UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 21, 2020

EA-2020-009
Mr. Jacob Clos
Quality Assurance Manager
Fisher Controls International, LLC
1702 South 12th Avenue
Marshalltown, IA 50158

SUBJECT: INDEPENDENT ASSESSMENT OF NONCONFORMANCES, 99900105/2019-201-01 AND -02; REVISED NOTICES OF NONCONFORMANCE

Dear Mr. Clos:

I am responding to your letter dated February 7, 2020 (Agencywide Documents Access and Management System (ADAMS) No. ML20038A240), in which you disputed the two Notices of Nonconformance (NONs) 99900105/2019-201-01 and 99900105/2019-201-02 as identified in the United States (U.S.) Nuclear Regulatory Commission (NRC) Inspection Report 99900105/2019-201 (ADAMS Accession No. ML19339F625), dated January 8, 2020. The NONs described examples where Fisher Controls International, LLC (hereafter referred to as Fisher Controls) failed to comply with requirements imposed on you by your customers or NRC licensees — specifically, requirements invoked in a purchase order from an NRC licensee for the procurement of Fisher Controls' Type 546NS electro-pneumatic transducers. The purchase order included a stipulation that the transducers be certified in accordance with Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 323, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," (1974 and 1983); and, IEEE Std 344, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," (1975 and 1987). The purchase order also stipulated that Fisher's qualification of the transducers to these IEEE standards be conducted in a manner that complied with requirements in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities."

The NRC staff identified the subject NONs during an inspection conducted from November 4 through November 8, 2019 at Fisher Controls' facility in Marshalltown, Iowa. The NRC staff conducted this inspection for the Type 546NS electro-pneumatic transducers as a follow-up to a non-cited violation (NCV) issued to Florida Power & Light Company (FPL) at the Turkey Point Nuclear Generating Station by the NRC as documented in an inspection report dated September 30, 2019 (ADAMS Accession No. ML19274C217). Enclosure 1 provides background information related to the inspection report findings.

We conducted a detailed, independent review of your response. This review was informed by guidance in Part I, Section 2.3.7, of the NRC Enforcement Manual, which is titled "Disputed Violation Resolution Process for Non-Escalated Enforcement Actions." The current Enforcement Manual is included on the NRC's Web Site at http://www.nrc.gov/about-nrc/regulatory/enforcement/guidance.html.

The NRC staff members who performed the review were not involved with the original inspection effort. After careful consideration of the basis for your dispute of the NONs, we have concluded that NON 99900105/2019-201-01 and -02 are valid; however, the NONs have been revised to include the specific purchase order and IEEE standards. Specifically, the NRC staff determined that Fisher Controls' qualification testing did not comply with IEEE Stds 344 and 323 and, therefore, Fisher Controls did not meet the procurement requirements specified in the FPL purchase order. The bases for NRC conclusions regarding this matter are provided in Enclosure 2 to this letter. The specific IEEE Std 344 and 323 sections applicable to NONs 99900105/2019-201-01 and 99900105/2019-201-02 are provided in Enclosures 3 and 4 to this letter, respectively.

In accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System component of the NRC's ADAMS. ADAMS is accessible from the NRC website at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any additional questions, please contact Deanna Zhang of my staff at 301-415-1946.

Sincerely,

Christopher G. Miller, Director **/RA/**
Division of Reactor Oversight
Office of Nuclear Reactor Regulations

Docket No.: 99900105
Enclosure 1: Background – Inspection Report 99900105/2019-201
Enclosure 2: Nuclear Regulatory Commission's Review and Conclusions for NON 99900105/2019-201-01 and NON 99900105/2019-201-02
Enclosure 3: IEEE Standards Applicable to NON 99900105/2019-201-01
Enclosure 4: IEEE Standards Applicable to NON 99900105/2019-201-02

SUBJECT: INDEPENDENT ASSESSMENT OF NONCONFORMANCES, 99900105/2019-201-01 AND -02; REVISED NOTICES OF NONCONFORMANCE
DATED: September 21, 2020

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Background – Inspection Report 99900105/2019-201

The United States (U.S.) Nuclear Regulatory Commission (NRC) staff identified two notices of nonconformance (NON) during an NRC inspection conducted from November 4 through November 8, 2019 at Fisher Controls International, LLC (hereafter referred to as Fisher Controls') facility in Marshalltown, Iowa. The NRC staff conducted this inspection for the Type 546NS electro-pneumatic transducers in response to a non-cited violation (NCV) issued to Florida Power & Light Company (FPL) for the Turkey Point Nuclear Generating Station by the NRC as documented in an inspection report dated September 30, 2019 (Agencywide Documents Access and Management System (ADAMS) ML19274C217).

In a letter dated February 7, 2020 (ADAMS Accession No. ML20038A240), Fisher Controls disputed NON 99900105/2019-201-01, which discussed Fisher Controls' failure to adequately seismically qualify the 546NS electro-pneumatic transducers through suitable qualification testing to verify the adequacy of the design. Specifically, Fisher Controls certified, as specified in purchase orders, that the 546NS electro-pneumatic transducer met the requirements of the 1975 and 1987 Editions of the IEEE Std 344, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations". Both the 1975 and 1987 versions of IEEE Std 344 require operating basis earthquake and safe shutdown earthquake testing as part of the seismic qualification testing for Class 1E equipment. The NRC inspection team determined that Fisher's qualification testing did not include the performance of operating basis earthquake or safe shutdown earthquake testing as stipulated in the IEEE standards. As a result, Fisher Controls did not demonstrate that the 546NS electro-pneumatic transducers could perform their intended safety function during and after a design basis seismic event.

Fisher Controls also disputed NON 99900105/2019-201-02 regarding the failure to comply with IEEE Std 323-1983 during the qualification of the 546NS electro-pneumatic transducer to verify its capability to withstand adverse environmental conditions.

The NRC staff performed an independent review of the two NONs based on the information in Inspection Report 99900105/2019-201, Fisher Controls' letter (February 7, 2020) disputing the two NONs identified in the inspection report, and additional information[1] provided by Fisher Controls that include NRC licensees' POs for the 546NS transducer, Fisher Controls' quotes, and certificates of conformance/compliance for these POs. The NRC staff determined that Fisher Controls' qualification testing did not comply with IEEE Stds 344 and 323 and, therefore, Fisher did not meet the qualification requirements invoked in a Turkey Point Nuclear Plant purchase order. The bases for NRC conclusions regarding the two NONs are provided below.

[1] The Turkey Point POs and certificates of conformance (CoCs) were not provided to the NRC staff during its inspection at the Fisher Controls facility from November 4 through November 8, 2019.

NUCLEAR REGULATORY COMMISSION'S EVALUATION AND CONCLUSION

1. Nonconformance 99900105/2019-201-01 (NON-01)

A. Summary of Fisher Controls Response (NON-01)

In its response to the NRC, Fisher Controls stated that the Fisher Qualification Report (FQR) prepared for the Type 546NS is an accurate representation of the testing that was conducted as part of the initial Type 546NS qualification program; and that this testing program was designed and conducted for a non-U.S. customer's application in 1994. Fisher utilized the summarized results from the 1994 testing in FQRs that were provided to subsequent customers. Fisher declared that the intent of the FQR was not to demonstrate full compliance to a standard or a specific customer application; and, that the purpose of these subsequent FQRs was to present the test sequence and results to the customer for their independent assessment as to whether the Type 546NS was suitable for use at their specific nuclear plant. Therefore, Fisher Controls does not believe any corrective actions are necessary.

B.1 NRC Evaluation (NON-01)

Based on its independent review, the NRC concluded that the findings identified in NON-01 occurred as described in the inspection report dated November 8, 2019. It was noted that Turkey Point PO 02385926 specified IEEE Std 344-1975/1987 for seismic qualification testing of Class 1E equipment (i.e., vibration, operating basis earthquake, and safe shutdown earthquake testing). However, as documented in its FQR, Fisher Controls only performed vibration testing of the electro-pneumatic transducers and did not perform the operating basis earthquake and safe shutdown earthquake testing as stipulated in the IEEE standards and PO 02385926. Fisher Control's letter, dated February 7, 2020, did not dispute the fact that the operating basis earthquake and safe shutdown earthquake testing were not conducted. The Fisher Controls letter stated that the CoC (19QN28-CC-01) for the Turkey Point PO did not specifically certify compliance to IEEE Std 344-1975/1987 or state that the requirements of PO 02385926 had been met. The letter also stated that the CoC certified that the subject Type 546NS electro-pneumatic transducers were essentially identical in construction to the test units evaluated per Environmental Qualification Report FQR-82. Although FQR-82, originally issued in 2006, stated that it provided a generic qualification for the Type 546NS electro-pneumatic transducer, Turkey Point's PO 02385926 stipulated that Fisher Controls certify that the 546NS electro-pneumatic transducer was qualified in accordance with IEEE standards 344, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," -1975 and 1987. Therefore, NON-01 remains valid, however, it has been revised to include reference to the specific purchase order and IEEE standards.

B.2 Revised Notice of Nonconformance (NON 99900105/2019-201-01)

Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," states, in part, that "Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the functions for the structures, systems and components. 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 qualification testing of a prototype unit under the most adverse design conditions."

Purchase Order 02385926, Rev. 9 (Florida Power & Light's Turkey Point Nuclear Plant), stated, in part, that the vendor shall certify the 546NS Electro-pneumatic Transducer is qualified in accordance with IEEE 344-1975 / 1987[2], "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations;" and, that the order was to be processed in accordance with Appendix B to 10 CFR Part 50.

Contrary to the above, as of November 8, 2019, Fisher Controls failed to conduct adequate testing to demonstrate suitable qualification testing of a prototype unit of the Type 546NS electro-pneumatic transducer under the most adverse design conditions as required in Florida Power & Light (FPL) Purchase Order 02385926, Rev. 9. Specifically, Fisher Controls failed to perform the operating basis earthquake and safe shutdown earthquake qualification testing in accordance with IEEE 344-1975/1987 standards to demonstrate that the Type 546NS electro-pneumatic transducers provided to FPL's Turkey Point Nuclear Plant could withstand the effects of site-specific earthquakes without the loss of capability to perform its intended safety function during and after a design basis seismic event.

[2] See Enclosure 3 for a listing of applicable IEEE 344-1975 / 1987 requirements

2. Nonconformance 99900105/2019-201-02 (NON-02)

A.1 Summary of Fisher Controls Response to Item 1 of 6 (NON-02)

In its response to the NRC, Fisher Controls stated that Section 5.4, "Combined Methods" of IEEE Std 323-1983, states, "...where size, application, time, or other limitations preclude the use of a type test on the complete equipment assembly, type testing of components supplemented by analysis may be used in the qualification process." Fisher Controls listed the interfaces for the Type 546NS electro-pneumatic transducers and stated that during the testing program conducted at Thermodyne, the Device Under Test (DUT) connections supplying the input signal and the supply air, and the connection for the output air were similar to those that would be used in a plant.

The response stated that during the entirety of the testing, the Type 546NS output was connected to a $100 in^3$ volume tank with a pressure gauge between the Type 546NS output and the volume tank input. This volume tank is approximately the size of a Fisher Type 657 Size 40 actuator casing.

A.1.a NRC Evaluation of Fisher Controls Response to Item 1 of 6 (NON-02)

Based on its independent review, the NRC determined that Fisher Controls had not provided adequate objective evidence to substantiate its statements. Specifically, Fisher Controls did not provide a supporting analysis to demonstrate that the DUT connections (input signal, supply air, and output air) were sufficiently similar to those that would be used in a plant such that the testing interfaces adequately represented in-plant interfaces of a nuclear power plant, as required by Section 6.3.1.3, "Connections" of IEEE Std 323-1983. IEEE Std 323-1983, Section 6.3.1.3, states in part, that "Equipment shall be connected in a manner that simulates its expected installation when in actual use unless an analysis can be performed to show that the equipment's ability to perform its safety function(s) would not be altered by other means of connection." Further, the NRC staff determined that Fisher Controls did not provide objective evidence to demonstrate that the volume tank connected to the Type 546NS output during the test evolution accurately represented a connected air operated valve at the plant.

A.2 Summary of Fisher Controls Response to Item 2 of 6 (NON-02)

In its response to the NRC, Fisher Controls stated that the 10mA-50mA version of the Type 546NS is mechanically similar to the 4mA-20mA version that was tested. Fisher Controls stated that the construction materials were the same between the two versions with two differences. The two dissimilarities included the use of a different bellows assembly with a higher spring rate in the 10mA-50mA version which is less susceptible to seismic input than the bellows in the 4mA-20mA construction; and the 10mA-50mA version contains fewer coil windings in order to incorporate the differing signal input and pressure output. Fisher Controls concluded that these differences have no impact on overall device qualification.

A.2.a NRC Evaluation of Fisher Controls Response to Item 2 of 6 (NON-02)

Based on its independent review, the NRC determined that Fisher Controls did not provide adequate objective evidence to substantiate its statements. Specifically, Fisher Controls did not provide the requisite evaluation to reach the conclusion that the differences (i.e., different bellows assembly with higher spring rate and fewer coil windings) between the

10mA-50mA and the 4mA-20mA versions of the Type 546NS have no impact on the overall device qualification. Fisher Controls did not provide any objective evidence such as an evaluation to show how the higher spring rate in the 10 mA-50mA version reduces the susceptibility of the bellows to seismic input or how the fewer coil windings in the 10 mA-50mA affect the qualification results.

A.3 Summary of Fisher Controls Response to Item 3 of 6 (NON-02)

In its response to the NRC, Fisher Controls stated that the Activation Energy used in this testing is based on previous Fisher Controls testing conducted under Fisher Lab Report 1685-3-11. Fisher Controls stated that based on these testing results, the Activation Energy is considered conservative for ethylene propylene diene monomer (EPDM) rubber components. Fisher Controls also stated that the nylon bobbin is a static component in this assembly and, therefore, its degradation would be considered inconsequential.

A.3.a Summary of NRC Evaluation of Fisher Controls Response to Item 3 of 6 (NON-02)

Based on its independent review, the NRC determined that Fisher Controls did not provided sufficient objective evidence to substantiate its statements. Specifically, Fisher Controls did not provide the results of any analysis performed to demonstrate that the selected activation energy based on the test results conducted under Fisher Lab Report 1685-3-11 is sufficiently conservative for EPDM components. Given that activation energy selection is a major component in the accuracy of thermal aging calculations (i.e., Arrhenius equation) and nonmetallic components are more thermally vulnerable than metallic material, all components within the Type 546NS electro-pneumatic transducer should be evaluated to determine the most conservative activation energy. This includes the nylon bobbin. Fisher Controls did not provide the necessary analysis to substantiate Fisher Controls' conclusion that due to the static nature of the nylon bobbin (i.e., its susceptibility to thermal aging), its degradation would be considered inconsequential in the determination of activation energies in the thermal aging analysis/calculations.

A.4 Summary of Fisher Controls Response to Item 4 of 6 (NON-02)

In its response to the NRC, Fisher Controls stated that Section 5.0 of the FQR, titled "Maintenance Requirements" provides recommendations for maintenance of the Type 546NS. Reference is made to the Instruction Manual which is publicly available online. Fisher Controls stated that during qualification testing, no device maintenance was necessary or conducted.

A.4.a Summary of NRC Evaluation of Fisher Controls Response to Item 4 of 6 (NON-02)

Based on its independent review, the NRC determined that Fisher Controls did not document in the qualification report that no device maintenance was necessary or conducted during qualification testing. Therefore, the FQR should be revised, as appropriate, to document that no device maintenance was required during qualification testing.

A.5 Summary of Fisher Controls Response to Item 5 of 6 (NON-02)

In its response to the NRC, Fisher Controls stated, "*Prior to any qualification testing, the Type 546 was subjected to baseline functional testing in order to establish a starting point for device performance. The results of this baseline functional testing are documented in the FQR. These results show the Type 546 performed as expected, within published performance criteria, prior to the start of any qualification testing.*"

A.5.a Summary of NRC Evaluation of Fisher Controls Response to Item 5 of 6 (NON-02)

Based on its independent review, the NRC determined that Fisher Controls did not provide any objective evidence to substantiate its statement. While Fisher Controls' response stated that baseline testing was performed prior to any qualification testing, Fisher Controls did not respond to the specific issue identified in the NON regarding the calibration of the DUT prior to baseline testing.

A.6 Summary of Fisher Controls Response to Item 6 of 6 (NON-02)

In its response to the NRC, Fisher Controls stated that the Thermodyne Equipment Qualification (EQ) Test Report No. 4F-3-1-2 does not identify any test anomalies. The "eight test anomalies" discussed in the NRC's inspection report are a reference to a post-test evaluation of the overall test program. Fisher Controls stated that after all testing was completed and documented, Fisher Controls prepared an independent document listing eight points of consideration for future testing. This document is titled, "Critique – Report 4F-3-1-2, Rev. 0" (For Planning Future 546 [electro-pneumatic] Test Programs). Fisher Controls stated that these points did not have an impact on device qualification and are instead suggestions for additional items to consider during any future test program.

A.6.a NRC Evaluation of Fisher Controls Response to Item 6 of 6 (NON-02)

Based on its independent review, the NRC determined that additional information was needed to support Fisher Control's claim that "Critique – Report 4F-3-1-2, Rev. 0" documented an independent assessment performed after the qualification test by Fisher Controls and that it only contains eight points of consideration for future testing. The NRC staff contacted Fisher Controls on February 27, 2020, to obtain access to the "Critique – Report 4F-3-1-2, Rev. 0" and the Thermodyne EQ Test Report in order to verify the information provided by Fisher Controls. The NRC staff's review of these documents determined that the eight issues identified in the "Critique – Report 4F-3-1-2, Rev. 0" could affect the validity of the Thermodyne EQ test results. However, the report did not evaluate whether these issues affected the validity of the Thermodyne EQ Test Report results.

B.1 NRC Overall Evaluation of NON-02 (Items 1 – 6)

The NRC staff determined that:

- Fisher Controls did not provide objective evidence to demonstrate that the volume tank connected to the Type 546NS output accurately represented a connected air operated valve at the plant (1 of 6);

- Fisher Controls did not submit sufficient evaluation to reach the conclusion that the differences between the 10mA-50mA version of the Type 546NS and the 4mA-20mA version had no impact on the overall device qualification (2 of 6);
- Fisher Controls did not submit a sufficient analysis to substantiate its conclusion that, due to the static nature of the nylon bobbin (i.e., its susceptibility to thermal aging), its degradation would be considered inconsequential in the determination of activation energies in the thermal aging analysis/calculations (3 of 6);
- Fisher Controls did not document in the qualification report whether device maintenance was necessary or conducted during qualification testing (4 of 6);
- Fisher Controls stated that baseline testing was performed prior to qualification testing; however, a response to the specific issue identified in the NON regarding the calibration of the DUT prior to baseline testing was not provided (5 of 6);
- Fisher Controls did not submit sufficient information to determine whether the eight issues in the critique report affected the validity of the Thermodyne EQ Test Report results (6 of 6).

Based on the available information, the NRC's independent review concluded that the findings associated with these items occurred as stated in the November 8, 2019, inspection report for NON 99900105/2019-201-02. However, NON-02 has been revised to include reference to the purchase order and IEEE standards.

B.2 Revised Notice of Nonconformance-02 (NON 99900105/2019-201-02)

Criterion III of Appendix B to 10 CFR Part 50 states, in part, that "Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the functions for the structures, systems and components. 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 qualification testing of a prototype unit under the most adverse design conditions."

Purchase Order 02385926, Rev. 9 (Florida Power & Light's Turkey Point Nuclear Plant), stated, in part, the vendor shall certify the 546NS Electro-pneumatic Transducer is qualified in accordance with IEEE 323-1974 / 1983[3], "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" (Harsh Environment); and, that the order was to be processed in accordance with 10CFR50, Appendix B Program.

Contrary to the above, as of November 8, 2019, Fisher Controls failed to conduct adequate testing to demonstrate suitable qualification of a prototype unit of the Type 546NS electro-pneumatic transducer under the most adverse design conditions as required in Florida Power & Light (FPL) Purchase Order 02385926, Rev. 9. In addition, Fisher Controls failed to appropriately perform testing in accordance with IEEE 323-1974/1983 standards to demonstrate that the 546NS electro-pneumatic transducers could perform their intended safety function. Specifically, Fisher Controls failed to:

[3] See Enclosure 4 for a listing of applicable IEEE 323-1974 / 1983 requirements

1. Test the electro-pneumatic transducers in a configuration similar to how it would be used once installed in a system at the plant.
2. Demonstrate that qualification testing was performed with service conditions and equipment specification considering a 10-50mA direct current design input.
3. Justify the selection methodology of the activation energies used in the thermal aging analysis/calculations to ensure the most conservative activation energies were used for establishing a qualified life.
4. Document in the qualification report whether device maintenance was necessary or conducted during qualification testing.
5. Adequately calibrate the test specimen prior to baseline testing.
6. Evaluate how eight test anomalies affected the qualification of the electro-pneumatic transducers.

Enclosure 3 – IEEE Standards Applicable to NON 99900105/2019-201-01

IEEE Std 344-1975

- IEEE Std 344-1975, Section 4, "Seismic Qualification Requirements," states in part, "The seismic qualification of Class1E equipment should demonstrate an equipment's ability to perform its required function during and after the time it is subjected to the forces resulting from one SSE. In addition, the equipment must withstand the effects of a number of OBEs (see Sections 5.4 and 6.1.4) prior to the application of an SSE."

- IEEE Std 344-1975, Section 5.4, "OBE and SSE Analysis," states in part, "…The analysis must show that OBE events followed by an SSE will not result in failure of equipment to perform its Class 1E function."

- IEEE Std 344-1975, Section 6.1.4, "OBE Tests", states in part, "Seismic qualification tests on Class 1E equipment designed to show adequacy of performance during and following an SSE must be preceded by one or more OBE tests. The number of tests shall be justified for each site or shall produce the equivalent effect of 5 OBEs."

IEEE Std 344-1987

- IEEE Std 344-1987, Section 4, "Seismic Qualification Approach," states in part, "The seismic qualification of Class1E equipment should demonstrate an equipment's ability to perform its required function during and after the time it is subjected to the forces resulting from one SSE. In addition, the equipment must withstand the effects of a number of OBEs (see Sections 6.5[4] and 7.1.5.1) prior to the application of an SSE."

- IEEE Std 344-1987, Section 6.6, "OBE and SSE Analysis," states in part, "…The analysis must show that OBE events followed by an SSE will not result in failure of equipment to perform its Class 1E function."

- IEEE Std 344-1987, Section 7.1.5, "Vibrational Aging," states in part, "Seismic qualification tests on equipment designed to show adequacy of performance during and following a SSE must be preceded by tests that produce the equivalent fatigue effect of the number of OBE specified for each site and the equivalent fatigue effects of specified in-plant vibration resulting from normal and transient plant operating conditions…Vibration-aging tests shall be performed preceding the OBE and SSE tests"

- IEEE Std 344-1987, Section 7.1.5.1, "Aging from Nonseismic Vibration Conditions," states in part, "Portions of seismic tests may be used to provide part of the gaining requirement of ANSI/IEEE Std 323-1983 for the specified nonseismic related vibration due to normal and transient plant operating conditions and inplant vibration. It shall be demonstrated that the equivalent amplitude response cycles achieve din the seismic tests, excluding those required for the seismic low-cycle fatigue requirement, exceed the amplitude response cycles required for the nonseismic loads…Credit may be taken for any test preceding the SSE."

[4] Note, the NRC staff found the reference to Section 6.5 is incorrect and that the reference should be Section 6.6.

Enclosure 4 – IEEE Standards Applicable to NON 99900105/2019-201-02

Item 1 of 6 (NON 2)

- IEEE Std 323-1974, Section 5.1, "Type Testing," states in part, "Type testing of actual equipment using simulated service conditions is the preferred method."

- IEEE Std 323-1974, Section 6.3.1.3, "Connections," states in part, "Equipment shall be connected in a manner that simulates its specified installation when in actual use unless an analysis can be performed and justified to show that the equipment's performance would not be altered by other means of connections."

- IEEE Std 323-1983, Section 6.1.5, "Service Condition," states, "The service conditions for the equipment shall be specified. These shall include the nominal values and their expected durations, and the extremes and their expected durations. Examples include but are not limited to: 1) Ambient pressure and temperature, 2) Relative humidity, 3) Radiation environment, 4) Seismic operating basis earthquake (OBE) and nonseismic vibration, 5) Operating cycles, 6) Electrical loading and signals, 7) Submergence."

- IEEE Std 323-1983, Section 6.1.5.2, "Design Basis Accident and Seismic Service Conditions," states, in part, "The postulated service conditions for the design basis accident and post design basis accidents and the seismic events during or after which the equipment is required to perform its safety function(s) shall be specified."

- IEEE Std 323-1983, Section 6.3, "Type Testing," Subsection 3.1, states, "The type test shall demonstrate that the equipment performance meets or exceeds its safety function requirements. The type test conditions shall meet or exceed the specified service conditions. Margin shall be added if not included in the specified service conditions," and Subsection 6.3.1.3, "Connections," states in part, "Equipment shall be connected in a manner that simulates its expected installation when in actual use unless an analysis can be performed to show that equipment's ability to perform its safety function(s) would not be altered by other means of connection."

Item 2 of 6 (NON 2)

- IEEE Std 323-1974, Section 6.3, "Type Test Procedures," Subsection 6.3.1, states in part, "The type test shall be designed to demonstrate that the equipment performance meets or exceeds the requirements of the equipment specifications for the plant," and Subsection 6.3.1.3, "Connections," states, in part, "Equipment shall be connected in a manner that simulates its specified installation when in actual use unless an analysis can be performed and justified to show that the equipment's performance would not be altered by other means of connections."

- IEEE Std 323-1983, Section 6.1.2, "Interfaces," states, "Loading at interfaces (that is, physical attachments, mounting, auxiliary devices, connectors to the equipment at the equipment boundary) shall be specified for each operating mode. Motive power or control signal inputs and outputs and the physical manner by which they are supplied (for example, connectors, terminals blocks) shall be specified. Control, indicating, and other auxiliary devices mounted internal or externally to the equipment and required for proper operation shall be included.

- IEEE Std 323-1983, Section 6.1.5, “Service Condition,” states in part, “The service conditions for the equipment shall be specified. These shall include the nominal values and their expected durations, and the extremes and their expected durations. Examples include but are not limited to: 1) Ambient pressure and temperature, 2) Relative humidity, 3) Radiation environment, 4) Seismic operating basis earthquake (OBE) and nonseismic vibration, 5) Operating cycles, 6) Electrical loading and signals, 7) Submergence.”

- IEEE Std 323-1983, Section 6.3, “Type Testing,” Subsection 6.3.1, states, “The type test shall demonstrate that the equipment performance meets or exceeds its safety function requirements. The type test conditions shall meet or exceed the specified service conditions. Margin shall be added if not included in the specified service conditions,” and Subsection 6.3.1.3, “Connections,” states in part, “Equipment shall be connected in a manner that simulates its expected installation when in actual use unless an analysis can be performed to show that equipment’s ability to perform its safety function(s) would not be altered by other means of connection.”

Item 3 of 6 (NON 2)

- IEEE Std 323-1974, Section 6.3.2, “Test Sequence,” states in part, “Equipment shall be aged in accordance with Section 6.3.3 to put it in a condition which simulates its expected end-of-qualified-life condition including the effect of radiation (design basis event radiation may be included,” and Section 6.3.3, “Aging,” states, in part “A short period of accelerated thermal aging merely simulates service life; however, it produces some deterioration and, when followed by vibration may produce realistic failure modes.”

- IEEE Std 323-1983, Section 6.2.1, “Aging Considerations,” states in part, “If the equipment is determined to have a significant again mechanism, then the mechanism shall be accounted for in the qualification program. If the qualification method is type testing, then preconditioning prior to qualification testing is required unless the effects of the significant aging mechanism can be accounted for by periodic inservice surveillance/maintenance…If age conditioning is required, a further determination shall be made as to whether accelerated aging technique can be applied to the equipment and yield valid results that may be correlated to real time.”

- IEEE Std 323-1983, Section 6.2.2, “Qualified Life Objective,” states in part, “Where applicable; a qualified life objective shall be determined consistent with the specification requirements, the anticipated capabilities of the equipment, and any limitations imposed by the specified aging program.”

- IEEE Std 323-1983, Section 6.3.3.2, “Age Conditioning,” states in part, “If naturally-aged equipment is not available with proper documentation and significant aging mechanism(s) have been identified, the equipment shall be age conditioned in the type test program unless the effects of significant aging mechanism can be accounted for by in-service surveillance/maintenance. Age conditioning is a process whereby the effects of significant aging mechanism are simulated in the test sample…Age conditioning generally involves applying simulated in-service stresses (for example, thermal, radiation, wear, and vibration) at magnitudes or rates that are greater than expected inservice levels but less than the material property limitations.”

Item 4 of 6 (NON 2)

- IEEE Std 323-1983, Section 6.2.4, “Maintenance,” states, “A periodic maintenance/replacement required during the aging portion of the qualification program shall be identified.”

Item 5 of 6 (NON 2)

- IEEE Std 323-1974, Section 6.3.1.2, “Mounting,” states in part, “Equipment shall be mounted in a manner and a position that simulates its expected installation when in actual use unless an analysis can be performed and justified to show that the equipment’s performance would not be altered by other means of mounting.”

- IEEE Std 323-1974, Section 8.3, “Type Test Data,” states in part, “The type test data shall contain…(4) The report shall include: (a) objective, (b) Equipment tested, (c) Description of test facility (test setup) and instrumentation used including calibration records reference.”

- IEEE Std 323-1983, Section 6.3.1.2 “Mounting,” states in part, “Equipment shall be mounted in a manner and a position that situates its expected installation when in actual use unless an analysis can be performed and justified to show that the equipment’s performance is not altered by other means of mounting”

- IEEE Std 323-1983, Section 6.3.2, “Test Sequence,” states in part, “The steps in type testing shall be run in a specified sequence appropriate to the postulated set of service conditions for each equipment application. The test sample shall be representative of the same design, materials, and manufacturing process as the installed equipment.”

- IEEE Std 323-1983, Section 8.3, “Type Test Data,” states in part, “The report of test results shall include a) test objective, b) detailed description of test sample, c) description of test setup, instrumentation and calibration data, d) Test procedure, e) Summary of test data, accuracy, and anomalies.”

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- IEEE Std 323-1983, Section 8.3, “Type Test Data,” states in part, “Summary and conclusions, including limitations and qualified life or periodic surveillance/maintenance interval determination” shall be included in the qualification file.