THE OKONITE COMPANY
Ramsey, New Jersey 07446

April 16, 1981

ENGINEERING REPORT NO. 344, REV. 1

MAIN STEAM LINE BREAK QUALIFICATION TEST ON OKOZEL INSULATION

FINAL REPORT

Introduction

A postulated design basis event - main steam line break (MSLB) test was performed on Okozel (Tefzel 280) insulated wire. The test was performed to determine if Okozel would remain operational in the event of such an accident. The test program was designed to incorporate the requirements of IEEE Standards 323-1974 and 383-1974 as well as TVA contract number 79K6-825902. The MSLB profile was taken from Figure 2 of the TVA specification. Margins in accordance with IEEE 323, section 6.3.1.5 were added to the profile.

Thermal aging was performed at the Okonite Passaic Laboratory. Isomedix, Incorporated was contracted for irradiation aging. A copy of the irradiation certification is attached as Appendix 1. The main steam line break profile was performed by Approved Engineering Test Laboratories. A copy of their final report is attached as Appendix 2. The AETL report also includes other materials tested in conjunction with the Tefzel 280.

Summary

Two sets of thermally aged and irradiated and unaged samples of Okozel insulated wire were exposed to the MSLB temperature-pressure profile as given in Figure 1. All samples maintained their electrical load throughout the entire profile. The two unaged samples and one of the aged samples passed the final IEEE 383 "Post-LOCA Simulation Test". The second aged sample also passed the final withstand test after two localized areas of physical damage were isolated. Evidence of physical damage is given in the body of this report.

Procedure

Four twenty foot samples of 1/C #16 AWG 7X tinned coated 0.015" Okozel (Tefzel 280) were prepared at Okonite for testing by marking the center fifteen feet. Two samples were placed in a circulating air oven for thermal aging at 180°C for one week. Upon completion of thermal aging SIC, % PF and insulation resistance (IR) measurements were made.

KYS Representatives

Switzer	Phone
Junod	Phone
Norman	Phone

Teams will consist of players in age groups (a) under 12 (born in 1971 and 1972), (b) under 14 (born in 1969 and 1970), and (c) under 16 (born in 1967 and 1968). Regular league play will include competition with Chattanooga teams and those from Kingsport on an away and home basis.

Tryouts will be held on , 1982 at Bearden Jr. High School (under 12 age level) and at Christian Academy of Knoxville (under 14 and under 16, from 1:00 - 3:30 pm.

Call for additional information.

The thermally aged Okozel samples along with other thermally aged samples were delivered to Isomedix for irradiation. The samples were exposed to a minimum 55 megarads of gamma radiation from a Cobalt 60 source. The 55 megarads simulates the expected total installed life exposure with margin added. (See attached radiation certification, Appendix 1.)

After irradiation all samples were sent to Approved Engineering Test Labs. for the MSLB test. The AETL report is included as Appendix 2 to this report.

Discussion of Results

All samples successfully maintained rated voltage and current throughout the MSLB event. The unaged Okozel samples and one of the aged and irradiated Okozel samples met the Post-LOCA simulation test requirements. The remaining aged and irradiated sample failed to withstand the 1200 volts at two localized areas. With these areas isolated the remainder of the sample passed the required withstand test.

The first failure occurred on the rise at 900 volts. The fault was found and isolated. The withstand voltage was reapplied and the sample held voltage for three minutes before failing again. No further work on this sample was attempted at AETL. Further investigation was performed at the Okonite laboratory. With both damaged areas isolated the remainder of the length passed the required withstand test.

If the damaged sites are examined it can be observed that the morphology of the damaged areas are identical with respect to the regions extending far enough from the sites to preclude cause and affect. The surface "condition" existed before the failure. Photographs on file at Okonite magnified 7.5 X show how the failure sites are identical to several other sites of apparent damage. These damaged areas have a reduced wall of insulation and the curvature of the dielectric is absent.

Upon further investigation, cross-sectional views were examined within 40 mils of both faults. The reduced wall at the first fault was approximately 2 mils. The wall thickness at the second fault was approximately 2.5 mils. Again photographs of these cross-sections were taken. The measurements were taken far enough from the fault so that the wall thickness was not affected by the dielectric puncture. Visual examination at 30 X magnification indicated that the damaged area wall thickness increased as the distance from the fault increased. Therefore, the wall thickness at the fault was probably as thin as or possibly thinner than those thicknesses measured.

If the measured thicknesses are used as the fault thicknesses, the dielectric failure of the first fault occurred at 900 volts through a 2 mil wall or 450 volts per mil. The second fault occurred at 1200 volts through a 2.5 mil wall or 480 volts/mil.

With these two faults cleared, the remainder of the sample passed the 5 minute 80 volts/mil ac withstand test requirement. A four foot effective length was then subjected to an ac rapid rise breakdown. Breakdown occured at 8.5kV in an area similar in damage to the first two except to a lesser extent. The wall thickness was 12 mils which meant a 708 volt/mil average breakdown strength.

The reason for physical damage could be attributed to two causes. First, the integrity of the insulation was violated during the manipulation necessary to remove the samples from the mandrel. Some minor difficulty was experienced when separating the turns from each other. They were stuck anywhere from a fraction of an inch to several inches. This occurrence was also observed to a lesser extent on the duplicate sample. Second, as situated on the mandrel, support is limited to seven half-inch steel brackets around the circumference. These supports are areas of greatest pressure which must be accounted for. The nature of this failure would not be seen on a multiconductor cable where the mode of support would be along each components entire length.

In summary, the two faults occurred at predictable locations where physical damage was observed. With the two faults isolated, the remainder of the sample, as well as its duplicate sample and the unaged sample, passed all requirements of this rigorous test and demonstrate a margin of assurance.

R. F. DeMair

J. R. Cancelosi

JRC/row

ISOMEDIX

February 25, 1981

Mr. George Dobrowolski
Okonite Corporation
Canal and Jefferson Street
Passaic, New Jersey 07055

Dear Mr. Dobrowolski:

This will summarize parameters pertinent to the irradiation of one (1) mandrel wrapped with cable and five (5) metal screens with cable samples, as per your Purchase Order No. 9-80-721. See attached sheet for specimen description.

The mandrel was placed in a Cobalt-60 gamma field and exposed at each of 4 quadrants, as marked on the mandrel. By integrating the dose rate at any point on the mandrel during its 4 position exposure, an average dose rate was obtained which, when multiplied by the total exposure time, yields total dose.

The specimen was exposed for a period of 118 hours at an average dose rate of 0.48 megarads per hour. The calculated dose based on dosimetry is 56 megarads. Incorporating the ± 3% accuracy of the dosimetry system, therefore, the reported minimum dose is 55 megarads.

The metal screens were exposed for a period of 240 hours at a nominal dose rate of 0.86 megarads per hour. The calculated dose based on dosimetry was 206 megarads. Incorporating the ± 3% accuracy of the dosimetry system, therefore, the reported minimum dose is 200 megarads. Halfway through the exposure, the specimens were rotated 180 degrees to give a more uniform dose distribution.

Dosimetry was performed using Harwell Red 4034 Perspex dosimeters utilizing a Bausch and Lomb Model 710 spectrophotometer as the readout instrument. This system is calibrated directly with NBS, with the last calibration being November 11, 1980. A copy of the dosimetry correlation report is available upon request.

Irradiation was conducted in air at ambient temperature and pressure. Radiant heat from the source heated the samples somewhat, but the temperature did not exceed 100 degrees F, as indicated by previous measurements on an oil solution in the same relative position.

Irradiation for the mandrel was initiated on December 6, 1980 and was completed on December 13, 1980.

Irradiation for the five metal screens was initiated on December 7, 1980 and was completed on December 27, 1980.

Very truly yours,

ISOMEDIX, INC.

David P. Constantine

David P. Constantine
Production Manager

DC:ns
Attachment
cc: Mr. G. Dietz

SPECIMEN DESCRIPTION

Mandrel - to 50 Mrads

Samples

03 - 99315	A-3 & A-4
03 - 99315	B-3 & B-4
TVA SLB	A-3 & A-4
TVA SLB	B-3 & B-4

Screens - to 200 Mrads

Samples

01 - 96656

30' samples
A - 1, 2, 5, 6 & 9
B - 1, 2, 3, 5, 6 & 9
C - 1, 2, 3, 5, 6 & 10

2' samples
A - 1, 5, 7 & 9
B - 1, 3, 5, 7 & 9
C - 1, 3, 5, 7 & 9