

December 14, 2016

Tracy Bolt, Director of Quality Assurance  
AZZ Nuclear | NLI  
7410 Pebble Drive  
Fort Worth, TX 76118

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION OF AZZ  
NUCLEAR | NLI, REPORT NO. 99901471/2016-201, NOTICE OF VIOLATION  
AND NONCONFORMANCE

Dear Mr. Bolt:

On September 19 through September 22, 2016, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a limited scope inspection of the AZZ NUCLEAR | NLI (hereafter referred to as AZZ | NLI) in Ft. Worth, TX. Subsequently, the NRC re-exited on October 31, 2016, to clarify a potential finding identified during the inspection. The purpose of this limited scope inspection was to assess AZZ | NLI's compliance with provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21, "Reporting of Defects and Noncompliance," and selected portions 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." This NRC inspection report does not constitute NRC endorsement of your overall quality assurance (QA) program or Part 21 programs.

This inspection specifically verified the closure of nonconformances identified in NRC Inspection Report 99901298/2012-201 involving the adequacy of design changes and commercial-grade dedication of requested testing services by Nemko. This inspection also verified critical characteristics associated with MIL-STD-461E, "Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment," and the applicable Electrotechnical Commission (IEC) 61000, "Electromagnetic compatibility (EMC)," tests were included in the commercial-grade survey.

Based on the results of this inspection, the NRC staff determined that a violation of NRC requirements occurred. The violation is cited in the enclosed Notice of Violation (NOV) and the circumstances surrounding it are described in detail in the subject inspection report. The violation is being cited in the NOV because the inspectors found that AZZ | NLI failed to sufficiently evaluate defects reported to them by their customers, as required by 10 CFR Part 21. AZZ | NLI failed to adequately evaluate spurious tripping of Masterpact circuit breakers supplied to Public Service Enterprise Group (PSEG) - Hope Creek. You are required to respond to this letter and should follow the instructions specified in the enclosed Notice of Violation when preparing your response.

During this inspection, NRC inspectors also found the implementation of your QA program failed to meet certain NRC requirements imposed on you by your customers. The inspectors determined AZZ | NLI was not fully implementing its QA program in the areas of design control and corrective action. Regarding the design control findings, AZZ | NLI did not; (1) adequately evaluate the use of electromagnetic compatibility standards that were different from those

identified in a purchase order for a safety-related power supply; (2) adequately verify the suitability of replacement circuit breakers for their potential use as motor-starters; (3) and fully identify and verify critical characteristics associated with the commercial grade dedication of an inverter and Masterpact circuit breakers. Regarding the corrective action finding, AZZ | NLI did not promptly identify and apply corrective actions associated with potential mechanisms that could result in binding of Masterpact circuit breakers. With respect to the findings associated with the circuit breakers, the NRC inspectors observed that the replacement circuit breakers are not like-for-like replacements at nuclear power plants, and such replacements require a detailed engineering evaluation to appropriately ensure the designed solution matches the plant's application. The findings at AZZ | NLI demonstrated a weakness in understanding the customer's application-specific requirements and/or notification to the customer on the scope of applications for which the breakers had been thoroughly evaluated. The specific findings and references to the pertinent requirements are identified in the enclosures to this letter. In response to the enclosed notice of violation and notice of nonconformance, AZZ | NLI should document the results of the extent of condition review for these findings and determine if there are any effects on other safety-related components.

Please provide a written statement or explanation within 30 days from the date of this letter in accordance with the instructions specified in the enclosed Notice of Nonconformance. We will consider extending the response time if you show good cause for us to do so.

In accordance with 10 CFR 2.390, "Agency Rules of Practice and Procedure," a copy of this letter, its enclosure(s), and your response (if applicable) will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response (if provided) should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or

financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

*/RA/*

Terry W. Jackson, Chief  
Quality Assurance Vendor Inspection Branch-1  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

Docket No.: 99901471

Enclosures:

1. Notice of Violation
2. Notice of Nonconformance
3. Inspection Report No. 99901471/2016-201  
and Attachment

financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

**/RA/**

Terry W. Jackson, Chief  
Quality Assurance Vendor Inspection Branch-1  
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and Attachment

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\*via e-mail

NRO-002

<b>OFC</b>	NRO/DCIP/QVIB-1	NRO/DCIP/QVIB-1	R-IV/DRS/EB2
<b>NAME</b>	AArmstrong	JJacobson	JWatkins*
<b>DATE</b>	11/28/16	11/28/16	11/29/16
<b>OFC</b>	NRO/DCIP/QVIB-2	NRO/DCIP/QVIB-1	
<b>NAME</b>	ABelen	TJackson	
<b>DATE</b>	12/12/16	12/13/16	

**OFFICIAL RECORD COPY**

## NOTICE OF VIOLATION

AZZ Nuclear Logistics Inc. (NLI)  
Fort Worth, TX

Docket No.:99901471

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the AZZ Nuclear | NLI (AZZ | NLI) facility in Ft. Worth, TX, from September 19, 2016, to September 22, 2016, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21, Reporting of Defects and Noncompliance, Paragraph 21.21(c)(1), states, in part, that, "A dedicating entity is responsible for identifying and evaluating deviations and reporting defects and failures to comply associated with substantial safety hazards for dedicated items."

Contrary to the above, as of September 22, 2016, AZZ | NLI failed to adequately evaluate deviations associated with a substantial safety hazard for a dedicated item. Specifically, AZZ | NLI failed to adequately evaluate spurious tripping of Masterpact circuit breakers supplied to Public Service Enterprise Group (PSEG) - Hope Creek, as required by 10 CFR 21.21(c)(1). AZZ | NLI's evaluation for this issue inadequately concluded that this issue was not reportable based upon the assumption that the only safety function of these breakers was to open and that spurious tripping would not affect the safety function of these breakers.

This issue has been identified as Violation 99901471/2016-201-01.

This is a Severity Level IV violation (Section 6.9.d of the NRC Enforcement Policy).

Pursuant to the provisions of 10 CFR 2.201, "Notice of Violation," AZZ | NLI is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-001 with a copy to the Chief, Quality Assurance Vendor Inspection Branch 1, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Violation (Notice). This reply should be clearly marked as a "Reply to a Notice of Violation" and should include for each violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation or severity level; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken; and (4) the date when full compliance will be achieved. Your response may reference or include previously docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, consideration will be given to extending the response time. If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, and Washington, DC 20555-0001.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/readingrm/adams.html>, to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the

public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this the 14th day of December 2016.

## NOTICE OF NONCONFORMANCE

AZZ Nuclear | NLI  
7410 Pebble Drive  
Fort Worth, TX 76118

Docket No. 99901471

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the AZZ Nuclear | NLI (AZZ | NLI) facility located in Fort Worth, TX, on September 19, 2016, through September 22, 2016, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on AZZ | NLI by its customers or NRC licensees.

- A. 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 include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled."

Procedure AZZ-QAP-03, "Design Control," Revision 2, Section 4.3.1.2, "Design and Production Tests," states, in part, that, "Design and production tests, where required, will be performed on assemblies that are designed, manufactured, and assembled by AZZ | NLI or by approved subcontractors. Testing will be performed in accordance with a Test Plan incorporating the client's requirements and/or applicable industry standards and the acceptance criteria will be specified."

Contrary to the above, as of September 22, 2016, AZZ | NLI failed to ensure that appropriate quality standards were specified and included in design documents. Specifically, AZZ | NLI failed to ensure that the requirements contained in a purchase order (PO) from Energy Northwest, associated with electromagnetic compatibility (EMC) testing of a safety-related power supply were properly incorporated into the design documents (the test plan). Consequently, AZZ | NLI performed the EMC testing to International Electrotechnical Commission (IEC) standard revisions that were not in accordance with the PO requirements. The standard revisions used for the testing were different than the referenced PO standards in parameters such as dB levels, test set up distances, equipment parameters, effective source impedances, insulation support, etc.

These issues have been identified as Nonconformance 99901471/2016-201-02.

- B. 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," states, in part, that, "The design control measures shall provide for verifying the adequacy of the 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."

Contrary to the above, as of September 22, 2016, AZZ | NLI failed to take adequate actions to verify the adequacy of the design for Masterpact breakers supplied to Public Service Enterprise Group (PSEG), for use at the Hope Creek Nuclear Station, and that are used as motor starters with overcurrent trip devices that are powered from the load side of the

breakers. Since the overcurrent trip devices for these breakers only receive power once the breakers are shut (upon starting of a motor), there is an undefined startup time before the breaker can accurately process load current data. When used as a motor starter, this startup time could potentially cause erroneous data to be acquired or make them more susceptible to noise interference. AZZ | NLI had not verified the adequacy of this aspect of the design as part of their design verification or commercial grade dedication processes.

This issue is identified as Nonconformance 99901471/2016-201-03.

- C. 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," 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 safety-related functions for the structures, systems and components."

Contrary to the above, as of September 22, 2016, AZZ | NLI failed to ensure the suitability of equipment that is essential to the safety-related functions for certain components supplied to the nuclear industry on two occasions. First, AZZ | NLI failed to verify the critical characteristic of total harmonic distortion and power quality on the output of a repaired Exeltec inverter supplied to Entergy under PO 10454062. In the second instance, AZZ | NLI failed to identify and verify the critical characteristic of current interrupting rating for Masterpact circuit breakers supplied to Tennessee Valley Authority under PO 758798.

This issue is identified as Nonconformance 99901471/2016-201-04.

- D. Criterion XVI, "Corrective Action," 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," states, in part, that, "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance's are promptly identified and corrected."

Procedure NLI-QUAL-06, "Nonconformance Reporting, Corrective, and Preventative Action," Revision 19, dated November 3, 2011, Section 2.2 states, "Activities which are considered nonconformance's and may require corrective action(s) to prevent reoccurrence include but are not limited to the following: (a.) Items or services identified by the client or other organizations and suspected of not conforming to safety-related purchase order requirements and (b.) Initiation of 10 CFR Part 21 activities.

Contrary to the above, as of September 22, 2016, AZZ | NLI failed to assure that a condition adverse to quality, associated with Masterpact circuit breakers supplied by AZZ | NLI to multiple facilities, was promptly identified and corrected. Specifically, AZZ | NLI failed to ensure that a condition associated with the binding of the Masterpact circuit breakers was promptly corrected and that their customers were sufficiently notified regarding the full scope of the issue. NLI's initial corrective actions were limited to breakers

that receive a “standing close signal” even though other conditions could also result in binding of the breakers, including:

- The breaker receiving a command to open electrically before, or at the same time, the close command is initiated.
- A remote closing action by a control room operator that may hold the close signal for a duration longer than 200 milliseconds, which would extend into the charging cycle.
- A logic scheme that would have a component controlling the close circuit that would apply the voltage to the close coil for a duration longer than 200 milliseconds, which would extend into the charging cycle.

This issue is identified as Nonconformance 99901471/2016-201-05.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Chief, Quality Assurance Vendor Inspection Branch-1, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Nonconformance. This reply should be clearly marked as a “Reply to a Notice of Nonconformance” and should include for each noncompliance: (1) the reason for the noncompliance, or if contested, the basis for disputing the noncompliance; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid noncompliances; and (4) the date when your corrective action will be completed. Where good cause is shown, consideration will be given to extending the response time.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC’s document system (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>, to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.”

Dated this the 14th day of December 2016.

**U.S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF NEW REACTORS  
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS  
VENDOR INSPECTION REPORT**

Docket No.: 99901471

Report No.: 99901471/2016-201

Vendor: AZZ NUCLEAR | NLI  
7410 Pebble Drive  
Fort Worth, TX 76118

Vendor Contact: Tracy Bolt, Director of Quality Assurance  
TracyBolt@AZZ.com  
817-284-0077

Nuclear Industry Activity: AZZ | NLI fabricates, tests, and dedicates a variety of components for nuclear facilities, including breakers, relays, switches, and software for the AP1000 construction activities and operating NRC licensees.

Inspection Dates: September 19-22, 2016

Inspection Team: Aaron Armstrong NRO/DCIP/QVIB-1, Inspection Leader  
Jeffrey Jacobson NRO/DCIP/QVIB-1  
Eugene Huang NRO/DCIP/QVIB-1  
John Watkins R-IV/DRS/EB2

Approved by: Terry W. Jackson, Branch Chief  
Quality Assurance Vendor Inspection Branch-1  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

## **EXECUTIVE SUMMARY**

AZZ NUCLEAR | NLI  
99901471/2016-201

The U.S. Nuclear Regulatory Commission (NRC) conducted a limited scope inspection at the AZZ NUCLEAR | NLI (hereafter referred to as AZZ | NLI) facility to verify that AZZ | NLI has implemented an adequate quality assurance (QA) program in compliance with the applicable requirements 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," and 10 CFR Part 21, "Reporting of Defects and Noncompliance."

This technically focused inspection evaluated AZZ | NLI activities associated with the design, fabrication, testing, and dedication of breakers, relays, switches, and other components that AZZ | NLI supplied to the nuclear industry. Additionally this inspection assessed AZZ | NLI corrective actions to close previous NRC identified non-conformances identified in Inspection Report 99901471/2012-201 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12179A375). The NRC conducted this inspection at the AZZ | NLI's facility in Fort Worth, TX.

Specific activities reviewed and/or observed by the NRC inspection team included:

- the design verification, commercial grade dedication, and corrective actions associated with AZZ/NLI's supply of Masterpact circuit breakers
- the commercial grade dedication testing of electrolytic capacitors
- the commercial grade dedication of Class 1E inverters
- the commercial grade dedication testing of pressure regulators and gauges for station air systems
- controls associated with measuring and test equipment (M&TE) used as part of the commercial grade dedication process.

The following regulations served as the bases for the NRC inspection:

- Appendix B to 10 CFR Part 50
- 10 CFR Part 21

During the course of this inspection, the NRC inspection team implemented Inspection Procedure (IP) 43002, "Routine Inspections of Nuclear Vendors;" IP 43004, "Inspection of Commercial-Grade Dedication Programs;" and IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance."

The information below summarizes the results of this inspection.

## 10 CFR Part 21

The NRC inspection team issued Notice of Violation (NOV) 99901471/2016-201-01 for AZZ | NLI's failure to implement the regulatory requirements of 10 CFR Part 21. NOV 99901471/2016-201-01 cites AZZ | NLI for their failure to adequately evaluate the evaluate a deviation concerning spurious tripping deviations for the Masterpact circuit breakers supplied to Public Service Enterprise Group (PSEG) - Hope Creek. AZZ | NLI's evaluation for this issue inadequately concluded that this issue was not reportable based upon the assumption that the only safety function of these breakers was to open and that spurious tripping would not affect the safety function of these breakers.

### Design Control and Qualification

The NRC inspection team concluded that AZZ | NLI had not fully implemented its design control program in accordance with the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team issued Notice of Nonconformance (NON) 99901471/2016-201-02 for AZZ | NLI's failure to ensure that the electromagnetic compatibility (EMC) qualification testing performed under purchase order (PO) 00339471 from Columbia Generating Station met the PO requirements.

The NRC inspection team also issued NON 99901471/2016-201-03 for AZZ | NLI's failure to take adequate actions to verify the adequacy of the design for certain configurations of Masterpact breakers which are used as motor starters with overcurrent trip devices that are powered from the load side of the breakers.

Lastly, the NRC inspection team issued NON 99901471/2016-201-04 for AZZ | NLI's failure to implement sufficient measures to ensure that safety functions of the supplied dedicated components were being adequately verified as part of its commercial-grade dedication process. In particular, AZZ | NLI's measures failed to verify total harmonic distortion and power quality for an inverter supplied to Entergy through PO 10454062, and current interrupting ratings for Masterpact circuit breakers supplied to Tennessee Valley Authority (TVA) under PO 758798.

### Test Control

The NRC inspection team determined that AZZ | NLI's implementation of its policies and procedures associated with test control met the requirements of Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50 based on the limited number of samples reviewed. No findings of significance identified.

### Control of Purchased Material, Equipment, and Services

The NRC inspection team determined that AZZ | NLI's implementation of its policies and procedures associated with control of purchased material, equipment, and services met the requirements of Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50 based on the limited number of samples reviewed. No findings of significance identified.

### Control of Measuring and Test Equipment

The NRC inspection team determined that AZZ | NLI's implementation of its policies and procedures associated with control of measuring and test equipment met the requirements of Criterion XII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50 based on the limited number of samples reviewed. No findings of significance identified.

### Corrective Action

The NRC inspection team concluded that AZZ | NLI did not implement its corrective action program in accordance with the regulatory requirements of Criterion XVI, "Corrective Action" of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team issued NON 99901471/2016-201-05 for AZZ |NLI's failure to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance's are promptly identified and corrected. Specifically, AZZ | NLI failed to assure that all potential conditions associated with binding of Masterpact circuit breakers were promptly corrected and their customers were sufficiently notified about the full scope of the issue.

## REPORT DETAILS

### 1. 10 CFR Part 21

#### a. Inspection Scope

The NRC inspection team reviewed AZZ | NLI's implementation of its policies and procedures associated with 10 CFR Part 21, "Reporting of Defects and Noncompliance." In addition, the NRC inspection team evaluated AZZ | NLI's 10 CFR Part 21 postings and a sample of purchase orders for compliance with the requirements of 10 CFR 21.21, "Notification of Failure to Comply or Existence of a Defect and its Evaluation," and 10 CFR 21.31, "Procurement Documents." The NRC inspection team verified the content of AZZ | NLI's 10 CFR Part 21 posting, as well as the location of the posting. The NRC inspection team also verified that AZZ | NLI's nonconformance and corrective action procedures provide a link to the 10 CFR Part 21 program. The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

#### b. Observations and Findings

The NRC inspection team reviewed AZZ | NLI's corrective actions and Part 21 evaluations associated with spurious tripping issues of Masterpact breakers supplied by AZZ | NLI to PSEG for use at the Hope Creek Nuclear plant. At AZZ | NLI, initial entry into the Part 21 process is through screening questions contained in the non-conformance reports (NCRs). The NRC inspection team reviewed NCR-490, 491, and 492, which detailed the spurious tripping issues and contained the Part 21 screening evaluations.

AZZ | NLI determined the spurious tripping of the Masterpact breakers was not reportable under 10 CFR Part 21 because the breaker's safety function to trip open was not affected. The NRC inspection team determined this was not a valid basis, as spurious tripping of the circuit breakers is a failure that could impact the safety function of these breakers to close and remain closed during certain accident scenarios and only trip open upon valid circumstances (e.g., short circuit).

10 CFR Part 21.21(c)(1) requires, in part, that a dedicating entity is responsible for identifying and evaluating deviations and reporting defects and failures to comply associated with substantial safety hazards for dedicated items. Contrary to the above, as of September 22, 2016, AZZ | NLI failed to adequately evaluate spurious tripping of Masterpact circuit breakers supplied to Public Service Enterprise Group (PSEG) - Hope Creek, as required by 10 CFR 21.21(c)(1). AZZ | NLI's evaluation for this issue inadequately concluded that this issue was not reportable based upon the assumption that the only safety function of these breakers was to open and that spurious tripping would not affect the safety function of these breakers. The NRC inspection team identified this issue as Violation 99901471/2016-201-01.

c. Conclusion

The NRC inspection team issued Violation 99901471/2016-201-01 which cites AZZ | NLI for failing to properly identify and evaluate deviations that could potentially be associated with a substantial safety hazard for dedicated items. Specifically, AZZ | NLI failed to appropriately evaluate a deviation concerning spurious tripping of the dedicated Masterpact breakers, as required by 10 CFR Part 21.

2. Design Control and Qualification

a. Inspection Scope

The NRC inspection team reviewed AZZ | NLI's policies and implementing procedures governing design control in order to verify compliance with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team focused the majority of their effort on design control activities associated with AZZ | NLI's supply of commercially procured and dedicated components. Additionally, POs from different licensees were reviewed to verify adherence to select portions of equipment qualification requirements contained in customer POs. The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

Qualification

The NRC inspection team reviewed Report QR-351021439-1, "Qualification Report for Power Supply Acopian P/N: S16306-1," regarding Columbia Generating Station PO 00339471, dated January 14, 2016. The NRC inspection team noted the licensee's PO required a safety-related power supply that was qualified in accordance with NRC Regulatory Guide (RG) 1.180, Revision 1. AZZ | NLI's certificate of conformance for the power supply stated it met NRC RG 1.180, Revision 1, and EPRI TR-102323, "Guidelines for Electromagnetic Interference Testing in Power Plants," Revision 3. However, the NRC inspection team noted the qualification testing performed by AZZ | NLI used later versions of International Electrotechnical Commission (IEC) standards that were not referenced by either the NRC RG 1.180, Revision 1, or EPRI TR-102323, Revision 3.

Specifically, the IEC standard revisions used for the testing were different than the referenced PO standards in parameters such as dB levels, test set up distances, equipment parameters, effective source impedances, insulation support, etc. AZZ | NLI had not performed an engineering evaluation or reconciliation to ensure any changes in the used IEC revisions were still conservative and the testing performed was bounded by NRC and PO requirements.

Appendix B to 10 CFR Part 50, Criterion III, requires, in part, that appropriate quality standards are specified and included in design documents and deviations from such standards are controlled. Upon discussion with the vendor, the NRC inspection team noted there may be other qualification reports that could be affected. This issue was determined to be more than minor using the IMC 0617 screening process as the issue, if left uncorrected, represents a condition adverse to quality that renders the quality of a

structure, system, or component (SSC) unacceptable or indeterminate, and the issue is a deficiency in the testing of an SSC which requires a detailed engineering justification to establish the adequacy of the SSC's ability to perform its intended safety function. The NRC inspection team identified this issue as Nonconformance 99901471/2016-201-02.

### Design Verification

AZZ | NLI supplied 480 Vac Masterpact circuit breakers and custom designed interfacing cradles to numerous nuclear utilities. The intent of the cradle and Masterpact breaker is to allow utilities to replace obsolete original equipment manufacturer equipment (such as GE or Square D breakers) with newer designed Masterpact components that fit into the existing switchgear with minimal to no modifications on the existing installation.

AZZ | NLI, in turn, procures the breakers and cradles commercially from Schneider Electric-Square D and commercially dedicates them for use as safety-related replacement components. Since this is not a like-for-like replacement, an engineering evaluation is required to ensure these devices meet the system level design requirements and to evaluate the interface between the Masterpact breaker/cradle and the existing installation.

The NRC inspection team reviewed documentation associated with numerous reports of Masterpact circuit breakers spuriously tripping at PSEG's Hope Creek Nuclear Plant, including Nonconformance Reports (NCRs) - 490, 491, and 492; all dated May 23, 2013. These NCRs involved three different breakers that were returned to AZZ | NLI from Hope Creek when they spuriously tripped open during starting of safety-related motors. PSEG relayed additional information to AZZ | NLI indicating there have been 22 instances since 2008 where Masterpact breakers, supplied by AZZ | NLI, have spuriously tripped open during motor starting. In response to the NCRs, AZZ | NLI performed troubleshooting activities on the returned breakers in an attempt to replicate the spurious tripping reported by PSEG. The troubleshooting included motor starts under similar loads while subjecting the breaker to electromagnetic interference (EMI). AZZ | NLI's theory was that spurious tripping may be related to a problem with EMI being picked up by the circuit breaker's "P" type digital overcurrent trip devices. Troubleshooting activities were documented in RCA-042-351023474, "Root Cause Analysis Report for PSEG Masterpact Circuit Breakers," Revision 0, dated October 1, 2015. The report was inconclusive, as AZZ | NLI was unable to replicate the conditions/failures identified at Hope Creek.

During the inspection, the NRC inspection team questioned the adequacy of the Masterpact circuit breaker design in this specific application since, at Hope Creek, the overcurrent trip devices only receive power from the load side of the breakers. The team identified that supplying power to the overcurrent trip devices in this manner is just one of three ways they can be powered. The other two methods to power the overcurrent trip unit is from the line side of the breaker/bus or from an external 24 Vdc power supply. The team identified that Page 19 of the Square D/Schneider Electric catalog sheet for these breakers, which is contained in, "Instruction Manual For AZZ | NLI /Square D Masterpact Breaker/Cradle Sds Part No: Lgsb4," states, "The P and H trip units were designed to be used with the external 24 Vdc power supply. The breaker's large liquid crystal display (LCD) requires too much current to be powered by current flow through the circuit breaker. The P and H type overcurrent trip units do have a voltage power supply which will power the overcurrent trip unit with 100 Vac or more between two phases or phase to neutral. The standard configuration for the voltage probes inside the

circuit breaker is at the bottom connections. If the circuit breaker was open in a top-fed application, there would be no voltage at the bottom of the circuit breaker and the trip unit would not be powered.”

The NRC inspection team identified that when the “P” type overcurrent trip devices are powered from the load side, and when the breakers are used as motor starters, as they are at Hope Creek, the trip devices may experience an undefined time period after the breaker first closes during which the overcurrent trip device may not be accurately processing data. This time period may also correspond to the time the load current being sensed by the trip devices is greatest due to the inrush starting current from the motors. It may also be the time when the electromagnetic noise interference (EMI) on the line is the greatest. During the inspection, AZZ | NLI was unable to provide any data on startup times for the overcurrent trip units. This aspect of the design was not evaluated during the original dedication and supply of the breakers to Hope Creek.

As a result of questions raised by the NRC inspection team, AZZ | NLI conducted a conference call with Hope Creek and Schneider Electric to further discuss the spurious tripping issue. During the phone call, Schneider Electric reiterated the statement contained in the instruction manual and stated they would not recommend powering the “P” type overcurrent trip units from the load side of the breakers if they are used as motor starters (for the reasons discussed above as well as for other technical issues). Schneider stated that consideration should be given to powering the overcurrent trip devices through an external 24Vdc power supply (preferred) or via the line side of the breaker. This would eliminate concerns associated with the startup time for the overcurrent trip device as the units would be continuously powered.

10 CFR Part 50, Appendix B, Criterion III, requires, in part, that design control measures shall provide for verifying the adequacy of the 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. The NRC inspection team identified that AZZ | NLI had not sufficiently verified the adequacy of the Masterpact circuit breaker design for the specific applications/configurations at Hope Creek and had not recognized this as a potential cause of the spurious tripping that had been reported to AZZ | NLI by PSEG-Hope Creek. The NRC inspection team identified NON 99901471/2016-201-03 for AZZ | NLI’s failure to take sufficient actions to verify the adequacy of the design for certain configurations of Masterpact circuit breakers which are used as motor starters with overcurrent trip devices that are powered from the load side of the breakers. This issue is more than minor as AZZ | NLI’s failure to verify the adequacy of the design for this application may have led to instances of spurious tripping of installed safety-related breakers, which impacts one of the safety functions of the breaker.

### Dedication

The NRC inspection team reviewed Entergy PO 10454062, Revision 3, to AZZ | NLI, dated May 11, 2016, for the repair of an Exeltech inverter which was part of an inverter assembly originally supplied to Entergy by AZZ | NLI. The PO invoked Appendix B to 10 CFR Part 50 and 10 CFR Part 21. The team noted that AZZ | NLI worked with the commercial supplier of the inverter (Exeltech) in troubleshooting and repairing the inverter. The inverter repairs resulted in the replacement of some internal components.

AZZ | NLI's standard practice requires the component to undergo commercial grade dedication for safety-related use by AZZ | NLI, following repairs performed by Exeltech. As part of its commercial grade dedication process, AZZ | NLI utilized a previously completed generic Technical Evaluation TE-E-5, "Invertors," Revision 0, to identify critical characteristics that need to be verified as part of this dedication process. One of the critical characteristics identified in Paragraph 5.0 of TE-E-5 was "Harmonic Distortion and Power Quality." However, unlike the other critical characteristics listed in Paragraph 5.0 of the generic technical evaluation, there was no guidance contained in the evaluation as to how harmonic distortion and power quality should be verified. AZZ | NLI utilizes these generic technical evaluations to develop unique verification plans. In this case, AZZ | NLI generated Verification Plan (VP)-0770131-1, Revision 2. The NRC inspection team noted that, although the technical evaluation identified harmonic distortion and power quality as a critical characteristic, this critical characteristic was not listed in VP-0770131-1. Therefore, no actions were taken to assess whether harmonic distortion and power quality of the inverter were acceptable after the repairs were made. This PO was for a repair of the inverter only, but the verification of harmonic distortion and power quality was not verified as part of the original commercial grade dedication. TE-E-5 provided no guidance on how to verify this specific critical characteristic nor did it provide any justification on why the absence of verifying this critical characteristic was acceptable.

Appendix B to 10 CFR Part 50, Criterion III, requires, in part, that measures be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components. Contrary to the above, as of September 22, 2016, AZZ | NLI failed to, as part of its commercial grade dedication process, implement sufficient measures to ensure the suitability of the inverter output which is essential to the safety-related functions of the component. Specifically, AZZ | NLI failed to verify the acceptability of the harmonic distortion and power quality which is a critical characteristic. This issue is more than minor as AZZ | NLI's failure to verify the adequacy of the inverter's output (harmonic distortion and power quality), as part of the commercial grade dedication process, which could impact the functionality of safety-related equipment powered by the inverter. The NRC inspection team identified this to be the first example of Nonconformance 99901471/2016-201-04.

The NRC inspection team reviewed PO 758798, Revision 7, dated February 17, 2015, from Tennessee Valley Authority (TVA) to AZZ | NLI for the purchase of 22 Masterpact NT 480 VAC circuit breakers. This was just one representative sample from a number of POs that AZZ | NLI received from nuclear utilities over the last 12 years for Masterpact circuit breakers. AZZ | NLI provided Masterpact circuit breakers along with custom-designed interface cradles to numerous nuclear utilities as direct replacements for several obsolete original equipment manufacturer (OEM) breaker styles. AZZ | NLI supplies these breakers as nuclear safety-related after procuring the breakers and cradles commercially from Schneider Electric – Square D and dedicating the equipment. As part of its commercial grade dedication process, AZZ | NLI performs a technical evaluation to determine the safety function and critical characteristics of the components being dedicated. In many instances, AZZ | NLI performed generic technical evaluations for families of components, such as is the case for low and medium voltage circuit breakers.

The NRC inspection team reviewed Technical Evaluation TE-E-02, Revision 0, which is a generic technical evaluation utilized to determine the critical characteristics for low and medium voltage circuit breakers. The NRC inspection team identified that, while a number of breaker functions were identified as critical characteristics, TE-E-02 did not identify verification of the breaker's current interrupting rating as a critical characteristic. A breaker's interrupting rating is critical to ensuring that the breaker can interrupt and clear faults that are postulated to occur. This is one of the primary safety functions of the breaker. Since the current interrupting rating was not identified as a critical characteristic in the technical evaluation, it was not carried over into the verification plan and no specific actions were taken by AZZ | NLI to validate the breakers' current interrupting rating as part of the dedication process.

The NRC inspection team discussed the breakers' current interrupting rating with AZZ | NLI. AZZ | NLI indicated they were taking credit for commercial testing done by Schneider Electric – Square D to establish the interrupting ratings and provided a copy of Commercial Grade Survey CGSR-AVL-191-09, dated March 24, 2016. In the survey, AZZ | NLI referenced certain commercial Square D test reports that documented the results of testing performed for the breakers and breaker/cradle assemblies which included current interrupting rating testing. However, AZZ | NLI could not provide objective and power quality evidence that the current interrupting rating testing was appropriately performed or the test was performed at an accredited laboratory facility. AZZ | NLI failed to implement sufficient measures to ensure the suitability of application for materials, parts, equipment, and processes that are essential to the safety-related functions of the SSCs. This issue is more than minor as the interrupting rating is a critical characteristic of the breaker and a circuit breaker's failure to properly interrupt a fault could lead to loss of redundant safety-related equipment. The NRC inspection team identified this to be the second example of Nonconformance 99901471/2016-201-04.

c. Conclusion

The NRC inspection team concluded that AZZ | NLI had not fully implemented its Design Control program in accordance with the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team identified Nonconformance 99901471/2016-201-02, where AZZ | NLI failed to ensure that requirements contained in PO 00339471 associated with EMC testing of a safety-related power supply were properly incorporated into the design documents. Consequently, AZZ | NLI performed the EMC testing to later IEC standard revisions that were not in accordance with the PO requirements. The standard revisions used for the testing were different than the referenced PO standards in parameters such as dB levels, test set up distances, equipment parameters, effective source impedances, insulation support, etc.

The NRC inspection team also determined that AZZ | NLI had not sufficiently verified the adequacy of the Masterpact breaker design for the specific applications/configurations at Hope Creek and had not recognized this as a potential cause of the spurious tripping that had been reported to AZZ | NLI by Hope Creek. The NRC inspection team identified Nonconformance 99901471/2016-201-03 for AZZ | NLI's failure to take sufficient actions to verify the adequacy of the design for certain configurations of Masterpact breakers which are used as motor starters with overcurrent trip devices that are powered from the load side of the breakers.

The NRC inspection team also determined that AZZ | NLI had not implemented sufficient measures to ensure the suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of SSCs. In the first example, AZZ | NLI had not verified a critical characteristic of harmonic distortion and power quality associated with a safety-related inverter supplied to Entergy. In the second example, AZZ | NLI had not taken sufficient actions to identify and verify the critical characteristic of interrupting current capability for Masterpact circuit breakers supplied to TVA and other utilities. The NRC inspection team identified these issues as Nonconformance 99901471/2016-201-04.

### 3. Test Control

#### a. Inspection Scope

The NRC inspection team reviewed policies and procedures associated with seismic qualification testing to verify compliance with Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. The review included procedures, qualification plans, and requirements associated with Tennessee Valley Authority PO 00078551 for safety-related switches at the Sequoyah Nuclear Power Plant. The inspectors evaluated the testing that was conducted, as well as, the calibration records of instruments and equipment used and the verification and validation of the software used. The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

#### b. Observations and Findings

No findings of significance were identified.

#### c. Conclusion

The NRC inspection team determined that the AZZ | NLI's implementation of its policies and procedures associated with test control met the requirements of Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50 based on the limited number of samples reviewed. No findings of significance identified.

### 4. Control of Purchased Materials, Equipment, and Services

#### a. Scope

The NRC inspection team reviewed AZZ | NLI's policies and procedures in compliance with Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. The NRC inspection team verified AZZ | NLI implemented provisions in their dedication plans to verify the capabilities of their suppliers. Specifically, the NRC inspection team verified that applicable quality requirements, including technical and regulatory requirements, were specified in the procurement documents and these were reviewed and extended to lower-tier suppliers when necessary. The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusion

The NRC inspection team determined that AZZ | NLI's implementation of its policies and procedures associated with the control of purchased material, equipment, and services met the requirements of Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50 based on the limited number of samples reviewed. No findings of significance identified.

5. Control of Measuring and Test Equipment

a. Scope

The NRC inspection team reviewed AZZ | NLI policies and implementing procedures governing the measuring and test equipment (M&TE) program to verify compliance with the requirements of Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50. The NRC inspection team performed a walk-down to ensure equipment located in the M&TE storage area, M&TE hold area and fabrication shop were labeled, handled, and stored in a manner that indicated the calibration status of the instrument and ensured its traceability to calibration test data. The NRC inspection team also reviewed a sample of calibration records and a sample of electrical and mechanical testing equipment used during commercial grade dedication testing. The inspectors also verified the M&TE was calibrated, adjusted, and maintained at prescribed intervals prior to use. The inspectors reviewed the electronic records for M&TE equipment to ensure no equipment that was out of calibration was in use, and for M&TE out of calibration, the inspectors verified a selection of the M&TE was properly marked and segregated. The NRC inspection team also verified that when M&TE equipment is received from the calibration service supplier and the calibration certificate states that it was found to be out of calibration, AZZ | NLI generated an NCR to identify the items that have been accepted using this equipment since the last valid calibration date and performed an extent of condition review. The NRC inspection team discussed the M&TE program with NLI's management and technical staff. The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusion

The NRC inspection team concluded that AZZ | NLI is implementing its M&TE program in accordance with the regulatory requirements of Criterion XII of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that AZZ | NLI is implementing its policies and procedures associated with the M&TE program. No findings of significance were identified.

## 6. Corrective Action

### a. Scope

The NRC inspection team reviewed AZZ | NLI's policies and implementing procedures used to address nonconformances, corrective and preventative actions. The NRC inspection team reviewed a sample of Corrective and Preventive Action (CAPA) Requests to evaluate the adequacy of AZZ | NLI corrective action plans. Procedure AZZ-QAP-16, "Corrective and Preventive Actions," Revision 0, dated July 1, 2015, provides guidance for identification, evaluation and resolution of conditions adverse to quality as CAPA Requests. In addition, the NRC inspection team reviewed AZZ | NLI's corrective actions for nonconformances associated with NRC Inspection Report 99901298/2012-201, dated July 3, 2012, to evaluate the adequacy of corrective actions taken by AZZ | NLI to the NRC's findings.

The NRC inspection team also reviewed NLI's corrective actions associated with an ongoing issue concerning mechanical binding of Masterpact breakers. These breakers were dedicated and supplied by AZZ | NLI to numerous nuclear utilities for safety-related applications. The attachment to this report lists the individuals interviewed and documents reviewed by the NRC inspection team.

### b. Finding and Observations

The NRC inspection team reviewed documentation associated with numerous instances where Masterpact breakers used in safety-related applications failed to close upon demand due to internal binding. AZZ | NLI received notice from several utilities identifying this potential problem as early as 2008. The NRC inspection team reviewed AZZ | NLI NCRs 440, 573, and Failure Analysis FA-042-351021500-1; all associated with the failure to close Masterpact breaker issues. The NRC inspection team also reviewed associated AZZ | NLI Part 21 notifications and Technical Bulletins associated with this issue.

- 1) In NCR-440, dated September 6, 2012, Hope Creek returned several Masterpact breakers to AZZ | NLI for failure analysis. AZZ | NLI concluded the root cause for the failure was that Hope Creek's switchgear operating scheme had not been adequately evaluated. AZZ | NLI did not adequately evaluate how the switchgear operating scheme affected the energization of the close and trip coils on Masterpact Type NW circuit breakers used in safety-related applications. AZZ | NLI stated in NCR-440 that a technical bulletin would be issued to notify all Masterpact users. AZZ | NLI wrote Technical Bulletin (TB)-12-007, Revision 0, dated April 13, 2015, but this bulletin was not issued to all the effected customers until February of 2016 (in conjunction with AZZ | NLI's Part 21 notification P21-02152016, Revision 0), following NRC staff discussion. Subsequently, AZZ | NLI issued Revision 1 to TB-12-007 on March 17, 2016. AZZ | NLI issued P21-02152016, Revision 1, dated May 12, 2016, and then Revision 2 on July 13, 2016. After discussion with the NRC inspection team, AZZ | NLI issued Revision 3 to P21-02152016 and Revision 3 to TB-12-00 to report information that was identified by the NRC inspection team.
- 2) In NCR-573, dated March 7, 2014, AZZ | NLI incorrectly concluded the plant logic scheme, which allows a "standing close" signal, was the root cause of the failure of several Masterpact breakers Hope Creek returned to AZZ | NLI for failure analysis.

AZZ | NLI further documented that pressure from the anti-pump latch pushing on the close coil plunger (down when energized by the standing close signal) caused the rear of the lever to rock up in the back and intermittently catch on the top frame of the mechanism, resulting in mechanical binding. NCR-573 stated that in one case a Hope Creek breaker had been rewired to incorporate a 52b (Normally Closed) OF contact in series with the close coil. This was the “fix” recommended by AZZ | NLI to River Bend in 2014 and 2015 for the same breaker binding issue. This was the “fix” recommended by AZZ | NLI even though there was at least one example of this “fix” having failed to prevent reoccurrence of the breaker binding issue.

- 3) In Failure Analysis FA-042-351021500-1, “Masterpact Circuit Breaker,” Revision 1, dated August 13, 2014, which incorporated Schneider/Square D Services Report Number TIR-351021500-2, Section 2.0, “History,” documented that PSEG informed AZZ | NLI of another breaker that failed to close on June 27, 2013. This breaker failed when subjected to a close signal whose duration was in the 3 to 5 second time-frame. This duration of close signal was concluded to be considered as a “standing close” signal in this report. Section 5.2 “Conclusions,” states, “The fail to close issue is a result of a control scheme that allows a standing close signal or a standing close signal combined with the charging cycle not completed. The modification of the wiring to put the close coil in series with a normally closed auxiliary contact will remove the standing close signal and also allow the charging motor to complete its cycle before the next close signal is given.” This conclusion was later determined to be incorrect in that wiring 52b NC contact in series with the close coil will not prevent the circuit breakers from mechanical binding in all cases.

In the above three examples, AZZ | NLI determined the root cause for the mechanical binding of Masterpact Type NT and NW circuit breakers was the plant logic scheme which allows a standing close signal to exist on the breaker. The NRC inspection team determined, AZZ | NLI’s root cause conclusion was incomplete. The NRC inspection team identified that information already obtained by AZZ | NLI stated that there were other situations that could also cause the breaker to fail to close, beyond a “standing close signal” including:

- The closing circuit is continually energized during charge and/or open operations.
- An anti-pump condition is present.
- The breaker receives a command to open electrically before, or at the same time, the close command is initiated.
- A remote closing action by an operator that may hold the close signal for a duration longer than 200 milliseconds, which would extend into the charging cycle.
- A logic scheme that would have a component controlling the close circuit that would apply the voltage to the close coil for a duration longer than 200 milliseconds, which would extend into the charging cycle.

Thus, the actual problem potentially applies to many more breakers than what was originally identified in the Part 21 reports that had been issued by AZZ | NLI prior to the inspection.

In summary, over the last several years, AZZ | NLI had not taken adequate corrective actions to resolve binding problems in order to accurately report the extent of the problem to their customers. While AZZ | NLI conducted extensive investigations into the scope and root causes for this issue, as of the completion this of the inspection, their corrective actions had not been adequate. AZZ | NLI had not sufficiently evaluated the data resulting from its investigations and had not identified to its customers the full scope of this problem or recommended sufficient corrective actions. Specifically, AZZ | NLI closed NCR-440 on September 6, 2012, but never issued a technical bulletin on the issue until prompted by the NRC staff in February of 2016. AZZ | NLI closed NCR-573 on September 6, 2014, even though there was evidence to show the potential for additional circuit breaker failures and the proposed “fix” would not completely prevent reoccurrence of the problem. The NRC inspection team identified these inadequacies to address conditions adverse to quality identified in AZZ | NLI’s corrective action program to be a Nonconformance to Criterion XVI, “Corrective Action,” of Appendix B to 10 CFR Part 50. The NRC inspection team identified this issue as Nonconformance 99901471/2016-201-05

As a result of questions raised by the NRC inspection team during the inspection, on September 22, 2016, AZZ | NLI issued Revision 3 to the 10 CFR Part 21 report on this issue as well as Revision 3 to their technical bulletin. AZZ | NLI’s technical bulletin appears to properly identify the full scope of the problem.

c. Conclusion

The NRC inspection team concluded that with respect to this issue, AZZ | NLI had not taken adequate corrective actions to correct conditions adverse to quality associated with the binding of Masterpact breakers, as required by Criterion XVI, “Corrective Action,” of Appendix B to 10 CFR Part 50. These breakers have been supplied by AZZ | NLI to numerous nuclear utilities as safety-related equipment. The NRC inspection team identified this issue as Nonconformance 99901471/2016-201-05.

7. Entrance and Exit Meetings

On September 19, 2016, the NRC inspection team discussed the scope of the inspection during an entrance meeting with Mr. Tracy Bolt, Quality Assurance Manager of AZZ | NLI, and other members of AZZ | NLI management and staff. On September 22, 2016, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Mathew Sweeny, General Manager, and other AZZ | NLI staff. Subsequently, the NRC re-exited on October 31, 2016. The attachment to this report lists the entrance and exit meeting attendees, as well as those individuals the NRC inspection team interviewed.

## ATTACHMENT

### 1. ENTRANCE/EXIT MEETING ATTENDEES

<b>Name</b>	<b>Title</b>	<b>Affiliation</b>	<b>Entrance</b>	<b>Exit</b>	<b>Interviewed</b>	<b>Re-Exit</b>
Chris Tribble	Engineering Manager	AZZ   NLI	X	X	X	X
Vincent Giancaspro	Seismic Technician	AZZ   NLI			X	
Tracy Bolt	Director of Quality Assurance	AZZ   NLI	X	X	X	X
Victor Lara	Director of Engineering	AZZ   NLI	X	X	X	
Les Taggart	Quality Assurance Program Manager	AZZ   NLI	X	X	X	X
Edward Wynne	Procurement Engineering Manager	AZZ   NLI	X	X	X	X
Matt Sweeny	General Manager	AZZ   NLI	X	X		X
Mark Harness	Human Recourse Manager	AZZ   NLI	X	X		X
Jim Hootman	Engineering Specialist	AZZ   NLI		X	X	
Allen Sadeghi	Quality Engineer	AZZ   NLI	X	X		
Craig Irish	VP Sales and Marketing	AZZ   NLI		X		
Kim Tomhnson	Scheduling Manager	AZZ   NLI	X			
Steve Redmon	Business Unit Manager	AZZ   NLI	X			
Vaugh Sinkewiz	Business Unit Manager	AZZ   NLI	X			
Dirk Bartley	Quality Assurance Engineer	AZZ   NLI	X			
Valerie Cox	Sale, Order entry, Customer Service	AZZ   NLI	X			
John Marshall	Production Manager	AZZ   NLI	X			
Aaron Armstrong	NRC Inspector	NRC	X	X		X
Eugene Huang	NRC Inspector	NRC	X	X		
Jeffrey Jacobson	NRC Inspector	NRC	X	X		X
John Watkins	NRC Inspector	NRC	X	X		
Terry Jackson	NRC Branch Chief	NRC		X		X

2. INSPECTION PROCEDURES USED

IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance," dated February 13, 2012 (Agencywide Document Access and Management System (ADAMS) Accession No. ML113190538)

IP 43002, "Routine Inspections of Nuclear Vendors," dated July 15, 2013 (ADAMS Accession No. ML13148A361)

IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated November 29, 2013 (ADAMS Accession No. ML13280A478)

3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

<u>Item Number</u>	<u>Status</u>	<u>Type</u>	<u>ITAAC</u>	<u>Description</u>
99901298/2012-201-01	CLOSED	NON	N/A	Criterion III
99901298/2012-201-02	CLOSED	NON	N/A	Criterion III
99901471/2016-201-01	OPEN	NOV	N/A	Part 21
99901471/2016-201-02	OPEN	NON	N/A	Criterion III
99901471/2016-201-03	OPEN	NON	N/A	Criterion III
99901471/2016-201-04	OPEN	NON	N/A	Criterion III
99901471/2016-201-05	OPEN	NON	N/A	Criterion XV

#### 4. LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
CAPA	Corrective and Preventive Action
CDI	Commercial Grade Dedication Instruction
CGD	Commercial-Grade Dedication
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ENC	Engineering Change Notice
FEA	Finite Element Analysis
FMEA	Failure Modes Effects and Analysis
IEC	Electrotechnical Commission
LCD	Liquid Crystal Display
M&TE	Measurement and Test Equipment
MP	Manufacturing Procedure
NCR	Nonconformance Report
NDE	Nondestructive Examination
NON	Notice of Nonconformance
NRC	Nuclear Regulatory Commission
PO	Purchase Order
PSEG	Public Service Enterprise Group
QA	Quality Assurance
RG	Regulatory Guide
SSC	System, Structure, and Component
TB	Technical Bulletin
TE	Technical Evaluation
TVA	Tennessee Valley Authority
VP	Verification Plan

#### 5. DOCUMENTS REVIEWED

##### Procedures

AZZ Nuclear Quality Assurance Manual, Second Edition, Revision 0, dated July 1, 2015

AZZ Nuclear Quality Assurance Procedure, AZZ-QAP-16, "Corrective and Preventative Actions," Revision 0, dated July 1, 2015

AZZ Nuclear Quality Assurance Procedure, AZZ-QAP-15, "Control of Nonconforming Items," Revision 1, dated August 15, 2016

AZZ Nuclear Nonconformance Reporting, Corrective, and Preventative Action Procedure NLI-QUAL-06, Revision 19

AZZ Nuclear Quality Assurance Procedure, AZZ-QAP-19, "10 CFR 21 Reporting," Revision 0, dated June 15, 2015

AZZ Nuclear Procedure, AZZ-ENG-11, "Root Cause Analysis, Apparent Cause Evaluation, and Common Cause Evaluation," Revision 0

AZZ Nuclear Quality Assurance Procedure, AZZ-QAP-12, "Control of Measuring and Test Equipment," Revision 1

AZZ Nuclear Quality Assurance Procedure, AZZ-QAP-03, "Design Control," Revision 2, dated July 13, 2016

#### Drawings

21015727-LD-10, 33 terminal controls and instrumentation layout drawing, Revision 3

31916341-CPLNG-1, 16" Butterfly Valve, Revision 4, dated September 1, 2016

#### Specifications, Calculations, Engineering Documents

AZZ | NLI Failure Analysis Report FA-042-351021500-1, Revision 1, for PSEG Masterpact Circuit Breakers, which incorporates Schneider Electric Report TIR-351021500-2

#### Corrective Action Reports (CARs) and Nonconformance Reports (NCR's)

CAPA# NLI-CAPA-76, dated November 11, 2015

CAPA# NLI-CAPA-77, dated October 30, 2015

CAPA# NLI-CAPA-130, dated December 10, 2015

CAPA# NLI-CAPA-109, dated December 31, 2015

CAPA# NLI-CAPA-139, dated April 7, 2016

CAPA# NLI-CAPA-170, dated August 1, 2016

CAPA# NLI-CAPA-164, dated July 13, 2016

CAPA# NLI-CAPA-151, dated May 2016

NCR-440, Revision 0, Project # 042-15193, PSEG-Hope Creek, Masterpact Style NW Replacement Circuit Breakers, dated August 30, 2012

NCR-573, Revision 0, Project # 351021500, PSEG-Hope Creek, Masterpact Style NW Replacement Circuit Breakers, dated August 6, 2014

NCR-709, Revision 1, NT and NW Style Masterpact Circuit Breakers, dated August 5, 2016

NCR-684, Revision 0, (Size 3) 057018-coil-3, (Size 4) 057018-coil-5, dated February 29, 2016

NCR-696, Revision 0, incorrect part # FH87 only stamped with FH8, dated August 5, 2016

NCR-697, Revision 9, Threads on recoil were stripped, dated February 29, 2016

NCR-698, Revision 11, MCC cubical was returned for breaker and thermal block corrosion, dated March 1, 2016

NCR-700, Revision 2, Not working after quick functional test was preformed after installation, dated March 22, 2016

NCR-701, Revision 8, ANCO M&TE-2315, dated April 1, 2016

NCR-702, Revision 22, NLI / Limitorque (Flowserve), dated April 4, 2016

NCR-704, Revision 14, PSEG reported breaker failed insulation testing, dated May 18, 2015

NCR-706, Revision 8, primary windings were damaged, dated June 17, 2016

NCR-708, Revision 1, OV relay dimensions incorrect 411u4175-HF-L, dated June 30, 2016

RMA# 35102639, Revision 2, Quick functional test but did not work, dated December 7, 2015

RMA# 351025018, Revision 9, Stripped coil threads, dated January 22, 2016

RMA# 351025063, Revision 2, Corrosion of thermal block, dated January 22, 2016

RMA# 351024909, Revision -, breaker failed insulation testing, dated January 22, 2016

#### CARs Generated During NRC Inspection

CAPA# NLI-CAPA-186, dated September 21, 2016

CAPA# NLI-CAPA-185, dated September 21, 2016

CAPA# NLI-CAPA-189, dated September 22, 2016

#### Miscellaneous

VVP/VVR-MTE-1818, Verification and Validation/Dedication plan/report for the seismic data acquisition system MTE-1818, Revision 2, dated August 2013

DR-15922, Revision 0

CGSR-AVL-1085-01, Commercial Grade Survey for Invensys, dated April 22, 2013

SVP-135, Standard verification plan for Square-D magnum type 5GSB3-350-1200/2000 4.16kV, 1200/2000A, 350MVA series circuit breakers, Revision 5, dated March 2016

NU-02SR726683, Nuclear Safety related water chillers, dated May 24, 2006

17025 Compliant Certificate of Calibration for Agilent Technologies Model 34401A, Digital Multimeter, MTE-730 Calibration Date May 27, 2016

17025 Compliant Certificate of Calibration for Keithley Model 3321, LCZ Meter, MTE-789 Calibration Date September 12, 2016

17025 Compliant Certificate of Calibration for Fluke Model 87III, Digital Multimeter, MTE-946 Calibration Date July 13, 2016

17025 Compliant Certificate of Calibration for Fluke Model 717-30G, Pressure Calibrator MTE-1581 Calibration Date December 23, 2015

17025 Compliant Certificate of Calibration for Fluke Model 700P07, Pressure Module MTE-1581A Calibration Date December 23, 2015

17025 Compliant Certificate of Calibration for Fluke Model PV350, Pressure/Vacuum Module MTE-1913 Calibration Date January 11, 2016

17025 Compliant Certificate of Calibration for Fluke Model 114, Digital Multimeter MTE-2103 Calibration Date March 23, 2016

Verification Plan VP-67DFR-25/C4/SF, Revision 0

Verification VP-139038-01, Revision 1, for DC Output Filter in Class 1E Battery Chargers

Fisher Bulletin 71.1:67D for NPS ½ 67DFR-25/C4/SF Power Conversion 37,000 micro Farad (MFD) Capacitor, Drawing H0221175437P, Revision 0

Discrepancy Report DR#: DR-16306 Capacitor dimensions out of tolerance

Discrepancy Report DR#: DR-15469 Torque wrenches calibration frequency change

Discrepancy Report DR#: DR-16244 Capacitor dimensions out of tolerance

Approved Vendor List AVL-131 Trescal MO Performance Assessment, PAC-AVL-131-01 and CGSR-AVL-131-04

Approved Vendor List AVL-38, Revision 26, dated April 27, 2016

AZZ/NLI Audit # PAR-AVL-38-04, dated April 25, 2016

Audit Plan CGSP/AP-AVL-131-05, Revision 0

#### Qualification and Certification Records

QR-351021439-1, Qualification Report for Power Supply Acopian P/N: S16306-1, Columbia Power Station, PO 00339471, dated January 14, 2016

QP-351025630-1, Seismic test plan for selector switch, Revision 1

#### ECN

ECNF-4855, Motor for hydraulic actuator assembly, dated June 28, 2016

ECNF-4959, 18" Butterfly valve, soft seated, dated July 18, 2016

ECNF-4860, Modified Ametek pressure transmitters, dated June 30, 2016

ECNF-4865, DC MCC cubicles, dated June 30, 2016

ECNF-5156, Terminal boxes, dated August 23, 2016

ECNF-5263, Valve and gearbox assembly, dated September 12, 2016

ECNF-4134, O-rings and filters, dated March 4, 2016

ECNF-4155, Medium voltage replacement breakers, dated March 9, 2016

ECNF-5266, Capacitor dimensions out of tolerance

Purchase Orders

PO 351021273, SCANA temperature sensor RTD with 440 series conditioner with thermowell, dated September 26, 2013

PO 00074944, Braidwood Circuit Board, Alarm, Battery Charger, dated June 8, 2016

PO 351024340, Inverter to Entergy, dated July 29, 2015

PO SNG2797-0237, Motor for Hatch, Revision 4

PO 00339471, Columbia Generating Station for Power Supply, Revision 5

PO 2194137, Switch for Sequoyah, dated July 7, 2016

NLI-78111, Revision 0, Purchase Order with Trescal for M&TE Calibration

NLI-79535, Revision 0, Purchase Order with RSCC Cable and Wire LLC, dated September 2, 2016