

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, D.C. 20555

August 8, 1988

NRC INFORMATION NOTICE NO. 88-57: POTENTIAL LOSS OF SAFE SHUTDOWN EQUIPMENT  
DUE TO PREMATURE SILICON CONTROLLED  
RECTIFIER FAILURE

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is being provided to alert addressees to recurring problems experienced with silicon controlled rectifiers (SCRs) that potentially can cause the loss of safety-related circuits. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

The NRC Vendor Inspection Branch conducted an inspection at the Elgar Corporation on January 25-28, 1988. This inspection was conducted because of recurring problems experienced with Elgar 25-kVA electrical inverters by the Palo Verde Nuclear Generating Station (PVNGS), Units 2 and 3, and is documented in NRC Inspection Report 99900871/88-01. The inspection revealed that the Elgar maintenance instruction for its 25-kVA inverters did not contain a critical torque requirement for the installation of replacement SCRs. Elgar has omitted the torque requirement value in its instructions.

The PVNGS licensee reported to the NRC in Licensee Event Report (LER) 87-013-00 that a fuse was found blown and subsequently replaced on May 9, 1987 and again on May 10, 1987, on the "C" train inverter that powers a 400-amp bus that supplies power to portions of the plant protection system, the engineered safety features actuation system, and various plant instrumentation. The licensee found nine SCRs shorted and replaced them. Attempts to energize the inverter caused the fuse to blow again. The licensee retested the SCRs and inspected all ac output circuitry components. The ac output circuitry components were

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found to be in satisfactory condition. Further investigation found that the SCR connections and mountings were loose. The licensee attributed this looseness to improper torquing.

Discussion:

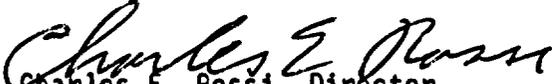
An SCR, also known as a thyristor, provides rectification and regulation in power conversion equipment. A review of the operating experiences of inverters and battery chargers used in nuclear power plants indicates that numerous SCR failures have occurred due to fabrication and installation errors. These SCRs conduct high electrical currents that generate heat. The heat is dissipated through heat sinks to which the SCRs are mounted. Typically, SCRs are either stud mounted or are arranged in a circular configuration, known as disc-type. In either case, the proper mounting of the SCR to its heat sink is extremely important.

Disc-type SCRs, such as the Elgar type, use a bracket to uniformly apply a force over the surface area of the SCR. This bracket is important not only for dissipating the heat from the SCR, but also for properly conducting the electrical current through the SCR. Loose brackets result in the current being carried through only a small area of the SCR. Therefore, without the proper torque applied to the SCR, the device will heat up beyond its normal operating temperature and prematurely fail or malfunction which may lead to the loss of safe shutdown equipment. This potential for premature failure is neither limited to one manufacturer or supplier, nor is it limited to only electrical inverters.

If a replacement SCR is installed without the appropriate torque, premature failure is likely to occur, resulting in the loss of a safety-related circuit. For a normally energized inverter or battery charger (INV/BC) application, the consequences could be a loss of power to important instrument and control functions, causing an electrical transient that could include a reactor trip. Conversely, if an SCR is replaced on an INV/BC used for standby equipment, a premature SCR failure could cause a loss of that equipment during an actual transient when the INV/BC is energized for emergency operations.

Additional detailed discussions on the operating experiences of battery chargers, inverters, and SCRs are available in NUREG/CR-4564, "Operating Experience and Aging-Seismic Assessments of Battery Chargers and Inverters," and NUREG/CR-5051, "Detecting and Mitigating Battery Charger and Inverter Aging."

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

  
Charles E. Rossi, Director  
Division of Operational Events Assessment  
Office of Nuclear Reactor Regulation

Technical Contacts: Joseph J. Petrosino, NRR  
(301) 492-0979

Jaime Guillen, NRR  
(301) 492-1170

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

| Information Notice No. | Subject  | Date of Issuance | Issued to   |
|------------------------|--|------------------|---|
| 88-56                  | Potential Problems with Silicone Foam Fire Barrier Penetration Seals                                 | 8/4/88           | All holders of OLS or CPs for nuclear power reactors.   |
| 88-55                  | Potential Problems Caused by Single Failure of an Engineered Safety Feature Swing Bus                | 8/3/88           | All holders of OLS or CPs for nuclear power reactors.   |
| 88-54                  | Failure of Circuit Breaker Following Installation of Amptector Direct Trip Attachment                | 7/28/88          | All holders of OLS or CPs for nuclear power reactors.   |
| 88-53                  | Licensee Violations of NRC Regulations, Which Led to Medical Diagnostic Misadministrations           | 7/28/88          | All manufacturers and distributors of radio-pharmaceuticals for human use, nuclear pharmacies, and medical licensees. |
| 88-52                  | Failure of Intrauterine Tandem of Fletcher Applicator Brachytherapy Devices During Patient Treatment | 7/27/88          | Medical licensees.  |
| 88-46, Supplement 1    | Licensee Report of Defective Refurbished Circuit Breakers  | 7/26/88          | All holders of OLS or CPs for nuclear power reactors.   |
| 88-51                  | Failures of Main Steam Isolation Valves  | 7/21/88          | All holders of OLS or CPs for nuclear power reactors.   |
| 88-50                  | Effect of Circuit Breaker Capacitance on Availability of Emergency Power                             | 7/18/88          | All holders of OLS or CPs for nuclear power reactors.   |

OL = Operating License  
CP = Construction Permit

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\*OGCB:DOEA:NRR \*VIB:DRIS:NRR

JGuillen JJPetrosino

06/23/88 07/06/88

\*VIB:DRIS:NRR

ETBaker

07/07/88

\*C/VIB:DRIS:NRR\*RPB:ARM

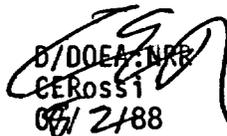
EWBrach

07/08/88

\*C/OGCB:DOEA:NRR\*A/D/DRIS:NRR

CHBerlinger BKGrimes

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D/DOEA:NRR  
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TechEd

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*ETB*  
VIB:DRIS:NRR  
ETBaker  
07/7/88

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CERossi  
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*CRB*  
C/VIB:DRIS:NRR  
EMBrach  
07/8/88

*CRB*  
C/OGCB:DOEA:NRR  
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| JGuillen                 | JJPetrosino  | ETBaker      | CERossi        | CHBerlinger     |
| 06/28/88                 | 06/ /88      | 06/ /88      | 06/ /88        | 06/ /88         |
|                          |              |              | C/VIB:DRIS:NRR | RPB:ARM         |
|                          |              |              | EWBrach        | TechEd          |
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