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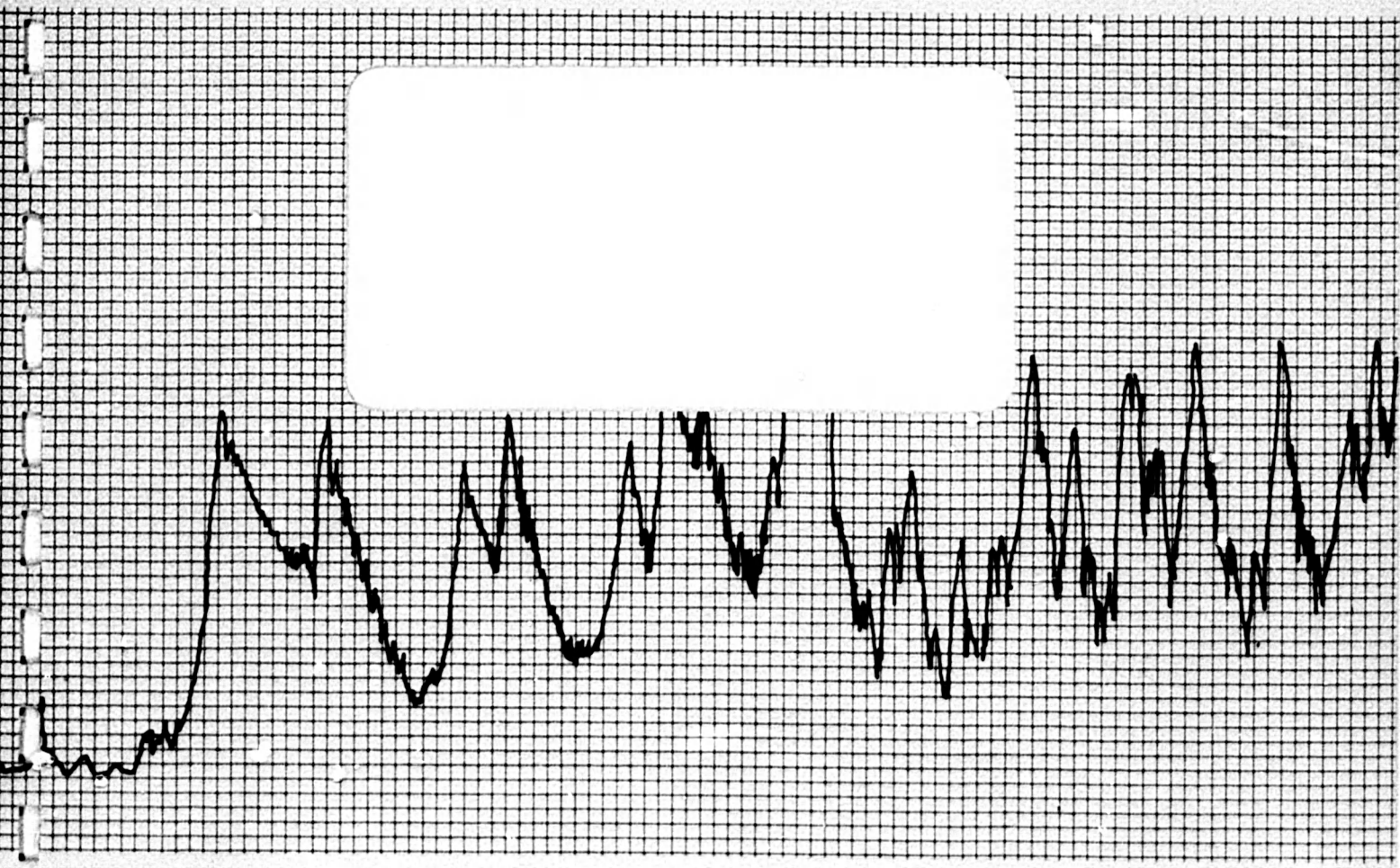
WYLE
LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP



NEQ
NUCLEAR ENVIRONMENTAL QUALIFICATION

test REPORT

QUALIFICATION TEST PROGRAM
FOR
SILICONE RUBBER INSULATED CABLES
FOR USE IN
TENNESSEE VALLEY AUTHORITY'S
SEQUOYAH AND WATTS BAR
NUCLEAR PLANTS

For

Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902

NEQ

Nuclear Environmental Qualification

Test Report

REPORT NO. 18056-1

WYLE JOB NO. 18056

CUSTOMER P. O. NO. TV-73743A

PAGE i OF 291 PAGE REPORT

DATE January 27, 1989

SPECIFICATION (S) See References in Paragraph 5.0 of this Summary Section

1.0 CUSTOMER Tennessee Valley Authority (TVA)

ADDRESS 400 West Summit Hill Drive, Knoxville, Tennessee 37902

2.0 TEST SPECIMEN Silicone Rubber Insulated Cables P/N KS-500 and P/N CC-2193 Nuclesil

3.0 MANUFACTURER Rockbestos and Anaconda-Continental, repsectively

4.0 SUMMARY

Silicone Rubber Insulated Cables, as described and noted in Paragraph 6.0, were subjected to a Qualification Program to verify their ability to maintain loads during an Accident Simulation as specified by TVA. The Qualification Program described herein represents installations at the Tennessee Valley Authority's Sequoyah and Watts Bar Nuclear Plants.

The Qualification Test Program was performed to satisfy the intent of IEEE Standards 323-1974, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," and 383-1974, "Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."

STATE OF ALABAMA
COUNTY OF MADISON } ss

Alabama Professional Engineer Reg. No. 7948

Frederick M. Sittason, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Frederick M. Sittason

SUBSCRIBED and sworn to before me this 10th day of February 19 89

Barbara Hill Cunningham

Notary Public in and for the State of Alabama at large.

My Commission expires June 4, 19 89

Wyle shall have no liability for damages of any kind to person or property, including special or consequential damages, resulting from Wyle's providing the services covered by this report.

PREPARED BY Robert T. Walter 02-10-89
R. T. Walter

APPROVED BY F. R. Johnson 2/10/89
F. R. Johnson

WYLE Q. A. G. W. Hight 2-13-89
G. W. Hight

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP
HUNTSVILLE, ALABAMA

4.0 SUMMARY (Continued)

The Qualification Program was performed on two independent manufacturer's types of silicone rubber insulated cables. A description of the test specimens is presented in Paragraph 6.0 of this Section. This report contains the following sections:

- Section I - Specimen Identification, Preparation, and Baseline Functional Test
- Section II - Normal Radiation Exposure and Post-Radiation Functional Test
- Section III - Thermal Aging and Post-Thermal Aging Functional Test
- Section IV - Accident Radiation Exposure and Post-Radiation Functional Test
- Section V - Accident Simulation and Post-Test Functional Test
- Section VI - Voltage Withstand Test and Post-Test Inspection
- Section VII - Wyle Laboratories' Qualification Plan No. 18057-00, Revision A

The test program was conducted in the sequence indicated by Section I through VI above and in accordance with Wyle Laboratories' Qualification Plan 18057-00, Revision A, which is contained in Section VII.

Four anomalies occurred during the test program. Details of the anomalies are included in the appropriate sections of this report and are briefly described below.

Notice of Anomaly No.	Date of Anomaly	Section	Description
1	11-03-88	III	Cable Trays A, C, and E were exposed to an over-temperature condition in the initial thermal aging period. During the thermal aging chamber temperature startup, the chamber temperature was inadvertently allowed to increase in excess of the temperature tolerance acceptance criteria. The out-of-specification temperature was determined to have been approximately 5.6 deg C above the required temperature of 112°C, for a period of less than 5 minutes. The short period of specimen exposure to the out-of-specification temperature was considered to have no effect upon the qualification program for the silicone rubber insulated cables.

4.0 SUMMARY (Continued)

Notice of Anomaly No.	Date of Anomaly	Section	Description
2	12-03-88	V	Low resistance values recorded for Cable Tray C were documented during the pre-test wet insulation resistance measurements. The test chamber was drained of water and insulation resistance measurements were repeated at certain intervals. At the Customer's request, Cable Tray C was removed from the Accident Chamber and discontinued from the test program. The pre-test wet insulation resistance measurements were repeated on the test specimens of Cable Trays A and E, and testing was continued.
3	12-28-88	V	Power supply line voltage fluctuations and power losses resulted in test specimen out-of-specification conditions. A conservative estimate of 5 hours 30 minutes was added to the test profile the post-DBE aging temperature of 150°F (+9, -0 deg F). The test specimens remained powered during the additional test period.
4	12-09-88	V	Out-of-specification PH levels existed for the chemical spray solution during the Accident Simulation. The high PH level (0.15 above tolerance) occurred for approximately the last 2 hours of the required chemical spray test. The short period of chemical spray at the high PH level was considered not to have a detrimental effect upon the test specimens' performance.

The test specimens were subjected to normal radiation exposure, thermal aging, and accident radiation exposure. The 40-year test specimens specified for Sequoyah Nuclear Plant demonstrated the capability to maintain specified voltage and current during the specified Design Basis Event (LOCA Simulation). It is therefore judged that the Sequoyah Nuclear Plant 40-year silicone rubber insulated cables, described and noted in Paragraph 6.0 of this section, met the acceptance criteria requirements of Wyle Laboratories' Qualification Plan (WLQP) 18057-00, Revision A.

5.0 REFERENCES

5.1 IEEE Standard 323-1974, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

5.2 IEEE Standard 383-1974, "Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."

5.3 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," U. S. Nuclear Regulatory Commission, 1973.

5.4 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants," U. S. Nuclear Regulatory Commission, January 21, 1983.

5.5 TVA Contract No. TV-73743A.

5.6 Wyle Laboratories' (Eastern Operations) Quality Assurance Program Manual, dated June, 1988.

5.7 Wyle Laboratories' Qualification Plan No. 18057-00, Revision A.

6.0 TEST SPECIMEN DESCRIPTION

Descriptions of the cable specimens are as follows:

Specimen No.	Manufacturer	P/N	Cable No.	Cable Size	Cable Tray
RWC-S-A.40	Rockbestos	KS-500	1-3V-62-4450A/CBBN	14 AWG	A*
RWC-S-B.40	Rockbestos	KS-500	1-3V-43-9841B/5SVN	14 AWG	A*
RWC-S-C.40	Rockbestos	KS-500	1-3V-67-3111B	14 AWG	A*
RWC-S-D.40	Rockbestos	KS-500	1-3V-67-3091A/9DG	14 AWG	A*
RWC-S-E.40	Rockbestos	KS-500	1-3V-62-2811B/6D1	14 AWG	A*
RWC-S-A.15	Rockbestos	KS-500	1-3V-62-4450A/CBB3	14 AWG	B
RWC-S-B.15	Rockbestos	KS-500	1-3V-43-9841B/5SVG	14 AWG	B
RWC-S-C.15	Rockbestos	KS-500	1-3V-67-3111B/9DR	14 AWG	B
RWC-S-D.15	Rockbestos	KS-500	1-3V-67-3091A/9DR	14 AWG	B
RWC-S-E.15	Rockbestos	KS-500	1-3V-62-2811B/6DG	14 AWG	B
RWC-W-A.40	Rockbestos	KS-500	1-3V-62-4450A/CBB8	14 AWG	C
RWC-W-B.40	Rockbestos	KS-500	1-3V-43-9841B/5SVR	14 AWG	C
RWC-W-C.40	Rockbestos	KS-500	1-3V-67-3111B/9DX	14 AWG	C
RWC-W-D.40	Rockbestos	KS-500	1-3V-67-3091A/9DX	14 AWG	C
RWC-W-E.40	Rockbestos	KS-500	1-3V-62-2811B/6DR	14 AWG	C
RWC-W-A.15	Rockbestos	KS-500	1-3V-62-4450A/CBB9	14 AWG	D
RWC-W-B.15	Rockbestos	KS-500	1-3V-43-9841B/5SV1	14 AWG	D
RWC-W-C.15	Rockbestos	KS-500	1-3V-67-3111B/9DY	14 AWG	D
RWC-W-D.15	Rockbestos	KS-500	1-3V-67-3091A/9DY	14 AWG	D
RWC-W-E.15	Rockbestos	KS-500	1-3V-62-2811B/6DC1	14 AWG	D

6.0 TEST SPECIMEN DESCRIPTION (Continued)

Specimen No.	Manufacturer	P/N	Cable No.	Cable Size	Cable Tray
ANA-S-A.40	Anaconda	CC-2193	1-3V-30-1362B/VFL11	12 AWG	E*
ANA-S-B.40	Anaconda	CC-2193	1-3V-31-7168A/VBL1	14 AWG	E*
ANA-S-C.40	Anaconda	CC-2193	2-3V-30-1362B/VFL3	12 AWG	E*
ANA-S-D.40	Anaconda	CC-2193	2-3PL-30-4830A/A27AC3	14 AWG	E*
ANA-S-E.40	Anaconda	CC-2193	2-4V-70-2855B/T1	12 AWG	E*
ANA-S-A.15	Anaconda	CC-2193	1-3V-30-1362B/VFL3	12 AWG	F
ANA-S-B.15	Anaconda	CC-2193	1-3V-31-7168A/VBLN	14 AWG	F
ANA-S-C.15	Anaconda	CC-2193	2-3V-30-1362B/VFLN	12 AWG	F
ANA-S-D.15	Anaconda	CC-2193	2-3PL-30-4830A/A27AA1	14 AWG	F
ANA-S-E.15	Anaconda	CC-2193	2-4V-70-2855B/T2	12 AWG	F

*Test specimens completed the test program including the Accident Simulation.

7.0 QUALITY ASSURANCE

All work performed on the test program was done in accordance with Wyle Laboratories' Quality Assurance Program, which complies with the requirements of 10 CFR 50 Appendix B, ANSI N45.2, and the "daughter" standards. Defects are reportable in accordance with the requirements of 10 CFR Part 21.

8.0 TEST EQUIPMENT AND INSTRUMENTATION

All instrumentation, measuring, and test equipment used in the performance of this test program were calibrated in accordance with Wyle Laboratories' Quality Assurance Program which complies with the requirements of Military Specification MIL-STD-45662A. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented as auditable.

SPECIMEN IDENTIFICATION, PREPARATION, AND BASELINE FUNCTIONAL TEST

SECTION I

SPECIMEN IDENTIFICATION, PREPARATION, AND BASELINE FUNCTIONAL TEST

1.0 REQUIREMENTS

1.1 Specimen Identification

The specimens shall be subjected to an inspection for the purpose of identification and documentation. The inspection shall be performed as specified in Paragraph 3.1 of Section VII.

1.2 Specimen Preparation and Baseline Functional Test

The test specimens, as provided by Tennessee Valley Authority (TVA), shall be mounted in open cable trays as specified in Paragraph 3.2 of Section VII. Upon completion of specimen preparation, the test specimens shall be subjected to the Baseline Functional Tests described in Paragraph 3.3 of Section VII.

2.0 PROCEDURES

2.1 Specimen Identification

A visual inspection of the test specimens was conducted upon receipt at Wyle Laboratories. This inspection was performed in order to document manufacturer and identification numbers of the specimens to be tested and any noticeable damage. In addition, all specimens were tagged with metal "Test Specimen" tags to facilitate their identification during the test program. The results of the identification inspections were recorded on the "Test Specimen Inspection" forms in the appendices of this Section.

2.2 Test Specimen Preparation

The test specimens were removed from the TVA shipping enclosure and separated according to manufacturer type. During test specimen removal and preparation, air sampling was conducted in a secured area. The air sampling was performed to determine if excessive levels of asbestos fibers existed during specimen preparation. Results of the air samples indicated that the asbestos fiber level was within safety requirements. The test specimens were placed in open cable trays 18 inches wide and 5 feet long. Rockbestos (RWC) and Anaconda-Continental (ANA) test specimens were placed in Cable Trays A through F as delineated in the following table.

2.0 **PROCEDURES (Continued)**

2.2 **Test Specimen Preparation (Continued)**

Cable Tray Designation	Specimen No.	Plant/Age Designation	Wire Size
A	RWC-S-A.40	Sequoyah	14 AWG (All)
	RWC-S-B.40	40-Year	
	RWC-S-C.40		
	RWC-S-D.40		
	RWC-S-E.40		
B	RWC-S-A.15	Sequoyah	14 AWG (All)
	RWC-S-B.15	15-Year	
	RWC-S-C.15		
	RWC-S-D.15		
	RWC-S-E.15		
C	RWC-W-A.40	Watts Bar	14 AWG (All)
	RWC-W-B.40	40-Year	
	RWC-W-C.40		
	RWC-W-D.40		
	RWC-W-E.40		
D	RWC-W-A.15	Watts Bar	14 AWG (All)
	RWC-W-B.15	15-Year	
	RWC-W-C.15		
	RWC-W-D.15		
	RWC-W-E.15		
E	ANA-S-A.40	Sequoyah	12 AWG
	ANA-S-B.40	40-Year	14 AWG
	ANA-S-C.40		12 AWG
	ANA-S-D.40		14 AWG
	ANA-S-E.40		12 AWG
F	ANA-S-A.15	Sequoyah	12 AWG
	ANA-S-B.15	15-Year	14 AWG
	ANA-S-C.15		12 AWG
	ANA-S-D.15		14 AWG
	ANA-S-E.15		12 AWG

Each test specimen was mounted to its respective cable tray such that both lead ends were positioned at one end of the tray. The lead ends of the test specimens were prepared for connection to test equipment, during functional tests, and elevated approximately four inches from the bottom of the cable tray. The specimens were positioned on each cable tray with a minimum 1/2-inch spacing between specimen cables and with an individual bend radius greater than the minimum as specified in Paragraph 3.2 of Section VII.

A small length of Rockbestos (RWC) cable was mounted to the center of Cable Tray A. An equal length of Anaconda-Continental (ANA) cable was mounted to the center of Cable Tray E. The small lengths of cable were intended for use by TVA personnel and the lead ends were not prepared for Functional Tests. The test specimens and small cable lengths were secured to the cable trays with Tefzel cable ties.

2.0 **PROCEDURES (Continued)**

2.2 **Test Specimen Preparation (Continued)**

Upon completion of specimen preparation, the cable specimens were photographed as mounted in their respective cable trays.

2.3 **Baseline Functional Test**

2.3.1 **Visual Inspection**

The test specimens were subjected to a visual inspection prior to initiation of the wet insulation resistance measurements. All observations noted during the visual inspection were recorded.

2.3.2 **Wet Insulation Resistance Measurements**

The test specimens as mounted in the cable trays were immersed in tap water with both leads of each specimen suspended out of the water. Insulation resistance measurements were taken of each cable specimen by applying 500 VDC for 1 minute prior to reading the resistance value between conductor and ground (the cable tray). All insulation resistance measurements were recorded for information only.

3.0 **RESULTS**

The test specimens were subjected to the specimen identification, preparation, and Baseline Functional Tests of Paragraph 2.0 and met the requirements of Paragraph 1.0. Observations recorded during the Baseline Functional Test visual inspection are presented below.

During the visual inspection it was noted that some of the cable specimens exhibited varying degrees of an ash discoloration on the asbestos jacket material. This discoloration of the jacket material did not seem to be attributable to a particular plant/age designation or manufacturer. Cable specimens that did not exhibit this discoloration were noted to maintain a dark black tone.

The data recorded during this phase of the test program is presented in Appendices I through IV of this Section as noted below.

- Appendix I contains the Test Specimen Inspection Sheets.
- Appendix II contains Photographs I-1 through I-12 which show the specimens mounted to the open cable tray.
- Appendix III contains the Data Sheet generated during Baseline Functional Tests.
- Appendix IV contains the Instrumentation Equipment Sheet generated for the Baseline Functional Tests.

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APPENDIX I

TEST SPECIMEN INSPECTION SHEETS

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TEST SPECIMEN INSPECTION

CHECK AS APPROPRIATE

CUSTOMER TENNESSEE VALLEY AUTHORITY

JOB NO. 18056

SPECIFICATION WL-00 18057-00

DATE 10-24-88

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
1.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-A-40 *	YES	YES	YES
	INSULATED CABLE		CBBN			
	14 AWG		1-3V-62-4450A			
2.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-B 40 *	YES	YES	YES
	INSULATED CABLE		5$VN			
	14 AWG		1-3V-43-9841B			
3.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-C-40 *	YES	YES	YES
	INSULATED CABLE					
	14 AWG		1-3V-67-3111B			
4.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-D-40 *	YES	YES	YES
	INSULATED CABLE		9DG			
	14 AWG		1-3V-67-3091-A			
5.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-E-40 *	YES	YES	YES
	INSULATED CABLE		6D1			
	14 AWG		1-3V-62-2811B			
6.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-A-15 **	YES	YES	YES
	INSULATED CABLE		CBB3			
	14 AWG		1-3V-62-4450-A			
7.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-$-B-15 **	YES	YES	YES
	INSULATED CABLE		5$VG			
	14 AWG		1-3V-43-7841B			
			8 RTH			

NOTES: * CABLE TRAY A

** CABLE TRAY B

ITEM 3.0 WAS NOT TAGGED "9DG" AS SPECIFIED

Specimen Failed NONE

Specimen Passed ALL

NOA Written NONE

Inspected By [signature] Date: 10-24-88

Witness N/A Date:

Sheet No. 1 of 5

Approved [signature] 01-24-89

TEST SPECIMEN INSPECTION

CHECK AS APPROPRIATE

CUSTOMER TENNESSEE VALLEY AUTHORITY

JOB NO. 18056

SPECIFICATION WLOP 18057-00

DATE 10-24-88

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
8.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-S-C-15 **	YES	YES	YES
	INSULATED CABLE		9DR			
	14 AWG		1-3V-67-3111B			
9.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-S-D-15 **	YES	YES	YES
	INSULATED CABLE		9DR			
	14 AWG		1-3V-67-3091A			
10.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-S-E-15 **	YES	YES	YES
	INSULATED CABLE		6DG			
	14 AWG		1-3V-62-2811B			
11.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-A-40 ***	YES	YES	YES
	INSULATED CABLE		CBBB			
	14 AWG		1-3V-62-4450A			
12.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-B-40 ***	YES	YES	YES
	INSULATED CABLE		5$VR			
	14 AWG		1-3V-43-9841B			
13.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-C-40 ***	YES	YES	YES
	INSULATED CABLE		9DX			
	14 AWG		1-3V-67-3111B			
14.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-D-40 ***	YES	YES	YES
	INSULATED CABLE		9DX			
	14 AWG		1-3V-67-3091A			

NOTES: ** CABLE TRAY B

*** CABLE TRAY C

Specimen Failed NONE

Specimen Passed ALL

NOA Written NONE

Inspected By [signature] Date: 10-24-88

Witness N/A Date:

Sheet No. 2 of 5

Approved [signature] 01-24-89

TEST SPECIMEN INSPECTION

CHECK AS APPROPRIATE

CUSTOMER TENNESSEE VALLEY AUTHORITY

JOB NO. 18056

SPECIFICATION WLOP 18057-00

DATE 10-24-88

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
15.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-E-40 ***	YES	YES	YES
	INSULATED CABLE		6DR			
RTN 16.0	14 AWG		1-3V-62-2811B			
16.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-A-15 ****	YES	YES	YES
	INSULATED CABLE		CBB9			
	14 AWG		1-3V-62-4450-A			
17.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-B-15 ****	YES	YES	YES
	INSULATED CABLE		5$V1			
	14 AWG		1-3V-43-9841B			
18.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-C-15 *****	YES	YES	YES
	INSULATED CABLE		9DY			
	14 AWG		1-3V-67-3111B			
19.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-D-15 ******	YES	YES	YES
	INSULATED CABLE		9DY			
	14 AWG		1-3V-67-3091A			
20.0	1/C SILICONE RUBBER	ROCKBESTOS	RWC-W-E-15 *******	YES	YES	YES
	INSULATED CABLE		6DC1			
	14 AWG		1-3V-62-2811B			
21.0	1/C SILICONE RUBBER	RTN ~~ROCKBESTOS~~	ANA-5-A-40 ********	YES	YES	YES
	INSULATED CABLE	ANACONDA	VFL11			
	12 AWG		1-3V-30-1362-B			

NOTES: *** CABLE TRAY C

**** CABLE TRAY D

***** CABLE TRAY E

Specimen Failed NONE

Specimen Passed ALL

NOA Written NONE

Inspected By Robert D. Smith Date: 10-24-88

Witness N/A Date:

Sheet No. 3 of 5

Approved Shonda Mickens 01-24-89

TEST SPECIMEN INSPECTION

CHECK AS APPROPRIATE

CUSTOMER TENNESSEE VALLEY AUTHORITY

JOB NO. 18056

SPECIFICATION WLGP 18057-00

DATE 10-24-88

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
22.0	1/C SILICONE INSULATED	ANACONDA	ANA-$-B-40 *****	YES	YES	YES
	CABLE		VBL1			
	14 AWG		1-3V-31-7168A			
23.0	1/C SILICONE RUBBER	ANACONDA	ANA-$-C-40 *****	YES	YES	YES
	INSULATED CABLE		VFL3			
	12 AWG		2-3V-30-1362-B			
24.0	1/C SILICONE RUBBER	ANACONDA	ANA-$-D-40 *****	YES	YES	YES
	INSULATED CABLE		AZ7AC3			
	14 AWG		2-3PL-30-4830-A			
25.0	1/C SILICONE RUBBER	ANACONDA	ANA-$-E-40 *****	YES	YES	YES
	INSULATED CABLE		T1			
	12 AWG		2-4V-70-2855-B			
26.0	1/C SILICONE RUBBER	ANACONDA	ANA-$-A-15 ******	YES	YES	YES
	INSULATED CABLE		VFL3			
	12 AWG		1-3V-30-1362-B			
27.0	1/C SILICONE RUBBER	ANACONDA	ANA-$-B-15 ******	YES	YES	YES
	INSULATED CABLE		VBLN			
	14 AWG		1-3V-31-7168-A			
28.0	1/C SILICONE RUBBER	ANACONDA	ANA-$-C-15 ******	YES	YES	YES
	INSULATED CABLE		VFLN			
	12 AWG		2-3V-30-1362-B			

NOTES: ***** CABLE TRAY E

****** CABLE TRAY F

Specimen Failed NONE

Specimen Passed ALL

NOA Written NONE

Inspected By Robert Lee Wilkes Date: 10-24-88

Witness N/A Date:

Sheet No. 4 of 5

Approved Sharon Mickens 01-24-89

TEST SPECIMEN INSPECTION

CHECK AS APPROPRIATE

CUSTOMER Tennessee Valley Authority

JOB NO. 18056

SPECIFICATION WLSP 18057-00

DATE 10-24-88

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
29.0	1/C Silicone Rubber	Anaconda	ANA-5-D-15 ******	Yes	Yes	Yes
	Insulated Cable		A27AA1			
	14 Awg		2-3PL-30-4830-A			
30.0	1/C Silicone Rubber	Anaconda	ANA-5-E-15 ******	Yes	Yes	Yes
	Insulated Cable		T2			
	12 Awg		2-4V-70-2855-B			

NOTES: ****** Cable Tray F

Specimen Failed None

Specimen Passed All

NOA Written None

Inspected By Robert L. Schmidt Date: 10-24-88

Witness N/A Date:

Sheet No. 5 of 5

Approved Sandra Micken 01-24-89

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APPENDIX II

PHOTOGRAPHS

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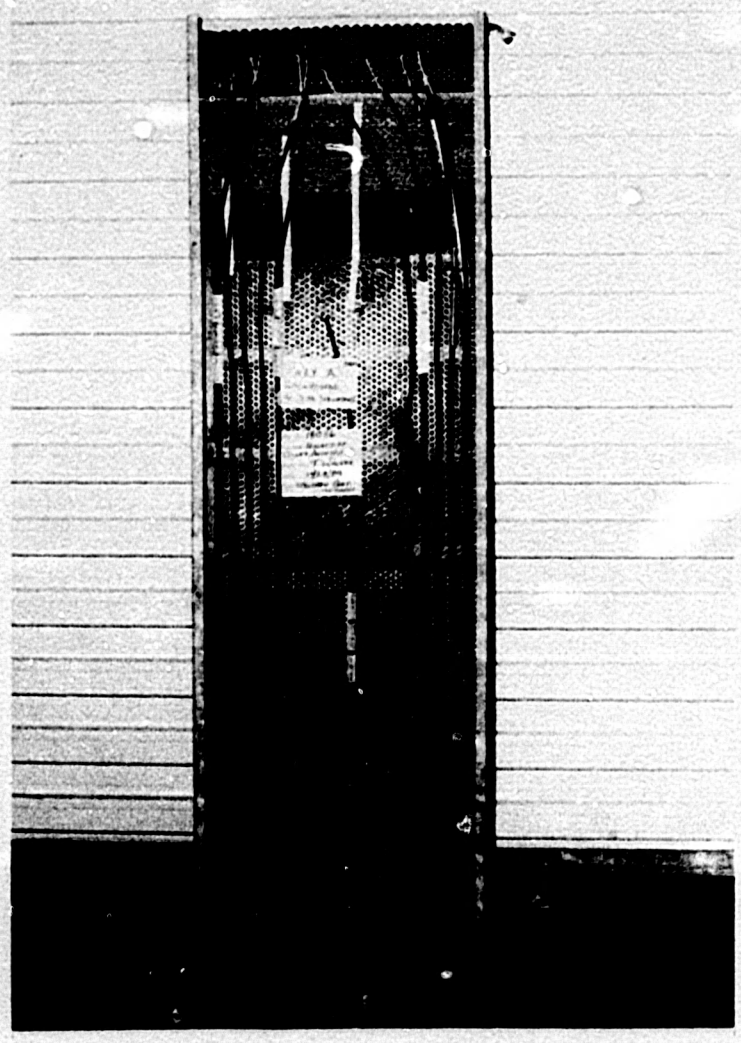


PHOTOGRAPH I-1

SPECIMEN PREPARATION

CABLE TRAY A WITH ROCKBESTOS 40-YEAR SPECIMENS, DESIGNATED FOR SEQUOYAH, MOUNTED TO PERFORATED STEEL BOTTOM

PHOTOGRAPH I-2

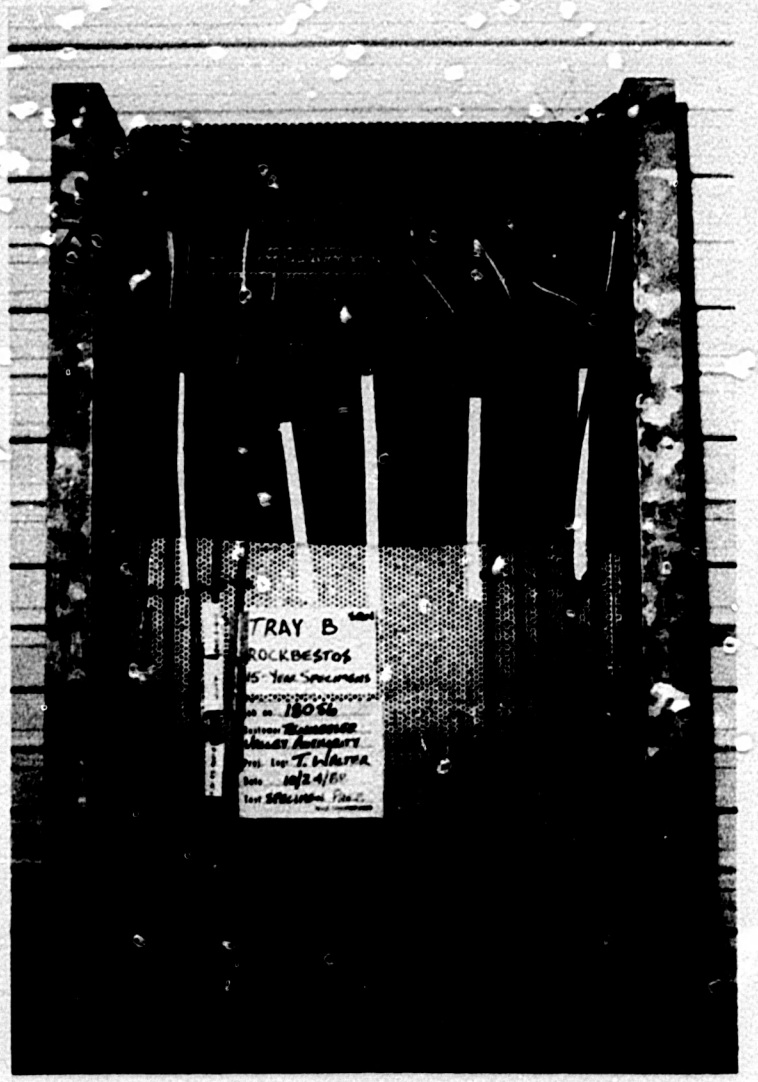
SPECIMEN PREPARATION

CABLE TRAY A WITH PREPARED CABLE SPECIMEN LEAD ENDS AND IDENTIFICATION TAGS AS PROVIDED BY TENNESSEE VALLEY AUTHORITY (TVA)

PHOTOGRAPH I-3

SPECIMEN PREPARATION

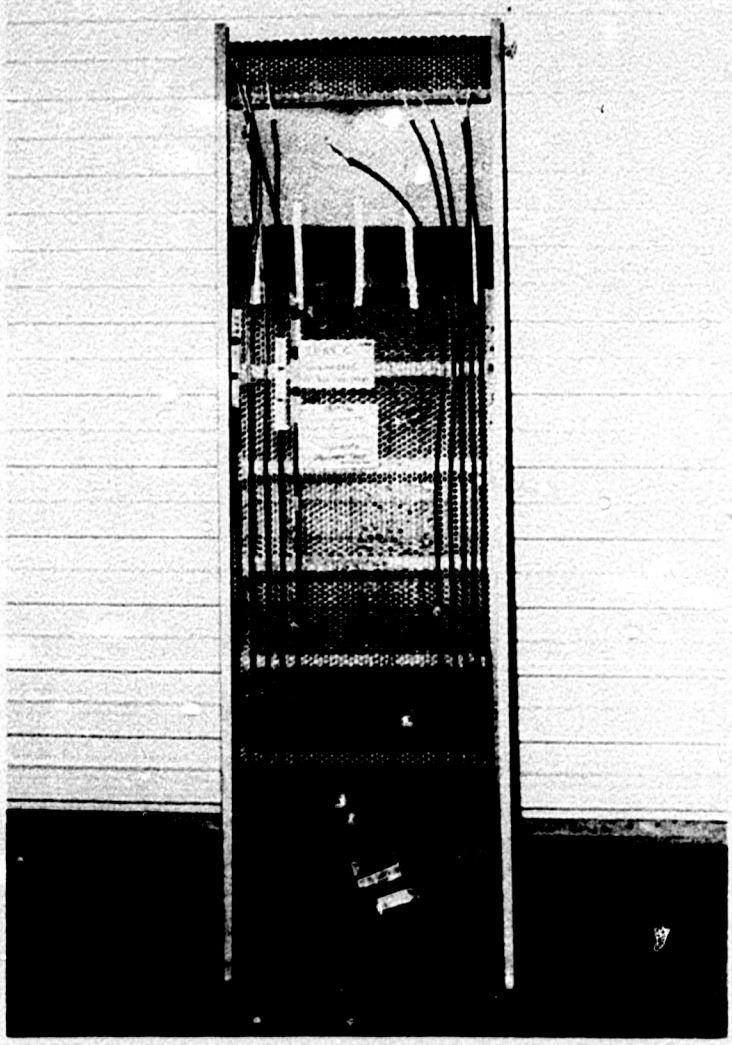
CABLE TRAY B WITH ROCKBESTOS 15-YEAR SPECIMENS, DESIGNATED FOR SEQUOYAH, MOUNTED TO PERFORATED STEEL BOTTOM



PHOTOGRAPH I-4

SPECIMEN PREPARATION

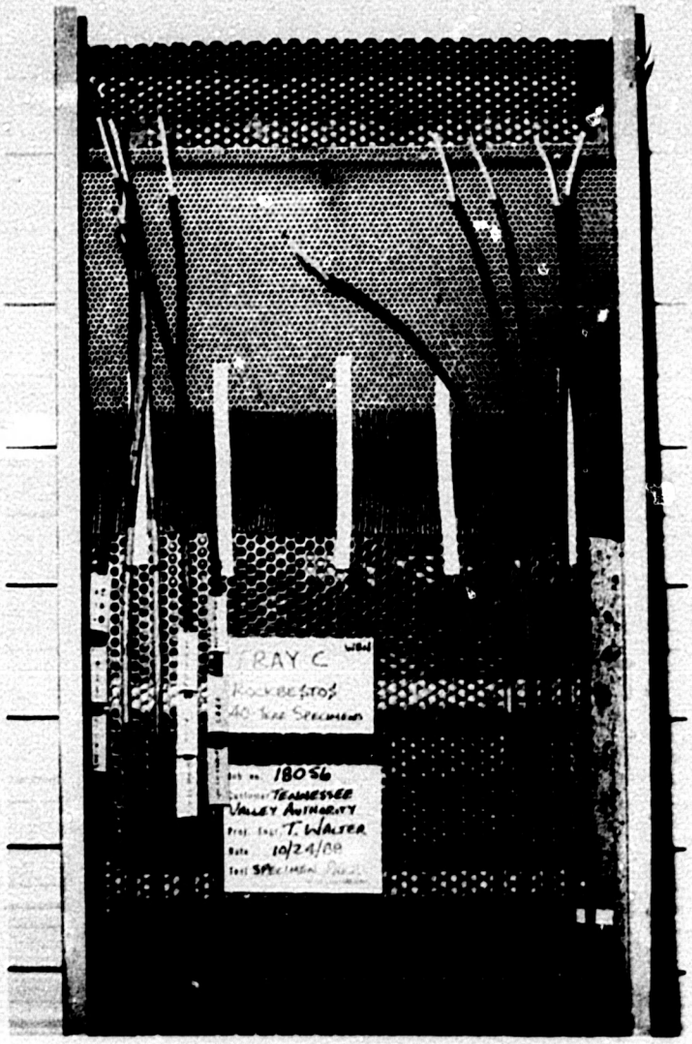
CABLE TRAY B WITH PREPARED CABLE SPECIMEN LEAD ENDS AND IDENTIFICATION TAGS AS PROVIDED BY TENNESSEE VALLEY AUTHORITY (TVA)



PHOTOGRAPH I-5

SPECIMEN PREPARATION

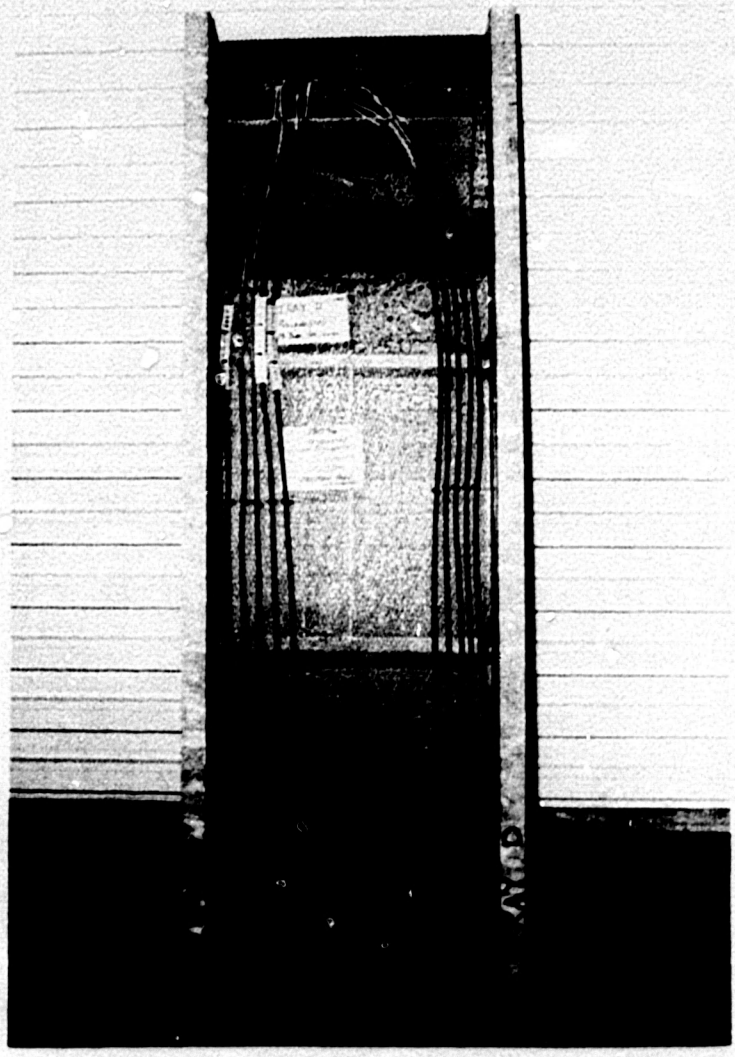
CABLE TRAY C WITH ROCKBESTOS 40-YEAR SPECIMENS, DESIGNATED FOR WATTS BAR, MOUNTED TO PERFORATED STEEL BOTTOM



PHOTOGRAPH I-6

SPECIMEN PREPARATION

CABLE TRAY C WITH PREPARED CABLE SPECIMEN LEAD ENDS AND IDENTIFICATION TAGS AS PROVIDED BY TENNESSEE VALLEY AUTHORITY (TVA)



PHOTOGRAPH I-7

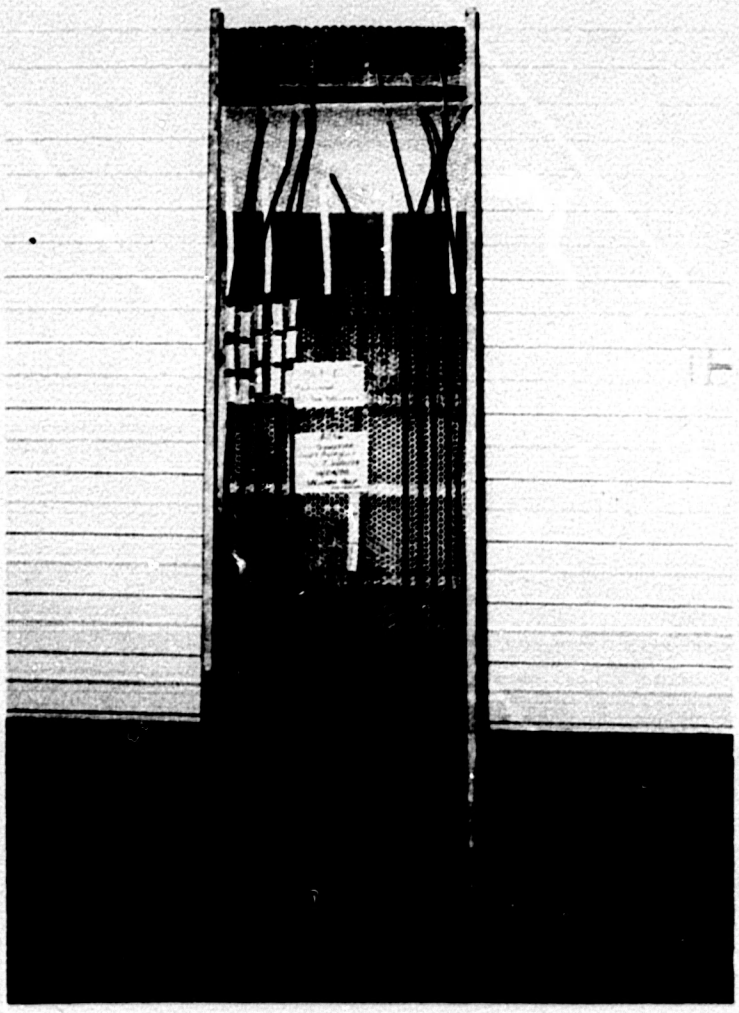
SPECIMEN PREPARATION

CABLE TRAY D WITH ROCKBESTOS 15-YEAR SPECIMENS, DESIGNATED FOR WATTS BAR, MOUNTED TO PERFORATED STEEL BOTTOM

PHOTOGRAPH I-8

SPECIMEN PREPARATION

**CABLE TRAY D WITH PREPARED CABLE SPECIMEN LEAD ENDS AN
IDENTIFICATION TAGS AS PROVIDED BY TENNESSEE VALLEY AUTHORITY (TVA)**



PHOTOGRAPH I-9

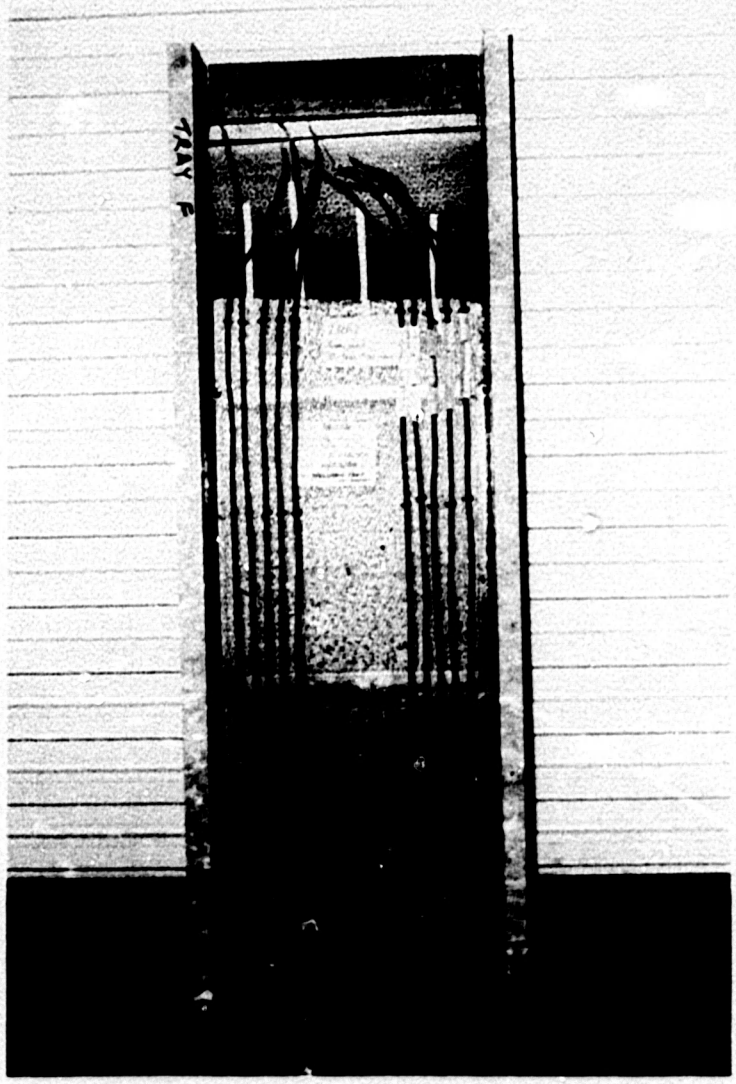
SPECIMEN PREPARATION

CABLE TRAY E WITH ANACONDA-CONTINENTAL 40-YEAR SPECIMENS, DESIGNATED FOR SEQUOYAH, MOUNTED TO PERFORATED STEEL BOTTOM

PHOTOGRAPH I-10

SPECIMEN PREPARATION

CABLE TRAY E WITH PREPARED CABLE SPECIMEN LEAD ENDS AND IDENTIFICATION TAGS AS PROVIDED BY TENNESSEE VALLEY AUTHORITY (TVA)



PHOTOGRAPH I-11

SPECIMEN PREPARATION

CABLE TRAY F WITH ANACONDA-CONTINENTAL 15-YEAR SPECIMENS, DESIGNATED FOR SEQUOYAH, MOUNTED TO PERFORATED STEEL BOTTOM

PHOTOGRAPH I-12

SPECIMEN PREPARATION

CABLE TRAY F WITH PREPARED CABLE SPECIMEN LEAD ENDS AND IDENTIFICATION TAGS AS PROVIDED BY TENNESSEE VALLEY AUTHORITY (TVA)

APPENDIX III

DATA SHEET

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DATA SHEET

Customer: Tennessee Valley Authority
Specimen: Silicone Rubber Insulated Cables
Part No.: Various
Spec.: WLOP 18057-00
Para.: 3.3.2
S/N: Listed
GSI: N/A

WYLE LABORATORIES

Amb. Temp.: 70°F
Photo: No
Test Med.: ~~Air~~ WATER
Specimen Temp.: Ambient

Job No.: 18056
Report No.: 18056-1
Start Date: 10-24-88

Test Title: BASELINE Functional Test

Specimen No.	Reading	Specimen No.	Reading
RWC-S-A.40	1.9×10^{12} Ω	RWC-W-A.15	3.5×10^{12} Ω
RWC-S-B.40	7.3×10^{12} Ω	RWC-W-B.15	1.0×10^{13} Ω
RWC-S-C.40	7.6×10^{12} Ω	RWC-W-C.15	7.2×10^{12} Ω
RWC-S-D.40	6.6×10^{12} Ω	RWC-W-D.15	7.4×10^{12} Ω
RWC-S-E.40	2.2×10^{12} Ω	RWC-W-E.15	4.0×10^{11} Ω
RWC-S-A.15	2.8×10^{12} Ω	ANA-S-A.40	1.5×10^{10} Ω
RWC-S-B.15	7.8×10^{12} Ω	ANA-S-B.40	4.5×10^{10} Ω
RWC-S-C.15	7.6×10^{12} Ω	ANA-S-C.40	7.5×10^{9} Ω
RWC-S-D.15	7.2×10^{12} Ω	ANA-S-D.40	1.5×10^{10} Ω
RWC-S-E.15	4.0×10^{12} Ω	ANA-S-E.40	4.0×10^{9} Ω
RWC-W-A.40	3.0×10^{12} Ω	ANA-S-A.15	8.0×10^{10} Ω
RWC-W-B.40	7.4×10^{12} Ω	ANA-S-B.15	8.4×10^{10} Ω
RWC-W-C.40	1.1×10^{12} Ω	ANA-S-C.15	6.2×10^{9} Ω
RWC-W-D.40	1.0×10^{12} Ω	ANA-S-D.15	1.6×10^{10} Ω
RWC-W-E.40	4.0×10^{12} Ω	ANA-S-E.15	2.8×10^{9} Ω

Tested By: D Compton Date: 10/24/88
Witness: N/A Date:
Sheet No.: 1 of 1
Approved: Robert Lee Walk 10-31-88

Notice of Anomaly: NONE

Wyle Form WH 614A, Rev. APR '84

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APPENDIX IV

INSTRUMENTATION EQUIPMENT SHEET

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INSTRUMENTATION EQUIPMENT SHEET

Page No. I-33

Test Report No. 18056-1

DATE: 10/21/88 JOB NUMBER: 18056-00 TEST AREA: ACOUSTICS

TECHNICIAN: B. COMPTON CUSTOMER: T. V. A. TYPE TEST: IR

NO.	INSTRUMENT	MANUFACTURER	MODEL#	SERIAL #	WYLE #	RANGE 1	ACCURACY 1	CALDATE	CALDUE
1	MEG MTR	GENERAL RADIO	1864	657113180	011898	50K-50TOHM	2-5%RANGE	10/13/88	04/11/89

THIS IS TO CERTIFY THAT THE ABOVE INSTRUMENTS WERE CALIBRATED USING STATE-OF-THE-ART TECHNIQUES WITH STANDARDS WHOSE CALIBRATION IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS.

INSTRUMENTATION R.E. Archer 10-21-88

CHECKED & RECEIVED BY Robert W. Walker 10-21-88

Q.A. TR Hamilton 10-21-88

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NORMAL RADIATION EXPOSURE AND POST-RADIATION FUNCTIONAL TEST

SECTION II

NORMAL RADIATION EXPOSURE AND POST-RADIATION FUNCTIONAL TEST

1.0 REQUIREMENTS

1.1 Normal Radiation Exposure

The test specimens shall be subjected to the normal radiation exposure as specified in Paragraph 3.4 of Section VII.

1.2 Post-Radiation Functional Test

The test specimens shall be subjected to a Functional Test upon completion of radiation exposure. The Functional Test shall be performed as specified in Paragraph 3.5 of Section VII.

2.0 PROCEDURES

2.1 Normal Radiation Exposure

The test specimens were subjected to the normal irradiation at Georgia Institute of Technology's Neely Nuclear Research Center. Each test specimen cable tray was subjected to a Total Integrated Dose (TID) depending upon plant and/or age designation. The TID to each of the cable trays was as described below:

Cable Tray Designation	Plant/Age Designation	Specimen Manufacturer	Cumulative TID (rads)
A	Sequoyah 40-year	RWC	8.07E7
B	Sequoyah 15-year	RWC	3.04E7
C	Watts Bar 40-year	RWC	8.03E7
D	Watts Bar 15-year	RWC	3.07E7
E	Sequoyah 40-year	ANA	2.07E7
F	Sequoyah 15-year	ANA	7.63E6

Upon completion of irradiation, the test specimens were returned to Wyle Laboratories' Test Facility for completion of testing.

2.0 PROCEDURES (Continued)

2.2 Post-Radiation Functional Test

Upon completion of irradiation, the test specimens were subjected to a Post-Radiation Functional Test. The Functional Test was performed as described in Paragraph 2.3, Section I, of this report.

3.0 RESULTS

The test specimens were subjected to the Normal Radiation Exposure and Post-Radiation Functional Tests of Paragraph 2.0 and met the requirements of Paragraph 1.0. Photographs of the test specimens mounted in the cable trays were taken upon receipt at Wyle Laboratories. Observations recorded during the Post-Radiation Functional Test Visual Inspection are presented in the following paragraphs.

During the visual inspection it was noted that, in general, the test specimens were in good condition and showed no indication of damage or severe degradation. The Tefzel cable ties were intact and were maintaining specimen cable position on the cable trays. The test specimens separated from the metal surface of the cable tray(s) in some areas between the specimen cable ties. This "flexing" of the test specimens can be attributed to the normal radiation exposure that the specimens received, and to the natural coiling nature of the cables. Visual inspections for each individual cable tray are presented in the following paragraphs.

Cable Tray A was noted to have silicone insulation on the lead ends of Test Specimens A and E that was much darker in apperance than the remaining test specimens on the tray. The asbestos braided jacket material on Test Specimen E was found to be fraying at the lead ends. All of the test specimens on this tray exhibited an ash coloring on their jacket material. The test specimens, as mounted in the cable tray, had lost some flexibility.

Cable Tray B was noted to have ash coloring on the jacket material on all of the test specimens, with Test Specimen D being the least apparent. The test specimens, as mounted in the cable tray, had lost some flexibility. All of the test specimens were noted to have curved at the lead ends in the elevated portion of the cable tray.

Cable Tray C was noted to have darkened silicone insulation at the lead ends of Test Specimens A and E, as described previously for Cable Tray A. The asbestos braided jacket material on Test Specimens A and E was found to be fraying at the lead ends. All of the test specimens on this tray exhibited an ash coloring on the jacket material with Test Specimens D and E being the least apparent. Test specimen flexibility was as described previously for Cable Tray A.

3.0 **RESULTS (Continued)**

Cable Tray D was noted to have ash coloring on the jacket material on all of the test specimens, with Test Specimens D and E being the least apparent. The asbestos braided jacket material on Test Specimen E was found to be fraying at one lead end. The test specimen lead ends were noted to have curved in the elevated portion of the cable tray. The test specimens had lost some flexibility.

Cable Tray E was noted to have ash coloring on the jacket material on all of the test specimens, with Test Specimen A being the least apparent. The asbestos braided jacket material on Test Specimens B through E was found to be fraying at the lead ends. Test specimen flexibility was as described previously for Cable Tray A.

Cable Tray F was noted to have ash coloring on the jacket material of Test Specimens B through E. The asbestos braided jacket material on Test Specimens C and E were found to be fraying at the lead ends. The test specimen lead ends were noted to have curved in the elevated portion of the cable tray. The test specimens had lost some flexibility.

The data recorded during this phase of the test program is presented in Appendices I through IV, of this Section, as noted below:

- Appendix I contains a Letter of Certification indicating dose rates, exposure time and cumulative total dose on the test specimens.
- Appendix II contains Photographs II-1 through II-8 which show the test specimens during the Post-Radiation Visual Inspection and Functional Test.
- Appendix III contains the Data Sheet generated during the Post-Radiation Functional Tests.
- Appendix IV contains the Instrumentation Equipment Sheet generated for the Post-Radiation Functional Tests.

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APPENDIX I

LETTER OF CERTIFICATION FOR THE IRRADIATION EXPOSURE

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