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

December 11, 1992

NRC INFORMATION NOTICE 92-81: POTENTIAL DEFICIENCY OF ELECTRICAL CABLES WITH BONDED HYPALON JACKETS

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 a potential deficiency in the environmental qualification of electrical cables with bonded Hypalon jackets. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response to this notice is required.

Description of Circumstances

Sandia National Laboratories (SNL), under contract to NRC, has been conducting tests on cables manufactured by three different manufacturers, including Okonite. The tests were performed to determine the minimum insulation thickness necessary for installed cable to perform its intended function should the insulation be damaged during installation, maintenance, or other activities. Therefore, the thermal and radiation aging and loss-of-coolant-accident (LOCA) testing for the cables were performed with reduced and full insulation thicknesses. The Okonite specimens tested were single-conductor, 600-volt, 12 American Wire Gauge (AWG) control cables insulated with ethylene propylene rubber (EPR) with a bonded Hypalon jacket (Okonite-Okolon). During LOCA testing, all 10 of the Okonite-Okolon cable samples failed. The other cables in this test program did not have bonded jackets and did not experience unexpected failures.

During this test program, the cables were first subjected to 130 megarads of radiation at the rate of 300 kilorads per hour for 433 hours and were then thermally aged at 158 °C (316 °F) for 336 hours. Based on the Arrhenius equation, accelerated thermal aging at this time and temperature is equivalent to a 40-year cable life at 69 °C (156 °F) for the jacket and 76 °C (169 °F) for the insulation. After thermal aging, through-wall cracks were noted on most of the Okonite-Okolon cables. However, the cracks did not prevent the

9212070135
PDR I&E Notice 920
DF01
1/1
002098
NRC FILE CENTER COPY

cables from passing an insulation resistance (IR) test that was conducted in a dry environment.

After the aging and IR tests, the cables were subjected to a LOCA test. The test sequence was (1) 94 hours of testing to simulate the LOCA environment defined in Appendix A to Institute of Electrical and Electronics Engineers (IEEE) Standard 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," and (2) 146 hours at 121 °C (250 °F) for the remainder of the test. No chemical spray was used. The cables were energized by 110-volt DC power during the test with no load. One cable with full insulation thickness failed just after the test chamber conditions became saturated at 11-1/2 hours into the test. By the fifth day of the test, all the Okonite cables had failed, as indicated by blown 1-ampere fuses. The test chamber was opened on October 24, 1992, and the cables were visually inspected. The insulation and jacket on the Okonite cables had split down the length of the cable, and bare conductor was visible.

On October 28, 1992, the NRC staff visited SNL to evaluate the test failures. During that visit, SNL personnel informed the staff that other Okonite cables with bonded Hypalon jackets had failed similarly at SNL under another NRC-sponsored test program (license renewal test program). For this test, the cables were thermally aged to the equivalent of a 40-year life at 56 °C (133 °F). One out of four Okonite-Okolon cables failed during LOCA testing. Another group of Okonite cables that had been aged to a 40-year life at 50 °C (122 °F) passed this testing.

In addition to the Okonite failures in the license renewal test program, cables manufactured by Samuel Moore also failed during LOCA testing. These cables were Dekoron Dekorad Type 1952, two-conductor, twisted, shielded pair, 16 AWG instrument cables covered with ethylene-propylene diene monomer (a type of EPR) insulation with a bonded Hypalon jacket and an overall jacket of Hypalon. One cable in which one conductor failed had been thermally aged to a 20-year life at 55 °C (131 °F), while the other cable in which both conductors failed had been thermally aged to a 40-year life at 56 °C (133 °F). These failures were similar to the failure of the Okonite-Okolon cable in that the insulation and bonded jacket had split open. Other samples of Samuel Moore cable survived aging and accident testing under similar conditions.

Discussion

The SNL test results from NRC-sponsored programs raise questions with respect to the environmental qualification of Okonite cables with bonded Hypalon jackets that have not been specifically qualified for service conditions exceeding 50 °C (122 °F) for 40 years. The staff reviewed the qualification data developed by the Okonite Company and noted that Okonite 2 kV cables with 0.76 mm [30 mil] bonded Hypalon jackets and 600-volt cables with unjacketed EPR insulation were previously tested. The 600-volt cables with 0.38 mm [15 mil] bonded Hypalon jackets were qualified based on the previous 2 kV and 600-volt test results. It was believed that if the unjacketed EPR insulation passed qualification testing, then EPR insulation with a bonded jacket would

also pass qualification testing. However, the Sandia test results indicate that Okonite cable with bonded Hypalon jackets may be susceptible to failure.

The qualification data reviewed by the staff for the Samuel Moore cables showed that cables with bonded Hypalon jackets had been previously tested by Isomedix, Inc. The tests documented qualification of the Dekoron Dekorad cable to a qualified life of 40 years at plant service conditions of 52 °C (126 °F) or less. The test results from the license renewal test program at SNL raise questions about the qualification of Samuel Moore Dekoron Dekorad Type 1952 cables when used at higher temperatures.

Other bonded-jacket cables, qualified for up to 90 °C (194 °F) applications as claimed by various vendors, may be susceptible to the same type of failures if not specifically tested in the bonded confirguration. The difference in aging rates between the jacket and the insulation may be a factor in the failure of bonded-jacket cables. Therefore, qualification testing that does not use the jacketed configuration may not be representative of actual cable performance.

Depending on the application, failure of these cables could affect the performance of safety functions in nuclear power plants. The functional integrity of the cables could be affected if the cables are used inside containment, used in continuous power circuits, routed with power cables, or routed close to hot pipes. Generic Letter 88-07, "Modified Enforcement Policy Relating to 10 CFR 50.49, 'Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants,'" provides relevant information on dealing with potential environmental qualification deficiencies.

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.

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

Technical contacts: Hukam C. Garg, NRR
(301) 504-2929

Ann M. Dummer, NRR
(301) 504-2831

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-80	Results of Thermo-Lag 330-1 Combustibility Testing	12/07/92	All holders of OLs or CPs for nuclear power reactors.
92-79	Non-Power Reactor Emergency Event Response	12/01/92	All holders of OLs or CPs for test and research reactors.
92-78	Piston to Cylinder Liner Tin Smearing on Cooper-Bessemer KSV Diesel Engines	11/30/92	All holders of OLs or CPs for nuclear power reactors.
92-77	Questionable Selection and Review to Determine Suitability of Electropneumatic Relays for Certain Applications	11/17/92	All holders of OLs or CPs for nuclear power reactors.
92-76	Issuance of Supplement 1 to NUREG-1358, "Lessons Learned from the Special Inspection Program for Emergency Operating Procedures (Conducted October 1988 - September 1991)"	11/13/92	All holders of OLs or CPs for nuclear power reactors.
92-75	Unplanned Intakes of Airborne Radioactive Material by Individuals at Nuclear Power Plants	11/12/92	All holders of OLs or CPs for nuclear power reactors
92-74	Power Oscillations at Washington Nuclear Power Unit 2	11/10/92	All holders of OLs or CPs for nuclear power reactors.
92-61, Supp. 1	Loss of High Head Safety Injection	11/06/92	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

FIRST CLASS MAIL
POSTAGE AND FEES PAID
USNRC
PERMIT NO. G-67

PRINTED ON RECYCLED PAPER

testing, then EPR insulation with a bonded jacket would also pass qualification testing. However, the Sandia test results indicate that Okonite cable with bonded Hypalon jackets may be susceptible to failure.

The qualification data reviewed by the staff for the Samuel Moore cables showed that cables with bonded Hypalon jackets had been previously tested by Isomedix, Inc. The tests documented qualification of the Dekoron Dekorad cable to a qualified life of 40 years at plant service conditions of 52 °C (126 °F) or less. The test results from the license renewal test program at SNL raised concerns about the qualification of Samuel Moore Dekoron Dekorad Type 1952 cables when used at higher temperatures.

The staff is also concerned that other bonded-jacket cables, qualified for up to 90 °C (194 °F) applications as claimed by various vendors, may be susceptible to the same type of failures if not specifically tested in the bonded confirguration. The difference in aging rates between the jacket and the insulation may be a factor in the failure of bonded-jacket cables. Therefore, qualification testing that does not use the jacketed configuration may not be representative of actual cable performance.

Depending on the application, failure of these cables could affect the performance of safety functions in nuclear power plants. The functional integrity of the cables could be affected if the cables are used inside containment, used in continuous power circuits, routed with power cables, or routed close to hot pipes. Generic Letter 88-07, "Modified Enforcement Policy Relating to 10 CFR 50.49, 'Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants,'" provides relevant information on dealing with potential environmental qualification deficiencies.

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.

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

Technical contacts: Hukam C. Garg, NRR
(301) 504-2929
Ann M. Dummer, NRR
(301) 504-2831

Attachment: List of Recently Issued NRC Information Notices

Document Name: 92-81 **SEE PREVIOUS CONCURRENCES

*See memo from CEMcCracken to GHMarcus dated 11/24/92

**SPLB:DSSA	**SPLB:DSSA	**SPLB:DSSA	*TECH ED	*HICB:DRCH
ADummer:mkm	GHubbard	CMcCracken		EMarinos
12/01/92	12/01/92	12/01/92	11/25/92	11/24/92

*HICB:DRCH	*HICB:DRCH	**OGCB:DORS	**D:DSSA	**C:OGCB:DORS	D:DORS
SNewberry	HGarg	PWen	AThadani	GHMarcus	BKGrimes
11/24/92	11/24/92	12/01/92	12/04/92	12/04/92	12/ /92

testing, then EPR insulation with a bonded jacket would also pass qualification testing. However, the Sandia test results indicate that Okonite cable with bonded Hypalon jackets may be susceptible to failure.

The qualification data reviewed by the staff for the Samuel Moore cables showed that cables with bonded Hypalon jackets had been previously tested by Isomedix, Inc. The tests documented qualification of the Dekoron Dekorad cable to a qualified life of 40 years at plant service conditions of 52 °C (126 °F) or less. The test results from the license renewal test program at SNL raise questions about the qualification of Samuel Moore Dekoron Dekorad Type 1952 cables when used at higher temperatures.

Other bonded-jacket cables, qualified for up to 90 °C (194 °F) applications as claimed by various vendors, may be susceptible to the same type of failures if not specifically tested in the bonded confirguration. The difference in aging rates between the jacket and the insulation may be a factor in the failure of bonded-jacket cables. Therefore, qualification testing that does not use the jacketed configuration may not be representative of actual cable performance.

Depending on the application, failure of these cables could affect the performance of safety functions in nuclear power plants. The functional integrity of the cables could be affected if the cables are used inside containment, used in continuous power circuits, routed with power cables, or routed close to hot pipes. Generic Letter 88-07, "Modified Enforcement Policy Relating to 10 CFR 50.49, 'Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants,'" provides relevant information on dealing with potential environmental qualification deficiencies.

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
Brian K. Grimes

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

Technical contacts: Hukam C. Garg, NRR
(301) 504-2929
Ann M. Dummer, NRR
(301) 504-2831

Attachment: List of Recently Issued NRC Information Notices

Document Name: 92-81 **SEE PREVIOUS CONCURRENCES

*See memo from CEMcCracken to GHMarcus dated 11/24/92

**SPLB:DSSA	**SPLB:DSSA	**SPLB:DSSA	*TECH ED	*HICB:DRCH
ADummer:mkm	GHubbard	CMcCracken		EMarinos
12/01/92	12/01/92	12/01/92	11/25/92	11/24/92

*HICB:DRCH	*HICB:DRCH	**OGCB:DORS	**D:DSSA	**C:OGCB:DORS	D:DORS
SNewberry	HGarg	PWen	AThadani	GHMarcus	BKGrimes
11/24/92	11/24/92	12/01/92	12/04/92	12/04/92	12/9/92

pass qualification testing. However, the Sandia test results indicate that the installed Okonite cable with bonded Hypalon jackets may be susceptible to failure.

The qualification data reviewed by the staff for the Samuel Moore cables showed that cables with bonded Hypalon jackets had been previously tested. The tests documented qualification of the Dekoron Dekorad cable to a qualified life of 40 years at plant service conditions of 52 °C (126 °F) or less. The test results from the license renewal test program at SNL raised concerns about the qualification of Samuel Moore Dekoron Dekorad Type 1952 cables when used at higher temperatures.

The staff is also concerned that other bonded-jacket cables, qualified for up to 90 °C (194 °F) applications as claimed by various vendors, may be susceptible to the same type of failures. The difference in aging rates between the jacket and the insulation may be a factor in the failure of bonded-jacket cables. Therefore, qualification testing that does not use the jacketed configuration may not be representative of actual cable performance.

Depending on the application, failure of these cables could affect the performance of safety functions in nuclear power plants. The functional integrity of the cables could be affected if the cables are used inside containment, used in continuous power circuits, routed with power cables, or routed close to hot pipes.

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.

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

Technical contacts: Hukam C. Garg, NRR
(301) 504-2929
Ann M. Dummer, NRR
(301) 504-2831

Attachment: List of Recently Issued NRC Information Notices

Document Name: OKONITE.IN **SEE PREVIOUS CONCURRENCES

*See memo from CEMcCracken to GHMarcus dated 11/24/92

**SPLB:DSSA	**SPLB:DSSA	**SPLB:DSSA	*TECH ED	*HICB:DRCH
ADummer:mkm	GHubbard	CMcCracken		EMarinos
12/01/92	12/01/92	12/01/92	11/25/92	11/24/92
*HICB:DRCH	*HICB:DRCH	**OGCB:DORS	D:DSSA	C:OGCB:DORS
SNewberry	HGarg	PWen	AThadani	GHMarcus GHM
11/24/92	11/24/92	12/01/92	12/4/92	12/4/92

D:DORS
BKGrimes
12/ /92

test results from the license renewal test program at SNL raised concerns about the qualification of Samuel Moore Dekoron Dekorad Type 1952 cables when used at higher temperatures.

The staff is also concerned that other bonded-jacket cables, qualified for up to 90 °C (194 °F) applications as claimed by various vendors, may be susceptible to the same type of failures. The difference in aging rates between the jacket and the insulation may be a factor in the failure of bonded-jacket cables. Therefore, qualification testing that does not use the jacketed configuration may not be representative of actual cable performance.

Depending on the application, failure of these cables could affect the performance of safety functions in nuclear power plants. The functional integrity of the cables could be affected if the cables are used inside containment, used in continuous power circuits, routed with power cables, or routed close to hot pipes.

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.

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

Technical contacts: Hukam C. Garg, NRR
(301) 504-2929

Ann M. Dummer, NRR
(301) 504-2831

Attachment: List of Recently Issued NRC Information Notices
Document Name: OKONITE.IN
*See memo from CEMcCracken to GHMarcus dated 11/24/92

SPLB:DSSA	SPLB:DSSA	SPLB:DSSA	*TECH ED	*HICB:DRCH
ADummer:mkm	GHubbard	CMcCracken		EMarinos
12/1/92	12/1/92	12/ /92	11/25/92	11/24/92

*HICB:DRCH	*HICB:DRCH	OGCB:DORS	D:DSSA	C:OGCB:DORS
SNewberry	HGarg	PWen	AThadani	GHMarcus
11/24/92	11/24/92	12/1/92	12/ /92	12/ /92

D:DORS
BKGrimes
12/ /92