June 5, 2017

Mr. Ethan Salsbury
Quality Manager
AMETEK SOLIDSTATE CONTROLS
875 Dearborn Drive
Columbus, OH 43085

SUBJECT: NUCLEAR REGULATORY COMMISSION VENDOR INSPECTION OF AMETEK SOLIDSTATE CONTROLS REPORT NO. 99901427/2017-201

Dear Mr. Salsbury:

During the period from April 17-21, 2017, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at the AMETEK facility in Columbus, Ohio. This was a pilot inspection which was performed to allow for early NRC engagement at vendors performing design type work associated with major plant safety-related modifications. This inspection focused on AMETEK's work to develop, test, and validate the design of a digital uninterruptable power supply (UPS) system (battery charger, inverter, and transfer switch) for the Hope Creek Nuclear Plant. Among the areas reviewed by the team were AMETEK's activities associated with software validation and verification, electrical testing, and environmental testing of prototype units. In addition, the inspection team reviewed certain safety-related activities associated with AMETEK's supply of analog legacy systems.

The enclosed report presents the results of this inspection. This NRC inspection report does not constitute NRC endorsement of your overall quality assurance (QA) program.

During this inspection, NRC inspectors found that the implementation of your Quality Assurance (QA) program failed to meet certain NRC requirements imposed on you by your Customers. The inspectors identified two Nonconformances in the areas of design control and corrective actions. These findings were associated with AMETEK's supply of replacement parts and legacy analog systems. No findings of significance were identified with AMETEK's work to develop, test, and qualify the digital UPS system.

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 response to the enclosed Notice of Nonconformance, AMETEK 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.

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, 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). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

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.: 99901427

Enclosures:
1. Notice of Nonconformance
2. Inspection Report No. 99901427/2017-201
   and Attachment

SUBJECT: NUCLEAR REGULATORY COMMISSION VENDOR INSPECTION OF AMETEK SOLIDSTATE CONTROLS REPORT NO. 99901427/2017-201

Dated: June 5, 2017

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OFC	NRO/DCIP	NRO/DCIP	NRO/DCIP	
NAME	PNatividad*	SSmith*	TJackson	
DATE	05/15/17	05/17/17	06/05/17	

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NOTICE OF NONCONFORMANCE

AMETEK SOLIDSTATE CONTROLS
Columbus, Ohio

Docket No. 99901427
Report No. 2017-201

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the AMETEK facility located in Columbus, Ohio, on April 17-21, 2017, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on AMETEK by 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 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."

   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 that, "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected."

   Contrary to the above, prior to April 21, 2017, AMETEK failed to establish measures 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. Specifically AMETEK failed to establish measures for ensuring that the seismically sensitive components (relays) utilized in production of uninterruptable power supply (UPS) units are bounded by previous qualification testing, and are the same in form, fit, and function as those that had previously undergone seismic qualification testing. This finding also represents a failure of AMETEK to promptly identify the extent of condition and correct a previously identified issue. Specifically, AMETEK failed to recognize that issues identified previously, which were associated with maintaining seismic qualification of replacement components that were being supplied through AMETEK's commercial grade dedication program, would also apply to similar components being used in the manufacture of complete safety-related UPS systems.

   This issue is identified as Nonconformance 99901427/2017-201-01.

B. 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 that "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected.

AMETEK Procedure 01-090141, Corrective Action, Rev. M, dated November 11, 2014, provides for identification and problem reporting, investigation of the problem for cause, reporting of the corrective actions, including the results of those actions, and evaluation of the effectiveness of the corrective action.

Contrary to the above, prior to April 21, 2017, NRC inspectors identified three examples where AMETEK failed to establish adequate measures to assure conditions adverse to quality were promptly identified and corrected. Specifically, AMETEK did not implement corrective actions associated with two findings from the previous NRC inspection 99901427/2013-201, dated October 2, 2013. Likewise, AMETEK did not take adequate corrective action to address an issue identified by the Nuclear Procurement Issues Committee (NUPIC) Finding SR-2013-36-03.

1. Corrective actions taken to SCI-CAR-0019 in response to NRC Violation 99901427/2013-201-01 were not adequate. This violation was for the failure to provide interim Part 21 reports within 60 days of discovery. In its response letter to the NRC dated November 1, 2013, AMETEK stated that it created a checklist for Part 21 reporting information and guidance to be used by Part 21 administrators. However, AMETEK was unable to demonstrate to the inspection team that such a check list had been developed and implemented.

2. Corrective actions taken in response to NRC Notice of Nonconformance (NON) 99901427/2013-201-02 for the failure to use a suitable test program to verify the adequacy of the design of battery chargers and inverters were not adequate. In its response to the NRC dated November 1, 2013, AMETEK stated that while it had not performed surge withstand capability testing on the charger/inverter sets in question, it did possess documentation to show that testing had been performed for similar equipment. When asked to provide such evidence during this inspection, AMETEK could not provide the information. In addition, NON 99901427/2013-201-02 identified that AMETEK failed to provide engineering justification for the acceptance of synchronization testing data results for several charger/inverter sets that were outside of the specification limits. Likewise, AMETEK could not provide any evidence that showed they took corrective actions to address that issue.

3. Corrective actions taken in response to NUPIC Finding SR-2013-36-03 were not adequate in that electrical tests implemented as corrective action to address issues concerning the establishment of similarity of seismically sensitive replacement components utilized acceptance criteria which did not provide reasonable assurance that the relays being dedicated were in fact the same in form, fit, and function as those previously tested and qualified. Specifically, the acceptance criteria were based upon nominal commercial specifications as opposed to those taken from components which had been previously seismically tested.

This issue has been identified as Nonconformance 99901427/2017-201-02.

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, 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 5th day of June 2017.

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

Docket No.:	99901427
Report No.:	99901427/2017-201
Vendor:	AMETEK SOLIDSTATE CONTROLS 875 Dearborn Drive Columbus, OH 43085
Vendor Contact:	Mr. Ethan Salsbury Quality Manager 875 Dearborn Drive Columbus, OH 43085
Nuclear Industry Activity:	AMETEK SOLIDSTATE CONTROLS manufactures analog based uninterruptable power supply (UPS) systems to the nuclear industry. AMETEK is also developing a new digital UPS system.
Inspection Dates:	April 17-21, 2017
Inspectors:	Jeffrey Jacobson, NRO/DCIP/QVIB-1, Team Leader Jermaine Heath, NRO/DCIP/QVIB-1 Greg Galletti, NRO/DCIP/QVIB-1 Phillip Natividad, NRO/DCIP/QVIB-1 Kenneth Mott, NRO/DEIA/ICE
Approved:	Terry W. Jackson, Chief Quality Assurance Vendor Inspection Branch-1 Division of Construction Inspection and Operational Programs Office of New Reactors

EXECUTIVE SUMMARY

AMETEK SOLIDSTATE CONTROLS
99901427/2017-201

During the period from April 17-21, 2017, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at the AMETEK SOLIDSTATE CONTROLS (AMETEK) facility in Columbus, Ohio. This was a pilot inspection which was performed to allow for early NRC engagement at vendors performing design-type work associated with major plant safety-related modifications. This inspection focused on AMETEK's work to develop, test, and validate the design of an uninterruptable digital power supply system (battery charger, inverter, and transfer switch) for the Hope Creek Nuclear Plant. Among the areas reviewed by the team were AMETEK's activities associated with software validation and verification, electrical testing, and environmental testing of prototype units. Since AMETEK's work in this area is ongoing, the inspection team was not able to perform a complete review of the design, testing, and validation processes, but was able to review sufficient work to establish whether or not AMETEK had developed appropriate processes and controls for completing their activities in this area.

In addition, the inspection team reviewed certain activities associated with AMETEK's supply of safety-related analog legacy UPS systems. During this portion of the review the inspection team focused on AMETEK's activities associated with the dedication and control of purchased components that are used in the manufacture of their safety-related analog legacy systems. The inspection team also reviewed implementation of AMETEK's corrective actions to previously identified NRC inspection findings.

Control of Purchased Material for Use in Analog UPS Systems

The inspectors concluded that AMETEK has not implemented sufficient controls to ensure the similarity of the relays utilized in the manufacture of Class 1E UPS systems to relays that had undergone seismic testing. AMETEK's failure to implement sufficient measures for ensuring the suitability of materials/components used in the manufacture UPS systems and for failing to take adequate corrective actions to a previous Nuclear Procurement Issues Committee (NUPIC) finding associated with similar components was identified as a Nonconformance to Criterion III, "Design Control," and Criterion XVI, "Corrective Actions" of Appendix B to 10 CFR Part 50. This issue is identified as Nonconformance 99901427/2017-201-01.

Commercial Grade Dedication of Replacement Parts and Components

The inspection team identified that Contrary to Criterion XVI of Appendix B to 10 CFR Part 50, AMETEK did not take sufficient corrective actions to NUPIC finding SR-2013-36-03 associated with the dedication of seismically sensitive components. The team identified that the acceptance criteria being utilized for testing the pick-up and drop-out performance of the commercially procured relays, for the purposes of establishing seismic similarity to previously tested and qualified relays, was non-conservative. The staff identified this issue as one example of Nonconformance 99901427/2017-201-02.

Nonconforming Materials, Parts, or Components

The inspectors concluded that AMETEK is implementing its program for control of nonconforming material, parts, or components consistent with the regulatory requirements in Criterion XV, “Nonconforming Materials, Parts, or Components,” of Appendix B to 10 CFR Part 50. No findings of significance were identified.

Corrective Action

The inspectors concluded that AMETEK’s implementation of its corrective action program did not meet the requirements of Criterion XVI, “Corrective Action,” of Appendix B to 10 CFR Part 50 and issued Nonconformance 99901427/2017-201-02. Nonconformance 99901427/2017-201-02 cites AMETEK for failure to establish adequate measures to assure conditions adverse to quality are promptly identified and corrected. Specifically, AMETEK did not provide objective evidence that corrective actions associated certain findings from the previous NRC Inspection 99901427/2013-201, dated October 2, 2013, were completed and adequately implemented. As a result, Violation 99901427/2013-201-01, and NON 99901427/2013-201-02 will remain open and may be reviewed for closure at a future NRC inspection. The NRC inspection team closes NON 99901427/2013-201-03 and NON 99901427/2013-201-04.

Review of Software Development Life Cycle

The inspectors concluded that AMETEK’s program for implementation of its digital instrumentation and controls (DI&C) software lifecycle activities associated with the development of a digital UPS system was consistent with the regulatory requirements of Appendix B to 10 CFR Part 50. No findings of significance were identified.

REPORT DETAILS

Control of Purchased Material for Use in Analog UPS Systems

a. Scope

AMETEK supplies Class 1E, nuclear safety-related UPS systems to the nuclear industry and, when requested, certifies that these systems are seismically qualified to IEEE 344-1975. This qualification requires both a demonstration of structural integrity of the UPS units, as well as demonstration of functional performance during the simulated seismic events. In general, AMETEK performs the seismic qualification by testing of prototype units; contracting out the testing to facilities with approved nuclear quality assurance programs. Since this testing is typically only performed on prototype units, the inspectors reviewed the methods employed by AMETEK to establish similarity of production UPS systems to those that actually underwent seismic testing.

b. Findings and Observations

The inspection team reviewed AMETEK's supply of four safety-related, 7.5 kVA, UPS units to Nextera Energy Seabrook under Purchase Order #02334057, Revision 9, dated February 8, 2017. The purchase order required the units to be qualified for Class 1E service, including seismic qualification/testing of a prototype unit per IEEE 344-1975 and pre- and post-electrical testing. AMTEK provided a certification back to Nextera on February 24, 2017, stating that the supplied UPS units met all purchase order requirements, including qualification to IEEE 344-1975.

Since only one of the four UPS systems was actually seismically tested, the team reviewed AMETEK's basis for establishing similarity of the other three production units to the prototype unit that underwent seismic testing. The team focused on assessing how AMETEK was controlling seismically sensitive parts such as relays that are used in the assembly of these systems. AMETEK procures these relays periodically from a commercial distributor and places them into their stock system. These are bulk purchases for stock items; thus at any given time, the available stock could contain relays with numerous manufacturing date codes. Since these are commercial grade items, AMETEK does not impose any specific requirements on the distributor to ensure that no manufacturing changes have been made that might impact their seismic performance.

Upon receipt of the relays from the distributor, AMETEK performs a visual inspection and verifies part numbers. For relays destined for nuclear safety-related applications, individual relays are given a new part number, but this process consists of a part number verification only. No additional electrical tests or other testing is done on the relays prior to their use at AMETEK as part of the UPS systems. Furthermore, the majority of the relays utilized in the UPS systems are part of printed circuit boards. Some of these printed circuit boards are supplied to AMETEK by a commercial facility contracted by AMETEK to produce the circuit boards (RBB, Inc.). This commercial facility purchases the individual components on the boards to AMETEK specifications, but AMETEK does not control the purchase of these components. While ultimately, both the boards produced in-house, as well as those produced by AMETEK's contractor, will be tested as part of the normal production testing process for the completed UPS systems, this testing does not include seismic performance testing. Thus, changes to the design or manufacturing methods of the commercial relays that might impact their seismic performance could go undetected.

The inspection team found that AMETEK had not established sufficient measures for ensuring that the seismically sensitive components (relays) utilized in production UPS units were suitable for their application and the same in form, fit, and function as those that had previously undergone seismic qualification testing. This condition would be applicable both at the system and the component level.

In addition, this finding also represents a failure of AMETEK to promptly correct a previously identified issue. Specifically, AMETEK failed to recognize that issues identified previously by the Nuclear Procurement Issues Committee (NUPIC) with regard to maintaining the seismic qualification of replacement components being supplied by AMETEK through their commercial grade dedication program would also apply to similar components being used in the manufacture of complete UPS systems. The failure to perform an adequate extent of condition review prevented corrective actions taken in response to the NUPIC finding concerning commercially dedicated replacement parts were not implemented for similar parts being utilized in the manufacture of safety-related UPS units. Other aspects of extent of condition, such as similarity for other seismically sensitive components or components sensitive to other environmental stressors, may be applicable, but were not evaluated by AMETEK.

AMETEK's failure to implement sufficient measures for ensuring the suitability of materials/components used in the manufacture safety-related UPS systems and for failing to take adequate corrective actions to the NUPIC finding was identified as a Nonconformance to Criterion III, "Design Control," and Criterion XVI, "Corrective Actions" of Appendix B to 10 CFR Part 50. This issue is identified as Nonconformance 99901427/2017-201-01.

c. Conclusion

AMETEK did not implement sufficient controls to ensure similarity of the relays utilized in the manufacture of Class 1E UPS systems to relays that had undergone seismic testing.

Commercial Grade Dedication of Replacement Parts and Components

a. Scope

AMETEK supplies replacement parts to the nuclear industry for its uninterruptable power systems. In most cases, AMETEK procures these parts as commercial grade items and dedicates them for use in safety-related applications. Instructions for dedicating parts and components are contained in AMETEK System Management Procedure 01-090102, "Commercial Grade Dedication," Revision G, January 7, 2016. While this procedure discusses dedication of both parts and completed systems, AMETEK dedicates only individual replacement parts or components. Completed systems are manufactured and controlled under AMETEK's 10 CFR Part 50, Appendix B program, including the control of purchased commercial parts and components.

The inspection team reviewed several examples of completed dedication packages for safety-related parts or components. Among the dedication packages reviewed were those for the Ameron relays used in several applications within the UPS systems. In response to a recent NUPIC finding (SR-2013-36-03), AMETEK began to develop individual Technical Evaluation Sheets for families of individual parts used in the manufacture of the UPS systems.

The inspection team reviewed the technical justification for relays (no document number), Revision 1, dated July 1, 2016. The inspection team also reviewed the associated Commercial Grade Dedication Test Data sheet for numerous 3A, 120 VAC relays supplied to Luminant (Comanche Peak NPP) under Purchase Order #397299, Revision 0, dated December 5, 2016. AMETEK provided a certification to Luminant indicating that all terms of the purchase order had been met.

b. Findings and Observations

The inspectors noted that AMETEK performs enhanced electrical testing of relays, including testing of pickup and dropout voltages, as part of the dedication process in an attempt to demonstrate similarity to the relays that were seismically tested. The team found that the acceptance criteria contained on the data sheet for the dedicated relays was not sufficient to ensure seismic qualification or similarity to the previously tested relays. Specifically, the inspectors identified that the acceptance criteria was based upon the commercial ratings of the relays as opposed to the performance of the relays that were seismically tested.

In order to establish similarity to the seismically tested relays, the acceptance criteria would need to be derived from electrical tests performed on the seismically tested relays. For these dedication tests, AMETEK utilized acceptance criteria that were non-conservative from the perspective of showing similarity to the relays that were part of the UPS systems that had actually undergone seismic testing. The acceptance criteria being utilized would allow relays with a coil pickup voltage of less than 108VAC and a drop out voltage of greater than 36 VAC to pass (the commercial ratings for the relays). These values are non-conservative when compared to nominal performance values for the relays being tested and would allow a relay of significantly different performance characteristics from a seismic perspective to still past the testing. For example, if the relays that were part of the UPS systems that underwent seismic testing had a drop out voltage of 65 volts, the dedicated relays would need to have a dropout voltage reasonably close to 65 volts or lower to show they had a comparable electromagnetic force holding the contacts closed as those that underwent seismic testing. A relay with a higher dropout voltage will have less force holding the relay closed than a similar relay with a lower dropout voltage. As such, a relay that tested with a dropout voltage 65 VAC would likely be more seismically sensitive than one with a dropout voltage of 36 VAC. In order to properly demonstrate seismic similarity, the test acceptance criteria should be derived from the performance of the relays that actually underwent seismic testing.

Contrary to Criterion XVI of Appendix B to 10 CFR Part 50, AMETEK did not take sufficient corrective actions to the NUPIC finding associated with the dedication of seismically sensitive components. The staff identified this issue as one example of Nonconformance 99901427/2017-201-02.

c. Conclusion

The inspection team identified that the acceptance criteria being utilized for testing the pick-up and drop-out performance of the commercially procured relays, for the purposes of establishing seismic similarity to previously tested and qualified relays, was non-conservative.

Corrective Action

A. Inspection Scope

The NRC inspection team reviewed AMETEK's policies and implementing procedures for the Corrective Action Program (CAP) to verify compliance with the requirements of Criterion XVI, "Corrective Action," in Appendix B to 10 CFR Part 50. The NRC team reviewed a sample of Corrective Action Requests (CARs) to view the adequacy of AMETEK's implementation and control of the CAP. The NRC inspection team discussed the CAP status and effectiveness with AMETEK's management and staff. In addition, the NRC inspection team reviewed AMETEK's corrective actions for the four findings, associated with NRC Inspection Report Number 999901427/2013-201," dated October 2, 2013 (ML13259A314), to evaluate the adequacy of corrective actions taken by AMETEK to the NRC's findings. The attachment to this report lists the documents reviewed by the NRC inspection team.

B. Observations and Findings

Closure of Violation 99901427/2013-201-01

The NRC issued Violation 99901427/2013-201-01, dated October 2, 2013 (ML13259A314). Violation 99901427/2013-201-01 cited AMETEK for failure to report a defect associated with Tyco/Potter & Brumfield relays as soon as practicable within 60 days of discovery, or file an interim report. By letter dated November 1, 2013 (ML13329A326), AMETEK provided a response to the Violation. In its response, AMETEK stated that it had created a checklist that would be used by Part 21 administrators to provide 10 CFR Part 21 reporting requirements and guidance. AMETEK issued corrective action request (CAR) # SCI-CAR-0019 to address this violation.

Upon review of AMETEK's corrective actions, the NRC inspectors determined that AMETEK failed to complete corrective actions in response to the NRC finding. Specifically, AMETEK could not provide evidence the checklist referred to in their response had actually been implemented. AMETEK generated CAR # SCI-CAR-0110 to address this issue.

The staff identified this issue as a second example of Nonconformance 99901427/2017-201-02. Violation 99901427/2013-201-01 will remain open based on this finding.

Closure of Nonconformance 99901427/2013-201-02

The NRC issued Nonconformance 99901427/2013-201-02 in the 2013 inspection report, dated October 2, 2013 (ML13259A314). Nonconformance 99901427/2013-201-02 cited AMETEK against Criterion III, "Design Control," of Appendix B to 10 CFR Part 50 and referenced two examples: (1) failure to review the adequacy of the design of safety-related 125 VDC/300A battery charger by not testing or evaluating the surge withstand capability and (2) failure to verify or validate a critical characteristic of synchronization testing which was outside of the acceptance criteria in eight out of nine battery charger/inverters sets.

By letter dated November 1, 2013 (ML13329A326), AMETEK provided a response to the Nonconformance. In response to example one, AMETEK concluded that surge withstand capability is not a critical characteristic required to be tested. However all of its safety-related battery chargers include circuitry to meet surge withstand requirements.

AMETEK stated that surge withstand capability is a battery charger design parameter, but it is not required to be tested on every customer order because it had been verified for the model equipment in the past. AMETEK further stated that while surge withstand capability was not performed in accordance with the customer-specific order, there was objective evidence the test had been demonstrated on similar equipment. Additionally, as part of its corrective actions, AMETEK updated its dedication and test procedures to include critical characteristics for battery chargers. AMETEK's letter did not address example two regarding the acceptance of test results found outside of synchronization specifications limits for the battery charger/inverters sets.

The NRC inspectors determined that AMETEK's corrective actions to example one were inadequate, and failed to provide verification that surge withstand testing was evaluated for the model 125 VDC/300A battery chargers (or equivalent). Specifically, when asked during this inspection, AMETEK could not provide any available test data or analyses that would demonstrate that circuitry for 125 VDC/300A battery chargers met surge withstand requirements. AMETEK captured the issue in CAR SCI-CAR-0110.

In addition, the NRC inspectors determined that AMETEK's corrective actions to example two were also inadequate. By the completion of the NRC inspection, AMETEK was unable to demonstrate that they had taken any corrective actions associated with test data that was found to be outside of the stated acceptance criteria, nor could AMETEK produce an evaluation as to why the results of the testing were acceptable.

The staff identified these issues as a third example of Nonconformance 99901427/2017-201-02. Based on these identified issues, NON 99901427/2013-201-02 will remain open. AMETEK captured these issues in CAR SCI-CAR-0110.

Closure of Nonconformance 99901427/2013-201-03

The NRC issued Nonconformance 99901427/2013-201-03 during the 2013 inspection. Nonconformance 99901427/2013-201-03 cited AMETEK for failure to provide adequate oversight of its suppliers. Specifically, AMETEK, issued a purchase order to C&D Technologies for safety-related batteries prior completing an audit of the company. AMETEK also issued a purchase order to Qualtech to perform seismic and environmental testing for the purposes of battery qualification prior to completing an audit of the company.

By letter dated November 1, 2013 (ML13329A326), AMETEK provided a response to the NON. AMETEK completed an audit of Qualtech in October 2013 and an audit of C&D Technologies in January 2013 with no significant issues identified. Additionally, AMETEK's corrective actions included an evaluation which determined that the batteries purchased from C&D Technologies were acceptable based upon AMETEK's supplier audit results. The NRC inspection team concluded that AMETEK's corrective actions in response to the nonconformance were adequate and therefore Nonconformance 99901427/2013-201-03 is closed.

Closure of Nonconformance 99901427/2013-201-04

The NRC issued Nonconformance 99901427/2013-201-04 during the 2013 inspection. Nonconformance 99901427/2013-201-04 cited AMETEK for failure to assure that conditions adverse to quality were promptly identified and corrected. Specifically AMETEK failed to

take corrective actions to ensure that the configuration for heat run testing on electrical enclosures was adequate.

By letter dated November 1, 2013 (ML13329A326), AMETEK provided a response to the Nonconformance 99901427/2013-201-04. AMETEK's corrective actions included updating the affected test procedures to ensure that the necessary panels be installed for heat runs. The NRC inspection team verified the procedure updates. The NRC inspection team concluded that AMETEK's corrective actions in response to the nonconformance were adequate and therefore Nonconformance 99901427/2013-201-04 is closed.

C. Conclusions

The NRC inspectors concluded that AMETEK's implementation of their policy and procedures for control of corrective actions associated with previous NRC-identified findings did not satisfy the regulatory requirements set forth in Appendix B to 10 CFR Part 50.

The inspectors determined that AMETEK failed to adequately implement corrective actions to address the findings associated with Violation 99901427/2013-201-01 and NON 99901427/2013-201-02. As a result, Violation 99901427/2013-201-01 and NON 99901427/2013-201-02 will remain open and may be reviewed for closure at a future NRC inspection. The NRC inspection team closed NON 99901427/2013-201-03 and NON 99901427/2013-201-04.

The NRC inspection team issued Nonconformance 99901427/2017-201-02 in association with AMETEK's failure to implement the regulatory requirements of Criterion XVI of Appendix B to 10 CFR Part 50. Nonconformance 99901427/2017-201-02 cites AMETEK for failure to establish adequate measures to assure conditions adverse to quality are promptly identified and corrected. Specifically, AMETEK did not provide objective evidence that the corrective actions associated with the findings from the previous NRC inspection 99901427/2013-201, dated October 2, 2013, were adequately implemented and completed.

Nonconforming Materials, Parts, or Components

a. Inspection Scope

The NRC inspection team reviewed policies and implementing procedures that govern the control of nonconforming materials, parts, and components to verify compliance with Criterion XV, "Nonconforming Materials, Parts, or Components," of Appendix B to 10 CFR Part 50. The inspectors verified that AMETEK's processes and procedures include the identification, documentation, segregation, evaluation, and disposition of nonconforming items.

The NRC inspection team verified that AMETEK's nonconformance process provides a link to the 10 CFR Part 21 program. The inspectors performed walk-downs of fabrication and assembly areas to inspect the segregation of nonconforming materials, the control of nonconformance reports (NCR) for ongoing work, and material conditions that could contribute to quality issues. The NRC inspection team observed ongoing craft work and inspection activities for the identification and control of NCRs. The NRC inspection team also verified that nonconforming materials were properly identified, marked, and segregated, when practical, to ensure that they were not reintroduced into the production processes.

The NRC inspectors selected a sample NCRs and verified that AMETEK: (1) dispositioned the nonconformances; (2) documented an appropriate technical justification for various dispositions; (3) took adequate action with regard to the nonconforming material or item; and (4) subjected any identified nonconformances, as appropriate, for 10 CFR Part 21 applicability. For those NCRs that were dispositioned as "repair" or "use as is," the inspectors confirmed that the technical justifications were documented to verify the acceptability of nonconforming items.

The NRC inspection team discussed the nonconformance process with AMETEK's management. The attachment to this inspection report lists the 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 AMETEK is implementing its program in accordance with Criterion XV, "Control of Nonconforming Materials, Parts or Components," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that AMETEK is implementing its policies and procedures associated with its nonconforming material, parts, and components. No findings of significance were identified.

Review of Software Development Life Cycle

Regarding AMETEK's activities designing and constructing digital instrumentation and control (I&C), the NRC inspection team reviewed AMETEK's software life cycle supplemental Digital System Program Policy 01-220001 and its implementing procedures. Using this supplemental quality policy, AMETEK handles its digital Quality Assurance (QA) program separately from the rest of its QA program applied to analog electronic systems. A listing of AMETEK's procedures reviewed by the NRC inspection team is provided in the attachment to this inspection report.

A. Inspection Scope

The inspectors reviewed AMETEK's software development activities associated with the development of a digital UPS system for the Hope Creek Nuclear Plant, under Purchase Order #MA00002333, dated April 18, 2014.

The NRC inspectors reviewed AMETEK's program for their digital I&C life cycle which includes the following phases:

Phase 1 – concept
Phase 2 – requirements (including Phase 2a-system requirements, Phase 2b-subsystem requirements, Phase 2c-software/logic requirements)
Phase 3 – design
Phase 4 – implementation
Phase 5 – system integration and validation testing

The NRC inspectors assessed whether key purchase order technical requirements were appropriately captured by AMETEK into the lifecycle documents. Certain digital component testing and prototype activities were about to begin in transition into lifecycle Phase 4 (Implementation). Since this inspection was conducted during Phase 3, the design development phase of the project, many of the important AMETEK's activities specified in the lifecycle development documents had not been completed at the time of inspection.

Configuration Management (CM)

The inspectors reviewed Procedure 01-221001, "Configuration Management Program Procedure," Revision C, dated September 28, 2016, and Procedure 01-221011, "Configuration Management Plan," Revision B, dated September 28, 2016, that were developed to provide guidance for configuration management (CM) activities and to assure proper document and software configuration controls used throughout the development life cycle. The procedures define the scope, roles and responsibilities of the CM organization, the CM repository including identified configuration items (CI), discrepancy reporting, and access control to CI files, and status of files such as draft, released, or baseline.

The inspectors reviewed the CM Artifact Status list that identifies CI's tracked through the development lifecycle. The list of CI's included documents by phase, number, title, group, date submitted to CM, report type, and notes. The inspectors selected a sample of completed CI's to verify completion of phase summary activities and management of configuration items and the configuration matrix.

The inspectors conducted interviews and reviewed completed program documentation to determine the process for identifying CIs and, as necessary, to determine if the CIs were audited prior to release in accordance with the requirements of IEEE 828-1990, "IEEE Standard for Software Configuration Management Plans" (IEEE-828) as endorsed by Regulatory Guide (RG) 1.169, dated September 1997, "Configuration Management Plans for Digital Computer Software used in Safety Systems of Nuclear Power Plants," (RG 1.169). The inspectors verified that the CM guidance documentation and resultant management of CIs was consistent with the vendor's guidance and standard industry practices described in IEEE-828-1990.

Requirements Traceability

The inspectors reviewed a sample of the UPS control actuation logic requirements to determine whether the lifecycle development process was in conformance with 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criterion III, "Design Control." In performing its review, the inspectors utilized the guidance of Branch Technical Position 7-14, "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems," Revision 6, August 2016. The inspectors selected two requirements from the Hope Creek Nuclear Plant contract to perform a requirements traceability review and to assess AMETEK's process for translating

requirements and design inputs into specifications. The inspectors selected from the Purchase Order section "Exhibit 3," requirement items:

- 7.1.4.12, Inverter Bridge Protection shall be provided such that when an insulated-gate bipolar transistor (IGBT) desaturation condition is sensed, the inverter will automatically turn off all gate signals….

- 7.1.5.2, c) and f). The static switch shall provide an automatic Uninterrupted Transfer of the critical load after the control logic senses Inverter Output Over/Under Voltage. The transfer logic shall not allow a transfer to the bypass source if the bypass source is out of sync with the inverter output.

The vendor's requirements traceability matrix (RTM) was reviewed and compared against accompanying design and implementation documents of the lifecycle development process in order to verify the vendor's process of translating contract requirements into design implementation documents. The inspectors verified that the above listed contract requirements were appropriately translated into the lower level design documents. The inspectors also reviewed lower level Design Document NDPP_SDD_3002, "NDPP UPS Single Phase Inverter Control Software Component Design Specification," Revision A, February 22, 2017.

Incorporation of Regulatory Standards

The inspectors reviewed contract requirements, regulations, and design standards to be used in the design and implementation of the UPS as necessary to establish whether the UPS design activities were being accomplished in accordance with the requisite Appendix B procedures and specific contract guidance.

Independent Verification & Validation (IV&V)

NRC inspectors reviewed reports completed by the IV&V organizations. IV&V activities are software design review activities performed as an independent quality check by individuals separate from the software developers. Additionally, ongoing activities such as preparation of IV&V test procedures were reviewed in draft format, as these activities were still in progress before the actual Phase 3 & 4 testing.

a. IV&V Program Control

   The inspectors reviewed Project Document 01-221009, "Digital Project Independent Verification and Validation Plan," Revision C, dated August 9, 2016, and 01-221003, "Digital System Test Program Plan," Revision A, dated August 9, 2016, that provides a detailed description of the IV&V process including staff roles and responsibilities; methods, tools, techniques for independent V&V assessments; document control related to task and summary reports; discrepancy reporting and resolution; and phase-specific IV&V tasks such as auditing, evaluation, and assessment of completed work products. Included in the document are a series of project IV&V Activity forms that are used to document the particular IV&V Activities performed during each phase of the development lifecycle.

The team reviewed a sample of completed assessments and audits of various IV&V activities for the concept, requirements, and design phases of the program. Specifically, the inspectors reviewed the Hazard Analysis and Risk Analysis performed by IV&V as part of the Phase 2B (I&C Subsystem Requirements phase) and confirmed the analyses were completed and documented pertinent information consistent with the guidance in IEEE Std. 1012-1998, "IEEE Standard for Software Verification and Validation," as endorsed by RG 1.168, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," dated February 2004.

b. IV&V Test Controls

The inspectors reviewed a sample of test specifications, test data logs, and test summary reports for both hardware and software elements of the system. Specifically, the team reviewed HDD_3001_VTS, "Independent Charger Hardware Component Build & Validation Test Specification," Revision A, dated February 1, 2017, which was developed to verify power supply functionality, analog to digital conversion capability and fault tolerance, system health capability, and status indication for the Charger Interface board. The inspectors verified that the document described the test purpose, scope, methods, tools, techniques, test system configuration, and specific test cases to verify the board functioned adequately. The inspectors assessed whether the document contained detailed test step sequences for each test case and whether the document was annotated to indicate test results and expected values.

The inspectors also reviewed HDD_3001_VTSrA_LOG, "Validation Test Log," Revision A, dated February 1, 2017, and confirmed the test log adequately reflected each of the test case results.

c. IV&V Training

The inspectors reviewed training records and discussed training curricula with members of the IV&V staff. Training covering areas including IV&V, CM, safety analysis, and software lifecycle phases were discussed. The inspectors reviewed Draft Dr0, "Ametek SCI Digital System Program Training – Introductory Training," dated October 6, 2015, that provided an overview discussion of regulatory requirements, common industry DI&C issues and concerns, Ametek's DI&C program, software lifecycle phases, and DI&C program roles, responsibilities and activities. Each section contained a summary description, learning objectives, and completion criteria and was supplemented by additional training materials such as program plans and procedures.

d. IV&V Organizational Structure

The NRC inspectors reviewed the independence of the organizational structure. The inspectors noted that while IV&V functions were spread among different functional groups (called V&V, System Safety, Configuration Control, and Quality), independence was maintained by having these IV&V tasks performed by individuals separate from the actual design development team under AMETEK's Research and Development director.

e. IV&V Phase Summary Report Review

The inspectors reviewed DI&C phase activity summary reports from each of the IV&V functional groups and assessed whether the reports were completed as required. The inspectors determined that for the one deficiency report to date that AMETEK assessed as a "significant" condition adverse to quality, appropriately included a causal analysis and addressed an issue of overall design philosophy with additional training as a completed corrective action.

Software Tool Validation

The inspectors reviewed a listing of test tools evaluated and determined by the vendor to be suitable for use on the project by Design and IV&V. The inspectors reviewed the suitability analysis performed by the DI&C Safety Team, 25-100011, "Digital Pre-developed Product Evaluation – Realterm," Revision 1, dated March 3, 2017. The analysis contained scope of use of the product, supplier information, critical characteristics, acceptance criteria, and evaluation of the information.

The inspectors reviewed AMETEK's software tool validation documentation. The software tool was used to produce the logic for the UPS's field programmable gate array (FPGA). AMETEK provided the FPGA software tool details and specifications document "P/N: 25-100006, Altera Quartus II V8.1," Revision 1, dated September 20, 2016. The vendor stated that the FPGA software tool would be qualified in accordance with Section 5.3.2, "Software Tools," Item B, of IEEE Std. 7-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," and via tool operating experience. The inspectors reviewed the FPGA validation test contained in LDD_3002_VTS, "Independent Inverter Embedded Logic Component Build & Validation Test Specification," Revision A, dated March 20, 2017. The inspectors reviewed several of the FPGA tests contained in Appendix A, "FPGA Test Logic," Appendix B, and Appendix C, "FPGA Logic Source Code." In addition, the inspectors reviewed the test procedure for the integrated inverter system contained in NDPP_IT_6002, "NDPP UPS Single Phase Inverter Integration Test Procedure."

The inspectors verified that the software tool validation process and procedures appropriately addressed the guidance of IEEE Std. 7-4.3.2-2003.

Control of Equipment

The inspectors reviewed documentation associated with the storage environment for the UPS software under development. The inspectors reviewed the guidelines contained in the AMETEK document titled, "Secure Development Environment Guidelines," Revision A. The guidelines state that the purpose of the secured development environment is to prevent any malicious firmware or software from getting into the system. The guidelines provide guidance to check for restricted access, such as passwords needed to log on and that network adapters have been disabled, the process used to authorize individuals access to the secured development environment, in addition to monitoring access and reviewing login history. The inspectors also reviewed a completed vendor assessment form of the secure development environment guideline implementation. The completed assessment activity was recorded in Document 2CSDA-V, "Secure Development Environment Assessment," Revision A, dated August 30, 2016. The requirements to ensure a secure development environment are listed in Document 01-220003, "Digital Systems Lifecycle Planning,"

Revision A, dated May 18, 2016, Section 5.4.1, "Software Safety Plans Criteria," which, in part, lists policy and required activities that demonstrate how the establishment of a secure environment, in accordance with BTP 7-14 guidance, is implemented. In addition, Document 01-220001, "Digital System Program Policy," Revision B, dated May 24, 2016, references in Section 1.4.4, "Regulatory Guides & Endorsed Standards," RG 1.152, Criteria for use of Computers in Safety Systems of Nuclear Power Plants," Revision 3, July 2011.

The inspectors verified that measures have been established to provide secure control of the handling and secure storage of the UPS software in accordance with the contract's regulatory listing of Appendix B criterion and BTP 7-14 guidance.

B. Observations and Findings

No findings of significance were identified in the area of digital I&C design control.

C. Conclusion

The inspectors concluded that AMETEK's implementation of their policies and procedures for control of design activities associated with digital I&C software design life cycle satisfied the regulatory requirements set forth in Appendix B to 10 CFR Part 50.

Qualification of Digital System to IEEE 650-2006

a. Scope

The inspection team reviewed completed portions of the testing and qualification of the Hope Creek Nuclear Generation Station 20/30 KVA UPS system. Specifically, the inspection team reviewed electrical testing performed by NTS under contract to AMETEK in order to qualify the equipment for Class 1E service in accordance with IEEE 650-2006. The following documents were reviewed and were associated with the testing and analysis performed of the UPS system:

- NTS Aging Analysis Report No. PR052689AA16, "Aging Analysis Report of 20 KVA UPS and 30 KVA Isolimiter Manufactured and Supplied by AMETEK Solid State Controls, LLS for Hope Creek Nuclear Generation Station," dated October 11, 2016

- NTS Test Report No. PR050748-01TR, "Qualification Testing of a 20 KVA Uninterruptible Power Supply," dated March 17, 2017

- NTS Test Procedure PR050748-10TP, "Qualification Testing of a 20 KVA Uninterruptible Power Supply," dated January 12, 2017

The inspectors reviewed the basis for the NTS aging analysis which concluded that all the materials contained in the UPS system have a qualified life greater than 40 years. The inspectors also discussed with AMETEK the absence of information to address operational cycling of electro-mechanical components (relays).

b. Findings and Observations

No findings of significance were identified.

c. Conclusions

The inspection team concluded that the testing and analysis performed met the intent of the IEEE 650 standard. The inspector's concluded that the aging matrix covered all materials of concern within the UPS systems. Furthermore, AMETEK conservatively assigns a qualified life of only 10 years to most of the electronic components. With regard to operational cycling, the inspectors determined that operational cyclic testing was specifically excluded from the NTS qualification testing and will have to be addressed separately by AMETEK. NTS is also performing EMI/RFI testing of the UPS system for AMETEK; however these test reports were not completed or available for the team's review at the time of the inspection.

ATTACHMENT

1. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Item Number	Status	Type	Description
99901427/2013-201-01	Remains Opened	NOV	10 CFR Part 21
99901427/2013-201-02	Remains Opened	NON	10 CFR Part 50, App. B, Criterion III
99901427/2013-201-03	Closed	NON	10 CFR Part 50, App. B, Criterion VII
99901427/2013-201-04	Closed	NON	10 CFR Part 50, App. B, Criterion XVI
99901427/2017-201-01	Open	NON	10 CFR Part 50, App. B, Criterion III
99901427/2017-201-02	Open	NON	10 CFR Part 50, App. B, Criterion XVI

2. EXIT MEETING

On April 21, 2017, the NRC inspection team conducted an exit meeting with AMETEK management and staff and discussed the results of the inspection.

NAME	ORGANIZATION	Attended Entrance Meeting	Attended Exit Meeting
Jason Cotton	AMETEK	X	
Ben Gordon	AMETEK	X	X
Daniel Huey	AMETEK	X	X
Ethan Salsbury	AMETEK	X	X
Cywthka Morriou	AMETEK	X	
Paul Robinson	AMETEK	X	
Rebekah Needham	AMETEK	X	X
Bogdon Proca	AMETEK	X	X
Steve Wetta	AMETEK	X	X
Douglas King	AMETEK	X	
Jon Paes	PSEG	X	X
George Ardolino	AMETEK		X
Jeffrey Jacobson	NRC	X	X
Greg Galletti	NRC	X	X
Jermaine Heath	NRC	X	X
Kenneth Mott	NRC	X	X
Phil Natividad	NRC	X	X
Terry Jackson	NRC		X

3. DOCUMENTS REVIEWED

Procedures

- 01-191304, Calibration of M&TE, Revision E, dated 01/01/2016
- 01-090065, Supplier Approval, Revision R, dated 10/12/16
- 01-090069, “Nuclear Approved Vendor List,” Revision D, dated 02/07/2017
- 01-090068,”Procurement Document Control,” Revision H, dated 09/10/2016
- 01-090141, “Corrective Action,” Revision M, dated 11/26/2014
- 01-090141, “Corrective Action,” Revision O, dated 09/14/2016
- 01-090130, “Control of Nonconforming Product,” Revision K, dated 06/28/2011
- 01-090145,”Failure Investigation/Part 21 Reporting,” Revision M, dated 09/20/2016
- 96000095, 300 Amp and 500 Amp Battery Chargers, Revision A, dated 05/31/2016
- 96000104, 50 Amp Battery Charger electrical test procedure addendum, Revision B, dated 08/08/2016
- 01-191011, Digital Process Power UPS Test Procedure, Revision J, dated 10/13/2013
- 01-191012, Mag-Amp Regulator Testing Procedure, Revision C, dated 10/13/2013
- 01-191016, Isolimiter Test Procedure, Revision D, dated 10/13/2013
- 01-191017, Analog Inverter Test Procedure, Revision C, dated 10/13/2013
- 30-100006, Charger Test Procedure, Revision 14, dated 10/13/2013
- 30-100074, Microprocessor Inverter Test Procedure, Revision F, dated 10/13/2013
- 01-221006, “Digital Project Management Plan”, Revision A, dated 01/22/2016
- 01-221002, “Discrepancy Reporting Program”, Revision A, dated 02/01/2016
- 01-220005, “Digital System Program Terms and Definitions”, Revision A, dated 09/28/2016
- 01-221009, “Digital Project Independent Verification & Validation Plan”, Revision C, dated 08/09/2016
- 01-221001, “Configuration Management Program Procedure,” Revision C, dated 09/28/2016
- 01-221011, “Configuration Management Plan,” Revision B, dated 09/28/2016
- 01-221003, “Digital System Test Program Plan,” Revision A, dated 08/09/2016
- 01-221009, “Digital Project Independent Verification and Validation Plan,” Revision C, dated 09/09/2016
- 01-090102, “Commercial Grade Dedication,” Revision G, dated 01/07/2016

Design Specifications

- NDPP_REQS_2001, NDPP UPS Single Phase Instrumentation & Control System Architecture & Requirements Specification, Revision C, 11/16/2016
- NDPP_SDD_3005, NDPP UPS Single Phase Software Component Interface Design Specification, Revision A, 11/16/2016
- NDPP_LGR_2002, Inverter Embedded Logic Component Architecture & Requirements Specification, Revision A, 08/23/2016
- NDPP_LDD_3002, Inverter Embedded Logic Component Design Specification, Revision C, 03/03/2017
- NDPP_SDD_3002, NDPP UPS Single Phase Inverter Control Software Component Design Specification, Revision A, 08/22/2017
- NDPP_REQS_2004, NDPP UPS Single Phase Display I&C Subsystem Architecture and Requirements Specification, Revision A, 05/12/2016

- NDPP_REQS_2003, NDPP UPS Single Phase Inverter I&C Subsystem Architecture Requirements Specification, Revision B, 08/23/2016
- NDPP_SDD_3005, NDPP UPS Single Phase Software Component Interface Design Specification, Revision A, 11/16/2016
- 88-R15000-01, Nuclear Safety-Related Digital Process Power (NDPP) Single Phase UPS Product-Line System Specification, Revision 3, 07/08/2016
- NDPP_SWR_2002, NDPP UPS Single Phase Inverter Software Component Architecture & Requirement Specification, Revision B, 01/16/2017
- LDD_3002_VTS, "Independent Inverter Embedded Logic Component Build & Validation Test Specification," Revision A, 03/14/2017
- NEXTERA Engineering Procurement Specification S-S-1-E-0232, "Seismic Requirements," Revision 1, no date
- HDD_3001_VTS, "Independent Charger Hardware Component Build & Validation Test Specification," Revision A, dated 02/01/2017

CARs and DRs

- SCI-CAR-0019, Response to 2013 NRC Findings, dated 11/13/2013
- SCI-CAR-0036, Action taken to resolve internal audit finding, dated 11/25/2015
- SCI-CAR-0048, Missing fuse in equipment sent to customer, dated 07/01/2015
- SCI-CAR-0059, CGI Technical Evaluation (NUPIC Finding), dated 07/20/2016
- SCI-CAR-0104, Analog oscillator PCB w/ incorrect capacitor, dated 03/20/2017
- SCI-CAR-0061, Internal Audit 015-003 #3 – Calibration, dated 02/05/2016
- SCI-CAR-0073, Nuclear ASL Oversight requirements issue, dated 07/20/2016
- SCI-CAR-0075, SCI Workmanship and Quality Discrepancies, dated 07/22/2016
- SCI-CAR-0095, Internal audit process effectiveness, dated 10/07/2016
- SCI-CAR-0080, Static switch xfmr does not meet design spec / Part 21, dated 05/27/2016
- SCI-CAR-0061, Internal audit 015-003 finding #3- calibration, dated 02/05/2016
- SCI-CAR-0111, "Software Tool Objective Evidence," dated 04/20/2017

- 2DR_001, initiated 03/23/16
- 2DR_002, initiated 03/23/16
- 2DR_011, initiated 06/02/16
- 2DR_016, initiated 06/22/16
- 3DR_021, initiated 10/20/16
- 3DR_022, initiated 11/02/16
- 4DR_041, initiated 03/02/17
- 4DR_042, initiated 03/03/17
- 4DR_049, Discrepancy Report, "Mislabeling of Requirement Identification Tag," Revision A, 04/20/2016
- 4DR_050, Discrepancy Report, "Reference Standard," Revision A, 04/20/2017

Nonconformances

- Trans. ID 810326607, Failed NEMA testing, dated 01/31/2017
- Trans. ID 759797710, Defective Component in SCI Test, dated 04/11/2016
- Trans. ID 74684929, DJ190303 failed during heatrun, dated 02/23/2016
- Trans. ID 73138056, Breaker trip, defective, dated 12/28/2015
- Trans. ID 72235950, Tag 858 possible fraudulent part, dated 11/23/2015
- Trans. ID 71413412, Failure analysis request from MFG, dated 10/23/2015

Test Procedures Reports

- NTS Test Procedure PR050748-10TP, "Qualification Testing of a 20 KVA Uninterruptible Power Supply," dated 01/12/2017
- Serial no. 96000095-1112, Battery Charger/Rectifier Final Test Report, dated 08/29/2016

Purchase Orders

- Nextera Purchase Order #02334057 to AMETEK, Revision 9, dated 02/08/2017
- AMTEK certification to Nextera for Purchase Order #02334067, dated 02/24/2017
- Luminant Purchase Order #397299 to AMETEK, Revision 0, dated 12/05/2016
- Scope Document (Exhibit 3) for Hope Creek Nuclear Generation Station 20/30 KVA UPS Replacement Contract
- MA00002333, Hope Creek UPS Contract, 04/18/2014

Reports

- 2CCCR-160823, "CCRB Baseline Review Record", dated 08/23/16
- Phase 2c (logic/component requirements) phase summary report – IV&V
- Phase 2c summary report – Safety
- Phase 2c summary report – Configuration Management
- NTS Aging Analysis Report No. PR052689AA16, "Aging Analysis Report of 20 KVA UPS and 30 KVA Isolimiter Manufactured and Supplied by AMETEK Solid State Controls, LLS for Hope Creek Nuclear Generation Station," dated 10/11/2016
- NTS Test Report No. PR050748-01TR, "Qualification Testing of a 20 KVA Uninterruptible Power Supply," dated 03/17/2017

Miscellaneous

- 02-190145, Substantial safety hazard determination for Job # 96000075, dated 03/27/2017
- 02-190145, Substantial safety hazard determination for Job # 96000076, dated 02/07/2017
- 02-190145, Substantial safety hazard determination for schematic discrepancy affecting power supplies 85-RP26XXX, dated 09/22/2016
- Certificate of calibration, #15-75095 for digital multimeter, dated 10/14/2015
- Certificate of calibration, #16-78339 for digital multimeter, dated 10/06/2016
- Final acceptance test instrument check for Job #96000104, Serial No. 0312, dated 09/23/2016

- Final acceptance test instrument check for Job #96000104, Serial No. 0212, dated 09/23/2016
- Quote No. PR1296, Rev. C, dated 04/08/2016
- Job #96000104-0312, Battery charger / rectifier model #85-CC0500-77, dated 10/05/2016
- Job #96000104-0212, Battery charger / rectifier model #85-CC0500-77, dated 09/30/2016
- NQA-1 Lead Auditor Qualification Record for Ethan Salsbury, dated 08/01/2016 and 11/04/2016
- Bill of Material Component List for assembly item 85-VC0075-37, "7.5kva INV, 480//125/118V, 1PH, 60HZ, Model #85-VC0075-37, Custom 1E," Revision D.
- Bill of Material Component List for printed circuit board assembly 80-9215911-90, "ASSY DC REL, 105-140 VDC, 4PDT RELAY W/3AMP CONTACT RATING," Revision C
- Component Family Technical Justification for relays (no document number), Revision 1, dated 07/01/2016
- Component Family Technical Justification for capacitors (no document number), Revision 1, dated 08/19/2016
- Supplier audit of Qualtech NP, dated 10/15/2013 and 12/20/2016
- Supplier audit of C&D Technologies, Inc. dated 12/12/2012
- Trip Report, Supplier evaluation for C&D Technologies dated 01/11/2013
- LDD_3002drB1_RTM, Inverter Subsystem RTM, Revision b1, 03/16/2017
- P/N: 25-100005, "Altera Quartus II V8.1," for the Development/Testing Tool, Revision 1, 09/19/2016
- "Secure Development Environment Guidelines," Revision A
- 2CSDA-V, "Secure Development Environment Assessment," Revision A, 08/30/2016
- 2-BPRA-V, "Project Risk Assessment," dated 06/30/2016
- 2-BSHA-S, "Safety Hazard Analysis," dated 06/20/2016
- Draft Dr0, "Ametek SCI Digital System Program Training – Introductory Training," dated 10/06/2015
- HDD_3001_VTSrA_LOG, "Validation test log," Revision A, dated 02/01/2017
- 25-100005, "Altera Quartus II V8.1," Revision 1, dated 09/20/2016

4. PERSONNEL INTERVIEWED

Ethan Salsbury, Quality Assurance Manager
James Larosa, Technician
Steve Wetta, Director
Dan Huey, Product Manager
Bogdan Proca, Director R&D

5. INSPECTION PROCEDURES USED

The inspectors used the following NRC inspection procedures/sections to perform this inspection:

- IP 43002 – Routine Inspections of Nuclear Vendors
- IP 43004 – Inspection of Commercial-Grade Dedication Programs
- IP 37805 – Engineering Design Verification Inspections
- IP 37805 – Appendix A, "Instrumentation and Control Inspection Plan Guidelines"
- IP 43002.03.03 – Design Control
- IP 43002.03.06 – Document Control
- IP 43002.03.09 – Control of Special Processes
- IP 43002.03.16 – Corrective Action

6. LIST OF ABBREVIATIONS USED IN REPORT

A	Ampere
ac	alternating current
CAR	corrective action request
CAP	corrective action program
CFR	*Code of Federal Regulations*
CI	configuration item
CM	configuration management
dc	direct current
DI&C	digital instrumentation and controls
EMI	electromagnetic interference
FPGA	field programmable gate array
IEEE	Institute of Electrical and Electronics Engineers
IGBT	insulated gate bipolar transistor
I&C	instrumentation and controls
IV&V	independent verification and validation
NCR	nonconformance report
NON	Notice of Nonconformance
NUPIC	Nuclear Procurement Issues Committee
QA	quality assurance
RG	regulatory guide
RTM	requirements traceability matrix
UPS	uninterruptible power supply
V	Volt
VAC	Volts AC