http://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/1993/in93033.html

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

April 28, 1993

NRC INFORMATION NOTICE 93-33: POTENTIAL DEFICIENCY OF CERTAIN CLASS 1E INSTRUMENTATION AND CONTROL CABLES

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 certain Class 1E instrumentation and control cables. 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 to this notice is required.

Description of Circumstances

Sandia National Laboratories, under contract to the NRC, tested cables to determine the long-term aging degradation behavior of typical instrumentation and control cables used in nuclear power plants and to determine the potential for using condition monitoring for assessing residual life. The results of this testing are described in NUREG/CR-5772, "Aging, Condition Monitoring, and Loss-of-Coolant Accident (LOCA) Tests of Class 1E Electrical Cables," Volumes 1, 2, and 3. The tests were conducted on cross-linked polyolefin/poly-ethylene, ethylene propylene rubber, and miscellaneous Class 1E cable types.

The test program generally followed the guidance of Institute of Electrical and Electronics Engineers (IEEE) Standard 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," and IEEE Standard 383-1974, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections." IEEE Standard 323-1974 is an industry-established standard endorsed by the NRC for qualifying Class 1E equipment for nuclear power generating stations, and IEEE Standard 383-1974 is an industry-established standard for type test of Class 1E electric cables, field splices, and connections for nuclear power generating stations.

The test program consisted of two phases; both phases used the same test specimens. Phase 1 consisted of simultaneous thermal and radiation aging of the cables at approximately 100 C (212 F) and 0.10 kGy per hour (10 kilorads per hour), respectively. Three different sets of cable specimens were tested in this phase: one was aged to a nominal lifetime of 20 years, a second to 40 years, and a third to 60 years. Phase II was a sequential accident exposure consisting of 1100 kGy (110 megarads) of high-dose-rate irradiation

at the rate of 6 kGy per hour (600 kilorads per hour) followed by a simulated exposure to LOCA steam. The test profile was similar to the one given in IEEE Standard 323-1974 for "generic" qualification. The cables were energized at 110 V dc during the accident simulation. Insulation resistance was measured on line throughout the test. No chemical spray was used during the steam exposure, but a post-LOCA submergence test was performed on the cables that were aged to a nominal equivalent of 40 years.

Cable types that failed during the accident tests or that exhibited marginal insulation resistances were Rockbestos Firewall III, BIW Bostrad 7E, Okonite-Okolon, Samuel Moore Dekoron Dekorad Type 1952, Kerite 1977, Rockbestos RSS-6-104/LE Coaxial, and Champlain Kapton. The list of cables included in the test program and a summary of the test results from NUREG/CR-5772 are shown in Attachments 1 and 2, respectively.

In addition, the Sandia National Laboratories (under contract to NRC) has also tested cables in a separate program 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. During LOCA testing, all 10 of the Okonite-Okolon cable samples failed. The results of this test program are summarized in NRC Information Notice 92-81, "Potential Deficiency of Electrical Cables With Bonded Hypalon Jackets," issued on December 11, 1992.

Discussion

The Sandia National Laboratories test results from NRC-sponsored programs raise questions with respect to the environmental qualification (EQ) of certain cables that either failed or exhibited marginal insulation resistance values. The staff reviewed the test data and noted that cable types identified as Firewall III, Okonite, Dekorad, and Kapton failed during the simulated accident exposure, while BIW Bostrad, Rockbestos Coaxial, and Kerite exhibited marginal insulation resistances. It should be noted that the insulation resistance of the Rockbestos coaxial cables may be too low to meet specifications for use in General Atomics radiation monitor circuits, depending on the environment to which the cable will be exposed. The low insulation resistance of these Rockbestos coaxial cables was the subject of a 10 CFR Part 21, "Reporting of Defects and Noncompliance," notification by General Atomics dated March 28, 1989.

As part of the NRC-sponsored aging research program, the Sandia National Laboratories searched licensee event reports (LERs) to find LERs that might be related to cable aging. In NUREG/CR-5461, "Aging of Cables, Connections, and Electrical Penetrations Assemblies Used in Nuclear Power Plants," the Sandia National Laboratories concluded that although cables are highly reliable
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devices under normal plant operating conditions, with no evidence of significant increases in failure rate with aging, the performance experience with these components under actual accident conditions is small. The current LER data provide a very limited database for this purpose. The only

significant data for cables subjected to design-basis events comes from EQ testing.

Depending on the application, failure of these cables during or following design-basis events could affect the performance of safety functions in nuclear power plants. NRC Generic Letter 88-07, "Modified Enforcement Policy Relating to 10 CFR 50.49, `Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants'," provides relevant information on dealing with potential EQ deficiencies. In Generic Letter 88-07, the NRC stated, in part:

> When a potential deficiency has been identified by the NRC or licensee in the equipment (i.e., a licensee does not have an adequate basis to establish qualification), the licensee is expected to make a prompt determination of operability (i.e., the system or component is capable of performing its intended design function), take immediate steps to establish a plan with a reasonable schedule to correct the deficiency, and have written justification for continued operation, which will be available for NRC review.
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> The licensee may be able to make a finding of operability using analysis and partial test data to provide reasonable assurance that the equipment will perform its safety function when called upon. In this connection, it must also be shown that subsequent failure of the equipment, if likely under accident conditions, will not result in significant degradation of any safety function or provide misleading information to the operator.

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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

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Attachments:
1. "Cables Included in the Test Program"
2. "Summary of Tested, Failed, and Marginal Insulation Resistance Cables"
3. List of Recently Issued NRC Information Notices

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CABLES INCLUDED IN THE TEST PROGRAM

	Supplier	Description
1.	Brand Rex	30 mil XLPE Insulation, 60 mil CSPE Jacket, 12 AWG, 3/C, 600 V
2.	Rockbestos	Firewall III, 30 mil XLPE Insulation, 45 mil Neoprene Jacket, 12 AWG, 3/C, 600 V

3.	Raychem	Flamtrol, 30 mil XLPE Insulation, 12 AWG, 1/C, 600 V
4.	Samuel Moore	Dekoron Polyset, 30 mil XLPO Insulation, 45 mil CSPE Jacket, 12 AWG, 3/C and Drain, 600 V
5.	Anaconda	Anaconda Y Flame-Guard FR-EP, 30 mil EPR Insulation, 45 mil CPE Jacket, 12 AWG, 3/C, 600 V
5a.	Anaconda*	Anaconda Flame-Guard EP, 30 mil EPR Insulation, 15 mil Individual CSPE Jackets, 45 mil Overall CSPE Jacket, 12 AWG, 3/C, 1000 V
6.	Okonite	Okonite-Okolon, 30 mil EPR Insulation, 15 mil CSPE Jacket, 12 AWG, 1/C, 600 V
7.	Samuel Moore	Dekoron Dekorad Type 1952, 20 mil EPDM Insulation, 10 mil Individual CSPE Jackets, 45 mil Overall CSPE Jacket, 16 AWG, 2/C TSP, 600 V
8.	Kerite	Kerite 1977, 70 mil FR Insulation, 40 mil FR Jacket, 12 AWG, 1/C, 600 V
8a.	Kerite	Kerite 1977, 50 mil FR Insulation, 60 mil FR Jacket, 12 AWG, 1/C, 600 V
9.	Rockbestos	RSS-6-104/LE Coaxial Cable, 22 AWG, 1/C Shielded
10.	Rockbestos	30 mil Firewall Silicone Rubber Insulation, Fiberglass Braided Jacket, 16 AWG, 1/C, 600 V
11.	Champlain	5 mil Polyimide (Kapton) Insulation, Unjacketed, 12 AWG, 1/C
12.	BIW**	Bostrad 7E, 30 mil EPR Insulation, 15 mil Individual CSPE Jackets, 60 mil Overall CSPE Jacket, 16 AWG, 2/C TSP, 600 V

* This cable was only used for the multiconductor samples in the 3-month chamber.

** The IR values in BIW Report B915 are approximately one order of magnitude higher than the values observed during the Sandia National

Laboratories testing..

Summary of Tested (T), Failed (F),
and Marginal Insulation Resistance (IR)* Cables

Cable Type		Pre-aged 20 years T--F/IR	40 years T--F/IR	60 years T--F/IR
Firewall III	M	3--0/0	3--0/0	6--1/0
Brand Rex	M	3--0/0	3--0/0	3--0/0
Polyset	M	3--0/0	3--0/0	6--0/0
Raychem	S	2--0/0	2--0/0	3--0/0
Anaconda	M	6--0/0	6--0/0	6--0/0
Anaconda	S	1--0/0	1--0/0	1--0/0
BIW Bostrad	M	2--0/2	2--0/2	4--0/4
BIW Bostrad	S	2--0/1	2--0/2	2--0/2
Okonite	S	3--0/0	3--0/0	4--1/0
Dekorad	M	4--1/0	4--0/0	4--2/0
Dekorad	S	2--0/0	2--0/0	2--0/0
Kerite	S	2--0/0	2--0/2	3--0/3
Coaxial	S	2--0/2	2--0/2	2--0/2

Silicone	S	2--0/0	2--0/0	2--0/0
Kapton**	S	2--1/0	2--1/?	2--1/0
Totals		39--2/5	39--1/8	50--5/11

* Minimum IR lower than 2500 ohm-1000 ft for instrument cable, 500 ohm-1000 ft for control cable, or 10E7 ohm-1000 ft for coaxial cable.

** Failed cables that were pre-aged to 40 and 60 years were damaged prior to accident test.

? No IR measurements were possible.

S Single conductor cables

M Multiconductor cables