UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

March 21, 1997

NRC INFORMATION NOTICE 92-27, Supplement 1: THERMALLY INDUCED ACCELERATED AGING AND FAILURE OF ITE/GOULD A.C. RELAYS USED IN SAFETY-RELATED APPLICATIONS

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 problems resulting from the thermally accelerated aging of relays manufactured by the ITE/Gould Manufacturing Company (currently Telemecanique). The accelerated aging could lead to relay coil failure, potentially rendering portions of associated safety-related systems inoperable. 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.

Background

In Information Notice (IN) 92-27, "Thermally Induced Accelerated Aging and Failure of ITE/GOULD A.C. Relays Used in Safety-Related Applications," dated April 3, 1992, the NRC staff informed licensees of the failure of three safety-related relays at the Millstone Nuclear Power Station, Unit 3. The relays were installed in the control circuits of three safety-related motor-operated valves (MOVs). These relays provided control power alarms and thermal overload protection for the MOVs.

The relays, which had been in service for about 7 years, were model J10 relays with J20M magnet block assemblies and standard G10JA126, 120V, 60 cycle coil assemblies manufactured by ITE/Gould. Inspection of the relays revealed that the movable plastic armature carrier, which surrounds the core and coil, and the retainer for the magnet yoke assembly were discolored, brittle, and severely cracked. Insulation degradation was severe, allowing electrical shorts to develop within the coils. The licensee concluded that the failures resulted from the thermal aging of the coil assemblies and plastic parts near the coil assemblies. The failed relays were mounted shoulder-to-shoulder in a horizontal "ganged" arrangement on a universal mounting strip supplied by the manufacturer. They were originally qualified, individually, for the life of the plant.

Description of Circumstances

On October 11, 1996, Duquesne Light Company determined that J12 relays with J20M magnet block assemblies and standard G10JA116, 110V, 60 cycle coil assemblies manufactured by ITE/Gould and installed at Beaver Valley Unit 2 were susceptible to thermally induced premature aging. (Licensee Event Report No. 96-005-00, November 11, 1996, NRC Accession No. 9611210045.) These relays provide alarms, "Bypass Inoperable Status Indication," and thermal overload protection for various MOVs, fans, and pumps. Systems potentially affected included safety injection, component cooling, charging, instrument air, quench spray, recirculation spray, service water, and emergency diesel generators.

Four of the J12 relays failed during routine outage testing. In each case, the normally energized relays had been deenergized for several days during electrical bus maintenance. When the relays were reenergized, two contact pairs on the relays failed to pick up. This mode of failure would have prevented manual operation of the safety-related valve that the relay controlled, but did not affect the automatic engineered safety features (ESF) actuation function. The ESF portion of the circuit bypasses the failed thermal overload relay and contacts.

The relays had been installed for 9 years. Thermal aging had caused the magnetic yoke assembly retainer and the movable plastic armature carrier, which surrounds the core and coil, to become discolored, deformed, brittle, and cracked. The deformation of the armature carrier was sufficient to interfere with free movement of the armature assembly and prevented pickup of the contacts. Following each of the four J12 relay failures at Beaver Valley, the power supply circuit breaker was opened and reclosed. The relay contacts then made up as expected following this cycling of the power supply breaker. The relay degradation may have remained unknown if the licensee had not investigated the anomaly further.

The licensee postulated that the failures of the contact pairs to pick up on the four J12 relays may be a precursor to coil failure and loss of control power similar to that reported in IN 92-27. The licensee determined that the J20M armature assembly was also installed in J10, J11, J13, and J14 class relays. The licensee stated that only the J10, J12, and J13 relays were normally energized and, therefore, susceptible to thermally induced accelerated aging.

There are 223 J12 relays installed at Beaver Valley Unit 2. None have been identified at Beaver Valley Unit 1. Before transitioning from mode 4 to mode 3 operation, the licensee replaced all J-class relays that were deemed susceptible to thermally induced accelerated aging.

Discussion

The J12 relay is one of a family of J-class relays currently manufactured by Telemecanique as commercial-grade items. Although the NRC staff is aware of failures of

J-class relays at other facilities, most of the failures occurred during surveillance testing and were attributed to "normal aging." The NRC staff is not aware of any analyses performed to determine the root cause for the failures at these other facilities. In analyzing the failure mode of the relays at Beaver Valley, the licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email: dmk@nrc.gov

N. Fields, NRR
(301) 415-1173
E-mail: enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

Attachment filed in Docket

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
97-11	Cement Erosion from Containment Subfoundations at Nuclear Power Plants	03/21/97	All holders of OLs or CPs for nuclear power reactors
97-10	Liner Plate Corrosion in Concrete Containments	03/13/97	All holders of OLs or CPs for power reactors
97-09	Inadequate Main Steam Safety Valve (MSSV) Setpoints and Performance Issues Associated with Long MSSV Inlet Piping	03/12/97	All holders of OLs or CPs for nuclear power reactors
97-08	Potential Failures for General Electric Magne-Blast Circuit Breaker Subcomponents	03/12/97	All holders of OLs or CPs for nuclear power reactors
97-07	Problems Identified During Generic Letter 89-10 Closeout Inspections	03/06/97	All holders of OLs or CPs for nuclear power reactors
97-06	Weaknesses in Plant-Specific Emergency Operating Procedures for Refilling the Secondary Side of Dry Once-Through Steam Generators	03/04/97	All holders of OLs or CPs for nuclear power reactors with with once-through steam generators

OL = Operating License
CP = Construction Permit

J-class relays at other facilities, most of the failures occurred during surveillance testing and were attributed to "normal aging." The NRC staff is not aware of any analyses performed to determine the root cause for the failures at these other facilities. In analyzing the failure mode of the relays at Beaver Valley, the licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

original signed by M.M. Slosson

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email: dmk@nrc.gov

N. Fields, NRR
(301) 415-1173
Email: enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

Tech Editor has reviewed and concurred on 11/13/96

DOCUMENT NAME: G:\NICK\IN92027 *See Previous Concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

OFFICE	CONTACTS	RI	C:PECB	D:DRPM
NAME	D. Kern* N. Fields*	PWEselgroth*	AEChaffee* RLD for	TTMartin
DATE	12/10/96	12/24/96	02/20/97	03/18/97

OFFICIAL RECORD COPY

J-class relays at other facilities, most of the failures occurred during surveillance testing and were attributed to "normal aging." The NRC staff is not aware of any analyses performed to determine the root cause for the failures at these other facilities. In analyzing the failure mode of the relays at Beaver Valley, the licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email: dmk@nrc.gov

N. Fields, NRR
(301) 415-1173
Email: enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\IN92027 *See Previous Concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

OFFICE	CONTACTS		RI		C:PECB		D:DRPM	
NAME	D. Kern* N. Fields*		PWEselgroth*		AEChaffee* RLD for		TTMartin	
DATE	12/10/96		12/24/96		02/20/97		03/ /97	

OFFICIAL RECORD COPY

mlem 3/4/97

DF03 1/1

J-class relays at other facilities, most of the failures occurred during surveillance testing andwere attributed to "normal aging." The NRC staff is not aware of any analyses performed to determine the root cause for the failures at these other facilities. In analyzing the failure mode of the relays at Beaver Valley, the licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email: dmk@nrc.gov

N. Fields, NRR
(301) 415-1173
Email: enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\IN92027 *See Previous Concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

OFFICE	CONTACTS		RI		C:PECB		D:DRPM	
NAME	D. Kern* N. Fields*		PWEselgroth*		AEChaffee* RLD for		TTMartin	
DATE	12/10/96		12/24/96		02/20/97		02/ /97	

OFFICIAL RECORD COPY

mkm 2/28/97

were attributed to "normal aging." The NRC staff is not aware of any analyses performed to determine the root cause for the failures at these other facilities. In analyzing the failure mode of the relays at Beaver Valley, the licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email: dmk@nrc.gov

N. Fields, NRR
(301) 504-1173
Email: enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\IN92027 *See Previous Concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

OFFICE	CONTACTS	RI	C:PECB	D:DRPM
NAME	D. Kern* N. Fields*	PWEselgroth*	AEChaffee* RLD for	TTMartin
DATE	12/10/96	12/24/96	02/20/97	02/ /97

OFFICIAL RECORD COPY

the failures at these other facilities. In analyzing the failure mode of the relays, the Beaver Valley licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email - dmk@nrc.gov

N. Fields, NRR
(301) 504-1173
Email - enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

S 2/11/97

DOCUMENT NAME: G:\NICK\IN92027 *See Previous Concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

OFFICE	CONTACTS	RI	C:PECB	D:DRPM
NAME	D. Kern* N. Fields*	PWEselgroth*	AECheffee	TTMartin
DATE	02/ /97	12/ /96	02/10/97	02/ /97

OFFICIAL RECORD COPY

the failures at these other facilities. In analyzing the failure mode of the relays, the Beaver Valley licensee determined that if the relay remains energized, the contacts remain shut, the armature field remains steady, and, therefore, there is no excessive current to cause insulation breakdown and circuit failure. However, because the relay is continuously energized, the resultant high temperature causes the plastic carriage material to deform. When the relay is deenergized, the spring-loaded armature assembly separates the two magnet halves. This creates the armature gap. When the relay is reenergized, the deformed plastic carriage restricts motion of the armature assembly, which, in turn, maintains the large armature gap. With the large gap, the circuit current is greater than normal. The higher current causes increased heat to be generated, eventually resulting in the breakdown of coil insulation and the development of a short circuit in the coil of the relay. The short circuit could cause the fuse in the control power circuit for the component to open, rendering the component inoperable.

Information Notice 92-27 focused on the importance of the thermal effects resulting from ganged mounting of J10 relays. The information notice may not have adequately emphasized that the problem could exist with different mounting configurations and with other J-class relays.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: D. Kern, Region I
(412) 643-2000
Email - dmk@nrc.gov

N. Fields, NRR
(301) 504-1173
Email - enf@nrc.gov

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\IN92027

To receive a copy of this document, indicate in the box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

OFFICE	CONTACTS NF VIA E-MAIL	RI	C:PECB	D:DRPM
NAME	D. Kern N. Fields NF	PWEselgroth NF for VIA E-MAIL	AEChaffee	TTMartin
DATE	12/16/97	12/24/96	01/ /97	01/ /97

OFFICIAL RECORD COPY