

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

October 7, 1988

NRC INFORMATION NOTICE NO. 88-81: FAILURE OF AMP WINDOW INDENT KYNAR SPLICES
AND THOMAS AND BETTS NYLON WIRE CAPS DURING
ENVIRONMENTAL QUALIFICATION TESTING

Addressees:

All holders of operating licenses or construction permits for nuclear power, test, and research reactors.

Purpose:

This information notice is being provided to alert addressees to potential generic problems involving failures of AMP window indent KYNAR electrical butt splices and Thomas and Betts nylon wire caps during environmental qualification (EQ) testing of these components by Illinois Power Company at the Wyle Laboratories. It is expected that recipients will review this 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:

During an August 17 through 21, 1987, site inspection at the Clinton Station, the Region III EQ inspection team determined that installed AMP window indent electrical butt splices with KYNAR (Polyvinylidene Fluoride) insulation and Thomas and Betts nylon-insulated wire caps were unqualified because of inadequate test documentation.

AMP Window Indent KYNAR Splices:

After the NRC findings during the Clinton inspection, the licensee conducted two tests at Wyle Laboratories, to demonstrate that the AMP window indent KYNAR butt splices were qualifiable to 10 CFR 50.49 for postulated accident environments at the Clinton Station.

During the first test, six specimens were irradiated to 2.2E8 R and thermally aged for a 40.6-year simulated life at 125°F ambient temperature. The specimens were then exposed to a simulated LOCA environment of elevated temperature (400°F peak), pressure, steam, and demineralized water spray while contacting grounded metal surfaces. During the LOCA portion of the test, five of the six specimens (energized by 528-Vac, 132-Vac, and 132-Vdc circuits) shorted to ground, thereby failing the test.

8810040066

ZA

TD-11C

In order to establish near-term qualification, the licensee then performed a second test on six samples irradiated to $2.2E8$ R and aged to simulate 8 years at 125°F . The samples were exposed to the same simulated LOCA environment. One of the six specimens failed during the first 6 minutes of the LOCA exposure. Two other specimens failed after 17 and 24 hours of testing, respectively. The licensee discontinued the test and concluded that the splices failed to perform under conditions tested. All of the tested splices were nuclear-type PIDG, AMP Part Number 53550-1.

Subsequent to this test, the licensee identified 196 window indent KYNAR butt splices in valve actuators, solenoid valve leads, and in one junction box. These splices have since been replaced at the Clinton Station with qualified tape or Raychem splices.

Thomas and Betts Nylon Wire Caps:

Subsequent to the NRC findings during the Clinton inspection, the licensee conducted two tests at Wyle Laboratories to demonstrate that the nylon wire caps were qualifiable to postulated accident environments at the Clinton Station. Models RB-4 and RC-6 were tested.

During the first test, six specimens were irradiated to $1.1E7$ R and thermally aged for an 8-year simulated life at 125°F ambient temperature and then exposed to the simulated plant high-energy-line-break (HELB) of 270°F peak temperature. With an applied phase-to phase-voltage of 537 Vac, no failures were observed.

The licensee performed a second test in which 12 specimens were irradiated to $1.1E7$ R. Six specimens were thermally aged to simulate 125°F for a 40-year life and six specimens were aged to simulate 150°F for an 8-year life. The specimens were then exposed to a simulated HELB environment of 270°F peak temperature while mounted on a metal surface. At the 22-hour-point of the test, five specimens were found shorted to ground. The test was discontinued.

The licensee determined that the nylon caps were qualified for at least a 9.9-year plant life on the basis of the success of the first test and the actual lower plant ambient temperature. The nylon wire caps will be replaced at Clinton before the end of their qualified life.

Discussion:

10 CFR 50.49 requires that electrical equipment important to safety be environmentally qualified for postulated accident conditions. AMP Qualification Test Report 110-11004, REL 2-2-82, "AMP Insulated Terminals and Splices for Class 1E, Inside Containment Service in Nuclear Power Generating Stations*," was used as a basis for qualifying the Clinton splices. This report covers testing of AMP window indent KYNAR splices suspended between terminal blocks in a configuration in which the splices did not touch each other or the metal enclosure.


*AMP Report 110-11004, REL 2-2-82 is available in the NRC Public Document Rooms as Accession Number 8809290403.

The tested configuration differs from the installed configuration of the splices. At the Clinton Station, AMP window indent KYNAR splices were free to touch each other or the metal enclosure and had been used to extend leads in various 10 CFR 50.49-designated circuits inside and outside the containment. Subsequent testing by the licensee demonstrated failures in configurations in which the splices touched a grounded metal surface. These qualification tests highlight the need for the testing of equipment in its expected installation configuration.

Nylon wire caps were found installed in 480V motor leads in 90 dual-voltage Limitorque actuators at the Clinton Station. Limitorque test reports did not identify these wire caps as part of the qualification tests, and Limitorque did not control the installed configuration of wire caps in delivered equipment. Insufficient evidence of testing was interpreted by the NRC as a lack of qualification of these wire caps. Subsequent testing of these wire caps by the licensee demonstrated the shorter qualified life of 9.9 years. These tests highlight the need to identify all degradable components in 10 CFR 50.49-designated equipment and to verify that they have been properly environmentally tested.

Information Notice 86-104, "Unqualified Butt Splice Connectors Identified in Qualified Penetrations," describes short circuits experienced during LOCA testing of nylon-insulated AMP butt splices, as well as Thomas and Betts and Hollinsworth splices, used in the Dresden Nuclear Power Station. This problem and those described in this information notice illustrate that some butt splices are designed to maintain circuit continuity and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

| Information Notice No. | Subject | Date of Issuance | Issued to |
|---------------------------|--|---------------------|---|
| 88-80 | Unexpected Piping Movement Attributed to Thermal Stratification | 10/7/88 | All holders of OLs or CPs for PWRs. |
| 88-79 | Misuse of Flashing Lights for High Radiation Area Controls | 10/7/88 | All holders of OLs or CPs for nuclear power reactors. |
| 88-69, Supp 1 | Movable Contact Finger Binding in HFA Relays Manufactured by General Electric (GE) | 9/29/88 | All holders of OLs or CPs for nuclear power reactors. |
| 88-78 | Implementation of Revised NRC-Administered Requali- fication Examinations | 9/22/88 | All holders of OLs or CPs for nuclear power reactors. |
| 88-77 | Inadvertent Reactor Vessel Overfill | 9/22/88 | All holders of OLs or CPs for BWRs. |
| 88-76 | Recent Discovery of a Phenomenon not Previously Considered in the Design of Secondary Containment Pressure Control | 9/19/88 | All holders of OLs or CPs for nuclear power reactors. |
| 88-75 | Disabling of Diesel Generator Output Circuit Breakers by Anti-Pump Circuitry | 9/16/88 | All holders of OLs or CPs for nuclear power reactors. |
| 88-74 | Potentially Inadequate Performance of ECCS in PWRs During Recirculation Operation Following a LOCA | 9/14/88 | All holders of OLs or CPs for W and B&W-designed nuclear power reactors. |
| 88-73 | Direction-Dependent Leak Characteristics of Containment Purge Valves | 9/8/88 | All holders of OLs or CPs for nuclear power reactors. |

OL = Operating License
CP = Construction Permit

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

FIRST CLASS MAIL
POSTAGE & FEES PAID
USNRC
PERMIT No. G-67

The tested configuration differs from the installed configuration of the splices. At the Clinton Station, AMP window indent KYNAR splices were free to touch each other or the metal enclosure and had been used to extend leads in various 10 CFR 50.49-designated circuits inside and outside the containment. Subsequent testing by the licensee demonstrated failures in configurations in which the splices touched a grounded metal surface. These qualification tests highlight the need for the testing of equipment in its expected installation configuration.

Nylon wire caps were found installed in 480V motor leads in 90 dual-voltage Limitorque actuators at the Clinton Station. Limitorque test reports did not identify these wire caps as part of the qualification tests, and Limitorque did not control the installed configuration of wire caps in delivered equipment. Insufficient evidence of testing was interpreted by the NRC as a lack of qualification of these wire caps. Subsequent testing of these wire caps by the licensee demonstrated the shorter qualified life of 9.9 years. These tests highlight the need to identify all degradable components in 10 CFR 50.49-designated equipment and to verify that they have been properly environmentally tested.

Information Notice 86-104, "Unqualified Butt Splice Connectors Identified in Qualified Penetrations," describes short circuits experienced during LOCA testing of nylon-insulated AMP butt splices, as well as Thomas and Betts and Hollinsworth splices, used in the Dresden Nuclear Power Station. This problem and those described in this information notice illustrate that some butt splices are designed to maintain circuit continuity and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

*RIII

AGautam

07/26/88

*OGCB:DOEA:NRR

BMann

06/30/88

*D/DEST:NRR

LCShao

08/12/88

*RVIB:DRIS:NRR

RCWilson

07/08/88

D/DOEA:NRR
CERoc881
10/4/88

*SAD/DEST:NRR

ATHadani

08/11/88

*SC/RVIB:DRIS:NRR

UPotapovs

07/14/88

*C/OGCB:DOEA:NRR

CHBerlinger

09/23/88

*C/SPLB:DEST:NRR

JCraig

08/08/88

*C/RVIB:DRIS:NRR

EWBrach

07/19/88

*RPB:ARM

TechEd

08/16/88

*SPLB:DEST:NRR

HWalker

08/13/88

*A/D/DRIS:NRR

BKGrimes

07/19/88

The tested configuration differs from the installed configuration of the splices. At the Clinton Station, AMP KYNAR splices were free to touch each other or the metal enclosure and had been used to extend leads in various 10 CFR 50.49-designated circuits inside and outside the containment. Subsequent testing by the licensee demonstrated failures in configurations in which the splices touched a grounded metal surface. These qualification tests highlight the need for the testing of equipment in its expected installation configuration.

Nylon wire caps were found installed in 480V motor leads in 90 dual-voltage Limitorque actuators at the Clinton station. Limitorque test reports did not identify these wire caps as part of the qualification tests, and Limitorque did not control the installed configuration of wire caps in delivered equipment. Insufficient evidence of testing was interpreted by the NRC as a lack of qualification of these wire caps. Subsequent testing of these wire caps by the licensee demonstrated the shorter qualified life of 9.9 years. These tests highlight the need to identify all degradable components in 10 CFR 50.49-designated equipment and to verify that they have been properly environmentally tested.

Information Notice 86-104, "Unqualified Butt Splice Connectors Identified in Qualified Penetrations," describes short circuits experienced during LOCA testing of nylon-insulated AMP butt splices used in the Dresden Nuclear Power Station. This problem and those described in this information notice illustrate that butt splices are designed to maintain circuit continuity and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices
*SEE PREVIOUS CONCURRENCES

| | | | | |
|----------------|----------------|-------------------|------------------|----------------|
| *RIII | *D/DEST:NRR | D/DOEA:NRR | C/OGCB:DOEA:NRR | *RPB:ARM |
| AGautam | LCShao | CERossi | CHBerlinger | TechEd |
| 07/26/88 | 08/12/88 | 09/ /88 | 09/23/88 | 08/16/88 |
| *OGCB:DOEA:NRR | *RVIB:DRIS:NRR | *SAD/DEST:NRR | *C/SPLB:DEST:NRR | *SPLB:DEST:NRR |
| BMann | RCWilson | ATHadani | JCraig | HWalker |
| 06/30/88 | 07/08/88 | 08/11/88 | 08/08/88 | 08/13/88 |
| | | *SC/RVIB:DRIS:NRR | *C/RVIB:DRIS:NRR | *A/D/DRIS:NRR |
| | | UPotapovs | EWBrach | BKGrimes |
| | | 07/14/88 | 07/19/88 | 07/19/88 |

various 10 CFR 50.49 designated circuits inside and outside the containment. Subsequent testing by the licensee demonstrated failures in configurations where the splices touched a grounded metal surface. These qualification tests highlight the need for testing equipment in its expected installation configuration.

Nylon wire caps were found installed in 480V motor leads in ninety dual voltage Limatorque actuators at the Clinton station. Limatorque test reports did not identify these wire caps as part of the qualification tests, and Limatorque did not control the installed configuration of wire caps in delivered equipment. Insufficient evidence of testing was interpreted by the NRC as a lack of qualification of these wire caps. Subsequent testing of these wire caps by the licensee demonstrated a shorter qualified life of 9.9 years. These tests highlight the need to identify all degradable components in 10 CFR 50.49 designated equipment and to verify that they have been properly environmentally tested.

Information Notice 86-104 describes a problem with nylon-insulated AMP butt splices at the Dresden Nuclear Power Station. This problem and those described in this information notice illustrate that butt splices are designed to maintain circuit continuity, and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices

***SEE PREVIOUS CONCURRENCES**

*RIII
AGautam
07/26/88
*OGCB:DOEA:NRR
BMann
06/30/88

D/DEST: NRR
LCShao
08/12/88
*RVIB: DRIS: NRR
RCWilson
07/08/88

D/DOEA:NRR
CERoss
08/ /88
SAD/DEST:NRR¹⁰₂₃
AThadani
08//1/88
*SC/RVIB:DRIS:NRR
UPotapovs
07/14/88

C/OGCB:DOEA:NRR*RPB:ARM
CHBerlinger TechEd
08/ /88 08/ /88
C/SPLB:DEST:NRR SPLB,DEST:NRR
JC ~~19~~ HW ~~19~~
08/6/88 08/13/88
*C/RVIB:DRIS:NRR *A/D/DRIS:NRR
EWBrach BKGrimes
07/19/88 07/19/88

various 10 CFR 50.49 designated circuits inside and outside the containment. Subsequent testing by the licensee demonstrated failures in configurations *in which* where the splices touched a grounded metal surface. These qualification tests highlight the need for testing equipment in its expected installation configuration.

set
Nylon wire caps were *set* found installed in 480V motor leads in *90* ninety dual-voltage Limitorque actuators at the Clinton station. Limitorque test reports did not identify these wire caps as part of the qualification tests, and Limitorque did not control the installed configuration of wire caps in delivered equipment. *set*
Insufficient evidence of testing was interpreted by the NRC as a lack of qualification of these wire caps. Subsequent testing of these wire caps by the licensee demonstrated a shorter qualified life of 9.9 years. These tests highlight the need to identify all degradable components in 10 CFR 50.49 designated equipment and to verify that they have been properly environmentally tested.

Information Notice 86-104 describes a problem with nylon-insulated AMP butt splices at the Dresden Nuclear Power Station. This problem and those described in this information notice illustrate that butt splices are designed to maintain circuit continuity, and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

| | | | |
|----------------|-------------------|------------------|---------------|
| *RIII | D/DOEA:NRR | C/DOEA:NRR | RPA:ARM |
| AGautam | CERossi | CHBerlinger | TechEd |
| 07/26/88 | 08/ /88 | 08/ /88 | 08/16/88 |
| *OGCB:DOEA:NRR | SAD/DEST:NRR | C/SPLB:DEST:NRR | SPLB,DEST:NRR |
| BMann | ATHadani | JC | HWA |
| 06/30/88 | 08/11/88 | 08/6/88 | 08/13/88 |
| | *SC/RVIB:DRIS:NRR | *C/RVIB:DRIS:NRR | *A/D/DRIS:NRR |
| | UPotapovs | EWBrach | BKGrimes |
| | 07/08/88 | 07/14/88 | 07/19/88 |

various 10 CFR 50.49 designated circuits inside and outside the containment. Subsequent testing by the licensee demonstrated failures in configurations where the splices touched a grounded metal surface. These qualification tests highlight the need for testing equipment in their expected installation configuration.

Nylon wire caps were found installed on 480V motor leads in ninety dual voltage Limitorque actuators at the Clinton Station. Limitorque test reports, however, did not identify these wire caps as part of the qualification tests. Insufficient evidence of testing was interpreted by the NRC as a lack of qualification of these wire caps. Subsequent testing of these wire caps by the licensee demonstrated a shorter qualified life of 9.9 years. These tests highlight the need to identify all degradable components in 10 CFR 50.49 designated equipment and to verify that they have been properly environmentally tested.

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: A. S. Gautam, RIII
(312) 790-5523

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

| | | | |
|-----------------|--------------|-----------------|---------------|
| RIII <i>ASG</i> | D/DOEA:NRR | C/OGCB:DOEA:NRR | RPB:ARM |
| AGautam | CERossi | CHBerlinger | TechEd |
| 07/26/88 | 07/ /88 | 07/ /88 | 07/ /88 |
| *OGCB:DOEA:NRR | SAD/DEST:NRR | C/SPLB:DEST:NRR | SPLB:DEST:NRR |
| BMann | ATHadani | JCraig | HWalker |
| 06/30/88 | 07/ /88 | 07/ /88 | 07/ /88 |
| | UPotapovs | EWBrach | A/D/DRIS:NRR |
| | 07/ /88 | 07/ /88 | BKGrimes |
| | | | 07/ /88 |

licensee does not have an adequate basis to establish qualification), the licensee shall make a prompt determination of operability, shall take immediate steps to establish a plan with a reasonable schedule to correct the deficiency, and shall have written justification for continued operation. This justification does not require NRC review and approval."

Information Notice 86-104 describes a problem with nylon-insulated AMP butt splices at the Dresden Nuclear Power Station. These problems illustrate that butt splices are designed to maintain circuit continuity, and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

| | | | | |
|----------------|---------------|------------------|-----------------|---------------|
| RIII | D/DEST:NRR | D/DOEA:NRR | C/OGCB:DOEA:NRR | RPB:ARM |
| AGautam | LCShao | CERossi | CHBerlinger | TechEd |
| 07/ /88 | 07/ /88 | 07/ /88 | 07/ /88 | 07/ /88 |
| *OGCB:DOEA:NRR | RVIB:DRIS:NRR | SAD/DEST:NRR | C/SPLB:DEST:NRR | SPLB:DEST:NRR |
| BMann | RCWilson | ATHadani | JCraig | HWalker |
| 06/30/88 | 07/8/88 | 07/ /88 | 07/ /88 | 07/ /88 |
| | | SC/RVIB:DRIS:NRR | C/RVIB:DRIS:NRR | A/D/DRIS:NRR |
| | | UPotapovs | EWBrach | BKGrimes |
| | | 07/14/88 | 07/19/88 | 07/19/88 |

OK as marked

licensee shall make a prompt determination of operability, shall take immediate steps to establish a plan with a reasonable schedule to correct the deficiency, and shall have written justification for continued operation. This justification does not require NRC review and approval."

Information Notice 86-104 describes a problem with nylon-insulated AMP butt splices at the Dresden Nuclear Power Station. These problems illustrate that butt splices are designed to maintain circuit continuity, and may not provide adequate electrical insulation from nearby conductors.

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: A. S. Gautam, RIII
(312) 790-5523

R. C. Wilson, NRR
(301) 492-0997

Attachment: List of Recently Issued NRC Information Notices

| | | | |
|---------------|------------------|-----------------|---------------|
| RIII | D/DOEA:NRR | C/OGCB:DOEA:NRR | RPB:ARM |
| AGautam | CERossi | CHBerlinger | TechEd |
| 06/ /88 | 06/ /88 | 06/ /88 | 06/ /88 |
| OGCB:DOEA:NRR | SAD/DEST:NRR | C/SPLB:DEST:NRR | SPLB:DEST:NRR |
| BMann | ATHadani | JCraig | HWalker |
| 06/30/88 | 06/ /88 | 06/ /88 | 06/ /88 |
| | SC/RVIB:DRIS:NRR | C/RVIB:DRIS:NRR | A/D/DRIS:NRR |
| | UPotapovs | EWBrach | BKGrimes |
| | 06/ /88 | 06/ /88 | 06/ /88 |