

January 28, 2016

Richard Kuntz, Quality Assurance Manager
SPX, Copes-Vulcan
5620 West Road
McKean, PA 16426-1504

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION OF SPX,
COPESES-VULCAN, REPORT NO. 99900080/2015-202

Dear Mr. Kuntz:

On December 12-17, 2015, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a limited scope inspection of SPX, Copes-Vulcan. The inspection was performed on the premises of United Technologies Incorporated in Fairfield, California who is a commercial contractor to SPX. The inspection was focused on the design validation testing of squib valve explosive system, which is part of a component that is being supplied for use in safety-related applications in the Westinghouse AP1000 reactor design. Since United Technologies does not have a nuclear quality assurance program, this inspection focused on SPX's commercial-grade dedication and oversight of these activities. The enclosed report presents the results of this inspection. This NRC inspection report does not constitute NRC endorsement of your overall quality assurance or Part 21 programs.

The activities inspected were also associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from Appendix C from the Combined License for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3. Specifically, these activities were associated with ITAAC 2.1.02.12a.v and 2.2.03.12a.ii. No adverse findings were identified that were associated with these ITAAC. In accordance with Title 10 of the *Code of Federal Regulations* 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure 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>.

Sincerely,

/RA/

Greg Galletti, Acting Chief
Electrical Vendor Inspection Branch
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 99900080

Enclosure:
Inspection Report No. 99900080/2015-202
and Attachment

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Letter to Richard Kuntz from Greg Galletti dated January 28, 2016

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COPES-VULCAN, REPORT NO. 99900080/2015-202

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

Docket No.: 99900080

Report No.: 99900080/2015-202

Vendor: SPX, Copes-Vulcan
5620 West Road
McKean, PA 16426-1504

Vendor Contact: Mr. Richard Kuntz,
Quality Assurance Manager

Background: SPX, Copes Vulcan is currently manufacturing squib valves that are being supplied for use in safety-related systems as part of the Westinghouse AP1000 reactor design at the Vogtle and V.C. Summer nuclear plants.

Inspection Dates: December 15-17, 2015

Inspection Team: Jeffrey Jacobson NRO/DCIP/EVIB Team Leader
Richard McIntyre NRO/DCIP/MVIB

Approved by: Greg Galletti, Acting Chief
Electrical Vendor Branch
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Enclosure

EXECUTIVE SUMMARY

SPX, Copes-Vulcan
99900080/2015-202

During the period from December 15-17, 2015, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a limited scope inspection of SPX, Copes-Vulcan, the supplier of the safety-related squib valves for the Westinghouse (WEC) AP1000 design. The inspection was performed on the premises of United Technologies Inc. in Fairfield, California who is a commercial contractor to SPX, and who was working under SPX oversight.

The activities inspected were associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from Appendix C from the Combined License for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3. Specifically, these activities were associated with ITAACs 2.1.02.12a.v and 2.2.03.12a.ii.

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

- Appendix B to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50
- 10 CFR Part 21

Explosive System Margin Testing

The inspection team reviewed the margin testing being performed by SPX of the squib valve explosive system. The testing was in response to a previously identified NRC Nonconformance (99900080/2013-201-01) which identified that SPX had failed to demonstrate that sufficient margin exists in the initiator to cartridge design interface to ensure reliable detonation and operation of the valves. SPX tested a sample of eight of each of the three types of squib valve cartridges which were mated to specially manufactured 80 percent loaded initiators. Due to the special permits required to handle/store explosive devices, the testing was performed at United Technologies Inc. The inspectors assessed the adequacy of the following specific attributes as part of the inspection:

- Appropriateness of selected test equipment
- Calibration of test equipment
- Adequacy of test procedures
- Documentation of test results
- Documentation and assessment of test anomalies
- Manufacturing records for test specimens

No findings of significance were identified with the margin testing. All tested cartridges fired and their performance was consistent in terms of output and other important parameters. The team considered the testing sufficient to close out Nonconformance 99900080/2013-201-01.

Commercial-Grade Dedication of Explosive Powder

During the inspection, the team reviewed SPX's corrective actions to NRC Nonconformance 9990080-2013-201-02. The previous concern raised had to do with the inadequate commercial-grade dedication of the explosive powder, primarily that the dedication process

failed to identify as a critical characteristic that the manufactured explosive powder was free from any impurities that could impact its performance (ignitability).

During this inspection, the inspectors determined that SPX had revised the commercial-grade dedication instructions for dedication of the explosive powder to require analysis of each of the individual ingredients that make up the powder to the purchase specification requirements. The inspectors verified that SPX had developed commercial-grade safety-related checklists that identified appropriate critical characteristics for the explosive powder and granules by part number and lot number for the specific sizes of the cartridge assemblies.

The inspectors determined that SPX had sent out lots of the explosive powder to a SPX approved laboratory, NSL Analytical. The inspectors reviewed the SPX purchase orders to, and the chemical analysis test reports from, NSL Analytical, and concluded that appropriate critical characteristics had been identified and tested by an approved testing laboratory that maintained a nuclear safety-related quality assurance program. As of the conclusion of the inspection, the actual test results were awaiting review and final verification by SPX.

No findings of significance were identified. The inspectors determined that SPX had developed and implemented appropriate corrective actions to close the issues identified in NRC Nonconformance 99900080/2013-201-02.

REPORT DETAILS

Background

Squib valves are relied upon to provide important safety functions within the WEC AP1000 passive design. They are used to depressurize the reactor as part of the automatic depressurization system, to actuate passive safety injection from the in-containment refueling water storage tank, and to activate sump recirculation. Each AP1000 reactor contains 12 squib valves (8-8" valves and 4-12" valves). Each squib valve contains an explosive cartridge that provides the motive force necessary to operate the valves. Each explosive cartridge is composed of two parts: the primary cartridge and the initiator. When called upon to operate, plant interfacing systems supply a current pulse to the initiator sufficient for detonation. Once detonated, the initiator releases its energy into the primary cartridge, igniting the primary explosive mixture, which then operates the valve.

During this inspection, the inspectors focused on testing being performed by SPX of the initiator to cartridge interface. The testing was designed to show that margin exists between the energy released by the initiators and the energy necessary to properly ignite the cartridge, which ultimately provides the motive force necessary to operate the valves.

Initiator Testing-Test Control

a. Scope

The inspection team reviewed the margin testing being performed by SPX of the squib valve explosive system. The testing was in response to a previously identified NRC Nonconformance (99900080/2013-201-01) which identified that SPX had failed to demonstrate that sufficient margin exists in the initiator to cartridge design interface to ensure reliable detonation and operation of the valves. To address the concerns raised in the nonconformance, SPX tested a sample of eight of each of the three types of squib valve cartridges (24 total) which were mated to specially manufactured 80 percent loaded initiators and installed into closed bomb testing fixtures. By using initiators loaded with only 80 percent of their explosive charge, SPX was essentially trying to show that a margin of at least 20 percent would exist between the expected output of a nominally loaded initiator and the input requirements for reliable cartridge detonation. This method of testing was derived from standard practice in the space/aerospace industry for ensuring sufficient margin exists between stages of an explosive system. Due to the special permits required to handle/store explosive devices, SPX conducted the testing at United Technologies, the manufacturer of the squib valve initiators and cartridges, and a contractor to SPX.

The inspectors reviewed the test acceptance criteria which were essentially just that the cartridges fire with no anomalous performance. The inspectors assessed the adequacy of the following specific attributes as part of the inspection:

- Appropriateness of selected test equipment
- Calibration of test equipment
- Adequacy of test procedures
- Documentation of test results
- Documentation and assessment of test anomalies
- Manufacturing records for test specimens

The inspectors reviewed SPX Procedure No. 4.1.470, "Test Plan for Margin Testing of Squib Valve Actuators," Revision 4, dated December 14, 2015. The inspectors reviewed the overall methods being utilized to ensure the testing was being conducted in compliance with Criterion XI, "Test Control," of Appendix B, to 10 CFR Part 50.

The inspectors reviewed the purchase order from SPX to United Technologies Inc., #4501153929, dated July 17, 2015, for the specially fabricated initiators and cartridges used for this testing. The inspectors also reviewed the Manufacturing Procedure for the Initiator Assembly, PN 17399400-1", Revision D, dated September 10, 2015, and associated data sign off sheets for ensuring that the initiators were loaded with 80 percent of their nominal charge.

b. Findings and Observations

The inspectors determined that the test acceptance criteria (essentially just that all cartridges successfully fire) was acceptable for demonstrating sufficient margin exists between the initiator output and cartridge input requirements. The inspectors observed that SPX was collecting data during the testing that included pressure traces from transducers installed in the spare initiator port (provides initiator output info) and in the closed bomb assembly (used to assess cartridge output). This data could also be used if necessary to assess the delay time between firing stages, a parameter which SPX had previously determined could be utilized to perhaps predict anomalous performance (delayed or non-detonation). The inspectors determined that the data was really being used for informational purposes only, primarily as an aid in troubleshooting if anomalous cartridge performance was to have occurred (this did not occur though). The inspectors verified that the testing was being properly controlled and that the test results were generally consistent with regard to time-to-fire and output pressure traces. The inspectors identified that SPX was using redundant methods to record data and that the recorded data was consistent between the systems.

Based upon a review a documentation including manufacturing data sign off sheets, the inspectors verified that the initiators being utilized for this test program had been loaded with 80 percent of their nominal charge as specified in the test plan. The inspectors observed the firing of several of each of three types of cartridges being tested. In all cases, the cartridges fired acceptably during the testing, with no unacceptable firing delays noted.

No findings of significance were identified associated with the margin testing.

c. Conclusions

The inspectors determined that SPX had developed an appropriate method to adequately establish that sufficient margin exists between the output of the initiators and the cartridge input requirements and that the testing was being conducted in compliance with Criterion XI, "Test Control," of Appendix B, to 10 CFR Part 50. The inspectors concluded that the margin testing results were sufficient to resolve the concerns raised previously in NRC Nonconformance 99900080/2013-201-01.

No findings of significance were identified.

Commercial-Grade Dedication of Explosive Powder

a. Scope

The NRC inspectors reviewed the corrective actions taken by SPX in response to NRC Nonconformance 99900080/2013-201-02. The nonconformance identified that SPX had failed to establish sufficient measures as part of its commercial-grade dedication process to ensure whether the explosive powder pyrotechnic mix was free of contaminants that could potentially degrade performance under design basis conditions. SPX's corrective actions to this issue were detailed in Corrective Action Report 962. The inspectors also reviewed the associated commercial-grade safety-related checklists and quality surveillances reports for the 8-inch low pressure, the 8-inch high pressure, and the 14 inch ADS squib valve margin cartridge assembly.

b. Observations and Findings

The inspectors determined that SPX had revised the commercial-grade dedication instructions for dedication of the explosive powder to require analysis of each of the individual ingredients that make up the powder to the purchase specification requirements. The inspectors verified that SPX had developed commercial-grade safety-related checklists that identified appropriate critical characteristics for the explosive powder and granules by part number and lot number for the specific sizes of the cartridge assemblies.

The inspectors determined that SPX had sent out lots of the explosive powder to a SPX approved safety-related laboratory, NSL Analytical. The inspectors reviewed the SPX purchase orders to, and the chemical analysis test reports from, NSL Analytical, and concluded that appropriate critical characteristics had been identified and tested by an approved testing laboratory. As of the conclusion of the inspection, the test results were awaiting review and final verification by SPX.

No findings of significance were identified.

c. Conclusions

Based on the review of CAR 962, the inspectors determined that SPX had developed and implemented appropriate corrective actions to close the issues identified in NRC Nonconformance 99900080/2013-201-02 associated with the commercial-grade dedication of the explosive powder pyrotechnic mix. No findings of significance were identified.

ITAAC

The NRC inspectors identified the following inspections, tests, analyses, and acceptance criteria (ITAAC) related to components being tested by SPX. At the time of the inspection, SPX was performing testing of the squib valve explosive system, which provides the motive force necessary to operate the valves. The squib valves are used as automatic depressurization valves in the reactor coolant system and as injection and recirculation valves in the passive core cooling system for the AP1000 reactor design. This testing is part of the overall design verification program for the squib valves and will be used to demonstrate that the ITAAC acceptance criteria shown below have been met. The ITAAC's design commitment referenced below are for future use by the NRC staff during the ITAAC closure process; the listing of these

ITAAC design commitments does not constitute that they have been met and/or closed. The NRC inspectors did not identify any findings associated with the ITAAC identified below.

Source Document	ITAAC Index No.	ITAAC	Acceptance Criteria
Appendix C from the Combined License for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3	No. 57	2.1.02.12a.v	A report exists and concludes that the as-built squib valves are bounded by the tests or type tests.
Appendix C from the Combined License for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3	No. 215	2.2.03.12a.ii	A report exists and concludes that the as-built squib valves are bounded by the tests or type tests.

ATTACHMENT

1. PERSONS CONTACTED

Name	Affiliation	Entrance	Exit	Interviewed
Richard Kuntz	SPX	X	X	X
Ty Bussell	United Technologies	X	X	
Gerald Riegel	WEC	X	X	
Nathan Hansen	SPX	X	X	X
Jeffrey Jacobson	NRC	X	X	
Richard McIntyre	NRC	X	X	
Ron Wessel	WEC	X	X	
Randolph Copeland	SCANA		X	
Robert Mohr	Southern Nuclear	X	X	
Michael Valore	WEC	X	X	
Dave Ristau	SPX	X	X	X
Corey Erven	SPX		X	
Bill Doctolero	United Technologies		X	

2. INSPECTION PROCEDURES USED

Inspection Procedure 43002, "Routine Inspections of Nuclear Vendors," dated April 25, 2011.

Inspection Procedure 43004, "Inspection of Commercial-Grade Dedication Programs," dated April 25, 2011.

3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

<u>Item Number</u>	<u>Status</u>	<u>Type</u>	<u>Description</u>
99900080/2013-201-01	Closed	NON	Criterion III
99900080/2013-201-02	Closed	NON	Criterion III

4. DOCUMENTS REVIEWED

SPX Procedure No. 4.1.470, "Test Plan for Margin Testing of Squib Valve Actuators," Revision 4, dated December 14, 2015

Westinghouse Design Specification APP-PV98-Z0-001, "Pyrotechnic Actuator for ASME Boiler and Pressure Vessel Code, Section III Class 1 Squib Valves (PV70)," Revision 2, dated April 1, 2015

Purchase Order from SPX to Universal Propulsion Company INC 4501153929 for 40, 80 percent loaded initiators and 8 each of the three 80 percent loaded cartridges, dated July 17, 2015

UTC Aerospace Systems "Manufacturing Procedure for the Initiator Assembly, PN 17399400-1", Revision D, dated September 10, 2015

SPX Corporation, Copes-Vulcan Operation (SPX), Test Procedure No. 4.1.470, "Test Plan for Margin Testing of Squib Valve Initiators," Revision 4, dated December 14, 2015

SPX Corrective Action Report (CAR) 850, "Cartridge Powder Mixing Issue at UTAS," dated March 7, 2013

CAR 881, "QME 2 Delivery Delay – SCAR 13-158-M007, dated June 5, 2013

CAR 943, "Cartridge Assembly Design Verification," dated September 30, 2013

CAR 944, "Corrective Action Reports 850 and 881 closed before objective evidence received," dated September 27, 2013

CAR 945, "X-Ray inspection of cartridge assembly," dated September 27, 2013

CAR 962, "Critical Characteristic for Pyrotechnic Powder Mix," dated December 5, 2013

UPCO Preventive and Corrective Action request (PCAR) 5480, dated March 7, 2013

NTH-150928, SPX Quality Surveillance Report for UTC Aerospace Systems, Fairfield CA, for the 8" LP, 8" HP, and 14" ADS cartridge assembly, dated December 9, 2015

SPX, "Commercial-Grade Dedication Instruction," (CDI) Number 17399105, Revision 0, dated, December 8, 2014 (part numbers 17399106-1 & 17399107-1)

QC86-416997, Commercial-Grade Safety-Related Check List, "8 Inch Low Pressure Squib Valve Margin Cartridge Assembly," Revision 0, dated November 9, 2015

QC86-416998, Commercial-Grade Safety-Related Check List, "8 Inch High Pressure Squib Valve Margin Cartridge Assembly," Revision 0, dated November 9, 2015

QC86-1739106-1, Commercial-Grade Safety-Related Check List, Revision 0, dated December 8, 2014

QC86-1739107-1, Commercial-Grade Safety-Related Check List, Revision 0, dated December 8, 2014

SPX DWG No. D-416998, "Cartridge Housing Assembly for 8 HP Margin testing (PN 416998)", Revision 2, dated September 4, 2015

SPX DWG No. D-400966, "Cartridge Housing Assembly for 8 "HP Squib Valve (PN 416998)," Revision 14, dated November 11, 2015

SPX DWG No. D-416997, "Cartridge Housing Assembly for 8 "LP Margin testing (PN 416997)," Revision 2, dated September 4, 2015

SPX DWG No. D-399896, "Cartridge Housing Assembly for 8 "LP Squib Valve," Revision 2, dated September 4, 2015

NSL Analytical Test Report No. 289493, "Potassium Nitrate chemical analysis," dated September 25, 2015 for lot KN-12-101-2510271

NSL Analytical Test Report No. 290624, "Carbon Black chemical analysis," dated September 28, 2015, for lot number 0009622705

NSL Analytical Test Report No. 290618, "Carbon Black chemical analysis," dated September 28, 2015, for lot number 0005614996

SPX Purchase Order No. 4501174606, to NSL Analytical Services, Cleveland OH, for chemical analysis of potassium nitrate, dated May 18, 2015

SPX Purchase Order No. 4501174460, to NSL Analytical Services, Cleveland OH, for chemical analysis of carbon black, dated May 22, 2015

SPX Purchase Order no 4501174459, to NSL Analytical Services, Cleveland OH, for chemical analysis of carbon black, dated May 22, 2015