



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

December 1, 2017

Melanie Dirks, Quality Manager  
SOR Inc.  
14685 West 105th Street  
Lenexa, KS 66215

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION REPORT OF SOR  
INC. NO. 99900824/2017-201, AND NOTICE OF NONCONFORMANCE

Dear Ms. Dirks:

On October 16-20, 2017, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the SOR Inc. (hereafter referred to as SOR) facility in Lenexa, Kansas. The purpose of this limited-scope routine inspection was to assess SOR's compliance with 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 SOR's quality assurance (QA) program activities including the design, fabrication, testing, and dedication of nuclear qualified pressure, differential pressure, vacuum and temperature switches supplied to the domestic nuclear operating fleet. The enclosed report presents the results of this inspection.

During this inspection, the NRC inspectors found that the implementation of your QA program failed to meet certain regulatory requirements imposed on you by your customers. Specifically, the NRC identified multiple examples where SOR failed to qualify safety-related switches in accordance with technical and purchase order requirements to verify the switches could meet their intended safety function under the most adverse design conditions. The specific findings and references to the pertinent requirements are identified in the enclosures to this letter. Please provide a written explanation or statement within 30 days from the date of this letter in accordance with the instructions specified in the enclosed Notice of Nonconformance (NON). We will consider extending the response time if you show good cause for us to do so. In response to the enclosed NON, SOR should also document the results of the extent of condition review for the findings and determine if there are any effects on other safety-related components.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," the NRC will make available electronically for public inspection a copy of this letter, its enclosure, and your response through the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, which is accessible at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible (and if applicable), your response should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy

or proprietary information is necessary to provide an acceptable response, 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 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 would create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

**/RA/**

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

Docket No.: 99900824

Enclosures:

1. Notice of Nonconformance
2. Inspection Report No. 99900824/2017-201  
and Attachment

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION REPORT OF SOR  
INC. NO. 99900824/2017-201, AND NOTICE OF NONCONFORMANCE

Dated: December 1, 2017

DISTRIBUTION:

ASakadales

JBurke

KKavanagh

ConE Resource

NRO\_DCIP Distribution

MDirks@sorinc.com

**ADAMS Accession No.: ML17324B317**

\*via e-mail

NRO-002

<b>OFFICE</b>	NRO/DCIP	NRO/DCIP	NRO/DCIP	NRO/DCIP
<b>NAME</b>	AArmstrong	NSavvoir	SSmith	TJackson
<b>DATE</b>	11/30/17	11/30/17	11/30/17	12/01/17

**OFFICIAL RECORD COPY**

## NOTICE OF NONCONFORMANCE

SOR Inc. Corporation  
14685 West 105th Street  
Lenexa, KS 66215

Docket No. 99900824  
Report No. 2017-201

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the SOR Inc. facility in Lenexa, KS, on October 16-20, 2017, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on SOR by NRC licensees.

- A. Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," states in part that, "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." SOR's Quality Assurance Manual 8303-100, Section 3, "Design Control," states, in part, "that the engineering department is responsible for adherence to applicable industry codes, standards, and regulations as well as product reliability, safety, and suitability for applications." IEEE 323-1983, Section 6.2.2, "Qualified Life Objective," states, in part, "A qualified life objective shall be determined consistent with the specification requirements, the anticipated capabilities of the equipment, and any limitations imposed by the specified aging program." Section 6.5.4, "Determination of Qualifications," states in part, "The equipment shall be considered qualified through demonstration that its performance meets or exceeds that required under the specific service conditions during its qualified life." Section 8.3. "Type Test Data," 7e, states in part, "the report of test results shall include summary of test data, accuracy, and anomalies." Section 8 states, in part, the qualification documentation shall provide documented evidence of analytical methods, computer program, or mathematical models used for the verification methods.

Contrary to the above, on October 20, 2017, SOR Test Report 9058-102, Revision 2, dated 1992, failed to include suitable qualification testing of prototype units under the most adverse design conditions to verify the adequacy of the design of safety-related switches as described by the examples below.

1. SOR failed to analyze how the current-carrying switch terminal and current-carrying conductor temperature rise would impact the qualified life of safety-related switches. Additionally, they failed to provide an adequate technical justification for activation energies used in the aging effects calculations.
2. SOR failed to demonstrate that safety-related temperature, pressure, and vacuum switches could perform their safety function at the bounding conditions of the adjustable ranges for pressure and temperature.
3. SOR failed to document how test anomalies affected the qualification of switches; particularly anomalies associated with hydrostatic pressure tests, repeatability tests, and pre-seismic test deviations. Specifically, SOR failed to evaluate anomalies with qualified switches against acceptance criteria to determine if the anomalies could invalidate the qualification.

These issues have been identified as Nonconformance 99900824/2017-201-01.

- B. Criterion IV, "Procurement Document Control," of Appendix B, 10 CFR Part 50, states, in part, that, measures shall be established to assure that applicable requirements which are necessary to assure adequate quality are suitably included or referenced in the documents for procurement." SOR Procedure 8520-059, "Procedure for Processing Nuclear Orders," Revision 17, Step 6.14 states, in part, "that authorized quality assurance personnel review all documentation to ensure that it is complete and approves the certificate of conformance and inspection."

Contrary to the above, SOR supplied a pressure switch to Exelon (LaSalle) with a certificate of conformance which stated the switch was environmentally and seismically qualified in accordance with Qualification Report 9058-112, Revision 3. However, the qualification report provided conflicting information, including statements that the switch configuration ordered by LaSalle did not meet qualification requirements.

This issue has been identified as Nonconformance 99900824/2017-201-02.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Quality Assurance Vendor Inspection Branch-1, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Nonconformance. This reply should be clearly marked as a "Reply to a Notice of Nonconformance" and should include for each noncompliance: (1) the reason for the noncompliance or, if contested, the basis for disputing the noncompliance; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid further noncompliance; and (4) the date when the corrective action will be completed. Where good cause is shown, the NRC will consider 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, 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 the NRC can make it 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 would create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards SGI is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this the 1<sup>st</sup> day of December 2017.

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

Docket No.: 99900824

Report No.: 99900824/2017-201

Vendor: SOR Inc.  
14685 West 105th Street  
Lenexa, KS, 66215

Vendor Contact: Melanie Dirks, Quality Manager  
MDirks@sorinc.com

Nuclear Industry Activity: This technically-focused inspection evaluated SOR's design, fabrication, testing, and dedication of nuclear qualified pressure, differential pressure, vacuum and temperature switches which are being supplied to the domestic nuclear operating fleet.

Inspection Dates: October 16-20, 2017

Inspection Team Leader: Aaron Armstrong      NRO/DCIP/QVIB-1, Team Leader

Inspectors: Stacy Smith      NRO/DCIP/QVIB-1  
Nicholas Savvoir      NRO/DCIP/QVIB-1  
Khalid Al Naqbi      Federal Authority for Nuclear Regulation  
   (FANR) observer

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

## **EXECUTIVE SUMMARY**

SOR, Inc.  
99900824/2017-201

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this vendor inspection to verify that SOR Inc. (hereafter referred to as SOR) 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 team also verified that SOR 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 from October 16-20, 2017. This was the second inspection of the Lenexa, KS facility.

This technically-focused inspection evaluated SOR's design, fabrication, testing, and dedication of nuclear qualified pressure, differential pressure, vacuum and temperature switches supplied to the domestic nuclear operating fleet. Additionally, this inspection evaluated the implementation of select portions of SOR's quality assurance (QA) program activities of Appendix B to 10 CFR Part 50 and 10 CFR Part 21.

The following regulations served as the basis for this NRC inspection:

- Appendix B to 10 CFR Part 50; and,
- 10 CFR Part 21.

Inspection procedure (IPs) used for this inspection include IP 43002, "Routine Inspections of Nuclear Vendors," dated January 27, 2017, IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated January 1, 2017, and IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance," dated February 13, 2012.

The results of this inspection are summarized below.

### **Part 21**

The NRC inspection team determined that SOR's 10 CFR Part 21 program meets the regulatory requirements of 10 CFR Part 21. Based on the limited sample of documents reviewed, the NRC inspection team also determined that SOR is implementing its policies and procedures associated with the 10 CFR Part 21 program. No findings of significance were identified.

### **Design Control and Qualification of Safety-Related Switches**

The NRC inspection team concluded that SOR has not fully implemented their procedure for design control in accordance with the regulatory requirements of Criterion III "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team issued Nonconformance 99900824/2017-201-01 for SOR's failure to: (1) appropriately consider aging factors that could impact qualified life; (2) demonstrate that switches could perform their safety function at the bounding conditions of their adjustable range; and, (3) evaluate anomalies that occurred during qualification testing to determine if the anomalies could invalidate the qualification.

### Design Control and Dedication of Safety-Related Switches

The NRC inspection team concluded that SOR has not fully implemented their procedure for processing nuclear orders in accordance with the regulatory requirements of Criterion IV "Procurement Document Control," of Appendix B to 10 CFR Part 50. The NRC inspection team issued Nonconformance 999000824/2017-201-02 for SOR's failure to assure qualification requirements, which are necessary to verify that a safety-related switch could meet its intended safety function under the most adverse design conditions, were suitably included or referenced in procurement documents.

### Oversight of Contracted Activities and Internal Audits

The NRC inspection team concluded that SOR is implementing its oversight of contracted activities in accordance with the regulatory requirements of Criterion VII, "Control of Purchased Material, Equipment, and Services," and Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed and interviews conducted, the NRC inspection team also determined that SOR is adequately implementing its policies and procedures associated with its oversight of contracted activities. No findings of significance were identified.

### Control of Measuring and Test Equipment (M&TE)

The NRC inspection team concluded that SOR has established control of M&TE in accordance with the regulatory requirements of Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed and interviews conducted, the NRC inspection team also determined that SOR is adequately implementing its policies and procedures associated with its control of M&TE. No findings of significance were identified.

### Nonconforming Materials, Parts, or Components and Corrective Action

The NRC inspection team determined that SOR's Nonconformance and Corrective Action programs met the regulatory requirements of Criterion XV, "Nonconforming Materials, Parts, or Components," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that SOR is implementing its policies and procedures associated with the Nonconformance and Corrective Action programs. No findings of significance were identified.

## **REPORT DETAILS**

### **1. 10 CFR Part 21 Program**

#### **a. Inspection Scope**

The NRC inspection team reviewed SOR Inc.'s (hereafter referred to as SOR's) policies and implementing procedures that govern SOR's 10 CFR Part 21, "Reporting of Defects and Noncompliance," program to verify compliance with regulatory requirements. In addition, the NRC inspection team evaluated a sample of SOR's purchase orders (POs) for compliance with the requirements of 10 CFR 21.21, "Notification of Failure to Comply or Existence of a Defect and its Evaluation," and 10 CFR 21.31, "Procurement Documents." The NRC inspection team also verified that SOR's nonconformance and corrective action procedures provide a link to the 10 CFR Part 21 program.

The NRC inspection team also discussed the 10 CFR Part 21 program with SOR's management and technical staff.

The documents reviewed by the inspectors are included in the attachment to this inspection report.

#### **b. Observations and Findings**

No findings of significance were identified.

#### **c. Conclusion**

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

### **2. Design Control and Qualification of Safety-Related Switches**

#### **a. Inspection Scope**

The NRC inspection team reviewed SOR's policies and implementing procedures that govern the design control and qualifications for SOR's pressure, temperature and vacuum switches to verify their compliance with the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team reviewed a sample of switch POs, engineering drawings and schematics, administrative procedures, engineering procedures, assembly/test procedures, manufacturing procedures, design verification procedures/reports, and corrective action reports.

The qualification reports for the following safety-related switch POs were reviewed:

- Vacuum Switch 5TA-B45-U8-C1A-JJTTNQ for Entergy Nuclear Vermont Yankee PO #418906, dated June 21, 2004
- Vacuum Switch 54N6-BB118-M4-C1A-JJTTNQ for Exelon- Peach Bottom PO #598160, dated January 8, 2015
- Pressure Switch 9RT-BB5-U1-C2A-JJTTNQ for Xcel PO #530114, dated January 11, 2011

The documents reviewed by the inspectors are included in the attachment to this inspection report.

b. Observations and Findings

The NRC inspection team reviewed Test Report 9058-102, Revision 2 and Test Plan 9058-101, Revision 8. These reports qualified SOR temperature, pressure, and vacuum switches for use in Class 1E applications for nuclear power generating stations. Qualification Test Report 9058-102, Revision 2, encompassed 10 different switch models, with a total of 35 different specimens. Product descriptions include, model number, serial number, adjustable range, maximum operating pressure, maximum operating temperature, electrical rating, sensing bulb, and fill media. Switch models are designated by their combination of subcomponents, which included pistons, housings, switch elements, spring, diaphragms, pressure ports, conduit adapters, nameplates, and nuclear designators. SOR's pressure, vacuum, and temperature switch models in the qualification report, consist of the above subcomponents used in various combinations and are listed in the document section of this report.

Qualified Life

Test Report 9058-102, Revision 2, described the thermal aging of switches to an equivalent of 20 years, assuming a maximum service temperature of 120°F. Test Plan 9058-101, Revision 8, was used for the qualification and Section 1 of the plan, stated, "SOR pressure, vacuum, and temperature switches meet or exceed the requirements for Class 1E qualification as specified by IEEE Std. 323-1974 and 1983." IEEE 323-1983, Section 6.2.2, "Qualified Life Objective," states, "A qualified life objective shall be determined consistent with the specification requirements, the anticipated capabilities of the equipment, and any limitations imposed by the specified aging program."

The aging temperature and duration that were used to determine qualified life of the switch were calculated using the Arrhenius equation and SOR's selection of activation energy. During thermal aging, the switches were in the de-energized state. SOR determined that having the switch de-energized during aging does not demonstrate the effects of an aged, energized switch. Therefore, SOR demonstrated the effects of aging on an energized switch through a combination of additional testing and comparative data by performing a temperature rise test. The temperature rise test was performed on a vacuum switch (54N6-BB118-M4-C1A-JJTTNQ) which SOR identified as a representative sample of the worst case. During the test, it was determined that

temperatures at the current-carrying switch element terminal and conductor wire would receive the highest temperatures. However, SOR failed to address these impacts on the qualified life.

In addition to the above, SOR failed to justify the basis for selection of activation energies. IEEE 323-1983, Section 8, states, in part, qualification documentation shall provide documented evidence of analytical methods, computer program, or mathematical models used for the verification methods. The aging acceleration rate and activation energies used during qualification testing, and the basis upon which the rate and activation energy were established, should be defined, justified, and documented.

Based on the above issues, the inspection team determined that SOR failed to adequately evaluate the impact of switch energization on the qualified life of Class 1E switches and also failed to provide a technical justification for activation energies used in determining the qualified life of the switches. The inspection team determined that SOR's failure to address these impacts on the qualified life is the first example of Nonconformance 999000824/2017-201-01.

#### Adjustable Ranges

The NRC inspection team reviewed SOR's seismic qualification analysis calculations for Test Report 9058-102, Revision 2. Test Plan 9058-101, Revision 8, Section 1, stated, "SOR pressure, vacuum, and temperature switches meet or exceed the requirements for Class 1E qualification as specified by IEEE std. 323-1974 and 1983." IEEE 323-1983, Section 6.5.4, "Determination of Qualifications," stated in part, "The equipment shall be considered qualified through demonstration that its performance meets or exceeds that required under the specific service conditions during its qualified life."

The NRC inspection team identified that safety-related temperature switch models 201TA-W125-U9-C7A-JJTTNQ and 201TA-W134-U9-C7A-JJTTNQ have adjustable ranges below the specified temperatures stated in the test report. The span of temperature between upper and lower limits within which the temperature switch can be adjusted to actuate or de-actuate was not analyzed. The adjustable range is the span of temperature/pressure between the upper and lower limits within which the temperature/pressure switch can be adjusted to actuate/de-actuate. SOR failed to demonstrate through qualification analysis that safety-related temperature, pressure, and vacuum switches could perform their safety function at the bounding conditions (upper and lower limits) of the adjustable range for the pressure and temperature of the switch. The NRC inspection team determined this is the second example of Nonconformance 999000824/2017-201-01.

#### Anomalies

In accordance with IEEE 323-1974 and 1983, SOR developed Test Plan 9058-101, Revision 8. IEEE 323-1983, Section 8.3. "Type Test Data," 7e, states in part, "the report of test results shall include summary of test data, accuracy, and anomalies." The test plan encompassed a test sequence and matrix with functional tests performed throughout the qualification program. The baseline functional test, post-radiation test, post-cycle test, post-seismic test, post-loss-of-coolant accident (LOCA) test, and post-high energy line break (HELB 2) test required a hydrostatic test in which the maximum operating pressure is applied for a period of time and the test specimen

monitored for leakage. In addition, the functional test required test personnel to record switch operability according to a specified accuracy and contact resistance. Test Plan 9058-101, Revision 8, Section 1, states, SOR pressure, vacuum, and temperature switches meet or exceed the requirements for Class 1E qualification as specified by IEEE std. 323-1974 and 1983.

During the surveillance performed by Tennessee Valley Authority for SOR, their personnel observed leaks during the hydrostatic test for the 9RT-B45-U8-C2A-JJTTNQ pressure switch. During the testing, the 9RT-B45-U8-C2A-JJTTNQ pressure switch had to retain a maximum operating pressure of 2500 psi for a period of 10 minutes without leakage. The test was incapable of retaining 2500 psi for 10 minutes without a pressure drop. In discussions with SOR engineering personnel, SOR determined the leakage was not indicative of a failure, but rather how the source pressure was applied in the test apparatus. The NRC inspection team noted the leakage could also be attributed to a non-catastrophic failure of the switch, which could lead to the switch not performing its intended safety function. SOR engineering personnel expressed to the inspection team the test was susceptible to such factors as in-trapped air bubbles, changes in temperature, and minute changes in volume due to quick-connect fittings and seals. SOR did not determine the cause of the leakage or isolate the failure to the test fixture, but they did implement corrective actions to fix the hydrostatic test fixture. The NRC inspection team found that SOR failed to document what was performed to fix the test apparatus. In addition, SOR failed to provide objective evidence of demonstrating acceptability in the subsequent test.

As a second example, SOR failed to document how pressure and temperature switch anomalies met test qualification requirements established in baseline functional tests for switch operability and contact resistance. Test Report 9058-102, Revision 2, Section 6.1.0 states, "SOR Test Plan 9058-101 require that all test specimens be subject to a switch operability test." Switch operability criteria consisted of setpoint, dead band and repeatability. Test Report 9058-102, Revision 2, Section 6.1.2, states specimen insulation resistance will be compared to the specified manufacturing requirement of 100MΩ. The switch models, with operability anomalies, are listed in the document section of this report along with the test anomaly occurred. The NRC inspection team observed the insulation resistance during the post-HELB 1 and 2 test significantly declined. The insulation resistance of switch 9RT-B45-U8-C2A-JJTTNQ was originally in excess of 100MΩ during the baseline functional test, but declined to 1MΩ following the HELB 1 test and 5MΩ following the HELB 2 test. All switches passed the dielectric final test except the 9RT-B45-U8-C2A-JJTTNQ pressure switch, which experienced a current leakage at 900 VAC. Test Plan 9058-101, Revision 8, Section 5, states, "At the conclusion of the qualification program check dielectric strength by slowly increasing the voltage until the leakage light comes on or until 1500 VAC is attained." SOR failed to evaluate the impacts of insulation resistance and dielectric strength anomalies on switch qualification." These issues are documented in CAR 972.

Lastly, the NRC inspection team identified SOR pressure switch 9RT-B45-U8-C2A-JJTTNQ (S/N 92-6-7039) was damaged prior to being seismically tested. The cause of the damage was never documented in the qualification report. It was not clear to the NRC inspection team as to how the switch was damaged or if the damage could affect the switch's ability to perform its intended safety function. The failure of SOR to document how test anomalies affected the qualification of safety-related switches is the third example of Nonconformance 99900824/2017-201-01.

c. Conclusion

The NRC inspection team concluded that SOR did not adequately implement their procedure for design control in accordance with the regulatory requirements of Criterion III "Design Control," of Appendix B to 10 CFR Part 50, as demonstrated by SOR's failure to include suitable qualification testing of a prototype unit under the most adverse design conditions to verify the adequacy of the design of safety-related switches. The NRC inspection team issued Nonconformance 999000824/2017-201-01 for SOR's failure to: (1) appropriately consider aging factors that could impact qualified life; (2) demonstrate that switches could perform their safety function at the bounding conditions of their adjustable range; and, (3) evaluate anomalies that occurred during qualification testing to determine if the anomalies could invalidate the qualification.

3. Design Control and Dedication of Safety-Related Switches

a. Inspection Scope

The NRC inspection team reviewed SOR's policies and implementing procedures for the design, commercial grade dedication (CGD), inspection, qualification, and testing of safety-related switches to verify compliance with the regulatory requirements of Appendix B to 10 CFR Part 50. The NRC inspection team reviewed CGD of parts used to assemble safety-related switches and inspections performed after SOR manufactured parts to ensure design requirements were met. Additionally, the NRC inspection team reviewed qualification reports and testing activities necessary to verify that safety-related switches met the technical and quality requirements established by the specifications identified in their customers' POs. Specifically, the inspectors reviewed the POs, qualification reports, incoming inspections, acceptance tests, measuring and test equipment (M&TE) records, applicable standards, and certificates of compliance of safety-related switch orders.

The safety-related switch packages related to the following POs were reviewed:

- Pressure switch 6N6-W3-U8C1A-JJTTNQ for TVA PO 3081088, dated June 28, 2017,
- Differential pressure switch 141N6-W4-M9-C1A-JJTTNQ for PSEG PO 4500981733, dated July 13, 2017, and
- Differential pressure switch 141N6-WX47-MX-C1A-JJTTNQ for Exelon PO 00497639.

The NRC inspection team also observed a portion of the temperature influence test and assembly of three pressure switches (Part No. 9N6-B5-U1-C1A-JJTTNQ). The team verified M&TE used for the assembly and testing was calibrated appropriately. In addition, the NRC team observed the quality inspection performed after manufacturing of 141 Lo Side ports (Part No. 8923469 – Work Order 1194210).

The documents reviewed by the inspectors are included in the attachment to this inspection report.

b. Observations and Findings

Exelon PO 00497639 requested that SOR provide a 141N6 series differential pressure switch, environmentally and seismically qualified in accordance with Qualification Report 9058-112, Revision 3. The standard configuration of the switch Exelon ordered included a u-cup seal above and below the diaphragm. Exelon requested that the switch use O-rings in place of the u-cup configuration. SOR supplied a pressure switch to Exelon (LaSalle) with the O-ring configuration as requested and a certificate of conformance stating the switch was environmentally and seismically qualified in accordance a Qualification Report 9058-112, Revision 3. Procedure 8520-059, "Procedure for Processing Nuclear Orders," Revision 17, Step 6.14, stated that "authorized quality assurance personnel review all documentation to ensure that it is complete and approves the certificate of conformance and inspection." During the review of this package, the NRC inspection team identified that Qualification Report 9058-112, Revision 3, provided conflicting information to the certificate of conformance and itself. Specially, the qualification report stated the switch configuration ordered by Exelon was not analyzed (O-ring in place of the u-cup). In addition, the report summary stated the switches qualified in accordance with this report are qualified for 20 years and 30 MRad. However, Table 1 of Appendix A to this report states that the qualified life is 10 years and 15MRad for the switch with the most similar configuration to the pressure switch supplied to Exelon. SOR's failure to assure that applicable requirements which are necessary to assure adequate quality are suitably included or referenced in the documents for procurement resulted in Nonconformance 999000824/2017-201-02.

c. Conclusion

The NRC inspection team concluded that SOR has not implemented their procedure for processing nuclear orders in accordance with the regulatory requirements of Criterion IV "Procurement Document Control," of Appendix B to 10 CFR Part 50. The NRC inspection team issued Nonconformance 999000824/2017-201-02 for SOR's failure to assure qualification requirements, which are necessary to verify that a safety-related switch could meet its intended safety function under the most adverse design conditions, were suitably included or referenced in procurement documents.

Oversight of Contracted Activities and Internal Audits

a. Inspection Scope

The NRC inspection team reviewed SOR's policies and implementing procedures that govern the implementation of its control of purchased material, equipment, and services program to verify compliance with the requirements of requirements in Criterion VII, "Control of Purchased Material, Equipment, and Services," and Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50. The NRC inspection team also discussed the oversight of contracted activities and with SOR's management and technical staff.

The documents reviewed by the inspectors are included in the attachment to this inspection report.

b. Observations and Findings

No findings of significance were identified.

c. Conclusion

The NRC inspection team concluded that SOR has established its oversight of contracted activities in accordance with the regulatory requirements of Criterion VII, "Control of Purchased Material, Equipment, and Services," and Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed and interviews conducted, the NRC inspection team also determined that SOR is adequately implementing its policies and procedures associated with its oversight of contracted activities. No findings of significance were identified.

4. Control of Measuring and Test Equipment

a. Inspection Scope

The NRC inspection team reviewed SOR's policies and implementing procedures that govern the measuring and testing equipment (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. For a sample of M&TE, the NRC inspection team verified that the M&TE had been calibrated, adjusted, and maintained at prescribed intervals prior to use. The NRC inspection team verified M&TE was calibrated appropriately to the range of operation for each described activity using procedures traceable to known industry standards. The NRC inspection team also verified the implementation of M&TE control through direct observation of SOR activities. The NRC inspection team discussed the M&TE program with SOR's management and technical staff.

The documents reviewed by the inspectors are included in the attachment to this inspection report.

b. Observations and Findings

No findings of significance were identified.

c. Conclusion

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

## 5. Nonconforming Materials, Parts, or Components and Corrective Action

### a. Inspection Scope

The NRC inspection team reviewed SOR's policies and implementing procedures that govern the control of nonconformances and corrective actions to verify compliance with the requirements of Criterion XV, "Nonconforming Materials, Parts, or Components," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50.

The NRC inspection team performed a walk-down of SOR's fabrication and receiving storage areas to verify that nonconforming items were properly identified, marked, and segregated, when practical, to ensure that they were not re-introduced into the production processes. Additionally the NRC inspection team reviewed a sample of SOR's non-conformance reports and corrective action reports (CARs) to verify that: (1) nonconforming items were dispositioned in accordance with procedures; (2) technical justification were documented as appropriate for dispositions; and (3) nonconforming items were evaluated for 10 CFR Part 21 applicability, as appropriate.

The NRC inspection team also discussed the nonconformance and corrective action programs with SOR's management and technical staff.

The documents reviewed by the inspectors are included in the attachment to this inspection report.

### b. Observations and Findings

No findings of significance were identified.

### c. Conclusion

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

## 6. Entrance and Exit Meetings

On October 16, 2017, the NRC inspection team discussed the scope of the inspection with Melanie Dirks, Quality Assurance Manager and other members of SOR's management and technical staff. On October 20, 2017, the NRC inspection team presented the inspection results and observations during an exit meeting with Melanie Dirks, and other members of SOR's management and technical staff. The attachment to this report lists the attendees of the entrance and exit meetings, as well as those individuals whom the NRC inspection team interviewed.

## ATTACHMENT

### 1. ENTRANCE/EXIT MEETING ATTENDEES

Name	Title	Affiliation	Entrance	Exit	Interviewed
Aaron Armstrong	Inspection Team Leader	NRC	X	X	
Stacy Smith	Inspection Team	NRC	X	X	
Nick Savwoir	Inspection Team	NRC	X	X	
Khalid Al Naqbi	FANR Observer	NRC	X	X	
Terry Jackson	NRC Branch Chief	NRC		X	
Charles Lautner	Customer Service Manager	SOR	X	X	
Bill Pence	Dir. Supply Chain	SOR	X	X	
Nelda Hutcheson	SR Manuf. Coordinator	SOR	X	X	
Mike Waters	President and CEO	SOR	X	X	
Linda Coutts	Project Quotation Rep.	SOR	X	X	
Mike Bequette	VP Engineering	SOR	X	X	
Glenn Radmacher	Quality Engineer	SOR	X	X	X
Reba Matlock	QT SCP Admin	SOR	X	X	
Joe Modig	Engineer	SOR	X	X	X
Bert Benton	C.O.O	SOR	X	X	
Kasee Zaerr	Senior Buyer	SOR	X	X	
Lance McCallen	Manuf. Supervisor	SOR	X	X	
Melanie Dirks	Quality Manager	SOR	X	X	X

## 2. INSPECTION PROCEDURES USED

- Inspection Procedure (IP) 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance," dated February 13, 2012.
- IP 43002, "Routine Inspections of Nuclear Vendors," dated October 25, 2011.
- IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated October 25, 2011.

## 3. LIST OF ITEMS OPENED

Item Number	Status	Type	Description
99900824/2017-201-01	Open	NON	Criterion III
99900824/2017-201-02	Open	NON	Criterion IV

## 4. DOCUMENTS REVIEWED

### Measurement and Test Equipment

- 094-070, "Torque wrench calibration procedure", Revision 5.
- 8215-340, "Insulation resistance test procedure", Revision 5.
- 8215-476, "Housing Pressure Test Procedure", Revision 5.
- 7418-100, "Calibration for Measuring and test equipment", Revision 22.
- 7418-002, "Calibration Certificate", October 10, 2017.
- 7741-038, "Calibration Certificate", September 22, 2017.
- 17-B2S8P-60-1, "Torque Tester Calibration", Revision 0, June 23, 2017.
- 13206, "Calibration Certificate", February 8, 2017.
- 90166297, "Certificate of Calibration", June 14, 2017.
- 90165025, "Certificate of Calibration", December 20 2017.
- 90158206, "Certificate of Calibration", July 21, 2014.
- 90152233, "Certificate of Calibration", September 13, 2012.

### Part 21, Nonconformance and Corrective Action

- RMA 34072, "Evaluation of Return switch, 131N6-BX5-M9-CIA-JJTTNQ", 7-17-15.
- Part 21 Evaluation of RMA #34072
- Part 21 Evaluation of RMA #34069
- Part 21 Evaluation of RMA #34070
- RMA 33743, "Return or Complaint in Nuclear Facility related, 20ITA-BB125-U9-C7A-JJTTNQ, "2-24-17.
- 094-043, "Nonconformance Report," Revision 42.
- 094-152, "Nonconformance Report," Revision 7.
- 208601, "Nonconformance Report," September 14, 2016.

- 208541, "Nonconformance Report," August 1, 2016.
- 208554, "Nonconformance Report," August 12, 2016.
- 208688, "Nonconformance Report," November 14, 2016.
- 208719, "Nonconformance Report," December 8, 2016.
- 208928, "Nonconformance Report," May 5, 2017.
- 208665, "Nonconformance Report," November 3, 2016.
- 58, "Preventive action report," November 4, 2015.
- 970, "Preventive action Report," June 15, 2017.
- 8303-100, "Nuclear QA Manual," Revision 15.
- 094-043, "Nonconformance Report Procedure," Revision 42.
- 094-152, "Corrective action report," Revision 7.

#### CARs generated during inspection

- 972, Corrective action report, dated October 18, 2017
- 973, Corrective action report, dated October 19, 2017
- 974, Corrective action report, dated October 19, 2017
- 975, Corrective action report, dated October 20, 2017
- 976, Corrective action report, dated October 20, 2017

#### Procedures

- Nuclear Procedure 8303-110, "Reporting of Potential Deviations for Defect per 10 CFR Part 21," Revision 14
- Nuclear Procedure 8303-112, "Vendor Audit / Commercial Grade Survey Procedure," Revision 9
- ANSI / ASQ Z1.4-2003 (R2013), "Sampling Procedures and Tables for Inspection By Attributes," October 2013
- 094-036, "Incoming Inspection," Revision 15
- 8520-017, "Commercial Grade Dedication Procedure," Revision 10
- 095-037, "Design Control," Revision 15
- 095-022, "Engineering Change Order (ECO)," Revision 19
- Nuclear Pressure Switch Automated Test System (NPSATS 10.0), Revision 10.

#### POs

- Exelon PO 00497639 for differential pressure switch 141N6-WX47-MX-C1A-JJTTNQ
- TVA PO 3081088 for pressure switch 6N6-W3-U8C1A-JJTTNQ, dated June 28, 2017
- PSEG PO 4500981733, for differential pressure switch 141N6-W4-M9-C1A-JJTTNQ, dated July 13, 2017
- NCMR 209217, dated October 17, 2017 related to the inconsistencies with leak test criteria
- PO 201033, Vendor #11399, dated July 7, 2017

#### Other

- TA Housing Part 8215330
- TA Housing after manufacturing 8923186
- Engineering Change Request 5286, dated July 24, 2014
- Element Lab Report PO 172618, dated November 13, 2015

- Work Order 1194210 for 141 Lo Side ports
- Vacuum Switch 5TA-B45-U8-C1A-JJTTNQ for Entergy Nuclear Vermont Yankee PO #418906, dated June 21, 2004
- Vacuum Switch 54N6-BB118-M4-C1A-JJTTNQ for Exelon- Peach Bottom PO #598160, dated January 8, 2015
- Pressure Switch 9RT-BB5-U1-C2A-JJTTNQ for Xcel PO #530114, dated January 11, 2011
- CAR 962- November 4, 2016 -update test report 9058-102 rev1 to 2
- Steris Isomedix 33Mrad and 200Mrad to 31Mrad and 186Mrad
- Test report 9058-102, Revision 2
- Engineering Design Change EO 3473
- Nuclear Vacuum Switches May 20, 1993
- Drawing 8923-219 analysis of design modification for vacuum
- Component classification: coupling shaft piston no.54
- Drawing 8520-017
- CGI worksheet 8215168CGI part number 8215168