

August 20, 2013

Mr. David Tuttle, Quality Assurance Manager  
Pentair Valves and Controls  
55 Cabot Boulevard  
Mansfield, MA 02048

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION REPORT  
NO. 99901431/2013-201 AND NOTICE OF NONCONFORMANCE

Dear Mr. Tuttle:

From June 24-28, 2013, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Pentair Valves and Controls (Pentair) facility in Mansfield, Massachusetts. The purpose of this limited-scope inspection was to assess Pentair's compliance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21, "Reporting of Defects and Noncompliance," and selected portions of Appendix B, "Quality Assurance Program Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

This inspection evaluated Pentair's quality assurance (QA) activities associated with the design, fabrication, assembly, and testing of the PV-16, PV-18, and PV-62 auxiliary relief valves, vacuum breaker valves, and pressurizer safety valves, respectively, for the Westinghouse Electric Company (WEC) AP1000 reactor design. The inspection also evaluated activities related to Section III, "Rules for Construction of Nuclear Power Plant Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) and ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," qualification testing.

During this inspection, the NRC staff reviewed qualification tests associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from Revision 19 to the certified AP1000 Design Control Document (DCD), Tier 1. Specifically, these activities were associated with ITAAC 2.1.2.02.a, ITAAC 2.1.2.04.a, ITAAC 2.1.2.05.a.ii, ITAAC 2.1.2.08.a.i, ITAAC 2.1.2.08.a.ii, ITAAC 2.2.3.02.a, ITAAC 2.2.3.04.a, and ITAAC 2.2.3.05.a.ii. This report contains one ITAAC finding, Nonconformance 99901431/2013-201-01, associated with ITAAC 2.1.2.02.a, ITAAC 2.1.2.05.a.ii, ITAAC 2.1.2.08.a.ii, ITAAC 2.2.3.02.a, and ITAAC 2.2.3.05.a.ii.

The NRC inspection team issued Nonconformance 99901431/2013-201-01 because Pentair failed to establish adequate design control measures for the implementation of a suitable testing program with respect to the seismic qualification of various AP1000 valves. This finding is material to the ITAAC acceptance criteria specifically pertaining to the design and construction of the AP1000 valves in accordance with the ASME Code, Section III, requirements, as well as the ability of the valves to withstand seismic design basis loads without a loss of safety function and to provide overpressure protection. These issues, if not corrected, may impact the ability of NRC licensees to meet applicable ITAAC from the AP1000 DCD. Currently, the combined licenses of the Vogtle Electric Generating Plant, Units 3 and 4, and the Virgil C. Summer

Nuclear Station, Units 2 and 3, incorporate these ITAAC. The specific issues and applicable ITAAC are contained in Attachment 1 of the report.

The enclosed report presents the results of this inspection. This NRC inspection report does not constitute NRC endorsement of Pentair's overall QA or 10 CFR Part 21 programs.

During this inspection, the NRC inspection team determined that the implementation of your QA program failed to meet certain NRC requirements imposed on you by your customers or by NRC licensees in the areas of design control, test control, commercial grade dedication, control of purchased materials, and control of special processes. The enclosed Notice of Nonconformance (NON) cites these nonconformances, identifies the specific findings and references the pertinent requirements. In addition, the circumstances surrounding the nonconformances are described in detail in the enclosed inspection report.

Please provide a written explanation or statement within 30 days of this letter in accordance with the instructions specified in the enclosed NON. Based on the extent of these findings, please discuss the steps you are taking to provide assurance that the identified weaknesses in your QA program do not have an adverse impact on other customers, including the operating fleet of power reactors. Specifically, Pentair should evaluate its method for QME-1 seismic qualification of valves using static side load testing being performed by Pentair and its contractors against the accepted ASME guidance for seismic side load test qualification. The extent of condition should also include a review of the QME-1 seismic qualification of AP1000 valves that have been completed or are currently in progress, as well as any other types of valves that may have been tested in the same manner. The NRC will consider extending the response time if you show good cause to do so.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), which is accessible from the NRC website 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 (SGI) so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, please provide a bracketed copy of your response that identifies the information that should be protected, as well as a redacted copy of your response that deletes such information.

If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If SGI is necessary to

D. Tuttle

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provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

*/RA/*

Edward H. Roach, Chief  
Mechanical Vendor Branch  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

Docket No.: 99901431

Enclosures:

1. Notice of Nonconformance
2. Inspection Report No. 99901431/2013-201  
and Attachment

D. Tuttle

- 3 -

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NRO-002

<b>OFFICE</b>	DCIP/CMVB	DCIP/CMVB	DE/CIB	RII/DCI/CIB3	DCIP/CMVB
<b>NAME</b>	MVaaler	PCoco	TScarbrough	JBartleman	JOrtega
<b>DATE</b>	08/12/2013	08/12/2013	08/14 /2013	08/14/2013	08/12/2013
<b>OFFICE</b>	DCIP/CAEB:BC	DCIP/CMVB:BC			
<b>NAME</b>	TFrye	ERoach			
<b>DATE</b>	08/1/2013	08/20/2013			

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## NOTICE OF NONCONFORMANCE

Pentair Valves and Controls  
55 Cabot Boulevard  
Mansfield, MA 02048

Docket No. 99901431  
Report No. 2013-201

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the Pentair Valves and Controls (Pentair) facility in Mansfield, Massachusetts from June 24-28, 2013, certain activities were not conducted in accordance with NRC requirements that were contractually imposed on Pentair by its customers or NRC licensees.

- A. Criterion III, "Design Control," of Appendix B, "Quality Assurance Program Criteria for Nuclear Power Plants and Fuel Processing 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 "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. The verifying or checking process shall be performed by individuals or groups other than those who performed the original design, but who may be from the same organization. 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. Design control measures shall be applied to items such as the following: reactor physics, stress, thermal, hydraulic, and accident analyses; compatibility of materials; accessibility for inservice inspection, maintenance, and repair; and delineation of acceptance criteria for inspections and tests."

Section III, "Design Control," of the Pentair Quality Assurance Manual (QC-110), Revision 42, dated June 13, 2013, establishes procedures to assure that the requirements for valve design specifications are correctly translated into Pentair specifications, drawings, procedures, and instructions. Pentair Valve Qualification Test (VQT) Procedures 38188, "[American Society of Mechanical Engineers (ASME)] QME-1 Functional Qualification Test Program for Active Valve Assemblies – APP-PV16-Z0-001," Revision 3, dated January 25, 2011, and VQT-38173, "ASME QME-1 Functional Qualification Test Program for Active Valve Assemblies – APP-RCS-PL-V005A/B," Revision 5, dated October 15, 2009, specify the qualification testing requirements for the AP1000 PV-16 auxiliary relief valves and PV-62 pressurizer safety valves, including seismic qualification using static side load testing, necessary to demonstrate their capability to perform their intended safety functions.

Westinghouse (WEC) Design Specification APP-GW-VP-010, "AP1000 Plant Equipment Qualification Methodology and Documentation Requirements for AP1000 Safety-Related Valves and Valve Appurtenance," Revision 2, dated April 2010, specifies that the AP1000 valves be seismically qualified in accordance with ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants." The WEC design specification allows for the use of static side load testing to accomplish the QME-1 seismic qualification of AP1000 valves.

WEC Design Specification APP-PV62-Z0-001, "Pressurizer Safety Valve, ASME [Boiler and Pressure Vessel] (B&PV) Code, Section III, Class 1," Revision 7, dated September 2012, specifies that for seismic qualification of the pressurizer safety valves,

the extended structure deflections which affect valve function shall be evaluated, and determination of the deflections and their effect shall be as per the WEC design specification. This WEC design specification also states that the valve inlet shall be pressurized at design pressure, the faulted condition seismic loads shall be applied in the direction of the weakest axis of the extended structure, and the valve set pressure and reseating pressure shall be verified using steam.

Contrary to the above, as of June 28, 2013, Pentair failed to ensure that its test program used to verify the ability of the AP1000 PV-16 auxiliary relief valves and PV-62 pressurizer safety valves to perform their intended safety functions included suitable qualification testing of a prototype unit under the most adverse design conditions.

Specifically, Pentair failed to provide assurance of the adequacy of its performance of static side load testing to demonstrate the seismic qualification of the AP1000 PV-16 auxiliary relief valves and PV-62 pressurizer safety valves as indicated by the following examples:

- Pentair Valve Qualification Test Procedures VQT-38188 and VQT-38173 for the AP1000 PV-16 auxiliary relief valves and PV-62 pressurizer safety valves specify static side load testing requirements for QME-1 seismic qualification with the load “applied to the least rigid axis.” Pentair failed to adequately evaluate the results of the natural frequency testing reports prepared by National Technical Systems and Wyle laboratories (Pentair’s contractors) to determine the proper setup of the QME-1 seismic qualification tests for the PV-16 auxiliary relief valves and PV-62 pressurizer safety valves, respectively. Specifically, the QME-1 qualification testing for a PV-16 valve observed by the NRC inspection team, as well as for a PV-62 valve based on review of the test results and photographs, did not apply the static load to the least rigid axis as required by the test procedures.
- Pentair Valve Qualification Test Procedure VQT-38173 does not specify that a static side load be applied during the QME-1 seismic qualification testing of the AP1000 PV-62 pressurizer safety valves at the design pressure set point of 2485 psig. Specifically, the Pentair QME-1 seismic qualification test of the PV-62 pressurizer safety valve failed to verify the proper lift of the safety valve at the design pressure set point under seismic conditions as required by the WEC design specification associated with this valve.

This issue has been identified as Nonconformance 99901431/2013-201-01.

- B. Criterion XI, “Test Control,” of Appendix B to 10 CFR Part 50, states, in part, that “a test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents.”

Anderson Greenwood Crosby Engineering Procedure T-161093, “Production Test Procedure,” Revision 6, dated August 2011, specifies that the PV-62 pressurizer safety valves be tested to ensure proper service performance. In addition, this procedure specifies that testing shall be performed at an ambient temperature between the range of 50 - 120°F.

Pentair Valve Qualification Test Procedures VQT-38188 requires that the test setup for the PV-16 auxiliary relief valves include a measuring device located at the outlet of the valve to collect any leakage in order to verify that the maximum valve leakage criterion of 10 cubic centimeters per hour is not exceeded.

Contrary to the above, as of June 28, 2013, Pentair failed to establish a test program that ensures the testing required to demonstrate that structures, systems, and components will perform satisfactorily in service was performed in accordance with written test procedures.

Specifically:

- During testing of the PV-62 pressurizer safety valves, Pentair failed to evaluate the validity of the test, which was performed at a temperature 25°F higher than the allowable ambient test temperatures, to ensure compliance with the Pentair T-161093 procedural requirements.
- During testing of the PV-16 auxiliary relief valve, Pentair failed to install a device to ensure that the tested valve satisfies the leakage acceptance criteria in Pentair procedure VQT-38188.

This issue has been identified as Nonconformance 99901431/2013-201-02.

- C. Criterion III of Appendix B to 10 CFR Part 50, states, in part, that, “measures shall...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.”

Supplement 6, “Dedication of Commercial Grade Parts to Comply with 10 CFR Part 50, Appendix B and 10 CFR Part 21 for Use in Safety Related Nuclear Plant Applications,” Revision 5, dated June 26, 2013, of QC-110, states, in part, that “a technical evaluation shall be performed to identify the necessary technical and quality requirements that ensure the part will meet the intended design conditions,” and that the associated Dedication Procedures shall address the technical evaluation, as well as the basis for selection of the critical characteristics and the acceptance methods.

Contrary to the above, as of June 28, 2013, Pentair failed to establish adequate measures for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety functions of certain structures, systems, and components.

Specifically:

- For the 18 Dedication Procedures reviewed, Pentair did not provide objective evidence that technical evaluations had been performed to justify that the critical characteristics and associated acceptance methods selected for various valve parts and components would provide reasonable assurance that the valves would perform their intended safety functions.

- For the measuring and test equipment (M&TE) calibration services procured from Essco Calibration Laboratories under the International Laboratory Accreditation Cooperation (ILAC) process, Pentair did not conduct a technical evaluation to identify additional technical requirements to be included in the purchase order for the specific M&TE being calibrated.

This issue has been identified as Nonconformance 99901431/2013-201-03.

- D. Criterion IV, "Procurement Document Control," of Appendix B to 10 CFR Part 50, states, in part, that "design bases and other requirements which are necessary to assure adequate quality are suitably included or referenced in the documents for procurement of material, equipment, and services, whether purchased by the applicant or by its contractors or subcontractors."

Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50, states, in part, that "measures shall be established to assure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents."

Contrary to the above, as of June 28, 2013, Pentair failed to establish proper measures to identify requirements necessary to assure the selection, purchase, use, and review for suitability of application of the lubrication material Neolube.

Specifically, Pentair failed to have adequate controls or documentation in place to select and verify that the appropriate type of Neolube was purchased and used to lubricate various valve types during and after testing activities in accordance with the application and design specifications for the valves. Exceeding a temperature of 400°F while using Neolube 1 causes a chemical breakdown of the product, which could lead to binding of lubricated areas, such as the valve stem. This binding would prevent the valves from accomplishing their intended safety functions.

This issue has been identified as Nonconformance 99901431/2013-201-04.

- E. Criterion VII of Appendix B to 10 CFR Part 50 states, in part, that "measures shall be established to assure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These measures shall include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery."

Supplement 6 of QC-110 states, in part, that the system for identification and control of all dedicated commercial grade parts shall include "measures that prevent the use of incorrect or defective parts and/or parts which have not received the required examinations, tests, or inspections. The system shall include measures for supplier qualification for establishment of material traceability for lot formation and material control."

Contrary to the above, as of June 28, 2013, Pentair failed to establish appropriate measures to assure that material, equipment, and services purchased through a



subcontractor were adequately evaluated via a source evaluation to allow for objective evidence of quality to be furnished by the subcontractor.

Specifically, Pentair failed to adequately verify that commercial items received from its suppliers conformed to the applicable specification requirements and failed to validate required critical characteristics during commercial grade dedication receipt inspection and testing for three U-cup O-rings that were being commercially dedicated using a sampling process. Instead, Pentair relied on a commercial supplier-issued certified material test report (CMTR) as the sole method to verify critical characteristics for the entire batch of U-cup O-rings without conducting a commercial-grade survey, source verification, or other surveillance of the supplier to verify that the supplier's quality program was capable of appropriate control of the required critical characteristics, including material traceability and adequacy of any certificates of conformance or CMTRs. This issue is common for procurement and dedication of all elastomeric parts.

This issue has been identified as Nonconformance 99901431/2013-201-05.

- F. Criterion IX, "Control of Special Processes," of Appendix B to 10 CFR Part 50 states, in part, that "measures shall be established to assure that special processes, including welding, heat treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements."

ASME B&PV Code, Section III, "Rules for Construction of Nuclear Facility Components," NB 2440, "Storage and Handling of Welding Material," states, in part, that "suitable storage and handling of electrodes, flux, and other welding material shall be maintained. Precautions shall be taken to minimize absorption of moisture by fluxes and cored, fabricated, and coated electrodes."

Contrary to the above, as of June 28, 2013, Pentair failed to establish measures to assure that special processes are controlled and accomplished in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

Specifically, Pentair's weld rod ovens failed to have controls in place for the temperature read out display and humidity indication to provide assurance that the weld rods were adequately maintained in accordance with the applicable sections of the ASME Code.

This issue has been identified as Nonconformance 99901431/2013-201-06.

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, Mechanical Vendor Branch, 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 further noncompliance; and (4) the date when the 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 Agencywide Documents Access and Management System (ADAMS), which is 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 (SGI) 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 be withheld, 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 SGI is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Requirements for the Protection of Safeguards Information."

Dated this 20th day of August 2013.

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

Docket No.: 99901431

Report No.: 99901431/2013-201

Vendor: Pentair Valves and Controls  
55 Cabot Boulevard  
Mansfield, Massachusetts 02048

Vendor Contact: Mr. David Tuttle  
Quality Assurance Manager  
Telephone: (508) 594-4430  
E-mail: [dave.tuttle@pentair.com](mailto:dave.tuttle@pentair.com)

Nuclear Industry Activity: Pentair Valves and Controls is an American Society of Mechanical Engineers (ASME) certificate holder with a scope of supply that includes ensuring design as procured; control and testing of safety-related ASME Boiler & Pressure Vessel (B&PV) Code valves; QME-1, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," testing; safety-related instrumentation, diagnostic and test equipment, service and repair; and engineering services to the nuclear power industry. Pentair has been contracted by the Westinghouse Electric Company (WEC) to provide pressurizer safety valves, auxiliary relief valves, and vacuum breaker valves for the AP1000 reactor design and to complete QME-1 testing for those valves.

Inspection Dates: June 24 – 28, 2013

NRC Inspection Team: Jonathan Ortega NRO/DCIP/CMVB, Team Leader  
Paul Coco NRO/DCIP/CMVB, Inspector  
Marlayna Vaaler NRO/DCIP/CMVB, Inspector  
Thomas Scarbrough NRO/DE/CIB, Technical Specialist  
John Bartleman RGN II/DCI/CIB3, Inspector

Approved by: Edward H. Roach, Chief  
Mechanical Vendor Branch  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

## **EXECUTIVE SUMMARY**

Pentair Valves and Controls  
99901431/2013-201

The U.S. Nuclear Regulatory Commission (NRC) conducted this inspection to verify that Pentair Valves and Controls (Pentair) 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." In addition, the NRC inspection also verified that Pentair implemented a program under 10 CFR Part 21, "Reporting of Defects and Noncompliance," that met the NRC's regulatory requirements. The NRC inspection team conducted the inspection at the Pentair facility in Mansfield, Massachusetts from June 24 - 28, 2013.

This inspection evaluated Pentair's QA activities associated with the design, fabrication, assembly, and testing of the PV-16, PV-18 and PV-62 auxiliary relief valves, vacuum breaker valves, and pressurizer safety valves, respectively, for the Westinghouse Electric Company (WEC) AP1000 reactor design. Some activities observed by the NRC inspection team are associated with or directly affect closure of inspections, tests, analyses, and acceptance criteria (ITAAC) from Revision 19 of the certified AP1000 design. These ITAAC are included in the combined licenses of Vogtle Units 3 and 4, and V. C. Summer Units 2 and 3.

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

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

The NRC inspection team implemented Inspection Procedure (IP) 43002, "Routine Inspections of Nuclear Vendors," dated April 25, 2011, IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated April 25, 2011, and IP 36100, "Inspection of 10 CFR Parts 21 and 50.55(e) Programs for Reporting Defects and Noncompliance," dated February 13, 2012, as supplemented by IP 65001 E, "Inspection of the ITAAC Related Qualification Program," dated August 19, 2008, and IP 35034, "Design Certification Testing Inspection," dated January 27, 2010, during the conduct of this inspection.

The NRC inspection team observed various activities associated with the implementation of Pentair's QA policies and procedures for the procurement, design, fabrication, assembly, testing, and commercial-grade dedication (CGD) of valves and associated parts for the AP1000 reactor design. In addition, the NRC inspection team verified that these activities were being implemented in accordance with the applicable requirements of 10 CFR Part 21 and Appendix B to 10 CFR Part 50.

Specific activities observed by the NRC inspection team included:

- implementation of the Pentair policies and procedures for design control and design changes associated with the AP1000 PV-16 auxiliary relief valves, PV-18 vacuum breaker valves, and PV-62 pressurizer safety valves
- seismic qualification testing activities for an AP1000 PV-16 auxiliary relief valve
- dimensional inspection and CGD activities for two valve disc insert orifices

- receipt inspection of three safety-related set screw rod pins and six U-cup O-rings to be used as valve components
- nondestructive examination of a valve disc (liquid penetrant testing) and a valve body (magnetic particle testing)
- welding activities for a valve bonnet assembly
- daily engineering and QA meetings for the disposition of nonconforming items

In addition to observing these activities, the NRC inspection team walked down Pentair's assembly floor and verified that nonconforming components were properly identified, marked, and segregated when practical, to ensure that they were not reintroduced into the manufacturing processes. The NRC inspection team also verified that Pentair personnel properly identified, marked, calibrated, and used within the calibrated range the measuring and test equipment (M&TE) used throughout the Mansfield, Massachusetts facility.

The NRC conducted its last inspection at Pentair's facility in Wrentham, Massachusetts in July 2009, while under the ownership of Anderson Greenwood Crosby, and documented the results of the inspection in Inspection Report 99900293/2009-201, dated September 16, 2009. The report documented one violation of NRC requirements and three nonconformances to NRC requirements that were contractually imposed upon Pentair by its customers or NRC licensees. This inspection report documents the NRC's verification of Pentair's implementation of corrective actions for these issues.

With the exception of the nonconformances described below, the NRC inspection team concluded that Pentair's QA policies and procedures comply with the applicable requirements of 10 CFR Part 21 and Appendix B to 10 CFR Part 50, and that Pentair personnel are implementing these policies and procedures effectively. The results of this inspection are summarized below.

#### Design Control

The NRC inspection team reviewed Pentair's implementing procedures governing the design control program to verify compliance with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. Based on this review, the NRC inspection team issued Nonconformance 99901431/2013-201-01 because Pentair did not establish adequate design control measures for the implementation of a suitable testing program with respect to the seismic qualification of various AP1000 valves. Specifically, Pentair's qualification testing for the PV-16 auxiliary relief valves and the PV-62 pressurizer safety valves failed to conform to the seismic qualification provisions specified in the Pentair Valve Qualification Test (VQT) Procedures and the WEC design specifications.

#### Commercial-Grade Dedication

The NRC inspection team reviewed Pentair's implementing procedures governing the CGD program to verify compliance with the requirements of Criterion III, "Design Control," and Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. Based on this review, the NRC inspection team issued Nonconformance 99901431/2013-201-03 because Pentair did not provide objective evidence that technical evaluations had been performed to justify that the critical characteristics and associated acceptance methods selected for various valve parts and components would provide reasonable assurance that the valves would perform their intended safety functions. In addition, for the procurement of commercial calibration services from Essco Calibration Laboratories for

the for the calibration of M&TE to be used in safety-related applications, Pentair did not conduct a technical evaluation to identify additional technical requirements that may need to be included in the purchase order for the specific M&TE being calibrated.

The NRC inspection team also issued Nonconformance 99901431/2013-201-05 because Pentair failed to adequately verify that commercial items received from its suppliers conformed to the applicable specification requirements and failed to verify critical characteristics during CGD special tests and inspections for three U-cup O-rings that were commercially dedicated using a sampling process. The NRC inspection team identified that, Pentair failed to conduct a commercial-grade survey, source verification, or other surveillance of the supplier to verify that the supplier's quality program was capable of appropriate control of the required critical characteristics, including material traceability and adequacy of any certificates of conformance or certified material test reports. This issue is common for Pentair's procurement and dedication of all elastomeric parts.

#### Control of Special Processes

The NRC inspection team reviewed Pentair's implementing procedures governing the control of special processes to verify compliance with the requirements of Criterion IX, "Control of Special Processes," of Appendix B to 10 CFR Part 50. Based on this review, the NRC inspection team issued Nonconformance 99901431/2013-201-06 because Pentair's weld rod ovens did not have controls in place for the temperature read out display and humidity indication to provide assurance that the environmental controls for the welding rods were adequately maintained in accordance with the applicable sections of the ASME B&PV Code.

#### Test Control

The NRC inspection team reviewed Pentair's implementing procedures governing the test control program to verify compliance with the requirements of Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. Based on this review, the NRC inspection team issued Nonconformance 99901431/2013-201-02 because Pentair failed to evaluate the results of performing testing when the recorded ambient temperature exceeded the temperatures specified in Pentair Procedures T-161093 and VQT-38173. In addition, Pentair failed to install a device to collect any leakage to ensure that the tested valve satisfies the leakage acceptance criteria of Pentair Procedure VQT-38188.

The NRC inspection team also issued Nonconformance 99901431/2013-201-04 because Pentair did not have adequate controls or documentation in place to purchase, select, and verify that the appropriate type of Neolube was used to lubricate various valve types during and after testing activities in accordance with the application and design specifications for the valves.

#### Other Inspection Areas

The NRC inspection team determined that Pentair's 10 CFR Part 21 program conforms to the regulatory requirements of 10 CFR Part 21. The NRC inspection team also determined that Pentair is implementing its programs for the oversight of contracted activities, control of measuring and test equipment, nonconforming materials parts and components, and corrective actions in accordance with the applicable regulatory requirements of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed and activities observed, the NRC inspection team also determined that Pentair is implementing its policies and procedures associated with these programs. No findings of significance were identified.

## REPORT DETAILS

### 1. 10 CFR Part 21 Program

#### a. Inspection Scope

The NRC inspection team reviewed the Pentair policies and implementing procedures that govern the programs and activities used to establish and verify compliance with the regulatory requirements of 10 CFR Part 21. In addition, the NRC inspection team evaluated the 10 CFR Part 21 postings as well as a sample of Pentair purchase orders (POs), internal audit results, and training documents in order to evaluate Pentair's compliance with the requirements of 10 CFR 21.6, "Posting Requirements," 10 CFR 21.21, "Notification of Failure to Comply or Existence of a Defect and its Evaluation," and 10 CFR 21.31, "Procurement Documents." Furthermore, the NRC inspection team discussed the 10 CFR Part 21 program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

#### b. Observations and Findings

##### b.1 10 CFR Part 21 Policies and Procedures

The NRC inspection verified that (1) Pentair had effectively implemented the requirements in 10 CFR 21.21(a)(1) for evaluating deviations and failures to comply associated with substantial safety hazards and that Pentair's procedures incorporated the appropriate timelines for evaluation and reporting identified in 10 CFR Part 21; (2) Pentair's nonconformance and corrective action procedures provided a link to the 10 CFR Part 21 program; and (3) Pentair's 10 CFR Part 21 procedures implemented the requirements in 10 CFR 21.21(d) in regard to directors or responsible officers notifying the NRC of identified defects or failures to comply associated with substantial safety hazards. In addition, the NRC inspection team verified that the information contained in Pentair's 10 CFR Part 21 postings met the requirements of 10 CFR 21.6. Lastly, for a sample of POs reviewed, the NRC inspection team verified that each procurement document specified, when applicable, that the provisions for reporting of defects and noncompliances were required in accordance with 10 CFR 21.31.

#### c. Conclusion

The NRC inspection team concluded that Pentair is implementing its 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 Pentair is appropriately implementing its policies and procedures associated with the 10 CFR Part 21 program. No findings of significance were identified.

### 2. Design Control

#### a. Inspection Scope

The NRC inspection team reviewed Pentair's policies and implementing procedures to verify that design control activities were being implemented in accordance with the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR

Part 50, as well the requirements of Section III, "Rules for Construction of Nuclear Facility Components," of the ASME B&PV Code, and ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment used in Nuclear Power Plants." Specifically, the NRC inspection team evaluated the implementation of the Pentair design control process associated with the AP1000 PV-16 auxiliary relief valves, PV-18 vacuum breaker valves, and PV-62 pressurizer safety valves, and observed the associated testing activities related to a PV-16 valve. In addition, the NRC inspection team reviewed documentation and observed activities associated with ITAAC 2.1.2.02.a, ITAAC 2.1.2.04.a, ITAAC 2.1.2.05.a.ii, ITAAC 2.1.2.08.a.i, ITAAC 2.1.2.08.a.ii, ITAAC 2.2.3.02.a, and ITAAC 2.2.3.05.a.ii from the AP1000 Design Control Document (DCD), Tier 1, Revision 19.

The NRC inspection team also reviewed (1) Pentair's procedures for its process to control design changes and examples of their implementation, as well as a sample of engineering drawings, design reports, contract changes, and the associated WEC POs; (2) the Center of Gravity (COG) determinations and associated inspection reports for PV-16 valves; (3) Engineering Change Request (ECR) 11-339 and its incorporation into the Pentair computer database; and (4) Pentair Test Report TR-5547 for PV-16 valves, which demonstrated verification of the valve capacities by the National Board of Boiler and Pressure Relief Vessel Inspectors.

In addition, the NRC inspection team reviewed completed test reports TR-5509 and TR-5556, which present the methods used for the qualification, program requirements, inputs and results of the qualification of the AP1000 PV-62 pressurizer safety valves; and Test Report TR-5557, which described the qualification testing performed by TopWorx for the Model C7 position indication switch used on the AP1000 PV-62 pressurizer safety valves. The NRC inspection team also reviewed the ASME Form NV-1 Reports prepared by Pentair, including the WEC Certificates of Conformance (CoCs) that accept the ASME Design Reports. Furthermore, the NRC inspection team discussed the design control program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

b.1 Design Control Process

The NRC inspection team sampled Pentair's design activities associated with the PV-16, PV-18, and PV-62 valves to verify implementation of the design control process. The NRC inspection team verified that Pentair prepared an Engineering Work Request, Quality Assurance Instruction (QAI-32829), Engineering Order Data Release, and applicable valve drawings, as required by the Pentair procedures for the PV-16 valves. The NRC inspection team also sampled similar documents prepared by Pentair for the PV-62 pressurizer safety valves and PV-18 vacuum breaker valves.

The design requirements for the AP1000 design are specified in WEC Design Specification APP-PV16-ZO-001, "Auxiliary Relief Valves, ASME III, Class 2 and 3." APP-PV16-ZO-001 establishes the requirements for safety related, ASME B&PV Code, Section III, Subsection NB, NC, and ND, Class 1, 2, and 3, auxiliary relief valves. WEC POs 4500340931 and 4500340946 describe the procurement of 30 safety-related, ASME B&PV Code, Section III, Class 2 (NC) and Class 3 (ND) auxiliary relief valves,



and their related materials and services, to be used in the AP1000 nuclear power plants V.C. Summer Units 2 and 3, and Vogtle Units 3 and 4.

Pentair used APP-PV16-Z0-001 to develop the QME-1 valve qualification procedure for the PV-16 auxiliary relief valves. The NRC inspection team reviewed Pentair's Valve Qualification Test (VQT) Procedure 38188, "ASME QME-1 Functional Qualification Test Program for Active Valve Assemblies – APP-PV16-Z0-001," and Test Procedure T-161162 for the QME qualification testing activities for PV-16 valves, and VQT-38173, "ASME QME-1 Functional Qualification Test Program for Active Valve Assemblies – APP-RCS-PL-V005A/B," and Test Procedure T-161093 for the PV-62 valves. At the time of the inspection, Pentair had not initiated qualification testing for the PV-18 valves.

The valve qualification test procedures specify pre-test inspections, operability tests, seat leak tests, natural frequency determination, seismic testing, environmental and aging requirements, post-test inspections, and applicable acceptance criteria. The NRC inspection team verified that the Pentair test procedures, which specify the performance of qualification testing, were in conformance with the applicable WEC design specifications and ASME B&BV Code requirements, with the exception of seismic qualification testing as discussed below.

The WEC design specifications require that the AP1000 valve qualifications meet ASME Standard QME-1-2007. The WEC design specifications also indicate that the preferred method of seismic qualification is static deflection testing. The Pentair valve qualification test procedures specify that the natural frequency of the tested AP1000 valves be determined as part of the seismic qualification process. The Pentair test procedures describe the performance of seismic qualification testing with the determination of an appropriate static load to be applied to the least rigid axis during the valve tests to demonstrate the seismic qualification of the tested valve.

With respect to the AP1000 PV-16 auxiliary relief valves, Pentair contracted National Technical Systems, Inc. (NTS) to determine the natural frequency of the PV-16 valves using a hammer test. The NTS report for PV-16 Valve DS-B900134 indicates that the resonance frequency for the side-to-side orientation is lower than the front-to-back orientation, demonstrating that the side-to-side orientation is the least rigid axis. However, during the observed test of the PV-16 valve, the NRC inspection team found that the test had been set up to apply the static load in the front-to-back orientation. During a teleconference phone call, the NRC inspection team confirmed with WEC that the intent of the AP1000 valve design specification is that the static load be applied to the least rigid axis during the QME-1 seismic qualification test. The NRC inspection team found this to be an example of inadequate design control to evaluate the natural frequency prior to setup of the QME-1 seismic qualification test for the PV-16 valve. Pentair's failure to perform the PV-16 seismic qualification test by applying the static load to the least rigid axis is an example of Nonconformance 99901431/2013-201-01. This issue, if not corrected, impacts the ability of NRC licensees to meet the design commitments of ITAAC 2.2.3.02.a in regard to the PV-16 valves being designed and constructed in accordance with the ASME B&PV Code, Section III, requirements, and ITAAC 2.2.3.05.a.ii in regard to the PV-16 valves being able to withstand seismic design basis loads without a loss of safety function.

With respect to the AP1000 PV-62 pressurizer safety valves, Pentair contracted Wyle Laboratories (Wyle) to determine the natural frequency of the tested valve. The NRC

inspection team reviewed Pentair Test Report TR-5509 that documented the ASME QME-1 functional qualification for active valve assemblies of the PV-62 pressurizer safety valves. The NRC inspection team also reviewed the valve capacities established by the National Board of Boiler and Pressure Relief Vessel Inspectors, including the applicable National Board Certification Number 15028 for the Pentair (Anderson Greenwood Crosby) HB series (Class 1) safety valve. Pentair Test Report TR-5509, Attachment VII, contained the Wyle report that indicated the resonance frequency of the valve in the side-to-side orientation (referred to as horizontal in the Wyle report) was lower than the front-to-back orientation (referred to as axial in the Wyle report). Based on the review of the test reports and photographs of the test setups, the NRC inspection team determined that the Pentair QME-1 seismic qualification tests for the PV-62 valve applied the static load in the front-to-back (i.e., more rigid) orientation. The NRC inspection team found this to be another example of inadequate design control to evaluate the natural frequency prior to setup of the QME-1 seismic qualification test for the PV-62 valve. Pentair's failure to perform the PV-62 seismic qualification test by applying the static load to the least rigid axis is another example of Nonconformance 99901431/2013-201-01. This issue, if not corrected, impacts the ability of NRC licensees to meet the design commitments of ITAAC 2.1.2.02.a in regard to the PV-62 valves being designed and constructed in accordance with the ASME B&PV Code, Section III, requirements, and ITAAC 2.1.2.05.a.ii in regard to the PV-62 valves being able to withstand seismic design basis loads without a loss of safety function.

The Pentair QME-1 seismic qualification test for the AP1000 PV-62 valve included a flow test with the static load applied at a prorated pressure that allowed full flow through the valve at the Pentair test facility. However, the Pentair QME-1 qualification test procedure (VQT-38173) did not include a lift test at the design set pressure with an applied seismic static load. The NRC inspection team considered the absence of a seismic qualification test of the AP1000 PV-62 valve at the design set pressure to be an example of inadequate design control. Failure to perform this type of test does not ensure adequate QME-1 seismic qualification testing to demonstrate that the valve could perform its safety function to lift at the design set pressure under seismic conditions. Pentair's failure to design the PV-62 seismic qualification test to demonstrate that the valve could perform its safety function to lift at the design set pressure under seismic conditions is another example of Nonconformance 99901431/2013-201-01. This issue, if not corrected, impacts the ability of NRC licensees to meet the design commitment of ITAAC 2.1.2.08.a.ii in regard to the PV-62 valves being able to provide overpressure protection in accordance with the ASME B&PV Code, Section III, requirements.

## b.2 Inspections, Testing, Analyses, and Acceptance Criteria

The NRC inspection team evaluated the Pentair processes, procedures, design control, and testing activities associated with AP1000 ITAAC for the PV-16 auxiliary relief valves, PV-18 vacuum breaker valves, and PV-62 pressurizer safety valves. Although Nonconformance 99901431/2013-201-01 is associated with ITAAC 2.1.2.02.a, ITAAC 2.1.2.05.a.ii, ITAAC 2.1.2.08.a.ii, ITAAC 2.2.3.02.a, and ITAAC 2.2.3.05.a.ii, the NRC inspection team determined that adequate documentation was available to satisfy portions ITAAC 2.1.2.04.a and ITAAC 2.1.2.08.a.i as they relate to specific components manufactured by Pentair that are identified in the AP1000 DCD, Tier 1, Revision 19, as well as the combined licenses of Vogtle Units 3 and 4, and V.C. Summer Units 2 and 3.

#### ITAAC 2.1.2.04.a

The pressure boundary integrity of the PV-62 valves is associated with ITAAC 2.1.2.04.a, which states that the components associated with this ITAAC must retain their pressure boundary integrity at their design pressure. The NRC inspection team reviewed Pentair valve test reports for four AP1000 PV-62 pressurizer safety valves and observed that the valves were hydrostatically tested in accordance with the ASME B&PV Code, Section III, requirements. Pentair tested and recorded the test results for these four PV-62 pressurizer safety valves in the associated valve test reports where Pentair documented a hydrostatic test pressure of 3750 psig and a hold time of 15 minutes. The serial numbers of the four PV-62 pressurizer safety valves tested were: N900028-00-0013, N900028-00-0014, N900028-00-0015, and N900028-00-0016. Based on the review of the PV-62 valve test reports, the NRC inspection team verified that four PV-62 valves met the associated acceptance criteria of ITAAC 2.1.2.04.a.

#### ITAAC 2.1.2.08.a.i

The flowrate provided by the PV-62 valves is associated with ITAAC 2.1.2.08.a.i, which states that the pressurizer safety valves must provide overpressure protection in accordance with the ASME B&PV Code, Section III, requirements. The NRC inspection team reviewed documentation from the National Board of Boiler and Pressure Relief Vessel Inspectors, including the applicable National Board Certification Number 15028, associated with the certification of the Pentair (Anderson Greenwood Crosby) HB Series (Class 1) steam safety valve, which is utilized for the AP1000 PV-62 pressurizer safety valves. The National Board testing certified that the flow rate for the PV-62 valves is 794,555 pounds per hour, as stamped on the valve nameplates for pressurizer safety valve serial nos. N900028-00-0013, N900028-00-0014, N900028-00-0015, and N900028-00-0016. Based on the review of National Board Certification No. 15028, the valve nameplate data, and since there are two pressurizer safety valves per AP1000 unit, the NRC inspection team verified that four PV-62 valves met the associated acceptance criteria of ITAAC 2.1.2.08.a.i.

#### c. Conclusion

The NRC inspection team issued Nonconformance 99901431/2013-201-01 in association with Pentair's failure to implement the regulatory requirements of Criterion III of Appendix B to 10 CFR Part 50. Nonconformance 99901431/2013-201-01 cites Pentair for failing to establish adequate design control measures for the implementation of a suitable testing program with respect to the seismic qualification of various AP1000 valves. Specifically, Pentair's ASME Standard QME-1 qualification testing for the PV-16 auxiliary relief valves and the PV-62 pressurizer safety valves did not conform to the seismic qualification provisions specified in the Pentair Valve Qualification Test Procedures and the WEC design specifications. These requirements are specified to verify that the AP1000 valves will perform their intended safety functions associated with flow performance and set lift pressure under seismic conditions.

### 3. Oversight of Contracted Activities

#### a. Inspection Scope

The NRC inspection team reviewed the Pentair policies and implementing procedures that govern the oversight of contracted activities to verify compliance with the regulatory requirements of Criterion IV, "Procurement Document Control," Criterion VII, "Control of Purchased Material, Equipment, and Services," and Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed a sample of POs, receipt inspection records, and external audit reports (including those conducted by third parties) to evaluate compliance with the Pentair technical and oversight program requirements and adequate implementation of those requirements. The NRC inspection team also reviewed a sample of the training and qualification records for Pentair's lead auditors, auditors, and inspection personnel. In addition, the NRC inspection team reviewed the disposition of corrective actions to resolve deficiencies identified by audit findings for adequacy and timeliness. Furthermore, the NRC inspection team discussed oversight of contracted activities with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

#### b. Observations and Findings

##### b.1 Procurement Document Control

The NRC inspection team reviewed a sample of POs issued by Pentair in support of several safety-related activities to verify that the requirements identified in the procedures were imposed in the applicable purchasing documents. The NRC inspection team verified that the Pentair POs adequately defined contract deliverables, instructions for the disposition of nonconformances, access rights, and provisions for the extension of contractual requirements to subcontractors. In addition, the NRC inspection team verified that all of the safety-related POs reviewed included clauses invoking the provisions of 10 CFR Part 21 and requiring the vendor or supplier to conduct safety-related work under its approved QA program.

##### b.2 Maintenance of the Approved Suppliers List

The NRC inspection team reviewed Pentair's approved suppliers list (ASL) to ensure that qualified and approved suppliers were listed, that authorized personnel maintained, distributed, and periodically updated the list, and that any revisions to the list were implemented following the applicable procedures. The NRC inspection team verified that the ASL documented (1) the vendor name, (2) the scope of qualification, (3) limitations and restrictions, if necessary, (4) the date that re-approval is due, and (5) the vendor's quality program. The NRC inspection team also confirmed that the suppliers performing work for Pentair were appropriately listed on the ASL and that the scope of supply was documented and consistent for the activities contracted. The NRC inspection team verified that, for the sample of vendors selected, Pentair performed supplier audits as required and that the corrective actions related to these audits were implemented in a timely manner.

### b.3 Receiving Inspections

The NRC inspection team reviewed the receiving inspection guidance provided in the Pentair Quality Assurance Manual (QAM) and associated procedures, which provide a system for the inspection and control of incoming traceable materials received at the Pentair facility. The NRC inspection team verified that Pentair is using appropriate methods to accept a basic component from a supplier, such as the review of CoCs and certified material test reports (CMTRs), and receipt inspections. The NRC inspection team also observed the receipt inspection of three safety-related set screw rod pins and six U-cup O-rings to be used as valve components to verify compliance with Pentair's receipt inspection program.

### b.4 Audits

The NRC inspection team reviewed a sample of external audits to verify implementation of the Pentair audit program. The NRC inspection team verified that Pentair prepared and approved plans that identify the audit scope, focus, and applicable checklist criteria before the initiation of the audit activity. The NRC inspection team confirmed that the audit reports contained a review of the relevant QA criteria in Appendix B to 10 CFR Part 50 for the activities that individual suppliers performed, as well as documentation of pertinent supplier guidance associated with each criterion. For audits that resulted in findings, the NRC inspection team verified that the supplier had established a plan for corrective action and that Pentair had reviewed and approved the corrective action and verified its satisfactory completion and proper documentation in a timely manner.

The NRC inspection team also confirmed that Pentair performed external audits commensurate with the required frequencies specified in the Pentair QAM, associated procedures, and the applicable section(s) of the ASME B&PV Code, and that audit results were adequately reviewed by responsible management. In the case of third-party audits, the NRC inspection team verified that Pentair reviewed and accepted the supplied third-party audit documentation before taking credit for the audit results.

### c. Conclusion

The NRC inspection team concluded that Pentair is implementing its oversight of contracted activities in accordance with the regulatory requirements of Criterion IV, Criterion VII, and Criterion XVIII of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Pentair is implementing its policies and procedures associated with the oversight of contracted activities. No findings of significance were identified.

## 4. Commercial-Grade Dedication

### a. Inspection Scope

The NRC inspection team reviewed Pentair's policies and implementing procedures that govern the dedication of commercial-grade items (CGIs) for use in safety-related applications to verify compliance with the applicable regulatory requirements of 10 CFR Part 21 and Criterion III, "Design Control," and Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed several dedication packages, including dedication plans,

the criteria for the selection of critical characteristics, the basis for sampling plan selection, and the selection of acceptance methods to verify effective implementation of the Pentair commercial grade dedication process. The NRC inspection team also observed the dedication of two valve disc insert orifices by a Pentair quality control (QC) inspectors. The NRC inspection team discussed the CGD program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

b.1 Technical Evaluations and Identification of Critical Characteristics

The NRC inspection team observed dedication activities and reviewed completed dedication packages to verify that Pentair properly developed and implemented a plan for CGIs. For safety-related valves manufactured by Pentair for the AP1000 reactor design, as well as for the current fleet of operating nuclear power plants, the NRC inspection team reviewed a sample of dedication packages to verify that Pentair appropriately identified basic components and their critical characteristics. Specifically, the NRC inspection team selected a sample of valve subcomponents that Pentair procured as CGIs and dedicated for use in safety-related applications. The NRC inspection team reviewed the dedication packages, associated drawings and inspection reports to verify that the critical characteristics and acceptance methods were correctly specified, that the drawings and material specifications containing the associated acceptance criteria for each critical characteristic were referenced, and that the inspection reports adequately documented the acceptance of the critical characteristics.

Supplement 6, "Dedication of Commercial Grade Parts to Comply with 10 CFR Part 50, Appendix B and 10 CFR Part 21 for Use in Safety Related Nuclear Plant Applications," of the Pentair Quality Assurance Manual (QC-110) identifies the methodology for performing commercial-grade dedication of items to be used in safety-related applications, as well as the specific process to be followed by Pentair as part of its dedication program. QC-110, Supplement 6 requires that a technical evaluation be performed to identify the necessary technical and quality requirements that ensure the part will meet the intended design conditions, and that the associated Dedication Procedures addresses the technical evaluation, as well as the basis for selection of the critical characteristics and the acceptance methods. For each part dedicated by Pentair, an engineer prepares an "Evaluation Criteria for Determination of Piece Part Classification as Safety Related" form (Form QC-639). This form contains the information relevant to the determination of a piece part as a commercial grade item, as well as the safety function classification and potential failure modes for the item.

For the sample of commercial-grade valve subcomponents selected, the NRC inspection team requested that Pentair provide the technical evaluations performed by the engineering group to create the Dedication Procedures associated with each part. During discussions with Pentair personnel, the NRC inspection team determined that Pentair did not document the technical evaluations or the engineering justification performed to select the critical characteristics and verification methods contained within the Dedication Procedures. Technical evaluations identify the necessary technical and quality requirements needed to provide reasonable assurance that the CGI will perform its intended safety function. The NRC inspection team identified this issue as Nonconformance 99901431/2013-201-03 for Pentair's failure to provide objective

evidence that technical evaluations had been performed to provide reasonable assurance that the commercial-grade items to be used as basic components will perform their intended safety function.

In addition, the NRC inspection team noted that Pentair uses the process described in the Arizona Public Service (APS) Company safety evaluation report (Agencywide Documents Access and Management System Accession (ADAMS) No. ML052710224) to dedicate commercial calibration services for use in safety-related applications. Accreditation by an accrediting body recognized by the National Voluntary Laboratory Accreditation Program (NVLAP) through the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) may only be used as the basis for qualifying a commercial calibration laboratory as part of the commercial-grade dedication process when all of the requirements described in the APS safety evaluation report are met. These requirements include performing a technical evaluation to identify any additional technical requirements for the specific M&TE being calibrated that need to be included in the PO, such as tolerances, accuracies, ranges over which the item is to be calibrated, specific industry standards to be used, etc. For the procurement of commercial M&TE calibration services from Essco Calibration Laboratories, Pentair did not conduct a technical evaluation to identify additional technical requirements to be included in the purchase order for the specific M&TE being calibrated. The NRC inspection team identified Pentair's failure to conduct a technical evaluation to identify critical characteristics for the dedication of commercial calibration services as another example of Nonconformance 99901431/2013-201-03.

## b.2 Acceptance of Commercial Grade Items

The NRC inspection team observed special tests and inspections performed as part of CGD, including dimensional verification, material identification, and hardness testing for commercial-grade dedication of two valve disc insert orifices, three safety-related set screw rod pins, and six U-cup O-rings to be used as valve components. During commercial-grade dedication activities for the U-cup O-rings, the NRC inspection team identified that Pentair only performs material verification on a sample of any elastomeric commercial parts procured because this testing involves the destruction of the part. Pentair Dedication Procedure (DP) 6002 (and all other dedication procedures for elastomeric parts) outlines Pentair's standard for sampling. This procedure follows MIL STD-105D, "Sampling Procedures and Tables for Inspection by Attributes," which is a nationally recognized industry standard for sampling, and Pentair adopts the most conservative approach outlined in this document. However, the NRC inspection team determined that Pentair did not adequately verify its commercial suppliers' (Niantic Seal Inc. in the case of the U-cup O-rings) performance, and as such failed to establish assurance that the remaining U-cup O-rings were from the same controlled lot, heat, or batch and would reasonably be able to perform their safety function.

In addition, the NRC inspection team identified that Pentair relied on a commercial supplier-issued CMTR as the sole method to verify critical characteristics of acceptance for the entire batch of U-cup O-rings without conducting a commercial-grade survey, source verification, or other surveillance of the supplier to verify that the supplier's quality program was capable of appropriate control of the lot and batch to ensure material traceability. This issue applies to Pentair's procurement and CGD of all elastomeric parts. The NRC inspection team identified this issue as Nonconformance 99901431/

2013-201-05 for Pentair's failure to adequately verify that the supplier's quality program was capable of appropriate control of the lot and batch to ensure material traceability.

c. Conclusion

The NRC inspection team issued Nonconformance 99901431/2013-201-03 for Pentair's failure to provide objective evidence that technical evaluations had been performed to justify that the critical characteristics and associated acceptance methods selected for various valve parts and components would provide reasonable assurance that the valves would perform their intended safety functions. In addition, Pentair did not conduct a technical evaluation to identify additional technical requirements to be included in the purchase order as part of the dedication of commercial calibration services for the specific M&TE calibrated by Essco Calibration Laboratories.

The NRC inspection team also issued Nonconformance 99901431/2013-201-05 for Pentair's failure to conduct a commercial-grade survey, source verification, or other surveillance of the supplier to verify that the supplier's quality program was capable of appropriate control of the lot and batch to ensure material traceability. This issue is common for Pentair's procurement and dedication of all elastomeric parts.

5. Control of Special Processes

a. Inspection Scope

The NRC inspection team reviewed Pentair's policies and implementing procedures that govern the control of special processes to verify compliance with the regulatory requirements of Criterion IX, "Control of Special Processes," of Appendix B to 10 CFR Part 50, Section III, Section V, "Nondestructive Examination," and Section IX, "Welding and Brazing Qualification," of the ASME B&PV Code. Specifically, the NRC inspection team reviewed a sample of test reports and observed liquid penetrant and magnetic particle testing of a valve disc and valve body, respectively, as well as welding of a valve bonnet. The NRC inspection team discussed the control of special processes program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

The NRC inspection team observed a sample of fabrication and special process activities for the manufacturing activities being undertaken by Pentair associated with the AP1000 reactor design in order to verify adequate implementation of the Pentair processes and procedures.

b.1 Welding Activities

The NRC inspection team observed Pentair's tack welding rework activities on a valve bonnet. The valve bonnet was associated with a nonconformance report that was dispositioned as rework. The nonconformance was related to porosity on the machined surface on top of the flange face of the valve bonnet. The NRC inspection team verified that welding was performed using an approved procedure, Welding Procedure Specification W13006, which met the ASME B&PV Code requirements.



In addition, the NRC inspection team verified that all components or parts at Pentair are fabricated in accordance with a Manufacture Routing Sheets (MRS) that documents each step of the process. MRSs provide Pentair's personnel with the appropriate procedures, processes, hold points, and quality control checks required during each step of the fabrication process.

#### b.2 Control of Weld Material

The NRC inspection team observed that Pentair clearly identified welding materials at all times, and that it retained identification of acceptable material throughout storage, handling, and use until the material was actually consumed in the welding process. The NRC inspection team also observed that covered weld electrodes and flux were stored in a heated storage area; however, the NRC inspection team noted that there was no indication to verify moisture and temperature environmental control within that area. The weld rod ovens have a thermostat to set the chamber temperature located inside the ovens, but the two weld rod ovens that stored all weld material did not have a temperature readout display and there were no devices around the oven that measured humidity in the weld rod ovens or the room. The weld rod ovens are surveyed quarterly to ensure the correct temperature and uniformity to Calibration Procedure CPIE-0220.

The NRC inspection team discussed the lack of instrumentation to ensure that the weld rod ovens were within the correct environmental limits with Pentair staff. The NRC inspection team requested objective evidence that Pentair is implementing the requirements of the ASME B&PV Code, Section III, NB 2440; however, Pentair was not able to provide any procedural guidance that explained how it is providing and verifying suitable storage of welding material. The NRC inspection team issued Nonconformance 99901431/2013-201-06 for Pentair's failure to have controls in place for the temperature read out display and humidity indication to provide assurance that the weld rods were adequately maintained in accordance with the requirements of the ASME B&PV Code.

#### b.3 Nondestructive Examination

The NRC inspection team observed a magnetic particle examination (MT) of a valve body assembly for a relief valve, and the liquid penetrant examination (PT) of two valve discs for a SS 300 Series valve. The NRC inspection team verified that the MT and PT were performed by Level II non-destructive examination (NDE) QC inspectors in accordance with approved procedures. The NRC inspection team reviewed the PT inspection report results and verified that the PT results for both valve discs met the acceptance criteria in accordance with Section III of the ASME B&PV Code. Upon completion of the NDE examinations, the NRC inspection team observed the QC inspection personnel document and log all the test results in accordance with the applicable procedures.

#### b.4 Qualification and Training of Welding and Nondestructive Testing Personnel

The NRC inspection team reviewed a sample of training and qualification records for Pentair's welders and welding operators to verify that these individuals had completed all the required training and had maintained qualification and certification in accordance with Pentair's policies and procedures, and were qualified in accordance with the applicable requirements of Sections III and IX of the ASME B&PV Code.

The NRC inspection team also selected a sample of training and qualification records for Pentair's NDE personnel to verify that these individuals were trained and qualified in accordance with Pentair's policies and procedures, the American Society for Nondestructive Testing SNT-TC-1A, "Personnel Qualification and Certification in Nondestructive Testing," 1992 Edition, and the applicable requirements of Section III and V of the ASME B&PV Code

c. Conclusion

The NRC inspection team issued Nonconformance 99901431/2013-201-06 for Pentair's failure to assure that weld rod ovens had controls in place for the temperature read out display and humidity indication to provide assurance that the rods were adequately maintained in accordance with the applicable sections of the ASME B&PV Code.

6. Test Control

a. Inspection Scope

The NRC inspection team reviewed Pentair's policies and implementing procedures that govern test control activities to verify compliance with the regulatory requirements of Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50, as well as the requirements of Section III of the ASME B&PV Code and ASME Standard QME-1-2007. Specifically, the NRC inspection team evaluated Pentair's test control associated with the AP1000 PV-16 auxiliary relief valves and PV-62 pressurizer safety valves. The NRC inspection team observed Pentair testing activities on a PV-16 auxiliary relief valve for application of test control provisions. The NRC inspection team discussed the test control program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

During the performance of the PV-16 test on June 25, 2013, the NRC inspection team observed that the test engineer used the component route sheet for QME-1 Qualification Testing (Form QC-60-53) to verify the steps of the test and record all information in the data log (Form QC-601). The form documented QC hold points and required sign offs for activities by either a QC inspector or an ASME Authorized Nuclear Inspector (ANI) when warranted. During review of the completed PV-16 test documentation, the NRC inspection team noted that the valve test records had been previously signed and approved on June 18, 2013. Pentair stated that the official QME-1 qualification test for the PV-16 valve had been performed on June 18, 2013; however, the test on June 25, 2013, was said to duplicate the previous test.

During the PV-16 test on June 25, 2013, the NRC inspection team also noted that the test setup for the PV-16 valve did not include a measurement device to collect any valve leakage to verify the test acceptance criteria in accordance with VQT-38188. Upon the NRC inspection team questioning how Pentair would measure leakage during the June 25, 2013, test, the Pentair test personnel did not stop the test, but located the device used to measure leakage at the outlet of the valve being tested. The test personnel installed a plastic cup that was cut to fit at the valve exit to identify and measure any valve leakage not to exceed 10 cubic centimeters per hour. Pentair's failure to install a device to verify leakage before conducting the test to ensure that the

tested valve satisfies the acceptance criteria in VQT-38188 is an example of Nonconformance 99901431/2013-201-02.

The NRC inspection team reviewed Pentair Test Report TR-5509, which documented QME-1 functional qualification activities for active valve assemblies of the PV-62 pressurizer safety valves. Pentair Engineering Procedure T-161093, "Production Test Procedure," specifies that the pressurizer safety valves be tested to ensure proper service performance. Pentair test engineers performed the qualification testing using VQT-38173 for AP1000 PV-62 pressurizer safety valves. During the review of TR-5509, the NRC inspection team noted that on two occasions the test engineer recorded an ambient temperature of 145°F and 146°F. However, T-161093 specifies that testing shall be performed at an ambient temperature between 50-120°F, as required in WEC Valve Datasheet APP-PV62-Z0R-001, "Pressurizer Safety Valves (PSV), ASME Code Section III, Class 1 Valve Datasheet Report." Pentair did not evaluate the validity of the test results as a result of performing testing activities at ambient temperatures higher than the specified temperature range. The NRC inspection team identified Pentair's failure to evaluate the higher than specified ambient test temperatures to ensure compliance with the Pentair procedural testing requirements to be another example of Nonconformance 99901431/2013-201-02.

The NRC inspection team witnessed a production valve flow test for a JB-35-TD-WR size 2H3 valve purchased under PO 762647/0 for Wolf Creek Nuclear Operations. This valve is a safety relief valve used in the residual heat removal system. Pentair test engineers performed the test using Test Procedure T-16193. This was a production valve test that included a hydrostatic shell test, an operational and capacity test, and a seat leak test. During the testing, the NRC inspection team observed that Pentair's cleaning procedure C-14012 was specified for the cleaning of the PV-16 auxiliary relief valves. The Engineering Order Data Release in QC-547 for Design Specification 952845 acknowledges this valve to be an ASME Code Class 2 valve with an ASME NV stamp. The valve specification has a rated design temperature of 400°F and can be used within primary containment. Pentair cleaning procedure C-14012 allows the use of the lubricant Neolube on the thread and bearing surfaces of the valve that can come into contact with the medium.

The NRC inspection team found that Pentair has in stock Neolube No. 1 and Neolube No. 1260. The Neolube manufacturer does not recommend the use of Neolube No. 1 for lubricating threads that are used within primary containment, where operating temperatures for the fittings may be greater than 400°F. The NRC inspection team confirmed during a teleconference call with a design engineer from the lubricant manufacturer (Huron Industries) that Neolube No. 650 or No. 1260 is recommended for use in containment and / or the secondary side in nuclear applications. The NRC inspection team observed during the review of a representative sample of cleaning procedures that Pentair does not differentiate between the type of Neolube product to be used for valves that are intended for end use in primary containment applications. The NRC inspection team issued Nonconformance 99901431/2013-201-04 for Pentair's failure to have adequate controls or documentation to select and verify the appropriate type of Neolube was being used to lubricate various valve types during and after testing activities in accordance with the application and design specifications for the valves.

c. Conclusion

The NRC inspection team issued Nonconformance 99901431/2013-201-02 with two examples for Pentair's failure to evaluate the higher than specified ambient test temperatures to ensure compliance with Pentair Procedures T-161093 and VQT-38173, and Pentair's failure to install a device to collect any leakage to ensure that the tested valve satisfies the leakage acceptance criteria of Pentair Procedure VQT-38188.

The NRC inspection team also issued Nonconformance 99901431/2013-201-04 for Pentair's failure to establish proper measures for the selection, purchase, use, and review for suitability of application of the lubrication material Neolube. Specifically, Pentair did not have adequate controls or documentation in place to select and verify that the appropriate type of Neolube was being used to lubricate various valve types during and after testing activities in accordance with the application and design specifications for the valves.

7. Control of Measuring and Test Equipment

a. Inspection Scope

The NRC inspection team reviewed the Pentair policies and implementing procedures that govern the M&TE program to verify compliance with the requirements of Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed a sample of Pentair M&TE activities related to the AP1000 PV-16, PV-18, and PV-62 valves and verified the calibration status of the related equipment. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

The NRC inspection team reviewed the Pentair database used for tracking calibration status, completion, and due dates of all their M&TE devices. The NRC inspection team performed a visual inspection of several M&TE devices used in activities related to the QME-1 testing of the PV-16, PV-18, and PV-62 valves. The NRC inspection team verified that the sampled M&TE had the appropriate calibration stickers and current calibration dates, including the calibration due date. In addition, the calibration records reviewed by the NRC inspection team indicated the as-found or as-left conditions, accuracy required, calibration results, calibration dates, and the due date for recalibration. The NRC inspection team also verified that the selected M&TE was calibrated using procedures traceable to known industry standards.

c. Conclusion

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

## 8. Control of Nonconforming Materials, Parts, or Components

### a. Inspection Scope

The NRC inspection team reviewed the Pentair policies and implementing procedures that govern the control of nonconformances to verify compliance with the regulatory requirements of Criterion XV, "Nonconforming Materials, Parts, or Components," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed a sample of Material Rejection Notices (MRNs) and verified that the disposition and control of nonconformances was in accordance with the Pentair procedural guidelines. In addition, the NRC inspection team discussed the nonconformance program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

### b. Observations and Findings

The NRC inspection team verified that Pentair's applicable policies and procedures associated with the nonconformance process provide for (1) reference to instructions or procedures for repair and rework activities (where required), reinspection of repaired and reworked items, and notification to affected organizations of nonconforming conditions, (2) deficiencies or nonconformances identified by customers to be entered into the corrective action program, adequately assessed, and properly dispositioned, and (3) reference to the applicable procedures to appropriately identify the responsibility and authority for review and disposition of nonconforming items, and control further processing, delivery, and installation of nonconforming items until disposition is completed. The NRC inspection team also performed a walkdown of the Pentair facility shop floor to verify that there were designated areas to segregate and control the various nonconforming materials.

For the sample of MRNs reviewed, the NRC inspection team verified that Pentair implemented an adequate program to assess and control nonconforming items, including appropriate identification, documentation, segregation, evaluation, and disposition of these items. The NRC inspection team verified that the MRNs properly applied the Pentair requirements of use-as-is acceptable, reject, repair or rework, or scrap and provided the applicable technical justifications to be adequately supported and properly documented, including the need for additional design control measures as necessary, commensurate with those applied to the original design. The NRC inspection team also verified that Pentair's nonconformance process provides guidance to evaluate nonconformances for reportability under Pentair's 10 CFR Part 21 program.

### c. Conclusion

The NRC inspection team concluded that Pentair is implementing its nonconforming materials, parts, or components program in accordance with the regulatory requirements of Criterion XV of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Pentair is implementing its policies and procedures associated with the control of nonconforming materials, parts, or components. No findings of significance were identified.

## 9. Corrective Action

### a. Inspection Scope

The NRC inspection team reviewed the Pentair policies and implementing procedures that govern the corrective action program to verify compliance with the regulatory requirements of Criterion XVI, "Corrective Actions," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed a sample of corrective action reports (CARs) and verified that the CARs' disposition and control provide adequate documentation and description of conditions adverse to quality, as well as specifying the cause of these conditions and the corrective actions taken to prevent recurrence. The NRC inspection team also reviewed the status of the corrective actions implemented in response to the findings from the 2009 NRC inspection at the Anderson Greenwood Crosby (AGC) facility, now Pentair. The NRC inspection team discussed the corrective action program with Pentair's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

### b. Observations and Findings

#### b.1 Corrective Action Program

The NRC inspection team verified that Pentair's implementing policies and procedures provide assurance that conditions adverse to quality are promptly identified, documented and corrected or otherwise handled in accordance with the established requirements. The procedures also ensure that the causes of the conditions adverse to quality are identified and that corrective or preventive action is taken to preclude recurrence.

The NRC inspection team reviewed a sample of Pentair's corrective actions including both internal CARs and CARs related to corrective actions imposed upon or implemented by Pentair's suppliers. The NRC inspection team verified that the CARs provide (1) adequate documentation and description of conditions adverse to quality; (2) an appropriate analysis of the cause of these conditions and the corrective actions taken to prevent recurrence; (3) direction for review and approval by the responsible authority; (4) a description of the current status of the corrective actions; and (5) the follow-up actions taken to verify timely and effective implementation of the corrective actions. The NRC inspection team also verified that Pentair's corrective action program provides appropriate guidance to evaluate CARs for reportability under Pentair's 10 CFR Part 21 program.

#### b.2 Corrective Action Associated with Violation 99900293/2009-201-01

Violation 9990293/2009-201-01 was issued for Pentair's failure to provide adequate guidance to meet the requirements of 10 CFR Part 21 in procedure QA-48-3016, "Reporting of Defects and Noncompliance," Revision 9, dated February 6, 2008. Specifically, Pentair failed to provide adequate procedural guidance to evaluate deviations and failures to comply associated with substantial safety hazards.

In its response to the NRC, Pentair stated that it would revise the applicable procedure accordingly.

The NRC inspection team reviewed CAR Nos. 373, 374, and 375, which Pentair initiated to address Violation 99900293/2009-201-01. CAR Nos. 373, 374, and 375 described the corrective actions detailed above, provided objective evidence of the completion of corrective actions, and all CARs were closed on October 26, 2009.

The NRC inspection team reviewed the documentation that provided objective evidence for the completion of the corrective actions. The NRC inspection team determined that Pentair's corrective actions were adequate to address the identified finding. Based on its review, the NRC inspection team closed Violation 9990293/2009-201-01.

#### b.3 Corrective Action Associated with Nonconformance 99900293/2009-201-02

Nonconformance 99900293/2009-201-02 was issued for Pentair's failure to implement their design control procedures as required. Specifically, for PO 45606428, Pentair failed to provide objective evidence related to the evaluation of safety valves for the conditions specified in Regulatory Guide 1.84, "Design and Fabrication Code Case Acceptability – AMSE Section III, Division 1," for ASME Code Case N-100, "Pressure Relief Valve Design Rules, Section III, Division 1, Class 1, 2, and 3." Pentair also failed to complete (1) the design checklist for PO QP081141 and PO 1023530, and (2) the calculation for determining the relieving capacity of the relief valves in PO QP081141. Completion of these activities was specified in Section 3.3.2.2 of QC-110.

In their response to the NRC, Pentair stated that a statement will be added to the engineering calculation file for the applicable POs to establish that stress limits in excess of those specified for the upset operating conditions were not used. In addition, Pentair stated that it had completed the design checklist for the original sales order from the Southern Nuclear Operating Company PO and placed it in the order file. Pentair also stated that the design checklist for the original sales order from the New York Power Authority PO was also completed and placed in the order file. Finally, Pentair stated that the calculation of the relieving capacity for the Farley Nuclear Plant relief valve was prepared, approved, and placed in the order file. To avoid recurrence, going forward, Pentair committed to perform a design analysis that will include a calculation of the relieving capacity in accordance with Section 3.3.2.2 of QC-110.

The NRC inspection team reviewed CAR Nos. 680, 681, and 682, which Pentair initiated to address Nonconformance 99900293/2009-201-02. CAR Nos. 680, 681, and 682 described the corrective actions detailed above, provided objective evidence of the completion of corrective actions, and all CARs were closed on July 26, 2013.

The NRC inspection team reviewed the documentation that provided objective evidence for the completion of the corrective actions. The NRC inspection team determined that Pentair's corrective actions were adequate to address the identified finding. Based on its review, the NRC inspection team closed Nonconformance 99900293/2009-201-02.

#### b.4 Corrective Action Associated with Nonconformance 99900293/2009-201-03

Nonconformance 99900293/2009-201-03 was issued for Pentair's failure to implement their control of M&TE procedures as required. Specifically, Pentair failed to perform yearly calibration of the primary standards and post-calibration checks of the inspection gages used during inspections, as well as to adequately control temperature and humidity in the calibration area.

In their response to the NRC, Pentair stated that the calibration due date for the affected gages was incorrectly entered into the M&TE database. The gages were subsequently calibrated again and no discrepancies were found from the last calibration; therefore, the activities completed using the affected gages since the last calibration were unaffected. Pentair stated that it performed an extent of condition in the M&TE database and verified that all the other calibration due dates were correct.

In addition, Pentair stated that it performed a post-calibration check for the affected inspection gages and provided training to each QC inspector emphasizing the requirement to perform the post-calibration check and document the result before releasing valves for shipping. Finally, Pentair stated that it trained the QC supervisor to measure and record the temperature and humidity in the calibration area whenever the gage calibration inspector is not available to perform this function.

The NRC inspection team reviewed CAR Nos. 391, 392, and 393, which Pentair initiated to address Nonconformance 99900293/2009-201-03. CAR Nos. 391, 392, and 393 described the corrective actions detailed above, provided objective evidence of the completion of corrective actions, and all CARs were closed on September 30, 2009. The NRC inspection team reviewed the documentation that provided objective evidence for the completion of the corrective actions. The NRC inspection team determined that Pentair's corrective actions were adequate to address the identified finding. Based on its review, the NRC inspection team closed Nonconformance 99900293/2009-201-03.

#### b.5 Corrective Action Associated with Nonconformance 99900293/2009-201-04

Nonconformance 99900293/2009-201-04 was issued for Pentair's failure to provide adequate procedural guidance and to implement its corrective action procedures as required. Specifically, Pentair failed to have controls in place to ensure that conditions adverse to quality, which are identified by Pentair's customers are reviewed, documented, and addressed by Pentair's corrective action program. In addition, Pentair failed to identify or document any corrective actions taken, actions to prevent recurrence, a proposed completion date, or follow up actions to be taken in CAR I-317 and CAR N-342, as required by Pentair policies and procedures.

In their response to the NRC, Pentair stated that QC-110 was revised to instruct Pentair staff to handle nonconformances identified by customers in accordance with Departmental Operating Instruction (DOI) QA-48-3051, "Complaint Reports." In addition, Pentair completed a root cause evaluation for CAR I-317, identified and documented the corrective actions, and verified that the corrective actions taken were effective. CAR I-317 was closed on August 6, 2009. Pentair also evaluated the planned corrective actions for CAR N-342 and determined that they were ineffective. Subsequently, Pentair revised the corrective actions and verified that they were effective for CAR N-342.

The NRC inspection team reviewed CAR Nos. 394 and 395, which Pentair initiated to address Nonconformance 99900293/2009-201-04. CAR Nos. 394 and 395 described the corrective actions detailed above, provided objective evidence of the completion of corrective actions, and were closed on May 6 and October 1, 2010, respectively.

The NRC inspection team reviewed the documentation that provided objective evidence for the completion of the corrective actions. The NRC inspection team determined that



Pentair's corrective actions were adequate to address the identified finding. Based on its review, the NRC inspection team closed Nonconformance 99900293/2009-201-04.

c. Conclusion

The NRC inspection team concluded that Pentair is implementing its corrective action program in accordance with the regulatory requirements of Criterion XVI of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that Pentair is implementing its policies and procedures associated with the CAR program. No findings of significance were identified.

10. Entrance and Exit Meetings

On June 24, 2013, the NRC inspection team discussed the scope of the inspection with Mr. David Tuttle, Pentair Quality Assurance Manager, and other members of the Pentair management and staff. On June 28, 2013, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Tuttle and other Pentair management and staff. The attachment to this report lists the entrance and exit meeting attendees, as well as those individuals interviewed by the NRC inspection team.

## ATTACHMENT

### 1. ENTRANCE / EXIT MEETING ATTENDEES AND PERSONS CONTACTED

Name	Title	Affiliation	Entrance	Exit	Interviewed
Caitlin Travers	Westinghouse Equipment Qualification Engineer	WEC	X		X
Brian Martin	Quality Control Manager	Pentair	X	X	
Eddie Renaud	Quality Control	Pentair			X
Mike Riccio	Quality Control	Pentair			X
Mark Fischer	Quality Control	Pentair			X
Mike Boyle	Quality Control	Pentair			X
David Tuttle	Quality Assurance Manager	Pentair	X	X	X
John Webb	Quality Assurance Engineer	Pentair	X	X	X
Chris Morin	Quality Assurance	Pentair			X
Tom Cotreau	Quality Assurance	Pentair			X
Lynn Skarin	Nuclear Projects Manager	Pentair	X	X	X
Chuck Dowd	Global Nuclear Sales Manager	Pentair	X		
David Smith	General Manager	Pentair	X	X	
Michael Rider	Engineering Manager	Pentair	X	X	X
David Thibault	Engineering	Pentair			X
Jin Yu	Engineering	Pentair			X

### 2. INSPECTION PROCEDURES USED

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

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

IP 36100, "Inspection of 10 CFR Parts 21 and Programs for Reporting Defects and Noncompliance," dated February 13, 2012.

IP 65001 E, "Inspection of the ITAAC Related Qualification Program," dated August 19, 2008.

IP 35034, "Design Certification Testing Inspection," dated January 27, 2010.

### 3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

<u>Item Number</u>	<u>Status</u>	<u>Type</u>	<u>Description</u>	<u>Applicable ITAAC</u>
99900293/2009-201-01	Closed	NOV	10 CFR Part 21	N/A
99900293/2009-201-02	Closed	NON	Criterion III	N/A
99900293/2009-201-03	Closed	NON	Criterion XII	N/A
99900293/2009-201-04	Closed	NON	Criterion XVI	N/A

<u>Item Number</u>	<u>Status</u>	<u>Type</u>	<u>Description</u>	<u>Applicable ITAAC</u>
99901431/2013-201-01	Open	NON	Criterion III	2.1.2.02.a, 2.1.2.05.a.ii 2.1.2.08.a.ii 2.2.3.02.a 2.2.3.05.a.ii.
99901431/2013-201-02	Open	NON	Criterion XI	N/A
99901431/2013-201-03	Open	NON	Criterion III	N/A
99901431/2013-201-04	Open	NON	Criterion IV & VII	N/A
99901431/2013-201-05	Open	NON	Criterion VII	N/A
99901431/2013-201-06	Open	NON	Criterion IX	N/A

#### 4. INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

The U.S. Nuclear Regulatory Commission (NRC) inspection team identified the following inspections, tests, analyses, and acceptance criteria (ITAAC) related to components being designed, manufactured, and tested at Pentair. At the time of the inspection, Pentair was involved in manufacturing and testing the PV-16 auxiliary relief valves, preparing for the manufacturing and testing of the PV-18 vacuum breaker valves, and had completed work on the PV-62 pressurizer safety valves for the AP1000 reactor design. For the ITAAC listed below, the NRC inspection team reviewed Pentair's quality assurance controls in the areas of design control, commercial grade dedication, special processes, test control, oversight of contracted activities, control of measuring and test equipment, nonconforming materials parts and components, and corrective actions. The ITAAC design commitments 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 inspection team identified findings associated with some of the ITAAC identified below, as specified in Section 3 of this attachment.

<b>ITAAC</b>	<b>Design Commitment</b>	<b>Component</b>
2.1.2.02.a	2.a) The components identified in Table 2.1.2-1 as ASME Code Section III are designed and constructed in accordance with ASME Code Section III requirements.	PV18 valves RCS-PL-V010A & B (ADS Discharge Header Vacuum Relief Valves)  PV62 valves RCS-PL-V005A & B (Pressurizer Safety Valves)
2.1.2.04.a	4.a) The components identified in Table 2.1.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.	PV18 valves RCS-PL-V010A & B (ADS Discharge Header Vacuum Relief Valves)  PV62 valves RCS-PL-V005A & B (Pressurizer Safety Valves)
2.1.2.05.a.ii	5.a) The seismic Category I equipment identified in Table 2.1.2-1 can withstand seismic design basis loads without loss of safety function.	PV18 valves RCS-PL-V010A & B (ADS Discharge Header Vacuum Relief Valves)  PV62 valves RCS-PL-V005A & B (Pressurizer Safety Valves)

ITAAC	Design Commitment	Component
2.1.2.08.a.i	8.a) The pressurizer safety valves provide overpressure protection in accordance with Section III of the ASME Boiler and Pressure Vessel Code.	PV62 valves RCS-PL-V005A & B (Pressurizer Safety Valves)
2.1.2.08.a.ii	8.a) The pressurizer safety valves provide overpressure protection in accordance with Section III of the ASME Boiler and Pressure Vessel Code.	PV62 valves RCS-PL-V005A & B (Pressurizer Safety Valves)
2.2.3.02.a	2.a) The components identified in Table 2.2.3-1 as ASME Code Section III are designed and constructed in accordance with ASME Code Section III requirements.	PV16 valves PXS-PL-V022A & B (Accumulator Relief Valves)
2.2.3.04.a	4.a) The components identified in Table 2.2.3-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.	PV16 valves PXS-PL-V022A & B (Accumulator Relief Valves)
2.2.3.05.a.ii	5.a) The seismic Category I equipment identified in Table 2.2.3-1 can withstand seismic design basis loads without loss of safety function.	PV16 valves PXS-PL-V022A & B (Accumulator Relief Valves)

## 5. DOCUMENTS REVIEWED

### Pentair Documents

- Pentair Quality Assurance Manual QC-110, Revision 42, dated June 13, 2013
- QC-110, "XV. Nonconformance Source Material or Items," Revision 40, dated May 1, 2011
- QC-110, "XVI Corrective Action," Revision 42, dated June 13, 2013
- Crosby Valve & Gage Company Manual DS-6103, "Design Specification for Series 900 Omni Trim Pressure Relief Valves," Revision 4, dated June 5, 1996
- Pentair Quality Assurance Instruction QAI-32829, "Quality Assurance Instruction ASME Boiler & Pressure Vessel Code Section III – Miscellaneous Relief Valves," Revision 7, dated September 21, 2010
- Pentair Quality Assurance Instruction QAI-32867, "Quality Assurance Instruction ASME Boiler & Pressure Vessel Code Section III – Vacuum Relief Valves," Revision 2, dated November 1, 2011

- Pentair Departmental Operating Instruction – Drafting DD-44-3004, “Engineering Document Control,” Revision 14, dated May 3, 2012
- Pentair Department Operating Instruction – Power Group PG-67-3004, “Quotations and Order Processing for ASME Section III New Application Pressure Relief Valves,” Revision 6, dated June 29, 2004
- Pentair Departmental Operating Instruction - General Engineering GE-40-3006, “Design Control Procedure,” Revision 8, dated June 29, 2004
- Anderson Greenwood Crosby Purchase Order No.M36894, “QME Testing of (1) 6XPX8 Pressurizer Safety Valve”, dated February 11, 2010
- Departmental Operating Instruction (DOI) Quality Assurance (QA) 48-3051, “Complaint Report,” Revision 0, dated May 10, 2012
- DOI QA-48-3016, “Reporting of Defect and Noncompliance-Section III / Nuclear,” Revision 10, dated October 13, 2009
- DOI QA-48-3055, “Corrective Action Board,” Revision 0, dated June 3, 2011
- Anderson Greenwood Crosby Engineering Procedure No. T-161093, “Production Test Procedure,” Component: 6” P 8” HB-BP-86 Pressurizer Safety Valves, Customer: Westinghouse Electric Corporation, Drawing Number: DS-B-900028, Equipment Specification: APP-PV62-Z0-001, Revision 6, dated August 8, 2011.
- Pentair Engineering Procedure T-161093, “Production Test Procedure – “6” P 8” HB-BP-86 Pressurizer Safety Valves,” Revision 6, dated September 22, 2008
- Pentair Engineering Procedure T-161162, “Production Test Procedure – APP-PV16-Z0-001,” Revision 2, dated January 25, 2011
- Pentair Valve Qualification Test Procedure VQT-38173, “ASME QME-1 Functional Qualification Test Program for Active Valve Assemblies – APP-RCS-PL-V005A/B,” Revision 5, dated October 15, 2009
- Pentair Valve Qualification Test Procedure VQT-38188, “ASME QME-1 Functional Qualification Test Program for Active Valve Assemblies – APP-PV16-Z0-001,” Revision 3, dated January 25, 2011
- Pentair Engineering Calculation EC-2829, “Design Report – Crosby 1x1 JMB-WR Auxiliary Relief Valve,” Revision 1, dated December 3, 2012
- Pentair Engineering Calculation EC-2914, “Design Report – AG Crosby 1x1 VR Vacuum Relief Valve,” Revision 0, dated April 23, 2012
- Pentair Engineering Change Request ECR 11-339, dated May 25, 2011
- Pentair Engineering Order Data Release for Purchase Order 4500340946 (PV-16 Valves), dated October 19, 2010

- Pentair Engineering Order Data Release for Factor Order G466770000 (V.C. Summer Pressurizer Safety Valves), Revision 2, dated June 7, 2013
- Pentair Engineering Work Request for Factory Order G41429 and G41430 (PV-16 Valves), dated June 15, 2010
- Anderson Greenwood Crosby Test Report No. 5509, "ASME QME-1 Functional Qualification Test Report for Active Valve Assemblies," WEC Tags Nos.: APP-RCS-PL-V005A/B, AG-Crosby Factory Order: G221160000, Component: 6 P 8 HB-BP-86 Type E, Pressurizer Safety Valves, Data Sheet Dwg: DS-B-900028, Revision 4, dated June 5, 2012
- Anderson Greenwood Crosby Test Report No. 5588, "6P8 HB Style Pressurizer Safety Valve Impact of Anticipated Transient Without SCRAM on Valve Performance," Revision 1, dated January 15, 2013
- Pentair Test Report TR-5509, "ASME QME-1 Functional Qualification Test Report for Active Valve Assemblies – 6 P 8 HB-BP-86 Type E, Pressurizer Safety Valves," Revision 4, dated June 5, 2012
- Pentair Test Report TR-5547, "Capacity Certification Report Safety Relief Valve," Revision 2, dated December 16, 2011
- Pentair Test Report TR-5556, "Qualification Test Report Summary for Style 6" P8" HB-BP-86 Pressurizer Safety Valve," Revision 2, dated June 6, 2012
- Pentair Test Report TR-5557, "Functional Qualification Test Report Summary for TOPWORX Model C7 Position Indication Switches," Revision 2, dated June 6, 2012
- Pentair Inspection Record for COG confirmation of Valve Assembly Serial No. N900134-00-0002, dated April 3, 2013
- Pentair Inspection Record for COG confirmation for AP1000 Pressurizer Safety Valves, dated June 24, 2013
- Evaluation Committee Report, Subject Base Assembly P/N K900040, dated May 15, 2013
- Evaluation of Potential Deviation or Failure to Comply for Nozzle Ring Set Screw, P/N 107460, dated September 20, 2012
- Evaluation of Potential Deviation or Failure to Comply for Cylinder S/NN97141-48-0046, dated February 2, 2012
- Evaluation Committee Report for Cylinder S/NN97141-48-0046, dated March 30, 2012
- Evaluation of Potential Deviation or Failure to Comply, Subject Bonnet Assembly P/N K72040, dated January 30, 2012

- Evaluation Committee Report , Subject Bonnet Assembly P/N K72040, dated March 27, 2012
- Evaluation Deviation for Linear Variable Differential Transformer, dated April 9, 2011
- Anderson Greenwood Crosby Drawing (Dwg.) No. DS B900028, “Nozzle Type Relief Valve – Size 6 P 8, Style HB-BP-86,” Revision J, dated July 7, 2008
- Pentair Drawing DS-B900028, “Nozzle Type Relief Valve,” Revision J, dated July 7, 2008
- Pentair Drawing DS-B900134, “Pressure Relief Valve,” Revision D, dated June 16, 2010
- Pentair Drawing DS-B900138, “Pressure Relief Valve,” Revision D, dated June 16, 2010
- Pentair Drawing DS-B900197, “Pressure Relief Valve,” Revision B, dated May 16, 2011
- Pentair Drawing DS-B900216, “Vacuum Relief Valve,” Revision A, dated November 4, 2011
- Pentair Drawing DS-B900272, “Pressure Relief Valve,” Revision A, dated October 23, 2012
- Pentair Drawing DS-B900273, “Pressure Relief Valve,” Revision A, dated October 23, 2012
- Pentair ASME Form NV-1 for AP1000 Pressurizer Safety Valves, dated June 24, 2013
- Letter from Dave Tuttle, Tyco Flow Control, to William R. Avery, First Energy, “Immediate Action Required for Failure to Provide a Linear Variable Differential Transformer as Safety Related,” dated March 18, 2011
- Letter from Dave Tuttle, Tyco Flow Control, to Richard A Danko, Exelon Business Service Co., “Immediate Action Required for Failure to Provide a Linear Variable Differential Transformer as Safety Related,” dated March 18, 2011
- Interoffice Memorandum, “Minutes of 2012 Quality Management Review,” dated June 26, 2012
- 2011 Management Review Agenda, dated July 30, 2012
- 2012 Management Review Agenda, dated May 31, 2013
- Interoffice Memorandum, “Minutes of 2011 Quality Management Review,” dated June 30, 2012
- Notification of Potential Deviation or Failure to Comply for Nozzle Ring Set Screw, P/N 107460, dated September 18, 2012

- Material Rejection Notice Nos. 43946, 43956, 43970, 43972, 43977, 44397, 44000, 44004, 44006, 44013, 44020, 44023, and 44140
- Corrective Action Request Nos. 373, 374, 375, 391, 392, 393, 394, 395, 493, 507, 544, 569, 570, 571, 579, 582, 593, 623, 625, 628, 629, 630, 633, 637, 639, 640, 642, 647, 663, 664, 669, 670, 671, 673, 674, and 676
- Complaint Report Nos. 273, 293, 295, 318, 326, and 327
- Corrective Action Board Minutes – January 16, 2013
- Corrective Action Board Minutes – January 24, 2013
- Corrective Action Board Minutes – February 6, 2013
- Corrective Action Board Minutes – February 28, 2013
- Corrective Action Board Minutes – March 13, 2013
- Corrective Action Board Minutes – March 26, 2013
- Corrective Action Board Minutes – April 10, 2013
- Corrective Action Board Minutes – May 8, 2013
- Corrective Action Board Minutes – June 10, 2013
- Corrective Action Board Minutes – June 18, 2013
- Corrective Action Board Minutes – June 21, 2013
- QC-110 Supplement 6, Dedication of Commercial Parts to Comply with 10CFR50 Appendix B and 10CFR21 for Use in Safety Related Nuclear Power Plant Applications,” Revision 5, dated June 26, 2013
- Supplier Quality Requirements SQR-1, Revision 10, dated June 13, 2013
- Pentair ,ASME Boiler and Pressure Vessel Code Section III, 10 CFR Appendix B, and Subsafe / Level 1 Approved Supplier List and Supplier Audit Status, dated June 7, 2013
- Pentair Approved Supplier QA Manuals, dated June 21, 2013
- Lead Auditor Qualification and Annual Evaluations for Bruce P. Wheeler
- Anderson Greenwood Assessment of Acceleron, Inc. Quality Assurance Program and Facilities, dated April 3, 2013
- Anderson Greenwood Assessment of Wyle Laboratories Quality Assurance Program and Facilities, dated May 31, 2012



- Anderson Greenwood Supplier Quality Evaluation for National Technical Systems, dated May 17, 2011
- Purchase Order (PO) A48939 from Pentair to Stainless Foundry – Sand, dated November 8, 2012 and Associated Receiving Inspection Checklist, dated March 8, 2013
- PO 762470 from Wolf Creek Nuclear Operations Corporation to Pentair, dated December 31, 2012 and Associated QA Records
- PO M47361 from Pentair to Essco Calibration Laboratory, dated June 12, 2013
- PO M47019 from Pentair to Hexagon Metrology, dated February 13, 2013, and Associated Calibration Certificates and QA Records
- PO M46970 from Pentair to National Technical Systems, dated January 21, 2013, and Associated PO Documentation
- PO M46970 Receiving Inspection Checklist, dated June 26, 2013
- Dedication Procedure (DP) 6044, Revision 10, dated April 6, 2012
- DP-6004, “Corrosion Resistant Springs,” Revision 1, dated August 22, 1990
- DP-6029, “Flexitallic Gasket – R Style,” Revision 1, dated June 27, 2013
- DP-6040, “Chrome Plated Pins,” Revision 0, dated September 9, 1993
- DP-6055, “O-Ring Kits,” Revision 0, dated February 10, 2000
- DP-6080, “Seal Gasket – Hammel Dahl,” Revision 2, dated April 24, 2013
- DP-6031, “Individual Commercial Bellows Prior to Welding to the Disc Holder Assembly,” Revision 1, dated July 31, 1992
- DP-6002, Revision 6, dated November 8, 1993
- DP-6069, “EPDM Packing Sets (Elastomeric),” Revision 1, dated June 27, 2013
- DP-6033, “O-Rings,” Revision 3, dated January 19, 1993
- DP-60135, “Spherical Washers,” Revision 0, dated January 21, 2011
- DP-6032, “Metallica Parts with Heat Treat Requirements,” Revision 0, dated October 30, 1992
- DP-6061, “Keystone Pneumatic Actuator,” Revision 5, dated August 28, 2002
- DP-6076, “Cage – Hammel Dahl,” Revision 0, dated February 27, 2004

- DP-6077, "Travel Stop Nut – Hammel Dahl," Revision 0, dated February 27, 2004
- DP-60113, "Hammel Dahl Self-Locking Nuts, Nylon Insert Type," Revision 0, dated August 19, 2008
- DP-60105, "Graphite Gasket," Revision 0, dated February 26, 2007
- DP-60142, "Dedication of Calibration Services," Revision 1, dated August 15, 2012
- CAR 672 for PO MA7019 not Containing All Requirements Specified in DP-60142, dated June 27, 2013
- CAR 667 for No Documented Process that Defines the Manner that Determines the Technical Evaluation for Critical Characteristics, dated June 27, 2013
- Inspection Instruction No. Q-549, "Positive Material Identification by Optical Spectrometer," Revision 1, dated February 14, 1995
- Inspection Instruction No. Q-507, "Sampling Instruction," Revision 14, dated November 8, 2002
- Inspection Instruction No. Q-506, "Final Parts Inspection," Revision 8, dated March 21, 1992
- Inspection Instruction No. Q-531, "Specific Alloy Identity Testing," Revision 15, dated March 8, 2005
- Inspection Instruction No. Q-532, "Visual Inspection," Revision 3, dated July 25, 2001
- Work Order (WO) 962239, D000174-0029 for Three Set Screw Pod Pins
- WO 961913, D00505-0021 for Six U-Cup O-Rings
- WO N90446-91 for Dedication of Two Disc Insert "L" Orifices
- Calibration Procedure CPIE-0220, Revision 4, dated February 22, 1996
- Welding Procedure Specification W13006, Revision 25, dated September 21, 2011
- MP-2415, "Magnetic Particle Inspection Procedure Dry Particles Continuous Method," Revision 22, dated February 7, 2005
- LP-1016, "Liquid Penetrant Procedure," Revision 4, dated June 24, 2009
- Test Procedure T-16193, Revision 22, dated April 18, 2006
- Cleaning Procedure C-14012, Revision 3, dated March 30, 1978

- Inspection Instruction No. QC-547, "Engineering Order Data Release," Revision E, dated January 23 2013
- Valve Maintenance Instruction 11068, Revision 6, dated March 25, 2000

#### Westinghouse Documents

- Westinghouse Document APP-PV16-Z0D-102, "PV16 Datasheet 102," Revision 4, dated October 3, 2011
- Westinghouse Document APP-PV16-Z0D-102, "PV16 Datasheet 104," Revision 2, dated September 29, 2011
- Westinghouse Document APP-PV62-Z5-001, "Appendix 3: Technical and Quality Requirements for the Procurement of PV62 Pressurizer Safety Valves for AP1000 Projects," Revision 0, dated September 23, 2010
- Westinghouse Document APP-PV62-Z0Y-001, "Design Transients for Pressurizer Safety Valves," Revision 0, dated March 16, 2009
- Westinghouse Valve Datasheet APP-PV62-Z0R-001, "Pressurizer Safety Valves (PSV), ASME Code Section III, Class 1 Valve Datasheet Report," Revision 4, dated September 27, 2012
- Westinghouse Design Specification APP-PV62-Z0-001, "Pressurizer Safety Valve, ASME B&PV Code Section III, Class 1," Revision 7, dated September 27, 2012
- Westinghouse Purchase Order No.4500261837, "Sanmen and Haiyang China AP1000 Projects, Pressurizer Safety Valves," dated March 31, 2008
- Westinghouse Purchase Order No.4500261837, "Change Notice 1, Sanmen and Haiyang China AP1000 Projects, Pressurizer Safety Valves," dated April 18, 2008
- Westinghouse Purchase Order No.4500340931, "Westinghouse Electric Corporation Purchase Order to Anderson Greenwood Crosby," dated March 31, 2010
- Westinghouse Purchase Order No.4500365092, "VC Summer Project, Units 2 and 3, PV-62, Pressurizer Safety Valves," dated October 25, 2010
- Westinghouse Purchase Order No.4500365094, "Vogtle Project, Units 3 and 4, PV-62, Pressurizer Safety Valves," dated October 25, 2010
- Westinghouse Valve Datasheet APP-PV16-Z0R-001, "Auxiliary Relief Valves, ASME Boiler and Pressure Vessel Code, Section III Class 1, 2, and 3 Valve Data Sheet Report," Revision 7, dated December 3, 2012
- Westinghouse Purchase Order No. 4500340946, dated March 31, 2010, and Change Notices 5, dated April 28, 2011, 10, dated August 29, 2012, and 11, dated June 4, 2013, for AP1000 PV-16 auxiliary relief valves.

- Westinghouse Purchase Order No. 45004008943 for AP1000 PV-18 Vacuum Breaker Valves, dated September 26, 2011
- Westinghouse Design Specification APP-GW-VP-010, "AP1000 Plant Equipment Qualification Methodology and Documentation Requirements for AP1000 Safety-Related Valves and Valve Appurtenance," Revision 2, dated April 2010
- Westinghouse Design Specification APP-GW-G1-002, "AP1000 Plant Equipment Qualification Methodology," Revision 3, dated February 2012
- Westinghouse Design Specification APP-PV16-Z0-001, "AP1000 Auxiliary Relief Valves," Revision 7, dated November 15, 2011
- Westinghouse Design Specification Datasheet APP-PV16-Z0D-102, "PV16 Datasheet 102," Revision 4, dated October 3, 2011
- Westinghouse Design Specification Datasheet APP-PV16-Z0R-001, "Auxiliary Relief Valves, ASME Boiler and Pressure Vessel Code, Section III, Class 1, 2 and 3 Valve Data Sheet Report," Revision 7, dated December 3, 2012
- Westinghouse Certificate of Conformance for AP1000 Pressurizer Safety Valves for Vogtle Unit 4, dated June 25, 2013
- Westinghouse Procurement Advisory Release 4500340946-054-C on approval of Pentair VQT-38188, dated April 23, 2013
- Westinghouse approval of EC-2829 Design Report ,dated January 15, 2013
- Westinghouse Quality Release & Certificate of Conformance QR-13-for AP1000 Pressurizer Safety Valves 2158, Revision 0, dated June 25, 2013
- Westinghouse Deviation Notice SV0-PV62-GNR-001, "Deviation Notice for PV62 Cleaning Requirements," Revision 0, dated September 28, 2012

#### Miscellaneous Documents

- NTS Test Report TR020556-14N-B900134, "Natural Frequency Determination of Tyco Anderson Greenwood Crosby Valve Assemblies," Revision 1, dated June 10, 2013
- Wyle Certification Test Report 57539-1, "6" P 8" HB-BP-86 Pressurizer Safety Relief Valve," Revision 0, dated April 20, 2010
- Wyle Laboratories Certification Test Report, Report No. 57539-1, Customer: Anderson Greenwood Crosby, Specimen: 6" P 8" HB-BP-86 Pressurizer Safety Relief Valve, Revision 0, dated April 20, 2010
- National Board Pressure Relief Device Certifications NB-18, Certification No. 15028, Pentair Ltd, dba Anderson Greenwood Crosby (CVM), Design Series: HB (Class 1), Type Classification: Safety Valve, dated June 6, 2013