TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

6N11 B Missionary Ridge Place

September 27, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

In the Matter of the	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

Our present environmental program and cable test schedule for Sequoyah should establish cable qualification near the end of November. However, even a moderate slippage in the schedule or an anomaly found in our on-going field verification of equipment in the environmental qualification program could impact our ability to establish cable qualification by November 30, 1985. Therefore, in accordance with the requirements of 10 CFR 50.49 and the August 6, 1985 letter to ALL LICENSEES OF OPERATING REACTORS which transmitted Generic Letter 85-15, "Information Relating to the Deadlines for Compliance with 10 CFR 50.49," we are requesting an extension to the schedule for final environmental qualification of electrical cables for units 1 and 2 of our Sequoyah Nuclear Plant. This extension request applies to two periods of operation. The first period is from restart of each unit until November 30, 1985 and the second period is for operation beyond November 30, 1985.

This extension request is needed for only one category of components, i.e., electrical cables. Previously, we had requested an extension for terminal blocks. Based on the preliminary test program results at Wyle Laboratories, terminal blocks, both coated and uncoated, performed satisfactorily during testing. Full qualification of the terminal blocks will be established prior to restart of a Sequoyah unit. Enclosure 1 provides a justification for continued operation (JCO) for both periods of time, up to and beyond November 30, 1985 for the electrical cables. We are presently reverifying that we have properly identified all of the electrical cables. The JCO provided in the enclosure is for those cables identified to date. Following complete cable identification we will amend the enclosed JCO if any additional cable-related issues are identified.

By our March 27, 1985 letter to NRC we indicated that unit 1 at Sequoyah lacked environmental qualification on approximately 166 components because of procurement, delivery, and installation-related problems. TVA has put forth a major effort and has completed replacement of all components identified in the March 27 letter.

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Requesting our extension now avoids the possibility of the need to submit an untimely request after September 30, 1985. We believe that our substantial progress toward replacement of all unqualified equipment at Sequoyah and our determination to ensure proper documentation of the qualification of electrical equipment, as well as the fact that the cables are in a test program to establish qualification prior to November 30, 1985, supports our request for an extension.

In accordance with 10 CFR 170.21 enclosed is an application fee of $150 for the review of this request. The fee is being wired to the Nuclear Regulatory Commission, Attention: Licensing Fee Management Branch.

If you have any questions or need any additional information in your evaluation of this extension request, please get in touch with R. E. Alsup at FTS 858-2725.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

H G Parris

H. G. Parris, Manager
Power and Engineering (Nuclear)

Sworn to and subscribed before me
this 27th day of Sept. 1985

Paulette A. White

Notary Public
My Commission Expires 8-24-88

Enclosure
cc (Enclosure):
U.S. Nuclear Regulatory Commission
Region II
Attn: Dr. J. Nelson Grace, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Mr. Carl Stahle
Sequoyah Project Manager
U.S.Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20814

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

TVA PN, PJ, PNJ, and PJJ Cable Types

These cables have polyethylene insulation. The cables are rated for 600V; however, the TVA system voltages are 120V ac, 250V dc, and 480V ac. All cables of this type were constructed, tested, and accepted for use in accordance with TVA Standard Specification 25.013 - Standard Specification for Polyethylene - Insulated Wire and Cable. TVA Standard Specification 25.013 invokes the applicable portions of IPCEA Standards (such as physical properties and methods of testing for tensile strength and elongation of the insulation and jacket materials). The TVA Specification included provisions for source inspection of factory testing and required submittal of certified test reports to assure compliance with the specification.

These cables are used outside containment only.

The following qualification tests are representative of the polyethylene cables which are presently installed:

Wyle Laboratory Test Report 17503-1 dated January 6, 1984, "Nuclear Environmental Qualification Test Program on Sequoyah Nuclear Power Station Control Equipment and Cables." The test included cable manufactured by Plastic Wire and Cable Corporation. The test included the following:

Temperature	- 340°F
Pressure	- 72 psig
Radiation	- 1.1×10^8
Aging	- 40 years equivalent aging based on 75°C conductor temperature

Passed post-accident hipot in water of 480V ac, 960V ac, and 2500V ac. (Each voltage level was held for 5 minutes.)

Wyle Laboratory Test Report 17501-1 dated March 12, 1982, "Nuclear Environmental Qualification Test Program on Four Sets of Polyethylene/Polyvinyl-Chloride Insulated Control Cable." The test included cable manufactured by Plastic Wire and Cable Corporation. The test included the following:

Radiation	- 1×10^8
Aging	- 40 years equivalent aging based on 90°C conductor temperature

TVA PN, PJ, PNJ, and PJJ Cable Types

Passed post-accident hipot in water of 480V ac, 960V ac, and 2400V ac. (Each voltage level was held for 5 minutes.)

TVA Central Laboratory Test Report 85-E03-4910. The test included the following cable:

1. The actual test specimen from Wyle Test Report 17501-1 dated March 12, 1982, as referenced above.

2. Polyethylene insulated cable manufactured by Triangle PWC and Okonite taken from Browns Ferry Nuclear Plant Unit 2 containment. These cables, which were deenergized, have been in containment for 6.75 years as part of an ongoing qualification test. The design service ambient temperature for in containment is 147 ^{o}F and the calculated total accumulated radiation dose was approximately 1×10^{7} rads. Both of these parameters exceed the outside containment parameters in which the actual 1E polyethylene cables are installed.

Test specimens from 1 and 2 above were placed in an oven which was preheated to 360 ^{o}F and mantained at this temperature for 30 minutes. The oven temperature was reduced to 300 ^{o}F and maintained at this temperature for 30 minutes.

The test specimens were then placed in water and passed a hipot test at the following voltage levels:

487V for 1 minute
965V for 1 minute
2200V for 5 minutes

Test specimens from 2 above were also subjected to elongation tests with the following results:

Sample	ICEA Requirements For New Cables	Test Results
Triangle PWC	350%	520%
Okonite	350%	379%

The elongation test results show that after exposure to a much harsher environment than the environment in which the cables are actually installed, the cables still have more elongation than ICEA minimum requirements for new cable. In addition, one of the recognized industry standards for end of life for cable is 40 to 60 percent elongation. The elongation test results indicate a considerable margin of safety for the elongation parameter.

Wyle Laboratory Test Report 17513-1 dated January 8, 1984, "Containment Accident Test Program on Electrical Cabling and Splices for Use in Browns Ferry Nuclear Power Generating Station." The test included polyethylene insulated cables manufactured by Rockbestos. The test included the following:

TVA PN, PJ, PNJ, and PJJ Cable Types

Temperature	- 330°F
Pressure	- 108 psig
Radiation	- 1.63×10^8 rads
Aging	- 40 years equivalent aging based on 90°C conductor temperature

Since the polyethylene cables successfully passed the above tests, it is reasonable to predict that the same types of insulation furnished by other manufacturers will perform similarly and without failure.

Futhermore, though these cables have been designed and tested for a 40 year service life temperature of 75°C, studies have shown that none of the subject cables experiences a service temperature in excess of 60°C. This reduced service temperature results in a significantly lowered rate of thermal degradation as compared to the successfully tested varieties.

In view of the above, we conclude that the results show that the polyethylene cables will perform their safety functions satisfactorily.

The cables are undergoing testing at Wyle Labs. Upon completion of those tests, the cable will either be deemed fully qualified or replaced with fully qualified cables.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

CP Family (CPJ, CPJJ, and CPSJ)

The CP family of cables consist of cross-linked polyethylene insulation and polyvinyl-chloride jacketing. All cable of this type was constructed, tested, and accepted for use in accordance with TVA Standard Specification 25.016 - Standard Specification for Cross-linked Polyethylene Insulated Wire and Cable. TVA Standard 25.016 invokes the applicable portions of IPCEA Standards (such as physical properties, and methods of testing for tensile strength and elongation of the insulation and jacket materials). The TVA Specification included provisions for source inspection of factory testing and required submittal of certified test reports to assure compliance with the specification. Cable manufactured since 1971 was controlled by a TVA approved QA program.

The following LOCA/SLB tests are representative for the CP family of cables which are presently installed.

> Wyle Laboratory Test Report 43854-3 dated April 26, 1978, Qualification Test on Eight Cable Splice Assemblies (cable assemblies comprised of CPJ cable).
>
> Wyle Laboratory Test Report 17513-1 dated January 24, 1984, Containment Accident Test Program on Electrical Cabling and Splices.

The test reports show a baseline functional test was first performed and passed. Then functional tests were performed and passed after the radiation test, after the temperature aging test, and after the LOCA/SLB test.

The tests included radiation at 1.13×10^8 rads.

The tests included temperature aging at 130°C for 2576 hours.

The tests included a LOCA/SLB at 325°F, 55 psig, 100 percent humidity.

NOTE: One sample of CPJJ (Plastic Wire and Cable) received 1.68×10^8 rads and temperature aging at 130°C for 5152 hours.

The tests included cable samples from General Electric, Okonite Company, and Plastic Wire and Cable. This cross section of cable manufacturers represented in the tests adequately demonstrated that the CP family of cables will perform similarly in the given DBE. The variety of vendors used also proved that successful completion of the test is a function of the chemical properties of the insulation and jacketing compound and is not dependent on the manufacturer. Consistency in the chemical properties

CP Family (CPJ, CPJJ, and CPSJ)

has been demonstrated by successfully completing the requirements of TVA Standard Specification 25.016. This approach to generic cable qualification follows the general guidelines for type testing as outlined by IEEE 383-1974.

All cables of the CP family met or exceeded the construction, testing, and acceptance requirements of TVA Standard specification 25.016. In addition representative samples of the CP family of cables supplied to TVA by different manufacturers successfully passed LOCA/SLB testing. Futhermore, the cables are exclusively used outside of containment. Whereas cables of this family are designed and tested for a 40 year service life temperature of 90 ^{o}C, design studies have shown that none of the cables from these contracts experiences a service temperature in excess of 60 ^{o}C. This reduced service temperature results in a significantly lowered rate of thermal degradation as compared to the successfully tested varieties. In view of the above, we conclude that the results show that the CP family of cables will perform their safety functions satisfactorily. The cables are undergoing testing at Wyle Labs. Upon completion of those tests, the cable will either be deemed fully qualified or replaced with fully qualified cables.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

PX Family (PXJ and PXMJ) - American Insulated Wire (AIW)

The PX cables covered by this JCO were manufactured by AIW and consist of cross-linked polyethylene with a chlorosulfonated-polyethlene jacket. All cable of this type was constructed, tested, and accepted for use in accordance with TVA Standard Specification 25.016 - Standard Specification for Low-Voltage Wire and Cable with Flame-Retardant, Cross-Linked Polyethylene or Ethylene-Propylene Rubber insulation. TVA Standard Specification 25.016 invokes the applicable portions of IPCEA Standards, such as, physical properties, and methods of testing for tensile strength and elongation of the insulation and jacketing materials. The TVA Specification included provisions for source inspection of factory testing and required submittal of certified test reports to assure compliance with the specification. Manufacture of all installed cable was controlled by a TVA approved QA program.

The following LOCA/SLB tests are representative of the PX family of cables which are presently installed.

Franklin Institute Test Report F-C4113 dated May 1975. (Brand-Rex Company)

Rockbestos Company Test Report dated July 1977 and revised November 26, 1977, "Qualification of Firewall III Class 1E Electric Cables (Chemically Cross-linked Insulation)"

Franklin Institute Test Report No. F-C5120-1 dated August 19, 1980, (Brand Rex Company) "Qualification Tests of Electrical Cables in a Simulated Steam Line Break (SLB) and Loss-of-Coolant Accident (LOCA) Environment"

Essex Project Report Number PE-53 dated May 7, 1980 "Main Steam Line Break (MLSB) Test on Aged and Irradiated Cable Specimens"

The Okonite Company Engineering Report No. 355 dated September 17, 1981, "Main Steam Line Break Qualification Test on Okonite, Okonite-FMR, X-Olene-FMR and Okoguard Insulations"

The test reports demonstrate the PXJ and PXMJ cables manufactured to meet the requirements of TVA Standard Specification 25.016 are suitable for Class 1E service in accordance with appropriate guidelines presented in IEEE Standards 323-1974 and 383-1974.

PX Family (PXJ and PXMJ)

The tests included radiation of 2×10^8 rads.

The tests also included a LOCA/SLB at 346°F, 113°psig 100 percent humidity and MSLB's at 455°F, 32 psig (Okonite) and at 440°F (Essex).

These tests included cable samples from Brand-Rex Company, Rockbestos Company, Essex International, Inc., and The Okonite Company. This cross section of cable manufacturers represented in the tests adequately demonstrated that the PX family of cables will perform similarly in the given DBE. The variety of vendors used also proved that successful completion of the tests is a function of the chemical properties of the insulation and jacketing compound and is not dependent on the manufacturer. Consistency in the chemical properties has been demonstrated by successfully completing the requirements of TVA Standard Specification 25.016. This approach to generic cable qualification follows the general guidelines for type testing as outlined by IEEE 383-1974.

All cables of the PX family met or exceeded the construction, testing, and acceptance requirements of TVA Standard Specification 25.016. Representative samples of the PX family of cables supplied to TVA by different manufacturers successfully passed LOCA/SLB testing. The AIW cables are exclusively used outside of containment. In addition, whereas cables of this family are designed and tested for a 40-year service life temperature of 90°C, design studies have shown that none of the cables from these contracts experiences a service temperature in excess of 60°C. This reduced service temperature results in a significantly lower rate of thermal degradation as compared to the successfully tested varieties. In view of the above, we conclude that the results show that the PX family of cables will perform their safety functions satisfactorily. The subject AIW PX cables are undergoing testing at Wyle Labs. Upon completion of those tests, the cable will either be deemed fully qualified or replaced with fully qualified cables.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

Rockbestos Firewall Silicone Rubber (TVA Type SR)

The silicone rubber cables are made of methyl phenyl vinyl silicone rubber. The cables are used exclusively inside containment in 480V or less power and control circuits. The actual conductor operating temperature is equal to or less than 50°C.

The cables are required to be qualifed to the following parameters:

	Normal	Abnormal	Accident
Temperature:	120°F	130°F	327°F for 33 minutes
Relative Humidity:	80%	100%	100%
Pressure:	14.7A	14.7A	26.4
Radiation:	2.5×10^7	NA	1×10^8
Chemical Spray:	NA	NA	*

The following qualification tests are representative of Rockbestos Firewall SR cables which are presently installed.

1. Franklin Institute Research Laboratories, Final Report F-C2857, Test of Electrical Cables Under Simulated Post-Accident Reactor Containment Service, September 1970. The test included the following:

   Temperature/Time: 276°F from t=15 seconds to t = 12 hours

   Relative Humidity: 100%

   Pressure: 50 psig

   Radiation: 2.34×10^8 rads

   Chemical Spray: 1720 ppm borated water

   Aging: Minimum of 10 years at 50°C (equivalent)

*2000ppm boron, 8.35 ph, 0.1847 molar H_2BO_3, 0.033 molar NaOH

Rockbestos Firewall Silicone Rubber (TVA Type SR)

A summary of F-C2857 to show applicability, to the actual plant conditions is as follows:

The actual accident profile is a 327°F peak for 33 minutes. The test profile maintained 276°F for approximately 12 hours which provides a much greater thermal saturation of the insulation material than the 327°F for 33 minutes; therefore, the test time temperature profile is more severe than the actual conditions. The relative humidity, pressure, and radiation parameters all exceeded the actual plant parameters. All cables inside containment are completely enclosed in conduits, junction boxes, or lead shields which protects the cable from chemical spray; therefore, the use of chemical sprays during the test provides additional conservatism. The tested specimens were not thermally aged prior to testing; however, REIC report No. 21 dated September 1, 1961, ("The Effects of Nuclear Radiation on Elastomeric and Plastic Materials," R. W. King, ET AL., Battelle Radiation Effects Center) states that the material is not susceptable to degradation at the temperatures which the cable actually operates. Consequently, the unaged tested sample is representative of a minimum 10-year sample for the plant specific application. The test specimens were energized with 480VAC, at 10 amps during the time temperature profile and passed a five minute 6000VAC post-accident hipot test.

2. Additionally, Rockbestos Firewall Silicone Rubber was again tested by Rockbestos as stated in their Qualification of Firewall SR Class 1E Electrical Cables dated March 2, 1978, and Addendum dated February 13, 1980. This report has been questioned because of QA concerns (reference 1E Bulletin 84-44); however, the cable was tested and proven to be acceptable. The test included the following:

Temperature/Time:	Same as IEEE 323-1974, Appendix A
Relative Humidity:	Same as IEEE 323-1974, Appendix A
Pressure:	Same as IEEE 323-1974, Appendix A
Chemical Spray:	Same as IEEE 323-1974, Appendix A
Radiation:	2×10^8 rads
Aging:	40 years at 125°C (equivalent)

Due to concerns noted by IE Bulletin 84-44, Rockbestos is currently planning to retest the Firewall SR cables in mid 1986.

Based on the above data, we conclude that the above cables are adequately qualified to the plant specific applications for a minimum of 10 years.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

MS CABLES

Belden Corporation (contract 85259)

This cable is XLPE insulated with a CPE jacket. The qualification report that applies is Isomedix (Component Test Division) test report dated February 1976, "Qualification Test of Electric Cables Under a Simulated LOCA/DBE by Sequential Exposure to Environments of Radiation, Steam, and Chemical-Spray." The test showed that the cable is qualified for the following conditions:

a. Temperature: 346°F

b. Pressure: 113 psig

c. Radiation: 2×10^8 rads gamma

d. Humidity: 100%

e. Chemical Spray: 3000 ppm boron, pH 9.0-11.0

Although no thermal aging was performed on the cable samples prior to the test, the XLPE was thermally aged during standard factory test as required by the TVA procurement specification. The standard factory testing on aged samples included tensile and elongation test. The aging performed during the standard factory testing equates to approximately 25 years of incontainment life. The results of the test indicate that the cable has a substantial amount of life left after the aging (greater than 75% of the original elongation). The accepted industry standard to predict the end of life is 40 to 60 percent of the original elongation. The above conditions envelope all areas of the plant in which the cables are located and perform safetyrelated functions.

In addition, the cables are undergoing a test program at Wyle Labs which includes thermal aging. It should be noted that the cables are used exclusively as signal cables both inside and outside containment. MS cables are designed and tested for a 40-year service life temperature of 90°C. Because of their service as signal cables ohmic heating is not a consideration and their 40-year service life is the 50°C plant containment ambient. This reduced service temperature results in a significantly lower rate of thermal degradation as compared to its rated conditions.

Based on the above we conclude that the test on an unaged sample is justified until testing currently in progress at Wyle Labs is completed. Upon completion of those tests, the cables will either be deemed fully qualified or replaced with fully qualified cables.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

MS CABLES

Okonite Company (contract 72C7-74910-2)

This cable is insulated with crosslinked polyethylene and jacketed with chlorosulfonated polyethylene. The following test report is representative of the insulation material of the cable: The Okonite Company Engineering Report No. 355 dated September 17, 1981, "Main Steam Line Break Qualification Test on Okonite, Okonite-FMR, X-Olene-FMR, and Okoguard Insulators." The test results showed that the cable is qualified for the following conditions:

a. Temperature: 470°F

b. Pressure: 75 psia

c. Humidity: 100%

d. Chemical Spray: IEEE 323-1974 Appendix A

e. Radiation: 5.5×10^7 rads gamma

f. Qualified Life: 40 years at 90°C conductor temperature

The MS cables are used exclusively outside of containment. Cables of this family are designed and tested for a 40-year service life temperature of 90°C. Since these cables are signal cables ohmic heating is not a consideration and their 40-year service life temperature is the 40°C plant ambient. This reduced service temperature results in a significantly lower rate of thermal degradation as compared to the successfully tested varieties.

Based on the above, we conclude that the above Belden and Okonite cables will perform their safety functions satisfactorily. Cables from this contract are undergoing testing at Wyle Labs. Upon completion of those tests, the cables will either be deemed fully qualified or replaced with fully qualified cables.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

MS CABLES

Rockbestos (contract 826961 and 823265)

Signal cables, type MS, are used both inside and outside of containment. The insulation is a chemically-crosslinked polyethylene with a hypalon jacket. The cables have been the subject of the following test programs:

1. Sandia Report - SAND81-2027/1 of 2, "Equipment Qualification Research Test of Electric Cable with Factory Splices and Insulation Rework Test No. 2, Report No. 1," September 1982.

2. Rockbestos Report No. QR 5804 "Report on Qualification Tests for Firewall III Chemically Crosslinked Polyethylene Constructions for Class IE Service in Nuclear Generating Stations."

The worst case accident condition parameters at SQN are as follows:

Temperature: 327°F

Pressure: 26.4 psia

Humidity: 100%

Radation: 1.2E8

Chemical Spray: (see below)

In test report number 1, samples were subjected to the following:

Aging: 40 years at 90°C

Temperature: 346°F

Pressure: 125 psig

Humidity: 100%

Radiation: 1.96E8

Chemical Spray: IEEE 323-1974

The following conditions were applied in test report 2.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

MS CABLES

Aging: 47 years at 90°C

Temperature: 342°F

Pressure: greater than IEEE 323-1974

Humidity: 100%

Radiation: 2.0E8

Chemical Spray: YES (as referenced in the test report)

As can be seen from the above, both of the referenced test reports envelope the service conditions of the subject cable. In addition, there are a number of other test reports conducted by Franklin Labs for Rockbestos. Though the validity of these reports has been brought into question by IE Notice 84-44 (because of Rockbestos' QA) it is significant to note that chemically crosslinked polyethylene manufactured by Rockbestos has been successfully tested a number of times.

TVA's specific application of these cables is far less severe than that demonstrated in the above tests. Whereas those cables were aged for 40 and 47 years respectively (at 90°C), because we utilize these cables exclusively in signal circuits with no ohmic heating our service conditions are 50°C for cables in containment and 40°C for those outside of containment.

This service temperature, well below the cables design rating, results in a significantly lowered rate of thermal degradation as compared to the successfully tested varieties.

In test number 2 there were a number of variances due to the conductor insulations sticking to the mandrel. The test specimens were individual conductors taken from a multiple conductor cable. As the individual conductors were removed from the mandrels for further testing portions of the insulation were torn away. Handling of the cables in this fashion is not indicative of their true service requirements. In addition, all of our cable constructions are multiconductor, shielded and jacketed varieties. As such, adhesion of the primary insulation to adjacent structures is not credible.

JUSTIFICATION FOR CONTINUED OPERATION (JCO)

MS CABLES

Finally, it should be noted that both of the subject test programs subjected the cables to direct impingement of a chemical spray solution. At SQN all cables inside of containment are in conduits so that no direct spray is credible. The presence of this spray in other successful programs gives a further measure of conservatism.

In light of the above, we conclude that the MS cables as supplied by Rockbestos will perform their safety functions satisfactorily. Upon full evaluation of Rockbestos report QR-5304 and discussion of its variances with Rockbestos the cable will either be deemed fully qualified, another test program will be initiated, or the cable will be replaced with fully qualified cable.