



**VALCOR ENGINEERING CORPORATION®**

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*Nuclear Business Group*

December 15, 2017  
Valcor/NRC 12162017

U.S. Nuclear Regulatory Commission  
ATTENTION: Document Control Desk  
Washington, D.C. 20555-0001

Subject: Response to a Notice of Nonconformances No. 99900728/I-2017-201-01, 99900728/I-2017-201-02, and 99900728/I-2017-201-03

Reference: NRC Inspection Report No. 99900728/I-2017-201

Enclosed are Valcor Engineering Corporation responses to NRC Report Number 99900728/I-2017-201 and Notice on Nonconformances No. 99900728/I-2017-201-01, -02, and -03.

The enclosure to this letter addresses the reason for the noncompliance, corrective steps that have been taken and the results achieved to date, corrective steps that will be taken to avoid future non-compliances, and the date when all corrective actions will be complete.

Please contact me if you have any questions or require any additional information.

Sincerely,

Mike Swirad  
Nuclear Quality Assurance Manager  
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CC: John P. Burke, Chief Quality Assurance Vendor Inspection Branch-2

Enclosures:

1. Valcor response to Notice of Nonconformance 99900728/I-2017-201-01 99900728/I-2017-201-02, and 99900728/I-2017-201-03

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**Valcor Response to NRC Notice of Nonconformance 99900728/I-2017-201-1**  
**Docket Number: 99900728**  
**Inspection Report Number: 99900728/I-2017-201**

**Noncompliance statement**

**Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," states, in part, that, "The design control measures shall provide for verifying the adequacy of the design, such as by the performance of design reviews, by the use of alternate or simplified calculation methods, or by the performance of a suitable testing program."**

**Contrary to the above, as of October 12, 2017, Valcor failed to fully verify the adequacy of the design of the solenoid valves voltage controllers. Specifically, as part of the design validation process, Valcor did not perform sufficient testing or analysis to verify that the voltage controller would be capable of providing an acceptable output to the valves, including those valves defined as being in a harsh environment resulting from a design basis accident.**

**1. Reason for the Nonconformance**

Each AP1000 PV13 Valve designed by Valcor Engineering Corporation, a Design Report is created as well as an Operability Report. In all cases, the minimum calculated voltage value required for the solenoid valve to pull in (cause valve to change state) was found to have significant margin when compared to the expected initial output of the voltage control box (VCB) plus line loss. The margin was of such scale that Valcor Engineering did not require a separate document detailing the values other than the information found within the Data Sheet Report for Voltage Control Box P/N S1140-23-23, MR 1140-23-23-2, Rev. A, Dated 1/17/2017, and the Engineering Actuator Sizing Analysis Report for Solenoid Valve Margins and Uncertainties, ER 037, Rev. D, Dated 10/07/2016. Additionally, the VCB sees no pressure and is only an electrical appurtenance necessary to extend the life of the process solenoid valve. Because of these factors, the design of the VCB was not fully verified with its own document.

**2. Corrective Steps Taken and the Results Achieved**

Effective at the time of the non-conformance, VCBs have been placed on hold and will not be shipped until the corrective action is completed. Corrective Action CA-2017-041 has been opened and assigned to this non-conformance in accordance with Valcor's Nuclear Quality Program.

At the time of the Nuclear Regulatory Commission inspection, a spreadsheet was created and presented to the inspectors identifying the minimum required voltages to pull-in all seven (7) 1E AP1000 PV13 Design Solenoid Valves along with the anticipated voltage drop due to line loss, for both the hot and cold solenoid coil state. This spreadsheet chronicled the margin of each valve design. Following the NRC inspection, Engineering Report for Westinghouse AP1000 Voltage Control Box P/N S1140-23-23 Output Voltage Design Analysis, ER 045, Rev. A, Dated 12/14/2017, was created. The report details the calculated values proving the VCB is capable of providing an acceptable output to the solenoid valves, including those solenoid valves defined as being in a harsh environment resulting from a design basis accident. The analysis performed within ER 045, indicates that all shipped VCB units have sufficient margin to meet all of their required operation conditions.

### **3. Corrective Steps to Prevent Future Noncompliance**

Further noncompliance will be avoided through the additional testing augmenting the Acceptance Test Report. This ensures every production unit outputs a voltage adequate to initially pull-in the solenoid valve. The testing also ensures the valve remains energized after the drop-down voltage is achieved while simulating the worst case hot and cold coil resistance loads. The margin for all future production VCBs will be verified through the creation of the Engineering Report for Westinghouse AP1000 Voltage Control Box P/N S1140-23-23 Output Voltage Design Analysis, ER 045, Rev. A, Dated 12/14/2017.

The VCB Acceptance Test Reports, TR 1140-23-23, Rev. C, Dated 11/18/2013, and TR 1140-23-25, Rev. C, Dated 2/21/2017, will be revised to add testing necessary to ascertain the initial output of the VCB when minimum, nominal, and maximum voltage is applied to the VCB. Furthermore, every VCB will be tested with a resistive load cell representing the worst case coil high and low resistance values to verify VCB operability.

Additionally, testing in accordance with the Test Report has been determined a 'Critical Characteristic' on the Commercial Grade Dedication Plan (Valcor Q-Drawings) No. S1140-23-23Q, Rev. A, Dated 12/14/2017, and S1140-23-25Q, Rev. A, Dated 12/14/2017, thus ensuring, with reasonable assurance, that every VCB will be able to perform its intended safety function.

### **4. Due Dates for Actions Yet to be Completed**

Expected completion date of corrective action is sixty (60) days following Customer Approval of TR1140-23-23, Rev D, TR1140-23-25, Rev. D, and S1477, Rev. H (Valcor Test Procedure).

**Valcor Response to NRC Notice of Nonconformance 99900728/I-2017-201-2  
Docket Number: 99900728  
Inspection Report Number: 99900728/I-2017-201**

**Noncompliance statement**

**Criterion III of Appendix B to 10 CFR Part 50 states in part that, "Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions for the structures, systems and components."**

**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. 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."**

**Contrary to the above, as of October 12, 2017, Valcor failed to ensure the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the solenoid valves. In addition, Valcor failed to establish appropriate measures for source evaluation or inspection at the contractor or subcontractors. Specifically:**

**Each sub-part and the responses for Reason, Correction, Corrective Action and Expected Completion Dates are identified on the following pages. Corrective Action CA-2017-028 has been opened and assigned to this non-conformance in accordance with Valcor's Nuclear Quality Program.**

**1. Valcor did not identify an appropriate set of critical characteristics for the voltage controller and the specified production testing was not adequate to fully verify the performance of the controller. The production testing did not verify the pull-in output voltage of the controller under the full range of input voltages, contained an acceptance criteria for the controller output of 180 VOC plus or minus 10 percent without any appropriate justification, and was performed under less than fully loaded conditions.**

**1. Reason for the Nonconformance**

The VCB P/N S1140-23-23 and S1140-23-25 critical characteristics were taken from Dedication of Commercial Grade Items for Nuclear Safety Related Applications, S2002, Rev. M. No additional critical characteristics were identified at that time other than to ensure the VCB operated satisfactorily in accordance with its Acceptance Test Report and Seismic / ElectroMagnetic Compatibility Qualification Testing. Valcor did verify the VCB holding voltage through the full range of input voltage, but failed to verify the initial VCB output voltage was within tolerance through the full range of input voltages. Valcor tested the VCB under nominal load condition and failed to utilize resistive loads that simulated worst case solenoid coil resistances. The minus ten (10) percent tolerance value was based on the voltage drop caused by the VCB electronic circuit.

**2. Corrective Steps Taken and the Results Achieved**

Critical Characteristics were established on Q Drawings S1140-23-23Q, Rev. A, Dated 12/14/2017, and S1140-23-25Q, Rev. A, Dated 12/14/2017. The 180 VDC minus 10% tolerance is justified within Engineering Document ER 045, Rev. A, Dated 12/14/2017, which performs the analysis showing that the margin to operate the solenoid valve is sufficient to operate all the AP1000 PV13 1E solenoid valves.

**3. Corrective Steps to Prevent Future Noncompliance**

Acceptance Test Reports, TR1140-23-23 and TR1140-23-25, will be revised to add tests to fully verify the initial VCB output voltage as well as the holding voltage throughout the entire range of input voltages. Additionally, the VCB will be tested under worst-case load conditions to verify satisfactory operability.

**4. Due Dates for Actions Yet to be Completed**

Expected completion date of corrective action is sixty (60) days following Customer Approval of TR1140-23-23, Rev D, TR1140-23-25, Rev. D, and S1477, Rev. H (Valcor Test Procedure).

**2. Valcor did not establish the technical basis to verify the suitability of the materials for the selection of the sample population for nondestructive and destructive testing of O-Rings, helical springs, stop springs and other commercial-grade items as part of the commercial-grade dedication process.**

**1. Reason for the Nonconformance**

The technical basis for the Commercial Grade Dedication sample basis used for O-rings, helical springs, stop springs and other commercial grade items was taken from Dedication of Commercial Grade Items for Nuclear Safety Related Applications Procedure S2002, Rev. M, which was written to coincide with Plant Engineering Guideline for the Acceptance of Commercial Grade Items in Nuclear Safety-Related Applications, EPRI NP-5652, and Valcor Standard S1503, Revision E, Standard Inspection Sampling Plan, based on MIL-STD-105 which was understood to be the industry standard guideline for Commercial Grade Dedication at the time.

**2. Corrective Steps Taken and the Results Achieved**

Dedication of Commercial Grade Items for Nuclear Safety Related Applications Procedure S2002, has been revised to Revision R on 9/5/2017, which included tables identifying Normal, Reduced, and Tightened Plan Sample Size and Destructive Test Sampling requirements. These tables along with vendor quality performance parameters, vendor survey, and the creation of part-specific Q-Drawings are all utilized to ensure the technical basis is met to verify the suitability of the materials for the selection of the sample population for nondestructive and destructive testing of O-Rings, helical springs, stop springs and other commercial-grade items as part of the commercial-grade dedication process.

**3. Corrective Steps to Prevent Future Noncompliance**

The technical basis of the sample population for commercial grade items, Valcor utilizes various factors including: part complexity, lot size, homogeneous or non-homogeneous lots provided, vendor overall rating, number of rejections by vendor with significant findings, vendor survey results, and vendor's performance when supplying the specific item.

Valcor has added fields to all Q-Drawings which document the sample plan and justification for each purchased lot. When each part is dedicated, the specific lot unique to each purchase order is evaluated and sample plan determined, based on the criteria listed above.

**4. Due Dates for Actions Yet to be Completed**

All Correctives steps to correct future noncompliance will be completed by 1/31/2018.

**3. Valcor did not use the correct sample size as to verify the suitability of the material of the O-Rings by a durometer and Fourier-transform infrared spectroscopy (FTIR) analysis, and other commercial-grade items by FTIR analysis as part of the commercial-grade dedication process.**

**1. Reason for the Nonconformance**

Valcor's procedure, S2002, Dedication of Commercial Grade Items for Nuclear Safety Related Items, Section 11.2.1 states:

*If the supplier's documentation indicates that all of the parts are from the same heat number, production lot number, or batch number, then there is a high level of confidence that all of the received parts will have similar properties. Therefore, in this instance, the sample size shall be one piece per lot.*

All O-rings are packaged in a sealed bag with full traceability identification from the vendor. Receiving inspection verifies the packaging and condition of the O-rings prior to detailed inspection of the O-rings.

Based on section 11.2.1 in S2002, the sealed packages with full traceability and the fact each of Valcor's purchase order line items impose all components to be built from one homogeneous lot of material, Valcor used only 1 part for Durometer and Fourier-Transform Infrared Spectroscopy (FTIR) analysis.

**2. Corrective Steps Taken and the Results Achieved**

Valcor immediately stopped using only 1 sample for Durometer destructive testing and FTIR analysis. Inspectors were trained to follow the appropriate tables (Table 11.1 – Non-Destructive Test and Sampling Plan or Table 11.2 – Destructive Test and Sampling Plan) in S2002 regardless if the supplier's documentation indicates that all of the parts are from the same heat number, production lot number, or batch number. 10 CFR Part 21 evaluation was initiated in accordance with Valcor internal procedure S2110 Revision K to evaluate the extent of the condition.

**3. Corrective Steps to Prevent Future Noncompliance**

Inspectors will continue to follow the appropriate tables (Table 11.1 – Non-Destructive Test and Sampling Plan or Table 11.2 – Destructive Test and Sampling Plan) in S2002 regardless if the supplier's documentation indicates that all of the parts are from the same heat number, production lot number, or batch number.

Engineering and Quality will complete an evaluation and justification for any items Valcor believes can follow reduced inspection.

S2002 will be modified to incorporate the changes for reduced inspection which will also include the need for Commercial Grade Surveys.

**4. Due Dates for Actions Yet to be Completed**

All Correctives steps to correct future noncompliance will be completed by 1/31/2018.

**4. Valcor did not establish the acceptance criteria for the verification of material hardness properties of the O-Rings to ensure that they met the material specification as part of the commercial-grade dedication process. Valcor instead relied on a range value provided in the commercial supplier's Certificate of Conformance without performing a commercial-grade survey or source surveillance to verify their validity.**

**1. Reason for the Nonconformance**

Durometer acceptance criteria was not included as part of the CGD plan for O-rings, S101Q, because Valcor Engineering used the material compound data sheet tolerances provided by the manufacturer as the tolerance for acceptance. The manufacturer is the design authority for the parts supplied to Valcor. S101, O-Ring Standard for Size and Compound, lists each compound by manufacturer and the compound number. The number includes the nominal value for durometer hardness. The manufacturer certifies the material including the durometer and Valcor's receiving inspection performs a verification. Due to the receiving inspection verification, no commercial grade survey or source surveillance was deemed necessary. Receiving inspectors verified the durometer to the manufacturer's certification because the durometer's acceptable tolerance was not clearly defined in S101Q.

**2. Corrective Steps Taken and the Results Achieved**

The Commercial Grade Dedication Plan, S101Q, was revised to revision C on 10/16/2017 to include acceptance criteria for the material compounds purchased based on the critical characteristics defined by Valcor Engineering.

The extent of the condition was evaluated by Engineering and Quality by reviewing all of the receiving inspection records. The tolerance value used during receiving inspection from the manufacturer's certification match the expected values for the durometer hardness which are now detailed in S101Q.

**3. Corrective Steps to Prevent Future Noncompliance**

The corrective actions already taken with changes to S101Q will prevent future non-compliance.

**4. Due Dates for Actions Yet to be Completed**

All Correctives steps to correct future non-compliances are complete.



**5. Valcor did not perform a commercial-grade survey or source surveillance of the commercial suppliers of the helical springs and top springs, to verify the validity of the Certificates of Conformance provided by these suppliers for the heat treatment and tensile strength, identified as critical characteristics.**

**1. Reason for the Nonconformance**

The Commercial Grade Dedication procedure, S2002 - Revision M, did not identify Heat Treat or Tensile Strength as a critical characteristics for springs. Tensile strength minimum values are listed on both spring drawings to achieve the desired spring rate and load @ length as listed on spring drawings. To achieve Tensile Strength proper heat treating at time and temperature as indicated on Valcor's drawings is necessary. Valcor verifies the spring rate or load @ length, when identified as critical characteristics, during receiving inspection as part of the commercial grade dedication. Acceptable values for spring rate or load @ length gives reasonable assurance the tensile values produced using proper heat treatment controls are correct and that the spring will perform its intended safety function.

**2. Corrective Steps Taken and the Results Achieved**

One of 3 spring suppliers utilized by Valcor had commercial grade survey performed in October 2017. In December 2017, Valcor obtained a third party audit report through our NIAC membership and validated the second spring vendor as an Appendix B compliant.

Valcor has performed evaluation for the extent of the condition and concluded that based on Valcor as the design authority for the springs, the supplier's performance over the past 10 years (receiving inspection records), and no reportable field incidents, all springs installed and supplied to Valcor's customers meet design drawing and will perform as designed.

**3. Corrective Steps to Prevent Future Noncompliance**

Valcor will perform a commercial grade survey on the third spring supplier.

As part of the revision to Valcor's commercial grade dedication process, Valcor will utilize the Q-drawings to determine if a commercial grade survey is required based on the Engineering justification provided.

**4. Due Dates for Actions Yet to be Completed**

All Correctives steps to correct future noncompliance will be completed by 1/31/2018.

**Valcor Response to NRC Notice of Nonconformance 99900728/I-2017-201-3**

**Docket Number: 99900728**

**Inspection Report Number: 99900728/I-2017-201**

**Noncompliance statement**

Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50, states that "Measures shall be established to assure that tools, gages, instruments, and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within necessary limits."

Certificate of Calibration No. 11000 for the rubber hardness test blocks from PTC Metrology, the calibration supplier, states that "Test Blocks are not to be used for Durometer calibration per ASTM D2240. Test blocks are intended to monitor changes in Durometer performance."

Note 2 in Section 10, "Report," of ASTM D2240, "Standard Test Method for Rubber Property- Durometer Hardness," 2015 Edition, states, in part, that "periodic checking of the operation and state of durometer calibration using commercially available rubber test blocks (refer to 7.8), specifically designed for this purpose, is recommended." Subsection 7.8 of Section 7, "Calibration," of ASTM D2240, states, in part, that "the rubber reference block(s) provided for verifying durometer operation and state of calibration are not to be relied upon as calibration standards."

Contrary to the above, as of October 12, 2017, Valcor failed to assure that measuring and test devices used in activities affecting quality were properly calibrated. Specifically, Valcor calibrated a durometer (serial No. 120978/KRW006) Using a rubber test block kit (serial No. 120978/WOT004), contrary to the requirements of ASTM D2240. This durometer was used during the commercial-grade dedication process to verify the material hardness properties of the O-Rings used in the solenoid valves.

**1. Reason for the Nonconformance**

The calibration technician listed the incorrect calibration method on the equipment control & calibration card in March 2009. The lack of Valcor QA oversight to review the calibration methods is a contributing factor to the nonconformance.

**2. Corrective Steps Taken and the Results Achieved**

Durometer hardness tester SHORE serial number 120978/KRW006 was removed from service on October 12, 2017 and sent to an approved calibration facility for calibration in accordance with ASTM D2240. The equipment control & calibration card that defines method of calibration was revised to reflect correct method of the durometer tester calibration. On October 26, 2017 Valcor was notified verbally by the calibration supplier that durometer tester was found out of calibration and was beyond repair. Valcor received formal report of calibration on October 30, 2017 and initiated Material Rejection Report (MRR) #853AB to document failed calibration condition. On November 7, 2017, a newly purchased and calibrated IAW ASTM D2240 replacement durometer hardness REX serial number KRW006 was placed into service. Corrective Action CA-2017-032 has been opened and assigned to this non-conformance in accordance with Valcor's Nuclear Quality Program.

On November 27, 2017, per disposition by the Material Review Board and as documented on Valcor MRR #853AB, the SHORE tester serial number 120978/KRW006 was scrapped and 10 CFR Part 21 evaluation was initiated in accordance with Valcor internal procedure S2110 Revision K.

**3. Corrective Steps to Prevent Future Noncompliance**

Valcor Calibration Procedure Control Requirement standard S1618 will be revised to include requirement for all new specialty gages entered into Valcor calibration system to have calibration method reviewed and approved by Quality Assurance. Training session will be held after the document release to make sure that all calibration technician are aware on the new requirement.

**4. Due Dates for Actions Yet to be Completed**

All Correctives steps to correct future noncompliance will be completed by 1/31/2018.