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

November 25, 1994

NRC INFORMATION NOTICE 94-80: INADEQUATE DC GROUND DETECTION IN DIRECT CURRENT DISTRIBUTION SYSTEMS

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the potential for operating with undetectable grounds in vital direct current (dc) distribution systems due to inadequate ground-detection equipment or inadequate ground-alarm setpoints or both. 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.

Background

NRC Information Notice 88-86 and its supplement, "Operating with Multiple Grounds in Direct Current Distribution Systems," alerted all addressees to potential problems and failure modes caused by grounds on vital dc distribution systems, which are normally ungrounded systems. Specifically, several plants had operated for extended periods with grounds on their dc systems. The information notice also listed licensee event reports (LERs) related to dc system grounds. Supplement 1 described a specific failure mode whereby grounds on a dc system could cause equipment to remain energized during harsh environments instead of assuming the de-energized state needed to comply with protection system requirements.

Description of Circumstances

Discussions between the staff and several licensees indicated that ground detectors may not be capable of detecting certain grounds and that ground detector alarm resistance-to-ground values may be inadequate. In addition, the discussions indicated that some licensee reviews and actions associated with Information Notice 88-86 and Supplement 1 were limited to specific examples cited, such as qualification of ASCO solenoids. Other specific examples follow.

Point Beach

During a monthly surveillance test on June 4, 1990, the licensee noted a solid ground on the dc distribution system. Although the ground detector was equipped with an alarm, the control room annunciator had not alarmed. The licensee determined that as a result of its design, the ground detector could become magnetized when a ground of one polarity occurred. Consequently, if a solid ground occurred of the opposite polarity, the hysteresis or magnetization of the ground relay coil would prevent actuation of the ground detector. The licensee concluded that the ground detector was insensitive and incapable of detecting even solid grounds. As corrective action, a new, more-sensitive ground detector was installed with an alarm value set at 20,000 ohms.

Palisades

On August 8, 1991, the licensee discovered a solid ground in a dc system. The associated control room annunciator had not alarmed. The ground-detector-alarm setpoint was based on a 5-milliampere (ma) current; however, the maximum current that could flow in the circuit was determined to be only 4.2 ma. Also, if a ground occurred gradually, it would not be detected because of the mechanical properties of the detector-alarm mechanism. For corrective action, the licensee is monitoring the battery voltage on the positive and negative buses once each shift.

Fermi

In September 1991, an NRC inspection determined that the licensee 260-volt battery ground detector could not consistently detect grounds since the relative brightness of lights was being used subjectively to indicate the presence of a ground. To improve sensitivity, the licensee replaced the existing 25-watt light bulbs with 10-watt bulbs. This change raised the threshold for detecting grounds from about 92 ohms to about 1000 ohms.

Davis-Besse

During a November 15-19, 1993 inspection, the NRC determined that the ground detector on the new alternate station blackout diesel generator battery was only capable of detecting solid grounds and that the detector manufacturer could not quantify the setpoint. In response, the licensee proposed to review the adequacy of the present ground detector and investigate alternative methods to detect the presence of grounds in the dc system.

Grand Gulf

On November 1, 1994, a reactor scram occurred due to a ground in the "A" backup scram valve control circuitry while a half scram was already present due to surveillance testing of the reactor protection system. The hard ground, in conjunction with the use of a newly upgraded 125-volt dc ground

detector, enabled enough current to flow to energize the backup scram valve's solenoid and open the backup scram valve. The modified detector circuitry provided a 1000-ohm path through an annunciating relay (control room alarm) to ground. This upgraded detector circuitry replaced a circuit which originally had a 100,000-ohm path to ground. For corrective action the licensee has removed the hard ground, will disable the 1000-ohm path and has de-energized the detector circuit used for local ground indication except when periodic ground checks are performed.

Discussion

In Information Notice 88-86, Supplement 1, the staff described the potential for ASCO solenoid valves to inadvertently actuate or fail to drop out due to grounds of approximately 4000 ohms or less at the Summer station. The Summer licensee has also removed the on-line ground detector because its inherent 1500-ohm resistance-to-ground value was below the plant threshold value.

After Information Notice 88-86 Supplement 1 was issued, the staff met with Commonwealth Edison on March 1, 1989, to discuss corrective action for the ground problem at Quad Cities (discussed in Information Notice 88-86). The Commonwealth Edison review revealed the potential for inadvertent relay operation at a much higher ground-resistance value for General Electric HFA, HMA, and HGA 125-volt dc relays. All Commonwealth Edison nuclear plants now have ground-clearing action with priorities based on two ground-threshold values, 125,000 and 20,000 ohms. The 125,000-ohm value is based on the minimum ground current required to keep an HGA relay from dropping out when its normal power is removed and an additional ground exists between the relay and its actuating switch contact (see Figure 1). The 20,000-ohm threshold is based on the minimum current needed to pick up the most sensitive relay (General Electric HMA) under the same conditions. (For further information on determining a ground threshold for a dc system, see Annex C of IEEE Std 946-1992, "IEEE Recommended Practice for the Design of DC Auxiliary Power Systems for Generating Stations.")

Nuclear power plant dc distribution systems are typically two-wire ungrounded battery/charger systems equipped with ground-detection/alarm circuitry including features such as annunciation in the control room, local indication, and recording. Ground detectors are incorporated in the dc systems so that if a single ground does occur, personnel are aware of the ground and can take immediate steps to clear the ground fault from the system.

Failure to promptly eliminate a single ground could mask subsequent additional grounds. Multiple grounds could lead to unpredictable spurious operation of equipment, inoperable equipment, unanalyzed loads on batteries, or unanalyzed equipment failure modes that could be expected to occur during harsh environments attendant to accidents. In addition, installed ground detectors and portable ground-locating equipment themselves may create a ground on the dc system and may not maintain a minimum threshold resistance-to-ground value above which predictable system/component operation can be assured.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate NRR project manager.

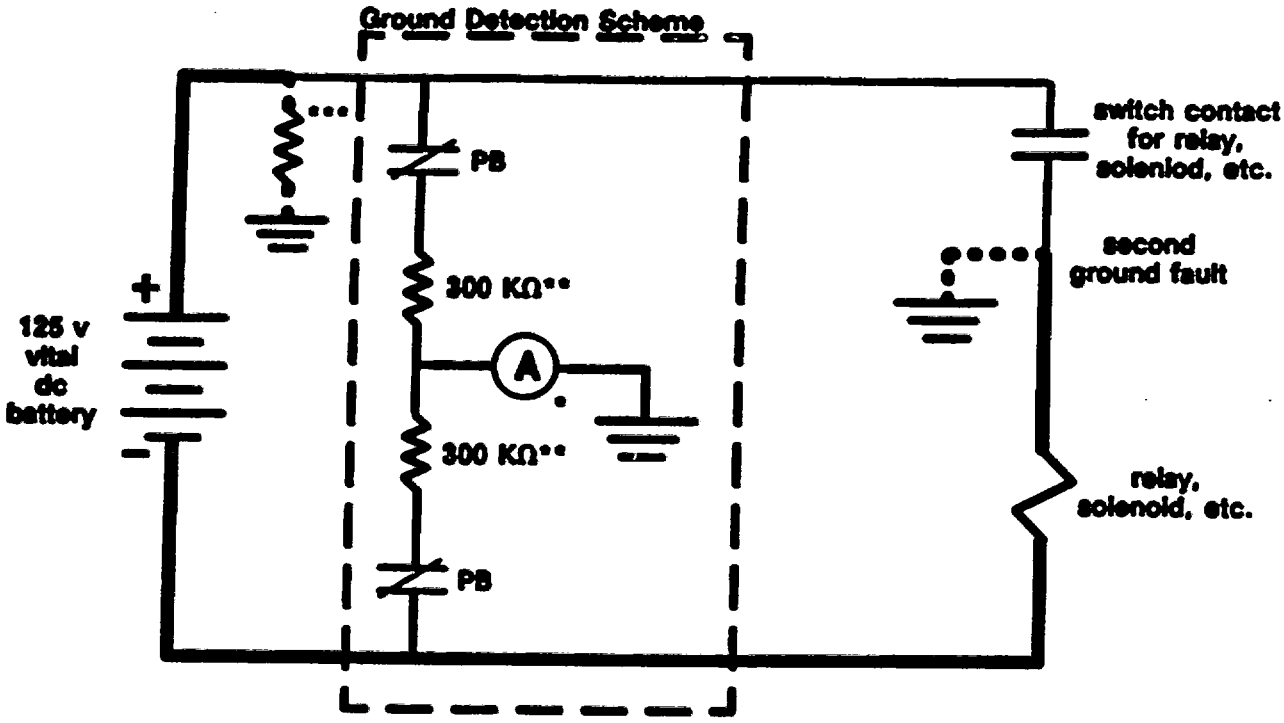
For Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts: Roger Mendez, RIII
(708) 829-9745

Fred Burrows, NRR
(301) 504-2901

Attachments:
1. Figure 1: Ground-Threshold Valves
2. List of Recently Issued NRC Information Notices

Attachments filed in Jackets



* Alarm Relay, Ammeter, etc.

** Plant Specific

*** Threshold Resistance-To-Ground

Note: A complete circuit through the relay (or solenoid), ground fault, and existing resistance-to-ground is shown by a heavy line.

Figure 1

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-79	Microbiologically Influenced Corrosion of Emergency Diesel Generator Service Water Piping	11/23/94	All holders of OLs or CPs for nuclear power reactors.
94-78	Electrical Component Failure due to Degradation of Polyvinyl Chloride Wire Insulation	11/21/94	All holders of OLs or CPs for nuclear power reactors.
94-77	Malfunction in Main Generator Voltage Regulator Causing Overvoltage at Safety-Related Electrical Equipment	11/17/94	All holders of OLs or CPs for nuclear power reactors.
94-76	Recent Failures of Charging/ Safety Injection Pump Shafts	10/26/94	All holders of OLs or CPs for pressurized water reactors.
93-60, Supp. 1	Reporting Fuel Cycle and Materials Events to the NRC Operations Center	10/20/94	All 10 CFR Part 70 fuel cycle licensees.
94-75	Minimum Temperature for Criticality	10/14/94	All holders of OLs or CPs pressurized-water reactors (PWRs).
94-74	Facility Management Responsibilities for Purchased or Contracted Services for Radiation Therapy Programs	10/13/94	All U.S. Nuclear Regulatory Commission Medical Licensees.
94-73	Clarification of Criticality Reporting Criteria	10/12/94	All fuel fabrication facilities.
94-72	Increased Control Rod Drop Time from Crud Buildup	10/05/94	All holders of OLs or CPs for pressurized water reactors.

OL = Operating License
CP = Construction Permit

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Original signed by B.D. Liaw for
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1. Figure 1: Ground-Threshold Valves
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DOCUMENT NAME: 94-80.IN

**Concurrence August 24, 1994, via telephone
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DATE	08/22/94		08/23/94		08/22/94		09/02/94		08/ /94	

OFFICE	OGCB/DOPS		OGCB/DOPS		OECB/DOPS		D/DOPS/NRR	C		
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