

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 241.3(B)

REPORT TYPE: SEQUOYAH ELEMENT

REVISION NUMBER: 1

TITLE: CABLE TERMINATION AND SPLICING

No Megger Test on Low Voltage Cables

PAGE 1 OF 7

REASON FOR REVISION:

1. Revised to incorporate SRP and TAS comments.

PREPARATION

PREPARED BY:

*M. J. Jakes*  
SIGNATURE

MD

WS

10/12/87  
DATE

REVIEWS

DEER: REVIEW COMMITTEE:

*AW Jordan Karl Siederer*  
SIGNATURE

10/15/87  
DATE

TAS:

*James E. Wortley* #4  
SIGNATURE

10/28/87  
DATE

CONCURRENCES

8711240213 871105  
PDR ADOCK 05000259  
P PDR

SIGNATURE

DATE

CEG-H: *Beng R. McHutt* 10-21-87

SRP: *Jimmie K. Jaffe* 10-28-87  
SIGNATURE DATE

APPROVED BY:

*W. R. Brown*  
ECSP MANAGER DATE 10/28/87

NA  
MANAGER OF NUCLEAR POWER DATE  
CONCURRENCE (FINAL REPORT ONLY)

\*SRP Secretary's signature denotes SRP concurrences are in files.

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1. CHARACTERIZATION OF ISSUES:

Concern:

Issue:

XX-85-094-006

"Electrical terminations do not have low voltage megger test."

- a. No megger tests are performed on low voltage cables.

2. HAVE ISSUES BEEN IDENTIFIED IN ANOTHER SYSTEMATIC ANALYSIS? YES NO X

Documentation Identifiers: None

3. DOCUMENT NOS., TAG NOS., LOCATIONS OR OTHER SPECIFIC DESCRIPTIVE IDENTIFICATIONS STATED IN ELEMENT:

No further information is available. The employee concern, although applicable to Bellefonte, is considered generic to all plants including Sequoyah.

4. INTERVIEW FILES REVIEWED:

File XX-85-094 was reviewed, and no additional unreviewed information for Sequoyah was identified for the concern in this report.

5. DOCUMENTS REVIEWED RELATED TO THE ELEMENT:

See Appendix A.

6. WHAT REGULATIONS, LICENSING COMMITMENTS, DESIGN REQUIREMENTS OR OTHER APPLY OR CONTROL IN THIS AREA?

See Appendix A.

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7. LIST REQUESTS FOR INFORMATION, MEETINGS, TELEPHONE CALLS, AND OTHER DISCUSSIONS RELATED TO ELEMENT.

See Appendix A.

8. EVALUATION PROCESS:

- a. Reviewed available transcripts of NRC investigative interviews for additional information on the concern.
- b. Reviewed Construction Specification G-38 and other TVA megger test requirements for SQN.
- c. Reviewed existing TVA Construction, QA/QC, Operations, and Material Control reports for the TVA Employee Concerns Special Program for applicability to the concerns discussed in this report; no relevant information was identified.
- d. Reviewed industry requirements for megger tests.
- e. Assessed validity of the concern and determined whether problems of megger testing on low voltage cable exist at SQN.

9. DISCUSSION, FINDINGS, AND CONCLUSIONS:

Chronology:

09/23/85: Concern acknowledged by TVA for BLN

Discussion:

The Employee Concern asserts that megger testing has not been performed on low voltage cables. This issue was raised at BLN and is considered generic to all plants including SQN since megger test requirements are similar for all plants.

Megger testing of cables is a good practice to verify that major cable insulation damage has not occurred during storage and installation. There are no industry requirements to perform such tests; however, IEEE Standards (App. A, 5.f and g) provide guidance for the testing of cable after installation but before connection to equipment. The IEEE Standards recommend that the insulation resistance of low voltage power, control, and instrumentation cables be tested with a minimum 500 Vdc test voltage; however, cable manufacturers' recommendations should always be considered. The minimum acceptable insulation resistance is determined by a

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formula as stated in the IEEE standards. IEEE Standard 422-1986 (App. A, 5.f) classifies low voltage power cables as designed to supply power to utilization devices of the plant auxiliary systems rated 600 V or less. This standard notes, however, "that these tests may not detect damage that may eventually lead to cable failure in service."

To provide guidelines during plant construction activities, TVA's Division of Construction issued the SQN Construction Test Instruction (CTI) No. 10 (App. A, 5.a; 08/08/73) which outlines the requirements, procedures, acceptance criteria, and documentation for megger testing the insulation of electrical cables. This procedure was in force until 1977, when it was revised, enhanced, and subsequently retitled SQN Inspection Instruction (II) No. 10 (App. A, 5.b; 05/26/77). The inspection instruction requires that cable insulation be tested with a 500 Vdc megger and the insulation resistance measured between:

- o Each conductor and ground
- o Each individual conductor and every other individual conductor in that cable assembly
- o Each (or all) conductors and shields when applicable

The acceptance criteria require megger readings of 1 megohm per 1,000 volts with a minimum of 1 megohm as acceptable for cables. The result of the insulation test is entered on a cable inspection data card, including the Megger I.D. No. and the calibration due date. Upon successful completion of the test, the data card is signed and dated by the inspector and processed in accordance with the requirements of SNP Construction Procedure No. P-8 (App. A, 5.i; 04/24/72 through 02/17/85). This procedure is applicable to the preparation of site-originated Quality Assurance (QA) records and describes the manner in which QA records are prepared, reviewed, handled, classified, stored, and transferred to the Division of Nuclear Power (NUC PR).

The cable testing requirements specified in TVA/SQN Modifications and Additions Instruction M&AI-12 (App. A, 5.d; 10/30/79) are identical to the requirements discussed above. The M&AI-12 was developed from the SQN Inspection Instruction No. 10 upon completion of construction in 1979, and outlines inspection and testing criteria for cables installed during modifications and additions to the facilities of the SQN plant. Similar megger test requirements to verify cable insulation integrity of new and repaired cables are also stated in Section 5.0 and 6.0 of M&AI-7 (App. A, 5.c; 11/08/79), with an option to perform functional testing of repaired cables.

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The evaluation team reviewed a number of representative samples of test records [samples included records from 1975 to 1986, (App. A, 7.b)]. This and the interviews conducted at the SQN site (App. A, 7.a) give a reasonable assurance that megger tests were performed at SQN in accordance with procedures. In addition, continuity checks and visual inspections after installation were also conducted. The records of these tests are on file at the SQN site. Although performance of these tests does not provide full assurance that damaged cables will be detected unless major damage has occurred, they are widely used to supplement good construction practices as they provide reasonable assurance that cables are functional.

In a related matter, corrective action plan (CAP) for Corrective Action Tracking Document (CATD) 238 01 SQN 03 for Sequoyah Element Report 238.1 addresses cable damage generally and cable tests specifically (including high-potential testing) to ensure the functional adequacy of cables in conduit. Completion of this CAP, and the resolution of the current problem identified regarding the silicone rubber cables, should satisfy the cable damage issues.

Findings:

Although there are no industry requirements for testing low voltage cables, IEEE Standards provide guidance for cable testing, and SQN Construction Test Instruction No. 10 and Inspection Instruction No. 10 established requirements for such testing procedures and documentation during construction. These test procedures and requirements were also incorporated in M&AI-12 and then M&AI-7 to verify insulation integrity of cables installed after completion of construction.

The evaluation team determined from existing records that a reasonable assurance exists that megger tests were performed on low voltage cables and that records of these tests are on file at SQN.

Conclusions:

Based on the evaluation conducted, the issue raised by the employee concern is not valid for SQN. The evaluation team concluded that TVA has adequate testing procedures and documentation requirements in place to verify cable insulation integrity. Megger tests of low voltage cables were performed and recorded in conformance with the established requirements and good industry practices.

10. CORRECTIVE ACTION

No corrective action is required.

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APPENDIX A

5. DOCUMENTS REVIEWED RELATED TO THE ELEMENT:

- a. SQN Construction Test Instruction No. 10, "Interconnecting Cable Termination and Insulation Checks," R0, (08/08/73) (SQN 840322010)
- b. SQN Inspection Instruction No. 10, Sections 7 and 8, "Interconnecting Cable Termination and Insulation Inspection," R7, (05/26/77), (SQN 840322018), R16, (03/30/83)
- c. SQN Modifications and Additions Instruction M&AI-7, "Inspection Criteria of Cables or Internal Panel Wiring," R0, Section 5.0, (11/08/79)
- d. SQN Modifications and Additions Instructions M&AI-12, "Interconnecting Cable Termination and Insulation Inspection," R0, Section 8.0 (10/30/79)
- e. Letter from B. J. Youngblood, NRC, to S. A. White, TVA, (06/23/86) with the attached transcript of the investigative interview conducted by the NRC on 02/21/86 at the First Tennessee Bank Building in Knoxville, TN (B46 860714 832)
- f. The Institute of Electrical and Electronics Engineers, Inc., Standard No. 422-1977 and 1986; IEEE Guide for the Design and Installation of Cable Systems in Power Generating Stations
- g. The Institute of Electrical and Electronics Engineers, Inc., Standard No. 690-1984; IEEE Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations
- h. General Construction Specifications G-38, "Installing Insulated Cables Rated Up to 15,000 Volts," R0 and R8, (07/25/73) (03/17/86)
- i. SNP Construction Procedure No. P-8, "Preparation, Review, Handling, and Temporary Storage of Quality Assurance Records," R0, (04/24/72), (SQN 831017037), R1, (01/25/74), (SQN 831017038), R16, (02/17/85), (SQN 831017063) retitled "Quality Assurance Records"

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6. WHAT REGULATIONS, LICENSING COMMITMENTS, DESIGN REQUIREMENTS OR OTHER APPLY OR CONTROL IN THIS AREA?

- a. SQN Inspection Instruction No. 10, Sections 7 and 8, "Interconnecting Cable Termination and Insulation Inspection," R7, (05/26/77), (SQN 840322018), R16, (03/30/83)
- b. SQN Modifications and Additions Instruction M&AI-7, "Inspection Criteria of Cables or Internal Panel Wiring," R0, Section 5.0, (11/08/79)
- c. SQN Modifications and Additions Instructions M&AI-12, "Interconnecting Cable Termination and Insulation Inspection," R0, Section 8.0, (10/30/79)
- d. SNP Construction Procedure No. P-8, "Preparation, Review, Handling, and Temporary Storage of Quality Assurance Records," R0, (04/24/72), (SQN 831017037), R1, (01/25/74), (SQN 831017038), R16, (02/17/83), (SQN 831017063), retitled "Quality Assurance Records"
- e. SQN Construction Test Instruction No. 10, "Interconnecting Cable Termination and Insulation Checks," R0, (08/08/73), (SQN 840322010)

7. LIST REQUESTS FOR INFORMATION, MEETINGS, TELEPHONE CALLS, AND OTHER DISCUSSIONS RELATED TO ELEMENT.

- a. Bechtel memo from D. Knudsen to I. Don-Doncow, "Summary of Interviews Conducted with Responsible Individuals Concerning Cable Pulling Practices Past and Present at the Sequoyah Nuclear Plant," IOM 521 (12/04/86)
- b. Bechtel memo from D. Knudsen to I. Don-Doncow, "Megger Test Records." Review of cable installation records and personnel interviews, IOM 522 (01/09/87)

**Enclosure 2**