NEXTera ENERGY
POINT BEACH

March 3, 2010

NRC 2010-0012
10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Point Beach Nuclear Plant, Units 1 and 2
Dockets 50-266 and 50-301
Renewed License Nos. DPR-24 and DPR-27

<u>License Amendment Request 261</u>
<u>Extended Power Uprate</u>
<u>Response to Request for Additional Information</u>

References: (1) FPL Energy Point Beach, LLC letter to NRC, dated April 7, 2009, License Amendment Request 261, Extended Power Uprate (ML091250564)

(2) NRC letter to NextEra Energy Point Beach, LLC, dated February 1, 2010, Point Beach Nuclear Plant, Units 1 and 2 – Request For Additional Information From Electrical Engineering Branch Re: Auxiliary Feedwater – Round 2 (TAC NOS. ME1081 and ME1082) (ML100120331)

NextEra Energy Point Beach, LLC (NextEra) submitted License Amendment Request (LAR) 261 (Reference 1) to the NRC pursuant to 10 CFR 50.90. The proposed amendment would increase each unit's licensed thermal power level from 1540 megawatts thermal (MWt) to 1800 MWt, and revise the Technical Specifications to support operation at the increased thermal power level.

Via Reference (2), the NRC staff determined that additional information is required to enable the staff's continue the review of LAR 261. Enclosure 1 provides the NextEra response to the NRC staff's request for additional information. Enclosure 2 provides the manufacturer's engineering report for the new auxiliary feedwater pump (AFW) motor power cables. Enclosure 3 provides the manufacturer's test report for the new AFW motor power cables.

<u>Summary of Regulatory Commitments</u>

The following new Regulatory Commitment is proposed:

- NextEra will provide final responses to Question 1 and Question 6 of the NRC letter dated February 1, 2010 (ML100120331) by March 26, 2010.

The information contained in this letter does not alter the no significant hazards consideration contained in Reference (1) and continues to satisfy the criteria of 10 CFR 51.22 for categorical exclusion from the requirements of an environmental assessment.

In accordance with 10 CFR 50.91, a copy of this letter is being provided to the designated Wisconsin Official.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on March 3, 2010.

Very truly yours,

NextEra Energy Point Beach, LLC

Larry Meyer
Site Vice President

Enclosures

cc: Administrator, Region III, USNRC
Project Manager, Point Beach Nuclear Plant, USNRC
Resident Inspector, Point Beach Nuclear Plant, USNRC
PSCW

ENCLOSURE 1

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 261
EXTENDED POWER UPRATE
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

The NRC staff determined that additional information was required (Reference 1) to enable the Electrical Engineering Branch continue review of the auxiliary feedwater (AFW) portion of License Amendment Request (LAR) 261, Extended Power Uprate (EPU) (Reference 2). The following information is provided by NextEra Energy Point Beach, LLC (NextEra) in response to the NRC staff's request for additional information (RAI).

Question 1

In response to staff's request for additional information (RAI) dated August 26, 2009, regarding the emergency diesel generator (EDG) voltage dip below the acceptance limit of 75 percent nominal voltage during motor start, the licensee stated that the EDGs are capable of starting safeguard loads, and the voltage recovers quickly to the acceptable level. Based on staff's review of the dynamic loading calculations, the staff notes that under certain loading conditions for Train "A" EDG, the frequency is outside 2 percent margin, the worst-case voltage dip is 45-48 percent and the voltage overshoot is 129.5 percent. Train "A" voltage and frequency variations are outside the industry accepted standards and guidance. Provide detailed analyses regarding the downstream effects on components such as contactors, control fuses, inverters, battery chargers, solenoids, motor-operated valves, solid state devices, etc., and the basis to show that all required loads will start and continue to run with sufficient margins after accounting for any uncertainties. Provide justification for the performance capabilities of the EDG "A" regulator and excitation systems to support shutdown equipment within design-basis requirements during a design-basis accident. The staff notes that Train "B" EDG bus voltages remain above 75 percent of nominal voltage, consistent with NRC Regulatory Guide (RG) 1.9, throughout the motor starting sequence in all postulated loading conditions. Provide a summary of all bus voltages for the 'B' train distribution system.

NextEra Response

NextEra is currently evaluating options to improve the emergency diesel generator (EDG) dynamic response under certain loading conditions. As a result, additional time is required to complete the supporting engineering analyses and calculations. Accordingly, a response to this question will be provided by March 26, 2010. This schedule was discussed with the NRC during a telephone conference on February 25, 2010.

Question 2

The cables for new auxiliary feedwater (AFW) pump motors are planned to be routed through the existing duct banks and manholes which are susceptible to moisture, wet or flooding conditions. The staff's review of Point Beach's operating experience indicates that, since 1997, numerous corrective action documents were generated to capture concerns associated with cable submergence and water ingress through underground cableways and manholes. Provide cable design specifications and manufacturer's certification to provide assurance that these cables are designed for the environment they will be subjected to. Also, provide details of the proposed initial tests and periodic tests for these cables including the type of tests and the frequency.

NextEra Response

Power to the new motor-driven auxiliary feedwater (MDAFW) pump 1P-53 motor from Train B EDGs will be routed through the existing duct banks. Power to the new MDAFW pump 2P-53 motor from Train A EDGs will be routed through the control building and primary auxiliary building (PAB) and will not be routed through existing duct banks and manholes.

The new MDAFW pump power cables are Okonite Okoguard Okoseal, Type MV-105 5/8 kV Shielded Power Cable. Enclosure 2 provides the engineering report from the manufacturer for this cable. Enclosure 3 provides the cable test report. As noted in Section 6 of the manufacturer's engineering report and in the cable test report, periodic wetting of the cables has been evaluated and results of the testing have shown acceptable results.

Post-installation testing of the MDAFW pump power cables will consist of wiring continuity testing and insulation resistance (megger) testing to meet the following acceptance criteria:

- Documented verification of continuity for wiring.
- Insulation resistance tests will be conducted for each conductor to all other conductors of the same cable tied together and grounded. Tests will be conducted at 1000 V for power cables. The test duration will be at least 60 seconds. The minimum acceptance measured value in meg-ohms shall be the rated cable insulation voltage, in kilovolts, plus 1.
- High potential test of 8000 V rated cables will be performed at 35,000 V for 15 minutes. Leakage will be recorded at one-minute intervals. If leakage current decreases or remains steady after leveling off, the test is considered satisfactory.
- Baseline Tan Delta testing will be performed on the power cable routed in the cable vault from the Train B switchgear to MDAFW pump 1P-53 motor.

A preventive maintenance activity will be initiated to Tan Delta test the new MDAFW pump 1P-53 motor cable at a 6-year interval after installation. The frequency may be adjusted based on observed conditions and operating experience.

The new MDAFW pump motor cables will be included in the cable condition monitoring program. The cable condition monitoring program manages aging of conductor insulation materials on cables and connectors, and other electrical insulation materials that are installed in adverse localized environments caused by heat, radiation or moisture.

Question 3

In response to the staff's RAI dated August 26, 2009, regarding EDG/loss of voltage relay time delays, the licensee stated that the EDG output breaker closure within 14 seconds is consistent with accident analysis. The staff notes that this is inconsistent with the design/licensing basis for the EDGs. Specifically, Final Safety Analysis Report Section 8.8.1, Design-Basis, states that the EDGs are required to start and be ready for loading within 10 seconds after receiving a start signal. In addition, Section 8.8.3 states that the time from receipt of start signal to EDG ready to accept load shall not exceed 10 seconds (reaches its rated speed and voltage and the associated breaker closes automatically to reenergize the safeguard buses). The staff notes that the existing EDG design (time delays for output breaker closure is 14 seconds) is inconsistent with chapter 8 design-basis requirements. Explain the inconsistency and identify all the loads that are started on the safety bus at 10 seconds in accordance with Chapter 8 design-basis.

NextEra Response

Final Safety Analysis Report (FSAR) Section 8.8.1, Diesel Generator System Design Basis, states the EDGs are required to start and be ready for loading within 10 seconds after receiving a start signal. This is a criterion for the EDG and is not affected by the EPU. The EDGs remain capable of starting and being ready to load within 10 seconds of a start signal, which is within the FSAR 8.8.1 requirement. There are no loads assumed to start on the safety related buses at 10 seconds.

The accident analysis time delays are based on the EDGs powering the buses within 14 seconds to support the timing requirements for safety-related loads. The 14 seconds is included within the total time requirements of the accident analysis for low head safety injection (LHSI), high head safety injection (HHSI), containment spray and containment fan coolers when a loss of offsite power (LOOP) is considered. The acceptance criteria take into consideration the degraded voltage logic, loss of voltage logic, and EDG ready to load logic.

The accident analysis described in PBNP FSAR Chapter 14 assumes delay times to account for delays associated with the processing of the accident signal, degraded voltage protection scheme to close EDG output breaker, and the start of the ESF equipment and components to attain design performance. The total delay time assumed for each accident also accounts for appropriate delays for instrumentation logic and signal transport. For the FSAR Chapter 14 accident analyses, the EDG is assumed to start and be ready to load within 10 seconds of receiving a start signal. Delays for instrumentation logic and signal transport account for the difference between the 10 second EDG ready to load time listed in the FSAR Section 8.8.1 and the assumed time of 14 seconds in the FSAR Chapter 14 accident analysis. Since the EDGs are required to start and be ready to load within 10 seconds, the EDG is capable of supplying power to the safeguards buses within 14 seconds and bounds the accident analyses.

Question 4

Explain how the EDG fuel oil consumption and volume calculation accounted for additional fuel oil requirements for AFW and other plant modifications. What is the basis for removing 10 percent margin from the original fuel oil consumption calculation? Provide details on how instrument uncertainties, instrument errors, temperature effects and specific gravity variations were accounted for in the calculation.

NextEra Response

The EDGs will remain within their rated loads with EPU, AFW, and alternative source term (AST) load additions. The EDG fuel oil consumption calculation determined fuel oil requirements based on the applicable EDG rated loads. Fuel oil consumption during the first 48 hours of operation for Train A EDGs is based on the 2000-hour rating of the EDG. Consumption during the first 48 hours of operation for Train B EDGs is based on the 195-hour rating. Fuel oil consumption for 7-day operation is based on the 2000-hour rating for Train A EDGs and the 195-hour rating for the first two days of Train B EDGs combined with 2000-hour rating for the remainder of the 7 days. Calculations have demonstrated that with the EPU, AFW and AST modifications, the EDG loading would be within the rated load.

The initial sizing of the EDG G-03 and G-04 fuel oil day tanks was based on a nominal fuel consumption rate and included a 10% margin. The revised EDG fuel oil consumption and volume calculation transmitted by Reference (3) used a more accurate determination of the fuel oil consumption rate based on EDG performance testing with corrections for specific gravity based on PBNP Fuel Oil Acceptance Criteria and a correction for the use of Ultra Low Sulfur Diesel fuel. The 10% margin was provided for initial tank sizing and is not considered applicable to subsequent capacity evaluations.

The EDG fuel oil consumption calculation determines the process limit for the minimum indicated level for the fuel oil storage tanks to meet the TS. Note that the calculation has been revised to account for two EDGs in either Train A or Train B, starting, drawing fuel from a common fuel oil storage tank, and continuing to operate for 48 hours at the most conservative analyzed EDG loading to satisfy license basis requirements. A change to the TS has been proposed to resolve this condition per Reference (4). The level switches used for alarms, "pump on" and "pump off" conditions on EDG fuel oil day tanks, high and low alarms for fuel oil day tanks, and low alarms on fuel oil storage tanks are GEMS (IMO) model LS-800 non-adjustable float switches. The repeatability uncertainty of the level switches is about 0.031 (1/32) inches and the switches were factory set using water. The acceptable range for specific gravity of the diesel fuel oil is 0.89 to 0.83 (average = 0.86). This represents an uncertainty of 0.12 inches. The uncertainty associated with the level switches is considered to be negligible.

The calculation assumes that, for the purposes of determining fuel oil consumption, the average temperature of the fuel oil is nominally at 60°F. Fuel oil is stored in small day tanks near the EDGs and in buried large capacity storage tanks. Fuel in the day tanks is at the normal ambient temperature of the storage tank rooms prior to the start of the engines. These rooms will heat up as the engine operates. The buried storage tanks are normally at the soil temperature at their average depth. The volume of fuel below ground is significantly larger than that in the day tanks. Based on the fuel consumption rates and the day tank size, fuel pumped from the below ground storage tanks will not significantly heat up as the engine operates when used to support the 48-hour and 7-day fuel consumption calculations (which are based on the engine operating at rated capacity).

Question 5

In response to the staff's RAI dated August 26, 2009, regarding environmental parameters for the AFW motor location, the licensee stated that the normal radiation level is 1300 RAD for 60-year total integrated dose, and the AFW pumps and associated equipment will not be included in the environmental qualification (EQ) program since they are not credited in the accident analysis although they are sequenced loads used in a loss-of-coolant accident. The performance capabilities of the non EQ AFW motor may be degraded after exposure to potentially harsh environment during the accident. Explain the rationale for allowing operation of the degraded motor connected to a safety related bus which is supplying power to safe shutdown equipment.

NextEra Response

In the event of a large break loss-of-coolant-accident (LBLOCA), radiological conditions could become harsh in the MDAFW pump area. However, for a LBLOCA the MDAFW pumps are not required for accident mitigation. Additionally, the AFW pumps are connected to safety-related busses through safety-related breakers. The breakers will prevent degraded MDAFW pump motors from adversely affecting the safety related bus during the accident.

Question 6

In response to the staff's RAI dated June 2, 2009, regarding the surveillance tests for EDGs, the licensee proposed new Technical Specification Surveillance Requirement 3.8.1.7 requirement (the performance of a 24-hour endurance and load margin test of each EDG). The staff notes that the proposed EDG endurance and margin test does not envelop the accident loads for the entire duration of the 24-hr run. Specifically, EDGs G01 and G-02 are loaded to 98.2 percent to 100.9 percent of the 2000-hour load rating for ≥ 2 hours and 90 to 100 percent of the 2000-hour load rating for the remaining 22 hours; G-03 and G-04 EDGs are loaded to 97.4 percent to 100 percent of the 200-hour load rating for ≥ 2 hours and 90 to 100 percent of the 2000-hour load rating for the remaining 22 hours with EDGs operating at the highest end of the 2-hour load range for 5 minutes. This is not consistent with RG 1.9 recommendations. The intent of the 24-hr test is to demonstrate that the EDG can operate at maximum postulated accident loads for extended duration. The 2-hour test requirement at a higher loading demonstrates design margins. Therefore, staff requests the licensee to provide basis why the proposed loading ranges are adequate to demonstrate the capability of the EDGs to operate for its intended mission time. Also, explain why EDGs designated for each unit cannot be tested during modes other than modes 1 and 2 as recommended in NUREG-1431.

NextEra Response

NextEra is currently evaluating options to reduce EDG loading and reduce the likelihood of overloading the EDGs during testing. As a result, additional time is required to complete the supporting engineering analyses and calculations. Accordingly, a response to this RAI will be provided by March 26, 2010. This schedule was discussed with the NRC during a telephone conference on February 25, 2010.

In response to the question regarding testing in MODES 1 and 2, at PBNP the EDGs are train-specific rather than unit-specific. The two Train A EDGs are available to supply Unit 1 and Unit 2, as are the two Train B EDGs. As a result, each EDG is available to be lined up to either or both units.

At least one reactor unit at PBNP is normally operating in MODE 1, although the other reactor unit may be shut down. Therefore, it is not practical to perform this surveillance on each EDG on an 18-month interval with both units shut down. PBNP has been performing 24-hour EDG load testing on a 24-month frequency safely with both units typically operating in MODE 1.

References

(1) NRC letter to NextEra Energy Point Beach, LLC, dated February 1, 2010, Point Beach Nuclear Plant, Units 1 and 2 – Request For Additional Information From Electrical Engineering Branch Re: Auxiliary Feedwater – Round 2 (TAC NOS. ME1081 and ME1082) (ML100120331)

(2) NextEra Energy Point Beach, LLC letter to NRC, dated December 8, 2009, License Amendment Request 261, Supplement 3, Extended Power Uprate (ML093430114)

(3) NextEra Energy Point Beach, LLC letter to NRC, dated September 25, 2009, License Amendment Request 261, Extended Power Uprate, Response to Request for Additional Information (ML092750395)

(4) NextEra Energy Point Beach, LLC letter to NRC, dated January 27, 2010, License Amendment Request 264, Diesel Fuel Oil Storage Requirements (ML100280230)

ENCLOSURE 2

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 261 EXTENDED POWER UPRATE
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

OKONITE COMPANY ENGINEERING REPORT #527

29 pages follow

OSD RESOLUTION (29 pgs)

THE OKONITE COMPANY
Ramsey, NJ

ENGINEERING REPORT #527

Class 1E Qualification of Okoguard Insulated Cables For Nuclear Power Generating Stations

Class 1E qualification of The Okonite Company's Okoguard medium voltage 90°C rated ethylene propylene rubber insulated cables is documented in this report. Qualification testing was conducted in accordance with the IEEE standards 323-2003 and 383-2003 which equal or exceed the requirements of the 1974 editions. Class 1E qualification is based on the generic qualification type test method and analysis. Design basis event (DBE) and flame test qualifications are based on type testing. Thermal aging to demonstrate normal life is based on type tests and analysis. R1 R1

The Okoguard insulation system consists of The Okonite Company's proprietary Okoguard (EPR) insulation and extruded semiconducting EPR based conductor and insulation shields. The testing described and documented in this report demonstrates environmental qualification of all three components of the insulation system.

The DBE tests were conducted on the thinnest insulation wall used by Okonite on medium voltage rated products. Qualification of the thinnest wall qualifies all thicker insulation walls used in all Okoguard medium voltage cables.

This report is divided into several sections. These sections address the testing and documentation required to demonstrate Class 1E qualification and are supported by the listed appendices.

Section	Title	
1	DBE-LOCA Qualification	
2	A Review of Design Life of Okoguard (Research Report No. 597 and Appendix to Research Report 597 2-13-07)	R1
3	Testing and Analysis to Determine Sequence of Thermal and Radiation Aging (Research Report No. 596 dated 12-08-05)	R1
4	Qualification for Normal Operation	
5	Vertical Tray Flame Test Qualification	
6	Moisture Resistance	
7	DBE-High Energy Line Break Qualification	R1

The testing conducted to demonstrated DBE-LOCA qualification is documented in Wyle Report No. 51055-2 and is provided as part of this report as Appendix A.

The testing conducted to demonstrated qualification for normal operation is documented in Wyle Report No. 51055-1 and is provided as part of this report as Appendix B.

Okoguard insulated cables have been qualified to IEEE 383-1974 for Class 1E, safety related use since 1977. This earlier qualification is documented in Okonite report NRQN-3 and is provided as part of this report as Appendix C.

Appendices	Title	
A	DBE-LOCA Test Report - Wyle Report 51055-2 Rev B	R1
B	Normal Operation Test Report - Wyle Report 51055-1	
C	Nuclear Environmental Qualification Report NQRN-3 Rev 4	
D	DBE-HELB Test Report – NTS TR62871-06N	R1

The test results included in this report demonstrate the ability of Okoguard insulated cable to perform its intended function. R1

Prepared by: *J. R. Cancelosi*
Manager Application Engineering

C. P. Zuidema
Director Polymer Research

Reviewed by: *J. V. Fitzgerald*
V. P. Application Engineering

Approved by: W. R. Kegerise
V. P. Research

Rev.	Date	Reason	Signature
0	12-09-05	New Issue	*J. R. Cancelosi*
1	05-24-07	Added rated temperature, IEEE Standard dates, additional information in Sections 1, 2 & 4, additional VTFT data, Section 7, revision 2 to Appendix A and new Appendix D. Also made editorial changes	*J. R. Cancelosi* *C. P. Zuidema* *J. V. Fitzgerald* *W. R. Kegerise*

SECTION 1

DBE-LOCA Qualification

The Okoguard insulation system was LOCA qualified basis a type test, generic qualification method as allowed by IEEE 323-2003 and IEEE 383-2003. The temperature/pressure/time/spray profile selected was based on IEEE 323-1974, Appendix A, Figure A1. This profile was chosen since it had been used in previous Okonite tests and was accepted by nuclear utilities as meeting their specific plant profiles. R1

The LOCA test was conducted on the thinnest insulation wall used by Okonite on medium voltage rated products. Qualification of the thinnest wall qualifies all thicker insulation walls used in all Okoguard medium voltage cables.

The Okoguard insulation system consists of Okoguard insulation (G-63), extruded semiconducting EPR based conductor shield (C-52) and extruded semiconducting EPR based insulation shield (C-53). The LOCA testing demonstrates environmental qualification of all three components of the insulation system.

The Okoguard test specimens were manufactured at Okonite under production run number X4668. A description of the specimens, voltage and current loads, and aging conditions are given in Table 1. Completed cable specimens were tested to determine if any detrimental synergistic affects due to the shield, tape and jacket layers would occur. R1

LOCA qualification was conducted by Wyle Laboratories, Huntsville, AL. A mutually agreed upon test procedure plan was developed and followed.

The performance requirements to demonstrate Class 1E qualification are:

1. Maintain electrical load as given in Table 1.

2. Pass the dielectric withstand test – post accident (prior to removal from the test chamber.) Charging current not to exceed 10 mA.

3. Pass the Post DBE Simulation Test (Bending Test). Charging current not to exceed 10 mA.

Insulation resistance and charging current measurements, taken during the test profile on each of the three specimens, could be used to demonstrate additional performance criteria. R1

Based on the analysis to determine the proper sequential order for thermal aging and radiation aging (see Section 3), the specimens were first exposed to 50 Mrads of gamma radiation. The specimens were then subjected to thermal aging. The thermal aging was selected to be three weeks at 150°C to simulate a 40 year design life and two weeks at 165°C to simulate a 60 year design life. Following the thermal aging conditioning, the specimens were exposed to an accident dose of 150 Mrads gamma radiation.

The Okoguard specimens were installed in the test vessel and subjected to the temperature/pressure/chemical spray profile shown in Wyle Report 51055-2. The specimens were voltage and current loaded in accordance with Table 1. Charging current was monitored throughout the profile.

To determine the specimen condition throughout the qualification test, the following additional Insulation Resistance measurements and ac withstand test (80 volts/mil) were made and results documented.

IR and ac withstand prior to aging
IR post aging dose radiation
IR post thermal aging
IR post accident dose radiation
IR at 345°F, 338°F, 318°F, 269°F
IR at 265°F (4th day)
IR at 212°F (19th day and 30th day)
Ac withstand test after removal from test vessel
and prior to removal from support mandrel

The specimens were then removed from their support mandrels, straightened and recoiled around a 40 x O.D. steel mandrel. Each specimen, while on the mandrel, was immersed in room temperature water for a minimum of one hour. While still immersed, each specimen was subjected to an 80 v/mil ac withstand test. The test voltage and charging current values were recorded.

All samples passed the Post DBE Simulation Test (Bending Test). All qualification testing is documented in Wyle Report No. 51055-2 (See Appendix A). Note that the Wyle report includes other specimens (low voltage insulations) that are not included in this qualification report. R1

Table 1
Description of Test Specimens, Electrical Loads and Aging Conditions

Specimen No.	Production Run No.	Description	Test Voltage phase to grd (volts)	Test Current (amps)	Required Thermal Aging Time (hours)	Required Thermal Aging Temp C	Required Radiation Dose Mrads
43	X4668	5 kV #6 AWG, .015" C-52, 0.115" G63, 0.024 C-53, .005" TC tape, cable tapes, 0.060" R-14 (TS-CPE) jkt	5000	80	Unaged	—	150
44	X4668		5000	80	504	150	200
45	X4668		5000	80	336	165	200

R1

Material	Trade Name
G63 (EPR)	Okoguard
C-52 & C-53	Semiconducting EPR Shield
R14 (TS-CPE)	Okoloh-CPE (Okosheath)

R1
R1

J. R. Cancelosi
Manager Application Engineering

Section 2
Design Life Based on Thermal Aging Study

Research Division Report

No. 597

A Review of Design Life of Okoguard, G63

December 01, 2005

By: Carl Zuidema

Introduction:

The demonstration of the design life of G63 was presented in the Nuclear Environmental Qualification Report NQRN 3, Appendix 2. That appendix referenced aging data, both natural and accelerated, for a number of Okonite compounds. The data in this report have been extracted from those earlier reports.

Discussion:

Appendix 2 of NQRN 3 included laboratory accelerated aging data for EPR and XLPE compounds analyzed via an Arrhenius type treatment and compared these data to similar data for butyl rubber, natural rubber and Neoprene. Results of tensile and elongation measurements on some service aged cable with natural rubber, Neoprene and butyl rubber components were also discussed. These results indicated that for cable aged in service, elongation retention values were much greater than those predicted by the extrapolation of the Arrhenius plots. It also showed that the life projections for EP and XLPE were greater than butyl rubber by a factor of 7.5 and better than natural rubber by a factor of at least 40. Data for the aging characteristics of single conductors aged as complete cables, (that is in jackets), were also presented to demonstrate the superior aging performance under installed conditions. Since the natural rubber compounds had been in service in generating stations for greater than forty years and butyl had been in service for greater than ten years it was argued that an aging regimen that met or exceeded the design life of butyl rubber was sufficient to simulate forty year aging of EPR. However, the aging regimen chosen, a time and temperature to 40% elongation retention for EPR, greatly exceeds the design life of the older insulations. This time and temperature, 21 days at 150°C, is still used as the simulation of 40 year design life.

The data for G63 was collected on specimens of insulated wire, #14 tinned copper, with 47 mils of insulation. The ovens were forced draft type similar to those used in the recent work but of an earlier manufacture. The data reported in Appendix 2 included oven aging data from 136°C to 180°C. That report referenced additional data collected at 121°C that were not included in the calculations. These 121°C data are included in the presentation below and illustrate one of the main contentions of the earlier report, namely that extrapolation of the data to temperatures outside the tested range will be erroneous. The data reported in Appendix 2 give an activation energy for G63 of 1.05 eV and an extrapolated life of 7.5 years at 90°C. When the data at 121°C are included the activation energy becomes 1.15 eV and an extrapolation to 90°C gives 10 years. If only the four lowest temperatures are used, - temperatures nearest the use temperature - the activation energy is 1.29 and the extrapolation to 90°C is 16 years. The data do not fit an Arrhenius treatment very well, so clearly, the best use for this type of data is to establish a means of comparing new materials to materials that have a proven service record. The class of EPR with the trade name Okoguard has a service record as a 90°C rated insulation of over forty years. This use includes generating stations. Butyl rubber has an even longer history as a 90°C rated insulation. The EPR compounds presented in Appendix 2 of NQRN 3, as a class, have a performance advantage over Butyl rubber by a factor of 7.5.

Oven Aging of G63, (ca. 1976)

1/T °K	Temp °C	Time to 40% Elong. Retention Hours
0.002207	180	80
0.002282	165	125
0.002363	150	420
0.002444	136	1344
0.002537	121	5664

Table No. 6

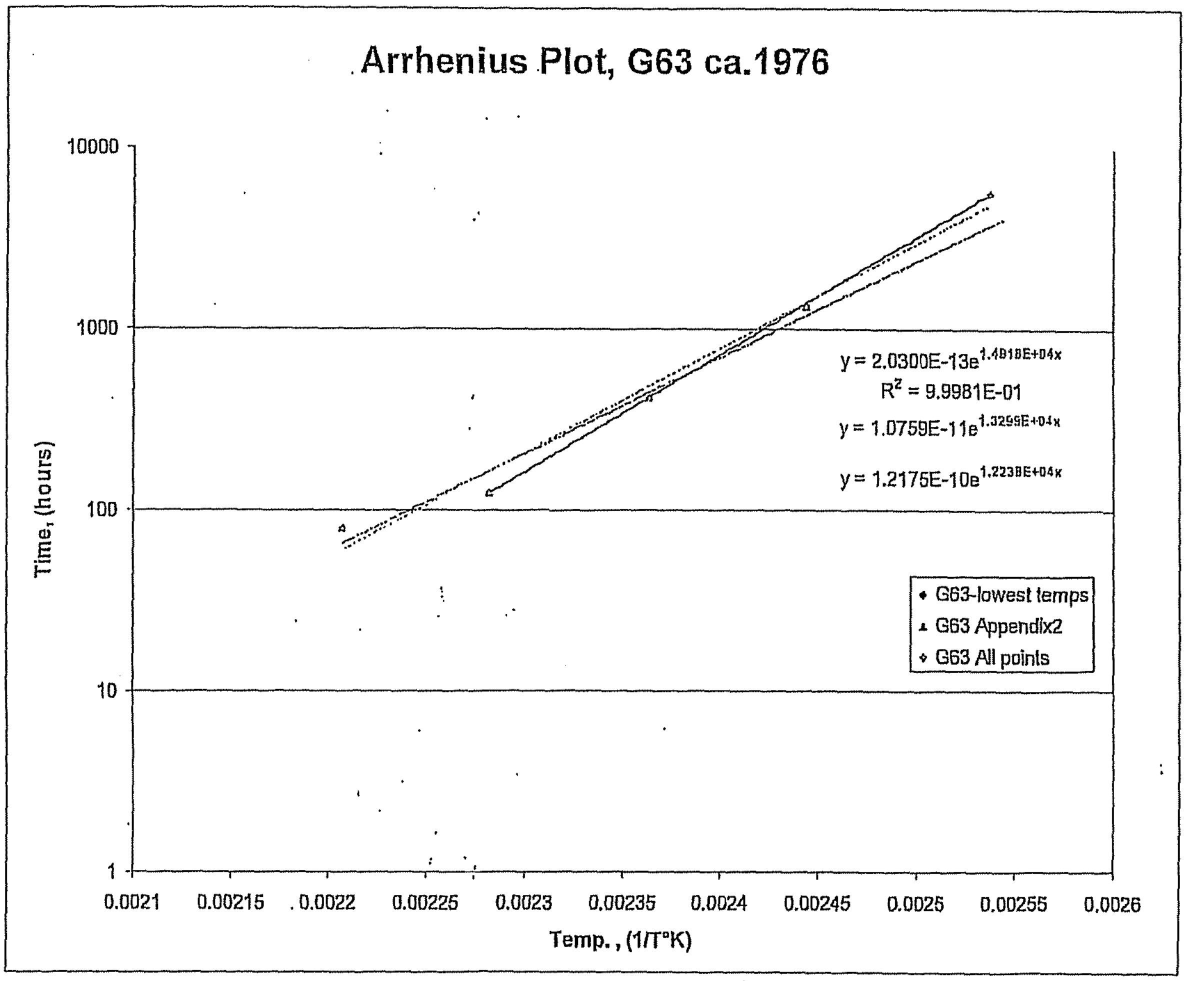

Arrhenius Plot, G63 ca.1976
10000
1000
100
10
1
Time, (hours)
y = 2.0300E-13e^1.4918E+04x
R^2 = 9.9981E-01
y = 1.0759E-11e^1.3299E+04x
y = 1.2175E-10e^1.2238E+04x
G63-lowest temps
G63 Appendix2
G63 All points
0.0021
0.00215
0.0022
0.00225
0.0023
0.00235
0.0024
0.00245
0.0025
0.00255
0.0026
Temp., (1/T°K)

Chart No. 3

Appendix to Research Division Report

No. 597

Thermal Aging Study of Semiconducting Compounds

Compounds C52 and C53

February 13, 2007

By: Carl Zuidema

Introduction:

This report covers the results of a study of Okonite's insulation shield and conductor shield compounds. Accelerated agings of pressed cured plaques were conducted in a manner similar to that used for the insulation compounds, G63 (reported in the body of this report), as well as B0304 and B22, (covered in Research Report No. 595).

Procedure:

Die cut tensile specimens were prepared from press cured plaques, as per ASTM D412 die "D", of Okonite compounds C52, (conductor shield) and C53, (insulation shield). Factory prepared compound, lot no. 5285 for C52 and lot no. 5335 for C53 were used for the evaluation. Specimens were suspended in forced convection ovens consistent with ASTM D5423 type II. Laboratory ovens #6, #10, #11 and #12 were used. The temperature consistency of the ovens was recorded via a chart recorder and daily readings of each oven thermometer were also recorded.

The procedure again generally followed UL 746B, as was used for B0304 and B22. In this case 50% retention of original elongation is used as the end point for each temperature studied. For these compounds the 50% value was chosen since it provided a determination with the least variance.

The aging data were plotted and a best fit polynomial used to determine the 50% retention value. Time to 50% elongation retention is plotted versus inverse absolute temperature and a best fit exponential was determined in accordance with the Arrhenius equation:

$$\mathbf{k = Ae^{-E^*/RT}}$$

Where k, (the rate constant), is represented by the time required to reach the designated end point and T is the aging temperature in degrees Kelvin. The terms "A", referred to as the pre-exponential or frequency factor, and "E*", referred to as the activation energy are constants derived from the equation generated by the data: "k" and "T".

These data are presented below in graphic format. Chart No.1 presents the aging data for C52 and Chart No. 2 presents the aging data for C53. The best fit polynomial constants are presented in Table No. 2 with the solutions for the calculated 50% retention point.

Chart no. 3 shows the Arrhenius treatment with log time to 50% elongation retention plotted versus inverse absolute temperature. For reference the "Masterplot" of earlier Okonite compounds is also displayed as is the curve for B22. The plot for C52 displays a frequency factor somewhat lower than that of the "Masterplot" but the slopes of the two curves are approximately equal. The equation derived for C53 has a frequency factor similar to the "Masterplot" equation but a moderately different slope. The fit of the C53 data to the Arrhenius equation is significantly poorer than for C52 with a correlation coefficient of around 0.970 versus about 0.999 for C52. Given that there is no theoretical justification for the application of the Arrhenius equation to this type of data, the lack of fit is not surprising and serves to demonstrate the limited usefulness of extrapolation as a means of determining design life at temperatures that are not readily testable. From the derived parameters of the Arrhenius equations the calculated activation energies would be 1.13eV for C52 and 1.32eV for C53.

The line labeled "Masterplot" on chart no. 3 is representative of a number of Okonite compounds whose qualification for use on Class 1E cables in nuclear power stations was reported in NQRN 1A, NQRN 2 and NQRN 3. For all of these cables, 21 days oven aging at 150°C was used to simulate 40 years of natural aging in a nuclear power plant. This choice was discussed in the appendix to each of these reports and summarized in the body of this report. That aging criteria was also applied to B0304 and B22, which display similar mechanisms in their aging performance. Research Report No. 595 and 597 discussed the selection of 14 days oven aging at 165°C to simulate 60 years of natural aging for B0304, B22 and G63. Since the aging characteristics of C53 and C52 are also showing a convergence of mechanisms with the other compounds, (as indicated by Chart No. 3), the accelerated aging criteria selected to represent natural aging for C52 and C53 is also identical to that of these other compounds.

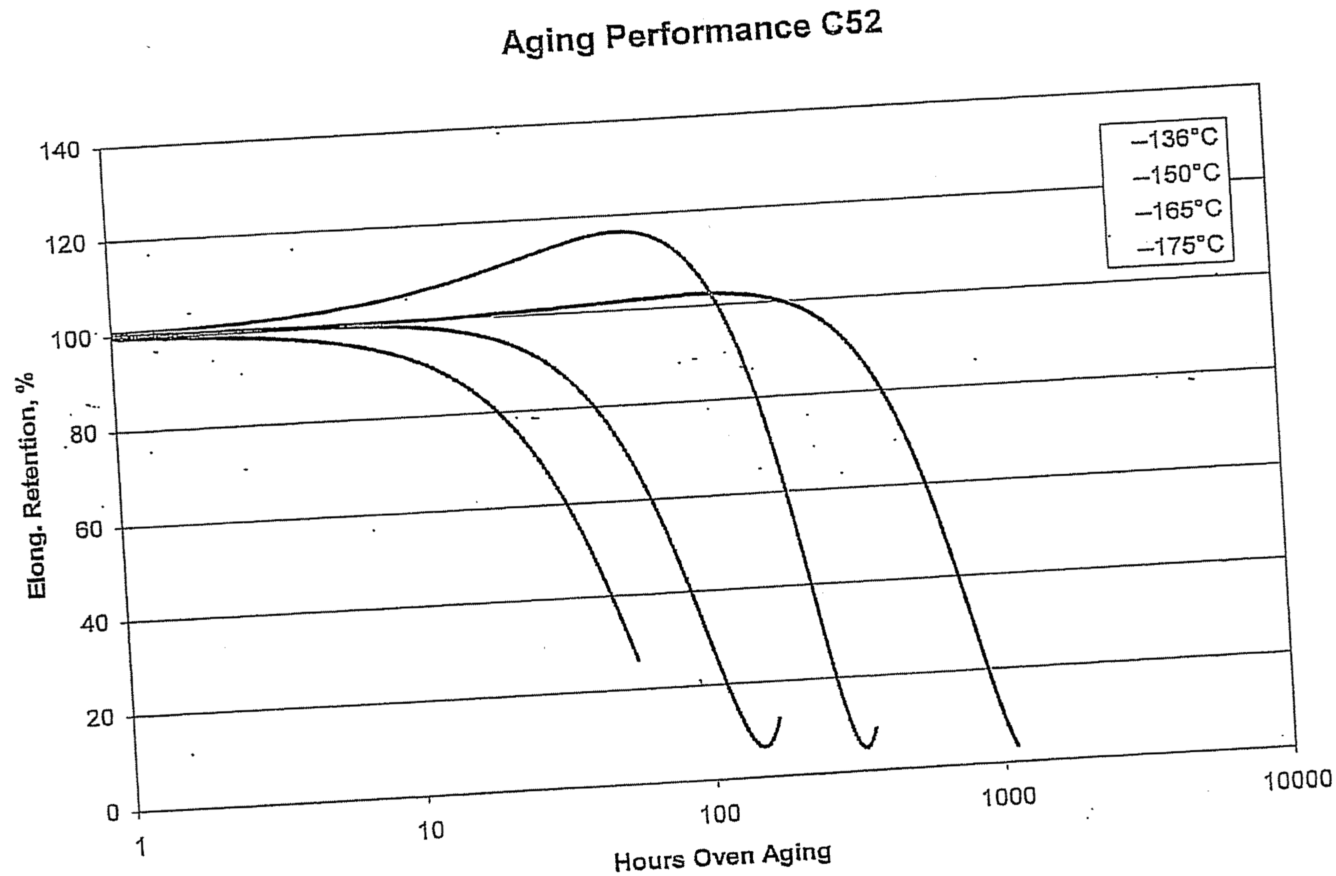


Chart No. 1

22/49

Aging Performance C53

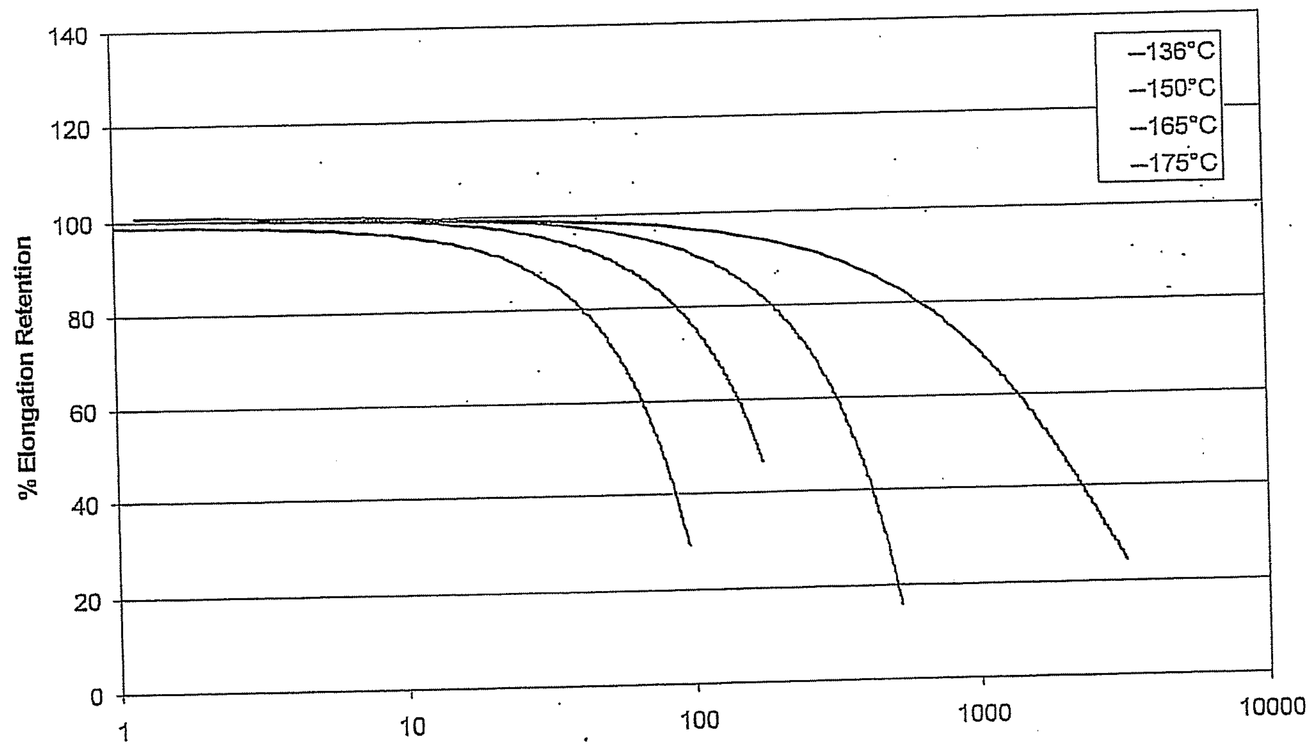


Chart No. 2

Oven Aging Data Analysis, C52

Temp °C	1/T°K	a	b	c	d	hours
		Polynomial Constants				
136	0.002444	1.54E-07	-3.00E-04	5.73E-02	9.96E+01	6.65E+02
150	0.002363	1.08E-05	-6.30E-03	6.14E-01	9.99E+01	2.12E+02
165	0.002282	5.87E-05	-1.31E-02	1.44E-02	1.00E+02	7.75E+01
175	0.002231	2.40E-04	-2.82E-02	-4.92E-01	1.00E+02	4.04E+01

Oven Aging Data Analysis, C53

Temp °C	1/T°K	a	b	c	hours
		Polynomial Constants			
136	0.002444	3.07E-06	-3.34E-02	1.00E+02	1.79E+03
150	0.002363	-1.62E-04	-7.54E-02	1.01E+02	3.73E+02
165	0.002282	-8.86E-04	-1.52E-01	1.01E+02	1.69E+02
175	0.002231	-5.17E-03	-2.31E-01	9.89E+01	7.75E+01

Table No. 2

Arrhenius Plot, Semiconducting Compounds

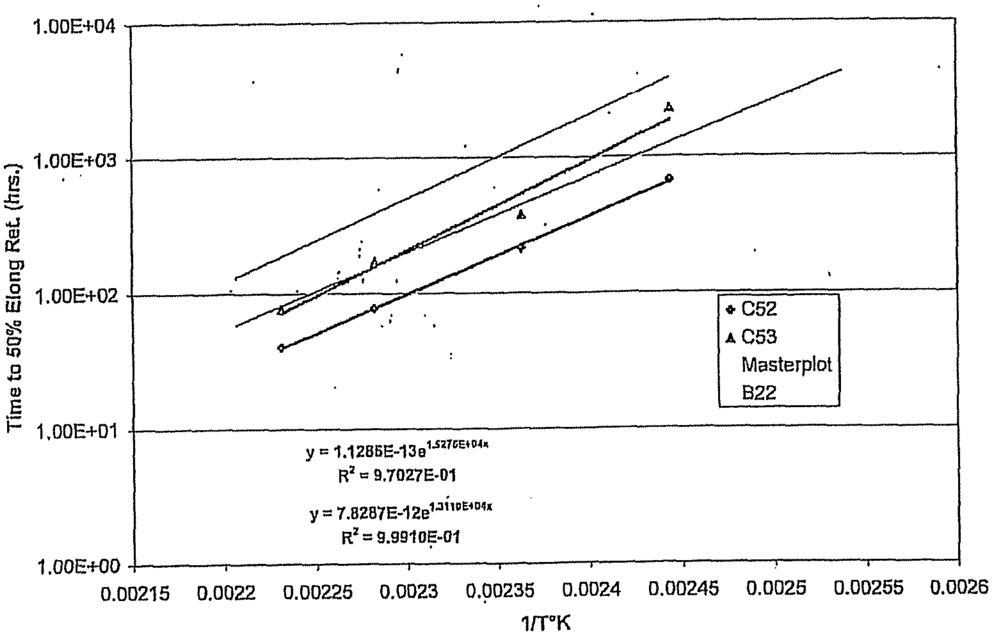


Chart No. 3

Section 3
Testing and Analysis to Determine Sequence of Thermal and Radiation Aging

Research Division Report

No. 596

Sequential Effects of Thermal and Radiation Aging

on EPR Compounds

December 8, 2005

By: Carl Zuidema

Introduction:

An investigation was conducted into the effect of sequential aging exposure on two EP FMR type compounds, B0304 and B0305, (also referred to as B22). This evaluation was performed to determine whether the sequence of thermal aging before radiation exposure or radiation exposure before thermal aging produced significant differences in final properties. These two compounds were likely candidates for a 1-E nuclear qualification program which requires both thermal aging to simulate natural aging and radiation exposure to simulate the radiation exposure during the lifetime in a nuclear power plant.

Procedure:

The experiment was labeled with the laboratory number LE 012104. Press cured plaques of the two compounds were prepared and treated via the design matrix described below and in the attached tables. The materials were tested in the original condition and after each step in the exposure sequence. That is, unaged, oven aged 21 days at 150°C or oven aged 14 days at 165°C, 50 Mrads radiation, and 150 Mrads radiation. The sequence of interest is between oven aging and the 50 Mrads exposure since these are intended to simulate the life time exposure of the materials. The two oven aging exposures are intended to represent 40 and 60 year design life. The properties of the two materials that were followed were tensile strength, elongation, hardness and density.. It was found that the elongation was the only property that demonstrated a consistent response to aging sequence and was therefore used as the basis judging the severity of any effects. Oven aging was conducted in ASTM type II forced draft ovens and the radiation exposure was performed at Steris/Isomedix in Whippany NJ. The physical property data is recorded in Insulations Log Book #17, pp 434-436.

Results:

Oven aging alone produced insignificant changes in the elongation and other properties as expected. 50 Mrads of radiation reduced the elongation to approximately 40% of the original value for all samples whether oven aged or not. When the radiation exposure preceded oven aging the elongation retention was approximately 10%. After the full 200 Mrads exposure the samples with no oven aging retained approximately 10% of the original elongation. Those samples that were oven aged prior to the 50 Mrads exposure were also around 10% of the original value while those that were radiated first retained around 2% of their original elongation.

Discussion:

These results indicate that radiation exposure produces a much more significant effect on mechanical properties than either of the thermal aging conditions. Exposure to 50 Mrads of radiation prior to thermal aging causes the subsequent thermal aging to be much more deleterious than the reverse sequence. However, after the final 150 Mrad exposure all materials experienced a severe loss of elongation to the point where the difference between all samples is very small. This difference in final elongation values is not clearly beyond normal variance for elongation tests but since the trend was observed in both materials it is recommended that radiation aging precede thermal aging for purposes of 1-E nuclear qualification testing of these compounds. Since the chemical nature of EPR insulation compounds are quite similar it is also recommended that the same aging sequence be followed for the re-qualification of Okoguard G63 compound.

The tables below outline the design matrix for this evaluation, (table 1), and the data generated, (tables 2 & 3). The elongation retention and tensile strength retention data is presented graphically in chart 1 for compound B0305. The behavior of B0304 is nearly identical to B0305.

LE 012104

Effect of Sequential Aging: Oven Aging with Irradiation
B0305 & B0305

6" x 8" x 0.075" slabs B0304 set #32611001
6" x 8" x 0.075" slabs B0305 set #33391001

1. Original
2. Oven aged, (2 conditions)
3. Original followed by 50 Mrads
4. Oven aged, (2 conditions), followed by 50 Mrads
5. 50 Mrads followed by oven aging, (2 Conditions)
6. 50 Mrads followed by 150 Mrads
7. Oven aged, (2 Conditions), followed by 50 Mrads plus additional 150 Mrads
8. 50 Mrads followed by oven aging, (2 Conditions), followed by additional 150 Mrads

Table 1

Test Results, B0304

Press Cured Plaques, 6" x 8" x 0.075"

Sample Id. / Tests	Unaged	Pre Aged 21 Days 150°	Pre Aged 14 Days 165°	Tensile Strength & Elong – %.Retained after Aging; Durometer & Specific gravity - measured value
		% Retention		
Tensile Strnth	1926	99	92	
Elongation	235	86	66	
Durometer	70	77	77	
Spec. Grav.	1.354	1.370	1.375	

After 50 Mrads

Tests	Unaged % Retention	Pre Aged 21 Days 150° % Retention	Pre Aged 14 Days 165° % Retention	Aged, 21 Days @ 150°C after 50 Mrads	Aged 14 Days @ 165°C after 50 Mrads
Tensile Strnth	117	121	103	45	30
Elongation	46	39	31	10	9
Durometer C	77	77	77	74	76
Spec. Grav.	1.345	1.365	1.369	1.392	1.398

After 150 Mrads

Tests	Unaged	Pre Aged 21 Days 150°	Pre Aged 14 Days 165°	Aged, 21 Days @ 150°C after 50 Mrads	Aged 14 Days @ 165°C after 50 Mrads
Tensile Strnth	82	90	75	41	28
Elongation	12	13	10	2	2
Durometer C	84	84	84	85	87
Spec. Grav.	1.370	1.373	1.372	1.387	1.390

Table 2

Test Results B0305

Press Cured Plaques, 6" x 8" x 0.075"

Sample Id. / Tests	Unaged	Pre Aged 21 Days 150°	Pre Aged 14 Days 165°	Tensile Strength & Elong - % Retained after Aging; Durometer & Specific gravity - measured value
		% Retention		
Tensile Strnth	1711	109	108	
Elongation	203	96	107	
Durometer C	80	83	83	
Spec. Grav.	1.432	1.450	1.454	

After 50 Mrads

Tests	Unaged % Retention	Pre Aged 21 Days 150° % Retention	Pre Aged 14 Days 165° % Retention	Aged, 21 Days @ 150°C after 50 Mrads	Aged 14 Days @ 165°C after 50 Mrads
Tensile Strnth	125	125	131	65	62
Elongation	47	45	47	13	12
Durometer C	83	83	83	80	82
Spec. Grav.	1.425	1.447	1.439	1.460	1.477

After 150 Mrads

Tests	Unaged	Pre Aged 21 Days 150°	Pre Aged 14 Days 165°	Aged, 21 Days @ 150°C after 50 Mrads	Aged 14 Days @ 165°C after 50 Mrads
Tensile Strnth	89	90	89	65	60
Elongation	8	8	8	3	2
Durometer	88	88	88	88	88
Spec. Grav.	1.445	1.450	1.462	1.478	1.482

Table 3

B0305, Effect of Aging Sequence

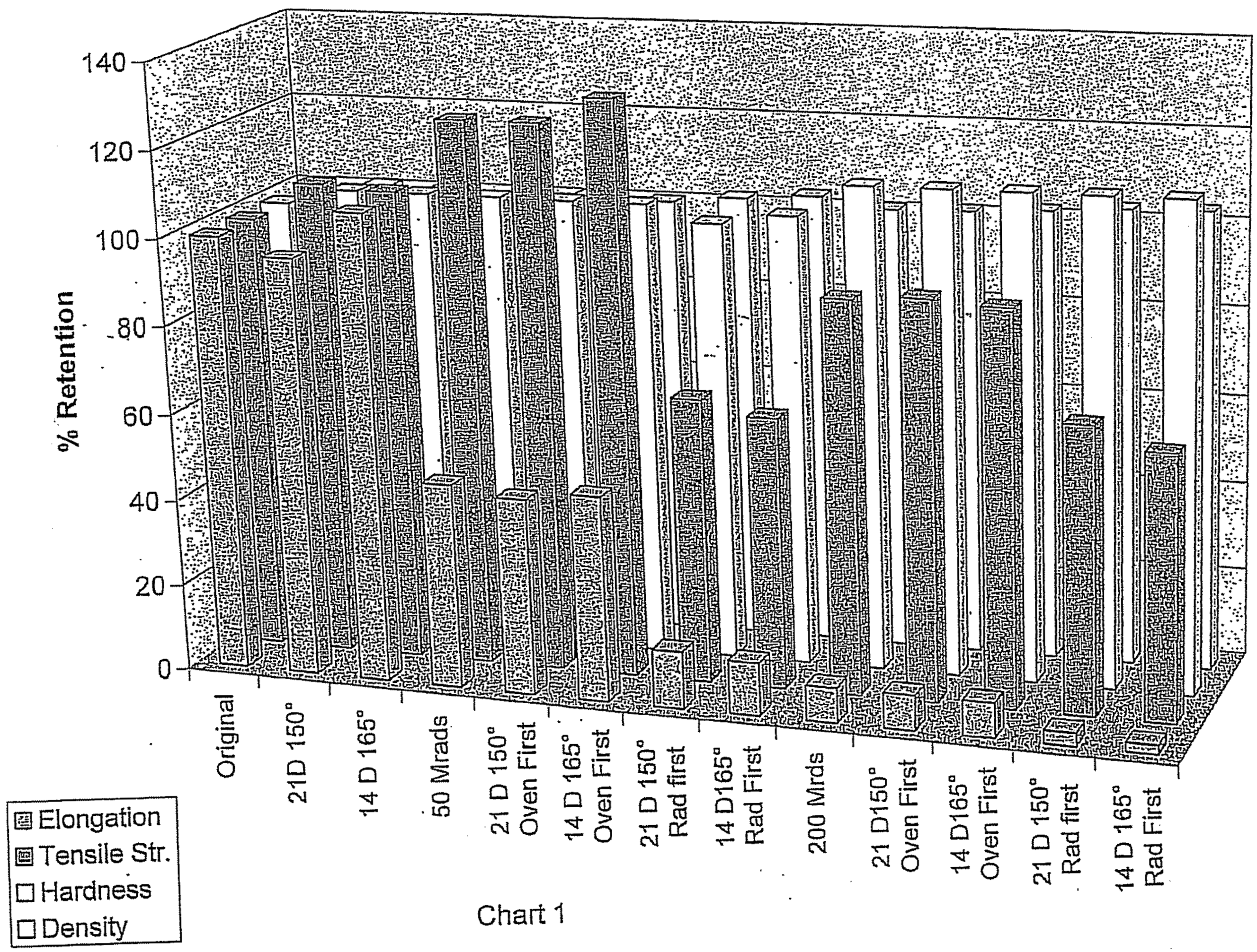


Chart 1

Section 4
Qualification for Normal Operation

This section demonstrates compliance to IEEE 383-2003, Section 4.6.2. Okoguard insulation was qualified for normal plant operation based on the generic qualification type test method and analysis. The normal plant qualification testing was conducted on the thinnest insulation wall used by Okonite on medium voltage rated products. Qualification of the thinnest wall qualifies all thicker insulation walls used in all Okoguard medium voltage cables. R1

The Okoguard test specimens were manufactured at Okonite under production run number X4668. A description of the specimens and aging conditions are given in Table 1.

The performance requirement to demonstrate Normal Operation qualification is that each specimen passes the post aging simulation test (bending test). Charging current is not to exceed 10 mA.

Normal plant operation qualification was conducted by Wyle Laboratories, Huntsville, AL. A mutually agreed upon test procedure plan was developed and followed. See Wyle Report No. 51055-1 - (Appendix B of this report). R1

Based on the analysis to determine the proper sequential order for thermal aging and radiation aging (see Section 3), the specimens were first exposed to 50 Mrads of gamma radiation.

The specimens were subjected to thermal aging. The thermal aging was selected to be three weeks at 150°C to simulate a 40 year design life and two weeks at 165°C to simulate a 60 year design life.

After removal from the oven the specimens were allowed to reach room temperature. The specimens were then straightened and recoiled around a 20 x O.D. steel mandrel. Each specimen was immersed in room temperature water for a minimum of one hour. The effective length (immersed length) of each specimen was an approximately 14 feet. While still immersed each specimen was subjected to an 80 v/mil ac withstand test. The test voltage and charging current values were recorded.

All samples passed the post aging simulation test (bending test). Charging current measurements were below 10 mA. [Note that the charging current was measured on specimens without special end leakage (guarded) terminations.] All qualification testing is documented in Wyle Report No. 51055-1 (Appendix B of this report). The specimens are identified as numbers 88 & 89. Note that the Wyle report includes other specimens (low voltage insulations) that are not included in this qualification report. R1

Table 1
Specimen Identification and Test Conditions

Specimen No.	Production Run No.	Description	Required Thermal Aging Time (hours)	Required Thermal Aging Temp C	Required Radiation Dose Mrads
88	X4668	5 kV #6 AWG, .015" C-52, 0.115" G63, 0.024 C-53, .005" TC tape, cable tapes, 0.060" R-14 (TS-CPE) jkt	504	150	150
89	X4668		336	165	200

Material	Trade Name
G63 (EPR)	Okoguard
C-52 & C-53	Semiconducting EPR Shield
R14 (TS-CPE)	Okolon-CPE (Okosheath)

R1

R1

J. R. Cancelosi
Manager Application Engineering

Section 5

Vertical Tray Flame Test

In accordance with IEEE 383, the completed cables must meet a vertical tray flame test. Flame testing was conducted in accordance with IEEE 383-1974 as modified by US Regulatory Guide 1.131. Compliance to the vertical tray flame test requirement is demonstrated in the following "Vertical Tray Flame Test Data Sheet SUMMARY OF FLAME TEST RESULTS". * R1

In addition, in order to meet the vertical tray flame test requirements of IEEE 383-2003 paragraph 8.0 "Flame Test Qualification", cables were subjected to the IEEE 1202-1991 vertical tray flame test procedure. Both unaged and aged cable specimens were tested. Compliance to IEEE 1202-1991 is demonstrated in the following summary sheet labeled "IEEE 1202 Vertical Tray Fire Propagation Test Data Sheet." * R1

VERTICAL TRAY FLAME TEST DATA SHEET

SUMMARY OF FLAME TEST RESULTS

Test Procedure: IEEE 383-1974, Paragraph 2.5 as modified by US Reg. Guide 1.131

Flame Source: Ribbon Gas Burner

Sample Construction: 5 kV 3-1/C 4/0 AWG Cu, extruded semicon (C-52), 0.115" Okoguard (EPR) (G-63), extruded insulation screen (C-53), 0.005" tinned copper tape shield, cable tapes, 0.080" Okolon (CSPE) (R-09) jacket. Triplexed with one # 3 AWG Okolon jacketed ground. OD = 2.38" 04-X4654 (Reference # 02:022-24 & 03:010-012)

Test Results:

	Unaged		
Test #	1	2	3
Afterburn, min:sec	0:00	7:55	0:00
Jacket Damage, inches	18	20	17
Core Damage, inches	10	11	10
Propagation	No	No	No
Pass/Fail	Pass	Pass	Pass

	Aged - 3 wks @ 150°C		
Test #	1	2	3
Afterburn, min:sec	9:05	9:40	7:35
Jacket Damage, inches	30	35	27
Core Damage, inches	19	27	18
Propagation	No	No	No
Pass/Fail	Pass	Pass	Pass

VTFT66

R1

IEEE 1202 VERTICAL TRAY FIRE PROPAGATION TEST DATA SHEET

Test Procedure: IEEE 1202 - 1991 standard for "Flame Testing of Cables for Use in Cable Tray in Industrial & Commercial Occupancies."

Construction: 5 kV /C 2/0 AWG Cu, extruded semicon (C-52), 0.115" Okoguard (EPR) (G-63), extruded insulation screen (C-53), 0.005" tinned copper tape shield, cable tapes, 0.080" Okolon-CPE (R-14N) jacket. OD = 0.945"
04-X4683B

Test Results:
Unaged

Test Number	06-055	06-056
Afterburn, min:sec	3:45	2:55
Jacket Damage, in.	34	32
Core Damage, in.	29	28
Maximum Allowable Damage, in.	59	
Propagation	No	No
Pass/Fail	Pass	Pass

Aged 3 weeks at 150 C

Test Number	06-030	06-031
Afterburn, min:sec	8:10	4:10
Jacket Damage, in.	51	37
Core Damage, in.	45	31
Maximum Allowable Damage, in.	59	
Propagation	No	No
Pass/Fail	Pass	Pass

Section 6

Moisture Resistance
Long Term 90°C Water Immersion Accelerated Test

To demonstrate long water stability of Okoguard insulated wire, specimens were directly immersed in 90°C water to accelerate the deteriorating effects of moisture. Testing was conducted in accordance with ICEA T-27-581, paragraph 2.6, "Accelerated Water Absorption test, Electrical Method at 60 Hz (EM-60)" except that the time was extended and 600 volts continuous stress was applied. Dielectric constant, dissipation factor and insulation resistance were monitored. Insulation resistance, measured at -500 volts dc, was also monitored. Results are tabulated below.

Sample: # 14 AWG Copper, 0.030" Okoguard (G-63)
Method: ICEA T-27-581, paragraph 2.6, except test time extended 600 volts ac continuous stress applied and insulation resistance measured at -500 volts dc

Reference: LE 102299A

90C Immersion Time	Stress v/m	Dielectric Constant	Dissipation factor -%	SIR megs-kft
1 Day	40	2.74	1.10	383
	80	2.74	1.16	
1 Week	40	2.76	0.83	488
	80	2.76	0.86	
2 Weeks	40	2.77	0.76	592
	80	2.77	0.79	
1 Month	40	2.81	0.71	836
	80	2.81	0.72	
3 Months	40	2.86	0.64	1080
	80	2.86	0.65	
6 Months	40	2.94	0.58	1410
	80	2.94	0.59	
9 Months	40	2.99	0.55	1920
	80	2.99	0.55	
12 Months	40	3.03	0.52	2090
	80	3.03	0.53	

SECTION 7

DBE-HELB Qualification

The Okoguard insulation system was DBE qualified basis a type test, generic qualification method. The temperature/pressure/time/spray profile selected is shown in Figure 1. This profile was chosen since it had been used in a previous Okonite qualification test and was accepted by nuclear utilities as meeting their specific plant profiles. Qualification was conducted in accordance with the "Test Plan for DBE-HELB Qualification to IEEE 383". This test plan is included in this section as Appendix 1.

The HELB test was conducted on the thinnest insulation wall used by Okonite on medium voltage rated Okoguard products. The Okoguard cable test specimens were manufactured at Okonite under production run number X4668. Specimen descriptions, voltage and current loads and aging conditions are given in Table 1. Okonite was responsible for Specimen Coiling, Aging Radiation Exposure and Thermal Aging Exposure.

Table 1

FO #	Description			
04-X4668	5kV #6 (7X) AWG Bare copper, 0.115" C-52 0.115" G-63 (Okoguard), C-53, 0.060" R-14 (Okolon CPE)			
Specimen	Specimen Chart, HELB, (25 ft. specimens)			
#	FO#	O.D.	Radiation	Oven Aging Regimen
11	X4468	0.720	0	N/A
12	X4668	0.720	50 Mrads	21 Days @ 150C
13	X4668	0.720	50 Mrads	14 Days @ 165C

HELB qualification (DBE-HELB and Functional Test After DBE-HELB Conditions) was conducted by National Technical Systems (NTS), Acton MA. A mutually agreed upon test procedure plan was developed and followed (see Section 7, Appendix 1).

The performance requirements to demonstrate Class 1E qualification are:

1. Maintain electrical load as given in Table 1.
2. Pass the dielectric withstand test – post accident (prior to removal from the test chamber.) Charging current not to exceed 10 mA.
3. Pass the Post DBE Simulation Test (Bending Test). Charging current not to exceed 10 mA.

Based on the analysis to determine the proper sequential order for thermal aging and radiation aging (see Section 3), the specimens were first exposed to 50 Mrads of gamma radiation. The specimens were then subjected to thermal aging. The thermal aging was selected to be three weeks at 150°C to simulate a 40 year design life and two weeks at 165°C to simulate a 60 year design life. Oven aging was conducted at Okonite in ASTM type II forced draft ovens and the radiation exposure was performed at Steris/Isomedix in Whippany, NJ. Radiation services for these specimens are documented in Section 7, Appendix 2, Table 1, specimens 11, 12 & 13.

At NTS, the three specimens were installed in the test vessel and were subjected to the temperature/pressure/chemical spray profile shown in NTS Report TR62871-06N. Okoguard (G-63) specimens are identified as specimens 11, 12 & 13. Specimens 1 through 10 are low voltage insulations and are not a part of this qualification report.

The specimens were voltage and current loaded in accordance with Table 1. Voltage, current and charging current were monitored throughout the profile. Temperature, pressure, and chemical spray flow rate were also monitored throughout the duration of the test.

During the test program, four deviations occurred. These deviations are documented in Appendix I of NTS report TR62871-06N. Notice of Deviation NOD-001 identified incorrect wiring when the voltage load was applied to the three specimens. After the load wiring was corrected (and other modifications were made – see NOD-001), all specimens were re-energized and the test profile resumed. Since the specimens were not energized throughout the double peak to 455F (due to the wiring error), it was decided to add a second double peak at the end of the 190F, 9 psig dwell peak. This additional double peak made the test more severe than originally intended. All three specimens maintained electrical load throughout the remainder of the test including the second double peak.

The specimens were then subjected to the Post DBE Simulation Test (Bending Test). The specimens were removed from the support mandrel, straightened and recoiled around a 40 x O.D. steel mandrel. Each specimen, while on the mandrel, was immersed in room temperature water for a minimum of one hour. While still immersed, each specimen was withstand tested at 80 v/mil ac (conductor to shield tape and water bath) for five minutes. The test voltage and charging current values were recorded.

All samples passed the Post DBE Simulation Test (Bending Test). All qualification testing is documented in NTS report TR62871-06N (See Appendix D).

Test Plan for DBE-HELB Qualification to IEEE 383

1.0 SCOPE

This document has been prepared to present the procedures for subjecting the cables described in Paragraph 1.1, hereinafter referred to as the specimens, to a Nuclear Environmental Qualification Test Program in accordance with the standards, specifications, and other documents listed in Paragraph 1.2.

1.1 Specimen Description

The specimens for the test program consist of three constructions of single conductor Okonite insulated wire. Two low voltage constructions will be represented by six specimens each. One medium voltage rated production run will be represented by two specimens. Factory order numbers and specimen details are listed in Appendix I.

1.2 Qualification Standards, Specifications and Documents

- IEEE Standard 323-2003, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations".
- IEEE Standard 383-2003, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations".
- U.S. Nuclear Regulatory Guide 1.131 "Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants".
- 10CFR21, "Reporting of Defects and Non-compliance".
- 10CFR50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants".
- The Okonite Company Quality Assurance Program Manual. (Okonite Only)

2.0 QUALITY ASSURANCE

All work on this test program shall be performed in accordance with The Okonite Company's Quality Assurance Program, which complies with the applicable requirements of 10 CFR 50 Appendix B, ANSI N45.2, and Regulatory Guides.

3.0 TEST EQUIPMENT AND INSTRUMENTATION

All instrumentation, measuring and test equipment used in the performance of this test program were calibrated in accordance with Okonite's Quality Assurance Program which complies with the requirements of ISO 10012-1. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology (NIST) by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented.

4.0 TEST REQUIREMENTS

The test program shall be performed in the sequence shown below. The tests are described in Paragraphs 4.1 through 4.5.

1. Specimen Coiling (OKONITE)
2. Aging Radiation Exposure (OKONITE)
3. Thermal Aging Exposure (OKONITE)
4. DBE-HELB (NTS)
5. Functional Test After DBE-HELB Conditions (NTS)

4.1 Specimen Coiling (OKONITE)

The non-shielded specimens shall be wound into approximately 12" coils. The shielded specimens shall be wound into approximately 24" coils. Each specimen shall be identified with the appropriate specimen number (as shown in Table I) by attaching a metal identification tag. The tag will be positioned so that it does not contact the specimen cable.

4.2 Aging Radiation Exposure (OKONITE)

The specimens which are to be exposed to radiation aging will be shipped by a dedicated shipper or Okonite personnel to and from the irradiation vendor for radiation aging.

The specimens detailed in Table I shall be carefully packaged and delivered. The specimens will be exposed to a Cobalt 60 radiation source to obtain the does specified in Table I. The specified radiation dose shall be controlled to the specified value within +10/-0%. The dose rate shall not exceed one megarad per hour. The irradiated specimens shall be returned to Okonite upon completion of radiation exposure.

4.3 Thermal Aging Exposure (OKONITE)

The specimens shall be placed in Okonite Thermal Aging Ovens and aged in air at 150C or 165C for the duration specified in Table I for each specimen. The specimens shall be installed such that a minimum of ten feet will be exposed to the aging conditions. The ends of the specimens shall exit the oven to prevent exposure. The specified thermal aging duration shall be kept within +2, -0% of the specified value. At the specified time, the specimens shall be removed from the thermal aging oven. During the Thermal Aging process, a chart recorder shall monitor chamber temperature. The chart shall be used to document the temperature consistency. Valid calibration certificates shall be available for the aging chamber instrumentation. The specimens shall not be energized for thermal aging.

The ends of the specimens identified in Table I may be placed through a penetration in the oven to prevent exposure of approximately 7 feet of each end to the elevated temperature inside the oven.

Special care will be used during handling of the specimens (during installation or removal from chamber) to prevent any damage.

4.4 Design Basis Event – High Energy Line Break (NTS)

Test Setup
The specimens shall be placed on the mandrels and installed inside the test chamber. The unaged ends of each specimen shall be routed through a chamber penetration. Each specimen will have an effective minimum length of ten feet. Each penetration shall then be potted. The specimens shall be placed to prevent direct steam impingement. Following installation in the test chamber, a 500 volt dc Insulation Resistance Test shall be performed to ensure no damage was caused during installation.

Electrical Powering and Loading
The specimens shall be powered and loaded as indicated in Attachment I, Table 1.

Monitoring
The specimens shall be monitored for applied voltage, circuit current, and leakage current throughout the duration of the High Energy Line Break Test.

At least three thermocouples shall be placed at points around and within two inches of the specimen fixture. The average of these thermocouples shall be used to control the test chamber temperature. The test chamber temperature shall be recorded throughout the duration of the test.

The test chamber pressure shall be monitored and recorded throughout the duration of the test.

The chemical spray flow rate shall be monitored and recorded throughout the duration of the test.

Temperature versus time plots shall be provided for all thermocouples. Additionally, average chamber temperature versus time, chamber pressure versus time, and chemical spray flow rate versus time plots shall be provided.

Accident Test
The specimens shall be exposed to the temperature and pressure profile as indicated in Attachment I, Table 2. The transient shall be performed on a best-effort basis holding as close to the required temperature as possible to achieve the conditions specified. The transient shall be continued until the peak conditions are achieved. The temperature shall then envelop the Accident Test Profile.

4.5 Functional Test after DBE-HELB Conditions (NTS)

The following steps shall be taken (in order) following completion of the normal radiation and thermal aging:

- After the test chamber has been allowed to cool to room temperature, each specimen shall be removed from the chamber, straightened and recoiled on a mandrel approximately 40 times the diameter of the cable.
- Each coil shall be submerged in room temperature water for a period of at least 1 hour.
- Each specimen shall be ac high-potential tested by applying voltage between each specimen and the tap water. The test voltage shall be 80 volts (ac) per mil of nominal insulation thickness. The voltage shall be increased to the full value rapidly, but not to exceed 500 volts per mil per second. Full voltage shall be maintained for 5 minutes and then reduced to zero in not more than 15 seconds. The circuit breaker of the dielectric tester shall interrupt the test if leakage current exceeds 10 milliamps. Charging current shall be recorded.
- The specimens will then be removed from the water, carefully packed and held for disposition.

5.0 TEST REPORT
(NTS to provide a complete report on parts 4.4 & 4.5 of this test plan)

A test report describing the test requirements, procedures and results shall be issued. The test report shall contain any anomalies, if any anomalies occur during the test program, tables, data sheets, sketches, etc. to document test setups, tests performed and results.

J. R. Cancelosi

ENCLOSURE 3

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 261 EXTENDED POWER UPRATE
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

OKONITE COMPANY CERTIFIED TEST REPORT #34549

13 pages follow

CERTIFIED TEST REPORT
CERTIFICATE OF COMPLIANCE

THE OKONITE COMPANY
1740 BEREA ROAD
RICHMOND KY 40475

Report No: 34549
DATE : 12/27/2007
Reg No : 34-6956

Customer: NMC SITE INVOICING/PB NUCLEAR PLT.
Customer Order Number: 00020066 Item No: N/A Code No: N/A
Manufacturing Order No: 07-3192-1 Product Code No: 114-23-2631
Manufacturing Spec: Applicable ICEA and/or AEIC and/or UL Specifications.
Cable Description: 1/C 4/0 AWG 19X BC C-RD .115 OKOGUARD .024 SC EPR .005 TC TAPE DW TAPE TAPE .080 OKOSHEATH CP-TS 5/8KV FOR CT USE

CERTIFICATE OF COMPLIANCE: Issued in conjunction with and subject to OKONITE's standard Warranty and Limitation Liability.

THE OKONITE COMPANY hereby certifies to the customer named above that the above described materials were duly tested during manufacture and that the materials meet or exceed the applicable requirements.

Order Quantity	Quantity Accepted for Shipment	Number of Reels	Cable QC Length No	Footage
4050	4124	3	770812B1 ✓	1417
			770812B2 ✓	1417
			770812B3 ✓	1290

CERTIFIED TEST REPORT

The insulated conductor(s) withstood the following tests:
23 kV AC for 5.00 Min

The insulated cable conductor(s) has an INSULATION RESISTANCE of not less than that corresponding to a constant of 50000 at 15.6 C.

The DC RESISTANCE of the conductor(s) at 25 C does not exceed ICEA values of 0.05200 Ohms per 1,000 ft.

Conductor Continuity PASSED Shield Continuity PASSED

Corona Level (cables over 3kV ONLY) PASSED ICEA S-93-639

This report covers material shipped from RICHMOND
to POINT BEACH NUCLEAR PLANT
6610 NUCLEAR ROAD
TWO RIVERS WI 54241

We hereby certify this to be a true and accurate copy of results of tests conducted in accordance with orders and specifications listed.
Special Statements for this CTR/COC
"Cables shipped are qualified by Okonite EQ Report 527"

THE OKONITE COMPANY

M Marriner

M. MARRINER
Engineer/Manager of Test
Q-123-C-el REV 11.4 06/10/02 Q

ELECTRICAL AND DIMENSIONAL RESULTS

THE OKONITE COMPANY
1740 BEREA ROAD
RICHMOND KY 40475

DATE : 12/27/2007

Customer: NMC SITE INVOICING/PB NUCLEAR PLT.
Customer Order Number: 00020066 Item No: N/A Code No: N/A

Manufacturing Order No: 07-3192-1

Cable Description: 1/C 4/0 AWG 19X BC C-RD .115 OKOGUARD .024 SC EPR .005 TC TAPE DW TAPE TAPE .080 OKOSHEATH CP-TS 5/8KV FOR CT USE

The following DATA SUPPORTS ACCEPTANCE OF CABLE SHIPPED on the above FACTORY ORDER

ELECTRICAL REQUIREMENTS - FINAL DRY TEST
23 kV AC for 5.00 Min
CEV (min kV) PASSED ICEA S-93-639

IR Constant (K value) 50000
Jacket was continuously SPARK TESTED at 7.0 KV AC.

QUALITY CONTROL NUMBER < >	LENGTH FEET < >	No of Cond < >	IR-MEG OHMS/ M ft 15.6 C < MIN>	COND SIZE < >	DC Cond Resistance OHM/M ft 25 C < MAX >	PRINT Sequential Numbers < Top >	< Bottom>
REQUIREMENTS			8440		0.05200		
770812B1	1417	1	21750	4/0 AWG	0.05119	7001468	7000040
770812B2	1417	1	18097	4/0 AWG	0.05129	7002880	7001472
770812B3	1290	1	16812	4/0 AWG	0.05151	7004172	7002886

WALL DIMENSIONS

QUALITY CONTROL NUMBER	STRAND SHIELD		INSULATION		INS SHIELD		JACKET	
	MIN POINT	AVG WALL	MIN POINT	AVG WALL	MIN POINT	AVG WALL	MIN POINT	AVG WALL
< >	< >	< >	< >	< >	< >	< >	< >	< >
REQUIREMENTS	0.006		0.103	0.115	0.024	0.000	0.070	0.080
770812B	0.013	0.014	0.120	0.122	0.029	0.030	0.070	0.083

Q-117E-el REV 11.4 06/10/02 Q

Prepared by: J. Clemons

TRACEABILITY SCHEMATIC

THE OKONITE COMPANY
1740 BEREA ROAD
RICHMOND KY 40475

Report No: 34549
DATE : 12/27/2007
Reg No : 34-6956
Page 3 of 12

Customer: NMC SITE INVOICING/PB NUCLEAR PLT.
Customer Order Number: 00020066 Item No: N/A Code No: N/A
Manufacturing Order No: 07-3192-1 Product Code No: 114-23-2631
Manufacturing Spec:
Cable Description: 1/C 4/0 AWG 19X BC C-RD .115 OKOGUARD .024 SC EPR .005 TC TAPE DW TAPE TAPE .080 OKOSHEATH CP-TS 5/8KV FOR CT USE

Okonite Traceability consists of assigning a Quality Control Number as each reel of wire is insulated. When lengths are combined into cable or units, a new Quality Control Number is assigned. Whenever a length is cut, an Alpha-Numeric designation is added to the Quality Control Number.

1/C Quality Control Numbers	Approved 1/C (Lot/Batch) Compound Identification: Strand Shield	Insulation	Ins. Jkt/Shield
770812B	718420242	722620282 722620277	720010164

Cabled QC Length #	Single Conductors and / or Units contained in each cabled length
N/A	N/A

Shipping QC Length #	Shipping Length	Customer Reel ID	Approved Jacket (Lot/Batch) Compound Identification
770812B1	1417	N/A	733716104;733716106
770812B2	1417	N/A	733716104;733716106
770812B3	1290	N/A	733716104;733716106

Q130D REV 11.4 06/10/02 (3)

Prepared by: J. Clemons

Page # of 12

THE OKONITE COMPANY

PLANT	7		
F.O.NO.	3192-1	CABLE NO.	770812-B1
CABLE RATING	5/8 kV	LENGTH	1417 ft
PHASE			
CUSTOMER	NMC SIT INVOICING	SPECIFICATION	
DESCRIPTION	1/C-4/0 AWG 19 X BC C-RD - 115 OKOGUARD		

	EQUIP. NO.	P/F
CORONA	110	PASS
VOLTAGE-AC 23 kV FOR 5 MIN.	9	PASS

INSULATION MATERIAL EPR

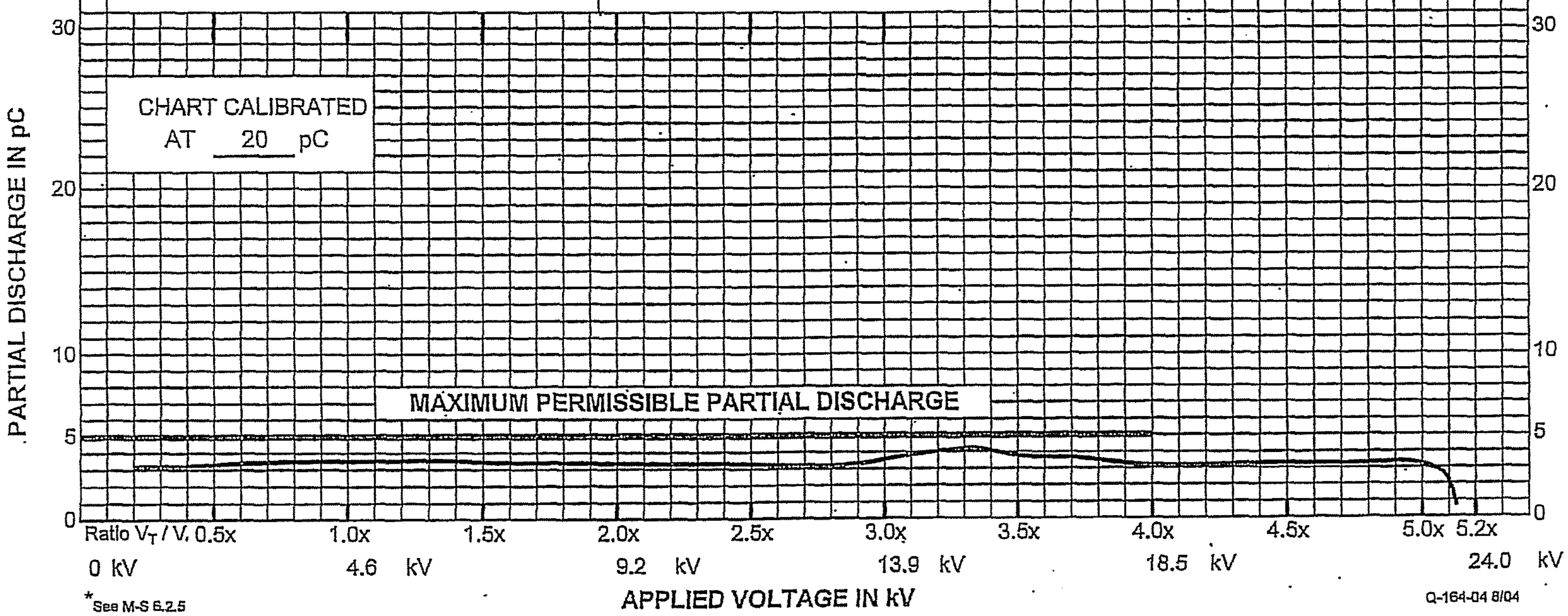
TESTED BY E. Jones

DATE 12/21/2007

SENT TO 61 HOLD

REVIEWED BY C.H. [signature] 12/27/07 DATE 12-21-07

CHART CALIBRATED AT 20 pC



*See M-S 6.2.5

Q-164-04 8/04

THE OKONITE COMPANY

PLANT 7

F.O.NO. 3192-1 CABLE NO. 770812-B2

CABLE RATING 5/8 kV LENGTH 1417 ft PHASE

CUSTOMER NMC SIT INVOICING SPECIFICATION

DESCRIPTION 1/C 4/0 AWG 19 X BC C-RD - 115 OKOGUARD

	EQUIP. NO.	P/F
CORONA	110	PASS
VOLTAGE-AC 23 kV FOR 5 MIN.	9	PASS

INSULATION MATERIAL EPR

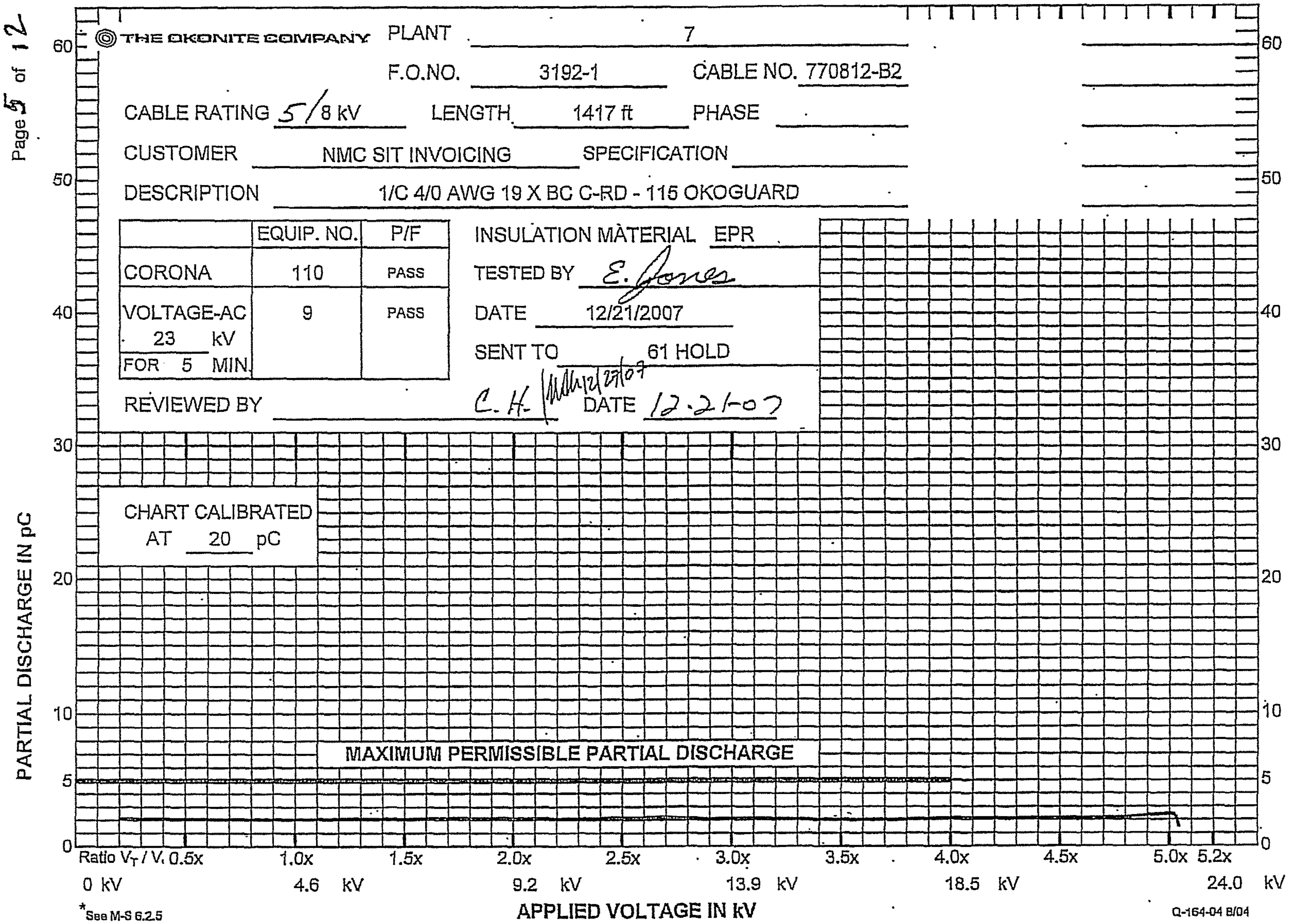
TESTED BY E. Jones

DATE 12/21/2007

SENT TO 61 HOLD

REVIEWED BY C. H. 12/27/07 DATE 12-21-07

CHART CALIBRATED AT 20 pC



*See M-S 6.2.5

Q-164-04 8/04

THE OKONITE COMPANY

PLANT 7

F.O.NO. 3192-1 CABLE NO. 770812-B3

CABLE RATING 5/8 kV LENGTH 1393 ft PHASE

CUSTOMER NMC SIT INVOICING SPECIFICATION

DESCRIPTION 1/C 4/0 AWG 19 X BC C-RD - 115 OKOGUARD

	EQUIP. NO.	P/F
CORONA	110	PASS
VOLTAGE-AC 23 kV FOR 5 MIN.	9	PASS

INSULATION MATERIAL EPR

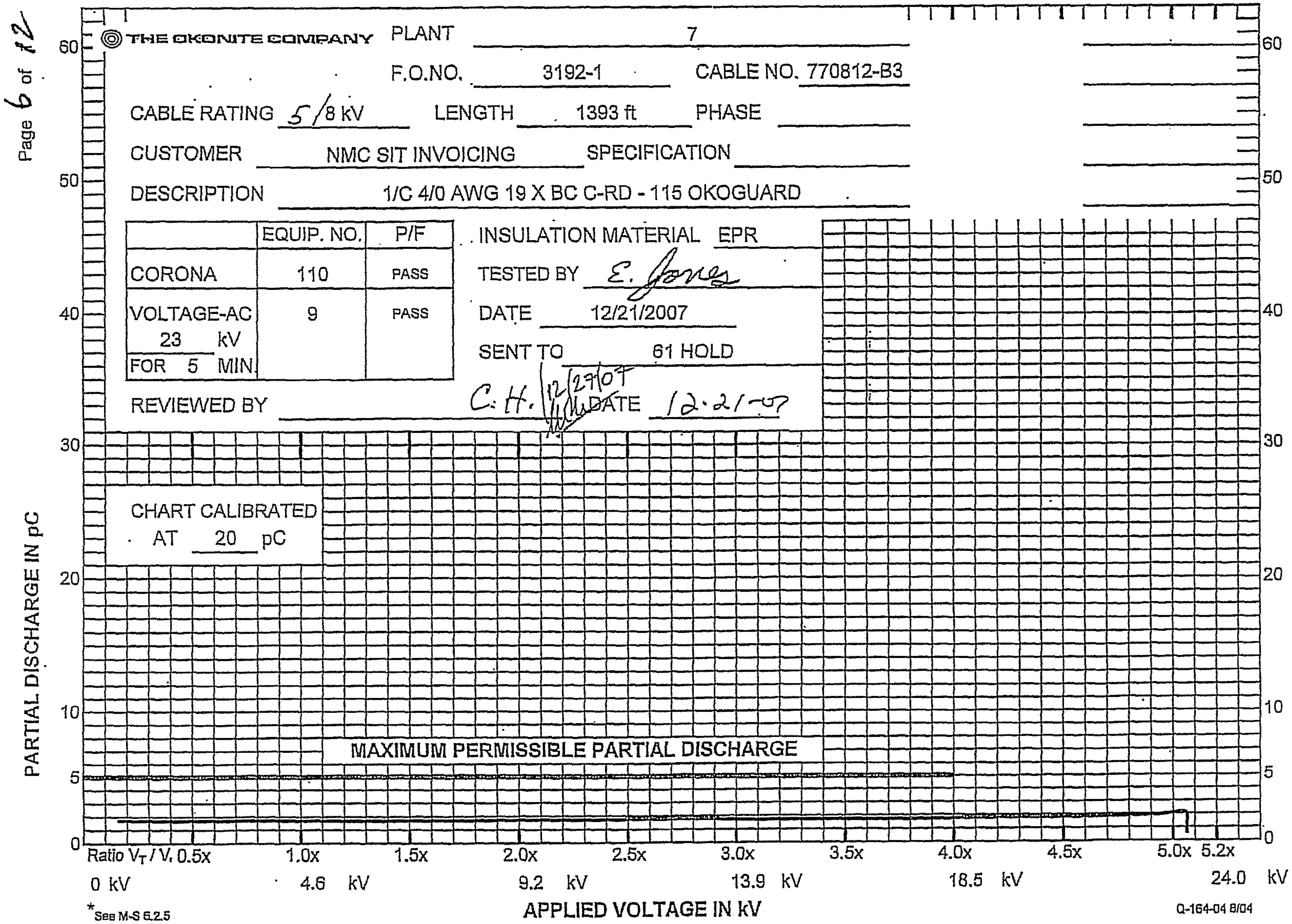
TESTED BY E. Jones

DATE 12/21/2007

SENT TO 61 HOLD

REVIEWED BY C.H. 12/27/07 DATE 12-21-07

CHART CALIBRATED AT 20 pC



*See M-S 6.2.5

Q-164-04 8/04

THE OKONITE COMPANY
PLANT NO 07

PHYSICAL TEST REPORT

DATE: 12/27/2007

CUSTOMER: NMC SITE INVOICING FACTORY ORDER NO: 07-3192-1 (89223)
CABLE DESCRIPTION: 1/C 4/0 AWG 19X BC C-RD - 115 OKOGUARD 024 SC EPR - 005 TC TAPE DW TAPE TAPE - 080 OKO-SHEATH CP-TS - 5/8KV

SPECIFICATION: PREPARED BY: K. CAMERON

THE FOLLOWING PHYSICAL TEST DATA SUPPORTS ACCEPTANCE OF CABLE SHIPPED ON THE ABOVE FACTORY ORDER. COMPOUNDS USED ON THIS ORDER ARE AS LISTED IN THE QUALIFICATION REPORT.

PHYSICAL PROPERTIES	REQMENTS	OKON EP SEMI-COND STRAND SHIELD	OKON EP SEMI-COND STRAND SHIELD
SAMPLE IDENTIFICATION (QC LENGTH NO)		770812B	
VOLUME RESISTIVITY (METER/OHMS)	MAXIMUM		
90 C	100	0.031	
130 C	100	0.022	
BRITTLENESS (NOT WARMER THAN)	-40C	PASS	
WAFER BOIL	MUST PASS	PASS	

Q118C Rev 2.991 11/03/03

THE OKONITE COMPANY
PLANT NO 07

PHYSICAL TEST REPORT

DATE: 12/27/2007

CUSTOMER: NMC SITE INVOICING FACTORY ORDER NO: 07-3192-1 (89223)
CABLE DESCRIPTION: 1/C 4/0 AWG 19X BC C-RD - 115 OKOGUARD 024 SC EPR - 005 TC TAPE DW TAPE TAPE - 080 OKO-SHEATH CP-TS - 5/8KV

SPECIFICATION: PREPARED BY: K. CAMERON

THE FOLLOWING PHYSICAL TEST DATA SUPPORTS ACCEPTANCE OF CABLE SHIPPED ON THE ABOVE FACTORY ORDER. COMPOUNDS USED ON THIS ORDER ARE AS LISTED IN THE QUALIFICATION REPORT.

PHYSICAL PROPERTIES	REQMENTS	OKON EP SEMI-COND INSULATION SCREEN	OKON EP SEMI-COND INSULATION SCREEN
SAMPLE IDENTIFICATION (QC LENGTH NO)		770812B	
VOLUME RESISTIVITY (METER/OHMS)	MAXIMUM		
90 C	50	0.223	
110 C	50	0.054	
BRITTLENESS (NOT WARMER THAN)	-40C	PASS	
ADHESION (LBS/.5")	MIN/MAX 4-18	5-15	
SCORE TEST	NO TEARS OR RESIDUE	PASS	
WAFER BOIL	CONTINUOUS COVERAGE	PASS	

Q118C Rev 2.991 11/03/03

THE OKONITE COMPANY
PLANT NO 07

PHYSICAL TEST REPORT

DATE: 12/27/2007

CUSTOMER: NMC SITE INVOICING FACTORY ORDER NO: 07-3192-1 (89223)
CABLE DESCRIPTION: 1/C 4/0 AWG 19X BC C-RD - 115 OKOGUARD 024 SC EPR - 005 TC TAPE DW TAPE TAPE - 080 OKO-SHEATH CP-TS - 5/8KV

SPECIFICATION: PREPARED BY: K. CAMERON

THE FOLLOWING PHYSICAL TEST DATA SUPPORTS ACCEPTANCE OF CABLE SHIPPED ON THE ABOVE FACTORY ORDER. COMPOUNDS USED ON THIS ORDER ARE AS LISTED IN THE QUALIFICATION REPORT.

PHYSICAL PROPERTIES	REQMENTS	OKOGUARD EPR INSULATION	OKOGUARD EPR INSULATION
SAMPLE IDENTIFICATION (QC LENGTH NO)		770812B	
MODULUS - 100%	MINIMUM		
	500	854	
UNAGED	MINIMUM		
TENSILE STRENGTH	1200	1397	
ELONGATION	250	258	
AFTER AIR OVEN AGING (168 HRS @ 136C)	MINIMUM		
TENS STRENGTH-% UNAGED	90	101	
AFTER AIR OVEN AGING (168 HRS @ 136C)	MINIMUM		
ELONGATION	85	113	
HOT CREEP (@150 C)	MAXIMUM		
ELONGATION %	50.00	0.0	
SET %	5.00	0.0	

VOIDS, CONTAMINANTS, AND EXTRUDED SHIELD PROTRUSIONS MEET AEIC SPECIFICATIONS

WAFER BOIL	MUST PASS	PASS	

THE OKONITE COMPANY
PLANT NO 07

PHYSICAL TEST REPORT

DATE: 12/28/2007

CUSTOMER: NMC SITE INVOICING FACTORY ORDER NO: 07-3192-1
CABLE DESCRIPTION: 1/C 4/0 AWG 19X BC C-RD - 115 OKOGUARD 024 SC EPR - 005 TC TAPE DW TAPE - 080 OKOSHEATH CP-TS-5/8KV
SPECIFICATION: PREPARED BY: TLA

THE FOLLOWING PHYSICAL TEST DATA SUPPORTS ACCEPTANCE OF CABLE SHIPPED ON THE ABOVE FACTORY ORDER. COMPOUNDS USED ON THIS ORDER ARE AS LISTED IN THE QUALIFICATION REPORT.

PHYSICAL PROPERTIES	REQMENTS	CHLORINATED PE JACKET	CHLORINATED PE JACKET
SAMPLE IDENTIFICATION (QC-LENGTH NO)		770812B	
MODULUS - 200%	MINIMUM		
	1400	1476	
UNAGED	MINIMUM		
TENSILE STRENGTH	2000	2138	
ELONGATION	300	307	
AFTER AIR OVEN AGING (168 HRS @ 121C)	MINIMUM		
TENS STRENGTH-% UNAGED	85	130	
AFTER AIR OVEN AGING (168 HRS @ 121C)	MINIMUM		
ELONGATION	70	116	
SET TEST (%) MAXIMUM	50.0	50.0	
OIL IMMERSION (18 HRS @ 121C)	MINIMUM		
TENS STRENGTH - % OF UNAGED	80	83	
ELONGATION	75	120	

Q118C Rev 2.991 11/03/03

THE OKONITE COMPANY

Ramsey, New Jersey 07446

CERTIFICATION

for

MEDIUM VOLTAGE OKOGUARD SHIELDED POWER CABLE

Accelerated Water Absorption Properties

Okoguard insulation meets the requirements of S-97-682, paragraph 4.3.2.2.4. Typical values are shown in the following table.

Accelerated Water Absorption Properties (Electrical Method)	Requirement	Okoguard	
Water Immersion Temperature	75 C or 90 C	75 C	90C
Dielectric Constant after 24 hours, max.	4.0	2.76	2.84
Increase in capacitance, max percent			
1 to 14 days	3.5	0.4	0.05
7 to 14 days	1.5	0.2	0.03
Stability Factor after 14 days, max	1.0	0.01	0.05
Alternate to Stability Factor – Stability Factor Difference, 1 to 14 days, max	0.5	0.00	0.01

These values were obtained on samples measured in our electrical laboratory.

John Cancelosi

John Cancelosi
Manager Application Engineering

H:\ENGCERT\07021.DOC

THE OKONITE COMPANY
www.okonite.com

Post Office Box 340
Ramsey, New Jersey 07446
Telephone: (201) 825-0300
Telefax: (201) 825-9026
E-Mail: okonite@okonite.com

CERTIFICATION

FOR

Medium Voltage OKOGUARD SHIELDED Power Cable

Quality Plan
Conductor & Insulation Shields

Elongation:

When tested in accordance with S-97-682, paragraph 9.4.14, the semiconducting EPR conductor screen material meets the 100% minimum elongation after 168 hours at 121°C.

Certification is based routine testing in the Okonite Materials Laboratory.

Carl Zuidema

Carl Zuidema

CZ/jv
Ref: Certification for Conductor & Insulation Shields

from PO file
ORIGINAL PART ORDERED 1/3

THE OKONITE COMPANY

Product Data
Section 2: Sheet 4

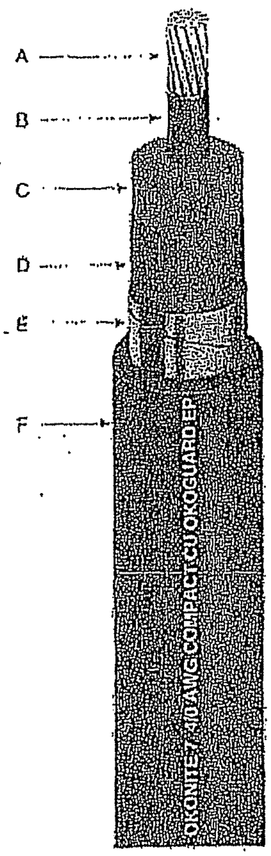
COMPACT STRAND
CONSTRUCTION

Okoguard®-Okoseal® Type MV-105

5/8kV Shielded Power Cable

One Okopact® (Compact Stranded) Copper Conductor/105°C Rating
5kV-133% or 8kV-100% Insulation Level

*



A Uncoated, Okopact (Compact Stranded) Copper Conductor

B Strand Screen-Extruded Semiconducting EPR

C Insulation-Okoguard EPR

D Insulation Screen-Extruded Semiconducting EPR

E Shielding-Copper Tape

F Jacket-Okoseal

Insulation

Okoguard is Okonite's registered trade name for its exclusive ethylene-propylene rubber (EPR) based, thermosetting compound, whose optimum balance of electrical and physical properties is unequalled in other solid dielectrics. Okoguard insulation, with the distinctive red color and a totally integrated EPR system, provides the optimum balance of electrical and physical properties for long, problem free service.

The triple tandem extrusion of the screens with the insulation provides optimum electrical characteristics.

Jacket

The Okoseal (PVC) jacket supplied with this cable is mechanically rugged and has excellent resistance to oil, acids and most chemicals.

Applications

Okoguard shielded Okoseal Type MV-105 power cables are recommended for distribution circuits, and for feeders or branch circuits.

Type MV cables may be installed in wet or dry locations, indoors or outdoors (exposed to sunlight), in any raceway or underground duct, directly buried if installed in a system with a grounding conductor in close proximity that conforms with NEC Section 310.7, or messenger supported in industrial establishments and electric utilities.

RJU
1-10-08
3/49