

May 27, 2016

Mr. Larry Friedman, Quality Assurance Manager
Electroswitch Corporation
180 King Avenue
Weymouth, MA 02188

SUBJECT: NUCLEAR REGULATORY COMMISSION VENDOR INSPECTION OF
ELECTROSWITCH CORPORATION REPORT NO. 99900833/2016-201 AND
NOTICE OF NONCONFORMANCE

Dear Mr. Friedman:

On April 25 to April 29, 2016, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at the Electroswitch Corporation (Electroswitch) assembly facility in Weymouth, MA, and its fabrication facility in Rockland, MA. The purpose of the limited-scope inspection was to assess Electroswitch's compliance with the provisions of selected portions 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 specifically evaluated Electroswitch's implementation of quality activities associated with the manufacturing, design, and testing, for safety-related power switches and relays supplied to U.S. operating nuclear power plants. The enclosed report presents the results of this inspection. This NRC inspection report does not constitute NRC endorsement of your overall quality assurance (QA) or 10 CFR Part 21 programs.

During this inspection, NRC inspectors found that the implementation of your QA program failed to meet certain NRC requirements imposed on you by your customers or NRC licensees in the areas of design control. Specifically, (1) Electroswitch failed to qualify multiple components and product lines to meet the requirements of Institute of Electrical and Electronics Engineers, (IEEE) 323 and IEEE C37.90 as required by multiple purchase orders; and (2) failed to ensure that commercially procured materials, components, and services had adequate verification to meet 10 CFR Part 50 Appendix B requirements and ensure that the commercial materials and parts are equivalent to what was originally qualified. Due to the NRC's inspection being a limited sample and based on the prevalence and significance of design control findings relating to qualification activities, it is expected that Electroswitch will perform and document a thorough extent of condition to evaluate for similar design control deficiencies related to all shipped safety-related product.

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 of the NRC's "Rules of Practice," a copy of this letter, its enclosure(s), and 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 at

<http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response, (if applicable), 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 that such material is 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).

Sincerely,

/RA/

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

Docket No.: 99900833

Enclosures:

1. Notice of Nonconformance
2. Inspection Report 99900833/2016-201
and Attachment

<http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response, (if applicable), 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 that such material is 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).

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|---------------|-----------------|-----------------|-----------------|
| OFFICE | NRO/DCIP/QVIB-1 | NRO/DCIP/QVIB-1 | NRO/DCIP/QVIB-1 |
| NAME | EHuang* | GLipscomb* | JJimenez* |
| DATE | 05/26/16 | 05/23/16 | 05/23/16 |
| OFFICE | NRO/DCIP/QVIB-3 | NRO/DCIP | NRO/DCIP/QVIB-1 |
| NAME | JHeath* | TFrye* | TJackson |
| DATE | 05/26/16 | 05/26/16 | 05/27/16 |

OFFICIAL RECORD COPY

NOTICE OF NONCONFORMANCE

Electroswitch Corporation
180 King Avenue
Weymouth, MA 02188

Docket No.: 99900833
Report Number 2016-201

Based on the results of a Nuclear Regulatory Commission (NRC) inspection conducted at Electroswitch Corporation (hereafter referred to as Electroswitch) facility in Weymouth, MA, on April 25, 2016, through April 29, 2016, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on Electroswitch by NRC licensees.

- A. Criterion III, "Design Control," of Appendix B to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 states, in part, that "The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions."

Contrary to the above, as of April 29, 2016, Electroswitch did not use a suitable test program for qualification testing under the most adverse design conditions. Specifically, Electroswitch used ESC-STD-1000, "General Specifications for Rotary Switches and Auxiliary Relays for Utility Applications including Class 1E Equipment Requirements for Nuclear Power Generating Stations," Revision 7, dated January 1, 1997, as a universal procedure to qualify components. The ESC-STD-1000 procedure was written to incorporate the requirements of Institute of Electrical and Electronics Engineers, (IEEE) 323-1984, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," IEEE 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," and IEEE C37.90-1989, "IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus," back in Revision 3, dated September 3, 1984. However, the Electroswitch final operational testing, which followed the aging, radiation, and seismic portions, used less than conservative testing parameters for dielectric withstanding voltage, insulation resistance, and contact resistance when compared to the baseline/operational testing parameters. This does not meet the requirements of IEEE 323 where the test sequence requires performing baseline operational testing, followed by aging, radiation, and seismic exposure (which is meant to simulate end of life and a design basis event (DBE)), then final operational testing using the previous testing parameters. This ensures the component on the last day of life can undergo a DBE and still be relied upon to perform its intended safety function. Furthermore, the final operational testing parameters do not meet the requirements of IEEE C37.90, which lists minimum dielectric withstanding testing voltages. In addition, Electroswitch's Class 2 testing, which is periodic and is meant to supplement final product testing performed on every component after assembly, does not test the dielectric withstanding voltage as required by IEEE C37.90. Therefore, the dielectric withstanding voltage, which is specified in various component data specification sheets, has not been verified since the original pre-aging, radiation, and seismic qualification tests were performed in the 1980s. This issue affects multiple purchase orders that required the component to meet either IEEE-323, IEEE C37.90, ESC-STD-1000, or a combination thereof, and will

require detailed engineering justification, replacement, supplemental test, or some other form of verification to establish that the components in question will be able to perform their intended safety functions.

This issue has been identified as Nonconformance 99900833/2016-201-01.

- B. Criterion III, "Design Control," 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 safety-related functions of the structures, systems and components."

Contrary to the above, as of April 29, 2016, Electrosch failed to establish measures for the selection and review for suitability of (1) material composition of precious metal blade overlay material, red metal blade material, molding compound for switch insulators, and carbon steel for securing rods, (2) precious metal overlay thickness of switch blade material, (3) small sub-components including solenoids and relays, and (4) services to support qualification. These products and services affect numerous nuclear safety-related product lines as they are integral to ensure the product lines can perform their intended safety function under the most adverse conditions, and ensure that the original qualification met testing requirements. Specifically, Electrosch chose not to dedicate any procured commercial materials, components, and services, but chose instead to take credit for all product development to be processed under their 10 CFR Part 50 Appendix B program. However, Electrosch does not adequately verify characteristics during their receipt, testing, or manufacturing processes to ensure the materials and components are equivalent to what was originally qualified. In addition, Electrosch does not perform adequate final testing or inspection on all of their product to ensure the functionality of the product is fully tested. Furthermore, Electrosch did not verify qualification testing services were suitable for use in that they had the capability and traceability to perform the required tests.

This issue has been identified as Nonconformance 99900833/2016-201-02.

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, Terry Jackson 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 27th day of May 2016

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

Docket No.: 99900833

Report No.: 99900833/2016-201

Vendor: Electroswitch Corporation
180 King Avenue
Weymouth, MA 02188

Vendor Contact: Mr. Larry Friedman, Quality Assurance Manager
LFriedman@electroswitch.com
(781) 607-3309

Nuclear Industry Activity: Electroswitch designs, manufactures, and tests power switches and relays for the operating reactor fleet. Electroswitch is located in Weymouth, MA.

Inspection Dates: April 25, 2016 - April 29, 2016

Inspection Team Leader: Eugene Huang NRC/NRO/DCIP/QVIB-1

Inspectors: George Lipscomb NRC/NRO/DCIP/QVIB-1
Jose Jimenez NRC/NRO/DCIP/QVIB-1
Jermaine Heath NRC/NRO/DCIP/QVIB-3

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

EXECUTIVE SUMMARY

Electroswitch Corporation
99900833/2016-201

The U.S. Nuclear Regulatory Commission (NRC) conducted a vendor inspection to verify Electroswitch Corporation (hereafter referred to as Electroswitch) implemented an adequate quality assurance (QA) program that complies with the 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 Electroswitch's implementation of quality activities associated with the manufacturing, design and testing of safety-related power switches and relays for operational U.S. commercial nuclear power plants. In addition to observing implementation of quality-affecting activities, the NRC inspection team evaluated completed documentation relating to problem resolution and reporting, manufacturing, test control, control of measuring and test equipment (M&TE), and design control, including effects on component qualification.

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 Program Implementation

The NRC inspection team concluded that Electroswitch established a 10 CFR Part 21 program in accordance with the regulatory requirements of 10 CFR Part 21. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Electroswitch is implementing its policies and procedures associated with 10 CFR Part 21. No findings of significance were identified.

Design Control and Qualification

The NRC inspection team concluded that Electroswitch did not adequately establish and implement its program to control design activities in accordance with the regulatory requirements of Criterion III of Appendix B to 10 CFR Part 50. The NRC inspection team identified NON 99900833/2016-201-01 for Electroswitch's failure to develop and use a suitable test program for qualification testing under the most adverse design conditions. Specifically, Electroswitch used Procedure ESC-STD-1000 to qualify multiple components, yet the procedure used less than acceptable final operational test parameters following the required aging, radiation, and seismic test sequence that do not meet the requirements of IEEE 323 and IEEE C37.90. Furthermore Electroswitch's Class 2 testing, which is periodic and is meant to

supplement final product testing performed on every component after assembly, does not test the dielectric withstanding voltage at the required IEEE C37.90 parameter. Therefore, the dielectric withstanding voltage, which is specified among different component data specification sheets, has not been verified since the original pre-aging, radiation, and seismic qualification tests performed in the 1980s. The NRC inspection team noted that these deviations were most likely attributed to Electroschwitch's attempt to incorporate multiple IEEE requirements into Procedure ESC-STD-1000 to be used as a universal procedure, but not ensuring that all the IEEE requirements were correctly translated over and would be met.

Additionally, the NRC inspection team identified NON 99900833/2016-201-02 for Electroschwitch's failure to establish measures for the selection and review for suitability of material composition of precious metal blade overlay material, red metal blade material, precious metal overlay thickness of switch blade material, molding compound for switch insulators, carbon steel for securing rods, solenoids, relays, and services to support qualification that affects numerous nuclear product lines. Specifically, Electroschwitch did not use any form of commercial grade dedication (CGD) for their commercially procured materials, parts, and services, and instead chose to manufacture and test final products under their 10 CFR Part 50 Appendix B program. This approach is acceptable, provided all safety function characteristics for their products are verified or tested to ensure the products can meet their intended safety function under the most adverse design conditions. However, Electroschwitch used commercial materials, components, and services without performing adequate verification during the receipt, testing, or other phases of their manufacturing process to ensure that the materials and components are equivalent to what was originally qualified, and the services were suitable for use in that they had the capability and traceability to perform the required tests. The NRC inspection team noted this practice had been in place since Electroschwitch began offering products under their 10 CFR Part 50 Appendix B program. Electroschwitch decided to discontinue their Appendix B program as of March 2016.

Manufacturing and Test Control

The NRC inspection team did not have a sufficient sample size to reach a conclusion on Electroschwitch's implementation of its policies and procedures associated with manufacturing, inspection, and testing, because only one safety-related assembly and test activity was available for evaluation. No findings of significance were identified.

Control of Purchased Material, Equipment, and Services

The NRC inspection team did not have a sufficient sample size to reach a conclusion on Electroschwitch's implementation of its policies and procedures associated with control of purchased materials, equipment, and services. Specifically, Electroschwitch did not have any 10 CFR Part 50 Appendix B suppliers nor performed commercial grade surveys of commercial suppliers since they elected to manufacture all safety-related products under their 10 CFR Part 50 Appendix B process. No findings of significance were identified.

Control of Measuring and Test Equipment (M&TE)

The NRC inspection team concluded that Electroschwitch has established control of M&TE 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 Electroschwitch is implementing its policies and procedures associated with controlling M&TE. No findings of significance were identified.

Nonconformance Control and Corrective Action Program

The NRC inspection team concluded that Electroswitch has established nonconformance and corrective action programs in accordance with the regulatory requirements of Criterion XV, "Nonconforming Material, Parts and Components," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Electroswitch is implementing its policies and procedures associated with its nonconformance and corrective action programs. No findings of significance were identified.

REPORT DETAILS

1. 10 CFR Part 21 Program Implementation

a. Inspection Scope

The NRC inspection team reviewed Electroswitch's policies and implementing procedures that govern its 10 CFR Part 21, "Reporting of Defects and Noncompliance," program to verify that the requirements had been effectively implemented for evaluating deviations and failures to comply. In addition, the NRC inspection team evaluated 10 CFR Part 21 postings and a sample of Electroswitch purchase orders (PO) 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 also verified that Electroswitch's nonconformance and corrective action procedures provided a connection 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

No findings of significance were identified.

c. Conclusions

The NRC inspection team concluded that Electroswitch established a 10 CFR Part 21 program in accordance with the regulatory requirements. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Electroswitch is implementing its policies and procedures associated with 10 CFR Part 21. No findings of significance were identified.

2. Design Control and Qualification

a. Inspection Scope

The NRC inspection team reviewed Electroswitch's policies and implementing procedures that govern design control to verify compliance with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team specifically evaluated control of design changes, conformance to customer PO requirements, and the effect of other QA processes on component design. The main emphasis was an assessment of the effect of various design control activities on equipment qualification. The samples reviewed included Model Series 24 switches, lockout relays (LOR) and control switch relays (CSR); Model Series 20 switches, relays, and hybrids; and Model Series 31 instrument and control switches. Additionally, POs from different licensees were reviewed to verify adherence of select portions of equipment qualification to customer requirements and if those requirements were reflected in Electroswitch's certification documentation.

The NRC inspection team evaluated a sample of raw materials to verify adherence to material and dimensional specifications and that materials were equivalent to the related

materials of qualification specimens. The raw material was used to fabricate sub-components for Series 24 safety-related switches, in addition to other switch assemblies. The sample included switch blade metal overlay thickness, switch blade metal material, molded insulator material, and securing rod metal material that was received and fabricated into subcomponents at Electroswitch's facility in Rockland, Massachusetts.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

Inadequate qualification testing under the most adverse design conditions

The NRC inspection team reviewed a sample of qualification reports for switches, hybrids, latching switch relays (LSR), LOR relays, CSR switches and relays, and a variety of modules. The NRC inspection team found multiple examples where Electroswitch referenced qualification reports that did not perform qualification testing under the most adverse design conditions in accordance with 10 CFR Part 50, Appendix B, Criterion III, which states, in part, that "The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions."

The NRC inspection team noted that Electroswitch created Test Procedure ESC-STD-1000, "General specifications for rotary switches and auxiliary relays for utility applications including class 1E equipment requirements for nuclear power generating stations," in an attempt to compile all the requirements of IEEE 323-1984, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," IEEE 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," and IEEE C37.90-1989, "IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus," back in Revision 3, dated September 3, 1984, into one documented procedure. The NRC inspection team noted that Procedure ESC-STD-1000 originated and is loosely based on MIL-DTL-21604, "General specification for switches, rotary, multipole and selector." The NRC inspection team identified the military standard's scope was intended for electrical loads up to 10 amperes and identified the components supplied by Electroswitch exceed that electrical load.

The NRC inspection team identified that Procedure ESC-STD-1000 used baseline operational testing parameters of: dielectric withstanding voltage at 2200VRMS; insulation resistance of 100 megaohms minimum; and contact resistance of 10 milliohms at 20A. However, the Electroswitch post-operational testing parameters (following the aging, radiation, and seismic portions of IEEE 323) were: dielectric withstanding voltage at 600VRMS; insulation resistance of 50 megaohms minimum; and contact resistance of 10 milliohms at 100mA. These testing parameters do not meet the requirements of IEEE 323, where the test sequence requires the user to perform baseline operation testing, then subject the test subjects to aging, radiation, and seismic stress, which is

meant to simulate end of life and a design basis event. At the simulated end of life, a final operational test is performed using the initial baseline operational testing parameters. This is to ensure the component, on the last day of life that undergoes a design basis event, can still be called upon to perform its intended safety function. Furthermore, the post-testing parameters also do not meet the requirements of IEEE C37.90, which lists minimum dielectric withstanding testing voltages. Electrosch's product data sheets list all of their components with the capability to meet 2200VRMS dielectric withstanding voltage, 100 megaohms minimum insulation resistance, and 10 milliohms maximum at rated current for contact resistance at end of life. Lastly, Electrosch's Class 2 testing, which is periodic and is meant to supplement final product testing performed on every component after assembly, does not test the dielectric withstanding voltage at the required parameter. Therefore, dielectric withstanding voltage has not been verified since the original pre-aging qualification tests were performed in the 1980s.

The NRC inspection team identified that Procedure ESC-STD-1000 was adhered to in every qualification report that was sampled. These qualification reports are referenced by similarity to multiple POs (listed in the Documents Reviewed section of this report) where the requirement is to meet either IEEE-323, IEEE C37.90, ESC-STD-1000, or a combination thereof. The NRC inspection team determined that any qualification report that utilized the testing parameters of Procedure ESC-STD-1000 did not meet the requirements of IEEE 323 and IEEE C37.90.

In accordance with NRC inspection manual chapter (IMC) 0617, "Vendor and Quality Assurance Implementation Inspection Reports," dated October 3, 2013, Appendix E, "Minor Examples of Vendor and QA Implementation Findings," this issue was screened to be greater-than-minor using E.8.2.A, "Screening for Greater-Than-Minor." This issue represents an issue that, if left uncorrected, would result in a condition adverse to quality that renders the quality of a structure, system, or component (SSC) or activity, unacceptable or indeterminate AND is a deficiency in the design, manufacture, construction, installation, inspection, or testing of a SSC, which will require a detailed engineering justification, replacement, supplemental test, or some other form of verification to establish that the components in question will be able to perform their intended safety functions.

This issue has been identified as Nonconformance 99900833/2016-201-01.

Inadequate review for suitability of commercial materials, parts, and services

The NRC inspection team reviewed the services used to qualify the control switches and relays in support of environmental qualifications performed in accordance with Procedure ESC-STD-1000. The NRC inspection team found two examples where Electrosch did not use commercial services, material, and components in accordance with 10 CFR Part 50, Appendix B, Criterion III which 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 of the structures, systems and components."

The NRC inspection team noted that, at the time of the inspection, Electrosch did not use any form of CGD and instead chose to manufacture and test safety-related products under their 10 CFR Part 50 Appendix B program. This approach is acceptable, provided

that all safety function characteristics for their products are verified or tested to ensure that the products can meet their intended safety function under the most adverse design conditions. However, the NRC inspection team identified in two examples below where Electroschitz did not adequately verify or validate the use of commercially procured materials, components, and services in their process.

In the first example, Electroschitz used the commercial services of Acton Environmental Testing Corp. (radiation aging), Arnold Greene Testing Lab (radiation aging), and ASL (seismic). The scope of the POs reflected the requirements of Procedure ESC-STD-1000 that was based on industry standards. Electroschitz could not provide documentation on whether the commercial services were dedicated, whether the three sub-suppliers had been surveyed, or otherwise evaluated and controlled under a quality assurance program in accordance with the requirements of 10 CFR Part 50 Appendix B, Criterion III. The NRC inspection team determined the commercial services were required to be verified by Electroschitz by some method of commercial-grade dedication (CGD) or another type of validation to ensure the commercial vendors had the capability and traceability to support qualification testing of the control switches and relays in order to demonstrate that the components could perform their intended safety function thru the end of life and following a design basis event.

In the second example, the NRC inspection team noted for selected raw material samples (latest receipt of each raw material sample), that no material or chemical analysis was performed at either the Rockland or Weymouth facilities to ensure products met material specifications and qualification requirements. Electroschitz personnel stated that material and chemical analysis had not been performed on previous received samples, an inspection or test plan had not been implemented to ensure material specifications had been met, nor had a dedication plan been established for the acceptance of the commercial raw materials. Additionally the inspectors noted that, although some dimensional specifications were verified during receipt inspection, the precious metal overlay thickness (set by fabrication at the commercial supplier) had not been verified by Electroschitz for the current or previous blade material. The evaluated material specification and dimensional properties of these raw materials were identified by Electroschitz personnel as critical to proper operation and longevity for multiple switch types; and in particular, to the 7825ED switch which is enveloped by Qualification Report 2983-2. The commercial raw materials orders that were sampled were from (1) Plenco Engineering Company under Electroschitz order P360022, (2) Copper and Brass Sales under Electroschitz order P360295, and (3) Precision Engineered Products (PEP) under Electroschitz order P358993. The specific dimensional and industry material specifications that were not verified by Electroschitz include: (1) precious metal blade overlay material thickness as specified in Drawing 50-900CP-16, (2) QQ-B-750/ASTM B-103 red metal blade material as specified in Drawing 50-900CP-16, (3) CFI-5 molding compound for switch insulators as specified in Drawing 50-650QN-1, and (4) QQ-S-637/ASTM A-108 carbon steel for securing rods as specified in Drawing 50-120DJ-10.

The NRC inspection team determined, the above dimensional and material specifications were required to be verified by Electroschitz by CGD, inspection, testing, or by another method during component fabrication to ensure material specification and qualification requirements were met. In accordance with NRC inspection manual chapter (IMC) 0617, "Vendor and Quality Assurance Implementation Inspection Reports," dated October 3, 2013, Appendix E, "Minor Examples of Vendor and QA

Implementation Findings,” this issue was screened to be greater-than-minor using E.8.3, “Screening for Greater-Than-Minor.” This issue represents an issue, if left uncorrected, represents a failure to establish, implement or maintain a process, program, procedure, or quality oversight function that could render the quality of the SSC or activity unacceptable or indeterminate.

This issue has been identified as Nonconformance 99900833/2016-201-02.

c. Conclusions

The NRC inspection team concluded that Electroschwitch did not adequately establish and implement its program to control design activities in accordance with the regulatory requirements of Criterion III of Appendix B to 10 CFR Part 50. The NRC inspection team identified NON 99900833/2016-201-01 for Electroschwitch’s failure to use a suitable test program for qualification testing under the most adverse design conditions. Specifically, Electroschwitch used Procedure ESC-STD-1000 to qualify multiple components, yet the procedure used less than acceptable final operational test parameters following the required aging, radiation, and seismic test sequence that do not meet the requirements of IEEE 323 and IEEE C37.90. Furthermore Electroschwitch’s Class 2 testing, which is periodic and is meant to supplement final product testing performed on every component after assembly, does not test the dielectric withstanding voltage at the required IEEE C37.90 parameter. Therefore, the dielectric withstanding voltage, which is specified among different component data specification sheets, has not been verified since the original pre-aging, radiation, and seismic qualification tests performed in the 1980s. The NRC inspection team noted that these deviations were most likely attributed to Electroschwitch’s attempt to incorporate multiple IEEE requirements into Procedure ESC-STD-1000 to be used as a universal procedure, but not ensuring that all the IEEE requirements were correctly translated over and would be met.

Additionally, the NRC inspection team identified NON 99900833/2016-201-02 for Electroschwitch’s failure to establish measures for the selection and review for suitability of material composition of precious metal blade overlay material, red metal blade material, precious metal overlay thickness of switch blade material, molding compound for switch insulators, carbon steel for securing rods, solenoids, relays, and services to support qualification that affects numerous nuclear product lines. Specifically, Electroschwitch did not use any form of dedication and instead chose to manufacture and test everything under their 10 CFR Part 50 Appendix B program, which is acceptable, provided that all safety function characteristics for their products are verified or tested to ensure that the products can meet their intended safety function under the most adverse design conditions. However, Electroschwitch used commercial materials, components, and services without performing adequate verification during the receipt, testing, or other phases of their manufacturing process to ensure that the materials and components are equivalent to what was originally qualified, and that the services were suitable for use in that they had the capability and traceability to perform the required tests. The NRC inspection team noted this practice had been in place since Electroschwitch began offering products under their 10 CFR Part 50 Appendix B program. Electroschwitch decided to discontinue their Appendix B program as of March 2016.

3. Manufacturing and Test Control

a. Inspection Scope

The NRC inspection team reviewed policies and procedures associated with a selection of manufacturing and testing processes for safety-related switches to verify compliance with Criterion V, "Instructions, Procedures, and Drawings," Criterion X, "Inspection," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50.

The selection included a review of procedures, plans, and process controls associated with Dominion PO 4500282588 for (3) Series 24 LOR – Part Number (P/N) 7825ED for North Anna Plant. This was the last safety-related order for US nuclear plants expected to be filled by Electroschwitch. The NRC inspection team specifically observed and assessed the order's assembly from stock sub-components, in-process inspection of completed assembly, final relay operational testing, and product tagging and packing. Additionally, the inspectors evaluated the product documentation package and compared it to PO requirements.

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. Conclusions

The NRC inspection team did not have a sufficient sample size to reach a conclusion on Electroschwitch's implementation of its policies and procedures associated with manufacturing, inspection, and testing, because only one safety-related assembly and test activity was available for evaluation. No findings of significance were identified.

4. Control of Purchased Materials, Equipment, and Services

a. Inspection Scope

The NRC inspection team reviewed Electroschwitch'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 reviewed samples from Electroschwitch's "Approved Supplier List" to ensure suppliers were qualified and approved. The NRC inspection team verified Electroschwitch implemented provisions in their quality plans to verify the capabilities of their suppliers. Specifically, the NRC inspection team verified that applicable quality requirements, including technical, regulatory, and reporting requirements, were specified in the procurement documents and that 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. Conclusions

The NRC inspection team did not have a sufficient sample size to reach a conclusion on Electroswitch's implementation of its policies and procedures associated with control of purchased materials, equipment, and services. Electroswitch did not have any 10 CFR Part 50 Appendix B suppliers nor performed commercial grade surveys of commercial suppliers since they elected to not use any method of dedication and instead manufactured all safety-related products under their 10 CFR Part 50 Appendix B process. No findings of significance were identified.

5. Control of Measuring and Test Equipment (M&TE)

a. Inspection Scope

The NRC inspection team reviewed M&TE policies and procedures to determine if Electroswitch was in compliance with Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50. The NRC inspection team verified the implementation of M&TE control through direct observation of Electroswitch activities and samples of M&TE. Specifically, the NRC inspection team verified calibration of various items ranging from thread gauge sets to ovens used during environmental testing. The NRC inspection team also sampled multiple gauges used for the manufacture of different components in the assembly of control switches and relays. The NRC inspection team reviewed samples of calibration certificates to ensure that they were traceable to nationally recognized standards. The NRC inspection team also selected samples to verify Electroswitch's M&TE was calibrated and appropriate for the range of operation for each described activity.

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. Conclusions

The NRC inspection team concluded that Electroswitch has established control of M&TE 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 Electroswitch is implementing its policies and procedures associated with controlling M&TE. No findings of significance were identified.

6. Nonconforming Materials, Parts, or Components, and Corrective Action Program

a. Inspection Scope

The NRC inspection team reviewed Electroswitch's policies and implementing procedures that govern the nonconformance and corrective action programs (CAP) to verify compliance with the requirements of Criterion XV, "Nonconforming Materials, Parts, or Components," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50.

The NRC inspection team reviewed Electroswitch's internal assembly inspection reports, final test and rejection reports, and corrective action reports (CARs), to verify that Electroswitch implemented an adequate program to ensure that nonconforming items and conditions adverse to quality were promptly identified and corrected. The NRC inspection team verified that nonconforming components were properly identified, marked, and segregated when practical, to ensure they were not reintroduced into the manufacturing processes. In addition, the NRC inspection team reviewed several returned material authorizations (RMA) to ensure they were adequately evaluated. Finally, the NRC inspection team verified that the Electroswitch nonconformance program, CAP, and RMA programs provided a connection 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

No findings of significance were identified.

c. Conclusions

The NRC inspection team concluded that Electroswitch has established nonconformance and corrective action programs in accordance with the regulatory requirements of Criterion XV, "Nonconforming Material, Parts and Components," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Electroswitch is implementing its policies and procedures associated with its nonconformance and corrective action programs. No findings of significance were identified.

7. Entrance and Exit Meetings

On April 25, 2016, the NRC inspection team discussed the scope of the inspection during an entrance meeting with Mr. Kenneth Lloyd, Plant Manager, and other members of Electroswitch management and technical staff. On April 29, 2016, the NRC inspection team presented the inspection results and observations during an on-site exit meeting with Mr. Kenneth Lloyd, Plant Manager, and other members of Electroswitch management and technical staff. The attachment to this report lists the attendees at the entrance and exit meetings, as well as those individuals whom the NRC inspection team interviewed.

ATTACHMENT

1. ENTRANCE/EXIT MEETING ATTENDEES

| Name | Title | Affiliation | Entrance | Exit | Interviewed |
|-----------------|---------------------------------|---------------|----------|------|-------------|
| Kenneth Lloyd | VP & GM | Electroswitch | X | X | |
| Larry Friedman | Quality Assurance Manager | Electroswitch | X | X | X |
| Peter Fullerton | Assembly Manager | Electroswitch | X | X | X |
| Ed Reszenski | Engineering Manager | Electroswitch | X | X | X |
| Dan Menard | Engineering Test Lab Supervisor | Electroswitch | X | | X |
| Scott Murphy | Plant Manager | Electroswitch | X | X | X |
| Mike Berardi | Shipping / Receiving | Electroswitch | | | X |
| Janice Gilson | Operator | Electroswitch | | | X |
| Cathy Nash | Shipping Lead | Electroswitch | | | X |
| Paco Mowrey | QA Engineer | Electroswitch | | | X |
| Bob Sicuranza | Sales | Electroswitch | X | | X |
| John Gilson | Product Engineer | Electroswitch | X | | |
| Lori Wight | Sales | Electroswitch | X | | |
| Bruce MacDonald | Sales | Electroswitch | | X | |
| Terry Jackson | Branch Chief | NRC | | X | |
| Eugene Huang | Team Lead | NRC | X | X | |
| George Lipscomb | Inspector | NRC | X | X | |
| Jose Jimenez | Inspector | NRC | X | X | |
| Jermaine Heath | Inspector | NRC | X | X | |

2. INSPECTION PROCEDURES USED

IP 43002, "Routine Inspections of Nuclear Vendors"

IP 43004, "Inspection of Commercial-Grade Dedication Programs"

IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance"

3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

| <u>Item Number</u> | <u>STATUS</u> | <u>TYPE</u> | <u>ITAAC</u> | <u>DESCRIPTION</u> |
|---------------------------|----------------------|--------------------|---------------------|---------------------------|
| 99900833/2016-201-01 | Open | NON | N/A | Criterion III |
| 99900833/2016-201-02 | Open | NON | N/A | Criterion III |

4. DOCUMENTS REVIEWED

Procedures and Work Instructions

"Quality Manual," Revision 23, dated April 11, 2011

QOP-010, "Material Control," Revision 8, dated October 18, 2006

QOP-012, "Assembly and Final Test," Revision 19, dated November 29, 2007

QOP-013, "Fabrication," Revision 11, dated January 29, 2009

ENG-SP017, "Handling Orders and Repairs for Class 1E Applications," Revision D, dated March 24, 2010

Traveler Job J7707-0000 for (3) 7825ED Series 24 ER/LOR Relay for Dominion order C000563213 Line 10

ENGSP004, "Product Control and Review," Revision 1, dated May 31, 2012

QOP 008, "Purchasing and Supplier Control," Revision 13, dated October 3, 2007

QOP 005, "Engineering," Revision 9, dated March 22, 2010

QCPGA041, "Dedication Program," Revision A, dated September 10, 2013

QOP 014, "Nonconforming Product," Revision 16, dated May 4, 2015

QOP 015, "Corrective and Preventive Action," Revision 12, dated May 4, 2015

QOP 019, "Internal Audits," Revision 10, dated March 1, 2011

QCP GA039, "10 CFR21 Posting, Evaluation, and Reporting," Revision B, dated May 5, 2015

QCP FT026, "Final Acceptance Operation Test – Series 24 CSR Test Procedure,"
Revision E, dated May 1, 2013

Nonconformance/Corrective Action Documents

Corrective Action Report (CAR) #14-001, dated September 10, 2014

CAR #14-001, dated October 30, 2014

CAR #13-004, dated July 5, 2013

CAR #13-006, dated July 1, 2013

CAR #13-002, dated November, 28, 2012

Inspection Report (IR) # 15-1014, dated February 14, 2015

IR #15-1045, dated February 27, 2015

IR #14-1136, dated June 2014

IR #13-1271, dated August 8, 2013

IR #13-1213, dated June 13, 2013

IR #15-1058, dated March 10, 2015

IR #15-1059, dated March 10, 2015

M177770, dated February 27, 2015

M16474, dated March 13, 2015

Report #10CFR21-50504, Revision 0, dated October 2, 2014

Report #10CFR21-032513, Revision 0, dated March 25, 2013

CAR #16-008, "Final Testing of 7825ED," dated April 28, 2016 (in-process)

CAR #16-009, "Adherence to NQA-1-1994," dated April 28, 2016 (in-process)

CAR #16-007 dated April 28, 2016

Engineering Reports and Change Notices

ECN 30915 – "Changed Operating Voltage from 125VDC to 48VDC," dated April 1, 2015

ECN 31064 – "Drive Frame part number revised," dated March 31, 2016

ECN 31063 – "Change Schematic on drawing to show isolation of connection points for trip and reset circuits," dated March 28, 2016

ECN 31027 – “Change manufacture from Argon to Carlisle Plastics Co.,” dated December 10, 2015

ECN 20436 - “Barrier Diameter Change,” dated August 26, 1992

ECN 30427 - “Drive Cam (CSR),” dated February 11, 2013

ECN 30431 - “Drive Cam (CSR Isolator),” dated February 15, 2013

Procurement and Receiving Documents

Dominion PO 4500088494, Change Order 1, for (1) Lockout Relay (LOR) – Part Number (P/N) 7828DD, dated September 13, 2013

Dominion PO 4500190344 for (2) Series 24 switches, dated December 10, 2014

Dominion PO 4500208260 for (1) Switch - P/N 9306QX, dated March 9, 2015

Dominion PO 4500282588 for (3) Series 24 LOR – P/N 7825ED for North Anna Plant, dated February 29, 2016

“Form 8A” for Dominion PO 4500282588 dated April 27, 2016

Nuclear Certificate of Conformance (CoC) for Dominion PO 4500282588 (Electroswitch order C563213) dated April 27, 2016

Plenco certification letter, “Electroswitch order P360022 - Phenolic lot 1074858,” dated March 30, 2016

Copper and Brass Sales Delivery Note, “Electroswitch order P360295 – Carbon Steel,” dated January 27, 2016

Precision Engineered Products CoC, “Electroswitch order P358993-02 – LOR Blade Material,” dated October 14, 2015

PO 4500257617 for Series 24 switch for Surry, dated October 30, 2015

PO SNG10118339 for Series 20 hybrid for Vogtle, dated October 21, 2015

PO 4500208260 for Series LSR relay for Surry, dated March 18, 2015

PO 4500190344 for Series 24 switch for Surry, dated December 29, 2014

PO 771204/0 for Series 20 switch for Wolf Creek, dated October 8, 2014

PO SNG10084538 for Series 20 module for Vogtle, dated August 5, 2014

PO 10410472 for Series 20 module for Indian Point, dated April 28, 2014

PO 10405423 for Series 24 CSR relay for Waterford 3, dated February 15, 2014

Drawings

7825ED, "Series 24 Electric Reset Lockout Relay," Revision C, dated November 18, 1992

50-900CP-16, "LOR Blade Material," Revision 0, dated December 29, 2014

50-650QN-1, "Molding Compound," Revision B, dated January 2, 1997

50-120DJ-10, "Securing Rod Material," Revision B, dated March 16, 2011

261-10-19, "Contact rivet," dated March 1, 1977

261-563-68, "Securing rod blank," dated October 31, 1979

261-10-20, "Contact rivet," dated April 22, 1993

50-900CC-4, "Tandem strip, raw stock," dated January 15, 2013

02005-11-C3, "Terminal," dated October 3, 2001

02035-3A, "Switch blade," dated March 18, 1993

261-562-68, "Securing rod," dated November 13, 2003

261-562 series, "Securing rod," dated October 30, 1974

Manufacturing, Qualification and Test Documentation

ESC-STD-1000, "General Specification for Rotary Switches and Auxiliary Relays for Utility Applications including Class 1E Equipment Requirements for Nuclear Power Generating Stations," Revision 6, dated January 1, 1997

QCPFT007, "Final Test Inspection Process," Revision K, dated December 3, 2013

QCPFT024, "Final Acceptance Operational Testing – Standard ER/LOR & SR/LOR Test Procedure," Revision D, dated December 7, 2015

Engineering Test Report 8592-1, "Series 24 LOR/ER – P/N 7828CC," dated April 23, 2015

Report No. 2970-2, "Qualification Inspection of Series 20 Instrument and Control Switches to ESC-STD-1000," dated December 12, 1984

Report No. 2983-3, "Qualification Inspection of Series 24LOR, LOR/ER, and LSR Auxiliary Relays and Lock-Out Relays to ESC-STD-1000," dated January 11, 1985

Report No. 2392-11, "Qualification Inspection of the Series 20L Lighted Instrument and Control Switch ESC-STD-1000," dated December 6, 1978

Technical Publication LOR-1, "High Speed Multi-Contact Lock-Out Relays for Power Industry Applications," dated January 1998

Technical Publication MIN-1, "A Miniature Instrument & Control Switch for Power Industry Applications," dated February 1998

Report 2983-2, "Qualification inspection of series 24 instrument and control switches to ESC-STD-1000," Revision 3, dated October 15, 1984

Report 2970-2A, "Qualification inspection of series 20 plug-in module instrument and control switches to ESC-STD-1000," Revision 3, dated January 24, 1985

Report No. 2392-6A, "Qualification inspection of series 31 latching switch relay and series 31 detent action switches instrument and control switches to ESC-STD-1000," Revision 1, dated December 19, 1984

No. 2904-1, "Report of seismic vibration qualification of series 24, type CSR isolator switch, P/N 88903LC," dated April 15, 1980

No. 2903-1, "Report of seismic vibration qualification of series 24, type CSR isolator switch, P/N 88903LB," dated April 15, 1980

Report 7737-1, "Series 24 control switch relay switch no. 8857DB class IIA inspection tests ESC-STD-1000," Revision 6, dated November 20, 2002

QCPFTP008, "Series 20 Plug-in Module Final Inspection and Test Procedure," Revision F, dated October 15, 2014

Calibration Records

Certificate of Calibration No. 73435 – Mainly Metrology, dated December 4, 2014

Certificate of Calibration No. 120415B – New England Calibration, dated December 7, 2015

Certificate of Calibration No. 1317235 – ESSCO, dated April 13, 2016

Certificate of Calibration No. 1067973 – ESSCO, dated October 6, 2014

Certificate of Calibration No. 1205311 – ESSCO, dated August 13, 2015

Certificate of Calibration No. 1164055 – ESSCO, dated May 12, 2015

Inspection Report No. 15-1235, "Test Equipment – ESSCO Calibration of EG26 & EG152-1," dated October 27, 2015

Return Authorizations

Credit Memo (CM) 6274, dated September 3, 2014

CM6820, dated March 30, 2015

CM6824, dated June 16, 2015

CM7303, dated November 3, 2015

CM7304, dated November 3, 2015

CM5355, dated September 19, 2013

CM4972, dated February 22, 2013

CM7043, dated August 13, 2015

CM6034, dated May 22, 2014

CM6824, dated April 16, 2015

CM7219, dated October 29, 2015

Miscellaneous Documents

MIL-DTL-21604F, "General specification for switches, rotary, multipole and selector," dated March 27, 2009

IEEE C37.90, "IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus," dated May 10, 1989

IEEE 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Systems," dated 1974

IEEE 344, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," dated 1975

Quality Control Records List, Revision 9, dated May 13, 2015

LIST OF ACRONYMS USED

| | |
|--------|--|
| 10 CFR | Title 10 of the <i>Code of Federal Regulations</i> |
| ADAMS | Agencywide Documents Access and Management System |
| CAP | corrective action program |
| CAR | corrective action request |
| COC | Certificate of Conformance |
| CGD | commercial-grade dedication |
| CSR | control switch relay |
| ECN | Engineering Change Notice |
| IEEE | Institute of Electrical and Electronics Engineers |
| IP | inspection procedure |
| LOR | lockout relay |
| M&TE | measuring and test equipment |
| NON | Notice of Nonconformance |
| NRC | Nuclear Regulatory Commission |
| PO | purchase order |
| QA | quality assurance |
| RG | NRC Regulatory Guide |