

Part 21 (PAR)

Event # 52736

<b>Rep Org:</b> AMETEK SOLID STATE CONTROLS	<b>Notification Date / Time:</b> 05/08/2017 09:52 (EDT)
<b>Supplier:</b> AMETEK SOLID STATE CONTROLS	<b>Event Date / Time:</b> 05/08/2017 (EDT)
	<b>Last Modification:</b> 06/01/2017
<b>Region:</b> 3	<b>Docket #:</b>
<b>City:</b> COLUMBUS	<b>Agreement State:</b> Yes
<b>County:</b>	<b>License #:</b>
<b>State:</b> OH	
<b>NRC Notified by:</b> ETHAN SALSBUURY	<b>Notifications:</b> JAMES DWYER R1DO
<b>HQ Ops Officer:</b> JEFF HERRERA	ROBERT ORLIKOWSKI R3DO
<b>Emergency Class:</b> NON EMERGENCY	PART 21/50.55 REACTORS EMAIL
<b>10 CFR Section:</b>	
21.21(a)(2) INTERIM EVAL OF DEVIATION	

## PART 21 - INTERIM NOTIFICATION OF A POTENTIAL DEFECT ON A PRINTED CIRCUIT BOARD

"Ametek Solidstate Controls began a 10 CFR Part 21 evaluation after receiving notification from NextEra Energy Seabrook Station that a 7.5kVA Inverter would prematurely transfer to alternate source at 27A load during commissioning. The X202 Crest factor board (80-9213516-90) was replaced and the unit operated normally.

"Analysis of the failed X202 Crest Factor board identified an SCR on the printed circuit board was turning on prematurely and resulted in a transfer to alternate source or with the absence of the alternate source, to a dead bus. A capacitor was placed across the SCR on the X202 board to protect the SCR from dv/dt turn on. Subsequent testing determined the added capacitor corrected the anomaly.

"In addition to Seabrook, Ametek has recently experienced similar anomalies on two separate occasions. However, these occurrences were discovered during manufacturing and in-house testing phase for new product and were attributed to a SCR failure, excessive noise, and long leads.

**"ACTION RECOMMENDED:**

Ametek Solidstate Controls recommends installing a 0.22 microfarad capacitor p/n 80-134734-90 across X202 terminals J1-11 to J1-12. This capacitor will have no effect on EMI or seismic qualifications.

"If you wish to acquire the 80-134734-90 capacitor, Ametek Solidstate Controls will work with you to provide spare parts. Please contact Mr. Mark Shreve of our Client Services group at 1-800-222-9079 or 1-614-846-7500 ext. 6332. mark.shreve@ametek.com"

\*\*\*UPDATE FROM ETHAN SALSBUURY TO VINCE KLCO ON 6/1/2017 AT 0750 EDT \*\*\*

IE19  
NRR

The following information was excerpted from an Ametek Solidstate Control email:

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Notified R1DO (Bower), R3DO (Daley) and Part 21 Group via email.

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**AMETEK**

**SOLIDSTATE CONTROLS**

**Quality Assurance**

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June 1, 2017

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, DC 20555-0001

Attention: Document Control Desk

Subject: Final Notification of Potential Defect - 10CFR Part 21

Reference: Interim Notification of Potential Defect regarding printed circuit board 90-9213516-90, submitted May 8, 2017

Product: Printed Circuit Board 80-9213516-90 Installed in Ametek Solidstate Controls Equipment Manufactured Since May 2015

Ametek Solidstate Controls is submitting the following Final Report of a Potential Defect in accordance with the requirements of 10CFR21. This report addresses the evaluation performed following the referenced Interim Notification.

A root cause has not been identified, but it has been confirmed that the addition of a dv/dt capacitor will prevent a premature transfer. The attached document provides details on the potential problem, cause and effect, and actions required. Please contact us at the phone number or email provided above if there are any questions.

Sincerely,

Ethan Salsbury  
Quality Manager  
Ametek Solidstate Controls



## **Final Notification of Potential Defect – Printed Circuit Board 80-9213516-90**

### **SUMMARY**

Ametek Solidstate Controls began a 10 CFR Part 21 evaluation after receiving notification from NextEra Energy Seabrook Station that a 7.5kVA Inverter would prematurely transfer to alternate source at 27A load during commissioning. The X202 Crest factor board (80-9213516-90) was replaced and the unit operated normally.

Analysis of the failed X202 Crest Factor board identified an SCR on the printed circuit board was turning on prematurely and resulted in a transfer to alternate source, or with the absence of the alternate source, to a dead bus. A capacitor was placed across the SCR on the X202 board to protect the SCR from dv/dt turn on. Subsequent testing determined the added capacitor corrected the anomaly.

In addition to Seabrook, Ametek has recently experienced similar anomalies on two separate occasions. However, these occurrences were discovered during manufacturing and in-house testing phase for new product and were attributed to an SCR failure, excessive noise, and long leads.

### **PROBLEM YOU COULD SEE**

The Inverter static switch could inadvertently transfer the load to bypass (or alternate source) with load applied.

The likelihood of failure is believed to be minimal based on the quantity operating in the field.

### **DISCUSSION**

The testing of the returned X202 Crest Factor board took place in AEP Inverter serial number 23797-5, which had been returned to the factory for refurbishment and testing. This unit is very similar to the Seabrook Inverter, which made it ideal for testing. The installed board from Seabrook transferred just as reported in the field. Analysis determined that the Q2 SCR was prematurely firing and causing the transfer to bypass.

It was suspected that Q2 was turning on due to dv/dt. The term dv/dt is the rate (speed) at which voltage is allowed to increase or decrease. This phenomenon, when an increase in voltage across the SCR occurs too quickly, can turn on the device even without a gate signal present. To prevent dv/dt turn on of the SCR, it is necessary to slow the rise time of voltage being imposed across the device. A capacitor was added across the Q2 SCR. The capacitor slows the rise time of the voltage. After the installation of the capacitor, the inverter can be subjected to any load from zero to short circuit without forcing any static switch transfer.

In February of 2017 during a 7.5kVA the AEP refurbishment, the originally-replaced X202 board exhibited similar behavior and was replaced. At the time, it was attributed to a defective SCR. Subsequent examination was performed on the failed board and found that the dv/dt was the issue and a capacitor solved the problem.

In January of 2017 during production testing of the 7.5 kVA inverters for Arizona Power, the inverters exhibited premature transfer at extreme overload. At the time, it was attributed to the unique configuration of the equipment and it was concluded that noise was entering long leads.



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In this instance, ferrite cores were added to noise-sensitive wires. Further testing confirmed a dv/dt capacitor installed on the X202 board in the APS inverters prevented premature transfer.

The most likely cause for the SCRs turning on prematurely is dv/dt. We have used this SCR in this application for many years and have not experienced this type of issue. The SCR in question is a 4A, 200V SCR with Ametek Part Number 03-610001-00 and date code NJS1518. Other SCRs in this date code could exhibit similar characteristics.

The SCRs were purchased in May of 2015 and again in November of 2016, and most likely have the same date code. These SCRs could be in X202 Crest Factor board, part number 80-9213516-90, or inverters manufactured since May of 2015. Based on performance of equipment installed prior to 2015, we have not experienced similar failures with SCRs of different date codes.

PCB X202 SCRs were within specifications. The suspect SCRs had a lower Gate Trigger Current ( $I_{GT}$ ) as compared to others in the same date code. The lower Gate Trigger Current ( $I_{GT}$ ) contributes to a lower dv/dt susceptibility. A dv/dt capacitor across the SCR limits the rise of the voltage across the SCR and potential unintended SCR turn on and static switch to bypass. There is no apparent defect with the SCR, but rather a variation in the gate trigger current. We cannot determine why this failure has occurred recently, especially since the suspect SCRs have been in production since 2015.

If you are operating at a steady state load, the opportunity for transfer is low. A transient or significant load increase could increase the possibility.

**ACTION RECOMMENDED:**

Ametek Solidstate Controls recommends installing a 0.22 microfarad capacitor, p/n 80-134734-90 across X202 terminals J1-11 to J1-12. This capacitor will have no effect on EMI, seismic, or aging qualifications.

If you wish to acquire the 80-134734-90 capacitor, Ametek Solidstate Controls will work with you to provide spare parts. Please contact Mr. Mark Shreve of our Client Services group at 1-800-222-9079 or 1-614-846-7500 ext. 6332. [mark.shreve@ametek.com](mailto:mark.shreve@ametek.com)