

September 21, 2007

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

via fax and US postal mail

Subject: Report of Defect in Accordance with 10 CFR 21

Dear Sir or Madam:

MPR commercially dedicates and supplies voltage regulators manufactured by Basler Electric to U.S. nuclear power plants. Recently we became aware of information that indicated that there may be a deviation in one of the voltage regulator components. MPR documented this potential deviation and, in accordance with 10 CFR 21, carried out an evaluation to determine if it is a reportable defect.

We determined that there is a defect. Details are provided in the enclosed report.

If you have any questions, please contact the undersigned.

Sincerely,



Paul S. Damerell
Principal Officer

Enclosure

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Report of Defect per 10CFR21 Basler Electric SBSR AVR Card Solder Joints

1.0 REPORTING INDIVIDUAL

Paul Damerell, Principal Officer
MPR Associates, Inc.
320 King Street
Alexandria, VA 22314

2.0 IDENTIFICATION OF THE BASIC COMPONENT

The basic component is an analog electronic circuit card in Basler voltage regulators used on emergency diesel generators (EDGs) in US nuclear power plants. The Basler SBSR excitation system provides closed-loop control of EDG stator voltage via an automatic voltage regulator (AVR) and an exciter. The AVR is the controller, while the exciter converts the control signal from the AVR to a field voltage that is applied to the EDG field winding. The AVR is an analog assembly. The main component of this assembly is an electronic circuit card that is referred to as the SBSR AVR card.

The SBSR AVR card contains a variety of mounted components (see Figure 1). The defect identified within this report deals specifically with the soldered electrical connections between the L1 magnetic amplifier module (magamp) and the card. While there are many Basler SBSR AVR card part numbers, all cards perform the same function and have similar components. Further, all cards utilize the same L1 magamp and all cards mount and electrically connect the L1 magamp in a similar manner.

3.0 IDENTIFICATION OF THE SUPPLIER

The SBSR AVR card is manufactured by Basler Electric Company in Highland, Illinois. Basler is a supplier of generator control equipment, including generator excitation systems and protective relays. The company maintained a 10 CFR 50, Appendix B Quality Assurance program until the mid 1990s but is presently a commercial supplier with an ISO 9001:2000 certified quality program.

Beginning in 1999, MPR became the supplier of Basler equipment to nuclear power plants. The scope of supply includes new systems and spare parts for existing systems, with MPR

performing commercial grade dedication of the Basler equipment when necessary. MPR has supplied SBSR systems and parts, including SBSR AVR cards, to several nuclear power plants for Class 1E safety related service.

The defect discussed in section 4 below has only been observed on equipment that was not supplied by MPR. After becoming aware of this experience, MPR concluded that it is applicable to all Basler SBSR AVR cards, including those supplied by MPR.

4.0 NATURE OF THE DEFECT

The nature of the defect is that over a period of many years, cracks can form in the solder joint connections between the L1 magamp and the circuit board. Figure 2 shows a cracked solder joint connection, as seen from the back of the SBSR AVR card. There are nine such solder connections at the L1 magamp, and all nine are susceptible to cracking. Cracks have been observed in five SBSR AVR cards that have been in service at two separate nuclear power plants. Also, another case (at one of the same two plants) exhibited symptoms similar to those exhibited by cards with cracked solder joints, but the card was not inspected for the presence of cracks nor retained. Accordingly, cracks are suspected but not confirmed in this other case.

It has been observed that full circumferential cracks can form. When a full circumferential crack forms, the electrical resistance at the connection can increase significantly and electrical continuity at the connection could be lost.

In four of the six cases, the observed symptom associated with the cracks is that during surveillance testing, the EDG starts and takes longer than specified to reach its rated voltage. The condition is observed to be intermittent, i.e., when the test is repeated the EDG typically starts and meets its time requirement to establish rated voltage. This intermittent nature has made troubleshooting more difficult as the symptom is typically not reproducible. This observation is consistent with the fact that a cracked solder joint may not fully and permanently lose electrical connectivity.

In one of the six cases, the observed symptom was that during surveillance testing, the voltage regulator failed to properly control output voltage of the EDG. The EDG had to be shut down, and it may not have been capable of powering its design basis loads.

In one of the six cases there were no symptoms or deficiencies during surveillance testing. Rather, the cracks were seen during a visual observation.

For SBSR AVR cards that have been supplied by MPR, MPR has not specified maintenance requirements related to inspection or replacement. Accordingly, there are no supplier-specified actions that would ensure that degraded cards are detected or avoided.

The safety hazard is that when electrical continuity is lost at L1 magamp soldered connections, the voltage regulator does not perform as intended, and the EDG could fail to deliver emergency AC power as intended. Analyses and testing by MPR in conjunction with Basler Electric confirmed that, although various symptoms can be observed, loss of electrical connectivity at

some combinations of L1 magamp soldered connections could render the voltage regulator unable to control voltage. In such a case, the associated EDG would not be able to provide emergency AC power as intended. Because EDGs are important safety-related components at nuclear power plants that are relied upon for safety-related functions, the cracked solder joints could be a substantial safety hazard.

5.0 DATE INFORMATION WAS OBTAINED

The observations of cracked solder joints have all occurred with equipment that was not supplied by MPR. The equipment that had failures was supplied before the time that MPR became a nuclear supplier of Basler equipment. MPR became aware of this problem through our involvement in the nuclear industry.

MPR first became aware that one plant experienced cracked solder joints in 2003. At that time, MPR assisted that plant with resolution of the problem and considered it to be an isolated case.

In June 2007, MPR became aware of a second plant that experienced an EDG start that took longer than specified to reach its rated voltage. MPR assisted the plant in the resolution of that condition. Cracked solder joints were observed in the SBSR AVR card from this second plant, and subsequent MPR analyses and evaluations (completed in July 2007) determined that cracked solder joints were the cause of the problem. Based on further internal reviews of the information from this failure and the prior failure, we judged that there was a potential concern related to this type of degradation of AVR cards in general (including those that have been supplied by MPR). As a result, MPR documented this potential concern in our corrective action program on August 2, 2007 and initiated an evaluation in accordance with 10CFR Part 21.

6.0 NUMBER AND LOCATION OF THE BASIC COMPONENTS

MPR has provided SBSR systems, including AVR circuit cards and spare AVR cards to the nuclear plants listed in Table 1 below. Table 2 lists US Nuclear plants believed by MPR to utilize the SBSR excitation system.

Table 1. List of SBSR AVR cards supplied by MPR

Nuclear Plant	Date Equipment Provided	Quantity
Beaver Valley Units 1 and 2	2003	4 systems and one spare AVR card
Millstone	2004	1 spare AVR card
Davis-Besse	2005	2 systems and one spare AVR card
Pilgrim	2005	1 spare AVR card
Beaver Valley	2006	2 spare AVR cards
Cooper Nuclear	2007	1 spare AVR
Davis-Besse	2007	1 spare AVR card (in process)
Ginna	2007	1 spare AVR card (in process)

Table 2. List of US Nuclear Plants that Utilize SBSR Excitation Systems on their EDGs

Plant	AVR Cards in Service
ANO 1	2
Beaver Valley 1	2
Beaver Valley 2	2
Calvert Cliffs 1	2
Calvert Cliffs 2	1
Cooper 1	2
Crystal River 3	2
Davis Besse 1	2
Diablo Canyon 1	3
Diablo Canyon 2	3
Duane Arnold 1	2
Farley 1	4
Farley 2	1
Fermi 2	4
FitzPatrick 1	4
Ginna 1	2
Hatch 1	3
Hatch 2	2
Indian Point 2	3

Plant	AVR Cards in Service
Indian Point 3	3
Kewaunee 1	2
McGuire 1	2
McGuire 2	2
Millstone 1	1
Millstone 2	2
North Anna 1	2
North Anna 2	2
Palisades 1	2
Peach Bottom 2	2
Peach Bottom 3	2
Pilgrim 1	2
Prairie Island 1	2
Robinson 2	2
Salem 1	3
Salem 2	3
Sequoyah 1	2
Vermont Yankee 1	2
TOTAL	84

7.0 CORRECTIVE ACTION PLAN

- For SBSR AVR cards that MPR has supplied, MPR will issue a maintenance bulletin to advise SBSR AVR owners that an inspection and repair program should be established. The inspection program should periodically inspect for L1 magamp solder joint cracks. The inspections should occur on a fuel cycle periodicity after 15 years of service. If cracks are found, the card should be replaced, or the joints repaired by remaking the solder connections.
- Using the list of nuclear power plant SBSR owners that MPR has developed through our industry knowledge and participation (Table 2), MPR will supply a copy of the maintenance bulletin to each SBSR owner, regardless of whether or not MPR supplied the equipment.
- In addition to the maintenance bulletin, MPR will update the technical manuals for the excitation systems supplied by MPR to Davis-Besse and Beaver Valley to include the

above guidance. The technical manual troubleshooting section will also be evaluated to determine if it requires an update to address lessons learned from this issue.


- For future SBSR AVR card procurements, MPR will include the above guidance in the required preventative maintenance.
- MPR will request that Basler evaluate a redesign of this electrical connection for systems supplied in the future.

All corrective actions will be completed within 45 days (November 5, 2007).

8.0 ADVICE GIVEN TO PURCHASERS OR LICENSEES

For the cracked solder joints at the two plants discussed earlier in this report, MPR provided assistance and advice to each plant in understanding the observed problems and tracing them to the cracked solder joints in the AVR card. Based on their evaluation and MPR's advice, each of the two plants proactively defined an inspection and replacement program for SBSR AVR cards. In both cases, MPR agrees that the programs are suitable.

The advice that will be given to plants that own Basler SBSR excitation systems is covered in Section 7 of this report.

QA Approval: 
Michael K. Dunkelberger, QA Manager

Date: 9-21-2007

Final Approval: 
Paul S. Damerell, Principal Officer

Date: 9-21-2007

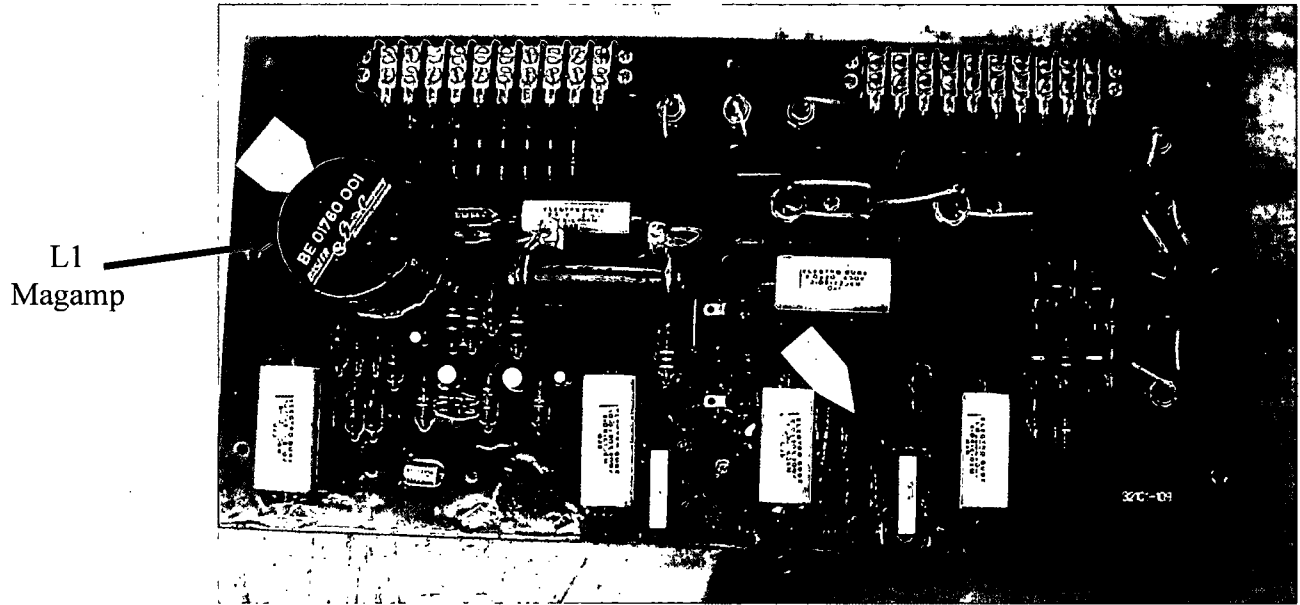


Figure 1. Photograph of SBSR AVR Circuit Card (Card is 8 by 16 inches)



Figure 2. Cracked Solder Connection as seen from back of SBSR AVR card