected acceleration from a design-basis earthquake of the uppermost row of MCCBs could be greater than 2.72g, which could reduce or eliminate the margins assumed by TVA.

ENCLOSURE

The 1992 test configuration did not simulate the clamped configuration of TVA's MCCBs and, therefore, did not follow the guidance in Section 6.1.1 or Section 6.4 of IEEE 344-1975 in this case.

Region II noted that TVA's test, based on Calculation No. WCG2893, "Determination of Test Load for Heinemann Breaker Walkdown," Revision 0, dated February 21, 2011, did not include additional forces arising from the mounting hardware's mass and flexibility. As such, TVA had not calculated the additional seismic loads on the MCCBs. Region II is concerned that the test and calculation are insufficient to determine whether the MCCBs would move under design-basis conditions, and that the additional loads of the mounting hardware could introduce impact forces to the MCCBs that could degrade performance of their intended safety function. Region II noted that the MCCBs do not fit into the 120 volts-alternating-current (VAC) vital instrument power boards as shown in the design specifications. TVA made undocumented changes to the mounting hardware of the MCCBs by installing bushings and filler material to compensate for not fitting as designed. Region II is concerned that this un-analyzed configuration provides additional variables that create uncertainties that were not accounted for in the original 1975 qualification.

During the 1975 test, TVA installed some instrumentation to monitor accelerations at different locations on the switchgear. The instrumentation indicated that higher accelerations were recorded at locations further up from the base of the switchgear (the switchgear is mounted firmly to the floor). The 1975 test measurement of 2.72g was recorded at a location on the bolted panel board that was 13 inches below the upper bolted panel of MCCBs and not on the MCCBs themselves. TVA had not installed instrumentation at the elevation of the top-most row of MCCBs, and it had not performed an analysis to extrapolate the accelerations seen at the upper location. The test also demonstrated that accelerations on welded panels (those not containing MCCBs) were lower than accelerations recorded on the MCCB's bolted panels.

In 1992, TVA procured replacement MCCBs that were manufactured by Heinemann as commercial-grade MCCBs. TVA performed a seismic qualification test of the replacement MCCBs using the highest midlevel (left side of the front panel) recorded acceleration from the 1975 test (2.72g), plus a 0.28g margin equal to 3.0g. TVA used a mounting method in a 1992 device-testing qualification (i.e., MCCBs fastened with four 6x32 cap screws to a test fixture) that seismically qualified the MCCBs. The issue was documented as an unresolved item. In 2009, TVA again procured additional commercial MCCBs that were also manufactured by Heinemann that had modifications to the critical characteristics (dimension) without a change to the MCCB model number. TVA claimed that the 1992 qualification also envelops these modified MCCBs.

TVA's contractor performed qualification testing of the 120-VAC vital instrument power board (switchgear) assembly by testing a prototype of the Westinghouse Panel Board Qualification in 1975. Region II notes that the records for that test do not clearly indicate which configuration was tested and which assembly is installed at WBN Unit 2. For example, the drawing for the test shows 12 MCCBs that protrude through a single 36 inch front panel to allow operation of the switches. In the drawings, the MCCBs are clamped between the horizontal front panel and two 1¼" x 1¼" x 3/16" x 3'-0" long steel angles (one upper and one lower) on the back. The drawings illustrate that the "clamping" pieces of steel angles are horizontal and bolted solidly to the vertical frame of the switchgear. This design shows that the MCCBs should fit between the front cover and the two rear angles, allowing a consistent compression against each MCCB and

a greater tensioning of the angle's bolts without deforming the angles. This condition cannot be achieved with the switchgear as it currently exists in the field. The actual field condition appears to allow for movement of the "clamping" front panel and angles relative to the rest of the assembly that may not have been possible during the 1975 test. In addition, the as-installed bushings and foam used between the angles, frame, and the MCCBs do not appear on the drawings for the 1975 test configuration.

In the current configuration of the switchgear and MCCBs at TVA, two variations of the clamped configuration exist:

(1) In the first configuration, both the upper and lower angles slightly bow around the row of MCCBs as a result of the two end bolts being tensioned to draw the angles tight against the MCCBs. The angles in this configuration cannot be bolted tight against the frame without damaging the MCCBs because the MCCBs extend past the vertical frame of the switchgear.

(2) In the second configuration, the upper angle cannot be clamped tightly against the MCCBs because bushings are used as a standoff device at each end between the vertical frame and the angle (about 0.5 inch). In this second configuration, the lower angle has no bushings and is in the same configuration as the first configuration.

In both configurations, the observed deformation (bowing) shows that greater forces are applied to the two outside MCCBs. Region II is concerned that this condition may cause deformations in the MCCB bodies over time. In addition, both of these mounting configurations have multiple degrees of freedom that could expose the MCCBs to impact forces during a design-basis earthquake. TVA has tried to compensate for the observed angle bowing by inserting pieces of foam along the horizontal length of the angles, with a thicker layer of foam in the middle of the angle to compensate for the bow. There does not appear to be a consistent application of these mounting hardware configurations across the rows of MCCBs, and there is no design control documentation of the function and impact of the foam, bowing, or the upper angles installation with bushings. The Region is also concerned that the clamping force imparted by the bowed angles could decrease over time as vibrations loosen the bolts.

Region II evaluated TVA's resolution of historical corrective action program issues during an inspection at WBN Unit 2. The Region determined the existence of a violation closely related to the WBN Unit 1 unresolved item and issued an NOV because TVA failed to adequately address the problem under its current corrective action program.

Licensee's Position

TVA contends that it is in full compliance because the MCCBs unique clamped arrangement is a firmly fit arrangement that is the same as a device rigidly attached to a panel. TVA claims the mounting for the 1992 seismic qualification met the requirements of Section 6.4 IEEE 344-1975. TVA determined its RRS which is the most adverse condition that the MCCBs would experience by using the highest recorded accelerometer (2.72g) from a lower row of MCCBs during a 1975 panel board qualification test. TVA then, conservatively used 3.0g in its test response spectrum for evaluating future device testing, as in the 1992 tests. TVA contends that the recorded data are all that is necessary and that it should not be required to determine whether the test response spectrum actually envelops the uppermost row of MCCBs. TVA also presented a

seismic qualification reporting and testing standardization (SQURTS) summary data sheet that was an attachment to Generic Procurement Evaluation No. G5925-2-213 dated January 29, 1997, as an alternate means of qualification. The Region noted that the SQURTS summary was the same 1992 test in question but that it now has a SQURTS label. The summary also emphasized that during the 1992 test, TVA used four screws to mount the MCCBs, which were considered rigid, as recommended by the manufacturer. TVA contends that Calculation No. WCG2893, which is neither safety nor quality related, was adequate to determine that a test load of 10 pounds (a force based on the weight of each MCCB and the seismic acceleration, but not on the potential impact loads if the components within the switchgear move in relation to one another) could be used to demonstrate the seismic adequacy of the MCCBs. TVA WBN Unit 2 claims the fit is adequate because it applied a 10-pound force to each MCCB in one direction at a time during the last outage while visually inspecting the MCCBs for movement. Additionally, TVA contends that the several undocumented changes to the mounting hardware for the MCCBs in the switchgear (i.e., the installation of bushings and filler material in areas in which the MCCBs did not fit as originally designed) are considered installation aids and were accounted for in its analysis of the configuration. TVA did not change its final safety analysis report (FSAR), associated drawings, and procedures to reflect the changes.

3.0 EVALUATION

Question 1

Has TVA met or adequately evaluated the requirements in Section 6.4 of IEEE 344-1975 for the 1992 seismic qualification of the MCCBs?

Response

No. Section 3.7.3.16 of the WBN current licensing basis states that the WBN Category I electrical equipment seismic qualification program is consistent with the Standard Review Plan (SRP) Section 3.10 acceptance criteria for plants with construction permit applications docketed before October 27, 1972. The equipment has been seismically qualified either in direct compliance with IEEE 344-1975 and Regulatory Guide (RG) 1.100, “Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants” (equipment procured after September 1, 1974), or in accordance with a program that, at a minimum, provided qualification to the requirements in IEEE 344-1975 and that addressed the guidance in SRP Section 3.10.

Section 6.4 of IEEE 344-1975 states that: “the devices shall be tested simulating operating conditions to either the levels dictated by expected service requirements or to their ultimate capacity. The device shall be mounted on the shake table in a manner that dynamically simulates the recommended mounting. If a device is intended to be mounted on a panel, the panel should be included in the test mounting, or the response at the device mounting location should be monitored in the assembly test….”

In TVA Quality Assurance Record No. T49-921007-817, “Nuclear Environmental and Seismic Qualification for Heinemann Electric Company Circuit Breaker Part Number CF2-Z51-1,” Revision 0, dated October 6, 1992 (Report No. S522-RP-02), Table 2.1 (page 7), under “Test Specimen Mounting,” TVA states that “the circuit breaker was mounted on a Southern Testing Services, Inc. (STS) seismic test fixture utilizing four (4) 6-32 machine screws. Mounting

hardware for the seismic test was provided by Southern Testing Services, Inc. where the test fixture was bolted to the shaker table. In addition, Section 3.0, "Test Procedure" (page 10), states that "Seismic testing was performed on the STS seismic simulation test system. This test system is a pseudo-biaxial seismic test system where the direction of motion of the mounting platform is inclined at an angle of 45 degree from the horizontal. The mounting platform itself is parallel to the floor. A schematic diagram of the system is presented in Figure 3.2." The schematic indicated that the circuit breaker was mounted horizontally instead of vertically (operating condition), which does not support the TVA claim of a vertical mounting, and it was bolted instead of unbolted during the test (operating condition). Therefore, the 1992 test has failed to simulate the operating conditions recommended by Section 6.4 of IEEE 344-1975.

The second paragraph on page 10 of the same report states that "Based on a technical assessment of these devices by experienced laboratory personnel and on previous test results of similar devices, these specimens do not have any closely spaced modes of vibration within the seismic frequency range of excitation. Therefore, resonance of response in one mode of vibration will not add to or influence the responses in another mode of vibration...." However, IEEE 344-1975 Section 3.5 states that, "For equipment composed of an assembly of components, there is usually no single value of damping. Damping is associated with every part of the equipment ranging from bolted construction to uniform material. The value of damping may vary from place to place depending on the numerous other factors." Bolted panel construction produces impacts, rattling, chatter, or banging. These impacts are transmitted throughout the equipment and result in increased acceleration levels that could be higher than the original acceleration input to the shake table. A low frequency input thereby produces high frequency response that may adversely affect devices mounted in the equipment and must be considered in their qualification. Section 6.4 requires that devices be mounted on the shake table in a manner that dynamically simulates the recommended mounting. Again, the 1992 test has failed to simulate the operating conditions recommended by Section 6.4 of IEEE 344-1975, WBN FSAR Section 3.7.3.16, and RG 1.100.

Based on the above, the NRR staff finds that the licensee did not adequately demonstrate that it has seismically tested the existing MCCBs in accordance with IEEE 344-1975 or WBN FSAR Table 3.10-3, "Watts Bar Seismic Qualification," particularly for 120-VAC vital instrumentation power boards, and it did not provide reasonable assurance that WBN Unit 2 can operate as intended during seismic or abnormal situations.

Question 2

Has TVA adequately evaluated configuration and control issues and differences that would allow it to maintain the validity of the 1975 qualification testing? Is TVA's current configuration and justification adequate to meet its design and licensing basis?

Response

No (for both parts of the question). Criterion III of Appendix B to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 states that measures shall be established for the "review for suitability of application of materials, parts, and equipment that are essential to the safety-related functions of the structures, systems, and components. The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the

performance of a suitable testing program. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions." In a letter dated June 9, 2011, the licensee revised its responses to the NOV and stated the following:

- The qualification tests performed in 1974 and 1992 have been reviewed and determined to be consistent with the existing field condition.

- The breakers have been determined to be rigidly locally mounted in the boards.

- The breakers have been confirmed to be properly mounted with respect to the bezel properly protruding through the panel opening and with respect to the breaker being rigidly (tightly) locally mounted. Any breakers not meeting these conditions were repaired to be acceptable.

- For WBN Unit 2, dense foam strips that were not shown on design output were replaced with ethylene propylene diene monomer. Metal spacers that were not found on the design output were also removed.

- Clamping pressure was shown to not hinder breaker operation.

- Representative gaps between the bezel and front panel opening were measured and were found to only allow small displacement in the unlikely event of any movement. Push tests on a 100-percent population indicated that the breakers did not displace under application of an anticipated seismic load.

TVA reiterated its contention of full compliance in regard to its current breaker mounting configurations. In regard to recurrence control for this violation example, TVA stated that it will provide the procedure installation guidance discussed previously by September 30, 2011.

The NRC staff reviewed the applicant's revised response and finds that TVA did not adequately comply with 10 CFR Part 50, Appendix B, Criterion III, "Design Control," as outlined in the original violation, for the following reasons:

- In WBN FSAR Table 3.10-3, for 120-VAC vital instrumentation power boards (for WBN Unit 1, Amendment 8, dated September 30, 2010, sheet 28 of 32 and for WBN Unit 2, Amendment 106, dated September 28, 2011, sheet 22 of 25), both WBN units referenced Westinghouse 1975 Seismic Test Procedure No. CO-33419. However, the staff was unable to locate, in the FSAR, a reference to the 1992 seismic qualification for Heinemann circuit breaker part No. CF2-Z51-1 (Report No. S522-RP-02).

- Section A-A of WBN drawing No. C0-33419-MKE-M2, Revision 902, dated October 8, 2010, as noted in Calculation No. WCG-ACQ-1301, Revision 0, Appendix B, sheet No. B3, shows that there is a deviation between the as-built and the actual field configurations.

- At a public meeting on October 14, 2011, TVA stated that the 2009 reconfigured breaker and equivalency evaluation (WBN Calculation No. WCQ-ACQ-1004, Revision 1, dated September 3, 2009) concluded that the reconfigured breaker plus Micata board spacer will respond seismically in a similar fashion as the original breaker and that no additional testing is necessary. TVA further stated that the reconfigured breaker with the addition of the Micata board is equivalent to the original breaker in form, fit, and function.

Based on the above, the NRR staff does not agree with TVA's revised responses. The NRR staff considers that TVA has not corrected the original NOV 2010603-08 and, therefore, is not in compliance with the licensing basis, (e.g., the qualification of Heinemann MCCBs as required in IEEE 344-1975 and as referenced in the WBN FSAR). Specifically, TVA has not satisfied the requirements in Sections 6.1.1 and 6.4 of IEEE 344-1975 and has not provided data from testing or analysis to support its contention that the test response spectrum used as a basis of design for seismic testing enveloped the RRS for the most adverse conditions under which the breaker might be exposed. Loss of configuration control of the 120-VAC vital instrument boards to their original qualification undermines the direct application of those results to the current configuration. The NRR staff also does not agree with TVA's statement that the new breaker is 0.25 inch shorter in depth and that it, therefore, no longer fits into the service location without modifying it by attaching the 0.25-inch-thick Micata board to it. Therefore, the fit criterion has not been met. In addition, Calculation No. WCQ-ACQ-1004, Revision 1, was intended for the cabinet and not for the breaker itself. Therefore, the NRR staff finds that the 2009 breaker has not met the requirements referenced in WBN FSAR Table 3.10-3 for 120-VAC vital instrumentation power boards or the 1992 test.

Based on its review, the NRR staff find that the licensee has not implemented a suitable test program of a prototype unit under the most adverse design conditions to verify the seismic adequacy of certain design features. TVA should follow the recommendations in IEEE 344-1975, as outlined in the original NOV, and should provide reasonable assurance that Heinemann circuit breaker part No. CF2-Z51-1 can operate as intended during a design basis seismic event.

Question 3

Are the most limiting seismic responses on the panel required to be determined for future device testing of the MCCBs, and has TVA adequately determined them? (Discuss any regulations or standards that would require the most adverse conditions to be analyzed during testing.)

Response

WBN FSAR Section 3.10.1, "Seismic Qualification Criteria," states that the local panels were tested using response spectra for the highest elevation on which any of these panels are mounted. The NRC staff also noted that Section 3.7.3.16 of Amendment 106 to the WBN Unit 2 FSAR states that the WBN Category I electrical and mechanical equipment seismic qualification program is consistent with SRP Section 3.10 acceptance criteria for plants with construction permit applications docketed before October 27, 1972. The equipment has been seismically qualified either in direct compliance with IEEE 344-1975 and RG 1.100 (equipment procured after September 1, 1974) or in accordance with a program that, at a minimum, provided qualification to the requirements of IEEE 344-1971 and addressed the guidelines of SRP Section 3.10.

Currently, TVA has not adequately determined a response spectra for the highest elevation at which any of these panels are mounted because TVA procured replacement MCCBs that were manufactured by Heinemann as commercial-grade MCCBs. TVA performed a seismic qualification test on the replacement MCCBs using the highest midlevel (left side of the front panel) recorded acceleration from the 1975 test (2.72g), plus a 0.28g margin equal to 3.0g. The NRC staff noted that the 1975 test measurement of 2.72g was recorded at a location on the bolted panel board that was 13 inches below the upper bolted panel of MCCBs and not on the MCCBs themselves. The NRC staff also noted that Calculation No. WCG2893 did not include the additional forces that account for the mounting hardware's mass and flexibility. The additional seismic loads on the MCCBs, such as cabinets with bolted doors or panels, produce impacts, rattling, chatter, or banging. These impacts are transmitted throughout the equipment and result in increased acceleration levels that could be higher than the original acceleration input to the shake table.

Based on its review, the NRR staff find that, in order to provide reasonable assurance that the analyses, inspections, and tests indicated in WBN FSAR Section 3.10.1 have been performed, TVA should evaluate the most limiting seismic responses on the panel that are required to be determined for future device testing of the MCCBs, as called for in WBN FSAR Section 3.10.1, and, demonstrate qualification to the requirements of IEEE 344-1975.

4.0 REGULATORY REQUIREMENTS

Criterion III of Appendix B to 10 CFR Part 50 requires the establishment of measures to ensure that design bases for structures, systems, and components are correctly translated into specifications, drawings, procedures, and instructions.

The WBN Category I electrical equipment seismic qualification program is required to be consistent with the FSAR commitments which are consistent with SRP Section 3.10 acceptance criteria for plants with construction permit applications docketed before October 27, 1972. The equipment should be seismically qualified either in compliance with IEEE 344-1975 or RG 1.100 (equipment procured after September 1, 1974).

5.0 CONCLUSION

Based on its review of TIA 2011-012, the NRR staff find the following:

- TVA should demonstrate that the existing MCCBs are seismically tested in accordance with Section 6.4 of IEEE 344-1975, or WBN FSAR Table 3.10-3, particularly for 120-VAC vital instrumentation power boards, and provide reasonable assurance that all MCCBs located in WBN Unit 2 panels can operate as intended during a design-basis seismic event.

- For the qualification of the subject circuit breakers, TVA needs to ensure that design bases for structures, systems, and components are correctly translated into specifications, drawings, procedures, and instructions and that the measures are followed and met. Specifically, a test program used to verify the adequacy of a specific

design feature shall include suitable qualifications testing of a prototype unit under the most adverse design conditions. TVA should follow IEEE 344-1975, as outlined in the original NOV, and provide reasonable assurance that Heinemann circuit breaker part No. CF2-Z51-1 can operate safely during seismic or abnormal situations.

- TVA should provide reasonable assurance that it has performed the analyses, inspections, and tests indicated in WBN FSAR Section 3.10.1. In addition, TVA should evaluate the most limiting seismic responses on the panel that are required to be determined for future device testing of the MCCBs, as called for in WBN FSAR Section 3.10.1, and, at a minimum, should demonstrate qualification to the requirements of IEEE 344-1975.

6.0 REFERENCES

1. TIA 2011-012, "Watts Bar, Unit 2, Seismic Qualification of Heinemann Molded Case Circuit Breakers," and its attachments.

2. IEEE 344-1975, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Plant Generating Stations."

3. WBN FSAR Section 3.10, "Seismic Design of Category 1 Instrumentation and Electrical Equipment," and Section 3.7.3.16, "Seismic Analysis and Qualification of Category I Equipment other Than NSSS".

4. Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

5. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 3, "Design of Structures, Components, Equipment, and Systems," Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment," Revision 2, issued July 1981.

Principal Contributor: Dan Hoang

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