

March 23, 2015

Mr. Rob Johnson, Quality Assurance Manager
General Cable
1600 West Main Street
Willimantic, CT 06226-1128

SUBJECT: NUCLEAR REGULATORY COMMISSION VENDOR INSPECTION REPORT
NO. 99900227/2015-201 OF GENERAL CABLE AND NOTICE OF VIOLATION
AND NOTICE OF NONCONFORMANCE

Dear Mr. Johnson:

On February 2, 2015, to February 6, 2015, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at the General Cable manufacturing facility in Willimantic, CT. The purpose of this limited-scope inspection was to assess General Cable's compliance with the provisions of selected portions of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 21, "Reporting of Defects and Noncompliance." This technically-focused inspection specifically evaluated General Cable's implementation of quality activities associated with the fabrication and testing of safety-related cables supplied to U.S. operating reactor plants and to the AP1000 plants under construction. The enclosed report presents the results of this inspection. During this inspection, the NRC staff looked at the environmental qualification of safety-related cables associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from revision 19 of the approved Westinghouse AP1000 design certification document. Specifically, these activities were associated with ITAAC 2.2.1.6a.ii, ITAAC 2.2.3.7a.ii, ITAAC 2.1.2.7a.ii, and ITAAC 2.1.3.9a.ii. The NRC inspection team did not identify any findings associated with the ITAAC contained in Section (4) of the attachment to this report. This NRC inspection report does not constitute NRC endorsement of your overall quality assurance (QA) or 10 CFR Part 21 programs.

Based on the results of this inspection, the NRC staff determined that a violation of NRC requirements occurred. The violation is cited in the enclosed Notice of Violation (Notice) and the circumstances surrounding it are described in detail in the subject inspection report. The violation is being cited in the NOV because General Cable failed to adequately evaluate a deviation identified through a Nuclear Industry Assessment Committee audit that hot creep, which is listed as a critical characteristic in qualification test document EP-XII-5, "Low voltage nuclear Ultrol Class 1E and non-Class 1E cables," was not tested as per Insulated

Cable Engineers Association T-27-581, "Test method for measurement of hot creep of polymeric insulations," in six purchase orders as required by 10 CFR 21.21, "Notification of failure to comply or existence of a defect and its evaluation."

You are required to respond to this letter and should follow the instructions specified in the enclosed Notice of Violation when preparing your response. If you have additional information that you believe the NRC should consider, you may provide it in your response to the Notice. The NRC review of your response to the Notice will also determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

During this inspection, NRC inspectors also found that the implementation of your Quality Assurance (QA) program failed to meet certain NRC requirements imposed on you by your customers. General Cable failed to ensure that assumptions from design qualification reports were correctly translated into certificates of conformance sent to their customers and General Cable failed to take measures to ensure that original type testing performed for safety-related cables envelop customer qualification requirements. The specific findings and references to the pertinent requirements are identified in the enclosures to this letter. Please provide a written statement or explanation within 30 days from the date of this letter in accordance with the instructions specified in the enclosed Notice of Nonconformance. We will consider extending the response time if you show good cause for us to do so.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure(s), and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response, (if applicable), should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the

R. Johnson

- 3 -

disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information).

Sincerely,

/RA/

Richard A. Rasmussen, Chief
Electrical Vendor Inspection Branch
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 99900227

Enclosures:

1. Notice of Violation
2. Notice of Nonconformance
3. Inspection Report 99900227/2015-201

R. Johnson

- 3 -

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Sincerely,

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Richard A. Rasmussen, Chief
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NRO-002

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DATE	03/05/2015	03/06/2015	03/09/2015	03/11/2015
OFFICE	RII/DCI	NRO/DCIP	NRO/DCIP/EVIB	
NAME	GCrespo*	TFrye*	RRasmussen	
DATE	03/04/2015	03/13/2015	03/23/2015	

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NOTICE OF VIOLATION

General Cable
1600 West Main Street
Willimantic, CT 06226

Docket No.: 99900227
Report Number: 2015-201

During a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at General Cable's facility in Willimantic, CT on February 2, 2015, through February 06, 2015, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

Title 10 of the *Code of Federal Regulations* (10 CFR) 21.21, "Notification of failure to comply or existence of a defect and its evaluation," requires, in part, that "Each corporation, dedicating entity or other entities subject to the regulations in this part shall adopt appropriate procedures to evaluate deviations and failures to comply to identify defects and failures to comply associated with substantial safety hazards as soon as practicable."

Contrary to the above, as of February 06, 2015, General Cable failed to adequately evaluate a deviation identified through a Nuclear Industry Assessment Committee audit that hot creep, which is listed as a critical characteristic in qualification test document EP-XII-5, "Low voltage nuclear Ultrol Class 1E and non-Class 1E cables," was not tested as per Insulated Cable Engineers Association (ICEA) T-27-581, "Test method for measurement of hot creep of polymeric insulations," in six purchase orders. Specifically, as stated per EP-XII-5, "verification of the cable's hot creep (both elongation and set) will ensure that the item was crosslinked in the manufacturing process and the cable will last its qualified life." However, General Cable's evaluation that a solder iron test, which is a simple go, no-go test, would be adequate to meet the testing requirements as stated by the ICEA standard is not sufficient to verify the critical characteristic of quantitatively measuring the elongation and set for crosslinking and qualified life purposes.

This issue has been identified as Violation 99900227/2015-201-01.

This is a Severity Level IV violation (Section 6.9.d of the NRC Enforcement Policy).

Pursuant to the provisions of 10 CFR 2.201, "Notice of Violation," General Cable is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-001 with a copy to the Chief, Electrical Vendor Inspection Branch, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Violation (Notice). This reply should be clearly marked as a "Reply to a Notice of Violation" and should include for each violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation or severity level, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken, and (4) the date when full compliance will be achieved. Your response may reference or include previously docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, consideration will be given to extending the response time.

Enclosure 1

If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, and Washington, DC 20555-0001.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>, to the extent possible, it should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this 23rd day of March 2015.

NOTICE OF NONCONFORMANCE

General Cable
1600 West Main Street
Willimantic, CT 06226

Docket No.: 99900227
Report Number: 2015-201

Based on the results of a Nuclear Regulatory Commission (NRC) inspection conducted at General Cable's facility in Willimantic, CT, on February 2, 2015, through February 6, 2015, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on General Cable by NRC licensees:

- A. Criterion III, "Design Control," of Appendix B, Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 states, in part, that "Measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in § 50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components."

Contrary to the above, General Cable failed to ensure that assumptions from design qualification reports were correctly translated into certificates of conformance sent to their customers. Specifically, certificates of conformance to Duke purchase order (PO) 00108282 and 00181215, stated in part that, "By virtue of testing performed on the core conductors, cable supplies under PO 00108282 and 00181215 qualifies per Institute of Electrical and Electronics Engineers (IEEE) 383-1974 as Class 1E material. It is also certified that the material supplied meets the requirements of IEEE 323-1974 as tested on the qualification reports F-C5120-1 and F-C5120-3. When used as Class 1E material inside containment, it is recommended that the PVC jacket be removed." However, Duke required the cable jacket to be PVC which was not evaluated or qualified to IEEE 323 or IEEE 383 by General Cable. The certificate of conformance statement did not adequately state the cable's qualified conditions for use which would require the removal of the PVC jacket inside containment (inside containment is an unanalyzed condition). Additionally, there is no statement in the certificate of conformance concerning harsh environments outside of containment which the PVC jacket is also not qualified to be in.

This issue has been identified as Nonconformance 99900227/2015-201-02

- B. Criterion III, "Design Control," of Appendix B to 10 CFR states, in part, that, measures should be established to assure that "...appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components."

Enclosure 2

Contrary to the above, General Cable failed to take measures to review for suitability that ensures that original type testing performed for safety-related cables envelop customer qualification requirements. General Cable failed to adequately evaluate whether qualification testing performed by Franklin Research Center conformed to the specified testing requirements. Additionally, General Cable failed to adequately verify that all instruments, and other measuring and testing devices used in activities affecting quality were properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within necessary limits. Specifically, qualification report F-C5120-1, "Qualification tests of electrical cables in a simulated steam line break and loss-of-coolant accident (LOCA) environment," for Class 1E cable qualified cables to IEEE 323-1974 and IEEE 383, states that all qualification testing was performed August through December 1979. However, the Hipotronics AC dielectric test set, which was the sole test equipment used for dielectric testing, was calibrated January 21, 1980. There is no documented evidence that the AC dielectric test set was calibrated before the five minute AC high potential withstand test to ensure that the insulation met the requirements post steam line break and LOCA environment.

This issue has been identified as Nonconformance 99900227/2015-201-03.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Electrical Vendor Inspection Branch, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Nonconformance. This reply should be clearly marked as a "Reply to a Notice of Nonconformance" and should include for each noncompliance: (1) the reason for the noncompliance, or if contested, the basis for disputing the noncompliance; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid noncompliance; and (4) the date when your corrective action will be completed. Where good cause is shown, the NRC will consider extending the response time.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, which is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>, to the extent possible, it should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this the 23rd day of March, 2015.

**U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS
VENDOR INSPECTION REPORT**

Vendor Docket No.: 99900227

Inspection Report No.: 99900227/2015-201

Vendor: General Cable
1600 West Main Street
Willimantic, CT 06226-1128

Vendor Contact: Rob Johnson, Quality Assurance Manager
rxjohnson@generalcable.com
(860) 465-8725

Nuclear Industry Activity: General Cable is a manufacturer of safety related cables. General cables supplies class 1E medium and low voltage cables and Non-Class 1E safety significant medium and low voltage cables under their ULTROL 60+ lines for power plants and new construction in applications inside and outside containment for a 60+ year service life.

Inspection Dates: February 2-6, 2015

Inspectors: Jose Jimenez NRO/DCIP/EVIB Team Leader
Eugene Huang NRO/DICP/EVIB
Annie Ramirez NRO/DCIP/EVIB
Aaron Armstrong NRO/DCIP/QVIB
Guillermo Crespo RII

Approved by: Richard A. Rasmussen, Chief
Electrical Vendor Inspection Branch
Division of Construction Inspection
and Operational Programs
Office of New Reactors

EXECUTIVE SUMMARY

General Cable
99900227/2015-201

The Nuclear Regulatory Commission (NRC) staff conducted a vendor inspection at the General Cable facility in Willimantic, CT to verify that it implemented an adequate quality assurance (QA) program that complies with the requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities." In addition, the NRC inspection also verified that General Cable implemented a program under 10 CFR Part 21, "Reporting of Defects and Noncompliance," that met the NRC's regulatory requirements. Also, the NRC staff looked at the environmental qualification of safety-related cables associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from revision 19 of the approved Westinghouse AP1000 design certification document. Specifically, these activities were associated with ITAAC 2.2.1.6a.ii, ITAAC 2.2.3.7a.ii, ITAAC 2.1.2.7a.ii, and ITAAC 2.1.3.9a.ii. The NRC inspection team conducted the inspection from February 2-6, 2015. This was the first NRC inspection at the General Cable Willimantic, CT facility.

This technically-focused inspection specifically evaluated General Cable's implementation of quality activities associated with the fabrication, inspection, and testing, of a sample of safety-related cables. In addition to observing these activities, the NRC inspection team evaluated design change control and its effect on component environmental qualification (EQ), supplier controls, commercial-grade dedication (CGD), audits, problem resolution and reporting, and control of measuring and test equipment (M&TE).

The following regulations served as the bases for the NRC inspection:

- Appendix B to 10 CFR Part 50
- 10 CFR Part 21

During the course of this inspection, the NRC inspection team implemented Inspection Procedure (IP) 43002, "Routine Inspections of Nuclear Vendors"; IP 43004, "Inspection of Commercial-Grade Dedication Programs"; and IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance."

The information below summarizes the results of this inspection.

10 CFR Part 21 Program

The NRC inspection team issued Violation 99900227/2015-201-01 in association with General Cable's failure to implement the regulatory requirements of 10 CFR Part 21. Specifically, General Cable failed to adequately evaluate a deviation potentially associated with a substantial safety hazard in accordance with 10 CFR 21.21(a) (1). General Cable's deviation evaluation that a solder iron test is equivalent to Insulated Cable Engineers Association (ICEA) T-27-581 in verifying cable hot creep, which is a critical characteristic, is inadequate since there are more quantitative steps required by the ICEA standard to measure the elongation and set to ensure adequate crosslinking and that the cable will perform for its qualified life.

Equipment Qualification and Inspection, Tests, Analyses, and Acceptance Criteria (ITAAC)

The NRC inspection team determined that, General Cable's procedures and implementation of cable qualification activities were consistent with requirements specified in customer orders. The NRC inspectors determined that General Cable's programmatic controls of procured qualification testing services for the qualification of instrumentation, control and power cables to be used in the AP1000 reactor design were adequate. No findings of significance were identified.

Design Control

The NRC inspection team identified two instances of inadequate implementation of the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team issued Nonconformance 99900227/2015-201-02 for General Cable's failure to ensure that assumptions from design qualification reports were correctly translated into certificates of conformance sent to their customers and Nonconformance 99900227/2015-201-03 for General Cable's failure to take measures to review for suitability that ensures that original type testing performed for safety-related cables envelop customer qualification requirements.

Commercial Grade Dedication

The inspectors determined that the implementation of General Cable's CGD program for the assembly, inspection, and testing of safety-related cables were consistent with the regulatory requirements of Criterion X, "Inspection," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

Control of Purchased, Material, Equipment, and Services

The NRC inspectors determined that General Cable established a program that adequately controls procurement of equipment and services in accordance with the regulatory requirements of Criterion IV, "Procurement Document Control," and VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

Manufacturing – Inspection and Test Controls

The NRC inspection team determined that General Cable established an adequate program for the manufacture, inspection, and test controls in accordance with the regulatory requirements of Criterion III, "Design Control," Criterion IV, "Procurement Document Control," Criterion VII, "Control of Purchased Material, Equipment, and Services," Criterion X, "Inspections," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

Measuring and Test Equipment Controls

The NRC inspection team determined that General Cable established a program that adequately controls M&TE activities in accordance with the regulatory requirements of Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also concluded that General Cable is effectively implementing its M&TE program. No findings of significance were identified.

Nonconformance Program

The NRC inspection team determined that the implementation of General Cable's program that documents and evaluates nonconformances was consistent with the regulatory requirements of Criterion XV, "Nonconforming Materials, Parts, or Components," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

Corrective Action Program

The NRC inspection team determined that the implementation of General Cable's program that documents and evaluates corrective actions was consistent with the regulatory requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

REPORT DETAILS

1. 10 CFR Part 21 Program

a. Inspection Scope

The NRC inspection team reviewed General Cable's policies and implementing procedures that govern the facility's compliance with the requirements of 10 CFR Part 21, "Reporting of Defects and Noncompliance." Specifically, the NRC inspection team reviewed General Cable's 10 CFR 21 procedure, which describes the authorities and responsibilities for evaluating and reporting defects and noncompliance.

The NRC inspection team reviewed the procedures for corrective action, nonconformance, and other processes that could identify a defect or nonconformance, to ensure that they provided for screening to determine if an evaluation for 10 CFR Part 21 reporting was required. The NRC inspection team walked down the facility to ensure that the 10 CFR Part 21 postings were in place as required.

The NRC inspection team reviewed General Cable's procedure for records to ensure it required records to be maintained in accordance with the requirements of 10 CFR Part 21. The NRC inspection team reviewed a sample of 10 CFR Part 21 evaluations that weren't reportable to ensure that the requirements of 10 CFR Part 21 were being adequately implemented.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

The NRC inspection team identified that General Cable failed to adequately evaluate a deviation identified through a Nuclear Industry Assessment Committee audit that hot creep, which is listed as a critical characteristic in qualification test document EP-XII-5, "Low voltage nuclear Ultrol Class 1E and non-Class 1E cables," was not tested as per ICEA T-27-581, "Test method for measurement of hot creep of polymeric insulations," in six purchase orders (POs) which included licensees and other vendors. EP-XII-5, states in part that, "verification of the cable's hot creep (both elongation and set) will ensure that the item was cross-linked in the manufacturing process and the cable will last its qualified life." General Cable's 10 CFR Part 21 evaluation determined that a solder iron test was adequate. However, the NRC inspection team determined the soldering iron test failed to meet the testing requirements of ICEA T-27-581. Specifically, the evaluation was not sufficient for the verification of its critical characteristic, which was quantitative measurements for the elongation and set for crosslinking required by ICEA T-27-581 for qualified life purposes. This issue is identified as NOV 99900227/2015-201-01.

c. Conclusions

The NRC inspection team issued Violation 99900227/2015-201-01 in association with General Cable's failure to implement the regulatory requirements of 10 CFR Part 21. Specifically, General Cable failed to adequately evaluate a deviation potentially associated with a substantial safety hazard in accordance with 10 CFR 21.21(a)(1). General Cable's soldering iron test deviation evaluation failed to verify the critical characteristic, which was quantitative measurements for the elongation and set for crosslinking required by ICEA T-27-581 for qualified life purposes.

2. **Equipment Qualification and Inspection, Tests, Analyses, and Acceptance Criteria (ITAAC)**

a. Inspection Scope

The NRC inspection team reviewed General Cable's test reports, design specifications, purchase orders, supplier reports, audits, and supporting documentation to verify that qualification processes and results were in compliance with purchaser requirements and Westinghouse design requirements including completion of ITAAC requirements for ITAAC 2.2.1.6a.ii, ITAAC 2.2.3.7a.ii, ITAAC 2.1.2.7a.ii, and ITAAC 2.1.3.9a.ii. In addition, the NRC inspection team interviewed responsible individuals in charge of the methods and implementation of the qualification type testing performed in response to the purchase orders from Chicago Bridge and Iron (CB&I).

Included in the inspection document reviews were signal and power cable qualification test reports to determine whether parameters and test scope defined for harsh environment testing of specimens incorporated the requirements specified in the applicable portions of the test plan and test results were adequately documented and evaluated. Functionality of the test specimens before, during, and after testing was verified by visual inspection and insulation resistance measurements. The inspection scope included review of purchaser approval of test results and acceptance of minor deviations from the established requirements.

The cable specimens tested included:

- 1/C, 16AWG, 600V, Tinned Cu Conductor, 25 mils XLPE insulation (Instrumentation/Control/Power)
- 1/C, 12AWG, 600V, Tinned Cu Conductor, 30 mils XLPE insulation (Instrumentation/Control/Power)
- 1 pair, 20AWG, 600V, Type EX Thermocouple, 25 mils XLPE insulation, Cu/Mylar Shield (25% overlap), 45 mils XLPO jacket (Instrumentation Thermocouple)
- 1 pair, 16AWG, 600V, Tinned Cu Conductor, 25 mils XLPE insulation, Cu/Mylar Shield (25% overlap), Tinned-Cu Braid (90% coverage), 45 mils XLPO jacket (Instrumentation)

- 1 pair, 18AWG, 600V, Tinned Cu Conductor, 25 mils XLPE insulation, Cu/Mylar Shield (25% overlap), Tinned-Cu Braid (90% coverage), 45 mils XLPO jacket (Instrumentation)
- 7/C, 12 AWG, 600V, Tinned Cu Conductor, 30 mils XLPE colored insulation, 60 mils XLPO jacket (Control)
- 3/C 2AWG with ground, 600V, Tinned Cu Conductor, 45 mils XLPE insulation, 2 mils Mylar binder tape, 80 mils XLPO jacket (LV Power)
- 3/C 2AWG with ground, 600V, Tinned Cu Conductor, 45 mils XLPE insulation, Cu/Mylar shield (25% overlap), Tinned Cu braid (90% coverage), 80 mils XLPO jacket (LV Power)
- 1/C, 2AWG, 2000V, Tinned Cu Conductor, 55 mils XLPE insulation, 30 mils XLPO jacket (LV Power)
- 1/C, 1/0AWG, 15KV, compressed Tinned Cu core, conductor shield B, 175 mils EPR insulation, insulation shield, 8mils longitudinal applied Tinned corrugated Cu tape shield, 85 mils XLPO jacket (MV Power)

The inspectors reviewed the test results compared to qualification requirements, which included: Condition of Service: Zones 1 – Inside Containment, 5 – Outside Containment, and 10 – Outside Containment. Each of these zones applied required maximum temperature, maximum pressure, relative humidity, loss of coolant accident (LOCA) event radiation, chemistry, submergence at full range of chemistry and increasing pressure by an additional 16.62 psig, and post-accident duration for 1 year.

The inspectors discussed the temperature lag response during cable temperature qualification testing where the temperature ramp in the test chamber did not meet the requirements established by CB&I and Westinghouse. Technical evaluations performed by General Cable indicated that the temperature increase during the first 10 seconds of a DBE will not expose the insulation/conductor interfaces of the cable to those high temperatures. According to the report, it will take more than 14 seconds to penetrate to the midpoint through the insulation for a low voltage conductor and close to 23 minutes to penetrate across a medium voltage cable. The testing and analysis developed by General Cable concluded that the initial temperature ramp rate within the first 30 seconds of the LOCA test will have no effect in the insulation properties and therefore not compromise the capability of the cable to perform its safety function.

The inspectors reviewed additional tests reports that exposed the cable to temperatures far in excess of the LOCA profile defined for the qualification tests as contained in the “Severe Accident Application Information” graphs performed for high temperature ULTROL® 60+ applications and thermogravimetric analysis (TGA). The TGA was performed to assure that the compounds meet requirements to detect counterfeit conditions by measuring changes in the physical and chemical properties of materials. This last test showed that at approximately 350°C spontaneous degradation starts and established the limitation for use of this type of insulation.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspection team determined that, General Cable's procedures and implementation of cable qualification activities were consistent with requirements specified in customer orders. The NRC inspectors determined that General Cable's programmatic controls of procured qualification testing services for the qualification of instrumentation, control and power cables to be used in the AP1000 reactor design were adequate in support of ITAAC 2.2.1.6a.ii, ITAAC 2.2.3.7a.ii, ITAAC 2.1.2.7a.ii, and ITAAC 2.1.3.9a.ii. No findings of significance were identified.

3. Design Control

a. Inspection Scope

The NRC inspection team reviewed General Cable's policies and procedures for the safety-related cables design control and qualification to verify compliance with Criterion III, "Design Control," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. The NRC inspection team evaluated General Cable's design change control process and procedures established in General Cable's Quality Assurance Manual.

Specifically, the NRC inspection team reviewed three of the most recent design changes documented in General Cable's RPS Nuclear Impact Form to ensure they did not invalidate the qualified safety-related cable product type with respect to its original design including its qualification for aging, radiation, and electrical properties. In addition, the NRC inspection team interviewed General Cable engineering staff to verify that their review of design changes considered the original design and qualification of the safety-related cables and that before issuance of the change it had gone through an independent review.

The NRC inspection team also reviewed a sample of General Cable test procedures, test reports, test plans, cable product specification drawings, technical bulletins, manufacturing process sheets, purchase orders, procurement and component design specification documents and equipment qualification reports.

The NRC inspection team evaluated the adequacy of equipment qualification procedures for the environmental qualification. The NRC inspection team evaluated the autoclave LOCA chamber, technical procedures and instrumentation. The NRC inspection team reviewed a sample of equipment qualification packages related to different cable design and configurations and verified that testing was done to the correct technical requirements and specifications. The NRC inspection team also evaluated that qualification reports were consistent with the guidance established in the Institute of Electrical and Electronics Engineers (IEEE)-323-1974 Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations as contractually required by purchase orders.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

The NRC inspection team reviewed qualification reports F-C5120-1 and F-C5120-3 which qualified cable to meet IEEE 323-1974 and IEEE 383-1974. The NRC inspection team identified that certificates of conformance to Duke purchase order (PO) 00108282 and 00181215, stated in part that, "By virtue of testing performed on the core conductors, cable supplies under PO 00108282 and 00181215 qualifies per IEEE 383-1974 as Class 1E material. It is also certified that the material supplied meets the requirements of IEEE 323-1974 as tested on the qualification reports F-C5120-1 and F-C5120-3. When used as Class 1E material inside containment, it is recommended that the PVC jacket be removed." However, the NRC inspection team identified that Duke required the cable jacket to be PVC which was not evaluated or qualified to IEEE 323 or IEEE 383 by General Cable. The certificate of conformance (COC) statement did not adequately state the cable's qualified conditions for use which would require the removal of the PVC jacket inside containment (inside containment is an unanalyzed condition). Additionally, there is no statement in the certificate of conformance concerning harsh environments outside of containment which the PVC jacket is also not qualified to be in. General Cable's failure to adequately identify in the COC the conditions for safety-related cable use is identified as Nonconformance 99900227/2015-201-02.

The NRC inspection team reviewed qualification report F-C5120-1, "Qualification tests of electrical cables in a simulated steam line break (SLB) and LOCA environment," for Class 1E cable qualified cables to IEEE 323-1974 and IEEE 383. General Cable had contracted out testing to Franklin Research Center, which compiled test data and the final results to support the qualification report. The report states that all qualification testing was performed August through December of 1979. However, the Hipotronics AC dielectric test set, which is the sole test equipment used for dielectric testing, was calibrated January 21, 1980. There was no additional documented evidence that the AC dielectric test set was calibrated before the five minute AC high potential withstand test to ensure that the insulation met the requirements post steam line break and LOCA environment. General Cable's failure to adequately evaluate whether qualification testing performed by Franklin Research Center met all testing requirements is identified as Nonconformance 99900227/2015-201-03.

c. Conclusions

The NRC inspection team identified two instances of inadequate implementation of the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team issued Nonconformance 99900227/2015-201-02 for General Cable's failure to ensure that assumptions from design qualification reports were correctly translated into certificates of conformance sent to their customers and Nonconformance 99900227/2015-201-03 for General Cable failed to take measures to

review for suitability that ensures that original type testing performed for safety-related cables envelop customer qualification requirements.

4. **Commercial Grade Dedication**

a. Inspection Scope

The NRC inspectors reviewed General Cable's policies and implementing procedures governing the implementation of its CGD program, including manufacture and testing, to verify compliance with Criterion III, "Design Control," Criterion X, "Inspection," Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. The NRC inspection team reviewed DC-100, "Receiving Raw Material," QCF-841B "Commercial Grade dedication of Low Voltage and Medium Voltage Primary Conductors," QCF-841A "Low Voltage 60 years Insulating Compound" and QC-500A Receiving Inspection Procedure which provides the methodology for dedicating commercial-grade items for use as basic components, including the technical evaluation to determine safety function, identification of critical characteristics, and the acceptance criteria.

The NRC inspection team observed the direct current resistance testing for low voltage cables and specifically verified that the requirements listed in the purchase order were adequately translated to the test plan. In addition, the inspectors observed General Cable's receipt inspection process for raw materials (i.e. copper and tin copper). These activities included visual, labeling, and physical characteristics of the item. Additionally, the inspectors reviewed General Cable's audits and procedures performed to their supplier.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined that the implementation of General Cable's CGD program for the assembly, inspection, and testing of safety-related cables were consistent with the regulatory requirements of " Criterion X, "Inspection," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

5. **Control of Purchased, Material, Equipment, and Services**

a. Inspection Scope

The NRC inspection team reviewed General Cable's policies and implementing procedures that govern the implementation of General Cable oversight of contracted activities to verify compliance with Criterion IV, "Procurement Document Control," and Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team verified that applicable quality requirements, including technical, regulatory, and reporting requirements, were specified in the procurement documents reviewed and extended to lower-tier suppliers when necessary. Additionally, the NRC inspection team reviewed the procedures and implementation to select and qualify vendors supplying basic components and services, through a sample of certificates of calibrations, audits, surveys, and receiving inspections.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspectors determined that General Cable established a program that adequately controls procurement of equipment and services in accordance with the regulatory requirements of Criterion IV, "Procurement Document Control," and VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. Based on the limited sample of procurement documents reviewed, the NRC inspection team also determined that General Cable is effectively implementing its procurement program in support of safety-related component manufacturing. No findings of significance were identified.

6. **Manufacturing – Inspection and Test Controls**

a. Inspection Scope

The NRC inspection team reviewed General Cable's policies and procedures governing the implementation of its manufacturing, test, and inspection programs to verify compliance with Criterion III, "Design Control," Criterion IV, "Procurement Document Control," Criterion VII, "Control of Purchased Material, Equipment, and Services," Criterion X, "Inspection," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50.

The NRC inspection team observed activities related to the manufacture of safety-related cables to ensure personnel were trained, that procedures were available, and that the proper in-process inspections took place. General Cable's specification and

process engineers were interviewed to verify that manufacturing instructions and procedures were in agreement with activities performed by the operators.

The NRC inspection team witnessed and reviewed a final inspection and electrical testing and verified that traveler documents, checklists, and testing procedures were implemented correctly. Specifically, for the electrical tests, the NRC inspection team witnessed conductor resistance, voltage, and insulation resistance tests. The NRC inspection team also verified that persons performing the final inspection and electrical testing were qualified and the inspection results, including deviations, were properly documented. The NRC inspection team verified the instruments used in the electrical tests and final inspection were calibrated. In addition, the NRC inspection team discussed the processes with General Cable's management and technical staff.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspection team determined that General Cable established an adequate program for the manufacture, inspection, and test controls in accordance with the regulatory requirements of Criterion III, "Design Control," Criterion IV, "Procurement Document Control," Criterion VII, "Control of Purchased Material, Equipment, and Services," Criterion X, "Inspections," and Criterion XI, Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

7. Measuring and Test Equipment Controls

a. Inspection Scope

The NRC inspector reviewed the General Cable's M&TE control procedure and verified during General Cable inspections and tests that General Cable inspectors recorded required information and used calibrated M&TE equipment. The inspectors also assessed the General Cable M&TE calibration lab control of M&TE and the disposition of out of calibration equipment.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspection team determined that General Cable established a program that adequately controls M&TE activities in accordance with the regulatory requirements of Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also concluded that General Cable is effectively implementing its M&TE program. No findings of significance were identified.

8. **Nonconformances**

a. Inspection Scope

The NRC inspection team reviewed policies, implementing procedures, and records that governed the control of nonconforming materials, parts, and components to verify compliance with Criterion XV, "Nonconforming Materials, Parts, or Components," of Appendix B to 10 CFR Part 50. The NRC inspection team reviewed the General Cable Quality Manual, which contain the overall quality policies, to ensure it addressed the regulatory requirements for nonconforming items. Additionally, the NRC inspection team reviewed a sample of nonconformances and General Cable's nonconforming items area to ensure adequate implementation.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspection team determined that the implementation of General Cable's program that documents and evaluates nonconformances was consistent with the regulatory requirements of Criterion XV, "Nonconforming Materials, Parts, of Components," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

9. **Corrective Action Program**

a. Inspection Scope

The NRC inspection team reviewed policies, implementing procedures, and records that govern corrective actions to verify compliance with Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. The NRC inspection team reviewed the General Cable

Quality Manual, which contain General Cable's overall quality policies, to ensure it addressed the regulatory requirements for corrective action. Additionally, the NRC inspection team reviewed a limited number of corrective action reports to assess General Cable's implementation.

The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspection team determined that the implementation of General Cable's program that documents and evaluates corrective actions was consistent with the regulatory requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

10. Entrance and Exit Meetings

On February 3, 2015, the NRC inspection team discussed the scope of the inspection during an entrance meeting with Mr. Rob Johnson, Quality Manager, and other members of General Cable's management and technical staff. On February 6, 2015, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. James Clark, Plant Manager, and other members of General Cable's management and technical staff. The attachment to this report lists the attendees at the entrance and exit meetings, as well as those individuals whom the NRC inspection team interviewed.

ATTACHMENT

1. ENTRANCE AND EXIT MEETING ATTENDEES

Name	Title	Affiliation	Entrance	Exit	Interviewed
Jose Jimenez	Inspection Team Leader	NRC	X	X	
Aaron Armstrong	Inspector	NRC	X	X	
Annie Ramirez	Inspector	NRC	X	X	
Guillermo Crespo	Inspector	NRC	X	X	
Eugene Huang	Inspector	NRC	X	X	
Richard Rasmussen	EVIB Branch Chief	NRC		X	
James Clark	Plant Manager	General Cable	X	X	
Rob Johnson	Quality Manager	General Cable	X	X	X
Steven Christensen	Quality Engineer	General Cable	X	X	X
Cristina Stevens	Quality Engineer	General Cable	X	X	X
Paul Tetreault	Manufacturing Manager	General Cable	X		X
Gerald Liskom	Sales Manager	General Cable	X		
Heidi Fiad	Inside Sales	General Cable	X		
Roy Haller	Engineer	General Cable	X	X	X
Chris Schneider	Material Manager	General Cable	X	X	
Karen Duff	Safety	General Cable	X		
Shannon Haddad	Human Resources	General Cable	X	X	
Koksai Tonyali	Director Technical Services	General Cable	X	X	
Larry Cunningham	Global Sales	General Cable	X	X	
Ed Aberbach	Product Engineer	General Cable	X		X
Jeff Schroeder	WTC Lab Manager	General Cable	X	X	X

Name	Title	Affiliation	Entrance	Exit	Interviewed
Walter Parsel	Facilities Manager	General Cable	X		X
Andy Mosher	DC Manager-Interim	General Cable	X		X
Mike Pascino	Engineering Manager	General Cable	X		X
Matt Vahlsing	Process Engineer	General Cable	X		X
Abbas Zaidi	Team Lead-Nuclear Products	General Cable	X		X
Roy Haller	Lead Engineer-Nuclear Products	General Cable	X		X
Gerry Liskom	Regional Sales manager	General Cable	X	X	X
Juana Hernandez	Extrusion Operator	General Cable			X
Joseph Halberdier	Irradiation Operator	General Cable			X
Arthur Barch	Jacket Extrusion Operator	General Cable			X
Mark Ouellete	Operator	General Cable			X
Dough Carignan	Receipt Inspector	General Cable			X
Clifton Waiste	Tank Test operator	General Cable			X
Lennart Walqui	Production Coordinator	General Cable			X

2. INSPECTION PROCEDURES USED

IP 43002, "Routine Inspections of Nuclear Vendors"

IP 43004, "Inspection of Commercial-Grade Dedication Programs"

IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance"

3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

<u>Item Number</u>	<u>Status</u>	<u>Type</u>	<u>ITAAC</u>	<u>Description</u>
99900227/2015-201-01	Opened	NOV	N/A	10 CFR 50 Part 21
99900227/2015-201-02	Opened	NON	N/A	App. B, Criterion III
99900227/2015-201-03	Opened	NON	N/A	App. B, Criterion III

4. Inspections, Tests, Analyses, and Acceptance Criteria

The NRC inspectors identified the following inspections, tests, analyses, and acceptance criteria (ITAAC) related to components being manufactured, designed, and tested) by General Cable. At the time of the inspection, General Cable was involved in manufacturing, designing, and testing of safety-related cables for the AP1000 reactor design. For the ITAAC listed below, the NRC inspection team reviewed General Cable's quality assurance controls in the areas of design control, procurement, training, inspection, testing, and measuring and test equipment. The ITAAC's design commitment referenced below are for future use by the NRC staff during the ITAAC closure process; the listing of these ITAAC design commitments does not constitute that they have been met and closed. The NRC inspection team did not identify any findings associated with the ITAAC identified below.

<p>Containment System - The Class 1E equipment identified in Table 2.2.1-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.</p>	<p>102</p>	<p>2.2.01.06a.ii</p>
<p>Passive Core Cooling System - The Class 1E equipment identified in Table 2.2.3-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.</p>	<p>171</p>	<p>2.2.3.7a.ii</p>
<p>The Class 1E equipment identified in Table 2.2.1-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.</p>	<p>25</p>	<p>2.1.02.07a.ii</p>
<p>The Class 1E equipment identified in Table 2.1.3-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.</p>	<p>82</p>	<p>2.1.03.09a.ii</p>

5. LIST OF ACRONYMS USED

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
ADAMS	Agencywide Documents Access and Management System
CB&I	Chicago Bridge and Iron
CGD	Commercial grade dedication
COC	Certificate of Conformance
EQ	Equipment Qualification
ICEA	Insulated Cable Engineer Association
IEEE	Institute of Electrical and Electronics Engineers
IP	Inspection Procedure
LOCA	Loss of Coolant Accident
M&TE	Measuring and test equipment
NRC	Nuclear Regulatory Commission
PO	Purchase order
QA	Quality Assurance
TGA	Thermogravimetric Analysis

6. DOCUMENTS REVIEWED

10 CFR Part 21 Documents

10CFR21 evaluation form for QA-222, dated February 7, 2012
10CFR21 evaluation form for irradiation reported by Steris, dated June 18, 2014
10CFR21 evaluation form for CCP 670759, dated March 6, 2012
10CFR21 evaluation form for CCP 680418, dated May 11, 2012
10CFR21 evaluation form for CCP 690501, dated June 21, 2012
10CFR21 evaluation form for CCP 700565, dated June 21, 2012
10CFR21 evaluation form for CCP 680107, dated May 21, 2012
10CFR21 evaluation form for CCP 702527A, dated June 3, 2013

Corrective Action (CAR)/Non-Conformance Reports

CAR 670759, dated October 21, 2011
CAR 700558, dated December 3, 2012
CAR 700559, dated December 3, 2012
CAR 700560, dated December 3, 2012
CAR 700561, dated December 3, 2012
Nuclear Non-conforming material (NCM) 00366, dated July 30, 2014
NCM 00380, dated August 4, 2014
NCM 00395, dated August 12, 2014
NCM 00447, dated September 6, 2014
NCM 00650, dated December 24, 2014
NCM 00555, dated November 21, 2014
NCM 00136, dated September 30, 2013
NCM 00077, dated October 9, 2013

Qualification Records

Juana Hernandez – Extrusion Operator
Joseph Halberdier – Irradiation Operator
Arthur Barsch – Jacket extrusion operator
Joan Burnore – Quality Laboratory Technician
Clifton Waite – Operator
Kathleen Jones – Operator
Lennart Walqui – Process Engineer

External Audit and Survey Documents

Audit of Indianapolis Technology Center – ISO 9001:2008 and Nuclear Internal Audit of ITC Quality System, dated July 10-11, 2012
Audit of DuQuoin - ISO 9001 and 10 CFR Part 50 App B Audit Final Report, dated March 13-14, 2014
Audit of TISI – RS-12-D, dated April 20, 2012
Survey of AVOX Technologies – dated May 24, 2012
Source verification of TA Instruments – dated February 13, 2013

Measuring and Test Equipment

QCF-841A2 “GCC Calibration Source Verification Plan TMI Willimantic” dated February 6, 2013
Certificate of Calibration for:

- Sintrax Instruments – 1502A Tweener and Digital Manometer
- Industrial Systech, Ltd. – Stop Watch and

Miscellaneous Documents

Certified test data, “When used as Class 1E material inside containment, it is recommended that the PVC jacket be removed.” Cable letter, dated March 8, 1993

F-C5120-1, “Qualification tests of electrical cables in a simulated SLB and LOCA environment,” dated August 19, 1980

K-W2014-2, “LOCA/MSLB Environmental Qualification Report for 60 years service Life 1 Class 1E ULTROL ® 60+ Low voltage Insulated Single conductor Cables and Low Voltage Jacketed Cable,” Rev 2, dated October 02, 2014

K-W2014-3, “HELB environmental qualification report for 60 year service life class 1E Ultrol 60+ low voltage insulated single conductor cables and low voltage jacketed cables,” Revision 1, dated October 2, 2014

K-115111-RP-0001, “Test report for class 1E qualification testing of general cable products: insulated single conductor low voltage cables, jacketed low voltage cables and medium voltage cables located outside containment,” revision 7

K-115111-RP-0002, "Test report for 60 year service life class 1E qualification testing of general cable products for AP1000 reactors zones 5 and 10 high energy line break 9HELB) test conditions: low voltage insulated single conductor cables, low voltage jacketed and medium voltage cables," revision 2

ICEA T-27-581/NEMA WC 53-2008, 2008

ICEA T-28-562, "Test Method for Measurement of Hot Creep of Polymeric Insulations," dated January 1983

EP-XII-5, "Low Voltage Nuclear Ultrol Class 1E and non-Class 1E Cables," Revision 7, dated January 3, 2014

ULTROL 60+ 1000V Class 1 E Rated 3/C 750 MCM XLPE 1000V Safety
Revision 6, dated June 11, 2014.

ULTROL 60+ 1000V Class 1E Rated 1/C 750MCM XLPE 1000V Safety
Revision 6, dated June 6, 2014.

ULTROL 600 V Class 1 E Rated 2/C 2AWG w/6G 600V XLPE/XLPO
Rev. 4, dated June 6, 2014.

Work Order (WO) 661353.00 – Turbo Type: Ultrol60-S600TC-14 2 SHLD E 2SWI, dated December 03, 2014

WO 467006.00 - Turbo type N-ULTL60-S600TC 1/0 2+G MA SWI, dated December 03, 2014

Procedures and QA Implementing Records

OI-75, "Operating Instruction: Quality Checks - Irradiation," Revision 5, dated December 2002

DC-100 Receiving Raw Material Rev. 0, 3/6/2013.

DC-101 Withdrawing Raw Material from Stores Rev 0, 3/6/2013.

DC-105 Stock Material Traceability Rev 0, 3/6/2013

QC-500A Receiving Inspection Procedure Rev 2, 9/28/2012

EP-XII-5-1 Low Voltage Nuclear ULTROL 60+ Class 1E and non- Class 1 E Cables Rev 6,
dated 1/19/2015.

EP-XII-7 Medium Voltage Nuclear ULTROL 60+ Class 1E and Non-Class 1 E Cables.

EP-XII-0-1 Engineering Change notices (ECN) Rev 9, 1/21/2015

EP-XII-3-1 Writing Manufacturing Specifications Rev 8, 1/21/2015

EP-XII-9 Nuclear Design Control Rev1, 1/21/2015.

EP-XII-8-0 Physical Properties of Irradiated Compounds Rev 3, 1/26/15

PE-102 Irradiation Requirements for Vault 2 Rev 0, 2/15/13

PE-111 Extruder Start Up Guidelines Rev 0, 3/11/13

PE-128 Jacketing Set Up Instructions Rev 0, 3/11/13

OI-017 Tensile Strength- Insulation Rev 2, 8/2000

OI-075 Quality Checks- Irradiation Rev 3, 8/2000

OI-012 Solder Pot Test Rev 4, 12/1990

Standard Operating Procedure (SOP) – 35.1 Weld/Braze/Solder Performance Qualification Rev. K dated 1/2014
Willimantic Facility Quality Assurance Manual Rev. S dated 9/19/2014
HH-POP-501 “Sourcing Operating Procedure for Supplier Selection and Qualification” dated March 5, 2009
QA-300 “Test Control” Rev. 15 dated 10/21/2014
QA-539 “Nuclear Purchase Order Review” Rev. 2 dated 08/07/2014
QC-536 “Nuclear Work Order Review Process” Rev. 1 dated 03/11/2013
OI-030 “Continuity Testing-General” Rev. 6 dated 02/22/2013
OI-032 “IR/DCR Test” Rev. 5 dated 7/24/2013
OI-038 “Insulation Resistance using a Manual Tester” Rev.8 dated 03/15/2013
OI-027 “Dry High Voltage Test – Conductor to Conductor” Rev. 6 dated 7/24/2013
OI-087 “Wet High Voltage Test” Rev. 8 dated 01/14/2015
OI-107 “Calibrated Equipment Verification” Rev. 3 dated 03/15/2013
QT-229 “Hot Iron Solder Test” Rev. 0 dated 07/10/2013
QT-252 “Environmental Stress Cracking Resistance (ESCR)” Rev. 0 dated 10/25/2013
QT-401 “Large Scale Tray Cable Flame Testing” Rev. 2 dated 10/31/2013
QT-402 “Limiting Oxygen Index (LOI) Testing” Rev.1 dated 11/06/2014
QT-510 “Weather (Sunlight) Resistance Testing Using the Atlas Ci3000+ and Ci5000 Weatherometers” Rev. 0 dated 08/27/2014
PE-101 “Irradiation Requirements for Vault 1” Rev. 0 dated 02/15/2013
PP-300 “Nuclear Grade Safety Related Materials/Services” Rev. 8 dated 01/28/2013

Procurement Documents

PO 33-424591, dated December 15, 2013
PO 762286, GC to Duke Energy, dated July 28, 2011
PO 915430, GC to Wolf Creek, dated January 25, 2012
PO 00115867, GC to Duke Energy, dated February 13, 2009
PO 131515, GC to STP, dated July 14, 2011
PO 00108282, GC to Duke Energy, dated July 28, 2011
PO 25494-708-FPA-EWJ4-00001, GC to Bechtel-point beach, dated October 19, 2009
PO 12094-016, GC to Nutherm, dated December 19, 2011
PO 624948, GC to Owl Wire and Cable Inc. (Tin wire, Bare wire), dated July 10, 2014
PO NU-932 (LW-132EG), GC to GC-Indianapolis, IN (Compound), dated October 27, 2014
PO SNA 10080048 – Alabama Power
PO SNA 10080048 – Alabama Power Revision 2 (another product addition)
PO SNG 10082996 – Georgia Power
PO SNG 10082996 – Georgia Power Revision 2 (another product addition)
PO 00181215 – Duke Energy

Commercial Grade Dedication Packages

Vendor – International Wire group IWG CGD of Low Voltage and Medium Voltage Primary conductors, Part # 21.0065 30601 GCC PO 583041 dated January 22, 2014

Vendor IWG – Outside CGD of Low Voltage and Medium Primary Conductors GCC PO 585724 Part Number 21.0041.30601 Lot # 8198490 dated April 25, 2014

Vendor Christy Metals - CGD of Medium Voltage Metallic Shield GCC PO 595245 Part Number Nu290217JKT Heat # F114692212 dated March 26, 2014

Vendor: OWL P/N 11-6410 Description: Primary Conductor Application: Ultrol 60+ for Class 1 E Low Voltage Cables P/N 23-0907