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

April 12, 1993

NRC INFORMATION NOTICE 93-29: PROBLEMS WITH THE USE OF UNSHIELDED TEST LEADS IN REACTOR PROTECTION SYSTEM CIRCUITRY

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 that induced current from unshielded test leads may cause problems with safety-related circuitry. 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On June 22, 1992, Duke Power Company engineers were performing an incore/excore calibration on the power range neutron monitoring system at the William B. McGuire Nuclear Station. The fuses in the control power circuit opened causing the actuation of the alarms for overpower rod stop, high flux rate, and high setpoint alert. The Duke Power Company engineers did not think the test probe connection caused the fuse to fail, because the fuse was in a different drawer and was completely isolated from the meter and test points. The engineers replaced the fuse and continued the test. Later in the test, the test probe was connected to a different channel. The control power fuse opened in that channel with the same results as above. The engineers responded by suspending the test.

On May 15, 1992, Southern Nuclear Operating Company technicians were performing an incore cross-calibration on the power range neutron monitoring system at the Joseph M. Farley Nuclear Plant while the plant was operating at 35 percent power. A reactor trip occurred because of a concurrent high flux trip and high flux rate trip on one channel, and a high flux trip and high flux rate trip on a separate channel. After the reactor trip, the technicians discovered that the high leg control power fuse for one channel and the neutral leg control power fuse for the other channel had opened.

Discussion

Each utility investigated the cause of the fuse failures at its plant. Southern Nuclear Operating Company testing revealed that a 0.4 volt

peak-to-peak (60 Hz) signal was induced on meter leads from unshielded test leads. This induced signal was verified to be present at the summing amplifier output. When the same digital volt meters were connected with shielded test leads, no induced signals were present.

Duke Power Company found that the particular digital multimeter used in the test could retain a charge for approximately five minutes after the leads were disconnected from the test points. If one of the leads inadvertently made contact with the drawer chassis during the test connection, the instrument could discharge and create a voltage spike.

Subsequent discussions with Westinghouse revealed that similar incidents had occurred at other sites. Westinghouse determined that the use of long, unshielded test leads may induce radio frequency (RF) noise into the leads of the digital multimeter. The induced RF is amplified by the power range drawer summing and level amplifier, then channeled into the Nuclear Instrumentation Systems bistable circuitry. The induced signal in the bistable circuitry may cause the silicon control rectifier to oscillate rapidly and produce coupling within the output transformer. The coupling within the transformer may have produced an excessive current, causing the associated control power fuses to open. This type of event may occur when the combination of induced RF and normal current/voltage signals pass through the bistables but are of sufficient magnitude to trip the channel or in some cases, blow the fuse. A blown fuse could itself result in a spurious channel or reactor trip. The blown fuse also would prevent resetting the channel until it is replaced. In other applications, where there are no obvious indications, blown fuses could remain undetected until the next surveillance or a valid demand.

Duke Power Company and Southern Nuclear Operating Company have revised procedures to require that digital multimeters be connected with shielded test leads and to limit test connections to one nuclear instrumentation channel at a time. Duke Power Company and Southern Nuclear Operating Company also revised procedures to require specific digital multimeters and test point connection methods when performing nuclear instrumentation testing.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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

Technical contact: Todd A. Cooper, RII
(704) 875-1681

Attachment:
List of Recently Issued NRC Information Notices

peak-to-peak (60 Hz) signal was induced on meter leads from unshielded test leads. This induced signal was verified to be present at the summing amplifier output. When the same digital volt meters were connected with shielded test leads, no induced signals were present.

Duke Power Company found that the particular digital multimeter used in the test could retain a charge for approximately five minutes after the leads were disconnected from the test points. If one of the leads inadvertently made contact with the drawer chassis during the test connection, the instrument could discharge and create a voltage spike.

Subsequent discussions with Westinghouse revealed that similar incidents had occurred at other sites. Westinghouse determined that the use of long, unshielded test leads may induce radio frequency (RF) noise into the leads of the digital multimeter. The induced RF is amplified by the power range drawer summing and level amplifier, then channeled into the Nuclear Instrumentation Systems bistable circuitry. The induced signal in the bistable circuitry may cause the silicon control rectifier to oscillate rapidly and produce coupling within the output transformer. The coupling within the transformer may have produced an excessive current, causing the associated control power fuses to open. This type of event may occur when the combination of induced RF and normal current/voltage signals pass through the bistables but are of sufficient magnitude to trip the channel or in some cases, blow the fuse. A blown fuse could itself result in a spurious channel or reactor trip. The blown fuse also would prevent resetting the channel until it is replaced. In other applications, where there are no obvious indications, blown fuses could remain undetected until the next surveillance or a valid demand.

Duke Power Company and Southern Nuclear Operating Company have revised procedures to require that digital multimeters be connected with shielded test leads and to limit test connections to one nuclear instrumentation channel at a time. Duke Power Company and Southern Nuclear Operating Company also revised procedures to require specific digital multimeters and test point connection methods when performing nuclear instrumentation testing.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Original signed by
Brian K. Grimes

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

Technical contact: Todd A. Cooper, RII
(704) 875-1681

Attachment:
List of Recently Issued NRC Information Notices

*RVIB:DRIL:NRR	D/DORS:NRR	*C/OGCB:DORS:NRR	*RPB:ADM	*C/HICB:DRCH:NRR
LJNorrholm	BKGrimes	GHMarcus	TechEd	JWermiel
03/17/93	04/7/93	04/02/93	03/03/93	03/16/93

*PDII-3:DRP:NRR	*OGCB:DORS:NRR	*R/RII	*R/RII	*RII
TAReed	NCampbell	TACooper	PKVanDoorn	BMiller
03/24/93	03/29/93	02/10/93	02/10/93	02/10/93

*PD-1:DRP:NRR
GFWunder
03/25/93

Document Name: 93-29.IN

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

Technical contact: Todd A. Cooper, RII
(704) 875-1681

Attachment: List of Recently Issued NRC Information Notices

Document Name: 92IN.TAC

RVIB:DRIL:NRR	D/DORS:NRR			
LJHolm	BKGrimes			
03/17/93	03/ /93			
C/OGCB:DORS:NRR	RPB:ADM	C/HICB:DRCH:NRR	PD1-3:DRP:NRR	
GHMarcus	TechEd	JWermiel	TAReed	
03/ /93	03/3 /93	03/16/93	03/18/93	
OGCB:DORS:NRR	R/RII	R/RII	RII	PD-1:DRP:NRR
NCampbell	TACooper	PKVanDoorn	BMiller	GFWunder
03/29/93	03/10/93	03/10/93	03/10/93	03/19/93
N.E.C.				C.F.W. 3/25/93

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-28	Failure to Consider Loss of DC Bus in the Emergency Core Cooling System Evaluation May Lead to Nonconservative Analysis	04/09/93	All holders of OLs or CPs for nuclear power reactors.
93-27	Level Instrumentation Inaccuracies Observed during Normal Plant Depressurization	04/08/93	All holders of OLs or CPs for nuclear power reactors.
93-26	Grease Solidification Causes Molded Case Circuit Breaker Failure to Close	04/07/93	All holders of OLs or CPs for nuclear power reactors.
93-25	Electrical Penetration Assembly Degradation	04/01/93	All holders of OLs or CPs for nuclear power reactors.
93-24	Distribution of Revision 7 of NUREG-1021, "Operator Licensing Examiner Standards"	03/31/93	All holders of operator and senior operator licenses at nuclear power reactors.
93-23	Weschler Instruments Model 252 Switchboard Meters	03/31/93	All holders of OLs or CPs for nuclear power reactors.
93-22	Tripping of Klockner-Moeller Molded-Case Circuit Breakers due to Support Level Failure	03/26/93	All holders of OLs or CPs for nuclear power reactors.
93-21	Summary of NRC Staff Observations Compiled during Engineering Audits or Inspections of Licensee Erosion/Corrosion Programs	03/25/93	All holders of OLs or CPs for light water nuclear power reactors.

OL = Operating License
CP = Construction Permit

peak-to-peak (60 Hz) signal was induced on meter leads, from the unshielded test leads. This induced signal was verified to be present at the summing amplifier output. When the same digital volt meters were connected with shielded test leads, no induced signal was present.

Duke Power Company found that the particular digital multimeter used in the test could retain a charge for approximately five minutes after the leads were disconnected from the test points. If one of the leads inadvertently made contact with the drawer chassis during the test connection, the instrument could discharge and create a voltage spike.

Subsequent discussions with Westinghouse revealed similar incidents had occurred at other sites. Westinghouse research revealed that the use of long, unshielded test leads may induce radio frequency (RF) noise into the leads of the digital multimeter. The induced RF is amplified by the power range drawer summing and level amplifier, then channeled into the Nuclear Instrumentation Systems (NIS) bistable circuitry. The induced signal in the NIS bistable circuitry may cause the bistable silicon control rectifier (SCR) to oscillate rapidly and produce coupling within the output transformer. The coupling within the transformer may have produced an excessive current, causing the associated control power fuses to open. This type of event may occur when the combination of induced RF and normal signals is of sufficient magnitude to cycle through the bistable setpoint.

Duke Power Company and Southern Nuclear Operating Company have revised procedures to require that digital multimeters be connected with shielded test leads and to limit test connections to one nuclear instrumentation channel at a time. Duke Power Company and Southern Nuclear Operating Company also revised procedures to require specific digital multimeters and test point connection methods when performing nuclear instrumentation testing.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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

Technical contact: Todd A. Cooper, RII
(704) 875-1681
Attachment: List of Recently Issued NRC Information Notices

*RVIB:DRIL:NRR	D/DORS:NRR	*C/OGCB:DORS:NRR	*RPB:ADM	*C/HICB:DRCH:NRR
LJNorrholm	BKGrimes	GHMarcus	TechEd	JWermiel
03/17/93	03/ /93	04/02/93	03/03/93	03/16/93

*PDII-3:DRP:NRR	*OGCB:DORS:NRR	*R/RII	*R/RII	*RII
TAReed	NCampbell	TACooper	PKVanDoorn	BMiller
03/24/93	03/29/93	02/10/93	02/10/93	02/10/93

*PD-1:DRP:NRR
GFWunder
03/25/93 Document Name: 92IN.TAC

to-peak (60 Hz) signal was induced on meter leads, from the unshielded test leads. This induced signal was verified to be present at the summing amplifier output. When the same digital volt meters were connected with shielded test leads, no induced signal was present.

Duke Power Company found that the particular digital multimeter used in the test could retain a charge for approximately five minutes after the leads were disconnected from the test points. If one of the leads inadvertently made contact with the drawer chassis during the test connection, the instrument could discharge and create a voltage spike.

Subsequent discussions with Westinghouse revealed similar incidents had occurred at other sites. Westinghouse research revealed that the use of long, unshielded test leads may induce radio frequency (RF) noise into the leads of the digital multimeter. The induced RF is amplified by the power range drawer summing and level amplifier, then channeled into the Nuclear Instrumentation Systems (NIS) bistable circuitry. The induced signal in the NIS bistable circuitry may cause the bistable silicon control rectifier (SCR) to oscillate rapidly and produce coupling within the output transformer. The coupling within the transformer may have produced an excessive current, causing the associated control power fuses to open. This type of event may occur when the combination of induced RF and normal signals is of sufficient magnitude to cycle through the bistable setpoint.

Duke Power Company and Southern Nuclear Operating Company have revised procedures to require that digital multimeters be connected with shielded test leads and to limit test connections to one nuclear instrumentation channel at a time. Duke Power Company and Southern Nuclear Operating Company also revised procedures to require specific digital multimeters and test point connection methods when performing nuclear instrumentation testing.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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

Technical contact: Todd A. Cooper, RII
(704) 875-1681
Attachment: List of Recently Issued NRC Information Notices

*RVIB:DRIL:NRR	D/DORS:NRR	C/OGCB:DORS:NRR	*RPB:ADM	*C/HICB:DRCH:NRR
LJNorrholm	BKGrimes	GHMarcus GHM	TechEd	JWermiel
03/17/93	03/ /93	04/2/93	03/03/93	03/16/93

*PDII-3:DRP:NRR	OGCB:DORS:NRR	*R/RII	*R/RII	*RII
TAReed	NCampbell	TACooper	PKVanDoorn	BMiller
03/24/93	03/29/93	02/10/93	02/10/93	02/10/93
	N.E.C.			

*PD-1:DRP:NRR
GFWunder
03/25/93

Document Name: 92IN.TAC

technical contact listed below or the appropriate Office of Nuclear Reactor Regulation project manager.

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

Technical Contacts: Roger W. Woodruff, NRR
(301) 504-1152

Elmo E. Collins, RIV
(817) 860-8291

Attachment:
1. List of Recently Issued Information Notices

CONCURRENCE:

OEAB	SC:DRP:RIV	PUB:ADM	SC:OEAB	PM:PD4[illegible]	D:DRP:RIV
RWWoodruff	EECollins	JDMain	RLDennig	RBBevan	ABBeach
/ /92	/ /92	11/17/92	/ /92	1/24/93	/ /92

C:EELB	C:SRXB	BC:OEAB	BC:OGCB	D:DORS
CHBerlinger	RCJones	AEChaffee	GHMarcus	BKGrimes
/ /92	/ /92	/ /92	/ /92	/ /92

407.in