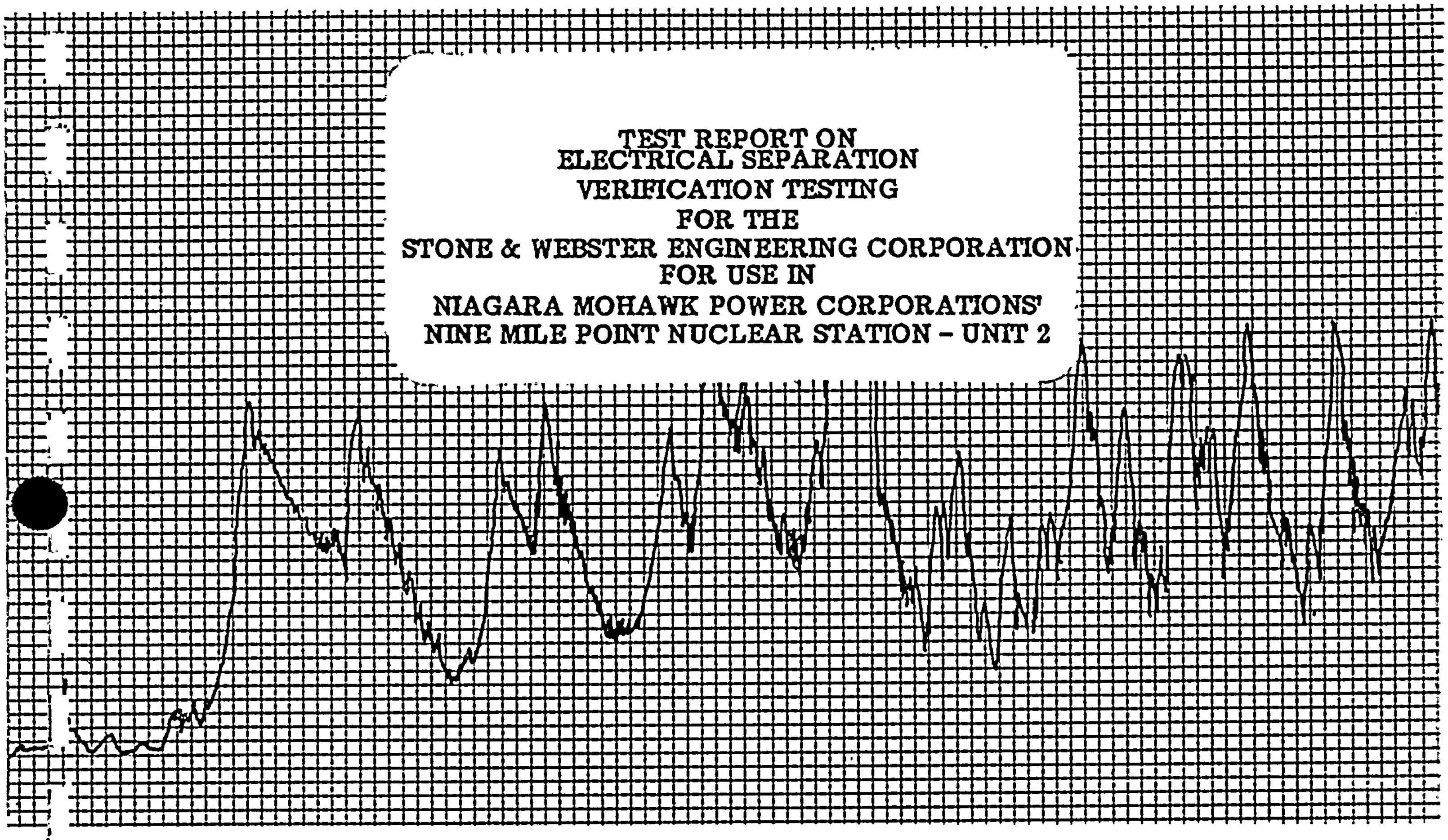
WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

TEST REPORT ON ELECTRICAL SEPARATION VERIFICATION TESTING FOR THE STONE & WEBSTER ENGINEERING CORPORATION FOR USE IN NIAGARA MOHAWK POWER CORPORATIONS' NINE MILE POINT NUCLEAR STATION - UNIT 2



test REPORT

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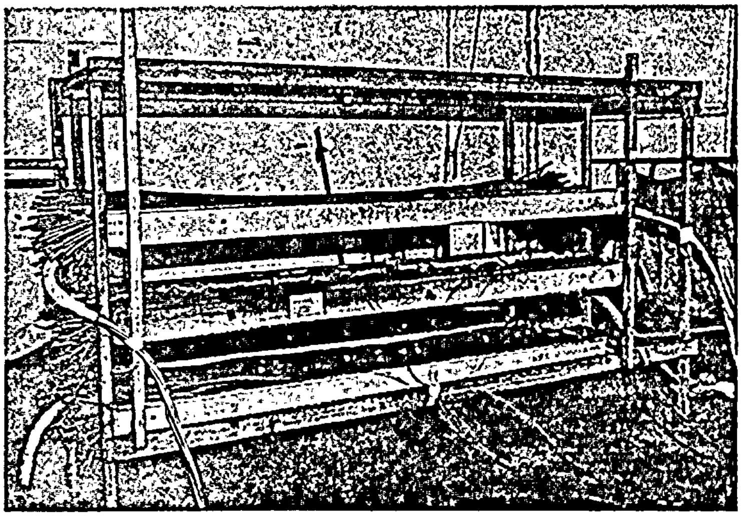

NEQ

Nuclear Environmental Qualification

Test Report

REPORT NO. 47906-02

WYLE JOB NO. 47906

CUSTOMER P. O. NO. NMP2-E0907

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DATE November 22, 1985

SPECIFICATION (S)

See References in Section 5.0.

1.0 CUSTOMER Stone & Webster Engineering Corporation

ADDRESS 3 Executive Campus, Cherry Hill, New Jersey 08034

2.0 TEST SPECIMEN Various Power, Control, and Instrumentation Cables as described in Paragraph 6.0

3.0 MANUFACTURER Okonite and Rockbestos

4.0 SUMMARY

The test program described herein was performed to test the design adequacy of worst case configurations of electrical cables and raceways, containing Class 1E and non-Class 1E electrical systems at Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station — Unit 2 (NMP2), and to demonstrate the adequacy of the physical separation of these electrical systems when an electrical fault occurred. The test results apply to the cables and raceways for 600 volt levels and below.

(jmk)

STATE OF ALABAMA } ss.
COUNTY OF MADISON }

Alabama Professional Eng. Reg. No. 13475

Gerald R. Carbonneau, 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.

SEAL Gerald R. Carbonneau

SUBSCRIBED and sworn to before me this 22nd day of November 1985

Virginia L. Neal

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

My Commission expires June 13, 1987

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4.0 SUMMARY (Continued)

4.1 Purpose

NMP2-specific tests were successfully conducted to provide a positive basis for plant-specific spatial separation. IEEE 384-1974 (as endorsed by Regulatory Guide 1.75, Revision-2), Paragraphs 5.1.1.2 and 5.1.1.3, allows for lesser minimum distances when substantiated by analysis (tests). Where the required spatial separation distances are not achieved, barriers will be used.

4.2 Objectives

The test program described here had the following primary objectives:

a. Demonstrate the acceptability of separation distances that are less than those specified in IEEE 384-1974.

b. Determine the minimum allowable separation between various types of raceways.

c. Demonstrate the use of SWEC protective wraps (Siltemp 188 CH) as effective barriers, as defined in Regulatory Guide 1.75 and IEEE 384, in cases where provided separation between Class 1E raceways and cables and Class 1E and non-Class 1E raceways and cables is less than specified.

4.3 Scope

The electrical separation tests address the potential hazard of electrically generated fires in raceways. These tests use NMP2-specific materials in NMP2-specific configurations, use conservative assumptions to establish a worst-case cable fault-current and worst-case cable, and establishes margin.

The program was limited to all 600 V cables and below. Cables rated at 15 and 5 kV were not part of the program. The tests were done with unaged NMP2 cables. Identical cables previously passed IEEE 383 flame tests, both aged and unaged.

4.4 Test Sequence

The test program was conducted as specified in References 5.1 and 5.3. The test results are presented in the appropriate sections of this report as follows:

- Section I — Screening Tests (Worst Case Cable Determination)
- Section II — Configuration Number 1 Test (Separation of Cable in Free Air to Cable in Free Air Without Barriers)
- Section III — Configuration Number 2 Test (Separation of Cable in Free Air to Cable in Free Air With Siltemp 188 CH Barriers)

4.0 SUMMARY (Continued)

4.4 Test Sequence (Continued)

- Section IV — Configuration Number 3 Tests (Horizontal Tray To Parallel Conduit Separation)
- Section V — Configuration Number 4 Tests (Vertical Separation of Horizontal Cable Trays in a Vertical Stack)
- Section VI — Configuration Number 5 Tests (Conduit to Conduit and Cable in Free Air Separation)
- Section VII — Configuration Number 6 Tests (Separation Inside Control/Instrumentation Cabinets)
- Section VIII — Wyle Laboratories Test Procedure Number 47906-01, Revision A.

Each configuration test was conducted in the following sequence as described in Reference 5.3:

- Baseline Functional Tests
- Overcurrent Test
- Post-Overcurrent Test Functional Tests

4.5 Test Anomalies

Six anomalies occurred during this test program. These anomalies are detailed in the appropriate section of this report and are briefly described as follows:

Notice of Anomaly No.	Date	Description	Reference Section
1	09/06/85	Documents a procedural anomaly for Configuration Number 1, Test 1. During the Baseline Functional Test of the 7/C 12 AWG control cable, the conductor connections were not made. The lack of conductor connections was judged to have no impact because the Post-Overcurrent Test Functional Test was performed with the connections made properly, and results showed acceptable values for insulation resistance and no evidence of insulation breakdown.	II
2	09/12/85	Documents a test equipment anomaly which occurred during Configuration Number 1, Tests 1, 2 and 3, and Configuration Number 2, Test 1. During these tests, some of the currents on the target cables were out of tolerance after applying test current to the fault cable. This out-of-tolerance condition was attributed to three causes:	II, III

4.0 SUMMARY (Continued)

4.5 Test Anomalies (Continued)

Notice of Anomaly No.	Date	Description	Reference Section
2	09/12/85	(Continued) 1. Unbalanced current between phases. 2. Temperature changes in the target cable conductors causing impedance of the cable to change. 3. Voltage fluctuations in the facility power delivered by the local utility. The out-of-tolerance condition was judged to have no impact on the test because the test results showed that the target cables' ability to carry current was not impaired by the test condition.	II, III
3	09/12/85	Documents a procedural anomaly for Configuration Number 1, Test 1. Initially, the current on the No. 2 AWG target power cable was set to 37.9A which was 1.6% below the required 38.5A +10%, -0%. Also, the current on the No. 16 AWG instrument cable was set to 1.152A which was 4.7% above the required 1A +10%, -0%. The out-of-tolerance currents were judged to have no impact on the test as discussed in NOA 2.	II
4	09/16/85	Documents a test equipment anomaly. During Configuration Number 4, Test 1 and Configuration Number 5, Tests 1, 2 and 3, some of the phase currents on the No. 2 AWG cable were above the +10% tolerance by as much as 8.4 amperes, while test current was flowing in the worst case cable. During Configuration Number 5, Test 3, one of the phase currents was below the -10% tolerance by 12.3 amperes while the other two phase currents were above the +10% tolerance by 8.4 amperes and 6.7 amperes, respectively. The out-of-tolerance currents were judged to have no impact on the test for the following reasons:	V & VI

4.0 SUMMARY (Continued)

4.5 Test Anomalies (Continued)

Notice of Anomaly No.	Date	Description	Reference Section
4	09/16/85	(Continued) 1. Current above the tolerance results in additional conductor heating and therefore higher cable temperatures which is a more severe condition than required. 2. In the case where one of the phase currents was below the -10% tolerance, the resulting lower conductor heating is compensated for by the additional heating in the other two phases. 3. Heating due to rated current of 38.5 amperes is very low. Screening Test No. 5 of the No. 2 AWG. cable showed no change in temperature of the cable conductor or jacket after 10 minutes of rated current.	V & VI
5	09/26/85	Documents a procedural anomaly for Configuration Number 2, Test 1; Configuration Number 3, Test 2; and Configuration Number 5, Tests 2 and 3. During the warmup period, the cable jacket temperature was higher than the conductor temperature. Therefore, the jacket temperature was used to determine that the cable had been warmed to 189°-199°F instead of the conductor temperature as required by the procedure. This anomaly was judged to have no impact on the test for the following reasons: 1. During warmup of the cable, the conductor temperature would have to be higher than the temperature of the adjacent jacket. 2. The conductor thermocouples can indicate a lower temperature than the jacket thermocouples because of differences in mounting and location along the cable segment. 3. The heat transferred from the fault cable to the target cables during warmup to, and maintenance at, 189°-199°F is very small compared to the heat transferred during burning of the fault cable, which occurred in every test.	III, IV & VI

4.0 SUMMARY (Continued)

4.5 Test Anomalies (Continued)

Notice of Anomaly No.	Date	Description	Reference Section
6	09/26/85	Documents a procedural anomaly for Configuration Number 3, Test 2. Installation of Thermocouples 18 and 19 on the cable tray were omitted. This anomaly was judged to have no impact on the test because the temperatures of the target cable, fault cable, and the conduit enclosing the fault cable were measured which are data adequate to record the test conditions.	IV

5.0 REFERENCES

5.1 Stone and Webster Engineering Corporation Engineering Service Scope of Work (ESSOW) No. E0907.

5.2 Wyle Laboratories Technical Proposal for Cable Separation Test Program for Stone and Webster Engineering Corporation, No. 543/3965-2/GH, dated July 26, 1985.

5.3 Wyle Laboratories' Test Procedure 47906-01, Revision A, "Electrical Raceway Separation Verification Testing for the Stone and Webster Engineering Corporation for use in Niagara Mohawk Power Corporation Nine Mile Point Nuclear Station - Unit 2."

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

5.5 IEEE Std. 384-1974, "IEEE Trial Use Standard Criteria for Separation of Class 1E Equipment and Circuits."

5.6 United States Nuclear Regulatory Commission Guide 1.75, Revision 2, "Physical Independence of Electric Systems."

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

5.8 Code of Federal Regulations, Section 10, Part 21.

5.9 Code of Federal Regulations, Section 10, Part 50, Appendix B.

5.10 Cable Vertical Flame Test Data for Nine Mile 2 Power Cable.

6.0 TEST SPECIMEN DESCRIPTION

All cables used in this test program were qualified to meet the requirements of IEEE Standard 383-1974, "IEEE Standard for Type Test of Class 1E Electrical Cables, Field Splices, and Connections for Nuclear Power Generating Stations". The test specimens consisted of power, control, and instrumentation cables as described below:

Item No.	Description	Cable Type	SWEC I.D. No.
1	Okonite Triplex 500 MCM Copper	L	NJM-46
2	Okonite Triplex 350 MCM Copper	L	NJM-45
3	Okonite Triplex 250 MCM Copper	L	NJM-33
4	Okonite Triplex 4/0 AWG Copper	L	NJM-31
5	Okonite Triplex 3/0 AWG Copper	L	NJM-30
6	Okonite Triplex 2/0 AWG Copper	L	NJM-28
7	Okonite Triplex 1/0 AWG Copper	L	NJM-34
8	Okonite Triplex 2 AWG Copper	K	NJM-25
9	Okonite Triplex 4 AWG Copper	K	NJM-41
10	Okonite Triplex 6 AWG Copper	K	NJM-40
11	Okonite 3/C 8 AWG Copper	K	NJM-12
12	Okonite 3/C 10 AWG Copper	K	NJM-08
13	Rockbestos 7C 12 AWG Copper	C	NJN-37
14	Okonite 2/C 16 AWG Copper	X	NJP-05
15	Rockbestos 2/C 12 AWG Copper	C	NJN-34
16	Rockbestos 5/C 12 AWG Copper	C	NJN-36
17	Rockbestos 1/C 14 AWG Copper	C	NAF-52

7.0 TEST RATIONALE

7.1 Potential Hazards

Separation criteria are intended to protect redundant safety-related equipment from a common mode failure caused by a potential hazard. In order to determine that separation requirements are appropriate, the potential hazard to be protected against must be identified. For electrical raceways in nuclear power plants, the potential hazards are (1) damage due to missiles, (2) damage due to pipe break, (3) damage due to exposure fires, and (4) damage due to electrical fires in adjacent raceways. Justification of the minimum separation required against hazard (4) has been accomplished through this test program.

7.2 Assumptions of Failure Mode for Screening Tests and Configurations Number 1-5 Overcurrent Tests

In order to perform a test program to verify the adequacy of the raceway separation criteria, it was necessary to define the worst-case electrical fault that could occur internal to a cable in a raceway. Assumptions were made regarding the failure mode to be simulated to ensure that ample conservatism would be demonstrated by the test results as follows:

a. The cable or equipment in the circuit develops a fault that is not cleared.

7.0 TEST RATIONALE (Continued)

7.2 Assumptions of Failure Mode for Screening Tests and Configurations Number 1-5 Overcurrent Tests (Continued)

b. The impedance of the fault adjusts itself automatically to maintain the fault current magnitude at a constant level.

c. The fault is not detected by an operator.

d. The maximum current during the worst case fault is considered to be the test current per Table I. The test current for each cable is equal to the locked rotor current of the motor fed by each cable. Currents higher than these values will result in a circuit breaker clearing the fault and/or a conductor open circuit.

e. The maximum effect on nearby cables is caused by a combination of high temperatures and the duration of these high temperatures.

f. The contribution of heat to a target cable from adjacent cables (other than a faulted cable) is negligible when compared to the heat generated by rated current flowing in the target cable and to the heat contributed by the faulted cable. The test procedure therefore required rated current be applied to the target cable during the Overcurrent Test and also that the fault cable be warmed to 189°-199°F prior to application of fault current.

TABLE I

Cable Size	Maximum Connected HP	Maximum Full Load Current	Test Current
10 AWG	5	5.6	34
8 AWG	10	10.3	51
6 AWG	20	20.6	156
4 AWG	20	20.6	156
2 AWG	40	38.5	264
1/0 AWG	150	139.0	908
2/0 AWG	150	139.0	908
3/0 AWG	150	139.0	908
4/0 AWG	180	159.0	746
250 MCM	180	159.0	746
350 MCM	180	159.0	746
500 MCM	180	159.0	746

The above assumptions are applicable to tests that simulate the effects of cable faults which cause sustained overcurrent conditions. Heating effects of this type of failure with the above assumptions have the greatest impact on adjacent cables; therefore, this failure mode was selected as the design basis for the tests of Configurations Number 1-5.

7.0 TEST RATIONALE (Continued)

7.3 Assumptions of Failure Mode for Configuration Number 6 Overcurrent Test

To verify the acceptability of design where control/instrument cables are bundled together inside a control/instrument cabinet, it was necessary to define the worst case fault that could occur on a control cable. Assumptions were made regarding the failure mode to be simulated as follows:

a. The cable or equipment in the circuit develops a fault that is cleared in 10 seconds or less.

b. The impedance of the fault adjusts itself automatically to maintain the fault current magnitude at a constant level of 100 amperes.

7.4 Application of Configuration Test Results

A configuration is demonstrated to be acceptable when the target cable(s) pass a functional test before and after simulation of a cable fault on the faulted conductor. Functional tests are measurements of insulation resistance and leakage current. Also, the target cable(s) are required to maintain continuity and carry current during the simulation of the fault.

Unaged cables were used in the tests. Identical cables, both unaged and aged at 150°C for three weeks, have passed 70,000-Btu/hour flame tests conducted in accordance with IEEE Std. 383-1974. Both the unaged and aged cables self-extinguished after removal of the flame source.

It should be noted that the cable separation distances used in the actual plant installation are greater than those used in the tests reported herein except where barriers have been used.

8.0 TEST DESCRIPTIONS

8.1 Screening Tests

The Screening Tests consisted of 12 overcurrent tests to determine which cable size, if subjected to the worst case electrical fault at the NMP2, would have the most impact on the adjacent target cables in the subsequent configuration tests. The "worst case cable" was established based on the amount of damage to the faulted cables' insulation system, intensity, and duration of its temperature rise (and hence the heat released to the adjacent cables), and the time and current required to open circuit the cable.

The cables tested in the Screening Test, warmup currents, and fault currents are as follows.

Test No.	Fault Cable Size	Warmup(1) Currents	Fault(2) Currents
1A*	3/C 10 AWG Cu	5.6A, 53A	34A, 455A
2	3/C 8 AWG Cu	10.3A, 87A	51A, 660A
3	Triplex 6 AWG Cu	20.6A, 105A	156A, 660A
4	Triplex 4 AWG Cu	20.6A, 145A	156A, 660A
5	Triplex 2 AWG Cu	38.5A, 185A	264A, 660A
6	Triplex 1/0 AWG Cu	139A, 235A	908A
7A*	Triplex 2/0 AWG	139A, 270A	908A
8A*	Triplex 3/0 AWG Cu	139A, 335A	908A
9	Triplex 4/0 AWG Cu	159A, 335A	746A, 1860A
10	Triplex 250 MCM Cu	159A, 400A	746A, 2200A
11	Triplex 350 MCM Cu	159A, 520A	746A, 2200A
12	Triplex 500 MCM Cu	159A, 650A	746A, 2200A

(1) Rated Current and Final Warmup Current to reach 189-199°F.

(2) Locked Rotor Current and Short Circuit Current, if applicable.

* The "A" designation indicates a test that was repeated. Data for the initial tests are not included in this report. Test No. 1 was repeated because the current source was unable to supply 660A through the No. 10 AWG conductors in series. Test No. 7 was repeated because a conductor-to-bus connection was not tightened properly. Test No. 8 was repeated because the test was interrupted by power outages due to severe weather conditions.

The fault cable was mounted at the top layer in the centerline of a cable tray filled with cables for Screening Tests No. 1 through 5. The fault cable was mounted as the center cable in a single layer of L-type cables (cables spaced 3/8 inch apart) for Tests No. 6 through 12. For all 12 tests, an array of thermocouples, at three locations along the fault cable, mounted one inch vertically and horizontally away, six inches vertically and horizontally away, and 8.5 inches vertically away from the fault cable, were utilized to ascertain the heat delivered to the environment.

8.0 TEST DESCRIPTIONS (Continued)

8.2 Configuration Number 1 Tests

Configuration Number 1 consisted of three tests for separation of cables in free air. Test No. 1 consisted of a test between a horizontal fault cable, a parallel horizontally separated 2/C 16 AWG cable, a parallel vertically separated Triplex 2 AWG cable, and a perpendicular horizontally separated 7/C 12 AWG cable. Test No. 2 consisted of a test between a vertical fault cable and two perpendicular cables separated horizontally by 6 inches. Test No. 3 consisted of a test between a horizontal cable in free air and a parallel cable tray vertically separated by 9 inches. The tests can be differentiated as described below:

TEST NO. 1

Cable Size	Function/Location	Voltage/Current
Triplex 2/0 AWG	Fault Cable/Horizontal	139A, 270A, 908A *
Triplex 2 AWG	Target Cable/Horizontal (9 in. above the fault cable)	575 VAC, 3ϕ, 38.5A
7/C 12 AWG	Target Cable/Vertical (6 in. horizontal separation)	120VAC, 1ϕ, 10A
2/C 16 AWG	Target Cable/Horizontal (6 in. horizontal separation)	50VAC, 1ϕ, 1A

TEST NO. 2

Cable Size	Function/Location	Voltage/Current
Triplex 2/0 AWG	Fault Cable/Vertical	139A, 285A, 908A *
Triplex 2 AWG	Target Cable/Horizontal (6 in. above the fault cable)	575 VAC, 3ϕ, 38.5A
7/C 12 AWG	Target Cable/Horizontal (9 in. below Triplex 2 AWG)	120VAC, 1ϕ, 10A

TEST NO. 3

Cable Size	Function/Location	Voltage/Current
Triplex 2/0 AWG	Fault Cable/Horizontal	139A, 275A, 908A *
Triplex 2 AWG	Target Cable/Horizontal (In tray 9 in. above the fault cable)	575 VAC, 3ϕ, 38.5A

* Rated Current, Final Warmup Current, Fault Current

8.0 TEST DESCRIPTIONS (Continued)

8.2 Configuration Number 1 Tests (Continued)

The purpose of the Configuration Number 1 Tests was to demonstrate the acceptability of design where two cables in free air pass either 9 inches vertically or 6 inches horizontally from each other or from a cable tray, when the worst case electrical fault occurs to one of these cables. This configuration represents field installation of free air cables going from:

a. Tray to tray

b. Tray to conduit

c. Conduit to conduit

d. Tray/conduit to equipment

e. Tray/conduit to wall sleeves, etc.

8.3 Configuration Number 2 Tests

Configuration Number 2 Tests consisted of two tests in free air between a cable wrapped in the SWEC protective wrap (Siltemp 188 CH)and an unwrapped cable. For Test No. 1, the faulted cable was the wrapped cable. For Test No. 2, the faulted cable was unwrapped and the target cable was wrapped. The tests can be differentiated as described below:

TEST NO. 1

Cable Size	Function	Layers of SWEC Wrap	Voltage/Current
Triplex 2/0 AWG	Fault Cable	4 Layers	139A, 270A, 908A *
Triplex 1/0 AWG	Target Cable	Unwrapped	575 VAC, 3ø, 139A

TEST NO. 2

Cable Size	Function	Layers of SWEC Wrap	Voltage/Current
Triplex 2/0 AWG	Fault Cable	Unwrapped	139A, 280A, 908A *
Triplex 1/0 AWG	Target Cable	4 Layers	575 VAC, 3ø, 139A

* Rated Current, Final Warmup Current, Fault Current

8.0 TEST DESCRIPTIONS (Continued)

8.3 Configuration Number 2 Tests (Continued)

The purposes of the Configuration Number 2 Tests were to:

1. Demonstrate the acceptability of design where two cables in free air come in contact with each other when a worst case electrical fault occurs to a bare cable in contact with a wrapped cable. This configuration represents field installations of free air cables going from:
    a. Tray to tray
    b. Tray to conduit
    c. Conduit to conduit
    d. Tray/conduit to equipment
    e. Tray/conduit to wall sleeves, etc.
2. Demonstrate that a fault cable enclosed within SWEC protective wrap, and in contact with external cables, does not affect the external cables.
3. Demonstrate that a faulted cable external to, and in contact with, a wrapped cable does not affect the protected cable.
4. Demonstrate acceptability of the SWEC protective wrap as a thermal barrier during a worst case electrical fault.

8.4 Configuration Number 3 Tests

Configuration Number 3 Tests consisted of two tests between a horizontal tray and a conduit mounted parallel to the tray. In Test 1, the faulted cable was in the cable tray 1 inch below the conduit. In Test 2, the faulted cable was in the conduit below the cable tray.

TEST NO. 1

Cable Size	Function/Location	Voltage/Current
Triplex 2/0 AWG	Fault Cable/Tray	139A, 280A, 908A*
7/C 12 AWG	Target Cable/1-in. Conduit (1 in. above the fault cable)	120 VAC, 1ϕ, 10A

* Rated Current, Final Warmup Current, Fault Current.

8.0 TEST DESCRIPTIONS (Continued)

8.4 Configuration Number 3 Tests (Continued)

TEST NO. 2

Cable Size	Function/Location	Voltage/Current
Triplex 2/0 AWG	Fault Cable/4-in. Conduit	139A, 255A, 908A*
7/C 12 AWG	Target Cable/Tray (Immediately above the fault cable conduit)	120 VAC, 1ø, 10A

* Rated Current, Final Warmup Current, Fault Current.

The purpose of the Configuration Number 3 Tests was to demonstrate that target cables enclosed in rigid steel conduit running parallel and 1 inch above a filled cable tray are not adversely affected by a faulted cable in the tray, and also that target cables in a tray running parallel and immediately above a cable in a rigid steel conduit are not adversely affected when the worst case fault occurs in the conduit.

8.5 Configuration Number 4 Test

Configuration Number 4 Test consisted of a test between three vertically separated cable trays with the fault cable located in the horizontal center tray. The trays were numbered T1, T2, and T3 from top to bottom.

TEST NO. 1

Cable Size	Function/Location	Voltage/Current
Triplex 2/0 AWG	Fault Cable/T2 (Top of tray)	139A, 280A, 908A
Triplex 2 AWG	Target Cable/T1 (Bottom of tray)	575 VAC, 3ø, 38.5A
7/C 12 AWG	Target Cable/T3 (Top of tray)	120 VAC, 1ø, 10A
2/C 16 AWG	Target Cable/T3 (Top of tray)	120 VAC, 1ø, 10A

The purpose of the Configuration Number 4 Test was to demonstrate the acceptability of design where three horizontal cable trays in a vertical stack were separated by 9 inches (from the top of one tray to the bottom of the next tray) when the worst case electrical fault occurs in the center cable tray.

8.0 TEST DESCRIPTIONS (Continued)

8.6 Configuration Number 5 Tests

Configuration Number 5 Tests consisted of three tests between flexible conduit, rigid conduit, and cable in free air. The cables and conduit were mounted such that physical separation between the faulted cable (or conduit containing the faulted cable) was greater than 0 inches but less than 1/4 inch. For Test No. 1, the faulted cable was in free air. For Test No. 2, the faulted cable was in rigid conduit. For Test No. 3, the faulted cable was in flexible conduit.

Cable Size	Function	Raceway	Voltage/Current
TEST NO. 1			
7/C 12 AWG	Target Cable	3-in. Flexible Conduit (Anaconda)	120 VAC, 1ø, 10A
Triplex 2 AWG	Target Cable	4-in. Rigid Conduit	575 VAC, 3ø, 38.5A
Triplex 2/0 AWG	Fault Cable	Free Air	139A, 280A, 908A *
TEST NO. 2			
7/C 12 AWG	Target Cable	Free Air	120 VAC, 1ø, 10A
Triplex 2 AWG	Target Cable	3-in. Flexible Conduit (BOA)	575 VAC, 3ø, 38.5A
Triplex 2/0 AWG	Fault Cable	4-in. Rigid Conduit	139A, 270A, 908A *
TEST NO. 3			
7/C 12 AWG.	Target Cable	4-in. Rigid Conduit	120 VAC, 1ø, 10A
Triplex 2 AWG	Target Cable	Free Air	575 VAC, 3ø, 38.5A
Triplex 2/0 AWG	Fault Cable	3-in. Flexible Conduit (Anaconda)	139A, 270A, 908A *

* Rated Current, Final Warmup Current, Fault Current

The purpose of the Configuration Number 5 Tests was to demonstrate the acceptability of design where a rigid conduit, flexible conduit, and a cable in free air are separated by less than 1/4-inch from each other (but not in contact), when the worst case electrical fault occurs in either conduit or to the free air cable.

8.0 TEST DESCRIPTIONS (Continued)

8.7 Configuration Number 6 Test

The Configuration Number 6 Test consisted of a test of cables and bundled, insulated conductors terminated on terminal blocks inside an enclosure, wherein a fault occurs on one of the cable conductors.

TEST NO. 1

Cable Size	Function	Voltage/Current
12 AWG & 14 AWG	Fault Conductor Loop	10A, 100A *
12 AWG & 14 AWG	Target Conductor Loop No. 1	120 VAC, 1ø, 10A
12 AWG & 14 AWG	Target Conductor Loop No. 2	120 VAC, 1ø, 10A

* Rated Current and Fault Current

The purpose of the Configuration Number 6 Test was to demonstrate the acceptability of design where control and/or instrumentation cables are bundled together inside any control and/or instrument cabinet when the worst case electrical fault occurs on any control cable.

9.0 CONCLUSIONS

The results of the cable separation verification tests demonstrated the following conclusions. These conclusions are separated into paragraphs for each test series to enhance the clarity of this report.

The successful testing of the test configurations demonstrates that the tested minimum separation distances are adequate to maintain independence of the redundant Class 1E raceways and cables from non-Class 1E raceways and cables at NMP2 for 600 volt level and below, and meets the requirements of IEEE 384-1974 and Regulatory Guide 1.75.

All target cables, in every test performed, maintained continuity of power during the overcurrent test and exhibited no significant degradation, as measured in the High Potential and Insulation Resistance Tests. The following results address observed temperatures, time to ignition, and time to open circuit.

9.1 Screening Tests

The results of the 12 Screening Tests are briefly summarized in the tables below:

Test No.	Fault Cable	Maximum Temperatures (°F) Jacket	1" Above	Time To* Ignition (sec)	Time To Open* Circuit (sec)
1A	3/C 10 AWG	456	160	N/A	38
2	3/C 8 AWG	615	1244	48	48
3	Triplex 6 AWG	1876	1481	24	59
4	Triplex 4 AWG	1798	1570	93	164
5	Triplex 2 AWG	1896	1706	225	464
6	Triplex 1/0 AWG	1855	1566	412	576
7A	Triplex 2/0 AWG	2206	1566	650	1124
8A	Triplex 3/0 AWG	1739	249	N/A	2424
9	Triplex 4/0 AWG	1313	1675	50	190
10	Triplex 250 MCM	1494	1490	125	350
11	Triplex 350 MCM	1579	1561	390	710
12	Triplex 500 MCM	1827	1513	1085	1964

* After initiation of fault current.

9.0 CONCLUSIONS (Continued)

9.1 Screening Tests (Continued)

BURN CHARACTERISTICS

Test No.	Fault Cable	Approximate Burn Time (min)	Max Current Applied
1A	3/C 10 AWG	N/A	455A
2	3/C 8 AWG	0.5	660A
3	Triplex 6 AWG	5.3	660A
4	Triplex 4 AWG	2.7	660A
5	Triplex 2 AWG	18.4	660A
6	Triplex 1/0 AWG	4.2	908A
7A	Triplex 2/0 AWG	9.0	908A
8A	Triplex 3/0 AWG	N/A	908A
9	Triplex 4/0 AWG	7.5	1860A
10	Triplex 250 MCM	8.8	2200A
11	Triplex 350 MCM	9.8	2200A
12	Triplex 500 MCM	20.0	2200A

Based on the following considerations, the Triplex 2/0 AWG cable was selected as the "worst case cable" and used as the fault cable for all subsequent configuration tests.

1. Only the 1/0 AWG and the 2/0 AWG cables ignited when subjected to the test current. Therefore, the "worst case cable" must be one of these two.

2. The 2/0 AWG cable carried the test current (908A) longer than the 1/0 AWG cable before it ignited (650 seconds versus 412 seconds).

3. The 2/0 AWG cable burned for a longer period than the 1/0 AWG cable (540 seconds versus 250 seconds).

4. The 2/0 AWG cable had a higher jacket temperature than the 1/0 AWG cable (2206°F versus 1855°F). The 2/0 AWG cable also stayed at a high jacket temperature (above 800°F) for a longer period than the 1/0 AWG cable (24.4 minutes versus 16.5 minutes).

5. The 2/0 AWG cable had as high a temperature 1 inch above the cable as did the 1/0 AWG cable (both were 1566°F).

9.0 CONCLUSIONS (Continued)

9.2 Configuration Number 1 Test

The results of the Configuration Number 1 Test are briefly summarized below:

TEST NO. 1

Cable Size	Function	Location	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	Horizontal	1598°F
Triplex 2 AWG	Target Cable	Horizontal 9 in. Above Fault Cable	239°F
7/C 12 AWG	Target Cable	Vertical 6 in. Separation	259°F
2/C 16 AWG	Target Cable	Horizontal 6 in. Separation	284°F

Time to Ignition: 11.0 minutes
Time to Open Circuit: 20.1 minutes

TEST NO. 2

Cable Size	Function	Location	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	Vertical	1503°F
Triplex 2 AWG	Target Cable	Horizontal 6 in. Separation	167°F
7/C 12 AWG	Target Cable	Horizontal 9 in. Below 2 AWG Cable	202°F

Time to Ignition: 11.5 minutes
Time to Open Circuit: 24.4 minutes

TEST NO. 3

Cable Size	Function	Location	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	Horizontal	1610°F
Triplex 2 AWG	Target Cable	Horizontal 9 in. Above Fault Cable	296°F

Time to Ignition: 10.9 minutes
Time to Open Circuit: 19.2 minutes

9.0 CONCLUSIONS (Continued)

9.2 Configuration Number 1 Test (Continued)

These results generated the following conclusions:

1. The test demonstrated the acceptability of design where two cables in free air pass either 9 inches vertically or 6 inches horizontally from each other or from a cable tray when the worst case electrical fault occurs on one of these cables.

2. It was demonstrated that a cable mounted parallel to and 9 inches above the worst case cable, which ignites during a fault condition, is not subjected to excessive temperature rise due to the flames.

9.3 Configuration Number 2 Tests

The results of the Configuration Number 2 Tests are briefly summarized below:

TEST NO. 1

Cable Size	Function	Layers of SWEC Wrap	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	4 Layers	1838°F
Triplex 1/0 AWG	Target Cable	Unwrapped	254°F

Time to Ignition: Did not ignite

Time to Open Circuit: 21.6 minutes

TEST NO. 2

Cable Size	Function	Layers of SWEC Wrap	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	Unwrapped	1783°F
Triplex 1/0 AWG	Target Cable	4 Layers	370°F

Time to Ignition: 10.7 minutes

Time to Open Circuit: 21.1 minutes

9.0 CONCLUSIONS (Continued)

9.3 Configuration Number 2 Tests (Continued)

These results generated the following conclusions:

1. The test demonstrated the acceptability of design where two cables in free air come in contact with each other when a worst case electrical fault occurs to a bare cable in contact with a wrapped cable.

2. The test demonstrated that a fault cable enclosed within SWEC protective wrap, and in contact with external cables, does not affect the external cables.

3. The test demonstrated that a faulted cable external to, and in contact with, a wrapped cable does not affect the protected cable.

4. The test demonstrated the acceptability of the SWEC protective wrap as a thermal barrier during a worst case electrical fault.

9.4 Configuration Number 3 Test

The results of the Configuration Number 3 Test are briefly summarized below:

TEST NO. 1

Cable Size	Function	Location	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	Tray	1830°F
7/C 12 AWG	Target Cable	1-inch Conduit (1 inch above fault cable)	788°F*

Time to Ignition: 10.5 minutes

Time to Open Circuit: 20.7 minutes

* The test conduit, 10 feet in length, was sealed at both ends during the test to prevent circulation of air and resultant cooling of the jacket. This configuration would result in higher jacket temperatures than would occur in the actual plant condition, where conduit runs are longer than 10 feet and air would circulate through the conduit.

9.0 CONCLUSIONS (Continued)

9.4 Configuration Number 3 Test (Continued)

TEST NO. 2

Cable Size	Function	Location	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	4-inch Conduit	1212°F
7/C 12 AWG	Target Cable	Tray (In contact and above fault cable conduit)	245°F

Time to Ignition: 22.0 minutes — Fire was very small and burned only on one end inside the conduit.

Time to Open Circuit: 22.0 minutes

These results generated the following conclusions:

1. The test demonstrated that the target cable enclosed in rigid steel conduit running parallel to, and 1-inch above, a filled cable tray performed in accordance with the acceptance criteria when subjected to the effect of a faulted cable in the tray.

2. The test demonstrated that target cables in a tray running parallel to, and immediately above, a cable in a rigid steel conduit are not affected when the worst case fault occurs in the conduit.

9.5 Configuration Number 4 Tests

The results of the Configuration Number 4 Tests are briefly summarized below:

TEST NO. 1

Cable Size	Function	Location	Maximum Jacket Temperature
Triplex 2/0 AWG	Fault Cable	T2 - Top of Tray	1820°F
Triplex 2 AWG	Target Cable	T1 - Bottom of Tray	343°F
7/C 12 AWG	Target Cable	T3 - Top of Tray	86°F
2/C 16 AWG	Target Cable	T3 - Top of Tray	86°F

Time to Ignition: 10.8 minutes

Time to Open Circuit: 22.0 minutes

9.0 CONCLUSIONS (Continued)

9.5 Configuration Number 4 Tests (Continued)

These results generated the following conclusion:

1. The test demonstrated the acceptability of design where three horizontal trays are separated by 9 inches (from the top of one tray to the bottom of the tray above) when the worst case electrical fault occurs in the center cable tray.

9.6 Configuration Number 5 Tests

The results of the Configuration Number 5 Tests are briefly summarized below:

TEST NO. 1

Cable Size	Function	Raceway	Maximum Jacket Temperature
7/C 12 AWG	Target Cable	3-in. Flexible Conduit (Anaconda)	585°F
Triplex 2 AWG	Target Cable	4-in. Rigid Conduit	387°F
iplex 2/0 AWG	Fault Cable	Free Air	1709°F

me to Ignition: 10.9 minutes

me to Open Circuit: 22.4 minutes

TEST NO. 2

Cable Size	Function	Raceway	Maximum Jacket Temperature
7/C 12 AWG	Target Cable	Free Air	318°F
riplex 2 AWG	Target Cable	3-in. Flexible Conduit (BOA)	162°F
iplex 2/0 AWG	Fault Cable	4-in. Rigid Conduit	1392°F

ie to Ignition: Did not ignite

ie to Open Circuit: 18.9 minutes

9.0 CONCLUSIONS (Continued)

9.6 Configuration Number 5 Tests (Continued)

TEST NO. 3

Cable Size	Function	Raceway	Maximum Jacket Temperature
7/C 12 AWG	Target Cable	4-in. Rigid Conduit	154°F
Triplex 2 AWG	Target Cable	Free Air	248°F
Triplex 2/0 AWG	Fault Cable	3-in. Flexible Conduit (Anaconda)	1759°F

Time to Ignition: Did not ignite

Time to Open Circuit: 20.0 minutes

The results generated the following conclusion:

The test demonstrated the acceptability of design where a rigid conduit, flexible conduit, and a cable in free air are separated by less than 1/4-inch from each other (but not in contact) when the worst case electrical fault occurs on a cable in either conduit or to the cable in free air.

9.7 Configuration Number 6 Test

The results of the Configuration Number 6 Test are briefly summarized below.

TEST NO. 1

Cable Size	Function	Maximum Jacket Temperature
12 AWG & 14 AWG	Fault Conductor Loop	128°F
12 AWG & 14 AWG	Target Conductor Loop No. 1	116°F
12 AWG & 14 AWG	Target Conductor Loop No. 2	91°F

Time to Ignition: Did not ignite

Time to Open Circuit: Did not open circuit

The results generated the following conclusion:

The test demonstrated the acceptability of design where control and/or instrumentation cables are bundled together inside any control and/or instrument cabinet when the worst case electrical fault occurs on any control cable.

10.0 QUALITY ASSURANCE

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

11.0 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-45662. Standards used in performing all calibrations are traceable to the National Bureau of Standards 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.

SCREENING TESTS
(Worst Case Cable Determination)

[illegible]

[illegible]

SECTION I

SCREENING TESTS
(WORST CASE CABLE DETERMINATION)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

There were no Acceptance Criteria for these tests. The Screening Tests were conducted to determine which cable, if faulted, would have the most impact on adjacent cables.

2.0 PROCEDURES

2.1 Test Specimen Identification

An inspection was performed upon receipt of the test specimen components at Wyle Laboratories. This inspection ensured that the test specimens were as described in Paragraph 6.0 of the Summary section. Applicable manufacturer, cable size, and SWEC ID Number were verified and recorded on Test Specimen Inspection Sheets. The test specimens were labeled, as necessary, to facilitate identification throughout the test program. The Test Specimen Inspection Sheets are contained in Appendix II of this section.

2.2 Test Specimen Preparation

1. The screening tests were conducted using a single run of the below listed cables supported by a 8-foot galvanized cable tray from NMP2 stock. The cable tray was filled to its siderails for the first five tests. The cables were spaced 3/8-inches apart for the last seven tests. The test cable was connected to the Multi-Amp Test Set per Figure 11 of Section VIII.

Test No.	Fault Cable
1A	3/C 10 AWG Cu
2	3/C 8 AWG Cu
3	Triplex 6 AWG Cu
4	Triplex 4 AWG Cu
5	Triplex 2 AWG Cu
6	Triplex 1/0 AWG Cu
7A	Triplex 2/0 AWG Cu
8	Triplex 3/0 AWG Cu
9	Triplex 4/0 AWG Cu
10	Triplex 250 MCM Cu
11	Triplex 350 MCM Cu
12	Triplex 500 MCM Cu

2.0 PROCEDURES (Continued)

2.2 Test Specimen Preparation (Continued)

2. The ends of the faulted cable from their termination to the edge of the cable tray were wrapped with a single layer, 50% overlap, of SILTEMP WT-65 covered with a single layer, 50% overlap, of 3M No. 69 glass tape. This was done to ensure that any ignition that might occur was contained to the cable tray area.

2.3 Instrumentation Setup

2.3.1 Thermocouple Locations

A total of 33 Type "K" thermocouples were utilized for these tests. These thermocouples were mounted as described below:

Channel No.	Location
1-10	Mounted directly to the outer cable jacket. The thermocouples were mounted approximately ten inches apart.
11 & 12	Mounted to the conductor of the fault cable at the two series connections.
13-33	Mounted in free air and spaced as shown in Figure 1.

These thermocouples were monitored using a Fluke Datalogger feeding a high-speed printer. The datalogger was operated at its maximum scan rate throughout the screening test.

2.3.2 Electrical Monitoring

The current to the test specimen was recorded with the test time that current was changed. These readings were taken using the Multi-Amp Test Set.

2.4 Screening Tests

The screening tests consisted of three sequential phases with no intentional time delay. The first phase consisted of powering the cable for 10 minutes with full load current. This was done to establish normal operating temperatures on this cable. The second phase consisted of raising the current to reach 90°C ±3°C conductor temperature. The third phase consisted of energizing the cable with the worst case electrical fault. The cable was subjected to this current level until either the cable open-circuited or the temperatures on the cable stabilized.

For Tests No. 1 through 12, when the fault cable temperatures stabilized (temperature rise less than 10°F over 15 minutes) but did not open-circuit, the fault current was increased to the maximum let-through current of the backup protective device, 660 amperes (Tests 1 through 5) or 2200 amperes (Tests 6 through 12), until the fault cable open-circuited.

2.0 PROCEDURES (Continued)

2.4 Screening Tests (Continued)

The screening tests were conducted using the following procedure:

1. The test specimen was connected to the Multi-Amp Test Set output stabs per Figure 11 of Section VIII. The cable termination was made in series or in parallel if necessary to obtain the required current.

2. The applicable full load current (FLA) from Table I was applied to the test specimen for 10 minutes.

3. The applied current and maximum cable temperature reached after the FLA current application were recorded.

4. The fault cable current was slowly increased until thermocouple Channels 1-11 or 12 indicated 90°C $\pm$3°C (189°-199°F). Each current level was maintained for a minimum of 5 minutes where possible and conductor temperature recorded. The current level was adjusted to maintain a cable temperature of 189°-199°F for 15 minutes.

5. The applied current and maximum cable jacket temperature were recorded.

6. The applicable test current from Table I was applied to the test specimen.

7. The test time of application, applied current level, and maximum cable jacket temperature were recorded.

8. The cable was allowed to conduct the test current until either an open circuit occurred or the cable temperature stabilized.

9. If an open circuit occurred, the elapsed time and maximum cable temperature were recorded.

10. If a 15-minute period of stabilized temperature occurred, the maximum temperature, elapsed time and applied current level were recorded. The cable was then subjected to the conditions of Step 11.

11. The fault cable current was increased to 660 amperes (Tests 1 through 5) or 2200 amperes (Tests 6 through 12) until the fault cable open-circuited or the test was terminated at the customer's request.

12. The Multi-Amp Test Set output was de-energized.

13. Photographs were taken of the post-test conditions.

NOTE: Steps 6-11 were skipped for tests where test current was less than the warmup current required to raise the conductor temperature to 189°F-199°F.

2.0 PROCEDURES (Continued)

2.4 Screening Tests (Continued)

TABLE I

Test No.	Cable Size	SWEC I.D No.	Maximum HP	Maximum Full-Load Current (FLA)	Test Current (Amperes)
1A	10 AWG-Cu	NJM-08	5	5.6	34
2	8 AWG-Cu	NJM-12	10	10.3	51
3	6 AWG-Cu	NJM-40	20	20.6	156
4	4 AWG-Cu	NJM-41	20	20.6	156
5	2 AWG-Cu	NJM-25	40	38.5	264
6	1/0 AWG-Cu	NJM-34	150	139	908
7A	2/0 AWG-Cu	NJM-28	150	139	908
8A	3/0 AWG-Cu	NJM-30	150	139	908
9	4/0 AWG-Cu	NJM-31	180	159	746
10	250 MCM-Cu	NJM-33	180	159	746
11	350 MCM-Cu	NJM-45	180	159	746
12	500 MCM-Cu	NJM-46	180	159	746

3.0 RESULTS

The twelve screening tests were conducted per Paragraph 2.0. Test No. 1 was repeated because the current source was unable to supply 660A through the No. 10 AWG conductors in series. Test No. 7 was repeated because a conductor-to-bus connection was not tightened properly. Test No. 8 was repeated because the test was interrupted by power outages due to severe weather conditions. The repeated tests are designated 1A, 7A and 8A.

The results obtained from the Screening Tests are summarized in Tables II, III and IV.

TABLE II. CURRENTS APPLIED AND TIME TO OPEN CIRCUIT

Test No.	Cable Size	Rated Current	Current at 90°C Temp	Test Current	Let-Through Current	Time to Open Circuit
1A	10 AWG - Cu	5.6	53	34	455 (1)	57 sec
2	8 AWG - Cu	10.3	87	51	660	48 sec
3	6 AWG - Cu	20.6	105	156	660	59 sec
4	4 AWG - Cu	20.6	145	156	660	237 sec
5	2 AWG - Cu	38.5	185	264	660	460 sec
6	1/0 AWG - Cu	139	235	908	(2)	300 sec
7A	2/0 AWG - Cu	139	270	908	(2)	1131 sec
8A	3/0 AWG - Cu	139	335	908	(2)	2351 sec
9	4/0 AWG - Cu	159	355	746	1860 (1)	190 sec
10	250 MCM - Cu	159	410	746	2200	350 sec
11	350 MCM - Cu	159	520	746	2200	732 sec
12	500 MCM - Cu	159	650	746	2200	1960 sec

Notes:

(1) Maximum current capability of current source

(2) Cable opened due to test current. Let-through current not applied.

3.0 RESULTS (Continued)

TABLE III. MAXIMUM TEMPERATURES

Test No.	Cable Size	Jacket	1 In. Above
1A	10 AWG - Cu	456°F	160°F
2	8 AWG - Cu	615°F	1244°F
3	6 AWG - Cu	1876°F	1481°F
4	4 AWG - Cu	1798°F	1570°F
5	2 AWG - Cu	1896°F	1706°F
6	1/0 AWG - Cu	1855°F	1566°F
7A	2/0 AWG - Cu	2206°F	1566°F
8A	3/0 AWG - Cu	1739°F	249°F
9	4/0 AWG - Cu	1313°F	1675°F
10	250 MCM - Cu	1494°F	1490°F
11	350 MCM - Cu	1599°F	1561°F
12	500 MCM - Cu	1827°F	1513°F

TABLE IV. TIME TO IGNITION AND BURN TIMES

Test No.	Cable Size	Time to Ignition	Approximate Burn Time	Max Current Applied
1A	10 AWG - Cu	N/A	N/A	455A
2	8 AWG - Cu	48 sec	30 sec	660A
3	6 AWG - Cu	24 sec	315 sec	660A
4	4 AWG - Cu	93 sec	160 sec	660A
5	2 AWG - Cu	225 sec	1103 sec	660A
6	1/0 AWG - Cu	412 sec	250 sec	908A
7A	2/0 AWG - Cu	650 sec	540 sec	908A
8A	3/0 AWG - Cu	N/A	N/A	908A
9	4/0 AWG - Cu	50 sec	450 sec	1860A
10	250 MCM - Cu	125 sec	525 sec	2200A
11	350 MCM - Cu	390 sec	585 sec	2200A
12	500 MCM - Cu	1085 sec	1200 sec	2200A

3.0 RESULTS (Continued)

Based on the preceding data and the following considerations, the Triplex 2/0 AWG cable was selected as the "worst case cable" and used as the fault cable for all subsequent configuration tests.

1. Only the 1/0 AWG and 2/0 AWG cables ignited when subjected to the test current. Therefore, the "worst case cable" must be one of these two.

2. The 2/0 AWG cable carried the test current (908A) longer than the 1/0 AWG cable before it ignited (650 seconds versus 412 seconds).

3. The 2/0 AWG cable burned for a longer period than the 1/0 AWG cable (540 seconds versus 250 seconds).

4. The 2/0 AWG cable had a higher jacket temperature than the 1/0 AWG cable (2206°F versus 1855°F). The 2/0 AWG cable also stayed at a high jacket temperature (above 800°F) for a longer period than the 1/0 AWG cable (24.4 minutes versus 16.5 minutes).

5. The 2/0 AWG cable had as high a temperature 1 inch above the cable as did the 1/0 AWG cable (both were 1566°F).

Appendices I through III contain the following data from these data:

Appendix I: Test Specimen Inspection Sheets which document material received from SWEC to conduct all phases of testing.

Appendix II: Instrumentation Equipment Sheets which list the equipment utilized to take data in all phases of testing.

Appendix III: Individual Test Data. This data is separated into individual sections for each test conducted. Each section contains: 1) Photographs of the test setup and post-test conditions; 2) Highlights of the test; 3) A plot of temperature data recorded; and 4) Data Sheets.

NOTE: During the warmup to 189°F-199°F period of Screening Tests 2, 3, 4, and 5, the cable jacket temperature as monitored by TC Channels 1-10 was higher than the conductor temperature as monitored by TC Channels 11 and 12. Therefore, the jacket temperature was used to determine that the cable had been warmed to 189°F-199°F. The indicated conductor temperature was lower than the indicated jacket temperature because thermocouples monitoring the conductor temperature were mounted near the conductor to bus connection. The bus acted as a heat sink resulting in lower conductor temperatures at the connection. During warmup of the cable, the conductor temperature would have to be higher than the temperature of the adjacent jacket, because the conductor is the heat source.

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APPENDIX I

TEST SPECIMEN INSPECTION SHEETS

TEST SPECIMEN INSPECTION

CUSTOMER STONE & WEBSTER ENGINEERING COMPANY

JOB NO. 47906

SPECIFICATION WLTP 47906-01

DATE 8-20-85

CHECK AS APPROPRIATE

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
1	500MCM TRIPLEX, 3-1/c+1 GND	OKONITE	SWEC I.D. No. NJM-46	✓	✓	
2	350 MCM TRIPLEX, 3-1/c +1GND	OKONITE	SWEC I.D. No. NJM-45	✓	✓	
3	250MCM TRIPLEX, 3-1/c+1 GND	OKONITE	SWEC I.D. No NJM-33	✓	✓	
4	4/0 AWG TRIPLEX, 3-1/c+2 GND	OKONITE	SWEC I.D. No. NJM-31	✓	✓	
5	3/0 AWG TRIPLEX, 3-1/c+2 GND	OKONITE	SWEC I.D. No. NJM-30	✓	✓	
6	2/0 AWG TRIPLEX, 3-1/c+2 GND	OKONITE	SWEC I.D. No. NJM-28	✓	✓	
7	1/0 AWG TRIPLEX, 3-1/c+2 GND	OKONITE	SWEC I.D. No. NJM-34	✓	✓	
8	2 AWG TRIPLEX, 3-1/c+1 GND	OKONITE	SWEC I.D. No. NJM-25	✓	✓	
9	4 AWG TRIPLEX, 3-1/c+1 GND	OKONITE	SWEC I.D. No. NJM-41	✓	✓	
10	6 AWG TRIPLEX, 3-1/c+1GND	OKONITE	SWEC I.D. No. NJM-40	✓	✓	
11	8 AWG 3/C	OKONITE	SWEC I.D. No. NJM-12	✓	✓	

NOTES: See attached list for items provided by SWEC to support cable testing. (Cable tray, conduit, fittings). SWEC also provided miscellaneous cables for use as filler cables.

Specimen Failed ______
Specimen Passed ✓
NOA Written ______

Inspected By B. N. Halligan Date: 8-20-85
Witness J. P. King Date: ______
Sheet No. 1 of 2
Approved J. P. King 8/20/85

TEST SPECIMEN INSPECTION

CUSTOMER STONE + WEBSTER ENGINEERING COMPANY

JOB NO. 47906

SPECIFICATION WLTP 47906-01

DATE 8-20-85

CHECK AS APPROPRIATE

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
12	10 AWG 3/C	OKONITE	SWEC I.D. No. NJM-08	✓	✓	
13	12 AWG 7/C	ROCKBESTOS	SWEC I.D. No. NJN-37	✓	✓	
14	16 AWG 2/C	OKONITE	SWEC I.D. No. NJP-05		✓	

NOTES:

Specimen Failed
Specimen Passed ✓
NOA Written

Inspected By [signature] Date: 8-20-85
Witness J. P. King Date:
Sheet No. 2 of 2
Approved J. P. King 8/20/85

STONE & WEBSTER ENGINEERING CORPORATION

RETURN REPORT

DATE	NO.	NO.	
8/12/85	10.07	12137	85-1043

180507

SHIPPED TO: BELOW

VIA: RANGER NATIONWIDE (EXCLUSIVE)

WYLE LABORATORIES
7800 GOVERNORS DRIVE WEST
HUNTSVILLE, ALABAMA 35807-5101
ATTN: GEORGE E. HAVER/SR CONTRACT ADMINISTRATOR

YOUR RETURN AUTHORIZATION: T LANDRY/SEG

REASONS FOR RETURNING: ESSOW NO. E0907
TESTING FOR ELECTRICAL SEPARATION VERIFICATION JOB ORDER 12177

YOUR INVOICE NO. OR DATE	NO. OF PKG'S	WEIGHT	QUANT.	SIZE	MATERIAL (RECORD IDENTIFICATION MARKS)	REMARKS (STATE CONDITION)
	1 Pall	995	4 EA		4" DEEP, 24" WIDE, 10' LONG TRAY	DAJ-01
			20 FT		1" RIGID CONDUIT	
			10 FT		3" RIGID CONDUIT	
			10 FT		5" RIGID CONDUIT	
			10 FT		1" BLACK ANACONDA FLEX	
			9 FT		3" BLACK ANACONDA FLEX	
			10 FT		5" BLACK ANACONDA FLEX	
			10 FT		3" BOA S.S. FLEX	
			100 FT		SIL TEMP #188-CH	
			2 EA		1" OZ GEDNEY #4Q100LT ST SEALTIGHT	CONNECTORS
			2 EA		3" OZ GEDNEY #4Q300LT ST SEALTIGHT	CONNECTORS
			2 EA		5" " " #\$4Q500LT " "	"
			2 EA		1" REG. LOCKNUTS	
			2 EA		3" REG. LOCKNUTS	
			2 EA		5" REG. LOCKNUTS	
			2 EA		1" GR. BUSHINGS	
			2 EA		3" GR. BUSHINGS	
			2 EA		5" GR. BUSHINGS	
			2 EA		3" MI BOA CONNECTORS	

FREEDOM

FREIGHT	ENCLOSURES	RETURNED BY (SHOW NAME P.O. ADDRESS)
☐ COLLECT	☐ ORIGINAL B/L	STONE & WEBSTER ENGINEERING CORPORATION
☒ PREPAID	☐ DUPLICATE B/L	P.O. BOX 63, LYCOMING, N.Y. 13093
		BY K Coffin

TEST SPECIMEN INSPECTION

CUSTOMER STONE & WEBSTER ENGINEERING CORP.

JOB NO. 47906 (CONFIGURATION 6)

SPECIFICATION WLTP 47906-01, IPR -02

DATE 10-17-85

CHECK AS APPROPRIATE

ITEM NO.	DESCRIPTION	MANUF.	PART/MODEL NO.	SAME I.D. AS SPEC	CONDITION SATISFACTORY	PHOTO TAKEN
1	5/C, #12 CABLE	ROCKBESTOS	SWEC I.D. No. NJN-36	✓	✓	
2	2/C, #12 CABLE	ROCKBESTOS	SWEC I.D. No. NJN-34	✓	✓	
3	1/C, #14 INSULATED COND.	ROCKBESTOS	SWEC I.D. No. NAF-52	✓	✓	

NOTES: SUPPORT ITEMS INCLUDED: NEMA 12 ENCLOSURE, 36" x 36" x 8" D, HOFFMAN # A363608LT WITH 33" x 33" PANEL # A-36P36; 12 POINT TERMINAL BLOCK, GE TYPE EB25A12W; 12 POINT TERMINAL BLOCK, MARATHON 1512 NUC DJ.

Specimen Failed ______
Specimen Passed ✓
NOA Written ______

Inspected By V. Romao Date: 10-17-85
Witness None Date: ______
Sheet No. 1 of 1
Approved J. P. King 10/17/85

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APPENDIX II

INSTRUMENTATION EQUIPMENT SHEETS

INSTRUMENTATION EQUIPMENT SHEET

Date 8/20/85 Job No. 47906 Test Area ACOUSTIC CHAMBER

Technician Victor Romao Customer NMPC Type Test CABLE SEPARATION

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
1	Visicorder	Honeywell	1508	NA	11022	120HZ	±2%	7-9-85	1-9-86
2	Visicorder	Honeywell	1508	NA	3085	120HZ	±2%	5-7-85	11-7-85
3	Galvo Amp	Honeywell	T6GA-500	NA	94501	1:1	±2%	7-9-85	1-9-86
4	Galvo Amp	Honeywell	T6GA-500	NA	11472	1:1	±2%	5-7-85	11-7-85
5	Galvo Amp	Honeywell	T6GA-500	NA	94502	1:1	±2%	5-21-85	11-21-85
6	Galvo Amp	Honeywell	T6GA-500	NA	94505	1:1	±2%	7-9-85	1-9-~~85~~ 86
7	Galvo Amp	Honeywell	T6GA-600	NA	96285	1:1	±2%	7-9-85	1-9-86
8	Data Logger	Fluke	2240B	NA	102141	mult	Mfg. Spec	8-2-85	2-2-86
9	DMM	Fluke	8020A	NA	102060	750Vac	.1% ac	12-7-84	12-7-85
10	DMM	Keithley	179	NA	0545	1000V	±.04%	7-23-85	1-23-86
11	Hi Speed Line Printer	Lear Siegler Inc.	300	NA	E.R 75543	mult	Mfg. Spec	Prior to 7-18-85	Test
12	Current Transformer	Brownell	5SFT-101	NA	100652	100 to 5	±10%	5-14-85	11-14-85
13	Transformer	Brownell	5SFT 101	NA	100666	100 to 5	±10%	5-14-85	11-14-85
14	Transformer	Brownell	5SFT 101	NA	100678	100 to 5	±10%	5-14-85	11-14-85
15	Transformer	Brownell	5SFT 101	NA	102783 ~~100 223~~	100 to 5	±10%	5-14-85	11-14-85
16	Transformer	Brownell	5SFT 101	NA	100676	100 to 5	±10%	5-14-85	11-14-85
17	Transformer	Brownell	5SFT 101	NA	100668	100 to 5	±10%	5-14-85	11-14-85
18	Transformer	Brownell	5SFT 101	NA	100679	100 to 5	±10%	4-12-85	10-12-85

Wyle 4/22/85

Instrumentation [signature] 8/20/85

2 Wyle 4/22/85

Checked & Received By [signature] 8·20·85

WH 1029 Rev. A 11/82

INSTRUMENTATION EQUIPMENT SHEET

Date 8/20/85 Job No. 47906 Test Area Acoustic Chamber

Technician Victor Romao Customer NMPC Type Test Cable Separation

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
19	Current Transformer	Brownell	55FT101	NA	100020	100 to 5	± 10%	5-14-85	11-14-85
20	Hypot	Associated Research	4030	NA	96776	5KVac	± 3%	7-23-85	10-23-85
21	Megohmmeter	General Radio	1864	NA	11898	1000	MFG.	4-25-85	10-25-85
22	DMM	Fluke	8020A	NA	96778	750Vac	±.1%	2-19-85	2-19-86
23	DMM	Keithley	130	NA	3105	750Vac	±5%	3-25-85	9-25-85
24	Clamp on Amp meter	Fluke	80I600	NA	92675	2 to 600 Amp	±3%	6-3-85	12-3-85
25	Mult Amp	Mult Amp	CB8130	NA	100413	mult	mult Amp	3-2-85	3-2-86
	8/22/85								
					Wyle	8/22/85			

Page No. I-17
Test Report No. 47906-02

Instrumentation [signature] 8-20-85 Checked & Received By [signature] 8·20·85

WH 1029, Rev. A 11/82

INSTRUMENTATION EQUIPMENT SHEET

Date 9-5-85 Job No. 47906 Test Area ACOUSTIC CHAMBER

Technician VICTOR ROMAO Customer NMPC Type Test CABLE SEPARATION

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
1	TRANSFORMER	WESTON	461	16132	3022	MULT	±1%	5-16-85	11-16-85
2	TRANSFORMER	WESTON	461	24981	97427	MULT	±1%	5-16-85	11-16-85
3	TRANSFORMER	WESTON	461	24979	97428	MULT	±1%	5-16-85	11-16-85
2 Wyle A	9-6-85								

2 Wyle A 9-6-85

Instrumentation Gregory M. Wirt 9-5-85 Checked & Received By J. King 9-5-85

WH 1029 Rev. A 11/82

INSTRUMENTATION EQUIPMENT SHEET

Date 10/17/85 Job No. 47906 Test-Area ACOUSTIC CHAMBER

Technician G. WIRT Customer SWEC Type Test CABLE SEPARATION

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
1	DATALOGGER	FLUKE	2240	N/A	96375	MULTI	MFG	10/7/85	4/7/86
2	LINE PRINTER	TEXAS INSTRUMENT	810 RO	N/A	3009	MULTI	PM	9/19/85	3/19/86
3	VISICORDER	HONEYWELL	1508	N/A	11022	MULTI	+/-2%	7/9/85	1/9/86
4	GALVO AMP	HONEYWELL	T6GA	N/A	94502	1:1	+/-2%	9/24/85	3/24/86
5	GALVO AMP	HONEYWELL	T6GA	N/A	94505	1:1	+/-2%	7/9/85	1/9/86
6	CURRENT X-FORMER	BROWNELL	SSFT101	N/A	100667	100:5	+/- ~~2%~~ 10% [illegible]	5/14/85	11/14/85
7	CURRENT X-FORMER	BROWNELL	SSFT101	N/A	100674	100:5	+/- ~~2%~~ 10% [illegible]	5/14/85	11/14/85
8	MEGOHMMETER	GENERAL RADIO	1864	N/A	11898	MULTI	MFG	4/25/85	10/25/85
9	AC HYPOT	ASSO. RESEARCH	04030A	N/A	100165	MULTI	+/-3%	10/16/85	4/16/86
10	MULTI AMP	INDIAN HEAD CO.	CB8130	N/A	100413	MULTI	MFG	3/2/85	3/2/86
11	CLAMP-ON-AMP	FLUKE	801600	N/A	92675	MULTI	+/-3%	06/03/85	12/03/85
12	DMM	KEITHLEY	178	N/A	11313	MULTI	MFG	9/25/85	3/25/86
2 Wyle A	10-18-85								

2 Wyle A 10-18-85

Instrumentation K Burkhart 10-17-85 Checked & Received By John P. King 10/18/85

WH 1029, Rev. A 11/82

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APPENDIX III

INDIVIDUAL TEST DATA

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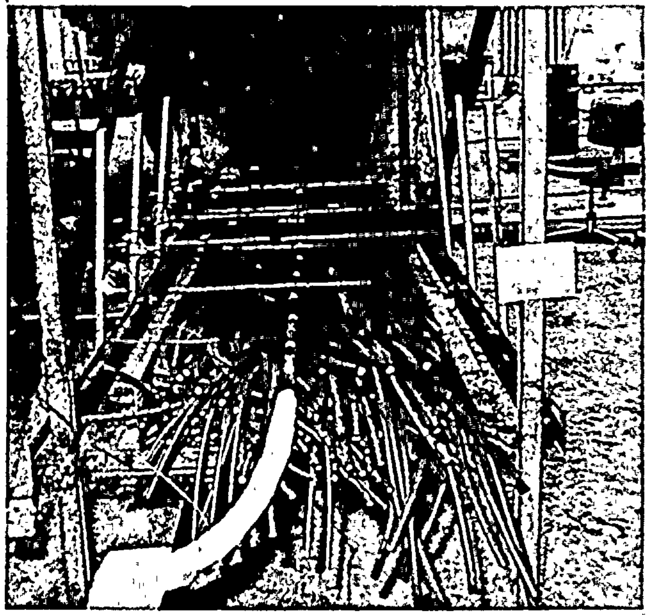
SCREENING TEST 1A DATA

SCREENING TEST #1A

(3/C 10 AWG Cu)

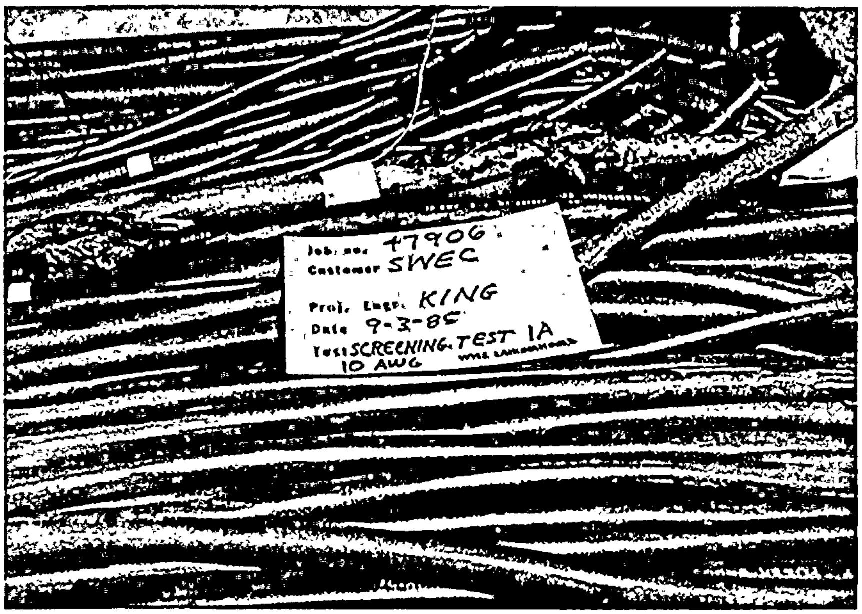
PHOTOGRAPH I-1

PRETEST VIEW — OVERALL



PHOTOGRAPH I-2

POST-TEST VIEW — OVERALL



PHOTOGRAPH I-3

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #1A

(3/C 10 AWG Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	88°F	Energized cable with 5.6A
10 Min	88°F	Energized cable with 59A
25 Min	143°F	Energized cable with 50A
30 Min	149°F	Energized cable with 55A
50 Min	170°F	Energized cable with 53A Conductor temp. at 189°F
62.1 Min	172°F	Energized cable with 455A, decreasing as conductor heated (current source at maximum output)
62.9 Min	1656°F	Open circuit
63 Min	456°F	Peak jacket temperature (456°F) Peak array temperature (160°F)
63.7 Min	440°F	Peak conductor temp. (1656°F)

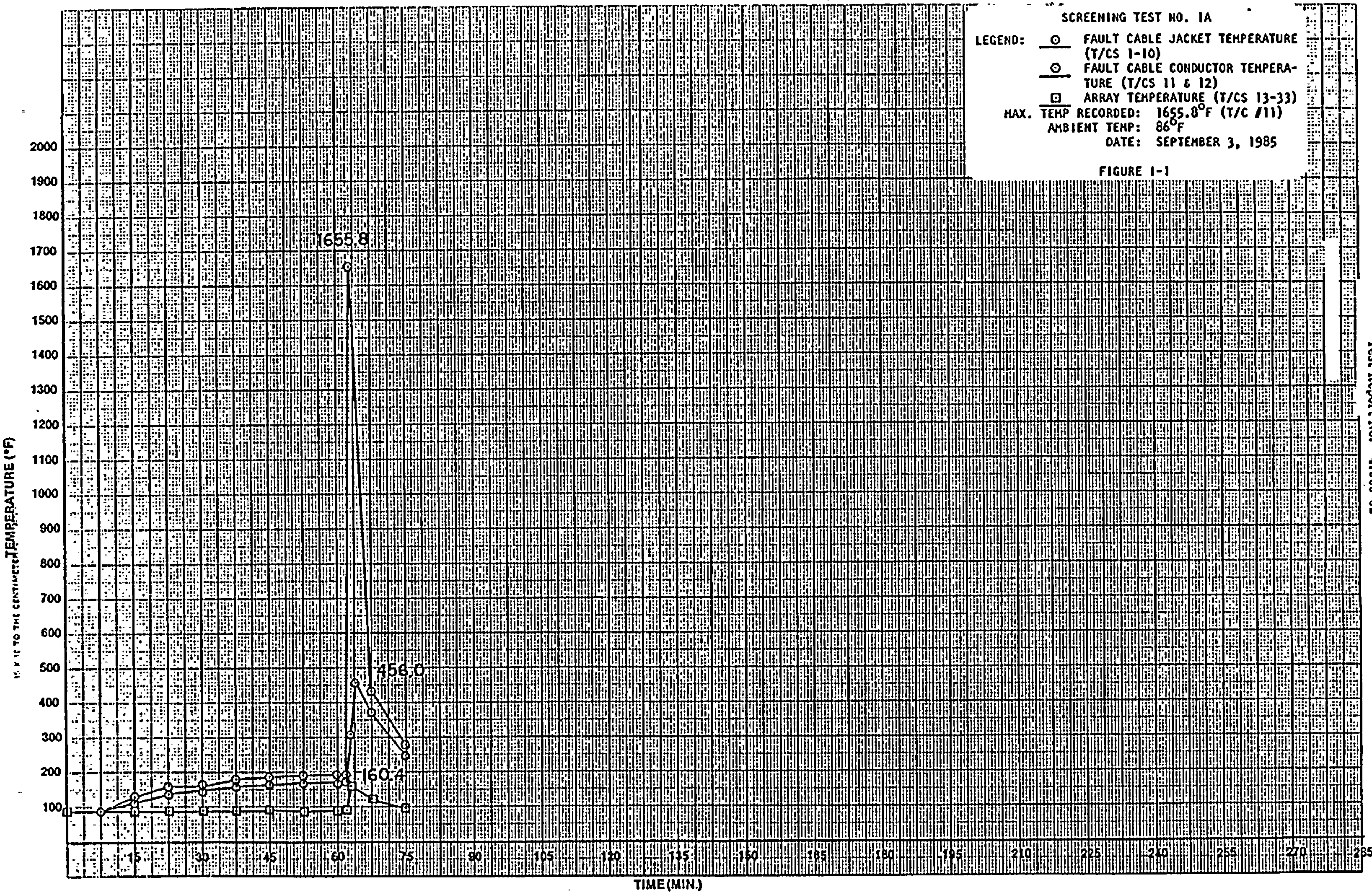

SCREENING TEST NO. 1A
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1655.8°F (T/C #11)
AMBIENT TEMP: 86°F
DATE: SEPTEMBER 3, 1985
1655.8
456.0
160.4
TEMPERATURE (°F)
TIME (MIN.)

FIGURE I-1

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 86°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-3-85

Test Title: Screening Test No. 1 A

Fault Cable Size:	10 AWG		
No. Conductors:	3		
3. readings after 10 minute application of FLA:			
Current:	5.6 A		
Max. Temp. °F Channels 1-10:	88°F/7		
Temp. Channel 11:	85°F	Temp. Channel 12:	87°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)			
Current:	55 A		
Max. Temp. °F Channels 1-10:	168°F	Channel No.	10
Temp. Channel 11:	187°F	Temp. Channel 12:	189°F

Notice of Anomaly: None

Tested By: [signature] Date: 9/3-85
Witness: None Date:
Sheet No. 1 of 3
Approved: [signature] 9/3/85

DATA SHEET

WYLE LABORATORIES

Customer	Stone & Webster				
Specimen	Cables				
Part No.	Various	Amb. Temp.	66°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-2
Para.	3.2.3	Test Med.	Air	Start Date	9-3-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title: Screening Test No. 1A

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current:	53 A	
	Max. Temp. °F Channels 1-10:	172°F	Channel No. 10
	Temp. Channel 11:	192°F	Temp Channel 12: 194°F
9-11.	Final readings with test current applied:	N/A Test current less than warmup current	
9.	If open circuit occurs:		
	Elapsed time:		
	Max. Temp. °F Channels 1-12:		Channel No.
10.	If 15-minute period of stabilized temperature occurs:		
	Current:		
	Elapsed time to beginning of 15-minute period:		
	Max. Temp. °F Channels 1-12:		Channel No.
11.	If fault cable ignites:		
	Elapsed time to ignition:		

Tested By [signature] Date: 9-3-85
Witness None Date:
Sheet No. 2 of 3
Approved [signature] 9/3/85

Notice of Anomaly: None

Wyle Form WH 614A Rev APR 31

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 86°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-3-85

Test Title: Screening Test No. 1A

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current: 455A (Limit of test equipment capability)
Max. Temp. °F Channels 1-10: 456 Channel No. 9
Elapsed time to open circuit or stable temp: 38 sec
Time to ignition if applicable: N/A

Tested By: Thomas Date: 9/3/85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 9/3/85

Notice of Anomaly: None

Wyle Form WH-614A Rev. APR '34

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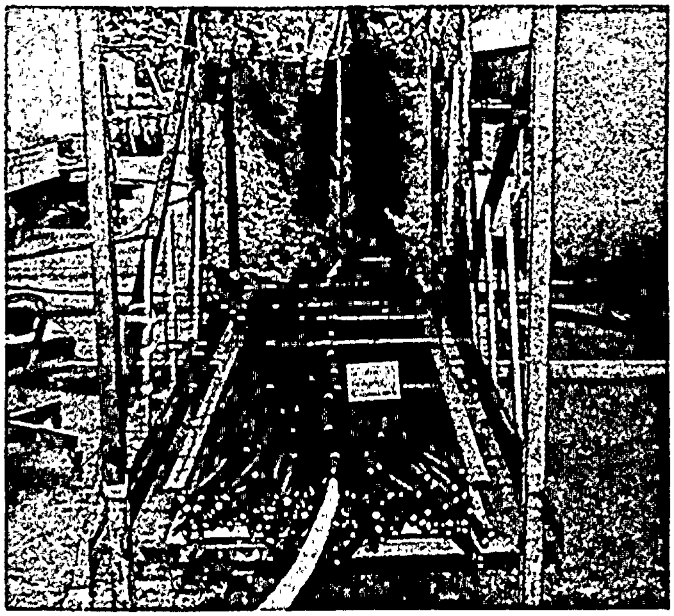
SCREENING TEST 2 DATA

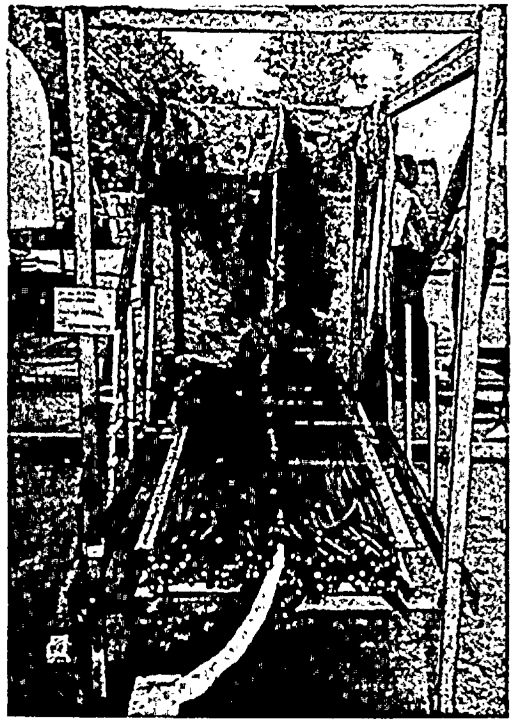
SCREENING TEST #2

(3/C 8 AWG Cu)



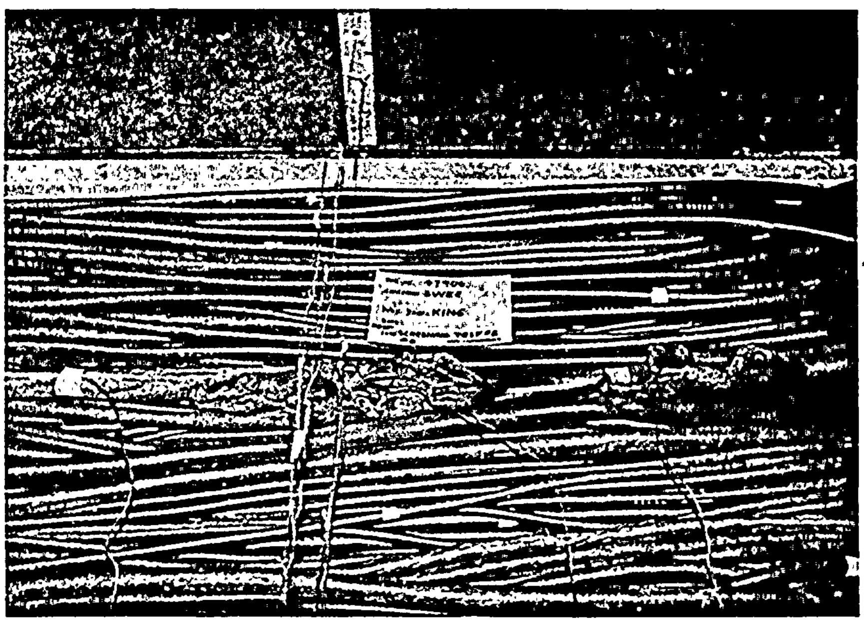
PHOTOGRAPH I-4

PRETEST VIEW — OVERALL



PHOTOGRAPH I-5

POST-TEST VIEW — OVERALL



PHOTOGRAPH I-6

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #2

(3/C 8 AWG Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	79°F	Energized cable with 10.3A
10 Min	81°F	Energized cable with 60A
37.7 Min	117°F	Energized cable with 70A
47.7 Min	130°F	Energized cable with 84A
72.7 Min	166°F	Energized cable with 87A
83.3 Min	178°F	Energized cable with 89A
97 Min	189°F	Jacket temp. at 189°F
112 Min	199°F	Energized cable with 660A (Max. let-through current of backup protection)
112.8 Min	614°F	Ignition and Open Circuit
113.3 Min	362°F	Fire out
113.3 Min	362°F	Peak conductor temp. (1054°F)
113.3 Min	362°F	Peak array temperature (1244°F)
114 Min	615°F	Peak jacket temp. (615°F)

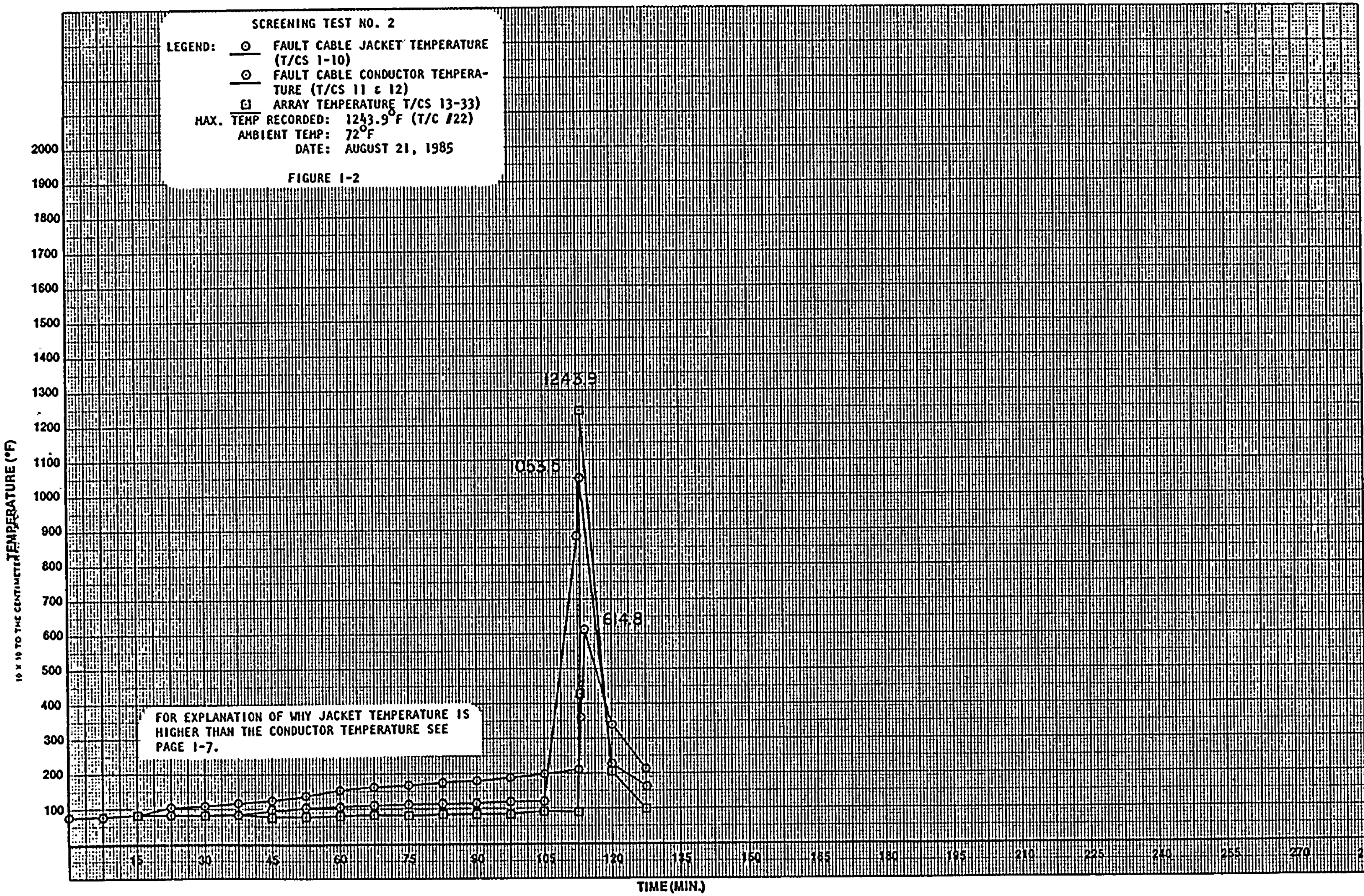

SCREENING TEST NO. 2
LEGEND: ⊙ FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
⊙ FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
⊡ ARRAY TEMPERATURE T/CS 13-33)
MAX. TEMP RECORDED: 1243.9°F (T/C #22)
AMBIENT TEMP: 72°F
DATE: AUGUST 21, 1985
1243.9
1053.5
614.8
FOR EXPLANATION OF WHY JACKET TEMPERATURE IS HIGHER THAN THE CONDUCTOR TEMPERATURE SEE PAGE I-7.
TEMPERATURE (°F)
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
TIME (MIN.)
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
10 X 10 TO THE CENTIMETER

FIGURE I-2

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/21/85

Test Title: Screening Test No. 2

Fault Cable Size: 8 AWG

No. Conductors: 3

3. readings after 10 minute application of FLA:

Current: 10.3 A

Max. Temp. °F Channels 1-10: 81°F/9

Temp. Channel 11: 80°F   Temp. Channel 12: 78°F

5. Readings at beginning of 15-minute period at 90°C +3°C (189°F-199°F)

Current: 92 A

Max. Temp. °F Channels 1-10: 189°F/9   Channel No. 9

Temp. Channel 11: 118°F   Temp. Channel 12: 111°F

Tested By: [signature] Date: 8/21/85
Witness: None Date:
Sheet No. 1 of 3
Approved: JKing 9/3/85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/21/85

Test Title: Screening Test No. 2

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current: 87A		
	Max. Temp. °F Channels 1-10: 199°F	Channel No.	9
	Temp. Channel 11: 120	Temp Channel 12:	112
9-11.	Final readings with test current applied: N/A Test current is less than warmup current.		
	9. If open circuit occurs:		
	Elapsed time:		
	Max. Temp. °F Channels 1-12:	Channel No.	
	10. If 15-minute period of stabilized temperature occurs:		
	Current:		
	Elapsed time to beginning of 15-minute period:		
	Max. Temp. °F Channels 1-12:	Channel No.	
	11. If fault cable ignites:		
	Elapsed time to ignition:		

Notice of Anomaly: None

Tested By: [signature] Date: 8/21/85
Witness: None Date:
Sheet No. 2 of 3
Approved: [signature] 8-21-85

Wyle Form WH 614A, Rev APR 34

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/21/85

Test Title: Screening Test No. 2

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current: 660 A
Max. Temp. °F Channels 1-10: 615°F Channel No. 8
Elapsed time to open circuit or stable temp: 48 sec to open
Time to ignition if applicable: 48 sec

Notice of Anomaly: None

Tested By: [signature] Date: 8/21/85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 8-21-85

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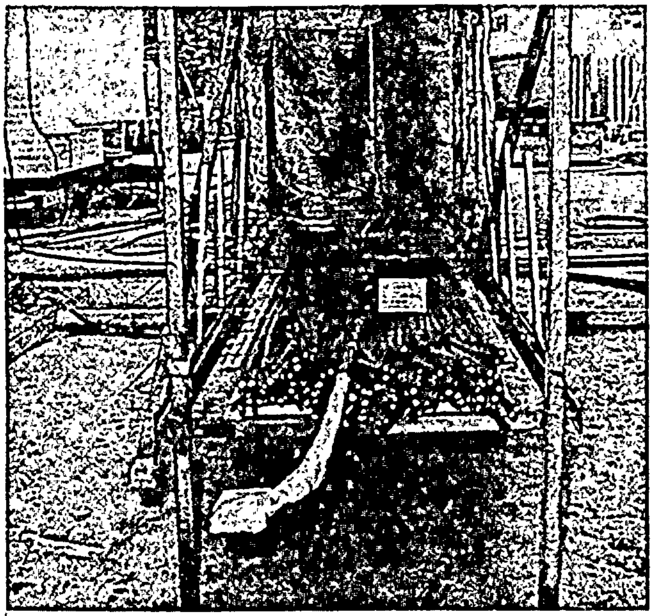
SCREENING TEST 3 DATA

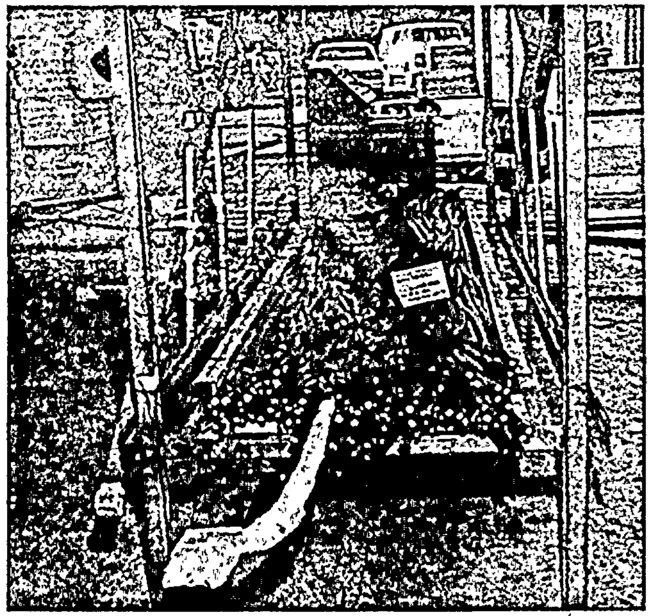
SCREENING TEST #3

(6 AWG Triplex)



PHOTOGRAPH I-7

PRETEST VIEW — OVERALL



PHOTOGRAPH I-8

POST-TEST VIEW — OVERALL

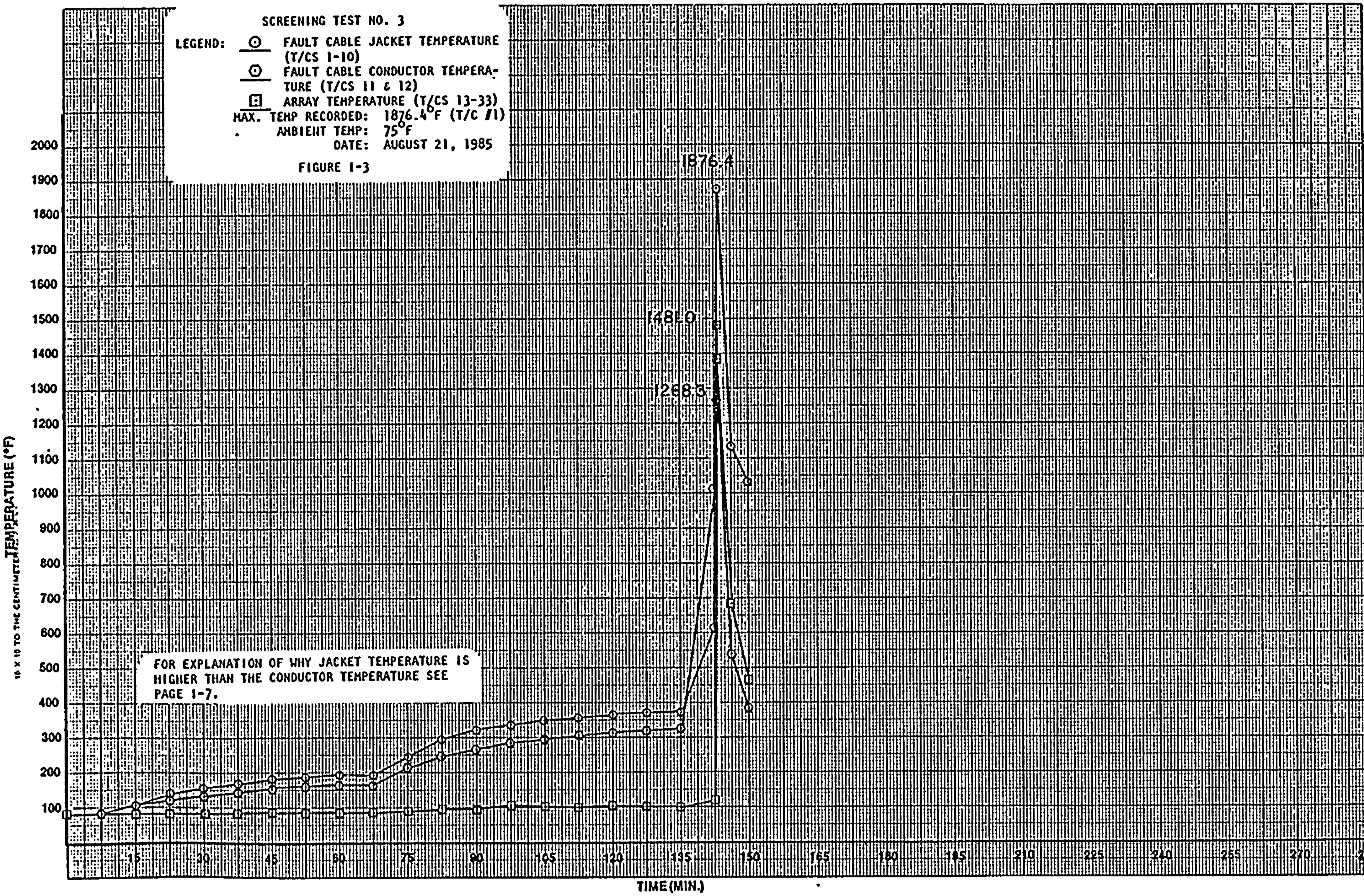
PHOTOGRAPH I-9

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #3

(6 AWG Triplex)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	82°F	Energized cable with 20.7A
10 Min	83°F	Energized cable with 100A
40 Min	164°F	Energized cable with 113A
44 Min	181°F	Energized cable with 105A
54.2 Min	189°F	Jacket temp. at 189°F
69.2 Min	191°F	Energized cable with 156A (Test current)
141.7 Min	373°F	Cable temperature stabilized for 15 minutes.
		Energized cable with 660A (Max. let-through current of backup protection)
142.2 Min	608°F	Ignition
142.6 Min	1876°F	Open Circuit
142.6 Min	1876°F	Peak conductor temp. (1268°F)
142.6 Min	1876°F	Peak jacket temp. (1876°F)
142.6 Min	1876°F	Peak array temp. (1481°F)
147.4 Min	1350°F	Fire Out



SCREENING TEST NO. 3
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1876.4°F (T/C #1)
AMBIENT TEMP: 75°F
DATE: AUGUST 21, 1985
FIGURE 1-3
FOR EXPLANATION OF WHY JACKET TEMPERATURE IS HIGHER THAN THE CONDUCTOR TEMPERATURE SEE PAGE 1-7.
1876.4
1481.0
1268.3
TEMPERATURE (°F)
TIME (MIN.)

DATA SHEET

Customer: Stone & Webster

WYLE LABORATORIES

Specimen: Cables

Part No.: Various

Spec.: WLTP 47906-01

Para.: 3.2.3

S/N: N/A

GSI: No

Amb. Temp.: 75°F

Photo: Yes

Test Med.: Air

Specimen Temp.: Ambient

Job No.: 47906

Report No.: 47906-2

Start Date: 8-21-85

Test Title: Screening Test No. 3

Fault Cable Size:	6 AWG Triplex		
No. Conductors:	3		
3. readings after 10 minute application of FLA:			
Current:	20.7 A		
Max. Temp. °F Channels 1-10:	83°F / 9		
Temp. Channel 11:	84°F	Temp. Channel 12:	85°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)			
Current:	105 A		
Max. Temp. °F Channels 1-10:	189°F	Channel No.	2
Temp. Channel 11:	161	Temp. Channel 12:	161

Tested By: [signature] Date: 8/21/85

Witness: [signature] Date:

Sheet No. 1 of 3

Approved: [signature] 8-21-85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 75°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-21-85

Test Title: Screening Test No. 3

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)	
	Current: 105 A	
	Max. Temp. °F Channels 1-10: 191°F	Channel No. 3
	Temp. Channel 11: 174	Temp Channel 12: 173
9-11.	Final readings with test current applied:	
	9. If open circuit occurs: N/A	
	Elapsed time:	
	Max. Temp. °F Channels 1-12:	Channel No.
	10. If 15-minute period of stabilized temperature occurs:	
	Current: 156 A	
	Elapsed time to beginning of 15-minute period: 3300 sec	
	Max. Temp. °F Channels 1-12: 368°F	Channel No. 1
	11. If fault cable ignites: N/A	
	Elapsed time to ignition:	

Tested By: [signature] Date: 8/21/85
Witness: [signature] Date:
Sheet No. 2 of 3
Approved: [signature] 8-21-85

Notice of Anomaly: None

Wyle Form WH 614A Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 75°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-21-85

Test Title: Screening Test No. 3

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current:	660A	
Max. Temp. °F Channels 1-10:	1876	Channel No. 1
Elapsed time to open circuit or stable temp:	59 sec	
Time to ignition if applicable:	24 sec	

Notice of Anomaly: None

Tested By: [signature] Date: 8/21/85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 8-21-85

Wyle Form WH 514A Rev APR 34

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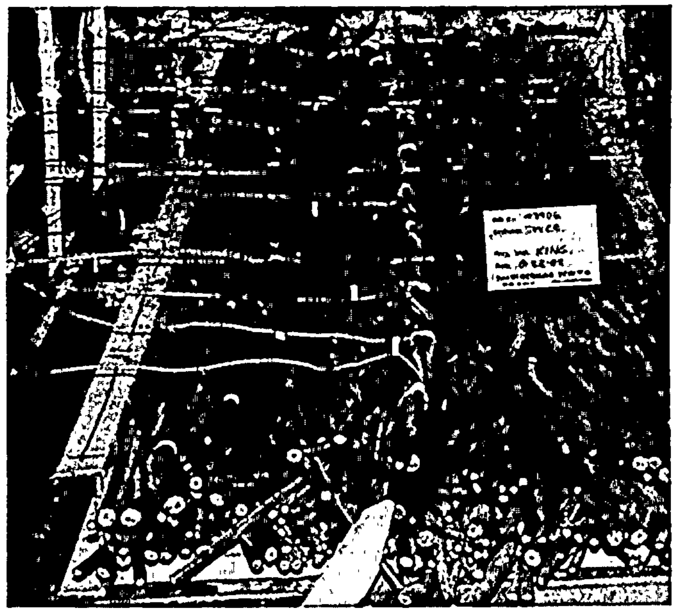
SCREENING TEST 4 DATA

SCREENING TEST #4

(4 AWG Triplex)

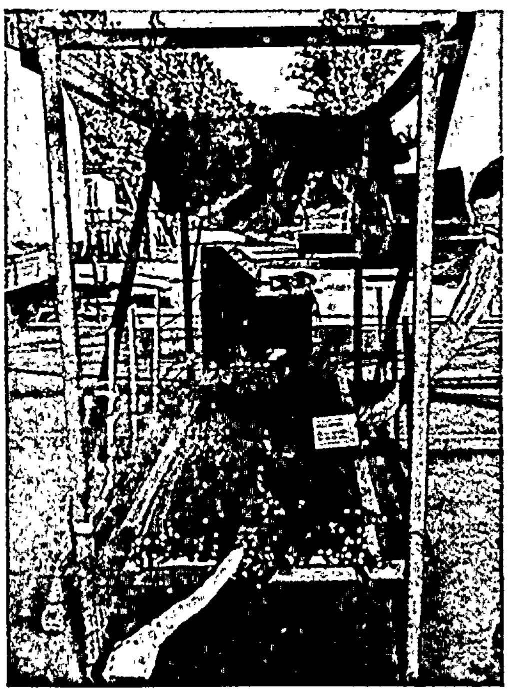
PHOTOGRAPH I-10

PRETEST VIEW — OVERALL



PHOTOGRAPH I-11

PRETEST VIEW — CLOSE-UP



PHOTOGRAPH I-12

POST-TEST VIEW — OVERALL

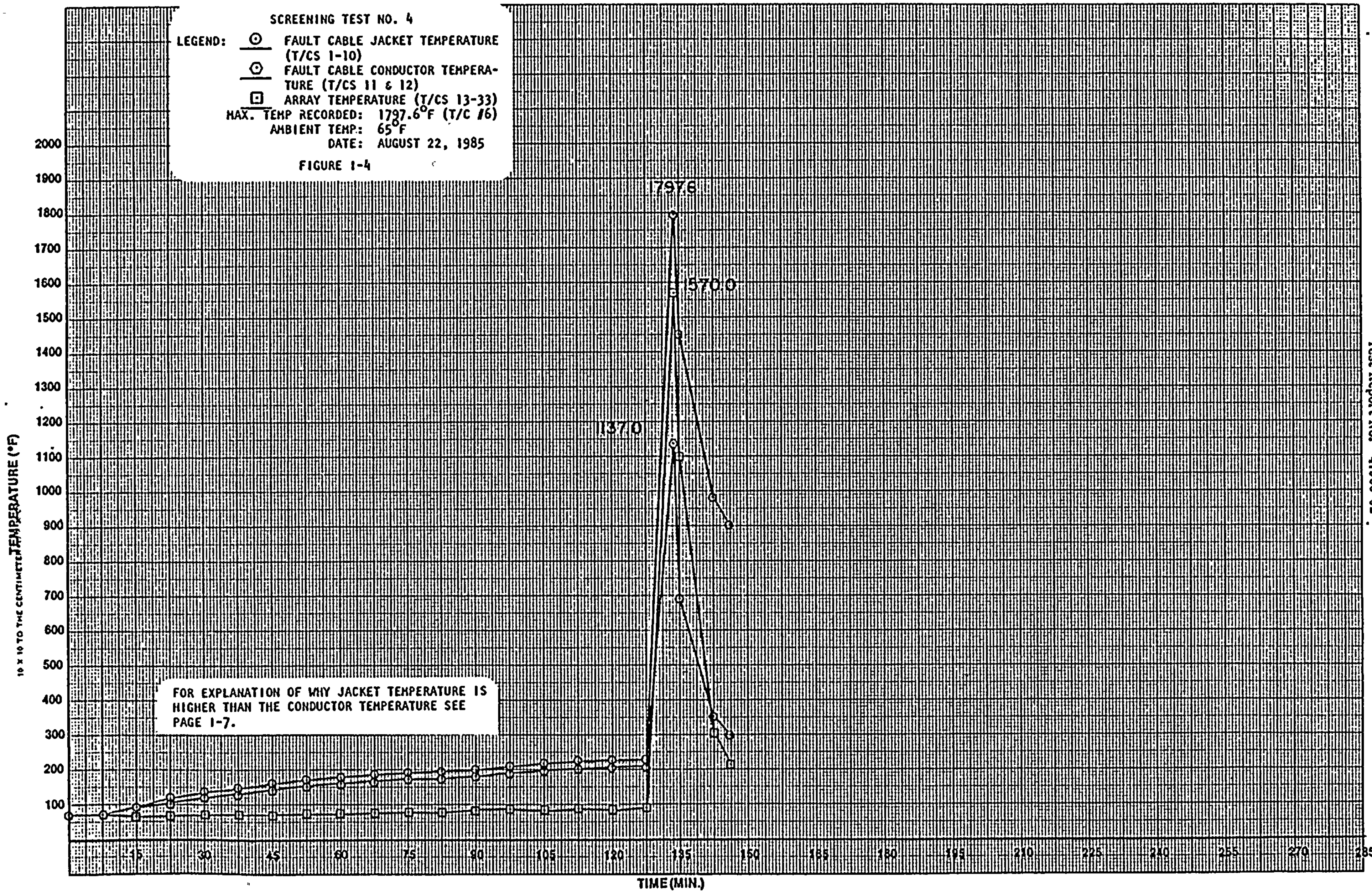
PHOTOGRAPH I-13

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #4

(4 AWG Triplex)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	73°F	Energized cable with 20.7A
10 Min	72°F	Energized cable with 130A
40 Min	151°F	Energized cable with 140A
70 Min	184°F	Energized cable with 145A
75.7 Min	189°F	Jacket temp. at 189°F
90.7 Min	200°F	Energized cable with 156A (Test current)
130.7 Min	226°F	Cable temperature stabilized for 15 minutes.
		Energized cable with 660A (Max. let-through current of backup protection)
132.2 Min	1420°F	Ignition
133.4 Min	1798°F	Open Circuit
133.4 Min	1798°F	Peak conductor temp. (1137°F)
133.4 Min	1798°F	Peak jacket temp. (1798°F)
133.4 Min	1798°F	Peak array temp. (1570°F)
136.4 Min	1375.0°F	Fire Out



SCREENING TEST NO. 4
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1797.6°F (T/C #6)
AMBIENT TEMP: 65°F
DATE: AUGUST 22, 1985
FIGURE 1-4
1797.6
1570.0
1137.0
FOR EXPLANATION OF WHY JACKET TEMPERATURE IS HIGHER THAN THE CONDUCTOR TEMPERATURE SEE PAGE 1-7.
TEMPERATURE (°F)
TIME (MIN.)
10 X 10 TO THE CENTIMETER
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various

Amb. Temp. 65°F

Job No. 47906

Spec. WLTP 47906-01

Photo Yes

Report No. 47906-2

Para. 3.2.3

Test Med. Air

Start Date 8-22-85

S/N N/A

Specimen Temp. Ambient

GSI No

Test Title Screening Test No. 4

Fault Cable Size:	4 AWG Triplex		
No. Conductors:	3		
3. readings after 10 minute application of FLA:			
Current:	20.7A		
Max. Temp. °F Channels 1-10:	72°F / 3		
Temp. Channel 11:	72°F	Temp. Channel 12:	71°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)			
Current:	145 A		
Max. Temp. °F Channels 1-10:	189°F / 6	Channel No.	6
Temp. Channel 11:	151	Temp. Channel 12:	175

Tested By [signature] Date: 8/22/85

Witness [signature] Date:

Sheet No. 1 of 3

Approved [signature] 8-22-85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No.	Various	Amb. Temp.	65°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-2
Para.	3.2.3	Test Med.	Air	Start Date	8-22-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title Screening Test No. 4

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current: 145 A		
	Max. Temp. °F Channels 1-10: 199° F	Channel No. 8	
	Temp. Channel 11: 160°F	Temp Channel 12: 183	
9-11.	Final readings with test current applied:		
9.	If open circuit occurs: N/A		
	Elapsed time:		
	Max. Temp. °F Channels 1-12:	Channel No. ______	
10.	If 15-minute period of stabilized temperature occurs:		
	Current: 156 A		
	Elapsed time to beginning of 15-minute period: 1200 sec		
	Max. Temp. °F Channels 1-12: 221°F	Channel No. 1	
11.	If fault cable ignites: N/A		
	Elapsed time to ignition:		

Tested By [signature] Date: 8/22/85

Witness None Date:

Sheet No. 2 of 3

Approved [signature] 8-22-85

Notice of Anomaly None

Wyle Form WH 614A Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 65°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-22-85

Test Title: Screening Test No. 4

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current: 660 A

Max. Temp. °F
Channels 1-10: 1798°F Channel No. 6

Elapsed time to open circuit or stable temp: 164 sec

Time to ignition if applicable: 9.3 sec

Notice of Anomaly: None

Tested By: [signature] Date: 8-22-85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 8-22-85

Wyle Form WH 614A, Rev. APR 84

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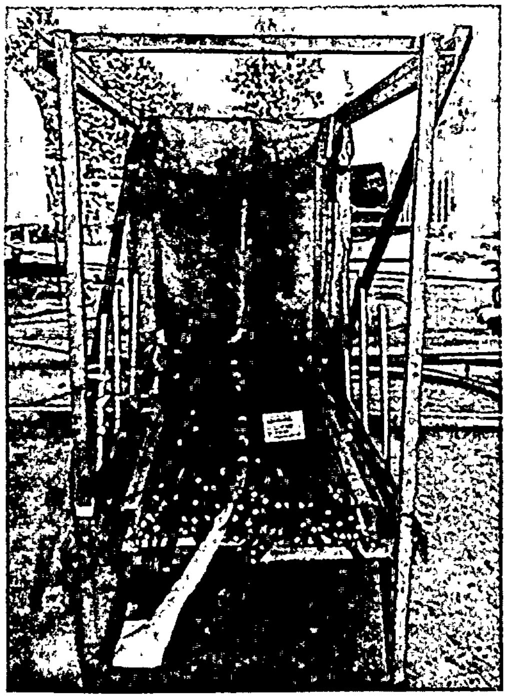
SCREENING TEST 5 DATA

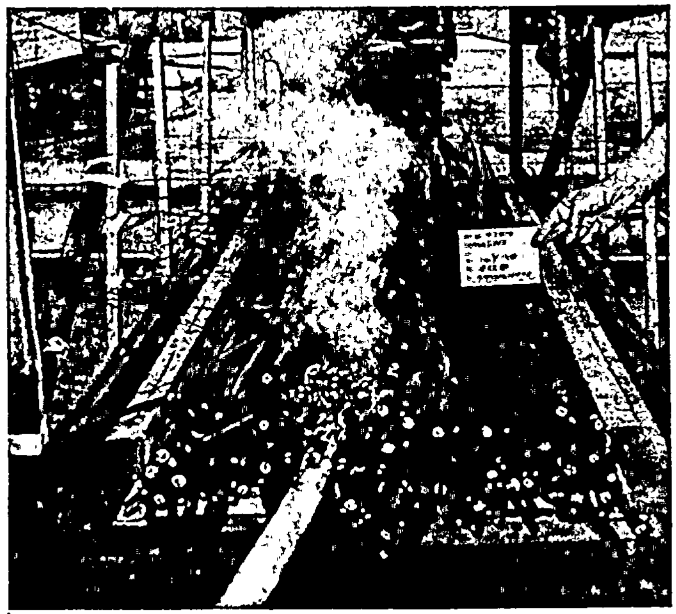
SCREENING TEST #5

(2 AWG Triplex)



PHOTOGRAPH I-14

PRETEST VIEW — OVERALL



PHOTOGRAPH I-15

POST-TEST VIEW — OVERALL

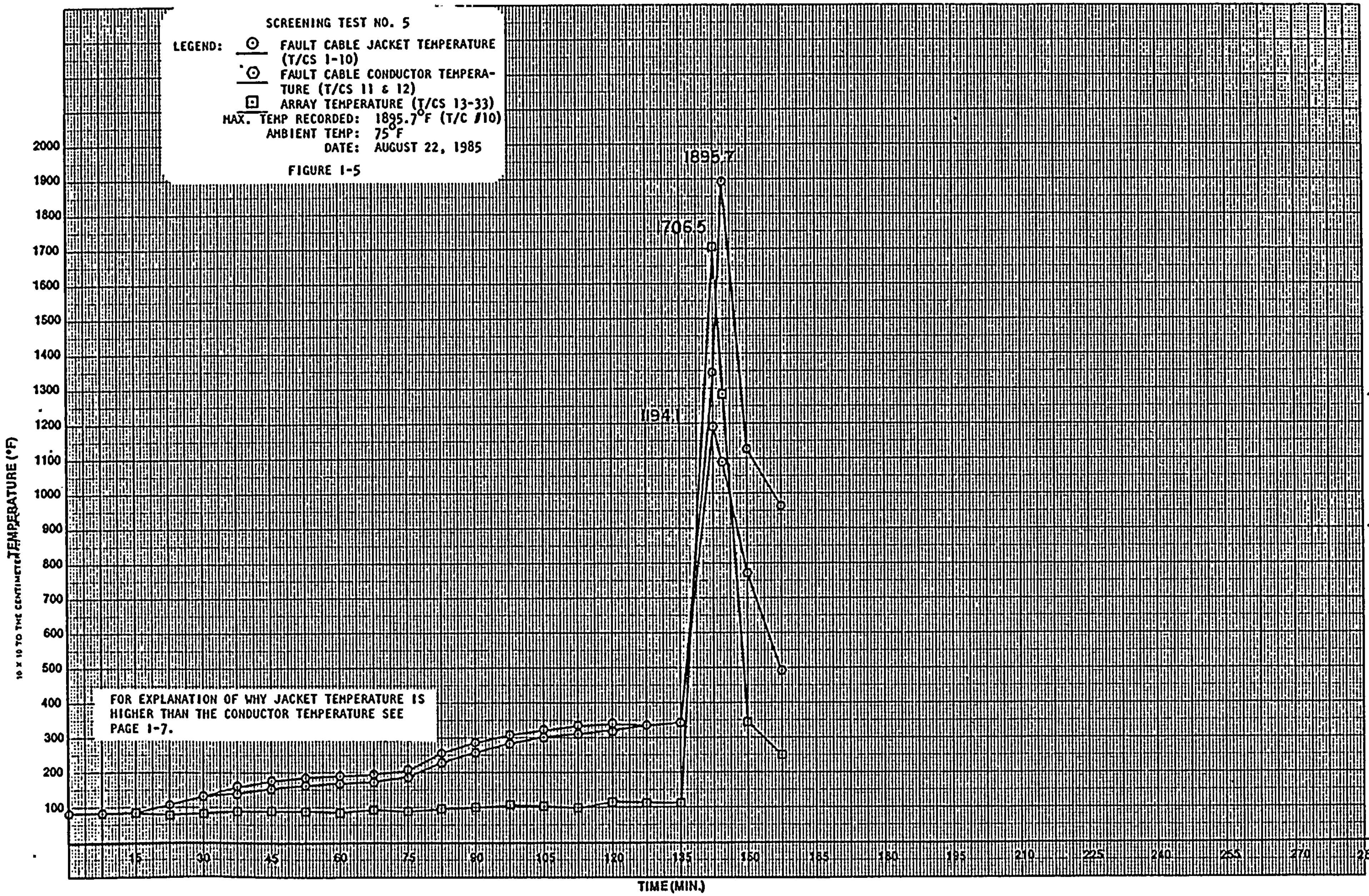
PHOTOGRAPH I-16

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #5

(2 AWG Triplex)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	84°F	Energized cable with 38.5A
15 Min	85°F	Energized cable with 185A
56.3 Min	189°F	Jacket temp. at 189°F
71.3 Min	198°F	Energized cable with 264A (Test current)
134.8 Min	346°F	Cable temperature stabilized for 15 minutes.
		Energized cable with 660A (Max. let-through current of backup protection)
138.5 Min	800°F	Ignition
142.5 Min	1345°F	Open Circuit
142.5 Min	1345°F	Peak conductor temp. (1194°F)
144.5 Min	1896°F	Peak jacket temp. (1896°F)
142.5 Min	1345°F	Peak array temp. (1707°F)
156.9 Min	962°F	Fire Out


SCREENING TEST NO. 5
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1895.7°F (T/C #10)
AMBIENT TEMP: 75°F
DATE: AUGUST 22, 1985
FIGURE 1-5
1895.7
1706.5
1194.1
FOR EXPLANATION OF WHY JACKET TEMPERATURE IS HIGHER THAN THE CONDUCTOR TEMPERATURE SEE PAGE 1-7.
TEMPERATURE (°F)
TIME (MIN.)
10 X 10 TO THE CENTIMETER
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 75°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-2
Start Date 8-22-85

Test Title Screening Test No. 5

Fault Cable Size:	2 AWG Triplex		
No. Conductors:	3		
3. readings after 10 minute application of FLA:			
Current:	38.5 A		
Max. Temp. °F Channels 1-10:	84°F/2		
Temp. Channel 11:	81°F	Temp. Channel 12:	82°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)			
Current:	185 A		
Max. Temp. °F Channels 1-10:	189°F	Channel No.	2
Temp. Channel 11:	146°F	Temp. Channel 12:	169°F

Tested By [signature] Date: 8-22-85
Witness None Date:
Sheet No. 1 of 3
Approved [signature] 8-22-85

Notice of Anomaly None

Wyle Form WH 614A, Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 75°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 8/22/85

Test Title Screening Test No.

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)	
	Current: 185A	
	Max. Temp. °F Channels 1-10: 198	Channel No. 2
	Temp. Channel 11: 157	Temp Channel 12: 182
9-11.	Final readings with test current applied:	
	9. If open circuit occurs: N/A	
	Elapsed time:	
	Max. Temp. °F Channels 1-12:	Channel No.
	10. If 15-minute period of stabilized temperature occurs:	
	Current: 264A	
	Elapsed time to beginning of 15-minute period: ~~2400~~ 2700 sec	
	Max. Temp. °F Channels 1-12: 337	Channel No. 2
	11. If fault cable ignites: N/A	
	Elapsed time to ignition:	

Tested By [signature] Date: 8/22/85
Witness None Date:
Sheet No. 2 of 3
Approved [signature] 8-22-85

Notice of Anomaly None

Wyle Form WH 614A Rev APR 34

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 75°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 8/22/85

Test Title Screening Test No. 5

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current:	660A	
Max. Temp. °F Channels 1-10:	1896	Channel No. 10
Elapsed time to open circuit or stable temp:	464 sec	
Time to ignition if applicable:	225 sec	

Tested By [signature] Date: 8/22/85
Witness None Date:
Sheet No. 3 of 3
Approved [signature] 8-22-85

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR 84

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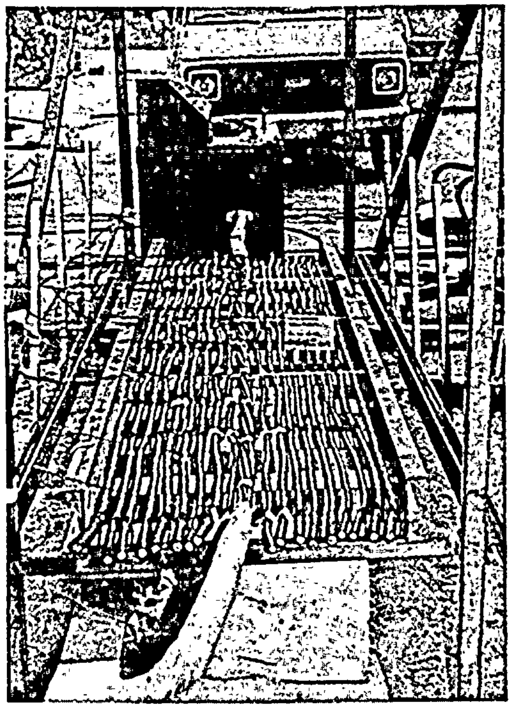
SCREENING TEST 6 DATA

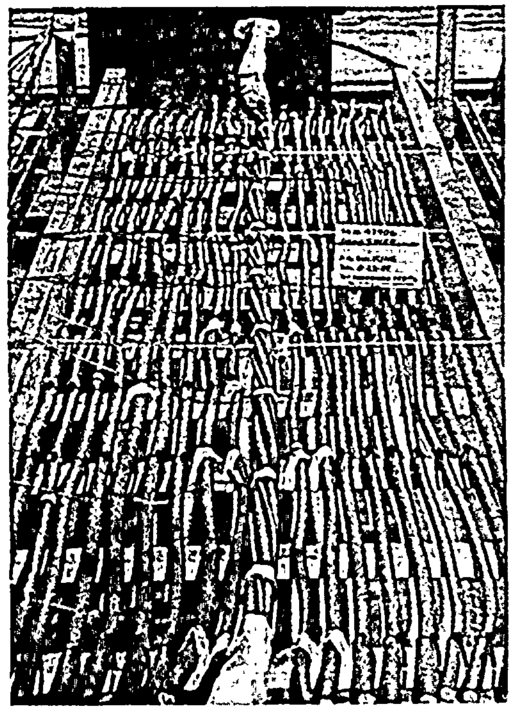
SCREENING TEST #6

(1/0 AWG Triplex-Cu)



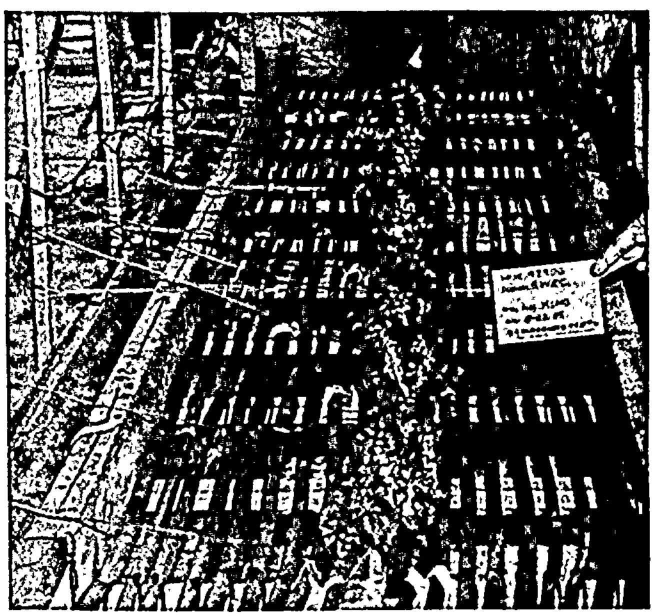
PHOTOGRAPH I-17

PRETEST VIEW — OVERALL



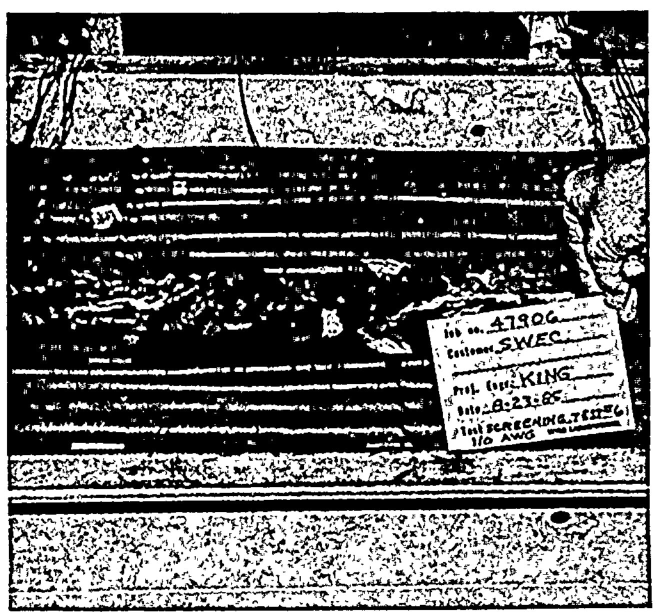
PHOTOGRAPH I-18

PRETEST VIEW — CLOSE-UP



PHOTOGRAPH I-19

POST-TEST VIEW — OVERALL



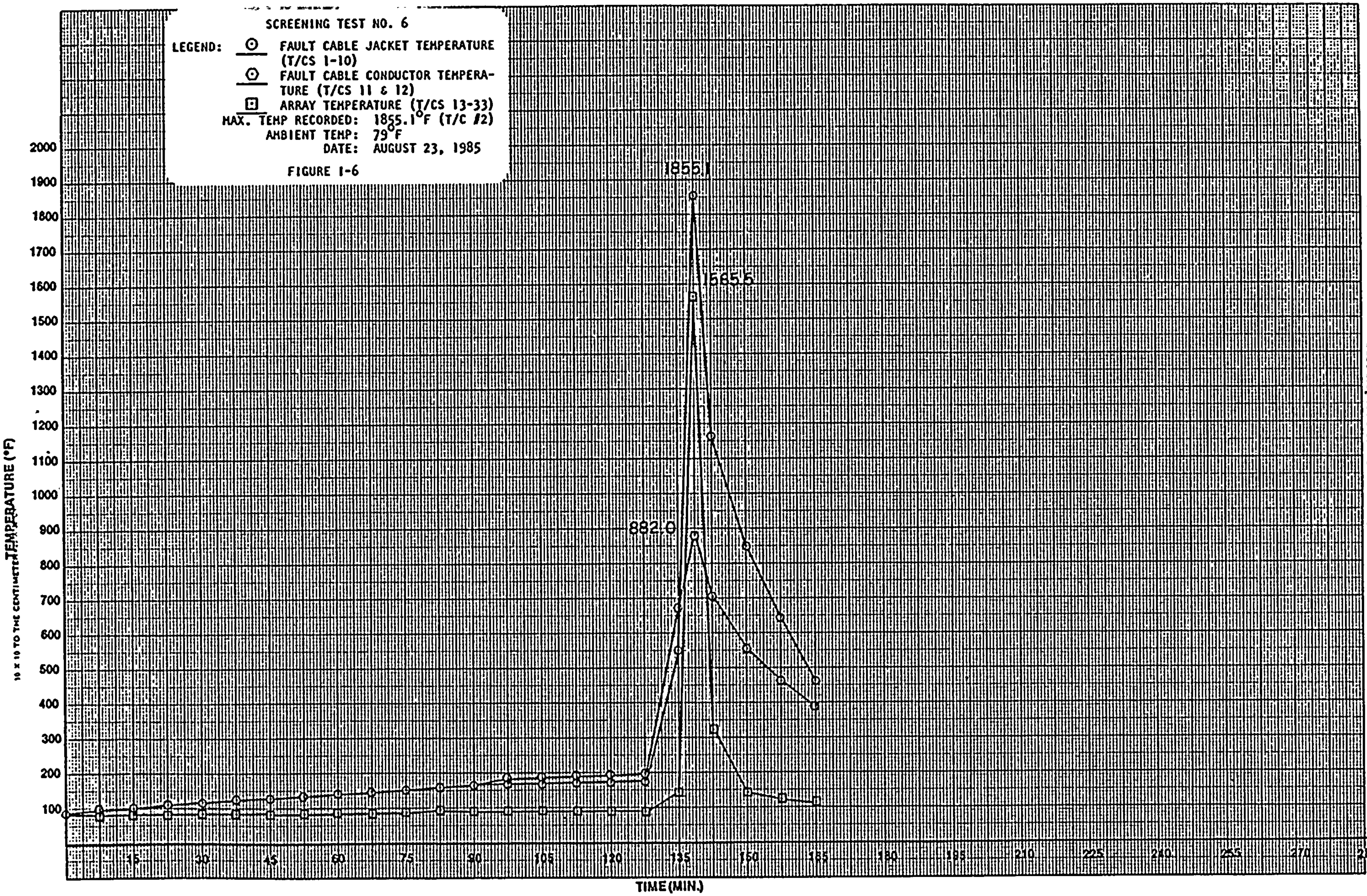
PHOTOGRAPH I-20

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #6

(1/0 AWG Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	86°F	Energized cable with 139A
15 Min	99°F	Energized cable with 185A
50 Min	131°F	Energized cable with 210A
75 Min	152°F	Energized cable with 230A
105.6 Min	172°F	Energized cable with 235A
113.8 Min	175°F	Conductor at 190°F
128.8 Min	181°F	Energized cable with 908A (Test Current)
135.7 Min	800°F	Ignition
136.6 Min	1050°F	Open Circuit
138.75 Min	1855°F	Peak conductor temp. (882°F)
138.75 Min	1855°F	Peak jacket temp. (1855°F)
138.75 Min	1855°F	Peak array temp. (1566°F)
139.9 Min	1650°F	Fire Out


SCREENING TEST NO. 6
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1855.1°F (T/C #2)
AMBIENT TEMP: 79°F
DATE: AUGUST 23, 1985
1855.1
1565.5
882.0
TEMPERATURE (°F)
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
TIME (MIN.)
FIGURE I-6

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 79°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-23-85

Test Title: Screening Test No. 6

Fault Cable Size: 1/0 AWG Triplex

No. Conductors: 3

3. readings after 10 minute application of FLA:

Current: 139 A

Max. Temp. °F Channels 1-10: 96°F/7

Temp. Channel 11: 92°F   Temp. Channel 12: 93°F

5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)

Current: 235A

Max. Temp. °F Channels 1-10: 175°F   Channel No. 9

Temp. Channel 11: 190°F   Temp. Channel 12: 181°F

Tested By: [signature] Date: 8/23/85
Witness: [signature] Date:
Sheet No. 1 of 3
Approved: [signature] 8-23-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 79°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 8-23-85

Test Title Screening Test No. 6

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current: 235A		
	Max. Temp. °F Channels 1-10: 181°F	Channel No. 9	
	Temp. Channel 11: 197°F	Temp Channel 12: 187°F	
9-11.	Final readings with test current applied: 908A		
9.	If open circuit occurs:		
	Elapsed time: 576 sec		
	Max. Temp. °F Channels 1-12: 1855°F	Channel No. 2	
10.	If 15-minute period of stabilized temperature occurs: N/A		
	Current:		
	Elapsed time to beginning of 15-minute period:		
	Max. Temp. °F Channels 1-12:	Channel No.	
11.	If fault cable ignites:		
	Elapsed time to ignition: 412 sec		

Notice of Anomaly None

Tested By [signature] Date: 8/23/85
Witness [signature] Date:
Sheet No. 2 of 3
Approved [signature] 8/23/85

Wyle Form WH 614A Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 79°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-23-85

Test Title: Screening Test No. 6

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12) N/A

Current:
Max. Temp. °F
Channels 1-10: Channel No. ——
Elapsed time to open circuit or stable temp:
Time to ignition if applicable:

Tested By: [signature] Date: 8/23/85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 8/23/85

Notice of Anomaly: None

Wyle Form WH 514A Rev APR 84

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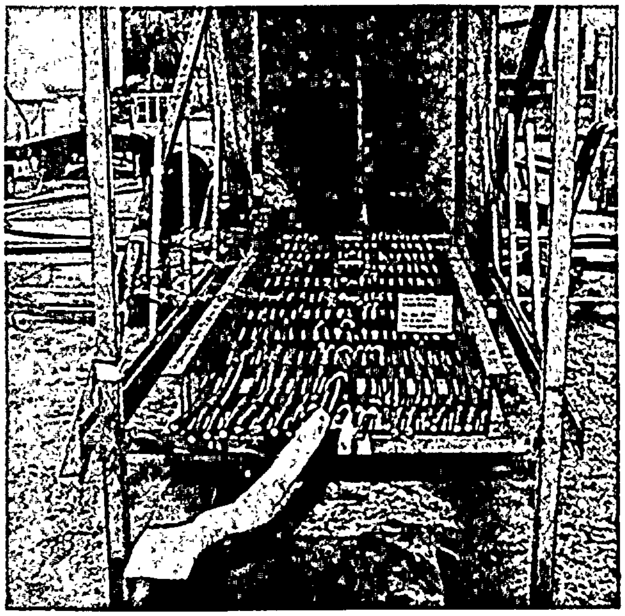
SCREENING TEST 7A DATA

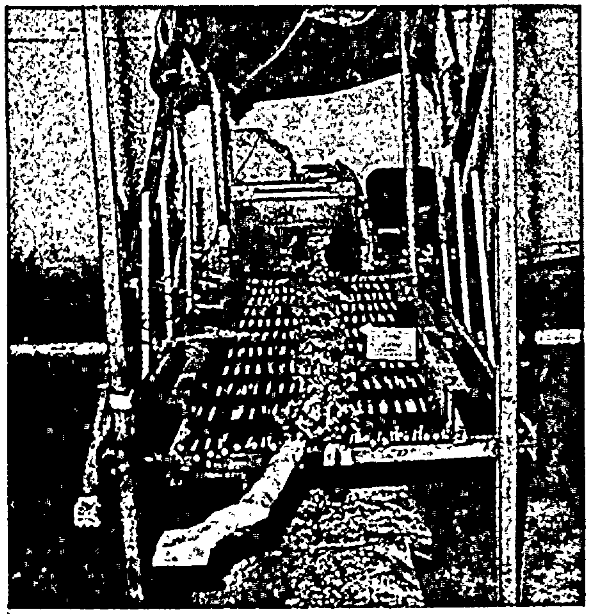
SCREENING TEST #7A

(2/0 AWG Triplex-Cu)



PHOTOGRAPH I-21

PRETEST VIEW — OVERALL



PHOTOGRAPH I-22

POST-TEST VIEW — OVERALL

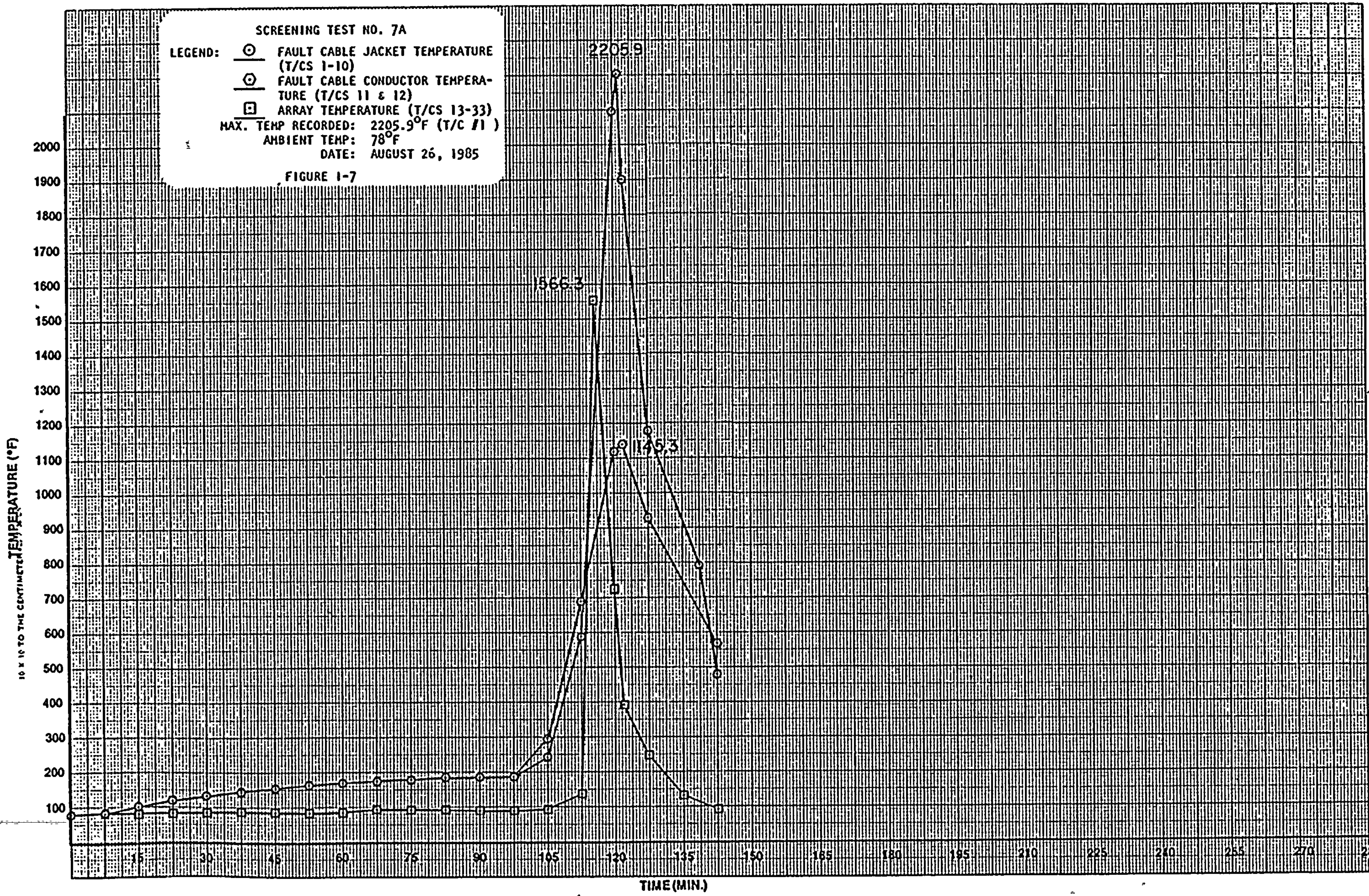
PHOTOGRAPH I-23

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #7A

(2/0 AWG Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	80°F	Energized cable with 139A
10.1 Min	88°F	Energized cable with 270A
88 Min	182°F	Conductor at 190°F
103.3 Min	184°F	Energized cable with 908A (Test current)
114.1 Min	900°F	Ignition
115.75 Min	1210°F	Peak array temp. (1566°F)
121.0 Min	2206°F	Peak jacket temp. (2206°F)
121.9 Min	1900°F	Open Circuit
121.9 Min	1900°F	Peak conductor temp. (1145°F)
123.2 Min	1750°F	Fire Out


SCREENING TEST NO. 7A
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 2205.9°F (T/C #1)
AMBIENT TEMP: 78°F
DATE: AUGUST 26, 1985
2205.9
1566.3
1145.3
TEMPERATURE (°F)
TIME (MIN.)
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
FIGURE 1-7

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 78°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-26-85

Test Title: Screening Test No. 7A

Fault Cable Size: 2/0 AWG Triplex	
No. Conductors: 3	
3. readings after 10 minute application of FLA:	
Current: 139 A	
Max. Temp. °F Channels 1-10: 88°F / 1	
Temp. Channel 11: 87 °F	Temp. Channel 12: 87°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)	
Current: 270A	
Max. Temp. °F Channels 1-10: 182°F	Channel No. 10
Temp. Channel 11: 185°F	Temp. Channel 12: 190°F

Tested By: [signature] Date: 8/26/85
Witness: None Date:
Sheet No. 1 of 3
Approved: [signature] 8-26-85

Notice of Anomaly: None

Wyle Form WH 614A Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 78°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-26-85

Test Title: Screening Test No. 7A

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)	
	Current: 270A	
	Max. Temp. °F Channels 1-10: 186°F	Channel No. 10
	Temp. Channel 11: 190°F	Temp Channel 12: 193°F
9-11.	Final readings with test current applied: 908A	
9.	If open circuit occurs: ~~1124 sec~~	
	Elapsed time: 1124 sec	
	Max. Temp. °F Channels 1-12: 2206°F	Channel No. 1
10.	If 15-minute period of stabilized temperature occurs: N/A	
	Current:	
	Elapsed time to beginning of 15-minute period:	
	Max. Temp. °F Channels 1-12:	Channel No.
11.	If fault cable ignites:	
	Elapsed time to ignition: 650 sec	

Tested By: [signature] Date: 8/26/85
Witness: None Date:
Sheet No. 2 of 3
Approved: [signature] 8-26-85

Notice of Anomaly: None

Wyle Form WH 612A Rev 100 34

DATA SHEET

Customer Stone & Webster | WYLE LABORATORIES
Specimen Cables
Part No. Various | Amb. Temp. 78°F | Job No. 47906
Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-2
Para. 3.2.3 | Test Med. Air | Start Date 8-26-85
S/N N/A | Specimen Temp. Ambient
GSI No

Test Title Screening Test No. 7A

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12) N/A

Current:
Max. Temp. °F
Channels 1-10: Channel No. ———
Elapsed time to open circuit or stable temp:
Time to ignition if applicable:

Tested By [signature] Date: 8/26/85
Witness None Date:
Sheet No. 3 of 3
Approved [signature] 8-26-85

Notice of Anomaly None

Wyle Form WH 614A Rev. APR 84

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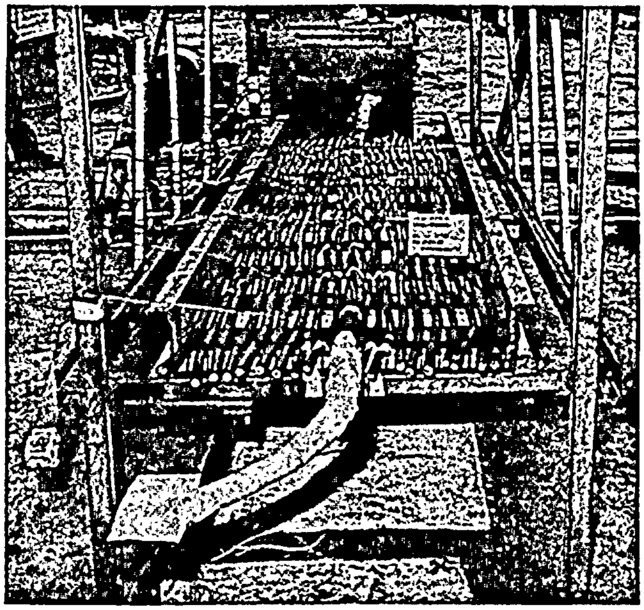
SCREENING TEST 8A DATA

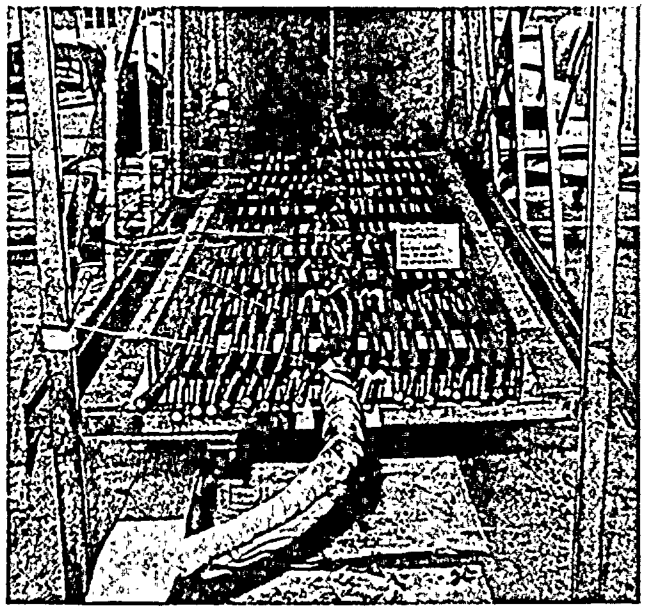
SCREENING TEST #8A

(3/0 AWG Triplex-Cu)



PHOTOGRAPH I-24

PRETEST VIEW — OVERALL



PHOTOGRAPH I-25

POST-TEST VIEW — OVERALL

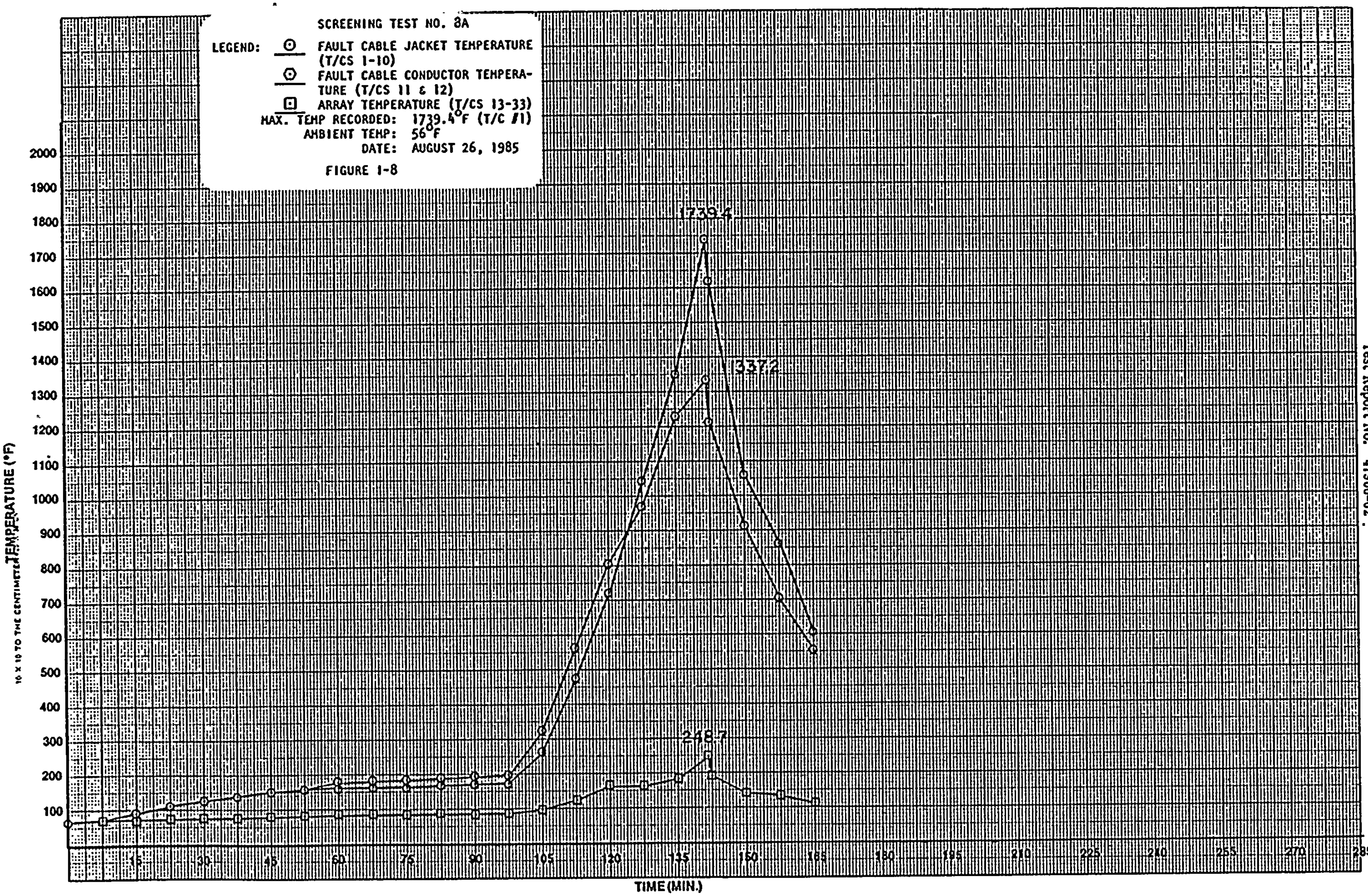
PHOTOGRAPH I-26

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #8A

(3/0 AWG Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	67°F	Energized cable with 139A
10 Min	74°F	Energized cable with 330A
86.2 Min	170°F	Conductor at 189°F
101.4 Min	177°F	Energized cable with 908A (Test current)
141.8 Min	1739°F	Open Circuit
141.8 Min	1739°F	Peak conductor temp. (1337°F)
141.8 Min	1739°F	Peak jacket temp. (1739°F)
141.8 Min	1739°F	Peak array temp. (249°F)



SCREENING TEST NO. 8A
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1739.4°F (T/C #1)
AMBIENT TEMP: 56°F
DATE: AUGUST 26, 1985
FIGURE 1-8
1739.4
1337.2
248.7
TEMPERATURE (°F)
TIME (MIN.)

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 56°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 8-26-85

Test Title Screening Test No. 8A

Fault Cable Size: 3/0 AWG Triplex	
No. Conductors: 3	
3. readings after 10 minute application of FLA:	
Current: 139 A	
Max. Temp. °F Channels 1-10: 74°F/4	
Temp. Channel 11: 74	Temp. Channel 12: 74
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)	
Current: 335A	
Max. Temp. °F Channels 1-10: 170°F	Channel No. 4
Temp. Channel 11: 190°F	Temp. Channel 12: 182°F

Notice of Anomaly None

Tested By [signature] Date: 8/26/85
Witness [signature] Date:
Sheet No. 1 of 3
Approved [signature] 8-26-85

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 56°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-26-85

Test Title: Screening Test No. 8A

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current:	335A	
	Max.. Temp. °F Channels 1-10:	174°F / 1 & 4	Channel No. 1 & 4
	Temp. Channel 11:	198°F	Temp Channel 12: 190°F
9-11.	Final readings with test current applied:	908A	
	9. If open circuit occurs:		
	Elapsed time:	2424 sec	
	Max. Temp. °F Channels 1-12:	1739°F	Channel No. 1
	10. If 15-minute period of stabilized temperature occurs:	N/A	
	Current:		
	Elapsed time to beginning of 15-minute period:		
	Max. Temp. °F Channels 1-12:		Channel No.
	11. If fault cable ignites:	N/A	
	Elapsed time to ignition:		

Tested By: [signature] Date: 8/26/85
Witness: [signature] Date:
Sheet No. 2 of 3
Approved: [signature] 8-26-85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.2.3

S/N N/A

GSI No

Amb. Temp. 56°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-2

Start Date 8-26-85

Test Title Screening Test No. 8A

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12) N/A

Current:
Max. Temp. °F
Channels 1-10: Channel No. ——
Elapsed time to open circuit or stable temp:
Time to ignition if applicable:

Tested By [signature] Date: 8/26/85
Witness [signature] Date:
Sheet No. 3 of 3
Approved [signature] 8-26-85

Notice of Anomaly None

Wyle Form WH 514A Rev APR 34

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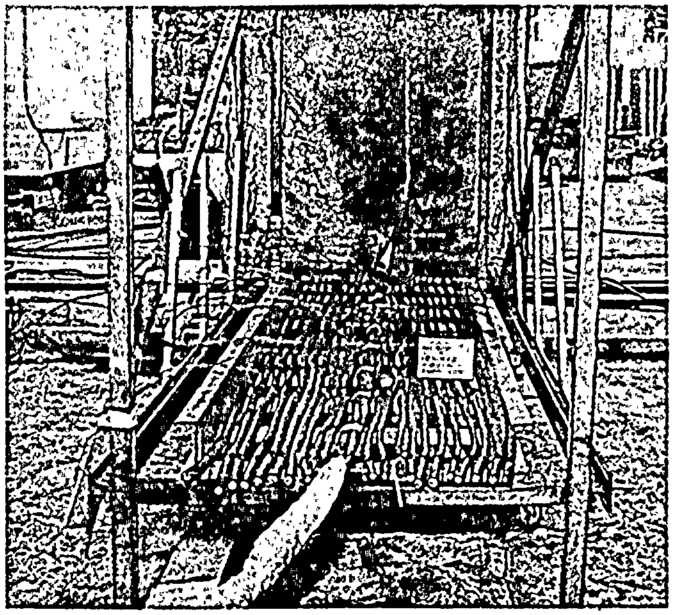
SCREENING TEST 9 DATA

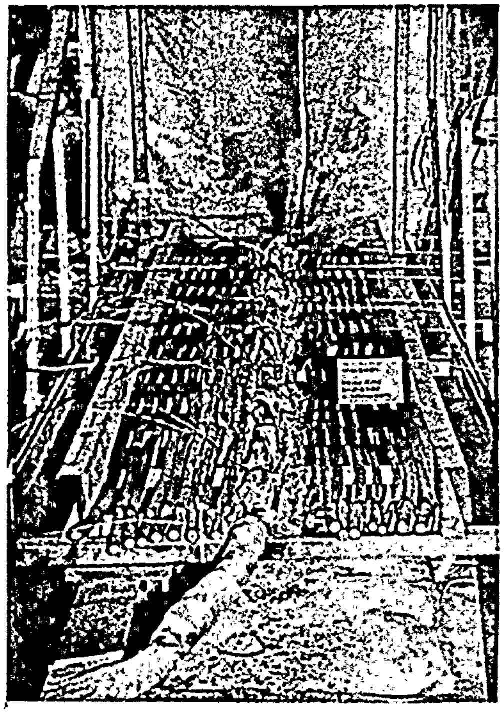
SCREENING TEST #9

(4/0 AWG Triplex-Cu)



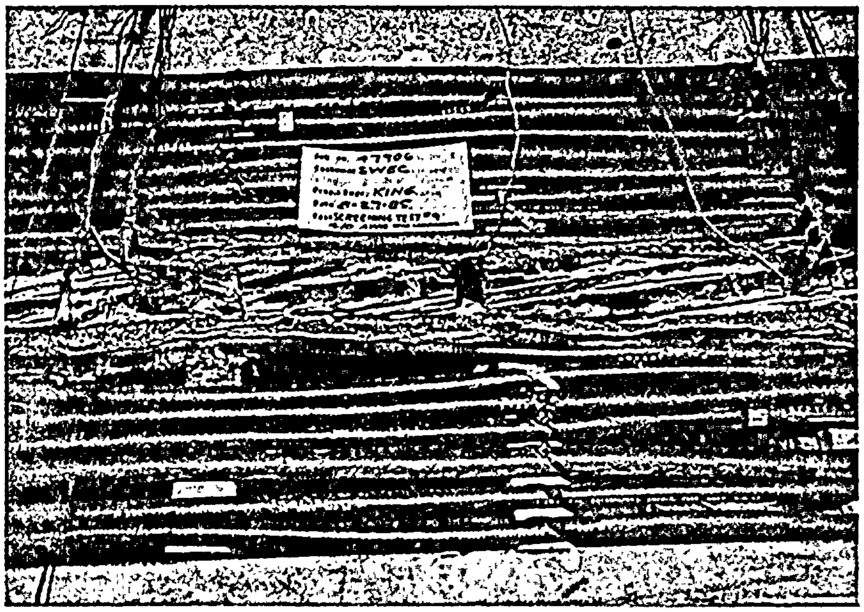
PHOTOGRAPH I-27

PRETEST VIEW — OVERALL



PHOTOGRAPH I-28

POST-TEST VIEW — OVERALL



PHOTOGRAPH I-29

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #9

(4/0 AWG Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	88°F	Energized cable with 159A
15 Min	103°F	Energized cable with 390A
65 Min	182°F	Conductor at 189°F
80 Min	187°F	Energized cable with 908A (Test current)
257.8 Min	744°F	Cable temperature stabilized for 15 minutes. Energized cable with 1860A (Let-through current is 2200A. 1860A was maximum capability of the current source)
259.2 Min	1000°F	Ignition
260.7 Min	1313°F	Open Circuit — Fire Out
260.7 Min	1313°F	Peak conductor temp. (1675°F)
260.7 Min	1313°F	Peak jacket temp. (1313°F)
260.7 Min	1313°F	Peak array temp. (1604°F)

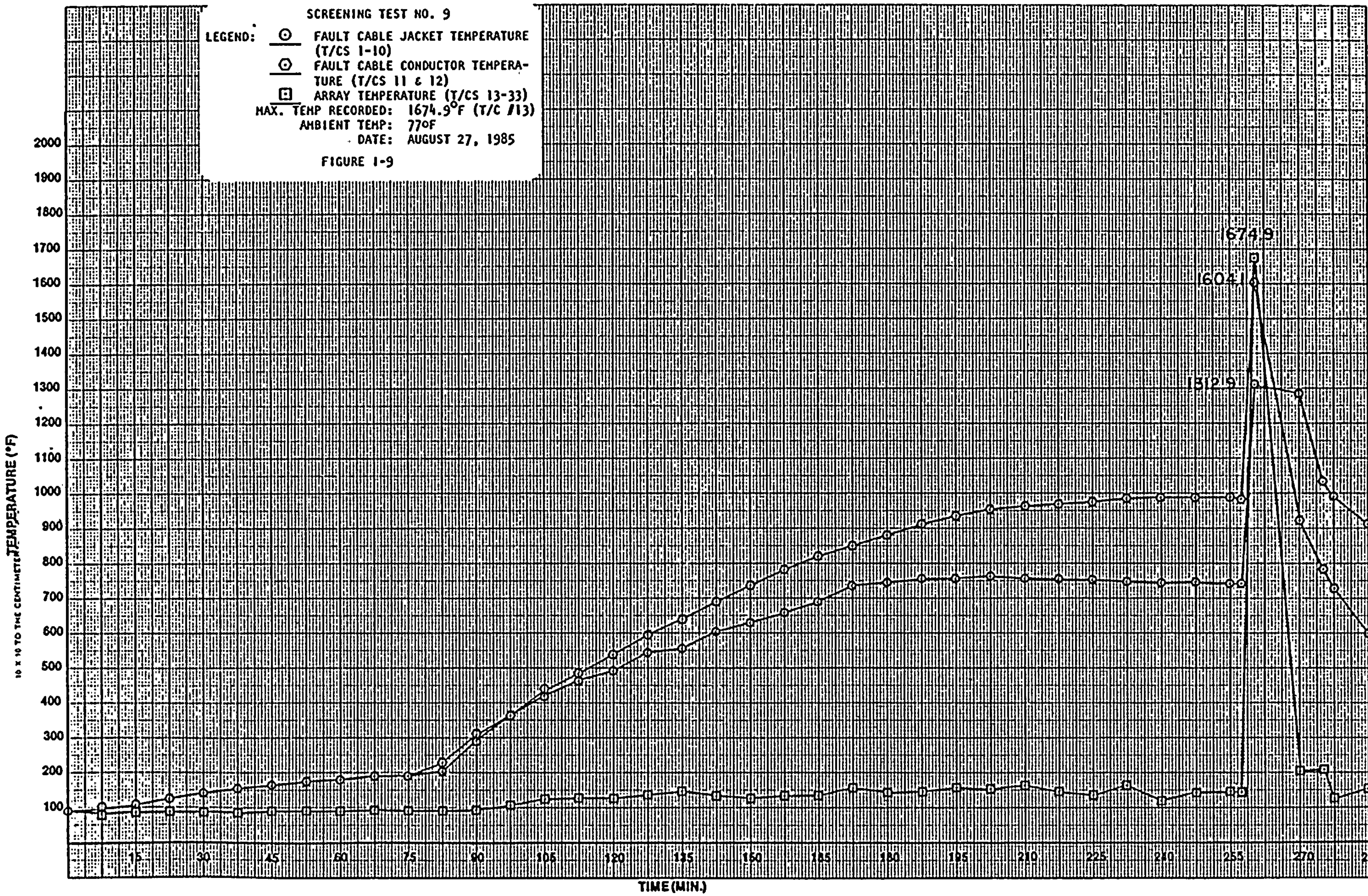

SCREENING TEST NO. 9
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1674.9°F (T/C #13)
AMBIENT TEMP: 77°F
DATE: AUGUST 27, 1985
1674.9
1604.1
1312.9
TEMPERATURE (°F)
TIME (MIN.)
10 X 10 TO THE CENTIMETER

FIGURE 1-9

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 77°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-27-85

Test Title: Screening Test No. 9

Fault Cable Size:	4/0 AWG Triplex		
No. Conductors:	3		
3. readings after 10 minute application of FLA:			
Current:	159A		
Max. Temp. °F Channels 1-10:	92°F / 2		
Temp. Channel 11:	91°F	Temp. Channel 12:	92°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)			
Current:	390A		
Max. Temp. °F Channels 1-10:	182°F	Channel No.	2
Temp. Channel 11:	189°F	Temp. Channel 12:	174°F

Tested By: [signature] Date: 8/27/85
Witness: [signature] Date: / /
Sheet No. 1 of 3
Approved: [signature] 8-27-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 77°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8-27-85

Test Title: Screening Test No. 9

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current: 355A		
	Max. Temp. °F Channels 1-10: 187°F	Channel No. 10	
	Temp. Channel 11: 195°F	Temp Channel 12: 183°F	
9-11.	Final readings with test current applied:		
9.	If open circuit occurs: N/A		
	Elapsed time:		
	Max. Temp. °F Channels 1-12:	Channel No.	
10.	If 15-minute period of stabilized temperature occurs:		
	Current:		
	Elapsed time to beginning of 15-minute period: 9675 sec		
	Max. Temp. °F Channels 1-12: 991°F	Channel No. 11	
11.	If fault cable ignites: N/A		
	Elapsed time to ignition:		

Tested By: [signature] Date: 8/27/85
Witness: None Date:
Sheet No. 2 of 3
Approved: [signature] 8-27-85

Notice of Anomaly: None

Wyle Form WH 614A Rev APR 74

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 77°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 8-27-85

Test Title Screening Test No. 9

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current:	1860		
Max. Temp. °F Channels 1-10:	1313°F	Channel No.	4
Elapsed time to open circuit or stable temp:	190 sec to open		
Time to ignition if applicable:	50 sec		

Notice of Anomaly None

Tested By [signature] Date: 8/27/85
Witness None Date:
Sheet No. 3 of 3
Approved [signature] 8-27-85

Wyle Form WH 814A Rev APR 84

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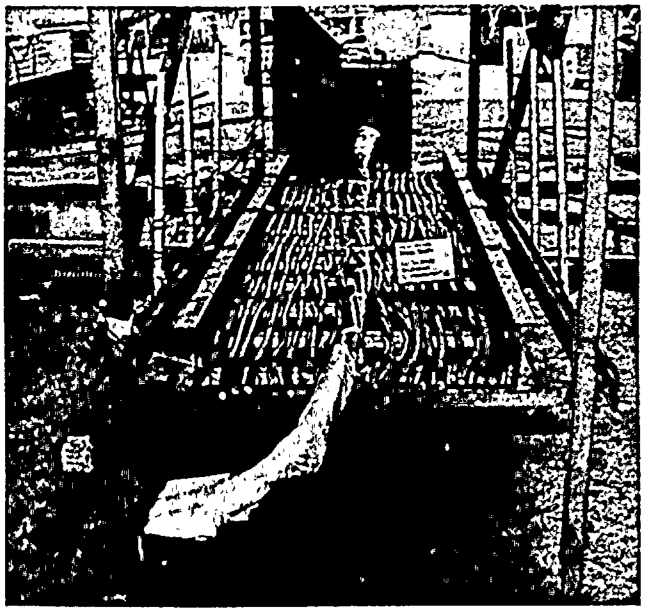
SCREENING TEST 10 DATA

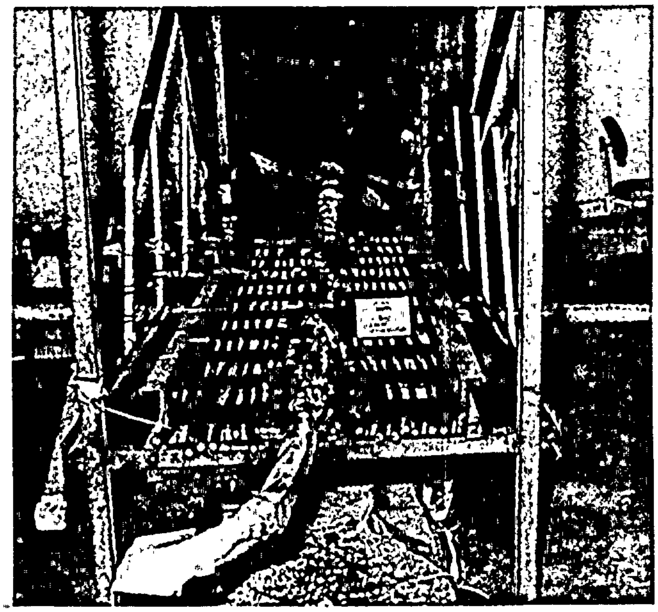
SCREENING TEST #10

(250 MCM Triplex-Cu)



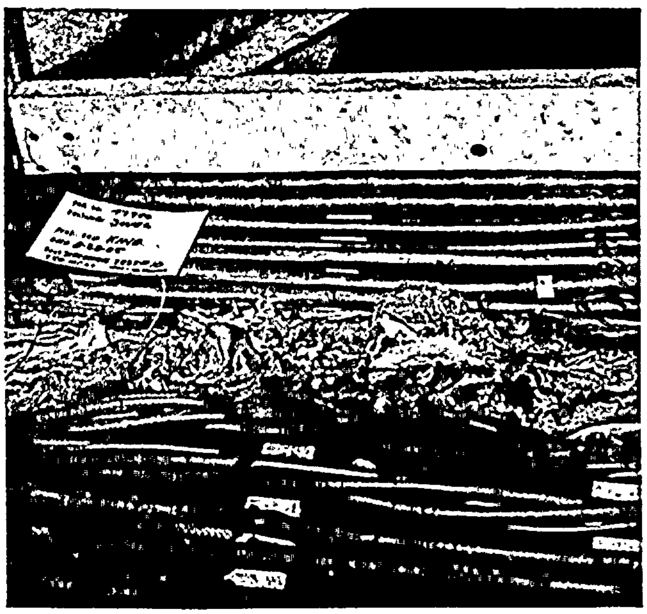
PHOTOGRAPH I-30

PRETEST VIEW — OVERALL



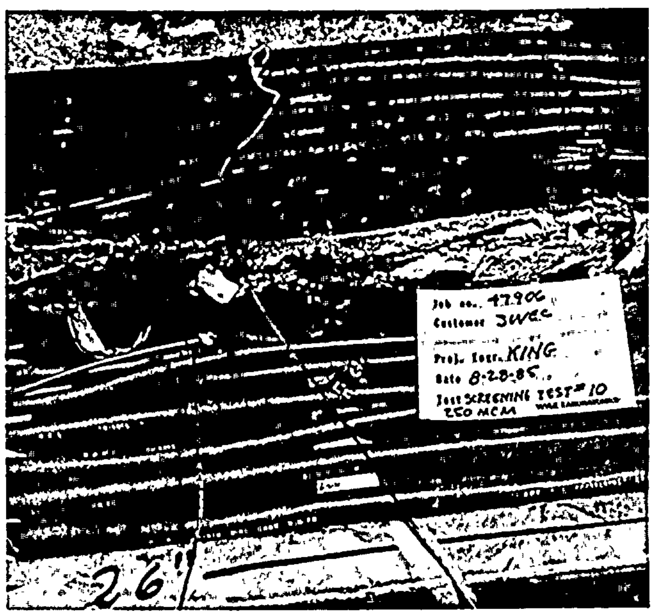
PHOTOGRAPH I-31

POST-TEST VIEW — OVERALL



PHOTOGRAPH I-32

POST-TEST VIEW — CLOSE-UP



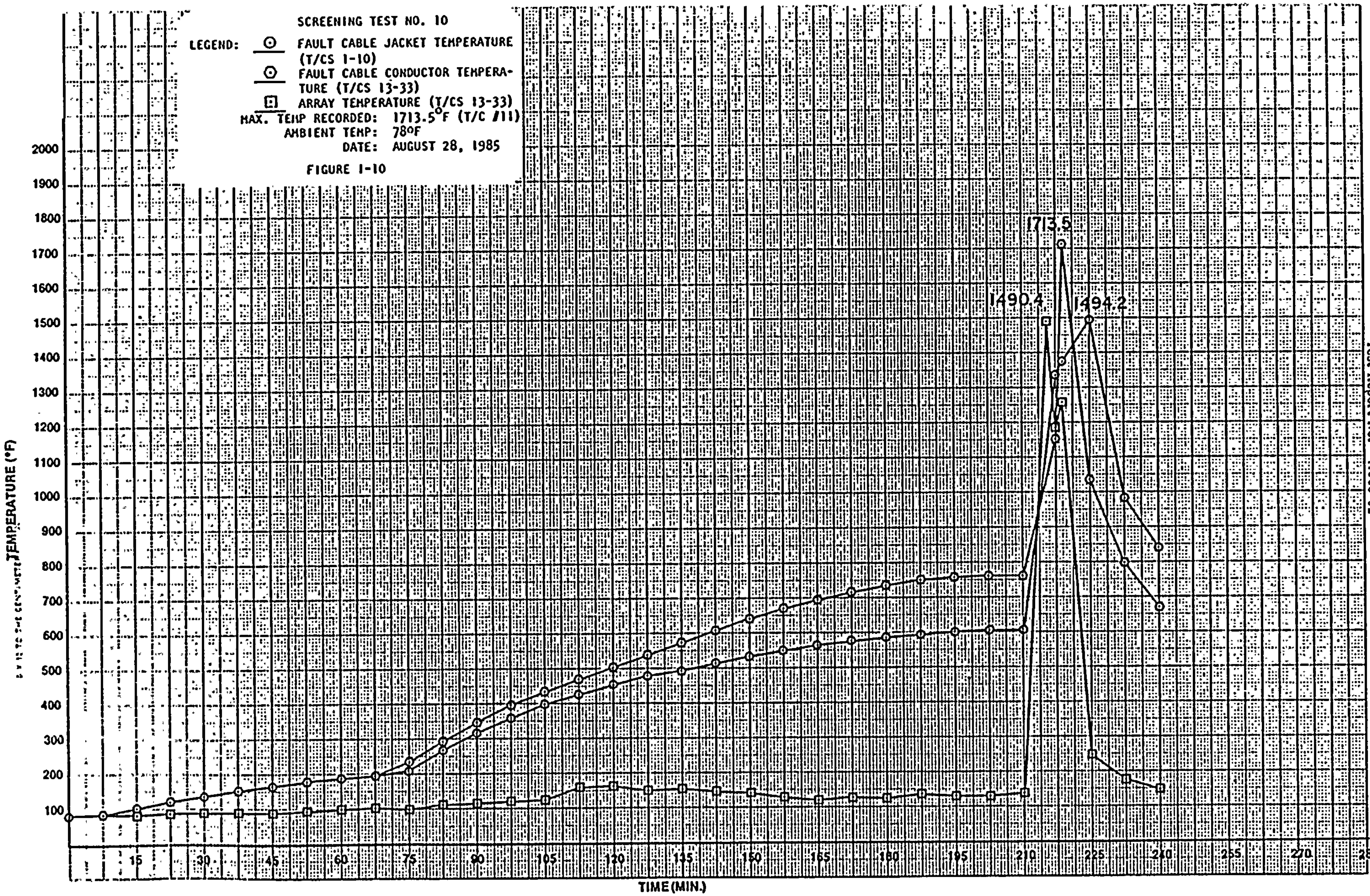
PHOTOGRAPH I-33

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #10

(250 MCM Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	83°F	Energized cable with 159A
10 Min	86°F	Energized cable with 440A
46.8 Min	180°F	Conductor at 189°F
61.8 Min	190°F	Energized cable with 746A (Test current)
212.0 Min	609°F	Cable temperature stabilized Energized cable with 2200A (Max. let-through current of backup protection)
214.2 Min	990°F	Ignition
219.0 Min	1375°F	Peak array temp. (1490°F)
219.0 Min	1375°F	Peak conductor temp. (1714°F)
220.0 Min	1395°F	Open Circuit
223.0 Min	1455°F	Fire Out
225.0 Min	1494°F	Peak jacket temp. (1494°F)


SCREENING TEST NO. 10
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 13-33)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1713.5°F (T/C #11)
AMBIENT TEMP: 78°F
DATE: AUGUST 28, 1985
FIGURE I-10
1713.5
1490.4
1494.2
TEMPERATURE (°F)
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
TIME (MIN.)

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 78°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/28/85

Test Title: Screening Test No. 10

Fault Cable Size:	250 MCM Triplex		
No. Conductors:	3		
3. readings after 10 minute application of FLA:			
Current:	159 A		
Max. Temp. °F Channels 1-10:	86°F/1		
Temp. Channel 11:	88°F	Temp. Channel 12:	83°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)			
Current:	430A		
Max. Temp. °F Channels 1-10:	180°F	Channel No.	1
Temp. Channel 11:	189°F	Temp. Channel 12:	184°F

Tested By: [signature] Date: 8/28/85
Witness: None Date:
Sheet No. 1 of 3
Approved: [signature] 8-28-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev APR 34

DATA SHEET

Customer Stone & Webster
Specimen Cables

WYLE LABORATORIES

Part No. Various	Amb. Temp. 78°F	Job No. 47906
Spec. WLTP 47906-01	Photo Yes	Report No. 47906-2
Para. 3.2.3	Test Med. Air	Start Date 8/28/85
S/N N/A	Specimen Temp. Ambient	
GSI No		

Test Title Screening Test No. 10

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current: 400		
	Max. Temp. °F Channels 1-10: 190°F	Channel No. 1	
	Temp. Channel 11: 203°F	Temp Channel 12: 196°F	
9-11.	Final readings with test current applied:		
	9. If open circuit occurs: N/A		
	Elapsed time:		
	Max. Temp. °F Channels 1-12:	Channel No.	
	10. If 15-minute period of stabilized temperature occurs:		
	Current: 746 A		
	Elapsed time to beginning of 15-minute period: 7310 sec		
	Max. Temp. °F Channels 1-12: 766°F	Channel No. 11	
	11. If fault cable ignites: N/A		
	Elapsed time to ignition:		

Tested By [signature] Date: 8/28/85
Witness [signature] Date:
Sheet No. 2 of 3
Approved [signature] 8·28·85

Notice of Anomaly None

Wyle Form WH 614A, Rev APR 34

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 78°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/28/85

Test Title: Screening Test No. 10

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current: 2200A

Max. Temp. °F Channels 1-10: 1494°F Channel No. 4

Elapsed time to open circuit or stable temp: 350 sec

Time to ignition if applicable: 125 sec

Notice of Anomaly: None

Tested By: [signature] Date: 8/28/85
Witness: [signature] Date:
Sheet No. 3 of 3
Approved: [signature] 8-28-85

Wyle Form WH 614A, Rev. APR '84

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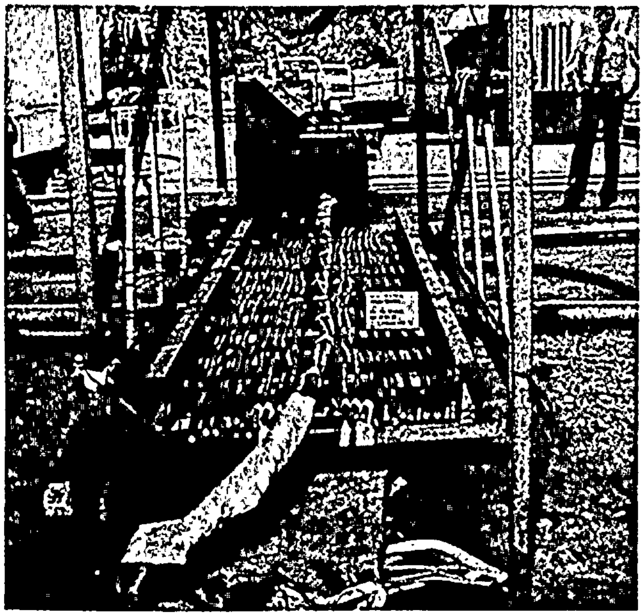
SCREENING TEST 11 DATA

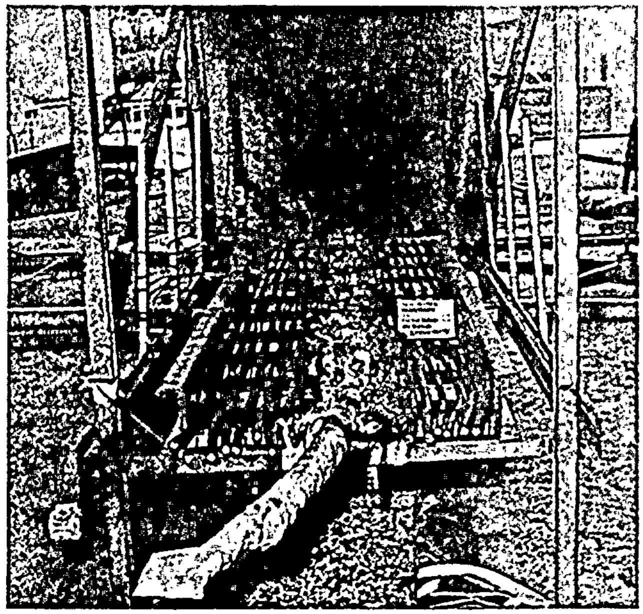
SCREENING TEST #11

(350 MCM Triplex-Cu)



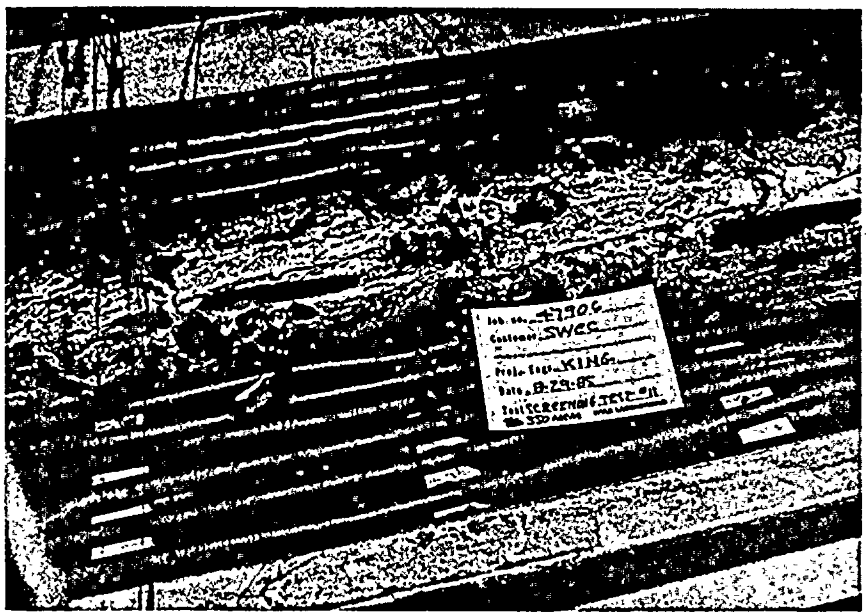
PHOTOGRAPH I-34

PRETEST VIEW — OVERALL



PHOTOGRAPH I-35

POST-TEST VIEW — OVERALL



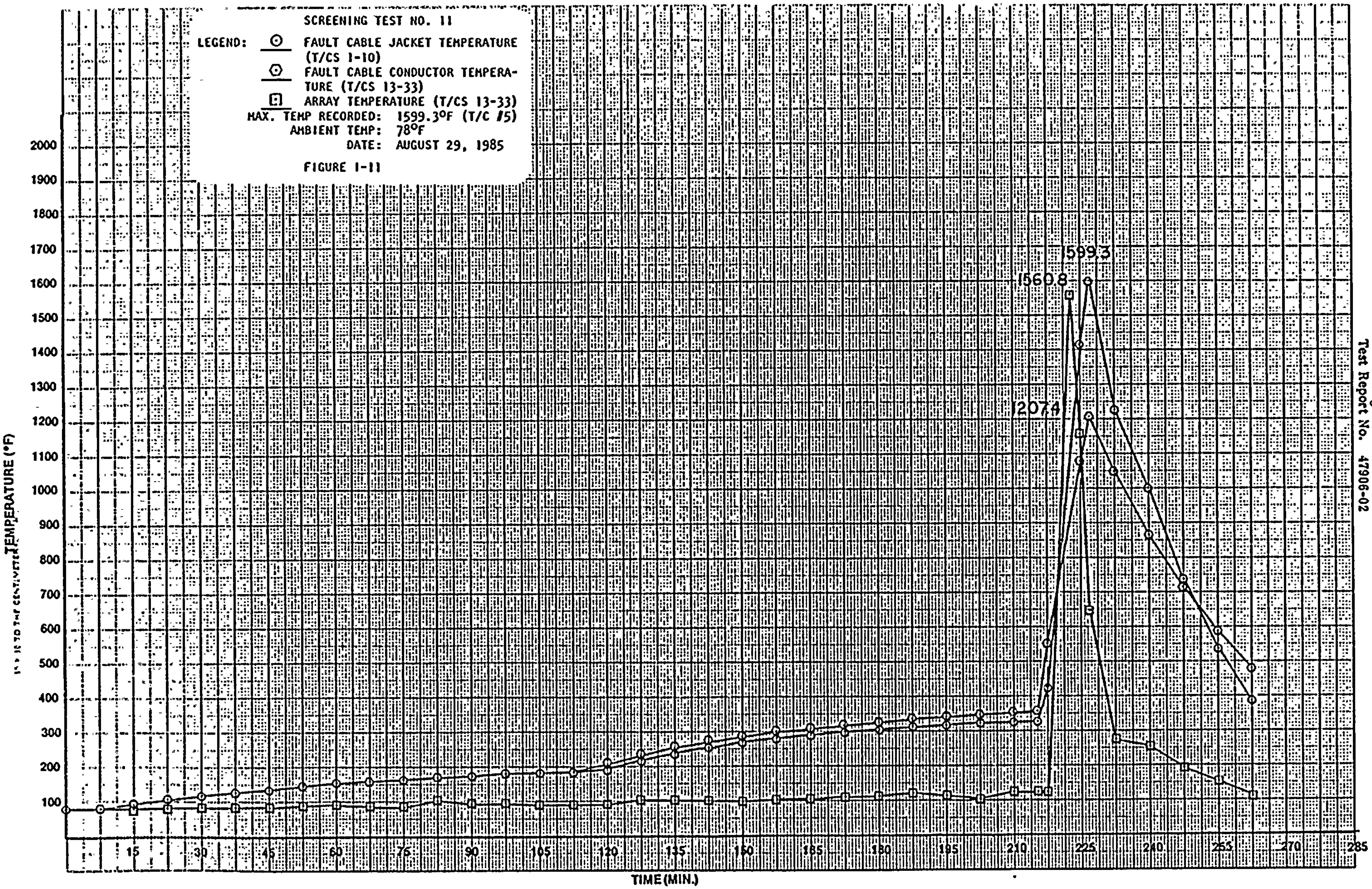
PHOTOGRAPH I-36

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #11

(350 MCM Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	79°F	Energized cable with 159A
10 Min	81°F	Energized cable with 500A
101.7 Min	181°F	Conductor at 189°F
116.7 Min	187°F	Energized cable with 746A (Test current)
215.0 Min	329°F	Cable temperature stabilized Energized cable with 2200A (Max. let-through current of backup protection)
221.5 Min	940°F	Ignition
222.8 Min	1100°F	Peak array temp. (1561°F)
226.8 Min	1599°F	Open Circuit
226.8 Min	1599°F	Peak conductor temp. (1207°F)
226.8 Min	1494°F	Peak jacket temp. (1599°F)
231.2 Min	1330°F	Fire Out


SCREENING TEST NO. 11
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 13-33)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1599.3°F (T/C #5)
AMBIENT TEMP: 78°F
DATE: AUGUST 29, 1985
FIGURE I-11
1599.3
1560.8
1207.4
TEMPERATURE (°F)
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
TIME (MIN.)

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 78°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 8/29/85

Test Title Screening Test No. 11

Fault Cable Size: 350 MCM Triplex	
No. Conductors: 3	
3. readings after 10 minute application of FLA:	
Current: 159 A	
Max. Temp. °F Channels 1-10: 81°F/9	
Temp. Channel 11: 81°F	Temp. Channel 12: 80°F
5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)	
Current: 520A	
Max. Temp. °F Channels 1-10: 181°F	Channel No. 10
Temp. Channel 11: 189°F	Temp. Channel 12: 176°F

Tested By [signature] Date: 8/29/85
Witness None Date:
Sheet No. 1 of 3
Approved [signature] 8-29-85

Notice of Anomaly None

Wyle Form WH 614A Rev APR 34

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.2.3

S/N N/A

GSI No

Amb. Temp. 78°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-2

Start Date 8/29/85

Test Title Screening Test No. 11

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current:	520A	
	Max. Temp. °F Channels 1-10:	187°F	Channel No. 10
	Temp. Channel 11:	195°F	Temp Channel 12: 181°F
9-11.	Final readings with test current applied:		
	9. If open circuit occurs:	N/A	
	Elapsed time:		
	Max. Temp. °F Channels 1-12:		Channel No.
	10. If 15-minute period of stabilized temperature occurs:		
	Current:	746A	
	Elapsed time to beginning of 15-minute period:	4800 sec	
	Max. Temp. °F Channels 1-12:	353°F	Channel No. 11
	11. If fault cable ignites:	N/A	
	Elapsed time to ignition:		

Tested By [signature] Date: 8/29/85

Witness None Date: / /

Sheet No. 2 of 3

Approved [signature] 8-29-85

Notice of Anomaly None

Wyle Form WH 614A Rev APR 34

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 78°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/29/85

Test Title: Screening Test No. 11

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current: 2200A

Max. Temp. °F Channels 1-10: 1599°F Channel No. 5

Elapsed time to open circuit or stable temp: 710 sec

Time to ignition if applicable: 390 sec

Tested By: [signature] Date: 8/29/85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 8-29-85

Notice of Anomaly: None

Form WH 314A Rev APR 34

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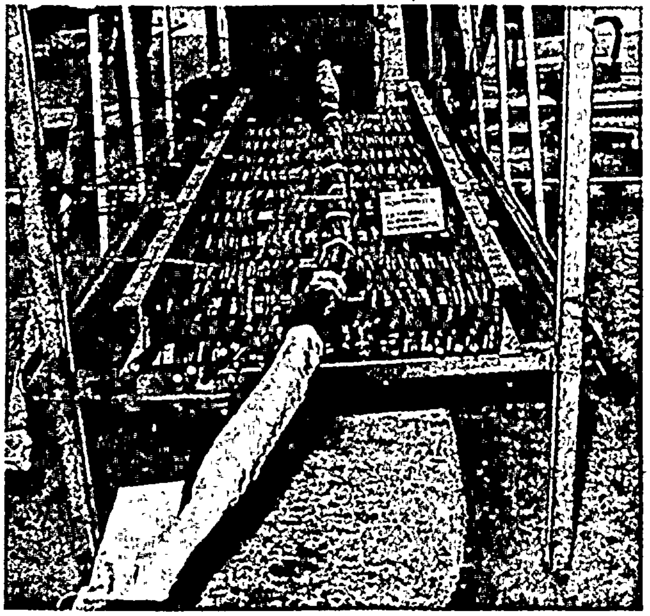
SCREENING TEST 12 DATA

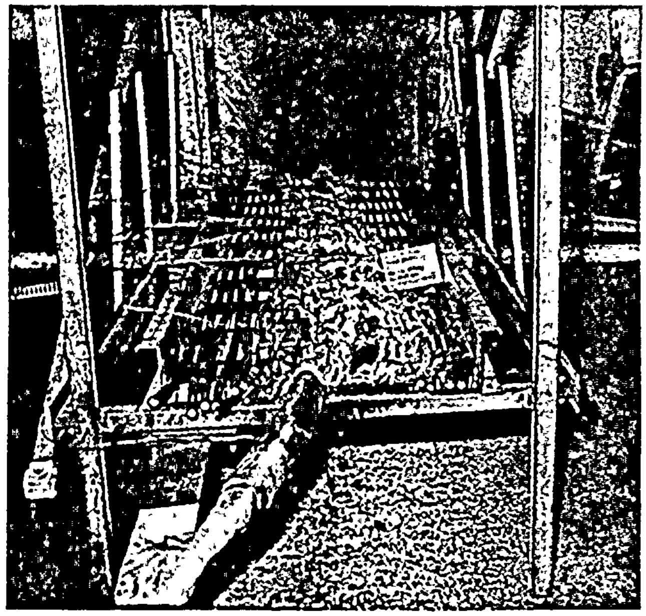
SCREENING TEST #12

(500 MCM Triplex-Cu)



PHOTOGRAPH I-37

PRETEST VIEW — OVERALL



PHOTOGRAPH I-38

POST-TEST VIEW — OVERALL

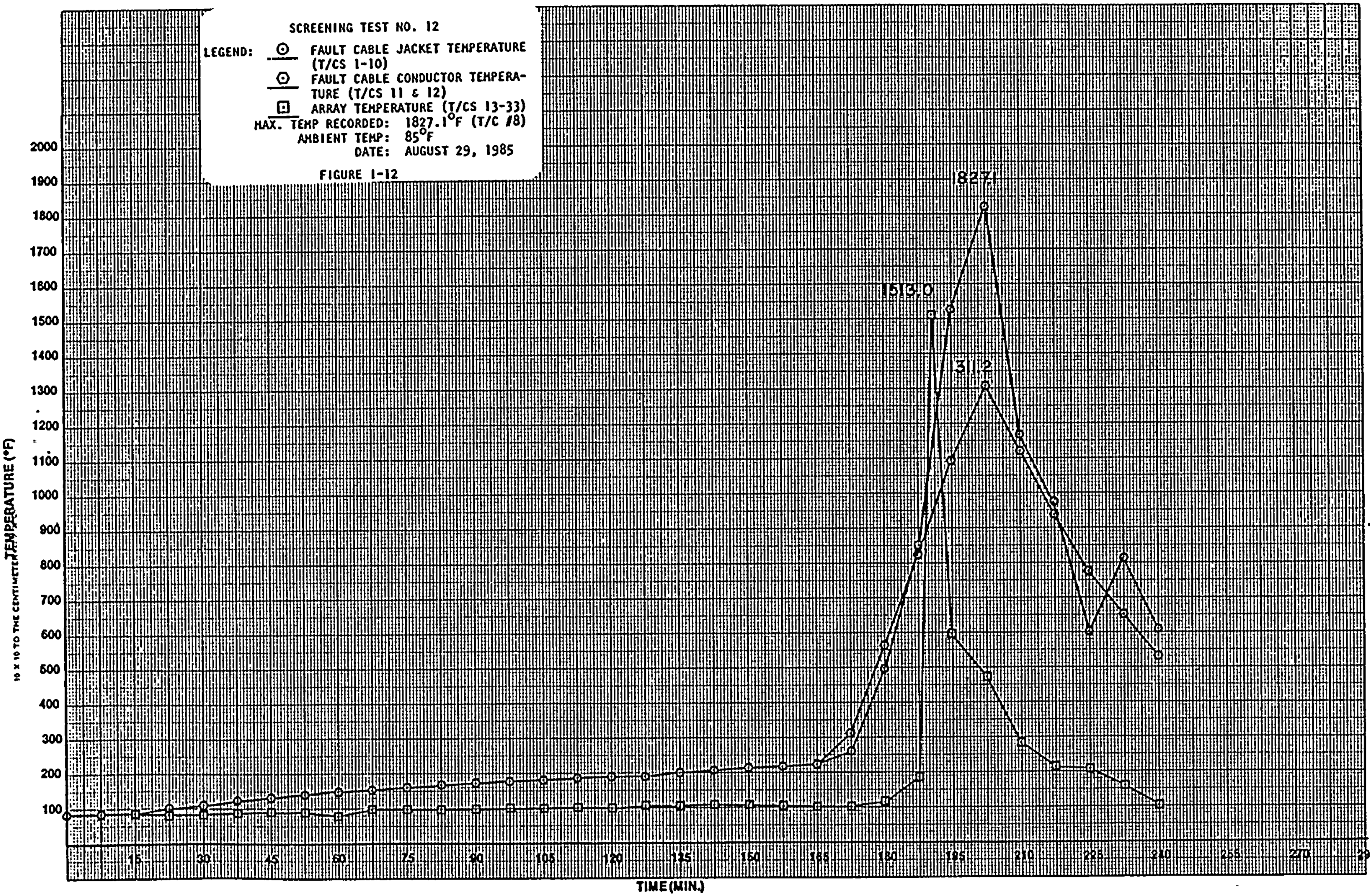
PHOTOGRAPH I-39

POST-TEST VIEW — CLOSE-UP

SCREENING TEST #12

(500 MCM Triplex-Cu)

Approximate Test Time	Approximate Jacket Temperature	Observation
0 Min	86°F	Energized cable with 159A
15 Min	88°F	Energized cable with 615A
110 Min	181°F	Conductor at 189°F
125 Min	187°F	Energized cable with 746A (Test current)
170 Min	217°F	Cable temperature stabilized Energized cable with 2200A (Max. let-through current of backup protection)
188 Min	907°F	Ignition
190.5 Min	1120°F	Peak array temp. (1513°F)
202.7 Min	1803°F	Open Circuit
208.0 Min	1340°F	Fire Out
202.5 Min	1827°F	Peak conductor temp. (1311°F)
202.5 Min	1827°F	Peak jacket temp. (1827°F)


SCREENING TEST NO. 12
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-10)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 11 & 12)
ARRAY TEMPERATURE (T/CS 13-33)
MAX. TEMP RECORDED: 1827.1°F (T/C #8)
AMBIENT TEMP: 85°F
DATE: AUGUST 29, 1985
FIGURE I-12
1827.1
1513.0
1311.2
TEMPERATURE (°F)
TIME (MIN.)
10 X 10 TO THE CENTIMETER

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 85°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/29/85

Test Title: Screening Test No. 12

Fault Cable Size: 500MCM Triplex

No. Conductors: 3

3. readings after 10 minute application of FLA:

Current: 159A

Max. Temp. °F Channels 1-10: 88°F/6

Temp. Channel 11: 86°F   Temp. Channel 12: 86°F

5. Readings at beginning of 15-minute period at 90°C ±3°C (189°F-199°F)

Current: 650 A

Max. Temp. °F Channels 1-10: 181°F   Channel No. 9

Temp. Channel 11: 189°F   Temp. Channel 12: 181°F

Tested By: [signature] Date: 8/29/85
Witness: None Date:
Sheet No. 1 of 3
Approved: [signature] 8-29-85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.2.3
S/N N/A
GSI No

Amb. Temp. 85°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-2
Start Date 8/29/85

Test Title Screening Test No. 12

7.	Readings at end of 15-minute period at 90°C ±3 °C (189°F-199°F)		
	Current: 650A		
	Max. Temp. °F Channels 1-10: 187°F	Channel No. 9	
	Temp. Channel 11: 196°F	Temp Channel 12: 189°F	
9-11.	Final readings with test current applied:		
	9. If open circuit occurs: N/A		
	Elapsed time: ~~1800 sec~~		
	Max. Temp. °F Channels 1-12:	Channel No.	
	10. If 15-minute period of stabilized temperature occurs:		
	Current: 746A		
	Elapsed time to beginning of 15-minute period: 1800 sec		
	Max. Temp. °F Channels 1-12: 232°F	Channel No. 11	
	11. If fault cable ignites: N/A		
	Elapsed time to ignition:		

Tested By [signature] Date: 8/29/85
Witness None Date:
Sheet No. 2 of 3
Approved [signature] 8·29·85

Notice of Anomaly None

Wyle Form WH 814A Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.2.3
S/N: N/A
GSI: No

Amb. Temp.: 85°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 8/29/85

Test Title: Screening Test No. 12

12. Readings with fault current applied (660 amperes for cables 1-5, 2200 amperes for cables 6-12)

Current:	2200 A		
Max. Temp. °F Channels 1-10:	1827°F	Channel No.	8
Elapsed time to open circuit or stable temp:	1964 sec		
Time to ignition if applicable:	1085 sec		

Tested By: [signature] Date: 8/29/85
Witness: None Date:
Sheet No. 3 of 3
Approved: [signature] 8-29-85

Notice of Anomaly: None

Wyle Form WH 514A Rev APR 34

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CONFIGURATION NO. 1 TESTS
(Separation of Cable in Free Air to Cable in Free Air Without Barriers)

[illegible]

SECTION II

CONFIGURATION NUMBER 1 TESTS (SEPARATION OF CABLE IN FREE AIR TO CABLE IN FREE AIR WITHOUT BARRIERS)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

1.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6×10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds.

1.1.2 High Potential Test

There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute.

1.1.3 Cable Continuity Test

Energized specimens in the target raceway shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current
1/0 AWG	Triplex	NJM-34	L	575	139
2 AWG	Triplex	NJM-25	K	575	38.5
12 AWG	7	NJN-37	C	120	10
16 AWG	2/C	NJP-05	X	50	1

1.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, -0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance.

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

2.0 PROCEDURES

2.1 Test Specimen Preparation

The test specimens were mounted to the unistrut frame assembly as shown in Figures 2, 3 and 4 of Section VIII. This apparatus was assembled to the indicated dimensions by Wyle technicians using materials supplied by the customer. The following was observed with regard to the materials and construction of the assembly:

1. The faulted cable was a Triplex 2/0 AWG cable from NMP2 stock for all three tests.

2. The ends of the faulted cable from their termination at the copper bus bar to the edge of the unistrut frame were wrapped with a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape. This wrapping was done to ensure that any ignition that might occur was contained to the test area.

3. For Test No. 1:
   - The vertically separated target cable was a Triplex 2 AWG cable from NMP2 stock. This cable was loosely tied to the unistrut of Figure 2 in Section VIII, with ceramic tie cords, such that the cable was 9 inches vertically above the centerline of the faulted cable.
   - The horizontally separated target cable was a 2/C 16 AWG cable from NMP2 stock. This cable was mounted such that the cable was 6 inches horizontally away from the faulted cable.
   - The vertical cable was a 7/C 12 AWG cable from NMP2 stock. This cable was mounted such that the cable was 6 inches away from the fault cable.

4. For Test No. 2:
   - The upper horizontal target cable was a Triplex 2 AWG cable from NMP2 stock. This cable was loosely tied to the unistrut of Figure 3 in Section VIII such that the cable was located 6 inches horizontally from the perpendicular fault cable and 9 inches above the lower target cable.
   - The lower horizontal target cable was a 7/C 12 AWG cable from NMP2 stock. This cable was loosely tied to the unistrut of Figure 3 in Section VIII such that the cable was located 6 inches from the perpendicular fault cable.

5. For Test No. 3:
   - The horizontal cable tray was filled to its siderails with K-Type cables from NMP2 stock as shown in Figure 4, Section VIII. The bottom centerline cable was a Triplex 2 AWG cable. The cable tray was mounted parallel to the centerline of the fault cable such that it was 9 inches vertically above this cable.

6. Photographs were taken of the test setup prior to each test.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup

2.2.1 Thermocouple Locations

Test No. 1

A total of 26 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the vertically separated target cable. These thermocouples were mounted approximately 16 inches apart.
15-20	Mounted to the jacket on the horizontally separated target cable. These thermocouples were mounted approximately 16 inches apart.
21-26	Mounted to the jacket on the perpendicular target cable. These thermocouples were mounted approximately 10 inches apart.

Test No. 2

A total of 20 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the upper horizontal target cable. These thermocouples were mounted approximately 16 inches apart.
15-20	Mounted to the jacket on the lower horizontal target cable. These thermocouples were mounted approximately 10 inches apart.

2.0 PROCEDURES (Continued)

2.2.1 Thermocouple Locations (Continued)

Test No. 3

A total of 14 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the target cable. These thermocouples were mounted approximately 16 inches apart.

The thermocouples were monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger was operated at its maximum scan rate throughout the overcurrent test.

2.2.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current were fed into an oscillograph recorder. The oscillograph was operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels were as specified in the following tables:

Test No. 1

Channel No.	Signal	Location
1	Current-Phase A	Triplex 2 AWG
2	Current-Phase B	Triplex 2 AWG
3	Current-Phase C	Triplex 2 AWG
4	Voltage A-B	Triplex 2 AWG
5	Voltage A-C	Triplex 2 AWG
6	Voltage B-C	Triplex 2 AWG
7	Current	7/C 12 AWG (V)
8	Voltage	7/C 12 AWG (V)
9	Current	2/C 16 AWG (H)
10	Voltage	2/C 16 AWG (H)
11	Current	Fault Cable
12	Skipped	N/A

H = Parallel Cable
V = Perpendicular Cable

2.0 PROCEDURES (Continued)

2.2.2 Electrical Monitoring (Continued)

Test No. 2

Channel No.	Signal	Location
1	Current-Phase A	Triplex 2 AWG
2	Current-Phase B	Triplex 2 AWG
3	Current-Phase C	Triplex 2 AWG
4	Voltage A-B	Triplex 2 AWG
5	Voltage A-C	Triplex 2 AWG
6	Voltage B-C	Triplex 2 AWG
7	Current	7/C 12 AWG
8	Voltage	7/C 12 AWG
9	Skipped	N/A
10	Skipped	N/A
11	Current	Fault Cable
12	Skipped	N/A

Test No. 3

Channel No.	Signal	Location
1	Current-Phase A	Triplex 2 AWG
2	Current-Phase B	Triplex 2 AWG
3	Current-Phase C	Triplex 2 AWG
4	Voltage A-B	Triplex 2 AWG
5	Voltage A-C	Triplex 2 AWG
6	Voltage B-C	Triplex 2 AWG
7	Skipped	N/A
8	Skipped	N/A
9	Skipped	N/A
10	Skipped	N/A
11	Current	Fault Cable
12	Skipped	N/A

A digital multimeter was utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data was recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC (120 VAC for control cables) throughout the overcurrent test.

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests

The baseline functional tests consisted of insulation resistance and high potential measurements on each of the target cables. These tests were performed as specified in the following paragraphs.

2.3.1 Insulation Resistance Test

1. All power and instrumentation leads were disconnected from the target cables and labeled per Figures 12, 13, and 14 of Section VIII.

2. Using a megohmmeter, a potential of 1000 VDC (500 VDC for 2/C 16 AWG cables) was applied and the minimum insulation resistance indicated after a period of 60 seconds was recorded between the following test points:

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut
1 to 3	2 to unistrut
2 to 3	3 to unistrut

Target Control Cable:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to unistrut
	4 to unistrut

Target Instrument Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut*
	2 to unistrut

* Shield tied to unistrut

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests

2.3.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cable) was applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute. The test points were as specified below.

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or tray
1 to 3	2 to unistrut or tray
2 to 3	3 to unistrut or tray

Target Control Cable:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to unistrut
	4 to unistrut

Target Instrument Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut*
	2 to unistrut

* Shield tied to unistrut

2. All power and instrumentation leads were reconnected per Figures 12, 13, and 14 of Section VIII.

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.2.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test

The overcurrent test was conducted in three sequential steps with no intentional time delay. The first phase consisted of energizing the fault cable with SWEC rated current. The second phase consisted of increasing the current until fault cable temperatures were within 189°-199°F for 5 minutes. The third phase consisted of energizing the fault cable with the worst case electrical fault current until the cable open-circuited.

The target cables conducted SWEC-rated current (see Paragraph 1.1.3) at 575 VAC (power cables), 120 VAC (control cables), or 50 VAC (instrument cables) throughout the overcurrent test. The overcurrent test was conducted using the following procedure:

1. The Triplex 2/0 AWG fault cable was connected to the copper bus bars per Figure 11 of Section VIII (Tests No. 1, 2, and 3).
2. A Triplex 2 AWG target cable was installed per Figure 2 (Test 1), Figure 3 (Test 2), and Figure 4 (Test 3) of Section VIII.
3. A 7/C 12 AWG target cable was installed per Figure 2 (Test 1) and Figure 3 (Test 2) of Section VIII.
4. A 2/C 16 AWG target cable was installed per Figure 2 (Test 1) of Section VIII.
5. The Triplex 2 AWG target cable was connected to the instrumentation and power supplies of Figure 12 (Tests 1, 2, and 3) of Section VIII.
6. The 7/C 12 AWG target cable was connected to the instrumentation and power supplies of Figure 13 (Tests 1 and 2) of Section VIII.
7. The 2/C 16 AWG target cable was connected to the instrumentation and power supplies of Figure 14 (Test 1) of Section VIII.
8. The Triplex 2 AWG target cable was energized with 38.5 amperes at 575 VAC (Tests 1, 2, and 3).
9. The 7/C 12 AWG target cable was energized with 10 amperes at 120 VAC (Tests 1 and 2).
10. The 2/C 16 AWG target cable was energized with 1 ampere at 50 VAC (Test 1).
11. The Triplex 2/0 AWG fault cable was energized with 139 amperes per phase (rated current) from the Multi-Amp Test Set.
12. Target cable voltages and currents and the fault cable current were recorded.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

13. The fault cable current was slowly increased until Thermocouple Channels 7 and/or 8 indicated 90 $\pm 3^oC$ (189-199^oF) conductor temperature.

14. The conductor temperature was maintained at 189-199^oF for five minutes.

15. Fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6 were recorded.

16. The Multi-Amp Test Set output was increased to 908A (test current).

17. Target cable voltages and currents and the fault cable current were recorded.

18. The fault cable was allowed to conduct test current until the cable open-circuited.

19. The elapsed time and maximum cable temperature were recorded.

20. The target cable voltages and currents were recorded.

21. The target cables and the Multi-Amp Test Set were de-energized.

22. Photographs were taken of the post-test condition.

For all performances of this test, the observed target cable operation was compared to the acceptance criteria, Paragraph 1.1.3.

2.5 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 2.3 were repeated.

3.0 RESULTS

3.1 Results of Test No. 1

Configuration Number 1, Test No. 1, with a Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1207 seconds (20.1 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1598°F which occurred on Thermocouple No. 2. The fault cable ignited after 660 seconds (11 minutes). The fire burned for approximately 12 minutes.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable), 120 VAC (control cable), or 50 VAC (instrument cable) was not impaired during this test. The maximum observed target cable temperature was 259°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix I contains the following data from this test:

1. Notices of Anomaly Number 1, 2 and 3.
2. Photographs II-1 through II-2 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure II-1 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

3.0 RESULTS (Continued)

3.2 Results of Test No. 2

Configuration Number 1, Test No. 2, with a Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1467 seconds (24.4 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1503°F which occurred on Thermocouple No. 3. The fault cable ignited after 690 seconds (11.5 minutes). The fire burned for approximately 16.5 minutes.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable), 120 VAC (control cable), or 50 VAC (instrument cable) was not impaired during this test. The maximum observed target cable temperature was 370°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix II contains the following data from this test:

1. Notices of Anomaly applicable to this section are contained in Appendix I.
2. Photographs II-3 through II-5 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure II-2 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

3.0 RESULTS (Continued)

3.3 Results of Test No. 3

Configuration Number 1, Test No. 3, with a Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1150 seconds (19.2 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1610°F which occurred on Thermocouple No. 3. The fault cable ignited after 653 seconds (10.9 minutes). The fire burned for approximately 10.0 minutes.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable), 120 VAC (control cable), or 50 VAC (instrument cable) was not impaired during this test. The maximum observed target cable temperature was 296°F. The target cable successfully completed the Post-Overcurrent Test Functional Test.

Appendix III contains the following data from this test:

1. Notices of Anomaly applicable to this section are contained in Appendix I.
2. Photographs II-6 through II-10 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure II-3 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

APPENDIX I

CONFIGURATION NUMBER 1, TEST NO. 1, DATA

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/6/85

NOTICE NO: 1 P.O. NUMBER: NMP2-E-0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/6/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/5/85

PART NAME: Electrical Cable PART NO. N/A

TEST: Configuration 1, Test 1 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 3.3.4.1 & 3.3.4.2

Requirements:

3.3.4.1

1. Disconnect all power and instrumentation leads from the target cables and label per Figures 12, 13, and 14.
2. Using a megohmmeter, apply a potential of 1000 VDC and record the minimum insulation resistance.

3.3.4.2

1. Using a HiPot Test Set, a potential of 2200 VAC shall be applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Description of Anomaly:

The conductor connections (Figure 13) of 1 to 2, 2 to 3, 4 to 5, 5 to 6, and 6 to 7 were not made at the time the baseline functional tests were performed.

Disposition - Comments - Recommendations:

The lack of conductor connections was judged to have no impact because the post-overcurrent test functional test results showed acceptable values for insulation resistance and no evidence of insulation breakdown.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ______

REPRESENTING: ______

QUALITY ASSURANCE: G.W. Knight 9/13/85

PROJECT ENGINEER: J. R. King 9/9/85

PROJECT MANAGER: [signature] 9/12/85

INTERDEPARTMENTAL COORDINATION: K Taylor 9-13-85

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/12/85

NOTICE NO: 2 P.O. NUMBER: NMP2-E0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/6, 9/7, 9/10/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☐ PROCEDURE ☒ TEST EQUIPMENT DATE OF ANOMALY: 9/5, 9/6, 9/9/85

PART NAME: Electrical Cables PART NO. N/A

TEST: Configuration 1, Tests 1, 2, 3 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 2.1.4, 3.3.5, 3.4.5

Requirements:

1. The two target cables shall conduct SWEC-rated current (see Paragraph 2.1.3) at 575 VAC (power cables) or 120 VAC (control cables) or 50 VAC (instrument cables) throughout the overcurrent test.
2. All target cable currents shall be maintained within a +10%, -0% tolerance.

Description of Anomaly:

During Configuration 1, Tests 1, 2 and 3, and Configuration 2, Test 1, some of the currents were out of tolerance after flowing test current. The maximum variation on the plus side was 15.3%. The maximum variation on the minus side was 6.8%.

Disposition - Comments - Recommendations:

The out of tolerance currents were judged to have no impact on the test. The test results showed that the target cable's ability to carry current was not impaired by the test conditions.

Maintaining the +10%, -0% tolerance is not always possible due to the following reasons.

1. Unbalanced currents between phases.
2. Temperature changes in the conductors causing the impedance of the cables to change.
3. Voltage fluctuations in the facility power delivered by the local utilities.

Therefore, the acceptance criteria for future tests was changed to require the initial setting of target cable currents (with rated current on the fault cable) to be within +10%, -0%. Thereafter, all target cable currents shall be maintained within ±10% tolerance.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ____

REPRESENTING: ____

QUALITY ASSURANCE: G.W. Wright 9/13/85

PROJECT ENGINEER: John P. King 9-12-85

PROJECT MANAGER: MM 9-12-85 [signature] 9/12/85

INTERDEPARTMENTAL COORDINATION: K Taylor 9/13-85

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/12/85

NOTICE NO: 3 P.O. NUMBER: NMP2-E-0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/6/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/5/85

PART NAME: Electrical Cables PART NO. N/A

TEST: Configuration 1, Test 1 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 3.3.5

Requirements:

1. The two target cables shall conduct SWEC-rated current (see Paragraph 2.1.3) at 575 VAC (power cables) or 120 VAC (control cables) or 50 VAC (instrument cables) throughout the overcurrent test.
2. All target cable currents shall be maintained within a +10%, -0% tolerance.

Description of Anomaly:

Initially the current on the No. 2 AWG target power cable was set to 37.9A which was 1.6% below the required 38.5A +10%, -0%. Also, the current on the No. 16 AWG instrument cable was set to 1.152A which was 4.7% above the required 1A +10%, -0%.

Disposition - Comments - Recommendations:

The out of tolerance currents were judged to have no impact on the test as discussed in NOA No. 2. For future tests, initial settings will be verified by the test engineer.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ____

REPRESENTING: ____

QUALITY ASSURANCE: G. W. Wright 9/13/85

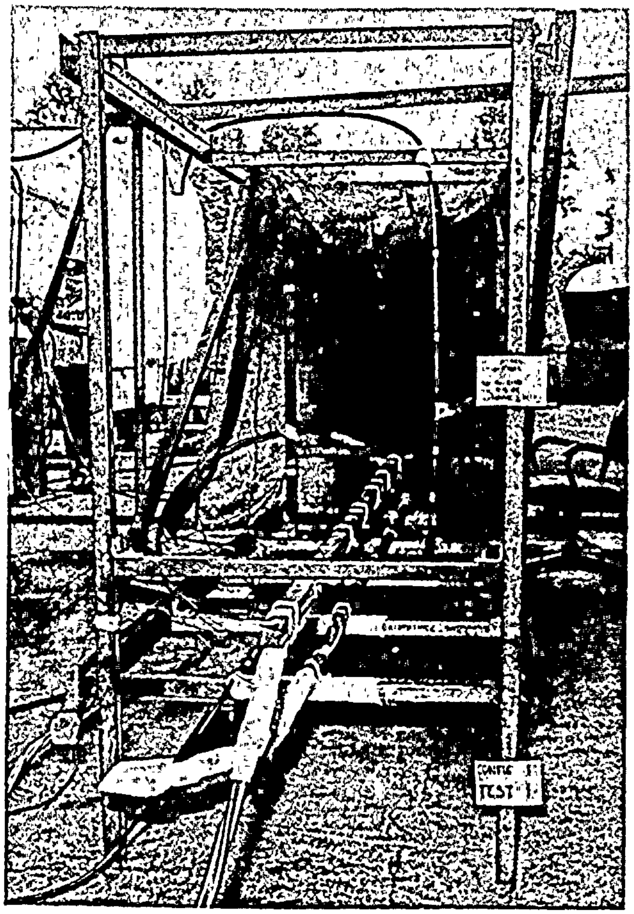
PROJECT ENGINEER: John D. King 9-12-85

PROJECT MANAGER: 9-12-85 9/12/85

INTERDEPARTMENTAL COORDINATION: K Taylor 9-13-85

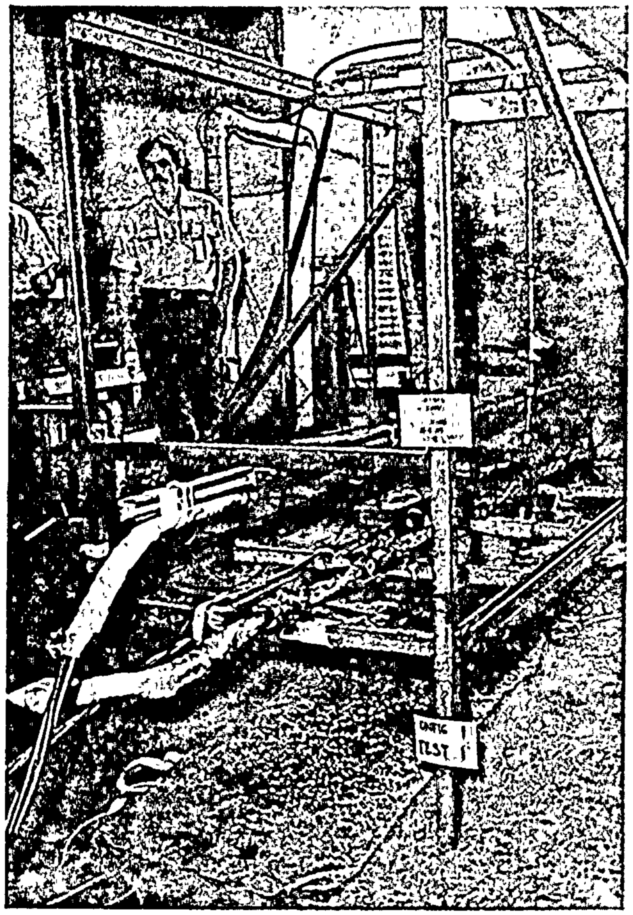
Wyle Form WH 1066, Rev. JAN '85

CONFIGURATION NUMBER 1, TEST NO. 1



PHOTOGRAPH II-1

PRETEST VIEW — OVERALL



PHOTOGRAPH II-2

POST-TEST VIEW — OVERALL

CONFIGURATION NUMBER 1, TEST NO. 1

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	83°F	Energized fault cable with 139A
10 Min	89°F	Energized fault cable with 270A
70 Min	176°F	Energized fault cable with 255A
75 Min	178°F	Energized fault cable with 270A
78.3 Min	179°F	Fault cable conductor reached 189°F
86.7 Min	182°F	Energized fault cable with 908A
89.9 Min	299°F	Light smoke visible
94.3 Min	522°F	Fault cable jacket rupturing
97.7 Min	746°F	Ignition of fault cable
106.8 Min	1598°F	Open circuit — Maximum fault cable jacket temperature
109.7 Min	1220°F	Fire out

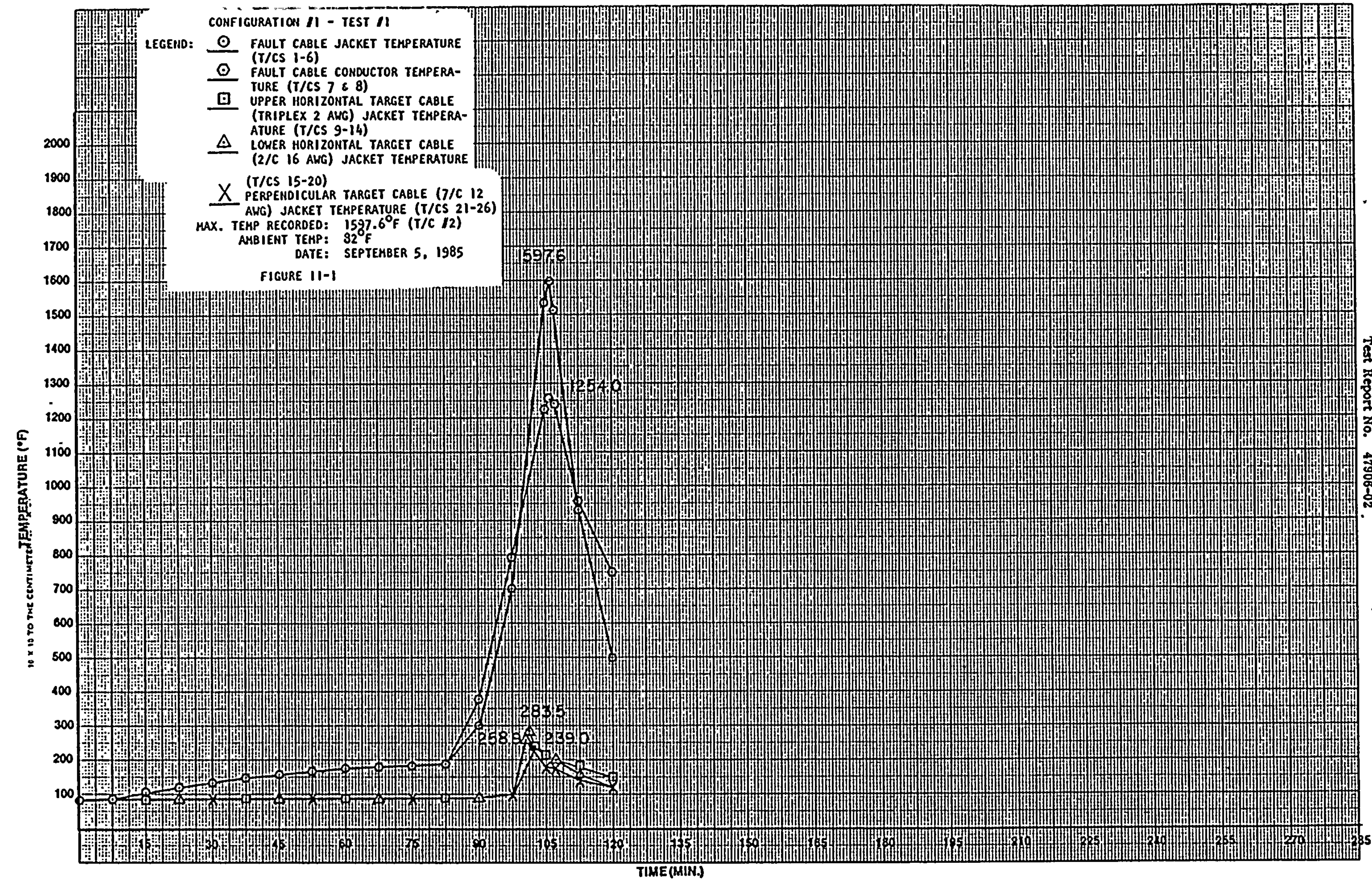

CONFIGURATION #1 - TEST #1
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
UPPER HORIZONTAL TARGET CABLE (TRIPLEX 2 AWG) JACKET TEMPERAATURE (T/CS 9-14)
LOWER HORIZONTAL TARGET CABLE (2/C 16 AWG) JACKET TEMPERATURE (T/CS 15-20)
PERPENDICULAR TARGET CABLE (7/C 12 AWG) JACKET TEMPERATURE (T/CS 21-26)
MAX. TEMP RECORDED: 1597.6°F (T/C #2)
AMBIENT TEMP: 82°F
DATE: SEPTEMBER 5, 1985
1597.6
1254.0
283.5
258.9
239.0
TEMPERATURE (°F)
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
TIME (MIN.)

FIGURE II-1

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.4
S/N N/A
GSI No

Amb. Temp. 74°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-2
Start Date 9-5-85

Test Title Configuration No. 1 Test No. 1
Pre-Test (circled) ~~Post-Test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC (500 for ~~5~~ 18K T.P. 16 AWG) applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	$7.0 \times 10^8 \Omega$
(vertically separated)	1 to 3	$5.0 \times 10^8 \Omega$
	2 to 3	$4.3 \times 10^8 \Omega$
	1 to Unistrut	$5.3 \times 10^8 \Omega$
	2 to Unistrut	$5.2 \times 10^8 \Omega$
	3 to Unistrut	$5.4 \times 10^8 \Omega$
7/C - 12 AWG	1 to 4	1.2×10^9
(horizontally separated)	1 to Unistrut	1.6×10^9
	4 to Unistrut	1.7×10^9

Tested By [signature] Date: 9-5-85
Witness NA Date:
Sheet No. 1 of 4
Approved [signature] 9-5-85

Notice of Anomaly ~~None~~ No. 1

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.4
S/N: N/A
GSI: No

Amb. Temp.: 74°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1
(Pre-Test) ~~Post-Test~~ Functional Test

Insulation Resistance Test (Continued)

Cable	Test Points	Reading
~~3~~ 1 T.P. 16 AWG	1 to 2	1.25X10⁹Ω
(Horizontally Separated)	3 to 4	NA
	5 to 6	NA
	7 to 8	NA
	9 to 10	NA
	1 to Unistrut	1.5X10⁹Ω
	2 to Unistrut	1.3X10⁹Ω
	3 to Unistrut	NA
	4 to Unistrut	NA
	5 to Unistrut	NA
	6 to Unistrut	NA
	7 to Unistrut	NA
	8 to Unistrut	NA
	9 to Unistrut	NA
	10 to Unistrut	NA

Tested By: Danny L Webb Date: 9-5-85
Witness: NA Date:
Sheet No. 2 of 4
Approved: J King 9-5-85

Notice of Anomaly: None

Wyle Form WH 614A Rev. APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.4
S/N: N/A
GSI: No

Amb. Temp.: 74°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1

(Pre-Test) ~~Post-Test~~ Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 5 T.P. 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
#2 AWG Triplex	1 to 2	1105µA
(Vertically Separated)	1 to 3	1150µA
	2 to 3	1160µA
	1 to Unistrut	1175µA
	2 to Unistrut	1195µA
	3 to Unistrut	1180µA
7/C - 12 AWG	1 to 4	590µA
(Horizontally Separated)	1 to Unistrut	500µA
	4 to Unistrut	495µA

Tested By: Danny L Webb Date: 9-5-85
Witness: NA Date:
Sheet No. 3 of 4
Approved: JMKing 9-5-85

Notice of Anomaly: No. 1

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.4
S/N: N/A
GSI: No

Amb. Temp.: 74°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1
(Pre-Test) ~~Post-Test~~ N Functional Test

High Potential Test (Continued)

Cable	Test Points	Reading
~~5~~ 1 JMC T.P. 16 AWG	1 to 2	600 MA
(Horizontally Separated)	3 to 4 NA JMC	
	5 to 6 NA JMC	
	7 to 8 NA JMC	
	9 to 10 NA JMC	
	1 to Unistrut	505 MA
	2 to Unistrut	510 MA
	3 to Unistrut NA JMC	
	4 to Unistrut NA JMC	
	5 to Unistrut NA JMC	
	6 to Unistrut NA JMC	
	7 to Unistrut NA JMC	
	8 to Unistrut NA JMC	
	9 to Unistrut NA JMC	
	10 to Unistrut NA JMC	

Tested By: Danny L Webb Date: 9-5-85
Witness: None Date:
Sheet No. 4 of 4
Approved: JMKing 9-5-85

Notice of Anomaly: None

Wyle Form WH 814A Rev APR '84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.5
S/N: N/A
GSI: No

Amb. Temp.: 82°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1 Overcurrent Test

12. Readings with rated current on fault cable

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex (Vertically Separated)	577	576	572	39.1	39.1	37.9
7/C - 12 AWG (Horizontally Separated)	120.9 Vac			10.11 Amps		
~~5~~ 1 T.P. 16 AWG (Horizontally Separated)	50.21 Vac			1.152 amps		

Fault Cable: #2/0 TRIPLEX
Rated Current: 139 A
Measured Current: 140A

Tested By: [illegible signature] Date: 9-5-85
Witness: None Date:
Sheet No. 1 of 5
Approved: [signature] 9-5-85

Notice of Anomaly: No. 3

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.5
S/N: N/A
GSI: No

Amb. Temp.: 83°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1 Overcurrent Test

13. Increasing current to raise fault cable temperature to 189°F-199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP/CHANNEL
270A	3600	186°F/8
255A	300	187°F/8
270A	700	195°F/8

15. Readings after fault cable warmup to 189°F-199°F

Fault Cable Current: 270

Conductor temperature: 193 Channel No. 8

Max. Temp. °F
Channels 1-6: 186

Tested By [illegible signature] Date: 9-5-85
Witness: None Date:
Sheet No. 2 of 5
Approved [signature] 9-5-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.5
S/N: N/A
GSI: No

Amb. Temp.: 83°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1 Overcurrent Test

17. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex (Vertically Separated)	518	575	570	42.6	36.9A	37.5A
7/C - 12 AWG (Horizontally Separated)	20.4 Vac					9.30 Amps
~~5~~ 1 T.P. 16 AWG (Horizontally Separated)	2? 5? Vac				1.149 Amps	

Fault Cable: #2/0 TRIPLEX

Test ~~Rated~~ Current: ~~139~~ 908 A

Measured Current: 708 A

Tested By: [illegible] Date: [illegible]
Witness: None Date:
Sheet No. 3 of 5
Approved: J. King 9-5-85

Notice of Anomaly: No. 2

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.5
S/N: N/A
GSI: No

Amb. Temp.: 83°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1

19. Open circuit on fault cable:			
Elapsed time:	1207 sec		
Maximum fault cable temperature:	1598	Channel No.	2
20. Stabilized temperature on fault cable:			
Elapsed time (beginning of 15-minute period):	N/A		
Maximum fault cable temperature:	N/A	Channel No.	N/A
Fault cable current:	N/A		
21. Ignition of fault cable:			
Elapsed time:	660 sec		
Maximum fault cable temperature:	1598	Channel No.	2
Fault cable current:	~~1598~~ 908A		

Tested By: [signature] Date: 9-5-85
Witness: None Date:
Sheet No. 4 of 5
Approved: J King 9-6-86

Notice of Anomaly: None

Wyle Form WH-611A Rev APR 84

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.3.5

S/N N/A

GSI No

Amb. Temp. 83°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-02

Start Date 9-5-85

Test Title Configuration No. 1 Test No. 1 Overcurrent Test

23. Readings after let-through current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
2 AWG Triplex (Vertically Separated)	578	579	573	37.3	37.9	36.6
7/C - 12 AWG (Horizontally Separated)	120.7 Vac				9.97 A	
1 pr T.P. 16 AWG (Horizontally Separated)	49.65 Vac				1.103 A	

Tested By [illegible] Date: 9-5-85

Witness None Date:

Sheet No. 5 of 5

Approved J King 9-5-85

Notice of Anomaly No. 2

[illegible]

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.6
S/N N/A
GSI No

Amb. Temp. 83°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 9-5-85

Test Title Configuration No. 1 Test No. 1
~~Pre-Test~~ N (Post-Test) Functional Test

Insulation Resistance Test		
Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC (500 for ~~8~~ 1 pair T.P. 16 AWG) applied for 60 seconds.		
Cable	Test Points	Reading
2 AWG Triplex	1 to 2	8.0 X 10⁹ Ω
(vertically separated)	1 to 3	8.0X10⁹ Ω
	2 to 3	8.0X10⁹ Ω
	1 to Unistrut	1.8X10⁸ Ω
	2 to Unistrut	2.0X10⁸ Ω
	3 to Unistrut	2.1X10⁸ Ω
7/C - 12 AWG	1 to 4	8.0X10⁹ Ω
(horizontally separated)	1 to Unistrut	8.0X10⁹ Ω
	4 to Unistrut	7.5X10⁹ Ω

Tested By [signature] Date: 9-5-85
Witness None Date:
Sheet No. 1 of 4
Approved J. King 9.5.85

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.6
S/N N/A
GSI No

WYLE LABORATORIES

Amb. Temp. 85°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-2
Start Date 9-5-85

Test Title Configuration No. 1 Test No. 1
~~Pre-Test~~ Post-Test (circled) Functional Test

Insulation Resistance Test (Continued)

Cable	Test Points	Reading
~~8~~ 1 T.P. 16 AWG	1 to 2	4.0 X 10^9 Ω
(Horizontally Separated)	3 to 4 NA JPK	
	5 to 6 NA JPK	
	7 to 8 NA JPK	
	9 to 10 NA JPK	
	1 to Unistrut	2.1 X 10^8 Ω
	2 to Unistrut	2.2 X 10^8 Ω
	3 to Unistrut NA JPK	
	4 to Unistrut NA JPK	
	5 to Unistrut NA JPK	
	6 to Unistrut NA JPK	
	7 to Unistrut NA JPK	
	8 to Unistrut NA JPK	
	9 to Unistrut NA JPK	
	10 to Unistrut NA JPK	

Tested By [signature] Date: 9-5-85
Witness None Date:
Sheet No. 2 of 4
Approved J. King 9-5-85

Notice of Anomaly None

Wyle Form WH 614A, Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.6
S/N: N/A
GSI: No

Amb. Temp.: 83°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-2
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 1
~~Pre-Test~~ Post-Test (circled) Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 5 T.P. 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
#2 AWG Triplex	1 to 2	790 µA
(Vertically Separated)	1 to 3	780 µA
	2 to 3	795 µA
	1 to Unistrut	1005 µA
	2 to Unistrut	1015 µA
	3 to Unistrut	1015 µA
7/C - 12 AWG	1 to 4	1540 µA
(Horizontally Separated)	1 to Unistrut	1000 µA
	4 to Unistrut	1200 µA

Tested By: [illegible signature] Date: 9-5-85
Witness: None Date:
Sheet No. 3 of 4
Approved: J. King 9-5-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.3.6

S/N N/A

GSI No

Amb. Temp. 83°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-2

Start Date 9-5-85

Test Title Configuration No. 1 Test No. 1

~~Pre-Test~~ N (Post-Test) Functional Test

High Potential Test (Continued)

Cable	Test Points		Reading
~~8~~ 1 T.P. 16 AWG	1 to 2		550 µA
(Horizontally Separated)	3 to 4	NA JPK	~~1150 µA~~ DW
	5 to 6	NA JPK	~~495 µ~~ DW
	7 to 8	NA JPK	
	9 to 10	NA JPK	
	1 to Unistrut		1150 µA
	2 to Unistrut		1195 µA
	3 to Unistrut	NA JPK	
	4 to Unistrut	NA JPK	
	5 to Unistrut	NA JPK	
	6 to Unistrut	NA JPK	
	7 to Unistrut	NA JPK	
	8 to Unistrut	NA JPK	
	9 to Unistrut	NA JPK	
	10 to Unistrut	NA JPK	

Tested By [signature] Date: 9-5-85

Witness None Date:

Sheet No. 4 of 4

Approved J. King 9-5-85

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR '84

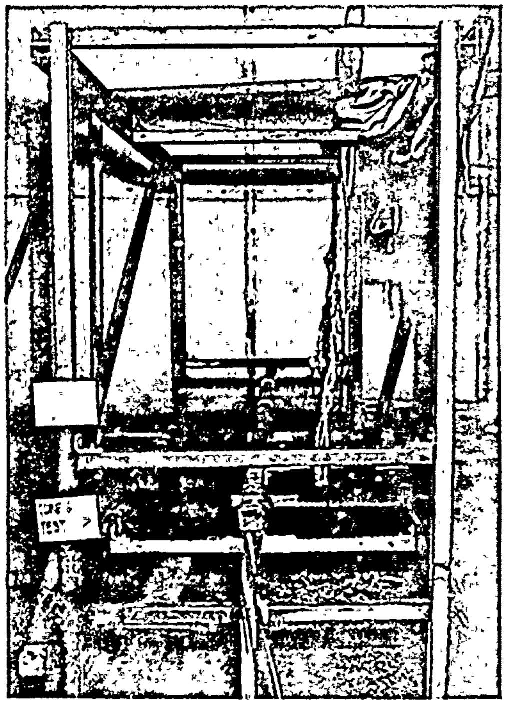
APPENDIX II

CONFIGURATION NUMBER 1, TEST NO. 2, DATA

CONFIGURATION NUMBER 1, TEST NO. 2

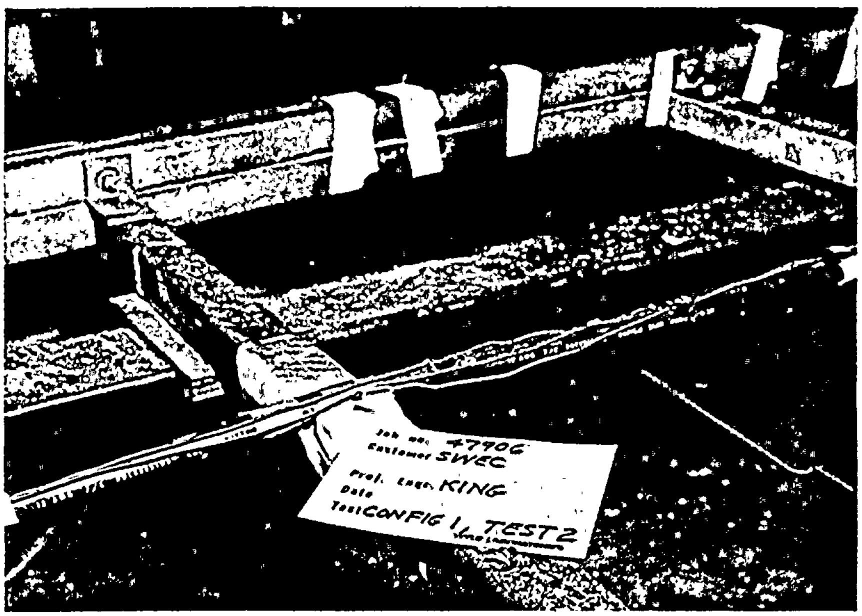
PHOTOGRAPH II-3

PRETEST VIEW — OVERALL



PHOTOGRAPH II-4

POST-TEST VIEW — OVERALL

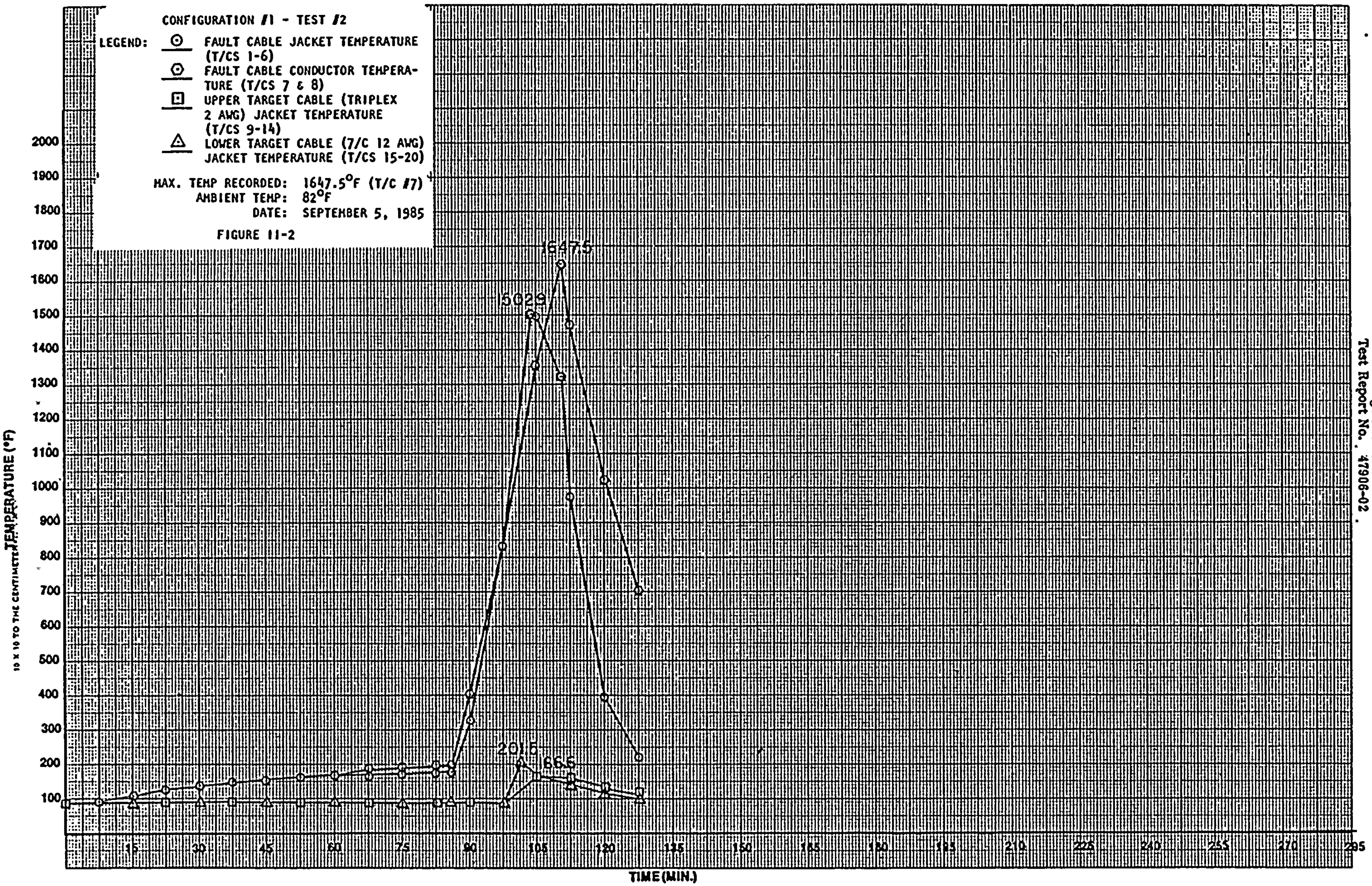


PHOTOGRAPH II-5

POST-TEST VIEW — CLOSE-UP
TARGET CABLE AT CLOSEST POINT
TO FAULT CABLE

CONFIGURATION NUMBER 1, TEST NO. 2

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	82°F	Energized fault cable with 139A
10 Min	89°F	Energized fault cable with 270A
65 Min	169°F	Energized fault cable with 275A
70 Min	172°F	Energized fault cable with 280A
75 Min	175°F	Energized fault cable with 285A
80 Min	176°F	Fault cable conductor reached 190°F
86.3 Min	178°F	Energized fault cable with 908A
91.3 Min	392°F	Light smoke visible
94.2 Min	515°F	Fault cable jacket rupturing
97.8 Min	856°F	Ignition of fault cable
110.7 Min	1648°F	Open circuit
113.3 Min	1420°F	Fire out


CONFIGURATION #1 - TEST #2
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
UPPER TARGET CABLE (TRIPLEX 2 AWG) JACKET TEMPERATURE (T/CS 9-14)
LOWER TARGET CABLE (7/C 12 AWG) JACKET TEMPERATURE (T/CS 15-20)
MAX. TEMP RECORDED: 1647.5°F (T/C #7)
AMBIENT TEMP: 82°F
DATE: SEPTEMBER 5, 1985
FIGURE II-2
1647.5
1502.9
201.5
166.5
TEMPERATURE (°F)
TIME (MIN.)
10 X 10 TO THE CENTIMETER

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.3.4

S/N N/A

GSI No

Amb. Temp. 82°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

Job No. 47906

Report No. 47906-02

Start Date 9-5-85

Test Title Configuration No. 1 Test No. 2

(Pre-Test) ~~Post-Test~~ Functional Test

INSULATION RESISTANCE TEST

ACCEPTANCE CRITERIA: Measured insulation resistance shall be greater than 1.6 Megohms with a potential of 1000 VDC (500 for ~~18~~ 16 T.P. 16 AWG) applied for 60 seconds.

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	6.0×10⁹ Ω
(Vertically Separated)	1 to 3	8.0×10⁹ Ω
	2 to 3	3.4×10⁸ Ω
	1 to Unistrut	4.2×10⁹ Ω
	2 to Unistrut	5.0×10⁹ Ω
	3 to Unistrut	4.5×10⁹ Ω
7/C - 12 AWG	1 to 4	8.0×10⁹ Ω
(Horizontally Separated)	1 to Unistrut	8.0×10⁹ Ω
	4 to Unistrut	7.5×10⁹ Ω

Tested By [signature] Date: 9-5-85

Witness None Date:

Sheet No. 1 of 2

Approved [signature] 9-5-85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No.	Various	Amb. Temp.	82°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.3.4	Test Med.	Air	Start Date	9-5-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title Configuration No. 1 Test No. 2
(Pre-test) ~~Post Test~~ Functional Test

HIGH POTENTIAL TEST

ACCEPTANCE CRITERIA: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 1/3 T.P. 16 AWG cables) applied for one minute:

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	930 μA
(Vertically Separated)	1 to 3	980 μA
	2 to 3	920 μA
	1 to Unistrut	905 μA
	2 to Unistrut	880 μA
	3 to Unistrut	890 μA
7/C - 12 AWG	1 to 4	1540 μA
(Horizontally Separated)	1 to Unistrut	1000 μA
	4 to Unistrut	1200 μA

Tested By [signature] Date: 9-5-85

Witness None Date:

Sheet No. 2 of 2

Approved [signature] 9-5-85

Notice of Anomaly None

Wyle Form WH 2VGA, Rev. 1/84

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various | Amb. Temp. 83°F | Job No. 47906

Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02

Para. 3.3.5 | Test Med. Air | Start Date 9-5-85

S/N N/A | Specimen Temp. Ambient

GSI No

Test Title Configuration No. 1 Test No. 2 Overcurrent Test

12. Readings with rated current on fault cable:

TARGET CABLE	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (AMPS) Phase A	Current (AMPS) Phase B	Current (AMPS) Phase C
2 AWG Triplex	578	577	571	40.0 A	41.0 A	39.9 A
(Vertically Separated)						
7/C - 12 AWG		120.5 Vac			9.99A	
(Horizontally Separated)						

FAULT CABLE: 2/0 AWG TRIPLEX

RATED CURRENT: 139 A

MEASURED CURRENT: 139 A

Tested By [signature] Date: 9-5-85

Witness N/A Date:

Sheet No. 1 of 5

Approved [signature] 9-5-85

Notice of Anomaly NOA 2

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.5
S/N N/A
GSI No

Amb. Temp. 83°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-5-85

Test Title Configuration No. 1 Test No. 2 Overcurrent Test

13. Increasing current to raise fault cable temperature to 189°F - 199°F:

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP./CHANNEL
270A	3300 sec	178°F/7
275A	300 sec	182°F/7
280A	300 sec	185°F/7
285A	300 sec	190°F/7

15. Readings after fault cable warmup to 189°F - 199°F

FAULT CABLE CURRENT:	285A		
CONDUCTOR TEMPERATURE:	192°F	CHANNEL NO.	7
Max. Temp. °F Channels 1-6	178°F		

Tested By [signature] Date: 9-5-85
Witness None Date:
Sheet No. 2 of 5
Approved [signature] 9-19-85

Notice of Anomaly None

DATA SHEET

Customer	Stone & Webster			WYLE LABORATORIES	
Specimen	Cables				
Part No.	Various	Amb. Temp.	83°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.3.5	Test Med.	Air	Start Date	9-5-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title: Configuration No. 1 Test No. 2 Overcurrent Test

17. Initial readings with test current on fault cable:

TARGET CABLE	Voltage (VAC) A-B	Voltage (VAC) A-C	Voltage (VAC) A-C	Current (AMPS) Phase A	Current (AMPS) Phase B	Current (AMPS) Phase C
2 AWG Triplex	573	568	570	39.9A	41.0A	39.4A
(Vertically Separated)						
7/C - 12 AWG	119.3 Vac			9.89 Amps		
(Horizontally Separated)						

FAULT CABLE 2/0 AWG TRIPLEX

Test ~~Rated~~ Current: ~~134 A~~ 908A

Measured Current: 908A

Notice of Anomaly: NO. 2

Tested By: Dianna L. Welt Date: 9-5-85
Witness: None Date:
Sheet No. 3 of 5
Approved: [signature] 9-19-85

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.5
S/N N/A
GSI No

Amb. Temp. 83°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-5-85

Test Title Configuration No. 1 Test No. 2 Overcurrent Test

19. Open circuit on fault cable:	~~1467 sec~~ BB		
Elapsed time:	1467 sec		
Maximum fault cable temperature:	1503°F	Channel No.	3
20. Stabilized temperature on fault cable:			
Elapsed time (beginning of 15-minute period):	N/A		
Maximum fault cable temperature:	N/A	Channel No.	N/A
Fault cable current:	N/A		
21. Ignition of fault cable:			
Elapsed time:	690 sec		
Maximum fault cable temperature:	1503°F	Channel No.	3
Fault cable current:	908 A		

Tested By [signature] Date: 9/5/85
Witness [signature] Date:
Sheet No. 4 of 5
Approved [signature] 9-5-85

Notice of Anomaly None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.5
S/N: N/A
GSI: No

Amb. Temp.: 83°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-5-85

Test Title: Configuration No. 1 Test No. 2 Overcurrent Test

23. Readings after ~~let-through~~ test current applied until fault cable open circuits:

TARGET CABLE	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (AMPS) Phase A	Current (AMPS) Phase B	Current (AMPS) Phase C
2 AWG Triplex	576	577	572	39.7	40.8	39.2
(Vertically Separated)						
7/C - 12 AWG	12.00 VAC	120.0 VAC			9.99 Amps	
(Horizontally Separated)						

Tested By: [signature] Date: 9-5-85
Witness: [signature] Date:
Sheet No. 5 of 5
Approved: [signature] 9-5-85

Notice of Anomaly: No. 2

Wyle Form WH 1134 Rev APR 33

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.6
S/N N/A
GSI No

Amb. Temp. 74°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9-6-85

Test Title Configuration No. 1 Test No. 2
~~Pre-Test~~ (Post-Test) Functional Test

INSULATION RESISTANCE TEST

ACCEPTANCE CRITERIA: Measured insulation resistance shall be greater than 1.6 Megohms with a potential of 1000 VDC (500 for ~~S~~ T.P. 16 AWG) applied for 60 seconds.

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	$3.7 \times 10^8 \Omega$
(Vertically Separated)	1 to 3	$2.0 \times 10^8 \Omega$
	2 to 3	$3.2 \times 10^8 \Omega$
	1 to Unistrut	$2.2 \times 10^8 \Omega$
	2 to Unistrut	$2.7 \times 10^8 \Omega$
	3 to Unistrut	$2.1 \times 10^8 \Omega$
7/C - 12 AWG	1 to 4	$3.7 \times 10^8 \Omega$
(Horizontally Separated)	1 to Unistrut	$1.0 \times 10^8 \Omega$
	4 to Unistrut	$2.7 \times 10^8 \Omega$

Tested By [signature] Date: 9-6-85
Witness [signature] Date:
Sheet No. 1 of 2
Approved [signature] 9-6-85

Notice of Anomaly None

Wyle Form WH 614A, Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.6
S/N N/A
GSI No

Amb. Temp. 74°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9-6-85

Test Title Configuration No. 1 Test No. 2
~~Pre-test~~ (Post-Test) Functional Test

HIGH POTENTIAL TEST

ACCEPTANCE CRITERIA: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for ~~8~~ 1 T.P. 16 AWG cables) applied for one minute.

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	980 μA
(Vertically Separated)	1 to 3	1100 μA
	2 to 3	975 μA
	1 to Unistrut	1090 μA
	2 to Unistrut	1025 μA
	3 to Unistrut	1025 μA
7/C - 12 AWG	1 to 4	1500 μA
(Horizontally Separated)	1 to Unistrut	1030 μA
	4 to Unistrut	1265 μA

Tested By [signature] Date: 9-6-85
Witness None Date:
Sheet No. 2 of 2
Approved [signature] 9-6-85

Notice of Anomaly None

Wyle Form WH 814A, Rev. APR '84

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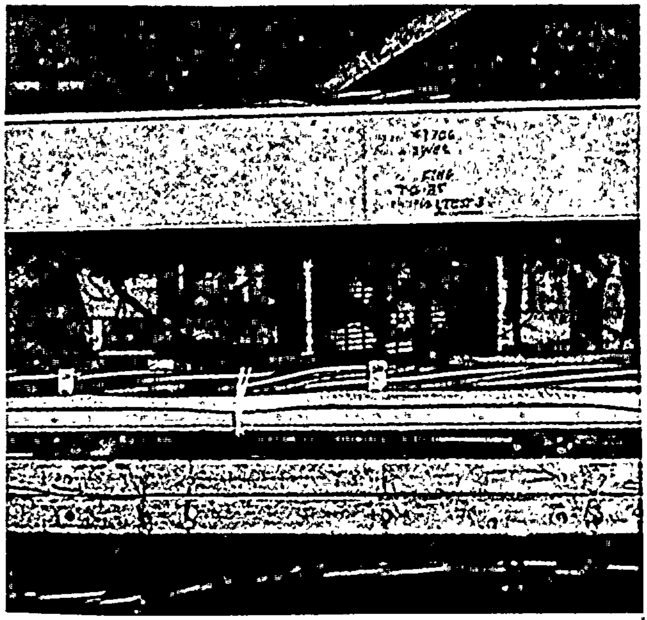
APPENDIX III

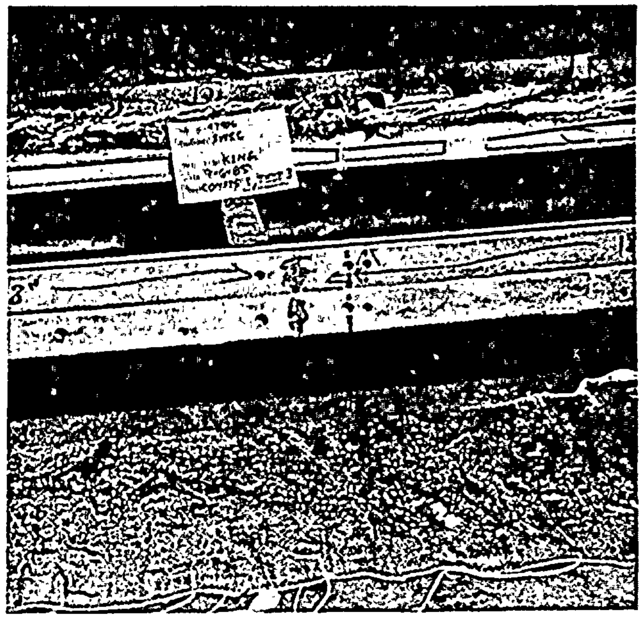
CONFIGURATION NUMBER 1, TEST NO. 3, DATA

CONFIGURATION NUMBER 1, TEST NO. 3



PHOTOGRAPH II-6

PRETEST VIEW — FAULT CABLE SUPPORTED ON SILTEMP COVERED UNISTRUT



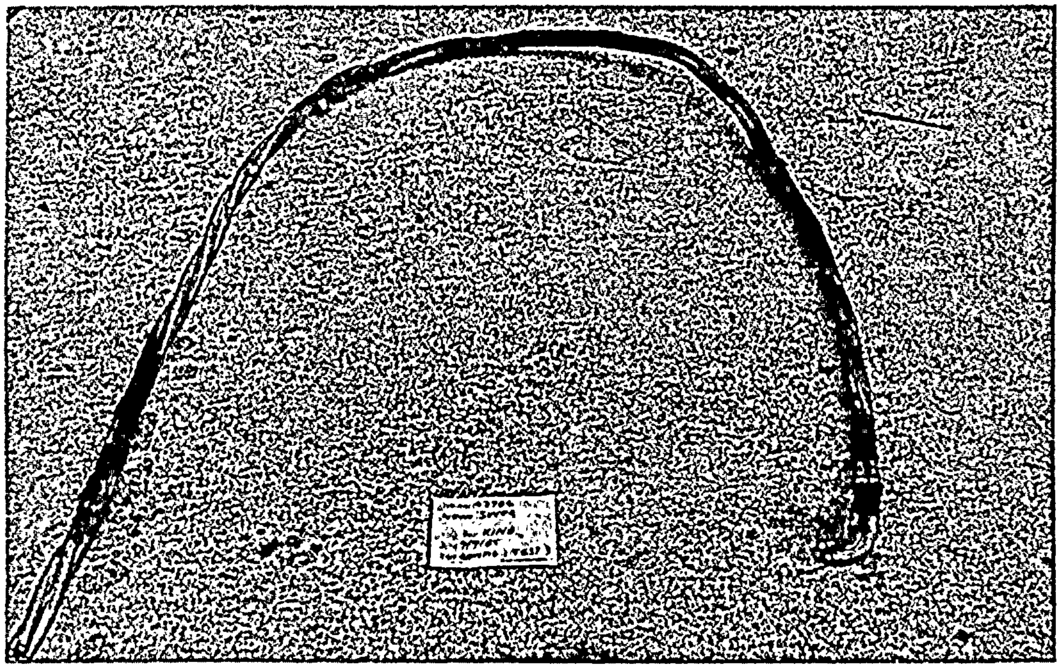
PHOTOGRAPH II-7

POST-TEST VIEW — FAULT CABLE

PHOTOGRAPH II-8

POST-TEST VIEW — CLOSE-UP BOTTOM VIEW OF TARGET CABLE IN TRAY

CONFIGURATION NUMBER 1, TEST NO. 3



PHOTOGRAPH II-9

POST-TEST VIEW — TARGET CABLE REMOVED FROM CABLE TRAY

PHOTOGRAPH II-10

POST-TEST VIEW — CROSS SECTION OF TARGET CABLE AT POINT WHERE MAXIMUM DAMAGE OCCURRED TO THE JACKET

CONFIGURATION NUMBER 1, TEST NO. 3

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	92°F	Energized fault cable with 139A
10 Min	97°F	Energized fault cable with 270A
75 Min	178°F	Energized fault cable with 275A
78.2 Min	179°F	Fault cable conductor reached 189°F
83.2 Min	181°F	Energized fault cable with 908A
86.5 Min	355°F	Light smoke visible
90.8 Min	575°F	Fault cable jacket rupturing
94.0 Min	925°F	Ignition of fault cable
102.4 Min	1610°F	Open circuit
104.0 Min	1280°F	Fire out

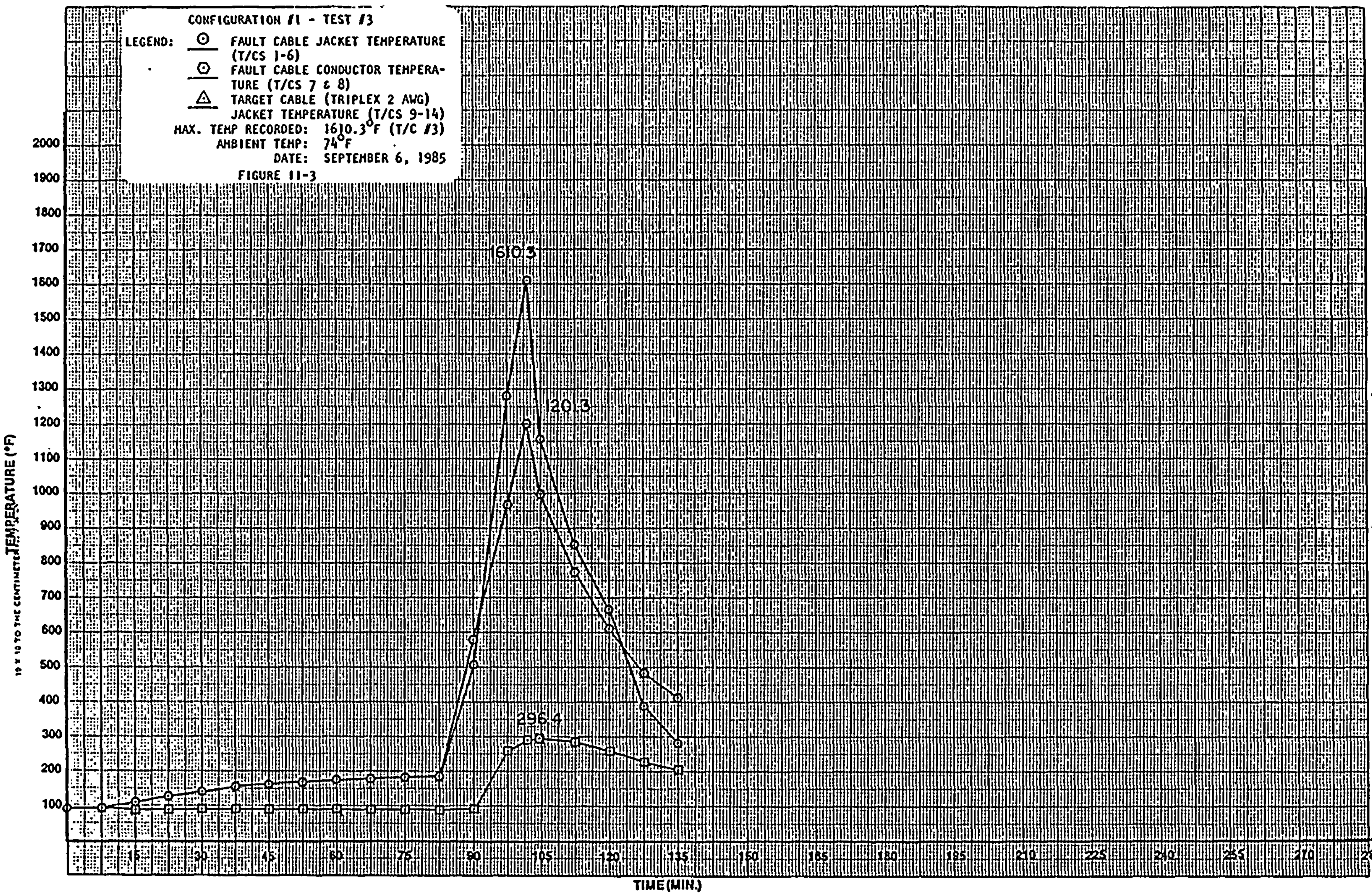

CONFIGURATION #1 - TEST #3
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
TARGET CABLE (TRIPLEX 2 AWG) JACKET TEMPERATURE (T/CS 9-14)
MAX. TEMP RECORDED: 1610.3°F (T/C #3)
AMBIENT TEMP: 74°F
DATE: SEPTEMBER 6, 1985
1610.3
1203
296.4
TEMPERATURE (°F)
TIME (MIN.)

FIGURE II-3

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.4
S/N: N/A
GSI: No

Amb. Temp.: 74°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-6-85

Test Title: Configuration No. 1 Test No. 3
(Pre-Test) ~~Post-Test~~ Functional Test

INSULATION RESISTANCE TEST		
ACCEPTANCE CRITERIA:	Measured insulation resistance shall be greater than 1.6 Megohms with a potential of 1000 VDC (500 for ~~8~~ 18PK T.P. 16 AWG) applied for 60 seconds.	
CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	3.7 X 10^8 Ω
(Vertically Separated)	1 to 3	3.0 X 10^8 Ω
	2 to 3	3.2 X 10^8 Ω
	1 to Unistrut	3.2 X 10^8 Ω
	2 to Unistrut	3.7 X 10^8 Ω
	3 to Unistrut	3.1 X 10^8 Ω

Tested By: [signature] Date: 9-6-85
Witness: None Date:
Sheet No. 1 of 2
Approved: [signature] 9/6/85

Notice of Anomaly: None

Wyle Form WH-614A Rev APR 'xx

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.3.4

S/N N/A

GSI No

Amb. Temp. 74°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-02

Start Date 9-6-85

Test Title Configuration No. 1 Test No. 3
(Pre-Test) #2 ~~Post-Test~~ Functional Test

HIGH POTENTIAL TEST

ACCEPTANCE CRITERIA: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 5 T.P. 16 AWG cables) applied for one minute.

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	980 MA
(Vertically Separated)	1 to 3	1000 MA
	2 to 3	975 MA
	1 to Unistrut	1090 MA
	2 to Unistrut	1025 MA
	3 to Unistrut	1025 MA

Notice of Anomaly None

Tested By [signature] Date: 9-6-85

Witness None Date:

Sheet No. 2 of 2

Approved [signature] 9/6/85

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.3.5

S/N N/A

GSI No

Amb. Temp. 74° F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-02

Start Date 9-6-85

Test Title Configuration No. 1 Test No. 3 Overcurrent Test

12. Readings with rated current on fault cable:

TARGET CABLE	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (AMPS) Phase A	Current (AMPS) Phase B	Current (AMPS) Phase C
2 AWG Triplex	578	570	570	41.7	41.3	40.2
(Vertically Separated)						

FAULT CABLE: 2/0 AWG TRIPLEX

RATED CURRENT: 139 A

MEASURED CURRENT:

Tested By [signature] Date: 9/6/85

Witness [signature] Date:

Sheet No. 1 of 5

Approved [signature] 9-6-85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various | Amb. Temp. 74°F | Job No. 47906

Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02

Para. 3.3.5 | Test Med. Air | Start Date 9-6-85

S/N N/A | Specimen Temp. Ambient

GSI No

Test Title Configuration No. 1 Test No. 3 Overcurrent Test

13. Increasing current to raise fault cable temperature to 189°F - 199°F:

FAULT CABLE CURRENT	ELAPSED TIME	CABLE ~~CONDUCTOR~~ TEMP./CHANNEL
270A	3900 Sec	188°F/7
275A	192	189°F/7

15. Readings after fault cable warmup to 189°F - 199°F:

FAULT CABLE CURRENT: ~~908~~ 275A

CONDUCTOR TEMPERATURE: 192°F CHANNEL NO.: 7

Max. Temp. °F Channels 1-6: 181

Tested By [signature] Date: 9/6/85

Witness [signature] Date:

Sheet No. 2 of 5

Approved [signature] 9/6/85

Notice of Anomaly None

Wyle Form WH 512A Rev APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.5
S/N: N/A
GSI: No

Amb. Temp.: 74°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-6-85

Test Title: Configuration No. 1 Test No. 3 Overcurrent Test

17. Initial readings with test current on fault cable:

TARGET CABLE	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (AMPS) Phase A	Current (AMPS) Phase B	Current (AMPS) Phase C
2 AWG Triplex	579	578	573	44.4	38.7	39.3
(Vertically Separated)						

FAULT CABLE: 2/0 AWG TRIPLEX
~~RATED~~ TEST CURRENT: 908A
MEASURED CURRENT:

Tested By: [signature] Date: 9/6/85
Witness: None Date:
Sheet No. 3 of 5
Approved: [signature] 9-6-85

Notice of Anomaly: No. 2

Wyle Form WH 614A Rev APR 82

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No. Various

Amb. Temp. 74°F

Job No. 47906

Spec. WLTP 47906-01

Photo Yes

Report No. 47906-02

Para. 3.3.5

Test Med. Air

Start Date 9-6-85

S/N N/A

Specimen Temp. Ambient

GSI No

Test Title Configuration No. 1 Test No. 3 Overcurrent Test

19. Open circuit on fault cable:			
Elapsed time:	1150 sec		
Maximum fault cable temperature:	1610°F	Channel No.	3
20. Stabilized temperature on fault cable:			
Elapsed time (beginning of 15-minute period):	N/A		
Maximum fault cable temperature:	N/A	Channel No.	N/A
Fault cable current:	N/A		
21. Ignition of fault cable:	~~65~~		
Elapsed time:	653		
Maximum fault cable temperature:	1610°F	Channel No.	3
Fault cable current:	908		

Tested By [signature] Date: 9/6/85

Witness [signature] Date:

Sheet No. 4 of 5

Approved [signature] 9-6-85

Notice of Anomaly None

Wyle Form WH-514A Rev APR '83

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No.	Various	Amb. Temp.	74°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.3.5	Test Med.	Air	Start Date	9-6-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title Configuration No. 1 Test No. 3 Overcurrent Test

23. Readings after ~~let-through~~ test JPK current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	577	576	578	37.8	38.7	37.9
(Vertically Separated)						

Tested By [signature] Date: 9/6/85
Witness [signature] Date:
Sheet No. 5 of 5
Approved [signature] 9-6-85

Notice of Anomaly No. 2

Wyle Form WH-512A Rev APR 34

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.3.6
S/N N/A
GSI No

Amb. Temp.
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9/7/85

Test Title Configuration No. 1 Test No. 3
~~Pre-Test~~ Post-Test (circled) Functional Test

HIGH POTENTIAL TEST

ACCEPTANCE CRITERIA: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 5 T.P. 16 AWG cables) applied for one minute.

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	760uA
(Vertically Separated)	1 to 3	760uA
	2 to 3	760uA
	1 to Unistrut	2000uA
	2 to Unistrut	1900uA
	3 to Unistrut	2020uA

Tested By [signature] Date: 9/7/85
Witness [signature] Date:
Sheet No. 1 of 2
Approved [signature] 9/9/85

Notice of Anomaly None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.3.6
S/N: N/A
GSI: No

Amb. Temp.:
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/7/85

Test Title: Configuration No. 1 Test No. 3 ~~Pre-Test~~ (Post-Test) Functional Test

INSULATION RESISTANCE TEST

ACCEPTANCE CRITERIA: Measured insulation resistance shall be greater than 1.6 Megohms with a potential of 1000 VDC (500 for ~~5~~ 1 pk T.P. 16 AWG) applied for 60 seconds.

CABLE	TEST POINTS	READING
2 AWG Triplex	1 to 2	$7.2 \times 10^8 \Omega$
(Vertically Separated)	1 to 3	$1.0 \times 10^9 \Omega$
	2 to 3	$8.0 \times 10^8 \Omega$
	1 to Unistrut	$1.2 \times 10^7 \Omega$
	2 to Unistrut	$2.0 \times 10^8 \Omega$
	3 to Unistrut	$1.3 \times 10^8 \Omega$

Tested By: [signature] Date: 9/7/85
Witness: None Date:
Sheet No. 2 of 2
Approved: [signature] 9/9/85

Notice of Anomaly: None

CONFIGURATION NO. 2 TESTS
(Separation of Cable in Free Air to Cable in Free Air With Siltemp 188 CH Barriers)

SECTION III

CONFIGURATION NUMBER 2 TESTS (SEPARATION OF CABLE IN FREE AIR TO CABLE IN FREE AIR WITH SILTEMP BARRIERS)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

1.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6 x 10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds.

1.1.2 High Potential Test

There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute.

1.1.3 Cable Continuity Test

Energized specimens in the target raceway shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current
1/0 AWG	Triplex	NJM-34	L	575	139
2 AWG	Triplex	NJM-25	K	575	38.5
12 AWG	7	NJN-37	C	120	10
16 AWG	2/C	NJP-05	X	50	1

1.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, -0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance.

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

2.0 PROCEDURES

2.1 Test Specimen Preparation

The test specimen was mounted to the unistrut frame assembly per Figure 5 (Test No. 1) and Figure 6 (Test No. 2) of Section VIII. This apparatus was assembled to the indicated dimensions by Wyle technicians using materials supplied from NMP2. The following guidelines were observed with regard to the materials and construction of the assembly:

1. The faulted cable was a Triplex 2/0 AWG cable from NMP2 stock.

2. For Test No. 1, the faulted cable was wrapped using four layers of SWEC protective wrap. For Test No. 2, the ends of the faulted cable from their termination at the copper bus bar to the edge of the unistrut frame were wrapped with a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape. This wrapping was done to ensure that any ignition that might occur was contained to the test area.

3. The target cable was a Triplex 1/0 AWG cable from NMP2 stock.

4. For Test No. 1, the target cable was an unwrapped cable. For Test No. 2, the target cable was wrapped for the length inside the unistrut test fixture and extending approximately two feet on either side as shown in Figure 6 of Section VIII. This wrapping was done using four layers of the SWEC protective wrap.

5. Photographs were taken of the test setup prior to each test.

2.2 Instrumentation Setup

2.2.1 Thermocouple Locations

A total of 14 Type "K" thermocouples were utilized for these tests. The thermocouples were mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 12 inches apart. For Test No. 1, the thermocouples were underneath the SWEC protective wrap.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the target cable. These thermocouples were mounted approximately 12 inches apart and close to the location of Channels 1-6. For Test No. 2, the thermocouples were inside the SWEC protective wrap.

The thermocouples were monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger was operated at its maximum scan rate throughout the overcurrent test.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup (Continued)

2.2.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current were fed into an oscillograph recorder. The oscillograph was operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels were as specified in the following table:

Channel No.	Signal	Cable
1	Current-Phase A	Triplex 1/0 AWG.
2	Current-Phase B	Triplex 1/0 AWG
3	Current-Phase C	Triplex 1/0 AWG
4	Voltage A-B	Triplex 1/0 AWG
5	Voltage A-C	Triplex 1/0 AWG
6	Voltage B-C	Triplex 1/0 AWG
7-9	Skipped	N/A
10	Current	Fault Cable
11 & 12	Skipped	N/A

A digital multimeter was utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data was recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC throughout the overcurrent test.

2.3 Baseline Functional Tests

The baseline functional tests consisted of insulation resistance and high potential measurements on each of the target cables.

2.3.1 Insulation Resistance Test

1. All power and instrumentation leads were disconnected from the target cable and labeled per Figure 12 of Section VIII.

2. Using a megohmmeter, a potential of 1000 VDC was applied and the minimum insulation resistance indicated after a period of 60 seconds was recorded between the following test points:

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests (Continued)

2.3.1 Insulation Resistance Test (Continued)

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut
1 to 3	2 to unistrut
2 to 3	3 to unistrut

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.3.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC was applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

   Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut
1 to 3	2 to unistrut
2 to 3	3 to unistrut

2. All power and instrumentation leads were reconnected per Figure 12 of Section VIII.

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.2.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test

The overcurrent test was conducted in three sequential steps with no intentional time delay. The first phase consisted of energizing the fault cable with SWEC rated current. The second phase consisted of increasing the current until fault cable temperatures were within 189°-199°F for 5 minutes. The third phase consisted of energizing the fault cable with the worst case electrical fault current until the cable open-circuited.

The target cables conducted SWEC rated current (see Paragraph 1.1.3) at 575 VAC throughout the overcurrent test. The overcurrent test was conducted using the following procedure:

1. The Triplex 2/0 AWG fault cable was connected to the copper bus bars per Figure 11 of Section VIII.

   For Test No. 1, this cable was wrapped. For Test No. 2, this cable was unwrapped.

2. A Triplex 1/0 AWG target cable was installed per Figure 5 or 6 of Section VIII.

   For Test No. 1, this cable was unwrapped. For Test No. 2, this cable was wrapped.

3. The Triplex 1/0 AWG target cable was connected to the instrumentation and power supplies per Figure 12 of Section VIII.

4. The Triplex 1/0 AWG target cable was energized with 124 amperes* at 575 VAC.

5. The Triplex 2/0 AWG fault cable was energized with 139 amperes per phase (rated current) from the Multi-Amp Test Set.

6. Target cable voltages and currents and the fault cable current were recorded.

7. The fault cable current was slowly increased until Thermocouple Channels 7 and/or 8 indicated 90 ±3°C (189-199°F) conductor temperature.

8. The conductor temperature was maintained at 189-199°F for five minutes.

---

* Although the procedure called for 124 amperes, the rated current for the 1/0 AWG cable is 139 amperes. The exact currents measured on the 1/0 AWG cable during the test ranged from 129.6 amperes to 141.3 amperes and are accounted for in NOA No. 2.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

9. The fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6 were recorded.

10. The Multi-Amp Test Set output was increased to 908 amperes (test current).

11. Target cable voltages and currents and the fault cable current were recorded.

12. The fault cable was allowed to conduct test current until the cable open-circuited.

13. The elapsed time and maximum cable temperature were recorded.

14. The target cable voltages and currents were recorded.

15. The target cables and the Multi-Amp Test Set were de-energized.

16. Photographs were taken of the post-test condition.

For all performances of this test, the observed target cable operation was compared to the acceptance criteria, Paragraph 1.1.3

2.5 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 2.3 were repeated.

3.0 RESULTS

3.1 Results of Test No. 1

Configuration Number 2, Test No. 1, with a Triplex 2/0 AWG fault cable inside four layers of SWEC protective wrap, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1296 seconds (21.6 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1836°F which occurred on Thermocouple No. 4. The fault cable did not ignite.

The capability of the target cable to conduct SWEC rated current at 575 VAC (power cable) was not impaired during this test. The maximum observed target cable temperature was 225°F. The target cable successfully completed the Post-Overcurrent Test Functional Test.

Appendix I contains the following data from this test:

1. Notices of Anomaly Number 2 and 5.
2. Photographs III-1 through III-2 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure III-1 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

3.0 RESULTS (Continued)

3.2 Results of Test No. 2

Configuration Number 2, Test No. 2; with an unwrapped Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1267 seconds (21.1 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1783°F which occurred on Thermocouple No. 6. The fault cable ignited after 640 seconds (10.7 minutes). The fire burned for approximately 12.5 minutes.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable), 120 VAC (control cable), or 50 VAC (instrument cable) was not impaired during this test. The maximum observed target cable temperature was 370°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix II contains the following data from this test:

1. Photographs III-3 through III-4 which show pretest and post-test conditions.
2. A narrative of the test which relates test time, fault cable temperatures, and important events.
3. Figure III-2 which plots the temperature readings versus time.
4. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

APPENDIX I

CONFIGURATION NUMBER 2, TEST NO. 1, DATA

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/12/85

NOTICE NO: 2 P.O. NUMBER: NMP2-E0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/6, 9/7, 9/10/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☐ PROCEDURE ☒ TEST EQUIPMENT DATE OF ANOMALY: 9/5, 9/6, 9/9/85

PART NAME: Electrical Cables PART NO. N/A

TEST: Configuration 1, Tests 1, 2, 3 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 2.1.4, 3.3.5, 3.4.5

Requirements:

1. The two target cables shall conduct SWEC-rated current (see Paragraph 2.1.3) at 575 VAC (power cables) or 120 VAC (control cables) or 50 VAC (instrument cables) throughout the overcurrent test.
2. All target cable currents shall be maintained within a +10%, -0% tolerance.

Description of Anomaly:

During Configuration 1, Tests 1, 2 and 3, and Configuration 2, Test 1, some of the currents were out of tolerance after flowing test current. The maximum variation on the plus side was 15.3%. The maximum variation on the minus side was 6.8%.

Disposition - Comments - Recommendations:

The out of tolerance currents were judged to have no impact on the test. The test results showed that the target cable's ability to carry current was not impaired by the test conditions.

Maintaining the +10%, -0% tolerance is not always possible due to the following reasons.

1. Unbalanced currents between phases.
2. Temperature changes in the conductors causing the impedance of the cables to change.
3. Voltage fluctuations in the facility power delivered by the local utilities.

Therefore, the acceptance criteria for future tests was changed to require the initial setting of target cable currents (with rated current on the fault cable) to be within +10%, -0%. Thereafter, all target cable currents shall be maintained within ±10% tolerance.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

PROJECT ENGINEER: John P. King 9-12-85

TEST WITNESS: ____

PROJECT MANAGER: [signature] 9-12-85 [signature] 9/12/85

REPRESENTING: ____

INTERDEPARTMENTAL COORDINATION: K Taylor 9/13-85

QUALITY ASSURANCE: G.W. [signature] 9/13/85

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/26/85

NOTICE NO: 5 P.O. NUMBER: NMP2-E-0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/27/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/9, 9/12, 9/17/85

PART NAME: Electrical Cable PART NO. N/A

TEST: Config. 2, Test 1; Config. 3, Test 2; Config. 5, Tests 2 and 3 I.D. NO. N/A

SPECIFICATION: WLTP 47906 PARA. NO. 3.4.5, 3.5.5, 3.7.5

REQUIREMENTS:

1. Slowly increase fault cable current until thermocouple channels 7 and/or 8 indicate 90 ±3°C (189°F-199°F) conductor temperature.
2. Maintain the conductor temperature at 189°F-199°F for five minutes.

DESCRIPTION OF ANOMALY:

The thermocouple channels 1-6 on the cable jacket were used instead of channels 7 and/or 8.

DISPOSITION · COMMENTS · RECOMMENDATIONS:

The anomaly was judged to have no impact on the test for the following reasons.

1. During warmup of the cable, the conductor temperature would have to be higher than the temperature of the adjacent jacket.
2. The conductor thermocouple can indicate a lower temperature than the jacket thermocouples because of differences in mounting and location.
3. The heat transferred from the fault cable to the target cables during warmup to, and maintenance at, 189°F-199°F is very small compared to the heat transferred during burning of the fault cable, which occurred in every test.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ______

REPRESENTING: ______

QUALITY ASSURANCE: G.W. Hight 10/2/85

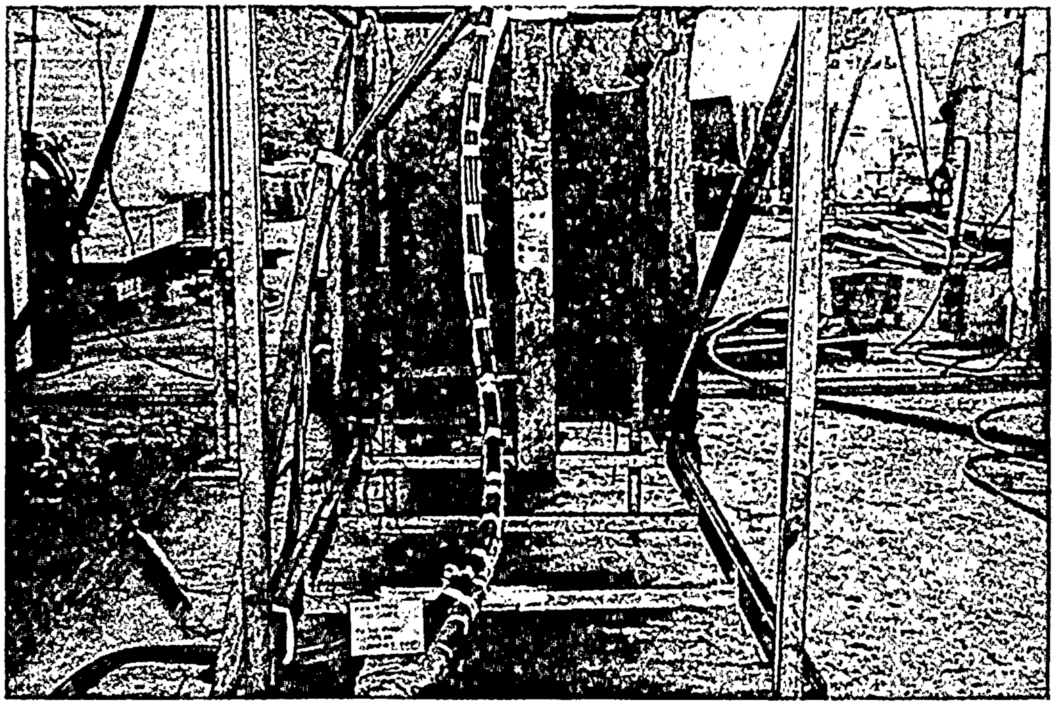
PROJECT ENGINEER: J. P. King 9/27/85

PROJECT MANAGER: [signature] 9/30/85

INTERDEPARTMENTAL COORDINATION: ______

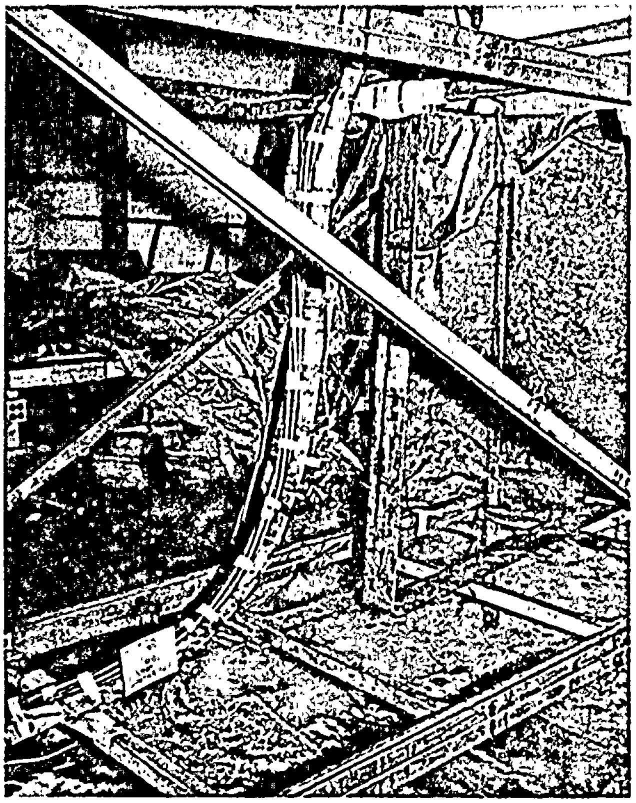
Wyle Form WH 1066, Rev. JAN '85

CONFIGURATION NUMBER 2, TEST NO. 1



PHOTOGRAPH III-1

PRETEST VIEW — OVERALL

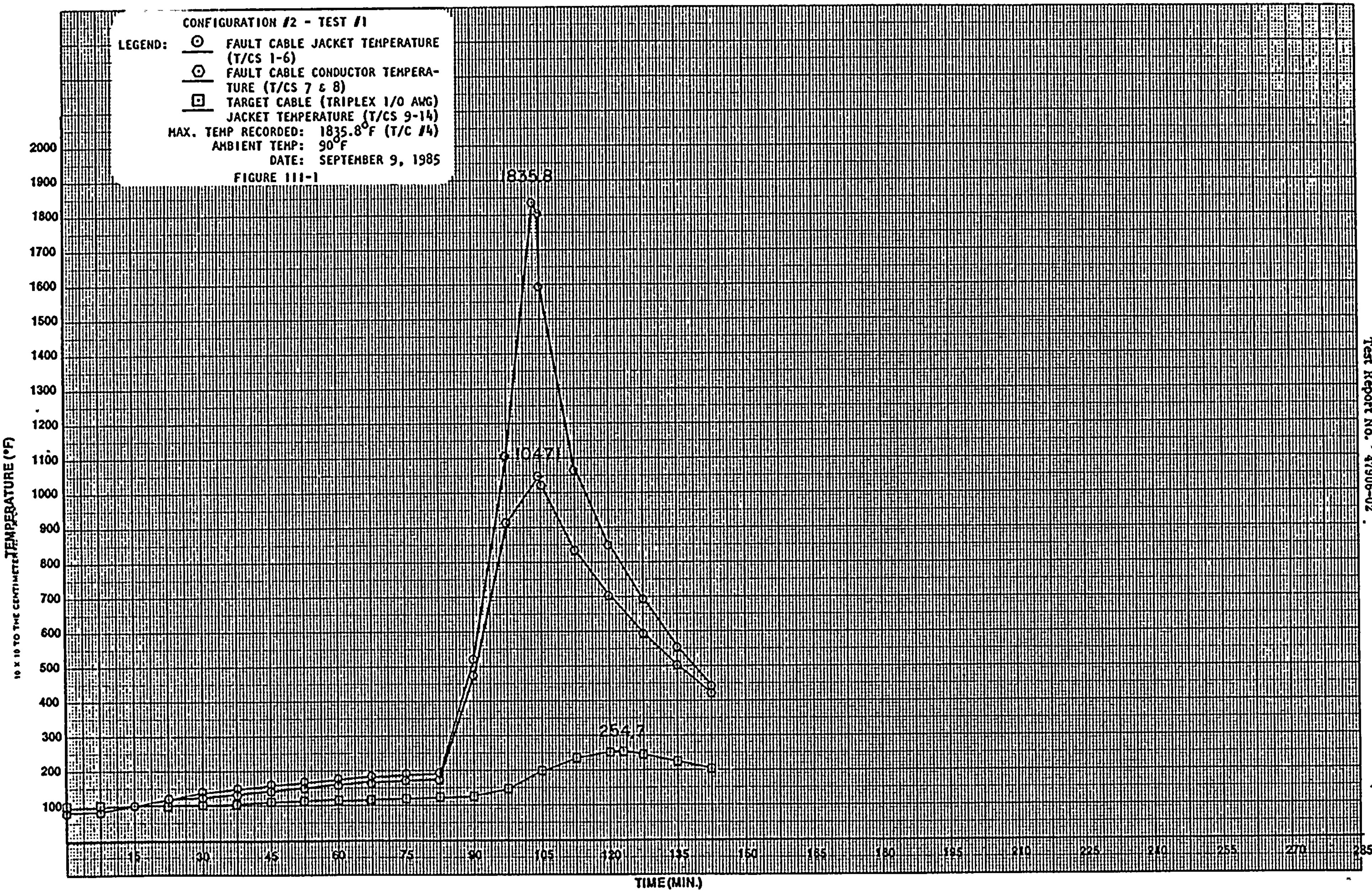


PHOTOGRAPH III-2

POST-TEST VIEW — OVERALL

CONFIGURATION NUMBER 2, TEST NO. 1

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	80°F	Energized fault cable with 139A
10 Min	88°F	Energized fault cable with 270A
77.7 Min	189°F	Fault cable conductor reached 189°F
82.7 Min	192°F	Energized fault cable with 908A
90.6 Min	500°F	Light smoke visible and fault cable jacket rupturing
104.3 Min	1807°F	Open circuit


CONFIGURATION #2 - TEST #1
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
TARGET CABLE (TRIPLEX 1/0 AWG) JACKET TEMPERATURE (T/CS 9-14)
MAX. TEMP RECORDED: 1835.8°F (T/C #4)
AMBIENT TEMP: 90°F
DATE: SEPTEMBER 9, 1985
FIGURE III-1
1835.8
1047.1
254.7
TEMPERATURE (°F)
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
TIME (MIN.)

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.4
S/N: N/A
GSI: No

Amb. Temp.: 90°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/8/85

Test Title: Configuration No. 2 Test No. 1

(Pre-Test) ~~Post-Test~~ Functional Test

Insulation Resistance Test		
Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.		
Cable	**Test Points**	**Reading**
1/0 AWG Triplex	1 to 2	I.R ~~700~~ $7.8 \times 10^9 \Omega$
	1 to 3	$9.0 \times 10^9 \Omega$
	2 to 3	$7.2 \times 10^9 \Omega$
	1 to Unistrut	$9.0 \times 10^9 \Omega$
	2 to Unistrut	$1.0 \times 10^{10} \Omega$
	3 to Unistrut	$6.0 \times 10^9 \Omega$

Tested By: [signature] Date: 9/7/85
Witness: [signature] Date:
Sheet No. 1 of 2
Approved: J. King 9/9/85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.4
S/N: N/A
GSI: No

Amb. Temp.: 90°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/8/85

Test Title: Configuration No. 2 Test No. 1
(Pre-Test) ~~Post Test Dz~~ Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for S.T.P. 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
1/0 AWG Triplex	1 to 2	800 μA
	1 to 3	800 μA
	2 to 3	800 μA
	1 to Unistrut	980 μA
	2 to Unistrut	920 μA
	3 to Unistrut	950 μA

Tested By: [signature] Date: 9/7/85
Witness: [signature] Date:
Sheet No. 2 of 2
Approved: J. King 9/9/85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.4.5
S/N N/A
GSI No

Amb. Temp. 90°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9/9/85

Test Title Configuration No. 2 Test No. 1 Overcurrent Test

6. Readings with rated current on fault cable:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
1/0 AWG Triplex	573	573	569	133.9	136.7	~~13.9~~ 131.0

Fault Cable: 2/0 AWG TRIPLEX
Rated Current: 139A
Measured Current: 139A

Tested By [signature] Date: 9/9/85
Witness [signature] Date:
Sheet No. 1 of 4
Approved [signature] 9/13/85

Notice of Anomaly No. 2

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various | Amb. Temp. 90°F | Job No. 47906

Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02

Para. 3.4.5 | Test Med. Air | Start Date 9-9-85

S/N N/A | Specimen Temp. Ambient

GSI No

Test Title Configuration No. 2 Test No. 1 Overcurrent Test

7. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP/CHANNEL
270A	~~3900~~ 4060 sec	189°F (4)

9. Readings after fault cable warmup to 189°F - 199°F

Fault cable current: ~~908~~ 270A

Conductor temperature: 178°F Channel No. 8

Max temp of Channels 1-6: 192°F

Tested By [signature] Date: 9/9/85

Witness [signature] Date:

Sheet No. 2 of 4

Approved [signature] 9/9/85

Notice of Anomaly ~~None~~ No. 5

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various | Amb. Temp. 90°F | Job No. 47906

Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02

Para. 3.4.5 | Test Med. Air | Start Date 9/9/85

S/N N/A | Specimen Temp. Ambient

GSI No

Test Title Configuration No. 2 Test No. 1 Overcurrent Test

11. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
1/0 AWG Triplex	577	573	571	134.5	141.3	133.4

Fault Cable 2/0 AWG TRIPLEX

Test ~~Rated~~ Current: 908A

Measured Current: 908A

Tested By [signature] Date: 9/9/85

Witness [signature] Date:

Sheet No. 3 of 4

Approved [signature] 9/9/85

Notice of Anomaly No. 2

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.4.5
S/N N/A
GSI No

Amb. Temp. 90°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9/9/85

Test Title Configuration No. 2 Test No. 1 Overcurrent Test

13. Open Circuit on fault cable:

Elapsed time: 1296 sec

Maximum fault cable temperature: 1836°F Channel No. 4

14. Stabilized temperature on fault cable:

Elapsed time (beginning of 15-minute period): N/A

Maximum fault cable temperature: N/A Channel No. N/A

Fault cable current: N/A

15. Ignition of fault cable:

Elasped time: N/A

Maximum fault cable temperature: N/A Channel No. N/A

Fault cable current: N/A

17. Readings after ~~let-through~~ test JRK current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
1/0 AWG Triplex	578	573	570	133.6	137.0	129.6

Tested By [signature] Date: 9/9/85
Witness [signature] Date:
Sheet No. 4 of 4
Approved [signature] 9/12/85

Notice of Anomaly No. 2

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.6
S/N: N/A
GSI: No

Amb. Temp.: 90° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/9/85

Test Title: Configuration No. 2 Test No. 1
~~Pre-Test~~ (Post-Test) Functional Test.

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
I/0 AWG Triplex	1 to 2	$3.0 \times 10^{10}\Omega$
	1 to 3	$3.0 \times 10^{10}\Omega$
	2 to 3	$5.0 \times 10^{10}\Omega$
	1 to Unistrut	$3.5 \times 10^{10}\Omega$
	2 to Unistrut	V.R. ~~2.0 x~~ $3.7 \times 10^{10}\Omega$
	3 to Unistrut	$7.0 \times 10^{10}\Omega$

Tested By: [signature] Date: 9/9/85
Witness: [signature] Date:
Sheet No. 1 of 2
Approved: [signature] 9/12/85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various

Amb. Temp. 90° F

Job No. 47906

Spec. WLTP 47906-01

Photo Yes

Report No. 47906-02

Para. 3.4.6

Test Med. Air

Start Date 9/9/85

S/N N/A

Specimen Temp. Ambient

GSI No

Test Title Configuration No. 2 Test No. 1

~~Pre-Test~~ (Post-Test) Functional Test

High Potential Test		
Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for S.T.P. 16 AWG cables) applied for one minute.		
Cable	Test Points	Reading
1/0 AWG Triplex	1 to 2	820 μA
	1 to 3	820 μA
	2 to 3	800 μA
	1 to Unistrut	830 μA
	2 to Unistrut	820 μA
	3 to Unistrut	835 μA

Tested By [signature] Date: 9/9/85

Witness None Date:

Sheet No. 2 of 2

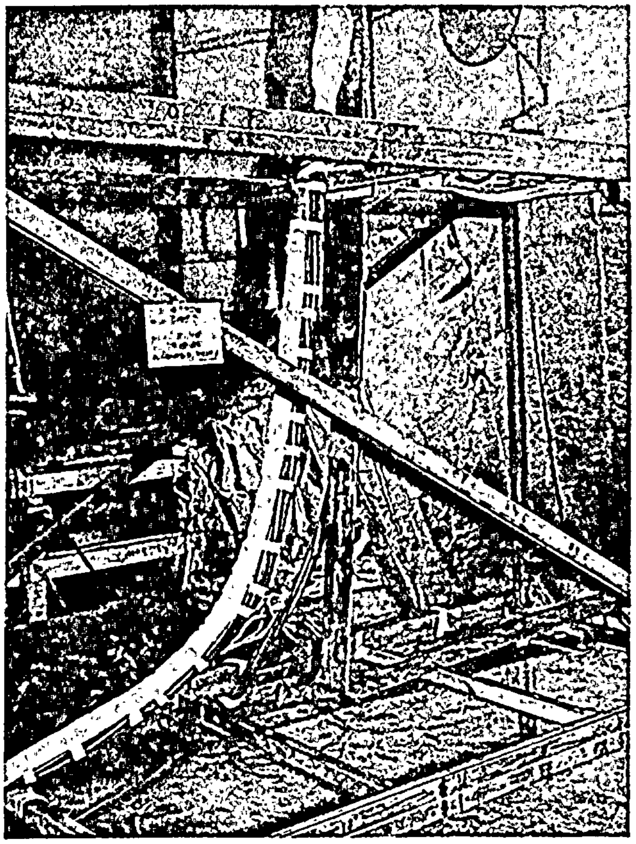
Approved [signature] 9/12/85

Notice of Anomaly None

APPENDIX II

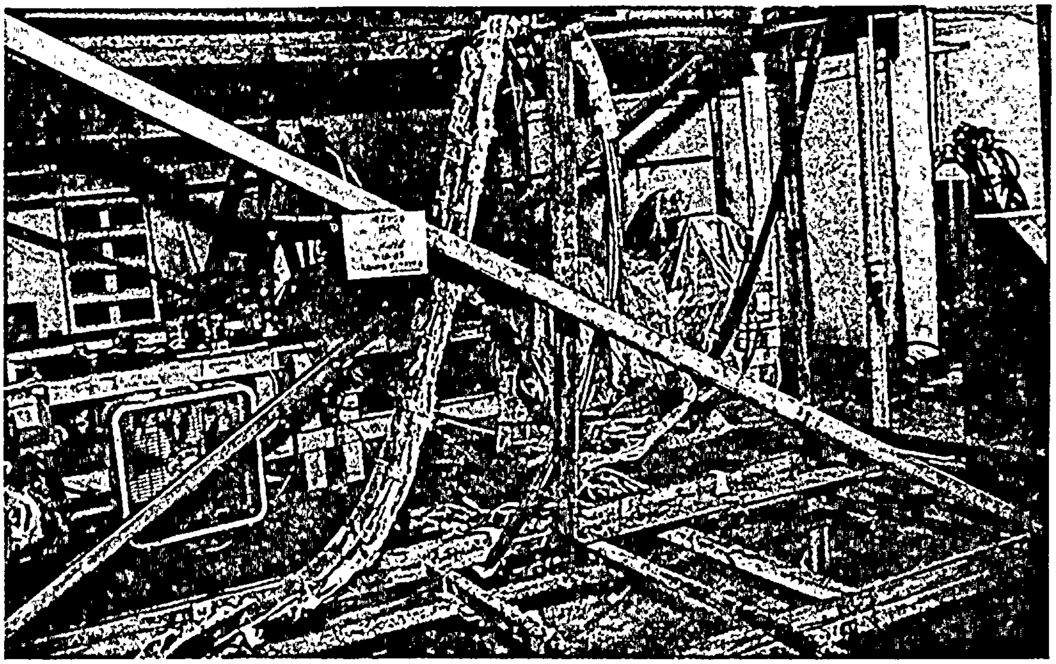
CONFIGURATION NUMBER 2, TEST NO. 2, DATA

CONFIGURATION NUMBER 2, TEST NO. 2



PHOTOGRAPH III-3

PRETEST VIEW — OVERALL



PHOTOGRAPH III-4

POST-TEST VIEW — OVERALL

CONFIGURATION NUMBER 2, TEST NO. 2

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	84°F	Energized fault cable with 139A
10 Min	93°F	Energized fault cable with 270A
65 Min	174°F	Energized fault cable with 275A
83.7 Min	184°F	Fault cable conductor reached 189°F
88.7 Min	186°F	Energized fault cable with 908A
93.3 Min	380°F	Light smoke visible
96.1 Min	515°F	Fault cable jacket rupturing
99.2 Min	800°F	Ignition of fault cable
109.8 Min	1783°F	Open circuit
111.8 Min	1470°F	Fire out

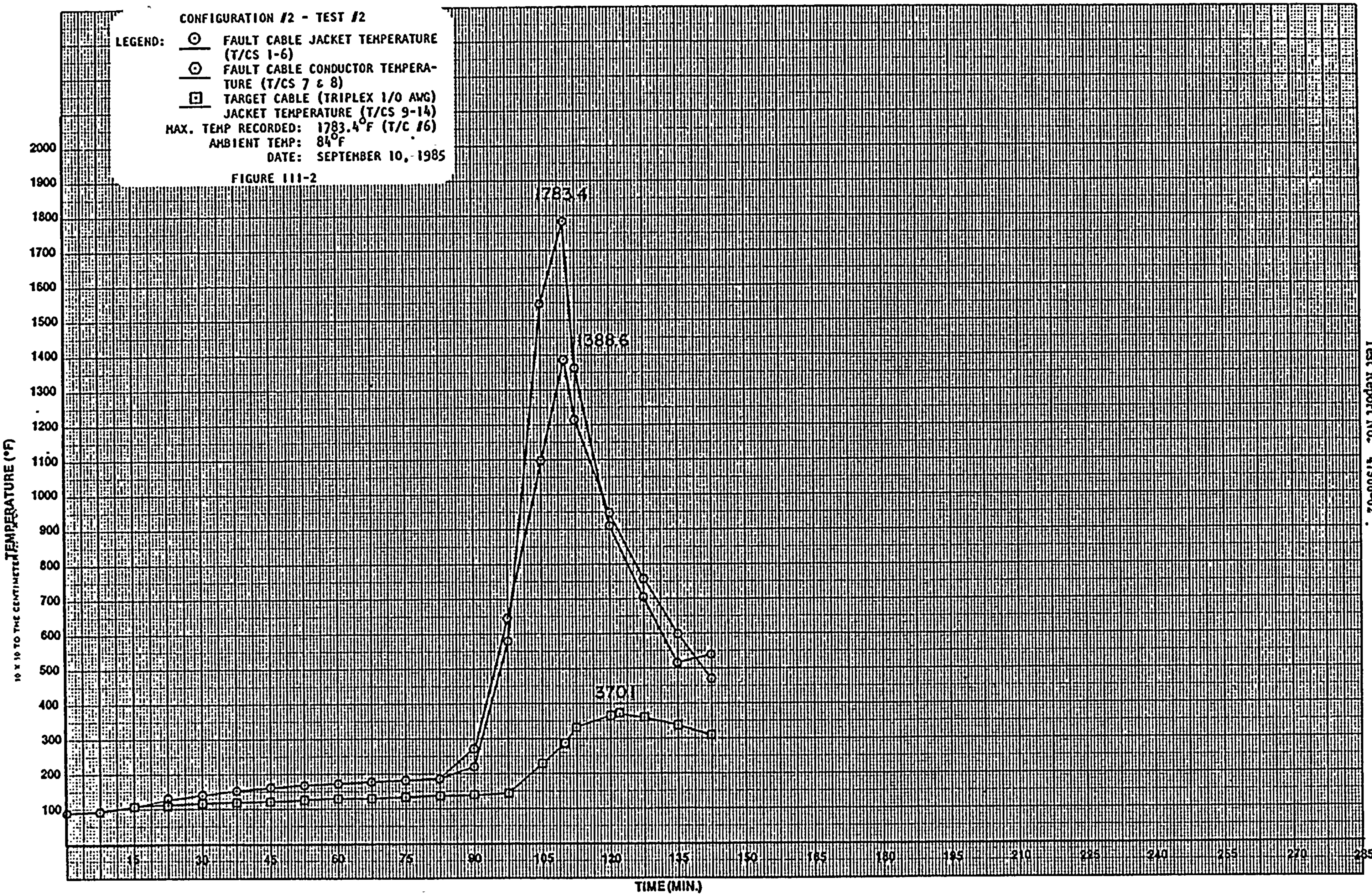

CONFIGURATION #2 - TEST #2
LEGEND: FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
TARGET CABLE (TRIPLEX 1/0 AWG) JACKET TEMPERATURE (T/CS 9-14)
MAX. TEMP RECORDED: 1783.4°F (T/C #6)
AMBIENT TEMP: 84°F
DATE: SEPTEMBER 10, 1985
1783.4
1388.6
370.1
TEMPERATURE (°F)
TIME (MIN.)

FIGURE III-2

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.4
S/N: N/A
GSI: No

Amb. Temp.: 84° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/10/85

Test Title: Configuration No. 2 Test No. 2

(Pre-Test) ~~Post-Test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
1/0 AWG Triplex	1 to 2	$1.0 \times 10^9 \Omega$
	1 to 3	$6.4 \times 10^8 \Omega$
	2 to 3	$9.0 \times 10^8 \Omega$
	1 to Unistrut	$1.1 \times 10^9 \Omega$
	2 to Unistrut	$1.6 \times 10^9 \Omega$
	3 to Unistrut	$1.3 \times 10^9 \Omega$

Notice of Anomaly: None

Tested By: [signature] Date: 9/10/85
Witness: [signature] Date:
Sheet No. 1 of 2
Approved: J. P. King 9/10/85

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.4
S/N: N/A
GSI: No

Amb. Temp.: 84° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/10/85

Test Title: Configuration No. 2 Test No. 2

(Pre-test) ~~Post-Test~~ Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 5 T.P. 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
1/0 AWG Triplex	1 to 2	750 uA
	1 to 3	720 uA
	2 to 3	800 uA
	1 to Unistrut	1920 uA
	2 to Unistrut	1830 uA
	3 to Unistrut	1820 uA

Tested By: [signature] Date: 9/10/85
Witness: None! Date: /
Sheet No. 2 of 2
Approved: J. D. King 9/10/85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.5
S/N: N/A
GSI: No

Amb. Temp.: 84° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/10/85

Test Title: Configuration No. 2 Test No. 2 Overcurrent Test

6. Readings with rated current on fault cable

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
1/0 AWG Triplex	580	576	572	144	147	141

Fault Cable: 2/0 AWG TRIPLEX
Rated Current: 139 A
Measured Current: 139A

Tested By: [signature] Date: 9/10/85
Witness: None Date:
Sheet No. 1 of 4
Approved: [signature] 9/10/85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.5
S/N: N/A
GSI: No

Amb. Temp.: 84°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-10-85

Test Title: Configuration No. 2 Test No. 2 Overcurrent Test

7. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP/CHANNEL
270 A	3300.	177/7
275 A	900	187/7
280 A	220	189/7

9. Readings after fault cable warmup to 189°F - 199°F

Fault cable current: 280 A

Conductor temperature: 191 Channel No. 7

Max temp of Channels 1-6: 186

Tested By: [signature] Date: 9-10-85
Witness: None Date:
Sheet No. 2 of 4
Approved: [signature] 9/10/85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.4.5
S/N: N/A
GSI: No

Amb. Temp.: 84°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date:

Test Title: Configuration No. 2 Test No. 2 Overcurrent Test

II. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
1/0 AWG Triplex	582	578	575	150	149	144

Fault Cable: 2/0 AWG TRIPLEX
~~Rated~~ Test JPK Current: 908A
Measured Current: 908A

Tested By: [signature] Date: 9/10/85
Witness: [signature] Date:
Sheet No. 3 of 4
Approved: J.P. King 9/10/85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.4.5

S/N N/A

GSI No

Amb. Temp.

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-02

Start Date

Test Title Configuration No. 2 Test No. 2 Overcurrent Test

13. Open circuit on fault cable:

Elapsed time: ~~1147~~ 1267 sec

Maximum fault cable temperature: 1783°F Channel No. 6

14. Stabilized temperature on fault cable:

Elapsed time (beginning of 15-minute period): N/A

Maximum fault cable temperature: N/A Channel No. N/A

Fault cable current: N/A

15. Ignition of fault cable:

Elapsed time: ~~520~~ 640 sec

Maximum fault cable temperature: 1783°F Channel No. 6

Fault cable current: 908 A

17. Readings after ~~let-through~~ test current applied until fault cable open circuits:

	Voltage (VAC)			Current (amps)		
Target Cable	A-B	B-C	A-C	Phase A	Phase B	Phase C
1/0 AWG Triplex	582	578	574	141	145	139

Tested By [signature] Date: 9/10/85

Witness None Date:

Sheet No. 4 of 4

Approved [signature] 9-12-85

Notice of Anomaly None

W.L. Form ... Rev APR 84

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various | Amb. Temp. | Job No. 47906

Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02

Para. 3.4.6 | Test Med. Air | Start Date 9-10-85

S/N N/A | Specimen Temp. Ambient

GSI No

Test Title Configuration No. 2 Test No. 2

~~Pre-Test~~ Post-Test Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
1/0 AWG Triplex	1 to 2	1.3×10^{10}
	1 to 3	1.0×10^{10}
	2 to 3	1.2×10^{10}
	1 to Unistrut	1.3×10^{10}
	2 to Unistrut	1.7×10^{10}
	3 to Unistrut	1.9×10^{10}

Tested By [signature] Date: 9-10-85

Witness None Date:

Sheet No. 1 of 2

Approved J. P. King 9-10-85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.4.6
S/N N/A
GSI No

Amb. Temp.
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-10-85

Test Title Configuration No. 2 Test No. 2

~~Pre-test Bb~~ Post-Test (circled) Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 5 T.P. 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
1/0 AWG Triplex	1 to 2	820 μA
	1 to 3	800 μA
	2 to 3	810 μA
	1 to Unistrut	1210 μA
	2 to Unistrut	1180 μA
	3 to Unistrut	1180 μA

Tested By [signature] Date: 9-10-85
Witness [signature] Date:
Sheet No. 3 of 3
Approved J. D. King 9-10-85

Notice of Anomaly None

CONFIGURATION NO. 3 TESTS
(Horizontal Tray to
Parallel Conduit Separation)

SECTION IV

CONFIGURATION NUMBER 3 TESTS (HORIZONTAL TRAY TO PARALLEL CONDUIT SEPARATION)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

1.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6×10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds.

1.1.2 High Potential Test

There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute.

1.1.3 Cable Continuity Test

Energized specimens in the target raceway shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current
1/0 AWG	Triplex	NJM-34	L	575	139
2 AWG	Triplex	NJM-25	K	575	38.5
12 AWG	7	NJN-37	C	120	10
16 AWG	2/C	NJP-05	X	50	1

1.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, 0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance.

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

---

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

2.0 PROCEDURES

2.1 Test Specimen Preparation

The test specimens were mounted to the unistrut frame assembly of Figure 7 (Test No. 1) and Figure 8 (Test No. 2) of Section VIII. This apparatus was assembled to the indicated dimensions by Wyle technicians using materials supplied by NMP2. The following guidelines were observed with regard to the materials and construction of the assembly:

1. The faulted cable was a Triplex 2/0 AWG cable from NMP2 stock.

2. For Test 1, the faulted cable was contained inside the cable tray at the centerline of the tray as shown in Figure 7 in Section VIII. The cable tray was mounted one inch below the conduit. For Test 2, the faulted cable was contained inside the conduit below the cable tray as shown in Figure 8 of Section VIII.

3. The ends of the faulted cable from their termination at the copper bus bar to the edge of the cable tray or conduit were wrapped with a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape. This wrapping was done to ensure that any ignition that might occur was contained to the test area.

4. For Test 1, the conduit was 1-inch rigid steel. For Test 2, the conduit was 4-inch rigid steel.

5. Photographs were taken of the test setup prior to each test.

2.2 Instrumentation Setup

2.2.1 Thermocouple Locations

A total of 17 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below for both Test 1 and Test 2.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-11	Mounted to the outside of the conduit. These thermocouples were mounted approximately 16 inches apart and above Channels 3, 4, and 5.
12-17	Mounted to the jacket of the target cable. These thermocouples were mounted approximately 16 inches apart and above Channels 1-6.

The thermocouples were monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger was operated at its maximum scan rate throughout the overcurrent test.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup (Continued)

2.2.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current were fed into oscillograph recorders. The oscillograph was operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels were as specified in the following table:

Channel No.	Signal	Cable/Location*
1	Current	7/C 12 AWG/C
2	Voltage	7/C 12 AWG/C
3-7	Skipped	N/A
8	Current	Fault Cable/T
9-12	Skipped	N/A

* C = Conduit
T = Tray

For Test 2, in addition to the above, the below listed thermocouples were added:

Channel No.	Location
18 & 19	Mounted to the rungs of the cable tray.

A digital multimeter was utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data was recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 120 VAC for the control cables throughout the overcurrent test.

2.3 Baseline Functional Tests

The baseline functional tests consisted of insulation resistance and high potential measurementrs on each of the target cables.

2.3.1 Insulation Resistance Test

1. All power and instrumentation leads were disconnected from the target cables and labeled per Figures 12 and 13 of Section VIII.

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests (Continued)

2.3.1 Insulation Resistance Test (Continued)

2. Using a megohmmeter, a potential of 1000 VDC was applied and the minimum insulation resistance indicated after a period of 60 seconds was recorded between the following test points.

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit 4 to conduit

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.3.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC was applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit 4 to conduit

2. All power and instrumentation leads were reconnected per Figures 12 and 13 of Section VIII.

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.2.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test

The overcurrent test was conducted in three sequential steps with no intentional time delay. The first phase consisted of energizing the fault cable wtih SWEC rated current. The second phase consisted of increasing the current until fault cable temperatures were within 189°-199°F for 5 minutes. The third phase consisted of energizing the fault cable with the worst case electrical fault current until the cable open-circuited.

The target control cable conducted SWEC-rated current (see Paragraph 1.1.3) at 120 VAC throughout the overcurrent test. The overcurrent test was conducted using the following procedure.

1. The Triplex 2/0 AWG fault cable was connected to the copper bus bars per Figure 11 of Section VIII.
2. A 7/C 12 AWG target cable was installed into the conduit (Test 1) per Figure 7 of Section VIII or into the cable tray per Figure 8 (Test 2) of Section VIII.
3. The 7/C 12 AWG target cable was connected to the instrumentation and power supplies of Figure 13 of Section VIII.
4. The 7/C 12 AWG target cable was energized with 10 amperes at 120 VAC.
5. The Triplex 2/0 AWG fault cable was energized with 139 amperes per phase (rated current) from the Multi-Amp Test Set.
6. Target cable voltages and currents and the fault cables current were recorded.
7. The fault cable current was slowly increased until Thermocouple Channels 7 and/or 8 indicated 90 $\pm$3°C (189-199°F) conductor temperature.
8. The conductor temperature was maintained at 189-199°F for five minutes.
9. Fault cable current, conductor temperature, and the highest of Thermocouple Channels 1 through 6 were recorded.
10. The Multi-Amp Test Set output was increased to 908 amperes (test current).
11. Target cable voltages, currents and the fault cable current were recorded.
12. The fault cable was allowed to conduct test current until the cable open-circuited.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

13. The elapsed time and maximum cable temperature were recorded.
14. Target cable voltages and currents were recorded.
15. The target cables and the Multi-Amp Test Set were de-energized.
16. Photographs were taken of the post-test condition.

For all performances of this test, the observed target cable operation was compared to the acceptance criteria, Paragraph 1.1.3

2.5 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 2.3 were repeated.

3.0 RESULTS

3.1 Results of Test No. 1

Configuration Number 3, Test No. 1, with a Triplex 2/0 AWG fault cable inside a 4-inch rigid steel conduit, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1240 seconds (20.7 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1836°F which occurred on Thermocouple No. 6. The fault cable ignited after 630 seconds (10.5 minutes). The fire burned for approximately 13.0 minutes.

The capabilities of the target cables to conduct SWEC rated current at 120 VAC were not impaired during this test. The maximum observed target cable temperature was 788°F. The target cable successfully completed the Post-Overcurrent Test Functional Test.

Appendix I contains the following data from this test:

1. Photographs IV-1 through IV-5 which show pretest and post-test conditions.
2. A narrative of the test which relates test time, fault cable temperatures, and important events.
3. Figure IV-1 which plots the temperature readings versus time.
4. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

3.0 RESULTS (Continued)

3.2 Results of Test No. 2

Configuration Number 3, Test No. 2, with a Triplex 2/0 AWG fault cable inside the cable tray, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1317 seconds (22.0 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1212°F which occurred on Thermocouple No. 4. The fault cable ignited at the mouth of the conduit after 1317 seconds (22.0 minutes). The fire burned out the end of the conduit and did not impinge upon the length of target cable under test.

The capabilities of the target cables to conduct SWEC rated current 120 VAC were not impaired during this test. The maximum observed target cable temperature was 245°F. The target cable successfully completed the Post-Overcurrent Test Functional Test.

Appendix II contains the following data from this test:

1. Notices of Anomaly Number 5 and 6.
2. Photographs IV-6 through IV-7 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure IV-2 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

APPENDIX I

CONFIGURATION NUMBER 3, TEST NO. 1, DATA

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/26/85

NOTICE NO: 5 P.O. NUMBER: NMP2-E-0907 CONTRACT NO: N/A
CUSTOMER: Stone & Webster WYLE JOB NO: 47906
NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/27/85
NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/9, 9/12, 9/17/85
PART NAME: Electrical Cable PART NO. N/A
TEST: Config. 2, Test 1; Config. 3; Test 2; Config. 5, Tests 2 and 3 I.D. NO. N/A
SPECIFICATION: WLTP 47906 PARA. NO. 3.4.5, 3.5.5, 3.7.5

REQUIREMENTS:

1. Slowly increase fault cable current until thermocouple channels 7 and/or 8 indicate 90 ±3°C (189°F-199°F) conductor temperature.
2. Maintain the conductor temperature at 189°F-199°F for five minutes.

DESCRIPTION OF ANOMALY:

The thermocouple channels 1-6 on the cable jacket were used instead of channels 7 and/or 8.

DISPOSITION · COMMENTS · RECOMMENDATIONS:

The anomaly was judged to have no impact on the test for the following reasons.

1. During warmup of the cable, the conductor temperature would have to be higher than the temperature of the adjacent jacket.
2. The conductor thermocouple can indicate a lower temperature than the jacket thermocouples because of differences in mounting and location.
3. The heat transferred from the fault cable to the target cables during warmup to, and maintenance at, 189°F-199°F is very small compared to the heat transferred during burning of the fault cable, which occurred in every test.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS:
REPRESENTING:
QUALITY ASSURANCE: G.W. Hight 10/2/85

PROJECT ENGINEER: J. P. King 9/27/85
PROJECT MANAGER: [signature] 9/30/85
INTERDEPARTMENTAL COORDINATION:

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/26/85

NOTICE NO: 6 P.O. NUMBER: NMP2-E-0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/27/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/12/85

PART NAME: Electrical Cables PART NO. N/A

TEST: Configuration 3, Test 2 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 3.5.3.2

REQUIREMENTS:

For Test 2, add thermocouple channels 18 and 19 to the rungs of the cable tray.

DESCRIPTION OF ANOMALY:

Installation of thermocouples 18 and 19 was omitted.

DISPOSITION · COMMENTS · RECOMMENDATIONS:

This anomaly was judged to have no impact on the test for the following reason.

1. Temperature of target cable, fault cable, and the conduit enclosing the fault cable were measured; therefore, the temperatures of the cable tray at two points are unnecessary data.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ____

REPRESENTING: ____

QUALITY ASSURANCE: G. W. Wright 10/2/85

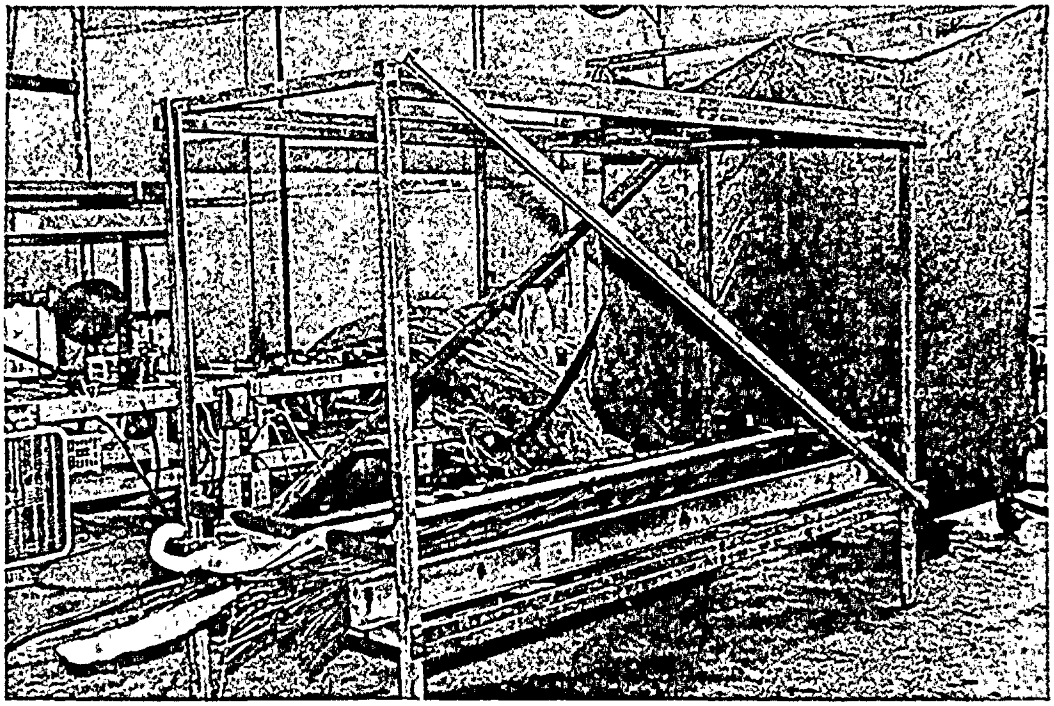
PROJECT ENGINEER: J. P. King 9/27/85

PROJECT MANAGER: [signature] 9/30/85

INTERDEPARTMENTAL COORDINATION: ____

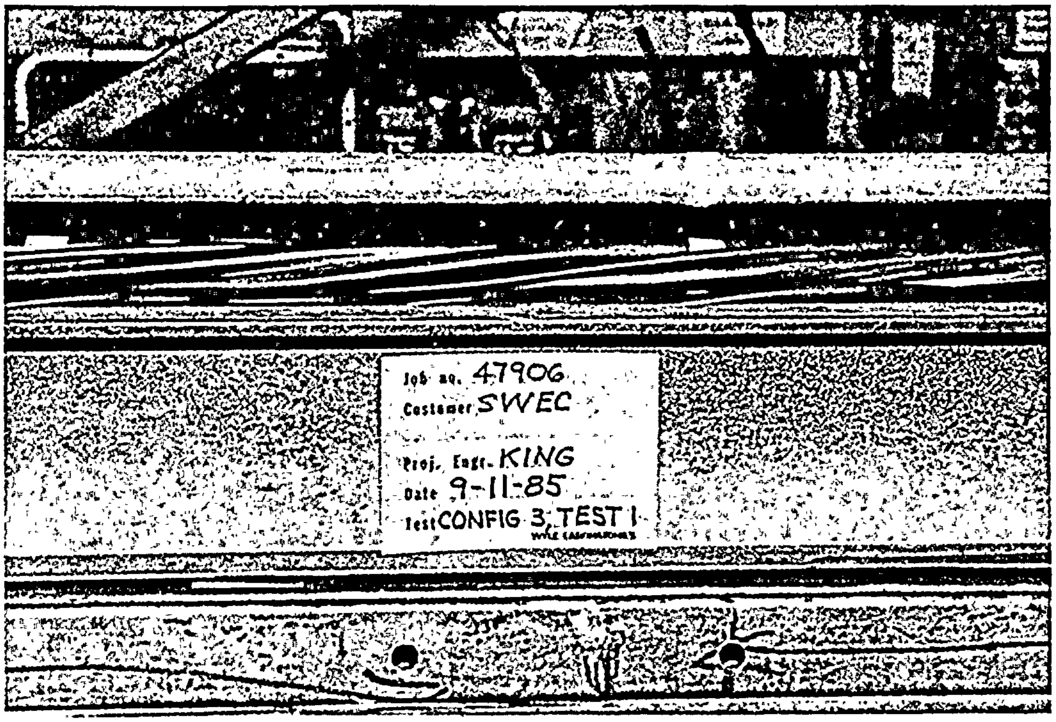
Wyle Form WH 1066, Rev. JAN '85

CONFIGURATION NUMBER 3, TEST NO. 1



PHOTOGRAPH IV-1

PRETEST VIEW — OVERALL



PHOTOGRAPH IV-2

POST-TEST VIEW — SHOWING TARGET CABLE CONDUIT
ONE INCH ABOVE FAULT CABLE

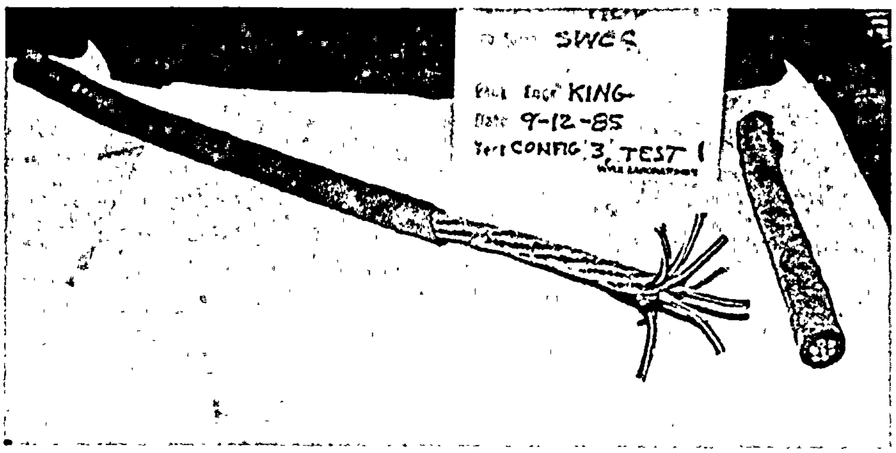
CONFIGURATION NUMBER 3, TEST NO. 1

PHOTOGRAPH IV-3

PRETEST VIEW — OVERALL

PHOTOGRAPH IV-4

POST-TEST VIEW — CLOSE-UP



PHOTOGRAPH IV-5

POST-TEST VIEW — CLOSE-UP SHOWING CONDITION OF TARGET CABLE AFTER REMOVAL FROM CONDUIT

CONFIGURATION NUMBER 3, TEST NO. 1

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	84°F	Energized fault cable with 139A
10 Min	90°F	Energized fault cable with 270A
65 Min	166°F	Energized fault cable with 280A
75 Min	182°F	Fault cable conductor reached 189°F
80 Min	184°F	Energized fault cable with 908A
83.2 Min	295°F	Light smoke visible
87.8 Min	480°F	Fault cable jacket rupturing
90.5 Min	630°F	Ignition of fault cable
100.7 Min	1790°F	Open circuit
103.5 Min	1450°F	Fire out

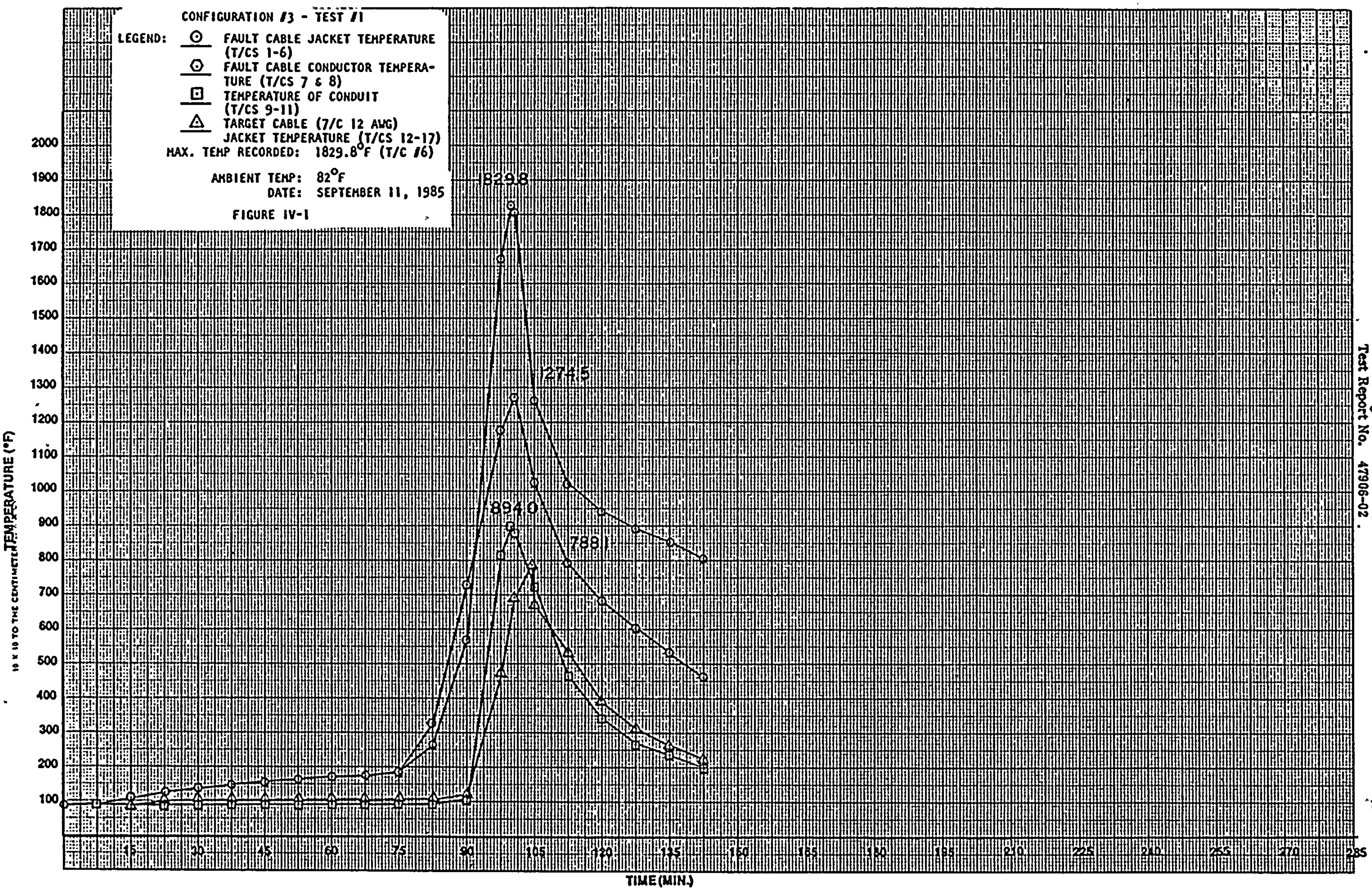


FIGURE IV-1

Page No. IV-15
Test Report No. 47906-02

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.4
S/N N/A
GSI No

Amb. Temp. 82°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9-11-85

Test Title Configuration No. 3 Test No. 1
(Pre-test) ~~Post-test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
7/C 12 AWG	1 to 4	6.0×10^{10}
~~(Horizontally Separated)~~	1 to Conduit	7.0×10^{10}
	4 to Conduit	3.8×10^{10}

Tested By Danny L Webb Date: 9-11-85
Witness None Date:
Sheet No. 1 of 2
Approved J. W. King 9-11-85

Notice of Anomaly None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.4
S/N: N/A
GSI: No

Amb. Temp.: 82°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-11-85

Test Title: Configuration No. 3 Test No. 1
(Pre-test) ~~Post-test~~ Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
7/C 12 AWG	1 to 4	1770 μA
~~(Horizontally Separated)~~	1 to Conduit	920 μA
	4 to Conduit	825 μA

Tested By: Danny L. Webb Date: 9-11-85
Witness: None Date:
Sheet No. 2 of 2
Approved: J. P. King 9-11-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev APR 82

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various

Amb. Temp. 82°F

Job No. 47906

Spec. WLTP 47906-01

Photo Yes

Report No. 47906-02

Para. 3.5.5

Test Med. Air

Start Date 9-11-85

S/N N/A

Specimen Temp. Ambient

GSI No

Test Title Configuration No. 3 Test No. 1 Overcurrent Test

6. Readings with rated current on fault cable

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
7/C - 12 AWG	120.8			10.5		

Fault Cable: 2/0 AWG TRIPLEX

Rated Current: ~~908A~~ 139 A

Measured Current:

Tested By [signature] Date: 9/11/85

Witness [signature] Date:

Sheet No. 1 of 4

Approved [signature] 9/13/85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.5
S/N N/A
GSI No

Amb. Temp. 82°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-11-85

Test Title Configuration No. 3 Test No. 1 Overcurrent Test

7. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ FLT CABLE TEMP/CHANNEL
270A	2700 sec	166/7 8
280A	1500 sec	~~194~~ 190/8

9. Readings after fault cable warmup to 189°F - 199°F

Fault cable current:	280A	
Conductor temperature:	194°F	Channel No. 8
Max temp of Channels 1-6	184 Channel 6	

Notice of Anomaly None

Tested By [signature] Date: 9/11/85
Witness None Date:
Sheet No. 2 of 4
Approved [signature] 9/13/85

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.5
S/N: N/A
GSI: No

Amb. Temp.: 82°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-11-85

Test Title: Configuration No. 3 Test No. 1 Overcurrent Test

II. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
~~2 AWG Triplex~~						
~~(Vertically Separated)~~						
7/C - 12 AWG	120.9			10.7		
~~(Horizontally Separated)~~						

Fault cable: 2/0 AWG TRIPLEX
Test ~~Rated~~ current: 908 A
Measured current:

Tested By: [signature] Date: 9/11/85
Witness: None Date:
Sheet No. 3 of 4
Approved: [signature] 9/13/85

Notice of Anomaly: None

Wyle Form WH-614A Rev APR 84

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No.	Various	Amb. Temp.	82° F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.5.5	Test Med.	Air	Start Date	9-11-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title Configuration No. 3 Test No. 1 Overcurrent Test

13. Open circuit on fault cable:			
Elapsed time:	1240 sec		
Maximum fault cable temperature:	1830°F	Channel No.	6.
14. Stabilized temperature on fault cable:			
Elapsed time (beginning of 15-minute period):	N/A		
Maximum fault cable temperature:	N/A		
Fault cable current:	N/A	Channel No.	N/A
15. Ignition of fault cable:			
Elapsed time:	630 sec		
Maximum fault cable temperature:	1830°F	Channel No.	6
Fault cable current:	908 A		
17. Readings after let-through current applied until fault cable open circuits:			

	Voltage (VAC)			Current (amps)		
Target Cable	A-B	B-C	A-C	Phase A	Phase B	Phase C
JMC ~~2 AWG Triplex~~						
~~(Vertically Separated)~~						
7/C - 12 AWG	121.4			10.5		
JMC ~~(Horizontally Separated)~~						

Tested By [signature] Date: 9/11/85

Witness [signature] Date:

Sheet No. 4 of 4

Approved JMKing 9/13/85

Notice of Anomaly None

Wyle Form WH-814A Rev APR '84

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.6
S/N N/A
GSI No

Amb. Temp. 82°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-11-85

Test Title Configuration No. 3 Test No. 1
~~Pre-test~~ BQ (Post-test) Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
7/C 12 AWG	1 to 4	2.8×10^6
JMK ~~(Horizontally Separated)~~	1 to Conduit	5.0×10^7
	4 to Conduit	6.0×10^7

Notice of Anomaly None

Tested By Denny K. Webb Date: 9-11-85
Witness None Date:
Sheet No. 1 of 2
Approved J M King 9-11-85

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.6
S/N: N/A
GSI: No

Amb. Temp.: 82°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-11-85

Test Title: Configuration No. 3 Test No. 1

~~Pre-test~~ (Post-test) Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
7/C 12 AWG	1 to 4	2220 μA
~~(Horizontally Separated)~~	1 to Conduit	1100 μA
	4 to Conduit	1230 μA

Tested By: Danny L. Webb Date: 9-11-85
Witness: None Date:
Sheet No. 2 of 2
Approved: J.P. King 9-11-85

Notice of Anomaly: None

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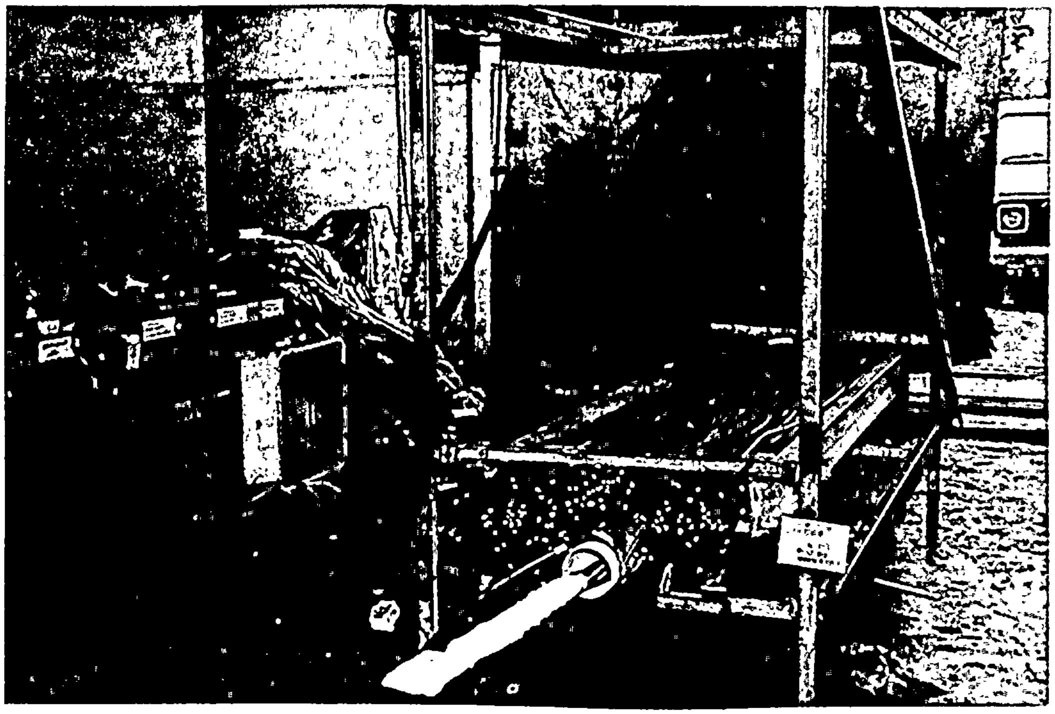
APPENDIX II

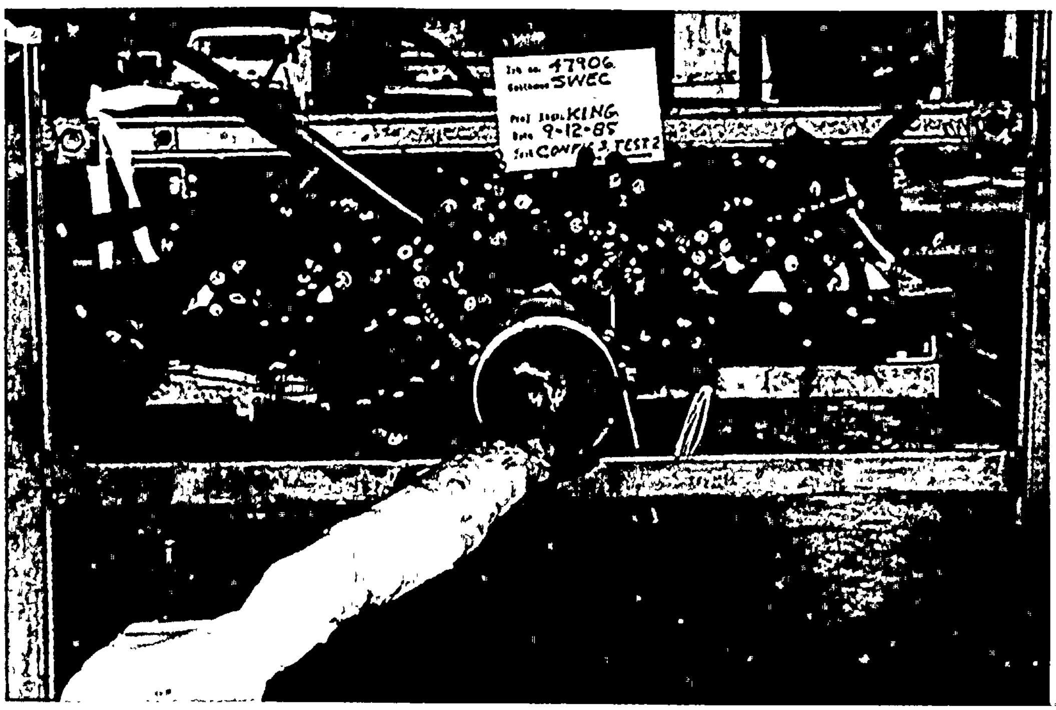
CONFIGURATION NUMBER 3, TEST NO. 2, DATA

CONFIGURATION NUMBER 3, TEST NO. 2



PHOTOGRAPH IV-6

PRETEST VIEW — OVERALL



PHOTOGRAPH IV-7

POST-TEST VIEW — CLOSE-UP

CONFIGURATION NUMBER 3, TEST NO. 2

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	81°F	Energized fault cable with 139A
10 Min	89°F	Energized fault cable with 270A
45 Min	181°F	Energized fault cable with 255A
50 Min	189°F	Fault cable conductor reached 189°F
57 Min	198°F	Energized fault cable with 908A
60 Min	309°F	Smoke visible
64.1 Min	590°F	Fault cable jacket rupturing
79 Min	1165°F	Ignition and Open circuit. Fire was very small and burned only on current source end immediately within the conduit.

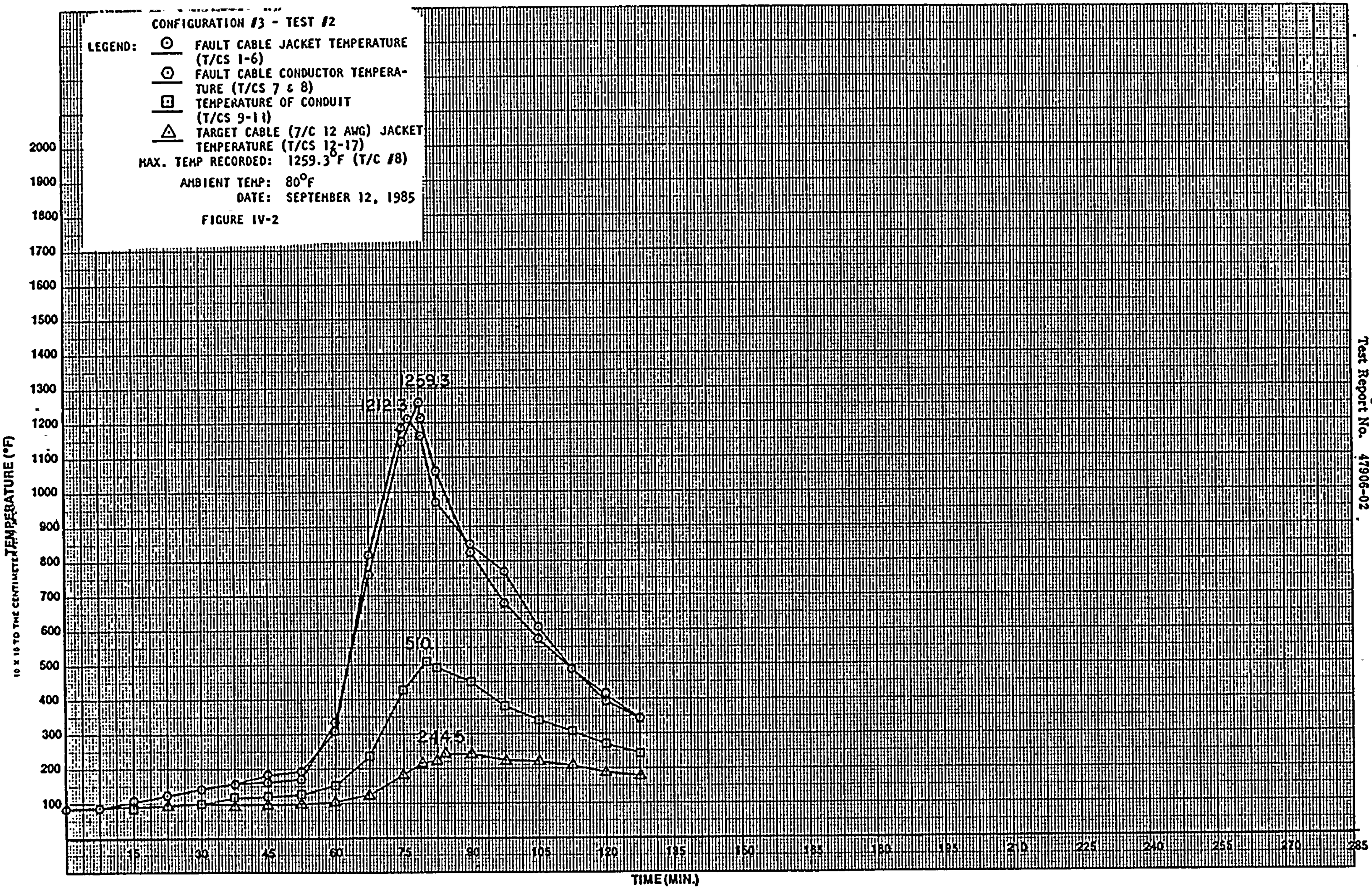

CONFIGURATION #3 - TEST #2
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
TEMPERATURE OF CONDUIT (T/CS 9-11)
TARGET CABLE (7/C 12 AWG) JACKET TEMPERATURE (T/CS 12-17)
MAX. TEMP RECORDED: 1259.3°F (T/C #8)
AMBIENT TEMP: 80°F
DATE: SEPTEMBER 12, 1985
1259.3
1212.3
510
244.5
TEMPERATURE (°F)
TIME (MIN.)

FIGURE IV-2

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.4
S/N: N/A
GSI: No

Amb. Temp.: 80° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-12-85

Test Title: Configuration No. 3 Test No. 2

(Pre-test) ~~Post-test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
7/C - 12 AWG	1 to 4	8.0 X 10^9 Ω
~~(Horizontally Separated)~~	1 to Conduit	5.0 X 10^{10} Ω
	4 to Conduit	7.0 X 10^{10} Ω

Notice of Anomaly: None

Tested By: [signature] Date: 9-11-85
Witness: None Date:
Sheet No. 1 of 2
Approved: [signature] 9-12-85

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.4
S/N: N/A
GSI: No

Amb. Temp.: 80° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-12-85

Test Title: Configuration No. 3 Test No. 2

(Pre-test) ~~Post-test~~ Functional Test

High Potential Test

Acceptance criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for ~~5~~ 1 T.P. ~~15~~ 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
7/C - 12 AWG	1 to 4	1825 µA
~~(Horizontally Separated)~~	1 to Conduit	700 µA
	4 to Conduit	780 µA

Tested By: [signature] Date: 9-12-85
Witness: [signature] Date:
Sheet No. 2 of 2
Approved: [signature] 9-12-85

Notice of Anomaly: None

Wyle Form [illegible]

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.5
S/N N/A
GSI No

Amb. Temp. 80°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9-12-85

Test Title Configuration No. 3 Test No. 2 Overcurrent Test

6. Readings with rated current on fault cable

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
7/C - 12 AWG	120.1			10.6		

Fault Cable: 2/0 AWG TRIPLEX
Rated Current: 139A
Measured Current: 139A

Tested By: [signature] Date: 9-12-85
Witness: None Date:
Sheet No. 1 of 4
Approved [signature] 9-12-85

Notice of Anomaly ~~None~~ No. 5, No. 10

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No. Various | Amb. Temp. 80°F | Job No. 47906

Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02

Para. 3.5.5 | Test Med. Air | Start Date 9-12-85

S/N N/A | Specimen Temp. Ambient

GSI No

Test Title Configuration No. 3 Test No. 2 Overcurrent Test

7. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP/CHANNEL
270A	2100 sec	181°F/(3)
255A	300 sec	189°F/(3)

9. Readings after fault cable warmup to 189°F - 199°F

Fault cable current: 255A

Conductor temperature: ~~196~~ 173°F Channel No. 8

Max temp of Channels 1-6 196°F Channel 3

Tested By [signature] Date: 9/12/85

Witness [signature] Date:

Sheet No. 2 of 4

Approved [signature] 9-12-85

Notice of Anomaly No. 5, No. 6

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.5
S/N: N/A
GSI: No

Amb. Temp.: 80°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-12-85

Test Title: Configuration No. 3 Test No. 2 Overcurrent Test

11. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
JPK ~~2 AWG Triplex~~						
JPK ~~(Vertically Separated)~~						
7/C - 12 AWG	120.1			10.6		
JPK ~~(Horizontally Separated)~~						

Fault Cable: 2/0 AWG TRIPLEX
JPK Test ~~Rated~~ Current: ~~139A~~ JPK 908A
Measured Current: 908A

Tested By: [signature] Date: 9-12-85
Witness: [signature] Date:
Sheet No. 3 of 4
Approved: J. King 9-12-85

Notice of Anomaly: ~~None~~ No.5, No.6

Wyle Form WH 614A Rev APR 81

DATA SHEET

Customer Stone & Webster | WYLE LABORATORIES
Specimen Cables
Part No. Various | Amb. Temp. | Job No. 47906
Spec. WLTP 47906-01 | Photo Yes | Report No. 47906-02
Para. 3.5.5 | Test Med. Air | Start Date 9-12-85
S/N N/A | Specimen Temp. Ambient
GSI No

Test Title Configuration No. 3 Test No. 2 Overcurrent test

13. Open circuit on fault cable:	~~1212~~		
Elapsed time:	13/7 sec		
Maximum fault cable temperature:	1212°F	Channel No.	4
14. Stabilized temperature on fault cable:			
Elapsed time (beginning of 15-minute period):	N/A		
Maximum fault cable temperature:	N/A	Channel No.	N/A
Fault cable current:	N/A		
15. Ignition of fault cable:			
Elapsed time:	13/7 sec		
Maximum fault cable temperature:	1212°F	Channel No.	4
Fault cable current:	908A		

17. Readings after let-through current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
JMC ~~2 AWG Triplex~~						
JMC ~~(Vertically Separated)~~						
7/C - 12 AWG	121.1v			10.66A		
JMC ~~(Horizontally Separated)~~						

Tested By [signature] Date: 9-12-85
Witness [signature] Date:
Sheet No. 4 of 4
Approved JMKing 9/13/85

Notice of Anomaly ~~None~~ No.5, No.6

Wyle Form WH 3124 Rev. APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.6
S/N: N/A
GSI: No

Amb. Temp.: 70°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-12-85

Test Title: Configuration No. 3 Test No. 2

~~Pre-test~~ Post-test (circled) Functional Test

Insulation Resistance Test
Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
7/C - 12 AWG	1 to 4	$2.4 \times 10^{10}\,\Omega$
~~(Horizontally Separated)~~	1 to Conduit	$1.1 \times 10^{9}\,\Omega$
	4 to Conduit	$2.0 \times 10^{10}\,\Omega$

Tested By: [signature] Date: 9-12-85
Witness: [signature] Date:
Sheet No. 1 of 2
Approved: [signature] 9-12-85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.6
S/N: N/A
GSI: No

Amb. Temp.: 80°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-12-85

Test Title: Configuration No. 3 ~~Test~~ No. 2
~~Pre-test BH~~ (Post-test) Functional Test

High Potential Test

Acceptance criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 1/~~5~~ T.P. 15 AWG cables) applied for one minute.

Cable	Test Points	Reading
7/C - 12 AWG	1 to 4	1880 μA
JMK ~~(Horizontally Separated)~~	1 to Conduit	700 μA
	4 to Conduit	770 μA

Tested By: [signature] Date: 9-12-85
Witness: [signature] Date:
Sheet No. 2 of 2
Approved: JMKing 9-12-85

Notice of Anomaly: None

Wyle Form WH 614A, Rev APR 82

CONFIGURATION NO. 4 TEST
(Vertical Separation of Horizontal Cable Trays in a Vertical Stack)

[illegible]

SECTION V

CONFIGURATION NUMBER 4 TESTS (3-TRAY HORIZONTAL STACK WITH VERTICAL SEPARATION)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

1.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6 x 10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds.

1.1.2 High Potential Test

There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute.

1.1.3 Cable Continuity Test

Energized specimens in the target raceway shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current
1/0 AWG	Triplex	NJM-34	L	575	139
2 AWG	Triplex	NJM-25	K	575	38.5
12 AWG	7	NJN-37	C	120	10
16 AWG	2/C	NJP-05	X	50	1

1.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, 0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance.

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

2.0 PROCEDURES

2.1 Test Specimen Preparation

The test specimens were mounted into the test assembly of Figure 9 of Section VIII. This apparatus was manufactured to the indicated dimensions by Wyle technicians using materials supplied by NMP2. The following guidelines were observed with regard to the materials and construction of the assembly:

1. The fault cable was a Triplex 2/0 AWG cable from NMP2 stock.

2. The faulted cable was located at the centerline of Tray T2 as shown in Figure 9 of Section VIII.

3. The ends of the fault cable were wrapped from their termination on the copper bus bar to the edge of their cable tray. This wrap consisted of a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape. This wrapping was done to ensure that any ignition that might occur was contained to the cable tray test area.

4. The horizontal cable trays were mounted such that there are nine inches between the top of the siderail of one tray to the bottom of the siderail to the next higher cable tray.

5. The cable trays contained the following cables from NMP2 stock:

Raceway No.	Raceway Cable Fill
T1	Mixture of K-Type cables with one Triplex 2 AWG target cable in the bottom layer at the centerline of the tray.
T2	Mixture of K-Type cables with one Triplex 2/0 AWG fault cable at the top centerline of the tray.
T3	Mixture of C- and X-Type cables with one 7/C 12 AWG and one 2/C 16 AWG target cables at the top centerline of the tray.

6. Photographs were taken of the test setup prior to the test.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup

2.2.1 Thermocouple Locations

A total of 20 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket of the target cable in Tray T1. These thermocouples were mounted approximately 16 inches apart.
15-20	Mounted to the jacket of the target cables in Tray T3. These thermocouples were mounted approximately 16 inches apart.

The thermocouples were monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger was operated at its maximum scan rate throughout the overcurrent test.

2.2.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current were fed into oscillograph recorders. The oscillograph was operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels were as specified in the following table:

Channel No.	Signal	Cable/Location
1	Current-Phase A	Triplex 2 AWG/T1
2	Current-Phase B	Triplex 2 AWG/T1
3	Current-Phase C	Triplex 2 AWG/T1
4	Voltage A-B	Triplex 2 AWG/T1
5	Voltage A-C	Triplex 2 AWG/T1
6	Voltage B-C	Triplex 2 AWG/T1
7	Current	7/C 12 AWG/T3
8	Voltage	7/C 12 AWG/T3
9	Current	2/C 16 AWG/T3
10	Voltage	2/C 16 AWG/T3
11	Skipped	N/A
12	Current	Fault Cable/T2

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup (Continued)

2.2.2 Electrical Monitoring (Continued)

A digital multimeter was utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data was recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) throughout the overcurrent test.

2.3 Baseline Functional Tests

The baseline functional tests consisted of insulation resistance and high potential measurements on each of the target cables. These tests were performed as described in the following paragraphs.

2.3.1 Insulation Resistance Test

1. All power and instrumentation leads were disconnected from the target cables and labeled per Figures 12, 13, or 14 of Section VIII.

2. Using a megohmmeter, a potential of 1000 VDC (500 VDC for 2/C 16 AWG cable) was applied and the minimum insulation resistance indicated after a period of 60 seconds was recorded between the following test points:

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or tray
1 to 3	2 to unistrut or tray
2 to 3	3 to unistrut or tray

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to tray or conduit
	4 to tray or conduit

Target Instrument Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to shield*
	2 to shield*

*One end of shield tied to unistrut, tray or conduit.

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests (Continued)

2.3.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cable) was applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to tray
1 to 3	2 to tray
2 to 3	3 to tray

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit or tray
	4 to conduit or tray

Target Instrument Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to shield*
	2 to shield*

*One end of shield tied to conduit or tray.

2. All power and instrumentation leads were connected per Figure 12, 13, or 14 of Section VIII.

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.2.

2.4 Overcurrent Test

The overcurrent test was conducted in three sequential steps with no intentional time delay. The first phase consisted of energizing the fault cable with SWEC rated current. The second phase consisted of increasing the current until fault cable temperatures were within 189°-199°F for 5 minutes. The third phase consisted of energizing the fault cable with the worst case electrical fault current until the cable open-circuited.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

The target control cables conducted SWEC-rated current (see Paragraph 1.1.3) at 575 VAC (power cables), 120 VAC (control cables), or 50 VAC (instrument cables) throughout the overcurrent test. The overcurrent test was conducted using the following procedure:

1. The Triplex 2/0 AWG fault cable was connected to the copper bus bars per Figure 11 of Section VIII.

2. A 7/C 12 AWG and a 2/C 16 AWG target cable were installed into Tray T3 per Figure 9 of Section VIII.

3. A Triplex 2 AWG target cable was installed into Tray T1 per Figure 9 of Section VIII.

4. The Triplex 2 AWG target cable was connected to the instrumentation and power supplies of Figure 12 of Section VIII.

5. The 7/C 12 AWG target cable was connected to the instrumentation and power supplies of Figure 13 of Section VIII.

6. The 2/C 16 AWG target cable was connected to the instrumentation and power supplies of Figure 14 of Section VIII.

7. The Triplex 2 AWG target cable was energized with 38.5 amperes at 575 VAC.

8. The 7/C 12 AWG target cable was energized with 10 amperes at 120 VAC.

9. The 2/C 16 AWG target cable was energized with one ampere at 50 VAC.

10. The Triplex 2/0 AWG fault cable was energized with 908 amperes per phase (rated current) from the Multi-Amp Test Set.

11. Target cable voltages and currents and the fault cables current were recorded.

12. The fault cable current was slowly increased until Thermocouple Channels 7 and/or 8 indicates 90 $\pm 3^{o}$C (189-199^{o}F) conductor temperature.

13 The conductor temperature was maintained at 189-199^{o}F for five minutes.

14. Fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6 were recorded.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

15. The Multi-Amp Test Set output was increased to 908 amperes (test current).
16. Target cable voltages, currents and the fault cable current were recorded.
17. The fault cable was allowed to conduct test current until the cable open-circuited.
18. The elapsed time and maximum cable temperature were recorded.
19. Target cable voltages and currents were recorded.
20. The target cables and the Multi-Amp Test Set were de-energized.
21. Photographs were taken of the post-test condition.

For all performances of this test, the observed target cable operation were compared to the acceptance criteria, Paragraph 1.1.3

2.5 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 2.3 were repeated.

3.0 RESULTS

3.1 Results of Test No. 1

Configuration Number 4, Test No. 1, with a Triplex 2/0 AWG fault cable inside a horizontal cable tray, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1322 seconds (22.0 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1820°F which occurred on Thermocouple No. 5. The fault cable ignited after 650 seconds (10.8 minutes). The fire burned for approximately 13.5 minutes.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable), 120 VAC (control cable), or 50 VAC (instrument cable) was not impaired during this test. The maximum observed target cable temperature was 343°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix I contains the following data from this test:

1. Notice of Anomaly Number 4.
2. Photographs V-1 through V-4 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure V-1 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

APPENDIX I

CONFIGURATION NUMBER 4, TEST NO. 1, DATA

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: September 16, 1985

NOTICE NO: 4 P.O. NUMBER: NMP2-E0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: Ranjit Das NOTIFICATION DATE: 9/13, 9/16, 9/17/85

NOTIFICATION MADE BY: John King VIA: Verbal

CATEGORY: ☐ SPECIMEN ☐ PROCEDURE ☒ TEST EQUIPMENT DATE OF ANOMALY: 9/13/85

PART NAME: Electrical Power Cable PART NO. N/A

TEST: Config. 4, Test 1; Config. 5, Tests 1,2,3 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 3.6.5, 3.7.5

Requirements:

1. The target cables shall conduct SWEC rated current (see Paragraph 2.1.3) at 575 VAC (power cables) throughout the overcurrent test.
2. All target cable currents shall be maintained within a ±10% tolerance (per NOA2).

Description of Anomaly:

During Configuration 4, Test 1 and Configuration 5, Tests 1, 2 and 3, some of the phase currents on the No. 2 AWG cable were above the +10% tolerance by as much as 8.4 amperes, while test current was flowing in the worst case cable. During Configuration 5, Test 3, one of the phase currents was below the -10% tolerance by 12.3 amperes while the other two phase currents were above the +10% tolerance by 8.4 amperes and 6.7 amperes, respectively.

Disposition - Comments - Recommendations:

The out of tolerance currents were judged to have no impact on the test for the following reasons.

1. Current above the tolerance results in additional conductor heating and therefore higher cable temperatures which is a more severe condition than required.
2. In the case where one of the phase currents was below the -10% tolerance the resulting lower conductor heating is compensated for by the additional heating in the other two phases.
3. Heating due to rated current of 38.5 amperes is very low. Screening Test No. 5 of the No. 2 AWG cable showed no change in temperature of the cable conductor or jacket after 10 minutes of rated current.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

PROJECT ENGINEER: John P. King 9/19/85

TEST WITNESS:

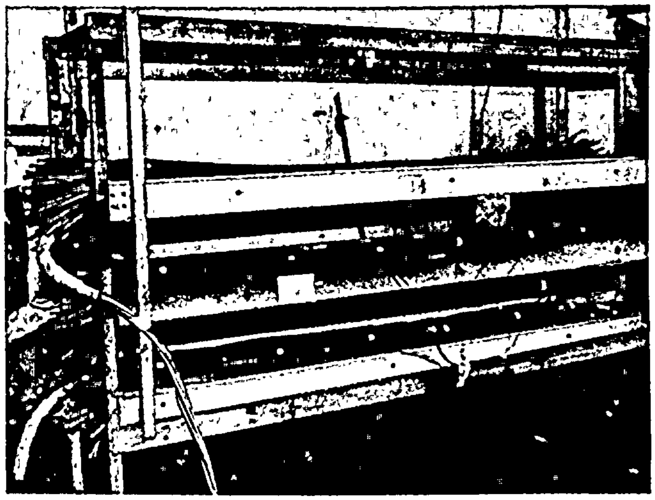
PROJECT MANAGER: [signature] 9/20/85

REPRESENTING:

INTERDEPARTMENTAL COORDINATION: K Taylor 9-20-85

QUALITY ASSURANCE: G.W. Knight 9/20/85

CONFIGURATION NUMBER 4, TEST NO. 1

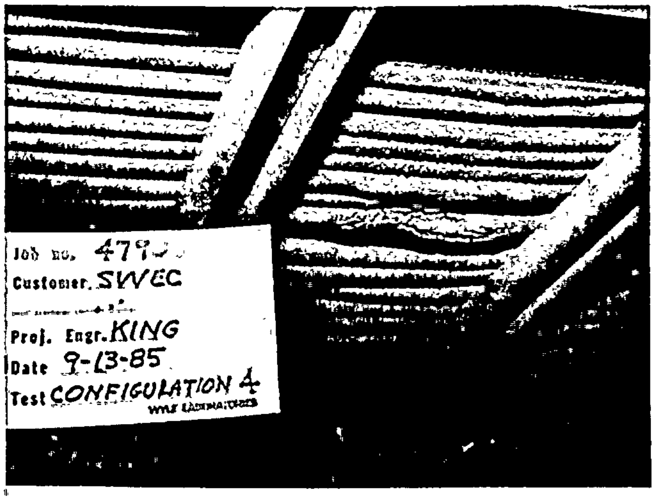


PHOTOGRAPH V-1

PRETEST VIEW — OVERALL

PHOTOGRAPH V-2

POST-TEST VIEW — OVERALL



PHOTOGRAPH V-3

POST-TEST VIEW — CLOSE-UP
BOTTOM VIEW OF TARGET CABLE
IN UPPER TRAY

PHOTOGRAPH V-4

POST-TEST VIEW — TARGET CABLE
AFTER REMOVAL FROM UPPER TRAY

CONFIGURATION NUMBER 4, TEST NO. 1

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	69°F	Energized fault cable with 139A
10 Min	73°F	Energized fault cable with 280A
68.7 Min	171°F	Fault cable conductor reached 190°F
74 Min	176°F	Energized fault cable with 908A
80.3 Min	430°F	Fault cable jacket rupturing
84.8 Min	810°F	Ignition of fault cable
96.0 Min	1697°F	Open circuit
98.3 Min	1460°F	Fire out

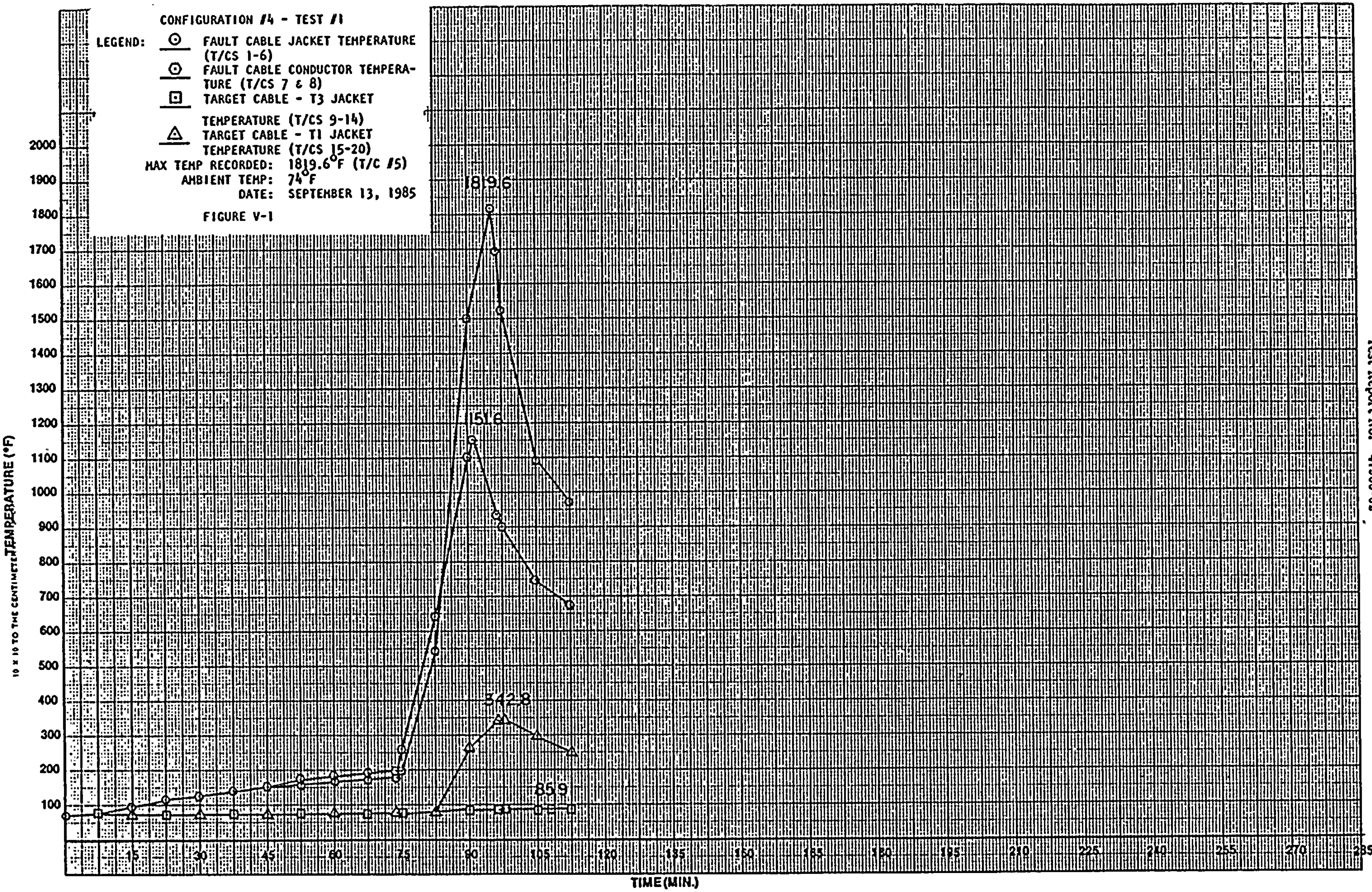

CONFIGURATION #4 - TEST #1
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/CS 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/CS 7 & 8)
TARGET CABLE - T3 JACKET TEMPERATURE (T/CS 9-14)
TARGET CABLE - T1 JACKET TEMPERATURE (T/CS 15-20)
MAX TEMP RECORDED: 1819.6°F (T/C #5)
AMBIENT TEMP: 74°F
DATE: SEPTEMBER 13, 1985
1819.6
1151.6
342.8
85.9
TEMPERATURE (°F)
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
TIME (MIN.)
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285
10 X 10 TO THE CENTIMETER

FIGURE V-1

DATA SHEET

Customer Stone & Webster

Specimen Cables

Part No. Various

Spec. WLTP 47906-01

Para. 3.5.4

S/N N/A

GSI No

Amb. Temp. 69°F

Photo Yes

Test Med. Air

Specimen Temp. Ambient

WYLE LABORATORIES

Job No. 47906

Report No. 47906-02

Start Date 9-13-85

Test Title Configuration No. 4 Test No. 1

(Pre-test) ~~Post Test~~ Functional Test

Insulation Resistance Test		
Acceptance Criteria:	Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC (500 for ~~18~~ T.P. 16 AWG) applied for 60 seconds.	
Cable	Test Points	Reading
2 AWG Triplex	1 to 2	2.0×10^{10} Ω
	1 to 3	1.8×10^{10} Ω
	2 to 3	1.9×10^{10} Ω
	1 to Unistrut or Tray	2.4×10^{10} Ω
	2 to Unistrut or Tray	2.9×10^{10} Ω
	3 to Unistrut or Tray	3.5×10^{10} Ω
7/C - 12 AWG	1 to 4	4.0×10^{10} Ω
	1 to Tray or Conduit	4.5×10^{10} Ω
	4 to Tray or Conduit	1.0×10^{11} Ω

Tested By [signature] Date: 9/13/85

Witness None Date:

Sheet No. 1 of 4

Approved [signature] 9/13/85

Notice of Anomaly None

[illegible]

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.4
S/N N/A
GSI No

Amb. Temp. 69°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-13-85

Test Title Configuration No. 4 Test No. 1
Pre-test (circled) ~~Post-test~~ Functional Test

Insulation Resistance Test (Continued)

Cable	Test Points	Reading
1 ~~8~~ T. P. 16 AWG	1 to 2	2.6x10^10 Ω
	3 to 4 NA	
	5 to 6 NA	
	7 to 8 NA	
	9 to 10 NA	
	1 to Shield	5.6x10^10 Ω
	2 to Shield	2.4x10^10 Ω
	3 to Shield NA	
	4 to Shield NA	
	5 to Shield NA	
	6 to Shield NA	
	7 to Shield NA	
	8 to Shield NA	
	9 to Shield NA	
	10 to Shield NA	

Tested By [signature] Date: 9/13/85
Witness [signature] Date:
Sheet No. 2 of 4
Approved [signature] 9/13/85

Notice of Anomaly None

Wyle Form WH-614A Rev APR 82

DATA SHEET

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.4
S/N: N/A
GSI: No

Amb. Temp.: 69°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

WYLE LABORATORIES
Job No.: 47906
Report No.: 47906-02
Start Date: 9-13-85

Test Title: Configuration No. 4 Test No. 1
Pre-test (circled) ~~Post-test~~ Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for ~~8~~ 18 T.P. 16 AWG cables) applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	600 µA
	1 to 3	610 µA
	2 to 3	620 µA
	1 to Tray	580 µA
	2 to Tray	580 µA
	3 to Tray	580 µA
7/C - 12 AWG	1 to 4	1080 µA
	1 to Conduit or Tray	540 µA
	4 to Conduit or Tray	590 µA

Tested By: [signature] Date: 9/13/85
Witness: [signature] Date:
Sheet No. 3 of 4
Approved: [signature] 9/13/85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster — WYLE LABORATORIES
Specimen Cables
Part No. Various — Amb. Temp. 69°F — Job No. 47906
Spec. WLTP 47906-01 — Photo Yes — Report No. 47906-02
Para. 3.5.4 — Test Med. Air — Start Date 9-13-85
S/N N/A — Specimen Temp. Ambient
GSI No

Test Title Configuration No. 4 Test No. 1
(Pre-test) ~~Post-test~~ Functional Test

High Potential Test (Continued)		
Cable	Test Points	Reading
1 ~~8~~ T.P. 16 AWG	1 to 2.	700 μA
	3 to 4 NA	
	5 to 6 NA	
	7 to 8 NA	
	9 to 10 NA	
	1 to Shield	330 μA
	2 to Shield	335 μA
	3 to Shield NA	
	4 to Shield NA	
	5 to Shield NA	
	6 to Shield NA	
	7 to Shield NA	
	8 to Shield NA	
	9 to Shield NA	
	10 to Shield NA	

Tested By [signature] Date: 9/13/85
Witness None Date:
Sheet No. 4 of 4
Approved [signature] 9/13/85

Notice of Anomaly None

DATA SHEET

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.5
S/N: N/A
GSI: No

Amb. Temp.: 69°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

WYLE LABORATORIES
Job No.: 47906
Report No.: 47906-02
Start Date: 9/13/85

Test Title: Configuration No. 4 Test No. 1 Overcurrent Test

11. Readings with rated current on fault cable

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	575	576	569	40.7	41.1	40.4
7/C - 12 AWG	120.0			10.5		
1 ~~8~~ T.P. 16 AWG	50.1			1.08		

Fault Cable: 2/0 AWG TRIPLEX
Rated Current: 139 A
Measured Current: 139A

Tested By: [signature] Date: 9/13/85
Witness: [signature] Date:
Sheet No. 1 of 5
Approved: [signature] 9/13/85

Notice of Anomaly: ~~None~~ No. 4

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.5
S/N: N/A
GSI: No

Amb. Temp.: 69°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/13/85

Test Title: Configuration No. 4 Test No. 1 Overcurrent Test

12. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP/CHANNEL
280A	3520	190°F/8

14. Readings after fault cable warmup to 189°F - 199°F

Fault Cable Current:	280A	
Conductor temperature:	195°F	Channel No. 8
Max.temp of Channels 1-6	175°F Channel 4	

Tested By [signature] Date: 9/13/85
Witness [signature] Date:
Sheet No. 2 of 5
Approved [signature] 9/13/85

Notice of Anomaly No 4

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.5
S/N: N/A
GSI: No

Amb. Temp.: 74°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/13/85

Test Title: Configuration No. 4 Test No. 1 Overcurrent Test

16. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	571	573	568	37.0	49.9 (circled)	44.7 (circled)
7/C - 12 AWG	120.4			10.6		
1.5 T.P. 16 AWG	50.3			1.0		

Fault Cable: 2/0 AWG TRIPLEX
Rated Current: 908A
Measured Current: 908A

Tested By: [signature] Date: 9/13/85
Witness: [signature] Date:
Sheet No. 3 of 5
Approved: [signature] 9/13/85

Notice of Anomaly: No. 4

DATA SHEET

Customer: Stone & Webster
Specimen: Cables
WYLE LABORATORIES

Part No.	Various	Amb. Temp.	74°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.5.5	Test Med.	Air	Start Date	9-13-85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title: Configuration No. 4 Test No. 1 Overcurrent Test

19. Open circuit on fault cable:			
Elapsed time:	1322 sec		
Maximum fault cable temperature:	1820° F	Channel No.	5
20. Stabilized temperature on fault cable:			
Elapsed time (beginning of 15-minute period):	N/A		
Maximum fault cable temperature:	N/A	Channel No.	N/A
Fault Cable Current:	N/A		
21. Ignition of fault cable:			
Elapsed time:	650 sec		
Maximum fault cable temperature:	1820° F	Channel No.	5
Fault cable current:	908 A		

Tested By: [signature] Date: 9/13/85
Witness: [signature] Date:
Sheet No. 4 of 5
Approved: [signature] 9/13/85

Notice of Anomaly: No. 4

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.5.5
S/N: N/A
GSI: No

Amb. Temp.: 74° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/13/85

Test Title: Configuration No. 4 Test No. 1 Overcurrent Test

22. Readings after ~~let through~~ test current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
2 AWG Triplex	571	574	568	42.3	42.3	39.9
7/C - 12 AWG	120.4			10.5		
1 ~~8~~ T.P. 16 AWG	50.2			1.1		

Tested By: [signature] Date: 9/13/85
Witness: [signature] Date:
Sheet No. 5 of 5
Approved: [signature] 9/13/85

Notice of Anomaly: No. 4

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No. Various Amb. Temp. 74°F Job No. 47906

Spec. WLTP 47906-01 Photo Yes Report No. 47906-02

Para. 3.5.6 Test Med. Air Start Date 9/13/85

S/N N/A Specimen Temp. Ambient

GSI No

Test Title Configuration No. 4 Test No. 1

~~Pre-test~~ Post-Test (circled) Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC (500 for ~~8~~ T.P. 16 AWG) applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	1.2×10^{11}
	1 to 3	1.4×10^{11}
	2 to 3	7.8×10^{10}
	1 to Unistrut or Tray	1.3×10^{11}
	2 to Unistrut or Tray	1.2×10^{11}
	3 to Unistrut or Tray	1.2×10^{11}
7/C - 12 AWG	1 to 4	~~1.3~~ 1.6 $\times 10^{11}$
	1 to Tray or Conduit	1.3×10^{11}
	4 to Tray or Conduit	9.0×10^{10}

Tested By [signature] Date: 9/13/85

Witness [signature] Date:

Sheet No. 1 of 4

Approved [signature] 9/13/85

Notice of Anomaly None

Wyle Form WH 614A Rev APR '80

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.6
S/N N/A
GSI No

Amb. Temp. 74°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9/13/85

Test Title Configuration No. 4 Test No. 1
~~Pre-test OK~~ (Post-test) Functional Test

Insulation Resistance Test (Continued)

Cable	Test Points	Reading
1 ~~8~~ JMK T. P. 16 AWG	1 to 2	4.5 x10¹¹
	3 to 4 NA JMK	
	5 to 6 NA JMK	
	7 to 8 NA JMK	
	9 to 10 NA JMK	
	1 to Shield	3.5 x10¹¹
	2 to Shield	5.0 x10¹⁰
	3 to Shield NA JMK	
	4 to Shield NA JMK	
	5 to Shield NA JMK	
	6 to Shield NA JMK	
	7 to Shield NA JMK	
	8 to Shield NA JMK	
	9 to Shield NA JMK	
	10 to Shield NA JMK	

Tested By E Thomas II Date: 9/13/85
Witness None Date:
Sheet No. 2 of 4
Approved J King 9/13/85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.6
S/N N/A
GSI No

Amb. Temp. 74°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9/13/85

Test Title Configuration No. 4 Test No. 1

~~Pre-test~~ Post-test (circled) Functional Test

High Potential Test		
Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for ~~8~~ 1pr T.P. 16 AWG cables) applied for one minute.		
Cable	**Test Points**	**Reading**
2 AWG Triplex	1 to 2	730 μA
	1 to 3	730 μA
	2 to 3	780 μA
	1 to Tray	1150 μA
	2 to Tray	1200 μA
	3 to Tray	1200 μA
7/C - 12 AWG	1 to 4	1980 μA
	1 to Conduit or Tray	590 μA
	4 to Conduit or Tray	620 μA

Notice of Anomaly None

Tested By [signature] Romanoff Date: 9/13/85
Witness None Date:
Sheet No. 3 of 4
Approved [signature] 9/13/85

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.5.6
S/N N/A
GSI No

Amb. Temp. 74°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9/13/85

Test Title Configuration No. 4 Test No. 1
~~Pre-test~~ Post-test (circled) Functional Test

High Potential Test (Continued)

Cable	Test Points	Reading
1/8 T.P. 15 AWG	1 to 2	700 μA
	3 to 4 NA	
	5 to 6 NA	
	7 to 8 NA	
	9 to 10 NA	
	1 to Shield	1380 μA
	2 to Shield	1420 μA
	3 to Shield NA	
	4 to Shield NA	
	5 to Shield NA	
	6 to Shield NA	
	7 to Shield NA	
	8 to Shield NA	
	9 to Shield NA	
	10 to Shield NA	

Tested By [signature] Date: 9/13/85
Witness [signature] Date:
Sheet No. 4 of 4
Approved [signature] 9/13/85

Notice of Anomaly None

CONFIGURATION NO. 5 TESTS
(Conduit to Conduit and Cable in Free Air Separation)

[illegible]

SECTION VI

CONFIGURATION NUMBER 5 TESTS
(CONDUIT TO CONDUIT AND FREE AIR SEPARATION)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

1.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6 x 10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds.

1.1.2 High Potential Test

There shall be no evidence of insulation breakdown or. flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute.

1.1.3 Cable Continuity Test

Energized specimens in the target raceway shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current
1/0 AWG	Triplex	NJM-34	L	575	139
2 AWG	Triplex	NJM-25	K	575	38.5
12 AWG	7	NJN-37	C	120	10
16 AWG	2/C	NJP-05	X	50	1

1.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, 0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance.

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

---

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

2.0 PROCEDURES

2.1 Test Specimen Preparation

The test specimens were mounted into the test assembly of Figure 10 of Section VIII. This apparatus was manufactured to the indicated dimensions by Wyle technicians using materials supplied by NMP2. The following guidelines were observed with regard to the materials and construction of the assembly:

1. The fault cable was a Triplex 2/0 AWG cable from NMP2 stock and mounted in Location 3 of Figure 10 of Section VIII for all three tests.

2. The ends of the faulted cable were wrapped from their termination on the copper bus bar to the edge of the test assembly. This wrap consisted of a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape. This wrapping was done to ensure that any ignition that might occur was contained to the cable tray test area.

3. A Triplex 2 AWG target power cable from NMP2 stock was mounted in Location 2 of Figure 10 of Section VIII for all three tests.

4. A 7/C 12 AWG target control cable from NMP2 stock was mounted in Location 1 of Figure 10 of Section VIII for all three tests.

5. The conduits and free air cable were orientated as described below:

Test No.	Location 1	Location 2	Location 3
1	3-Inch Anaconda Flexible Conduit	4-Inch Rigid Conduit	Free Air Cable
2	Free Air Cable	3-Inch BOA Flexible Conduit	4-Inch Rigid Conduit
3	4-Inch Rigid Conduit	Free Air Cable	3-Inch Anaconda Flexible Conduit

6. The conduits and cable were mounted within 1/4-inch of each other (but not in contact) for all three tests.

7. Photographs were taken of the test setup prior to each test.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup

2.2.1 Thermocouple Locations

A total of 24 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples were mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket of the target cable in Location 1. These thermocouples were mounted approximately 16 inches apart.
15-20	Mounted to the jacket of the target cable in Location 2. These thermocouples were mounted approximately 16 inches apart.
21 & 22	Mounted to the outside of the flexible conduit on the side towards the rigid conduit.
23 & 24	Mounted to the outside of the rigid conduit on the side towards the flexible conduit.

The thermocouples were monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger was operated at its maximum scan rate throughout the overcurrent test.

2.2.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current were fed into oscillograph recorders. The oscillograph was operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels were as specified in the following table.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup (Continued)

2.2.2 Electrical Monitoring (Continued)

Channel No.	Signal	Cable
1	Current	7/C 12 AWG Target Cable
2	Voltage	7/C 12 AWG Target Cable
3	Current-Phase A	Triplex 2 AWG Target Cable
4	Current-Phase B	Triplex 2 AWG Target Cable
5	Current-Phase C	Triplex 2 AWG Target Cable
6	Voltage A-B	Triplex 2 AWG Target Cable
7	Voltage A-C	Triplex 2 AWG Target Cable
8	Voltage B-C	Triplex 2 AWG Target Cable
9 & 10	Skipped	N/A
11	Current	Fault Cable
12	Skipped	N/A

A digital multimeter was utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data was recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC (120 VAC for control cables) throughout the overcurrent test.

2.3 Baseline Functional Tests

The baseline functional tests consisted of insulation resistance and high potential measurements on each of the target cables. These tests were performed as specified in the following paragraphs.

2.3.1 Insulation Resistance Test

1. All power and instrumentation leads were disconnected from the target cables and labeled per Figure 12 or 13 of Section VIII.

2. Using a megohmmeter, a potential of 1000 VDC was applied and the minimum insulation resistance indicated after a period of 60 seconds was recorded between the following test points.

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests (Continued)

2.3.1 Insulation Resistance Test (Continued)

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or conduit
1 to 3	2 to unistrut or conduit
2 to 3	3 to unistrut or conduit

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit or unistrut
	4 to conduit or unistrut

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.3.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC was applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or conduit
1 to 3	2 to unistrut or conduit
2 to 3	3 to unistrut or conduit

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit or unistrut
	4 to conduit or unistrut

2. All power and instrumentation leads were reconnected per Figure 12 or 13 of Section VIII.

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.2.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test

The overcurrent test was conducted in three sequential steps with no intentional time delay. The first phase consisted of energizing the fault cable with SWEC rated current. The second phase consisted of increasing the current until fault cable temperatures were within 189°–199°F for 5 minutes. The third phase consisted of energizing the fault cable with the worst case electrical fault current until the cable open-circuited.

The target control cables conducted SWEC-rated current (see Paragraph 1.1.3) at 575 VAC (power cables) or 120 VAC (control cables) throughout the overcurrent test. The overcurrent test was conducted using the following procedure:

1. The Triplex 2/0 AWG fault cable was connected to the copper bus bars per Figure 11 of Section VIII.
2. A 7/C 12 AWG target cable was installed per Figure 10 of Section VIII.
3. A Triplex 2 AWG target cable was installed per Figure 10 of Section VIII.
4. The Triplex 2 AWG target cable was connected to the instrumentation and power supplies of Figure 12 of Section VIII.
5. The 7/C 12 AWG target cables were connected to the instrumentation and power supplies of Figure 13 of Section VIII.
6. The Triplex 2 AWG target cable was energized with 34 amperes at 575 VAC.
7. The 7/C 12 AWG target cable was energized with 10 amperes at 120 VAC.
8. The Triplex 2/0 AWG fault cable was energized with 139 amperes per phase (rated current) from the Multi-Amp Test Set.
9. Target cable voltages and currents and the fault cable current were recorded.
10. The fault cable current was slowly increased until Thermocouple Channels 7 and/or 8 indicates 90 $\pm$3°C (189–199°F) conductor temperature.
11. The conductor temperature was maintained at 189–199°F for five minutes.
12. Fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6 were recorded.
13. The Multi-Amp Test Set output was increased to 908 amperes (test current).
14. Target cable voltages, currents and the fault cable current were recorded.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

15. The fault cable was allowed to conduct test current until the cable open-circuited.

16. The elapsed time and maximum cable temperature were recorded.

17. The target cable voltages and currents were recorded.

18. The target cables and the Multi-Amp Test Set were de-energized.

19. Photographs were taken of the post-test condition.

For all performances of this test, the observed target cable operation was compared to the acceptance criteria, Paragraph 1.1.3.

2.5 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 2.3 were repeated.

3.0 RESULTS

3.1 Results of Test No. 1

Configuration Number 5, Test No. 1, with a Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1343 seconds (22.4 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1709°F which occurred on Thermocouple No. 5. The fault cable ignited after 652 seconds (10.9 minutes). The fire burned for approximately 14 minutes.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable) or 120 VAC (control cable) were not impaired during this test. The maximum observed target cable temperature was 585°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix I contains the following data from this test:

1. Notices of Anomaly Number 4 and 5.
2. Photographs VI-1 through VI-6 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure VI-1 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

3.0 RESULTS (Continued)

3.2 Results of Test No. 2

Configuration Number 5, Test No. 2, with a Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1135 seconds (18.9 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1392°F which occurred on Thermocouple No. 2. The fault cable did not ignite.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable) or 120 VAC (control cable) were not impaired during this test. The maximum observed target cable temperature was 318°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix II contains the following data from this test:

1. Notices of Anomaly applicable to this section are contained in Appendix I.

2. Photographs VI-7 through VI-8 which show pretest and post-test conditions.

3. A narrative of the test which relates test time, fault cable temperatures, and important events.

4. Figure VI-2 which plots the temperature readings versus time.

5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

3.0 RESULTS (Continued)

3.3 Results of Test No. 3

Configuration Number 5, Test No. 3, with a Triplex 2/0 AWG fault cable in free air, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The 908 amperes test current was applied for 1202 seconds (20.0 minutes) until the cable open-circuited. The maximum observed temperature on the fault cable was 1759°F which occurred on Thermocouple No. 5. The fault cable did not ignite.

The capabilities of the target cable to conduct SWEC rated current at 575 VAC (power cable), 120 VAC (control cable), or 50 VAC (instrument cable) were not impaired during this test. The maximum observed target cable temperature was 248°F. All target cables successfully completed the Post-Overcurrent Test Functional Test.

Appendix III contains the following data from this test:

1. Notices of Anomaly applicable to this section are contained in Appendix I.
2. Photographs VI-9 through VI-10 which show pretest and post-test conditions.
3. A narrative of the test which relates test time, fault cable temperatures, and important events.
4. Figure VI-3 which plots the temperature readings versus time.
5. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

APPENDIX I

CONFIGURATION NUMBER 5, TEST NO. 1, DATA

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: September 16, 1985

NOTICE NO: 4 P.O. NUMBER: NMP2-E0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: Ranjit Das NOTIFICATION DATE: 9/13, 9/16, 9/17/85

NOTIFICATION MADE BY: John King VIA: Verbal

CATEGORY: ☐ SPECIMEN ☐ PROCEDURE ☒ TEST EQUIPMENT DATE OF ANOMALY: 9/13/85

PART NAME: Electrical Power Cable PART NO. N/A

TEST: Config. 4, Test 1; Config. 5, Tests 1,2,3 I.D. NO. N/A

SPECIFICATION: WLTP 47906-01 PARA. NO. 3.6.5, 3.7.5

Requirements:

1. The target cables shall conduct SWEC rated current (see Paragraph 2.1.3) at 575 VAC (power cables) throughout the overcurrent test.
2. All target cable currents shall be maintained within a ±10% tolerance (per NOA2).

Description of Anomaly:

During Configuration 4, Test 1 and Configuration 5, Tests 1, 2 and 3, some of the phase currents on the No. 2 AWG cable were above the +10% tolerance by as much as 8.4 amperes, while test current was flowing in the worst case cable. During Configuration 5, Test 3, one of the phase currents was below the -10% tolerance by 12.3 amperes while the other two phase currents were above the +10% tolerance by 8.4 amperes and 6.7 amperes, respectively.

Disposition - Comments - Recommendations:

The out of tolerance currents were judged to have no impact on the test for the following reasons.

1. Current above the tolerance results in additional conductor heating and therefore higher cable temperatures which is a more severe condition than required.
2. In the case where one of the phase currents was below the -10% tolerance the resulting lower conductor heating is compensated for by the additional heating in the other two phases.
3. Heating due to rated current of 38.5 amperes is very low. Screening Test No. 5 of the No. 2 AWG cable showed no change in temperature of the cable conductor or jacket after 10 minutes of rated current.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ______ PROJECT ENGINEER: John P. King 9/19/85

REPRESENTING: ______ PROJECT MANAGER: [signature] 9/20/85

INTERDEPARTMENTAL COORDINATION: K Taylor 9-20-85

QUALITY ASSURANCE: G.W. Knight 9/20/85

WYLE LABORATORIES (Eastern Operations)

NOTICE OF ANOMALY

DATE: 9/26/85

NOTICE NO: 5 P.O. NUMBER: NMP2-E-0907 CONTRACT NO: N/A

CUSTOMER: Stone & Webster WYLE JOB NO: 47906

NOTIFICATION MADE TO: R. Das NOTIFICATION DATE: 9/27/85

NOTIFICATION MADE BY: J. King VIA: Telephone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/9, 9/12, 9/17/85

PART NAME: Electrical Cable PART NO. N/A

TEST: Config. 2, Test 1; Config. 3, Test 2; Config. 5, Tests 2 and 3 I.D. NO. N/A

SPECIFICATION: WLTP 47906 PARA. NO. 3.4.5, 3.5.5, 3.7.5

REQUIREMENTS:

1. Slowly increase fault cable current until thermocouple channels 7 and/or 8 indicate 90 ±3°C (189°F-199°F) conductor temperature.
2. Maintain the conductor temperature at 189°F-199°F for five minutes.

DESCRIPTION OF ANOMALY:

The thermocouple channels 1-6 on the cable jacket were used instead of channels 7 and/or 8.

DISPOSITION · COMMENTS · RECOMMENDATIONS:

The anomaly was judged to have no impact on the test for the following reasons.

1. During warmup of the cable, the conductor temperature would have to be higher than the temperature of the adjacent jacket.
2. The conductor thermocouple can indicate a lower temperature than the jacket thermocouples because of differences in mounting and location.
3. The heat transferred from the fault cable to the target cables during warmup to, and maintenance at, 189°F-199°F is very small compared to the heat transferred during burning of the fault cable, which occurred in every test.

NOTE: IT IS THE CUSTOMER'S RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21.

VERIFICATION:

TEST WITNESS: ______

REPRESENTING: ______

QUALITY ASSURANCE: G.W. Hight 10/2/85

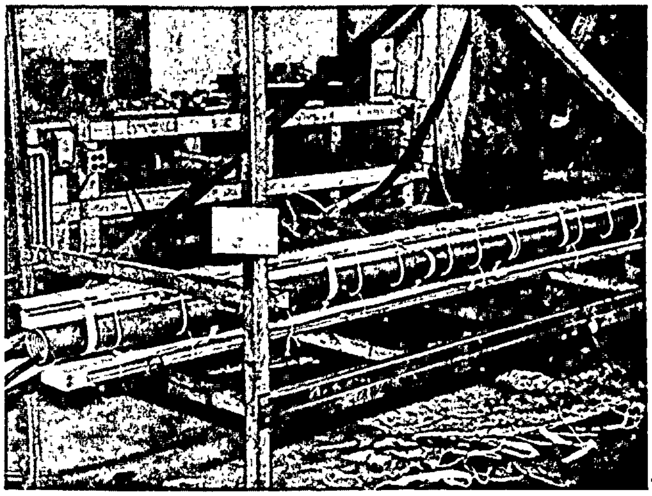
PROJECT ENGINEER: J. P. King 9/27/85

PROJECT MANAGER: [signature] 9/30/85

INTERDEPARTMENTAL COORDINATION: ______

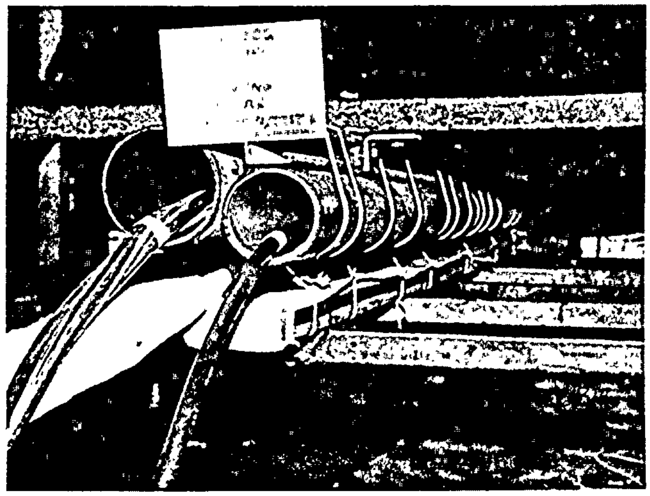
Wyle Form WH 1066, Rev. JAN '85

CONFIGURATION NUMBER 5, TEST NO. 1



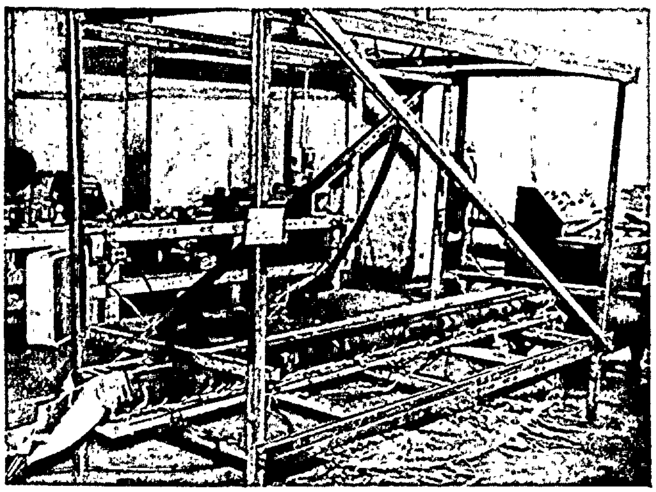
PHOTOGRAPH VI-1

PRETEST VIEW — OVERALL



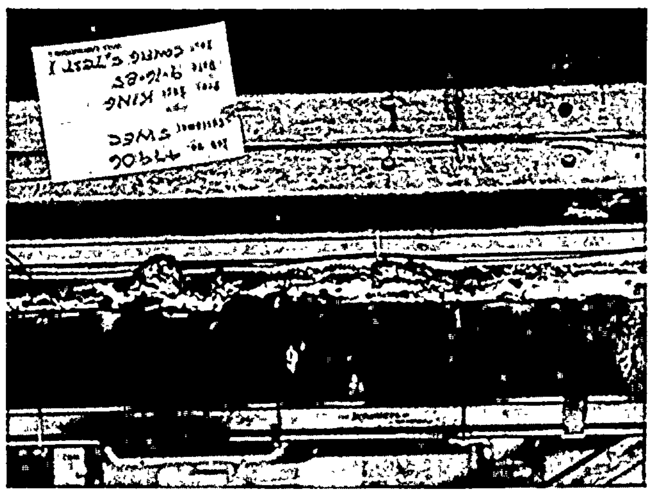
PHOTOGRAPH VI-2

PRETEST VIEW — CLOSE-UP



PHOTOGRAPH VI-3

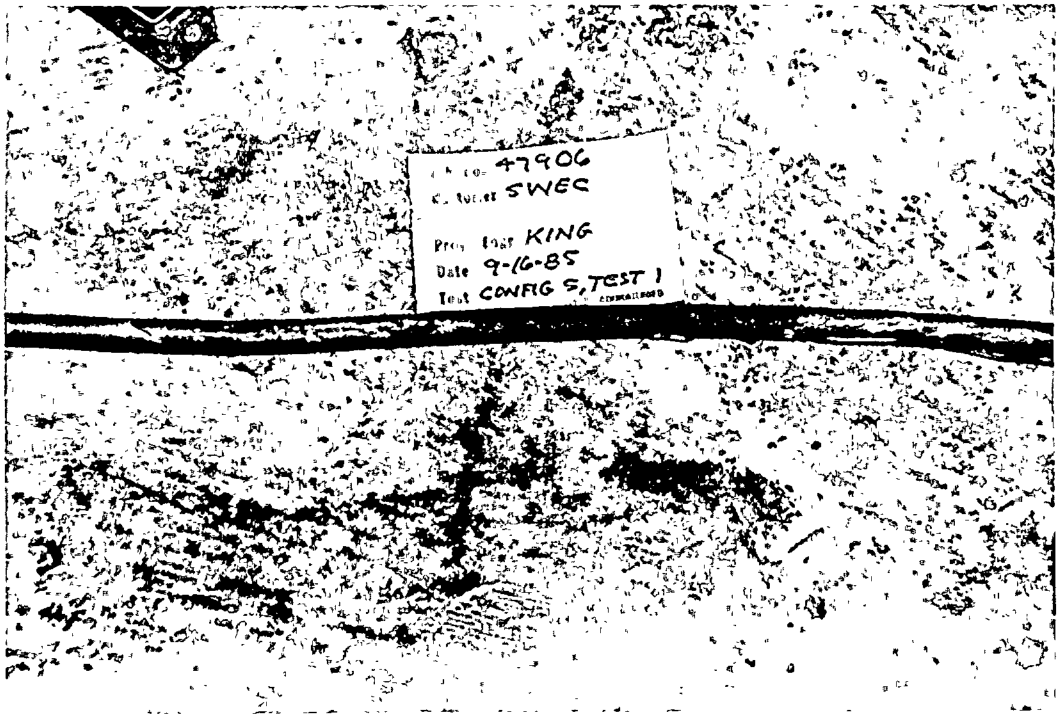
POST-TEST VIEW — OVERALL



PHOTOGRAPH VI-4

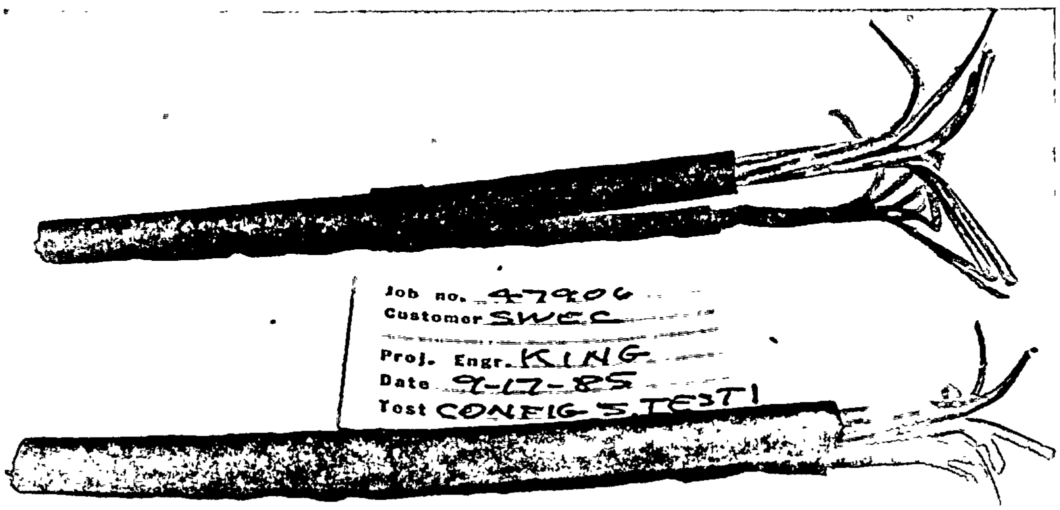
POST-TEST VIEW — CLOSE-UP OF 3-INCH ANACONDA FLEXIBLE CONDUIT

CONFIGURATION NUMBER 5, TEST NO. 1



PHOTOGRAPH VI-5

POST-TEST VIEW — 7/C 12 AWG TARGET CABLE AFTER REMOVAL FROM 3-INCH ANACONDA FLEXIBLE CONDUIT



PHOTOGRAPH VI-6

POST-TEST VIEW — 7/C 12 AWG TARGET CABLE WITH CABLE JACKET REMOVED TO SHOW INDIVIDUAL CONDUCTORS

CONFIGURATION NUMBER 5, TEST NO. 1

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	70°F	Energized fault cable with 139A
10 Min	78°F	Energized fault cable with 270A
65 Min	166°F	Energized fault cable with 280A
87.3 Min	184°F	Fault cable conductor reached 189°F
92.3 Min	187°F	Energized fault cable with 908A
96.4 Min	370°F	Smoke visible
99.7 Min	585°F	Fault cable jacket rupturing
103.2 Min	850°F	Ignition of fault cable
114.7 Min	1709°F	Open circuit
117.2 Min	1435°F	Fire out

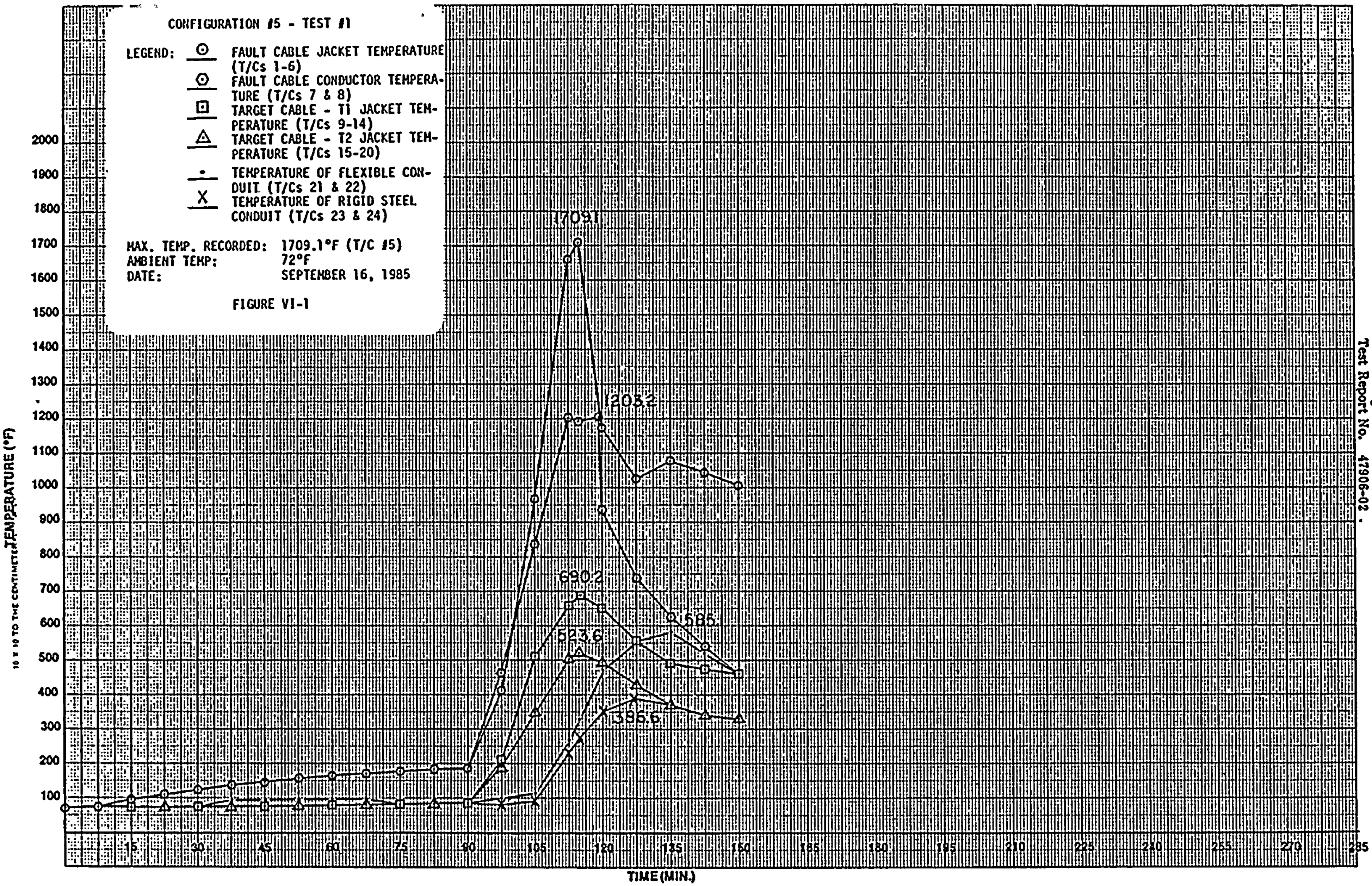

CONFIGURATION #5 - TEST #1
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/Cs 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/Cs 7 & 8)
TARGET CABLE - T1 JACKET TEMPERATURE (T/Cs 9-14)
TARGET CABLE - T2 JACKET TEMPERATURE (T/Cs 15-20)
TEMPERATURE OF FLEXIBLE CONDUIT (T/Cs 21 & 22)
X TEMPERATURE OF RIGID STEEL CONDUIT (T/Cs 23 & 24)
MAX. TEMP. RECORDED: 1709.1°F (T/C #5)
AMBIENT TEMP: 72°F
DATE: SEPTEMBER 16, 1985
1709.1
1203.2
690.2
585
523.6
386.6
TEMPERATURE (°F)
TIME (MIN.)
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285

FIGURE VI-1

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.7.4
S/N N/A
GSI No

Amb. Temp. 72°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9/16/85

Test Title Configuration No. 5 Test No. 1

(Pre-test) ~~Post-test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 meghoms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	1.5 x 10¹¹ Ω
	1 to 3	2.0 x 10¹¹ Ω
	2 to 3	1.9 x 10¹¹ Ω
	1 to Unistrut or Conduit	1.5 x 10¹¹ Ω
	2 to Unistrut or Conduit	2.6 x 10¹¹ Ω
	3 to Unistrut or Conduit	1.7 x 10¹¹ Ω
7/C - 12 AWG	1 to 4	2.6 x 10¹¹ Ω
	1 to Unistrut or Conduit	2.6 x 10¹¹ Ω
	4 to Unistrut or Conduit	1.8 x 10¹¹ Ω

Tested By [signature] Date: 9/16/85
Witness [signature] Date:
Sheet No. 1 of 2
Approved J. King 9/16/85

Notice of Anomaly None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.4
S/N: N/A
GSI: No

Amb. Temp.: 72° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-16-85

Test Title: Configuration No. 5 Test No. 1
(Pre-test) ~~Post-test~~ BA Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	750 μA
	1 to 3	720 μA
	1 to Unistrut or Conduit	840 μA
	2 to Unistrut or Conduit	880 μA
	3 to Unistrut or Conduit	880 μA
	2 to 3	760 μA
7/C - 12 AWG	1 to 4	1600 μA
	1 to Unistrut or Conduit	650 μA
	4 to Unistrut or Conduit	720 μA

Tested By: [signature] Date: 9/16/85
Witness: None Date:
Sheet No. 2 of 2
Approved: J. King 9/16/85

Notice of Anomaly: None

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.7.5
S/N N/A
GSI No

Amb. Temp. 72°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9-16-85

Test Title Configuration No. 5 Test No. 1 Overcurrent Test

9. Readings with rated current on fault cable

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
2 AWG Triplex	578	578	572	39.0	42.4	39.3
7/C -12 AWG	120.9			10.6		

Fault Cable: 2/0 AWG TRIPLEX
Rated Current: 139 A
Measured Current: 139A

Tested By [signature] Date: 9/16/85
Witness [signature] Date:
Sheet No. 1 of 4
Approved [signature] 9/16/85

Notice of Anomaly ~~None~~ No. 4

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.5
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/16/85

Test Title: Configuration No. 5 Test No. 1 Overcurrent Test

10. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	~~CONDUCTOR~~ CABLE TEMP/CHANNEL
270A	3300 sec	171F/57
280A	1340 sec	189°F/7

12. Readings after fault cable warmup to 189°F - 199°F

Fault Cable Current: 908A
Conductor temperature: 191°F Channel No. 7
Max temp of Channels 1-6: 187°F channel 5

Tested By: [signature] Date: 9/16/85
Witness: [signature] Date:
Sheet No. 2 of 4
Approved: John P. King 9/19/85

Notice of Anomaly: ~~None~~ No. 4

Wyle Form WH 614A Rev APR 81

DATA SHEET

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.5
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

WYLE LABORATORIES
Job No.: 47906
Report No.: 47906-02
Start Date: 9/16/85

Test Title: Configuration No. 5 Test No. 1 Overcurrent Test

14. Initial readings with test current on fault cab è:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
2 AWG Triplex	576	574	569	37.6	50.8	49.1
7/C - 12 AWG	120.2			10.6		

Fault Cable: 2/0 AWG TRIPLEX

Test ~~Rated~~ Current: 908A

Measured Current: 908A

Tested By: [signature] Date: 9/16/85
Witness: [signature] Date:
Sheet No. 3 of 4
Approved: [signature] 9/17/85

Notice of Anomaly: No. 4

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.5
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/6/85

Test Title: Configuration No. 5 Test No. 1 Overcurrent Test

16. Open circuit on fault cable:

Elapsed time: 1343 sec

Maximum fault cable temperature: 1709°F Channel 5

17. Stablized temperature on fault cable:

Elapsed time (beginning of 15-minute period): N/A

Maximum fault cable temperature: N/A

Fault cable current: N/A

18. Ignition of fault cable:

Elapsed time: ~~1343~~ 652 sec JPK

Maximum fault cable temperature: 1709°F

Fault cable current: 908 A

20. Readings after ~~let-through~~ test JPK current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
2 AWG Triplex	575	~~570~~ 575	570	42.3	42.8	41.9
7/C - 12 AWG	119.7			10.2		

Tested By: [signature] Date: 9/6/85
Witness: [signature] Date:
Sheet No. 4 of 4
Approved: JPKing 9/19/85

Notice of Anomaly: No. 4

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.6
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/16/85

Test Title: Configuration No. 5 Test No. 1

~~Pre-test~~ Post-test (circled) Functional Test

Insulation Resistance Test		
Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 meghoms with a potential of 1000 VDC applied for 60 seconds.		
Cable	Test Points	Reading
2 AWG Triplex	1 to 2	$2.8 \times 10^{10}\,\Omega$
	1 to 3	$3.5 \times 10^{10}\,\Omega$
	2 to 3	$3.0 \times 10^{10}\,\Omega$
	1 to Unistrut or Conduit	$4.5 \times 10^{10}\,\Omega$
	2 to Unistrut or Conduit	$4.0 \times 10^{10}\,\Omega$
	3 to Unistrut or Conduit	$4.5 \times 10^{10}\,\Omega$
7/C - 12 AWG	1 to 4	$2.2 \times 10^{7}\,\Omega$
	1 to Unistrut or Conduit	$4.0 \times 10^{7}\,\Omega$
	4 to Unistrut or Conduit	$4.0 \times 10^{7}\,\Omega$

Tested By: [signature] Date: 9/16/85
Witness: None Date:
Sheet No. 1 of 2
Approved: J. King 9/17/85

Notice of Anomaly: None

DATA SHEET

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.6
S/N: N/A
GSI: No

Amb. Temp.: 72°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

WYLE LABORATORIES
Job No.: 47906
Report No.: 47906-02
Start Date: 9/16/85

Test Title: Configuration No. 5 Test No. 1
~~Pre-test~~ (Post-test) Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	710 µA
	1 to 3	700 µA
	1 to Unistrut or Conduit	820 µA
	2 to Unistrut or Conduit	850 µA
	3 to Unistrut or Conduit	870 µA
	2 to 3	720 µA
7/C - 12 AWG	1 to 4	2090 µA
	1 to Unistrut or Conduit	780 µA
	4 to Unistrut or Conduit	820 µA

Notice of Anomaly: None

Tested By: [signature] Date: 9/16/85
Witness: None Date:
Sheet No. 2 of 2
Approved: J. King 9/17/85

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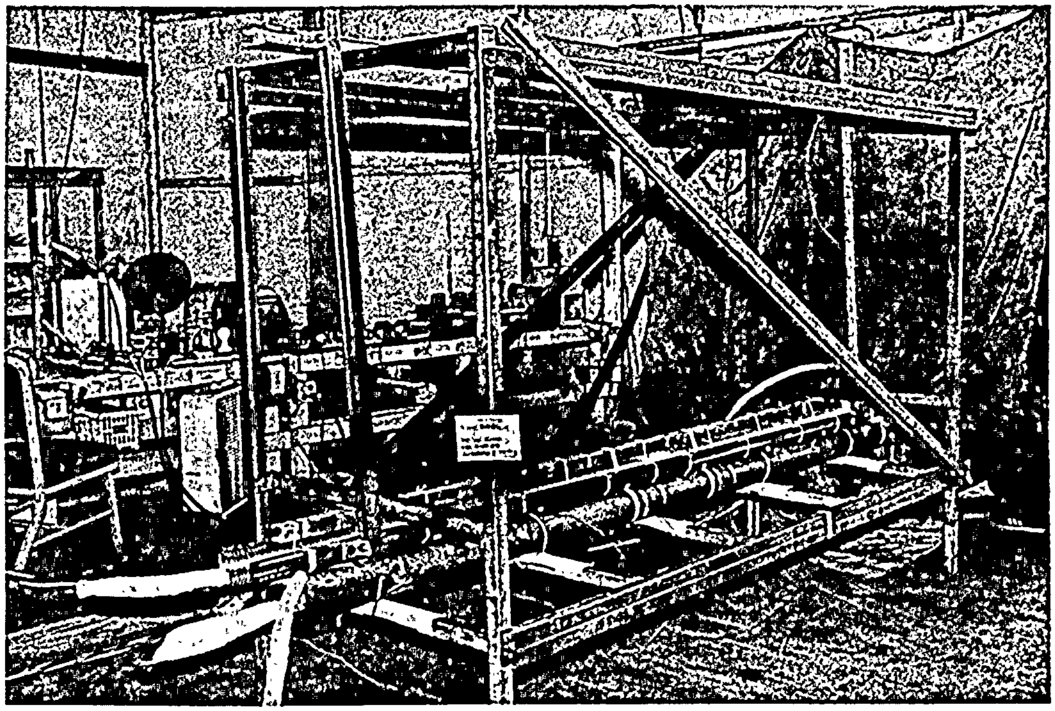
APPENDIX II

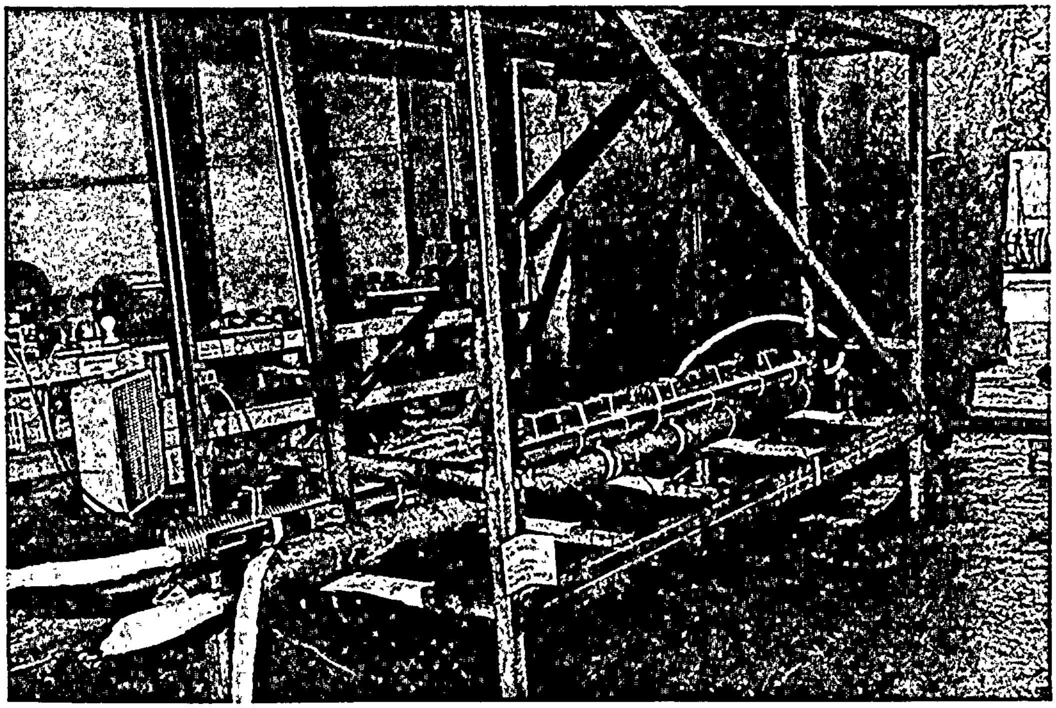
CONFIGURATION NUMBER 5, TEST NO. 2, DATA

CONFIGURATION NUMBER 5, TEST NO. 2



PHOTOGRAPH VI-7

PRETEST VIEW — OVERALL



PHOTOGRAPH VI-8

POST-TEST VIEW — OVERALL

CONFIGURATION NUMBER 5, TEST NO. 2

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	77°F	Energized fault cable with 139A
10 Min	85°F	Energized fault cable with 270A
55.5 Min	190°F	Fault cable conductor reached 190°F
60.5 Min	197°F	Energized fault cable with 908A
64.3 Min	380°F	Smoke visible
67.4 Min	515°F	Fault cable jacket rupturing
79.4 Min	1389°F	Open circuit

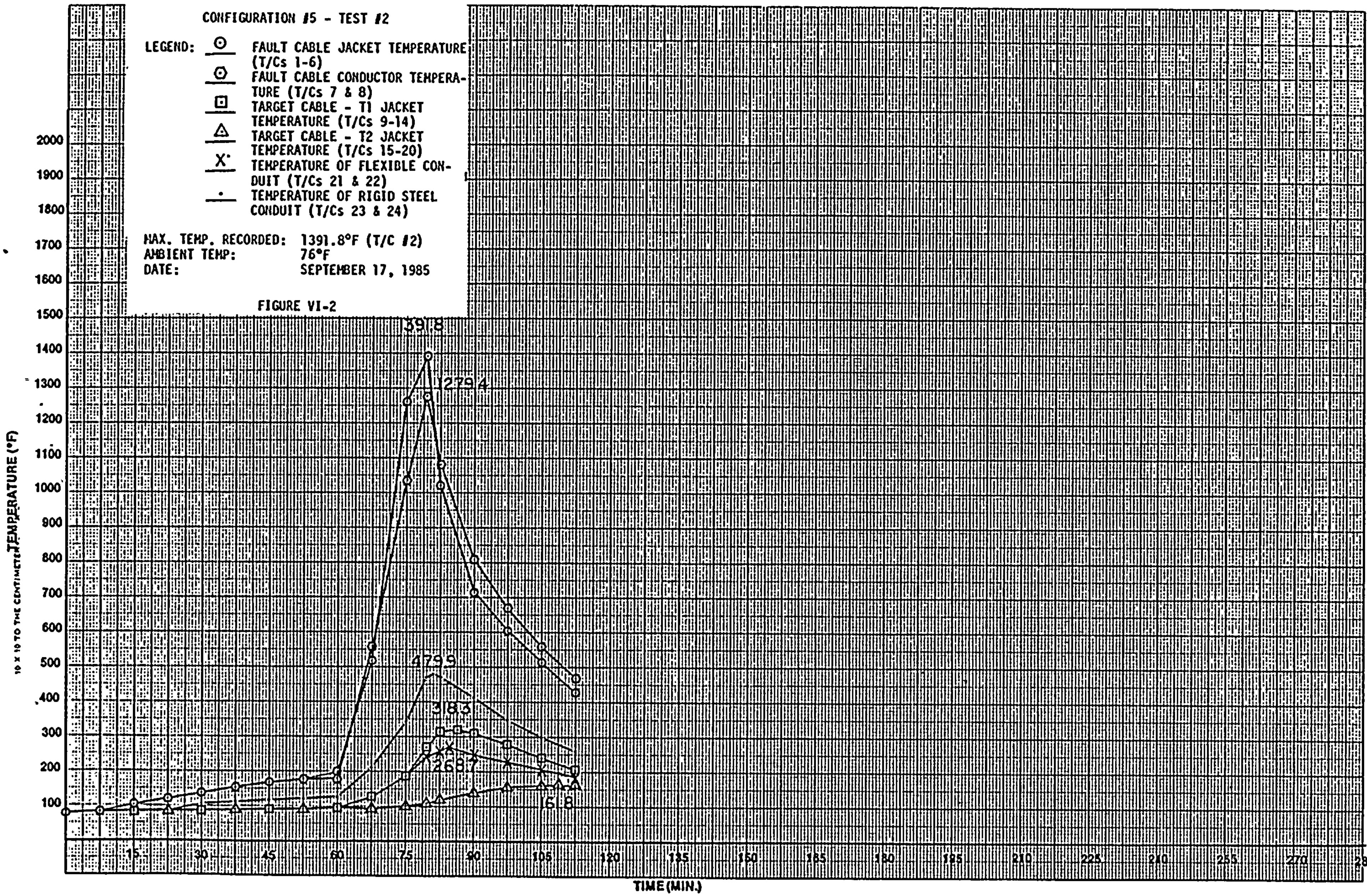

CONFIGURATION #5 - TEST #2
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/Cs 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/Cs 7 & 8)
TARGET CABLE - T1 JACKET TEMPERATURE (T/Cs 9-14)
TARGET CABLE - T2 JACKET TEMPERATURE (T/Cs 15-20)
TEMPERATURE OF FLEXIBLE CONDUIT (T/Cs 21 & 22)
TEMPERATURE OF RIGID STEEL CONDUIT (T/Cs 23 & 24)
MAX. TEMP. RECORDED: 1391.8°F (T/C #2)
AMBIENT TEMP: 76°F
DATE: SEPTEMBER 17, 1985
TEMPERATURE (°F)
TIME (MIN.)
1391.8
1279.4
479.9
318.3
268.7
161.8
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
240
255
270
285

FIGURE VI-2

DATA SHEET

Customer: Stone & Webster		WYLE LABORATORIES
Specimen: Cables		
Part No.: Various	Amb. Temp.: 76°F	Job No.: 47906
Spec.: WLTP 47906-01	Photo: Yes	Report No.: 47906-02
Para.: 3.7.4	Test Med.: Air	Start Date: 9/17/85
S/N: N/A	Specimen Temp.: Ambient	
GSI: No		

Test Title: Configuration No. 5 Test No. 2

Pre-test (circled) ~~Post-test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	$1.8 \times 10^{11}\ \Omega$
	1 to 3	$2.4 \times 10^{11}\ \Omega$
	2 to 3	$3.0 \times 10^{11}\ \Omega$
	1 to Unistrut or Conduit	$2.8 \times 10^{11}\ \Omega$
	2 to Unistrut or Conduit	$2.8 \times 10^{11}\ \Omega$
	3 to Unistrut or Conduit	$2.6 \times 10^{11}\ \Omega$
7/C - 12 AWG	1 to 4	$4.5 \times 10^{11}\ \Omega$
	1 to Unistrut or Conduit	$3.5 \times 10^{11}\ \Omega$
	4 to Unistrut of Conduit	$2.2 \times 10^{11}\ \Omega$

Tested By: [signature] Date: 9/17/85
Witness: None Date:
Sheet No. 1 of 2
Approved: [signature] 9/18/85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.7.4
S/N N/A
GSI No

Amb. Temp. 76°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9/17/85

Test Title Configuration No. 5 Test No. 2
Pre-test ~~Post-test~~ Functional test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	790 uA
	1 to 3	800 uA
	2 to 3	780 uA
	1 to Unistrut or Conduit	710 uA
	2 to Unistrut or Conduit	690 uA
	3 to Unistrut or Conduit	710 uA
7/C - 12 AWG	1 to 4	1550 uA
	1 to Unistrut or Conduit	650 uA
	4 to Unistrut or Conduit	710 uA

Tested By [signature] Date: 9/17/85
Witness None Date:
Sheet No. 2 of 2
Approved [signature] 9/18/85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster | WYLE LABORATORIES

Specimen Cables

Part No.	Various	Amb. Temp.	76°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.7.5	Test Med.	Air	Start Date	9/17/85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title Configuration No. 5 Test No. 2 Overcurrent Test

9. Readings with rated current on fault cable.

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	579	577	571	42.0	41.4	39.1
7/C - 12 AWG	120.[illegible]			10.6		

Fault Cable: 2/0 AWG TRIPLEX

Rated Current: 139A

Measured Current: 139A

Tested By [signature] Date: 9/17/85

Witness [signature] Date:

Sheet No. 1 of 4

Approved [signature] 9/18/85

Notice of Anomaly ~~None~~ No.4, No.5

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.:
S/N: N/A
GSI: No

Amb. Temp.: 76°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/17/85

Test Title: Configuration No. 5 Test No. 2 Overcurrent Test

10. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	CONDUCTOR TEMP/CHANNEL
270	2730	190°F/3

12. Readings after fault cable warmup to 189°F - 199°F

Fault Cable current: 270A
Conductor temperature: 198°F Channel No. 8
Max temp of Channels 1-6 197°F Channel 3

Tested By: [signature] Date: 9/17/85
Witness: [signature] Date:
Sheet No. 2 of 4
Approved: [signature] 9/17/85

Notice of Anomaly: ~~None~~ No. 4, No. 5

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.5
S/N: N/A
GSI: No

Amb. Temp.: 76°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/17/85

Test Title: Configuration No. 5 Test No. 2 Overcurrent Test

14. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	580	581	575	(48.7)	37.3	37.3
7/C - 12 AWG	120.2			10.5		

Fault Cable: 2/0 AWG TRIPLEX
~~Rated~~ Test Current: ~~439 A~~ 908A
Measured Current: ~~439 A~~ 908A

Tested By: [signature] Date: 9/17/85
Witness: None Date:
Sheet No. 3 of 4
Approved: [signature] 9/18/85

Notice of Anomaly: No. 4, No. 5

DATA SHEET

Customer Stone & Webster

Specimen Cables

WYLE LABORATORIES

Part No.	Various	Amb. Temp.	76°F	Job No.	47906
Spec.	WLTP 47906-01	Photo	Yes	Report No.	47906-02
Para.	3.7.5	Test Med.	Air	Start Date	9/17/85
S/N	N/A	Specimen Temp.	Ambient		
GSI	No				

Test Title Configuration No. 5 Test No. 2 Overcurrent Test

16.	Open circuit on fault cable:	3
	Elapsed time:	1135
	Maximum fault cable temperature:	1392°F Channel 2
17.	Stablized temperature on fault cable:	
	Elapsed time (beginning of 15-minute period):	N/A
	Maximum fault cable temperature:	N/A
	Fault cable current:	N/A
18.	Ignition of fault cable:	
	Elapsed time:	N/A
	Maximum fault cable temperature:	N/A
	Fault cable current:	N/A

20. Readings after ~~let-through~~ test JPK current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	B-C	A-C	Current (amps) Phase A	Phase B	Phase C
2 AWG Triplex	582	582	578	40.3	41.1	38.7
7/C - 12 AWG	120.1			10.4		

Tested By [signature] Date: 9/17/85
Witness None Date:
Sheet No. 4 of 4
Approved [signature] 9/18/85

Notice of Anomaly ~~None~~ No. 4, No. 5

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.7.6
S/N N/A
GSI No

Amb. Temp. 66°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 9/18/85

Test Title Configuration No. 5 Test No. 2

~~Pre-test~~ (Post-test) Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	$3.0 \times 10^{10}\ \Omega$
	1 to 3	$1.8 \times 10^{10}\ \Omega$
	2 to 3	$2.4 \times 10^{10}\ \Omega$
	1 to Unistrut or Conduit	$3.5 \times 10^{10}\ \Omega$
	2 to Unistrut or Conduit	$4.0 \times 10^{10}\ \Omega$
	3 to Unistrut or Conduit	$3.5 \times 10^{10}\ \Omega$
7/C - 12 AWG	1 to 4	$5.0 \times 10^{10}\ \Omega$
	1 to Unistrut or Conduit	$7.6 \times 10^{10}\ \Omega$
	4 to Unistrut of Conduit	$8.2 \times 10^{10}\ \Omega$

Tested By [signature] Date: 9/18/85
Witness [signature] Date:
Sheet No. 1 of 2
Approved [signature] 9/18/85

Notice of Anomaly None

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.6
S/N: N/A
GSI: No

Amb. Temp.: 66°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9/18/85

Test Title: Configuration No. 5 Test No. 2
~~Pre-test~~ (Post-test) Functional test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	760 μA
	1 to 3	780 μA
	2 to 3	740 μA
	1 to Unistrut or Conduit	900 μA
	2 to Unistrut or Conduit	870 μA
	3 to Unistrut or Conduit	890 μA
7/C - 12 AWG	1 to 4	1610 μA
	1 to Unistrut or Conduit	690 μA
	4 to Unistrut or Conduit	780 μA

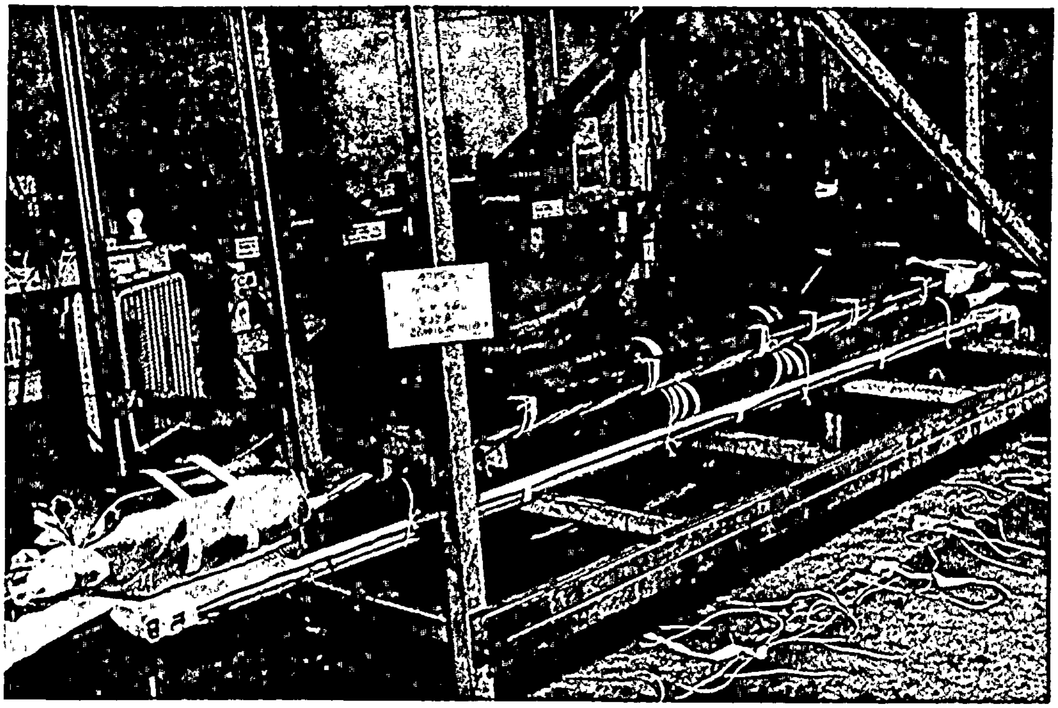
Notice of Anomaly: None

Tested By: [signature] Date: 9/18/85
Witness: None Date:
Sheet No. 2 of 2
Approved: [signature] 9/18/85

APPENDIX III

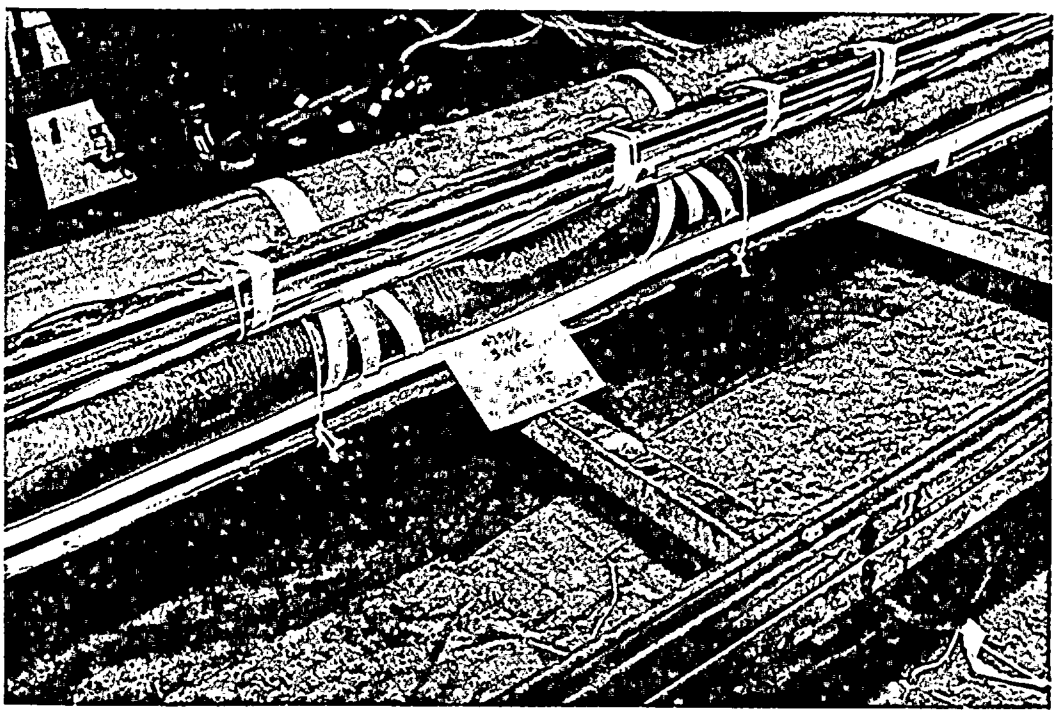
CONFIGURATION NUMBER 5, TEST NO. 3, DATA

CONFIGURATION NUMBER 5, TEST NO. 3



PHOTOGRAPH VI-9

PRETEST VIEW — OVERALL



PHOTOGRAPH VI-10

POST-TEST VIEW — CLOSE-UP OF 3-INCH ANACONDA FLEXIBLE CONDUIT CONTAINING THE FAULT CABLE

CONFIGURATION NUMBER 5, TEST NO. 3

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	67°F	Energized fault cable with 139A
10 Min	74°F	Energized fault cable with 280A
45 Min	178°F	Energized fault cable with 270A
50 Min	189°F	Fault cable conductor reached 189°F
55 Min	198°F	Energized fault cable with 908A
58.3 Min	375°F	Smoke visible
61.6 Min	535°F	Fault cable jacket rupturing
75 Min	1709°F	Open circuit

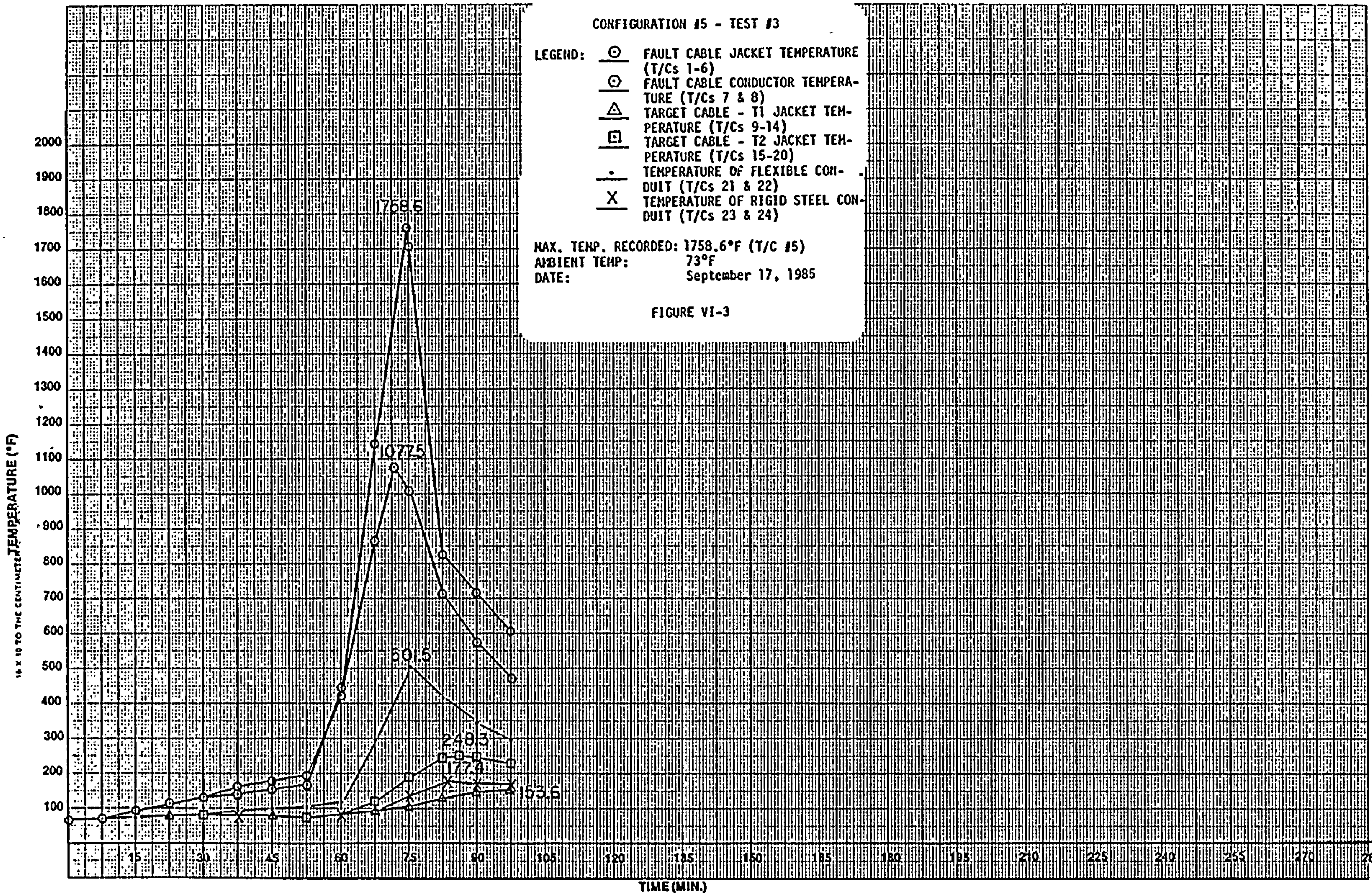

CONFIGURATION #5 - TEST #3
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/Cs 1-6)
FAULT CABLE CONDUCTOR TEMPERATURE (T/Cs 7 & 8)
TARGET CABLE - T1 JACKET TEMPERATURE (T/Cs 9-14)
TARGET CABLE - T2 JACKET TEMPERATURE (T/Cs 15-20)
TEMPERATURE OF FLEXIBLE CONDUIT (T/Cs 21 & 22)
X TEMPERATURE OF RIGID STEEL CONDUIT (T/Cs 23 & 24)
MAX. TEMP. RECORDED: 1758.6°F (T/C #5)
AMBIENT TEMP: 73°F
DATE: September 17, 1985
TEMPERATURE (°F)
TIME (MIN.)
1758.6
1077.5
501.5
248.3
177.4
153.6

FIGURE VI-3

DATA SHEET

Customer: Stone & Webster — WYLE LABORATORIES
Specimen: Cables
Part No.: Various — Amb. Temp.: 66°F — Job No.: 47906
Spec.: WLTP 47906-01 — Photo: Yes — Report No.: 47906-02
Para.: 3.7.4 — Test Med.: Air — Start Date: 9-17-85
S/N: N/A — Specimen Temp.: Ambient
GSI: No

Test Title: Configuration No. 5 Test No. 3
(Pre-test) ~~Post-test~~ Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	3.5 x 10¹⁰ Ω
	1 to 3	6.8 x 10¹⁰ Ω
	2 to 3	4.5 x 10¹⁰ Ω
	1 to Unistrut or Conduit	6.6 x 10¹⁰ Ω
	2 to Unistrut or Conduit	5.0 x 10¹⁰ Ω
	3 to Unistrut or Conduit	3.5 x 10¹⁰ Ω
7/C - 12 AWG	1 to 4	6.6 x 10¹⁰ Ω
	1 to Unistrut or Conduit	4.0 x 10¹⁰ Ω
	4 to Unistrut or Conduit	2.8 x 10¹⁰ Ω

Tested By: [signature] Date: 9/17/85
Witness: None Date:
Sheet No. 1 of 2
Approved: [signature] 9/17/85

Notice of Anomaly: None

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.7.4
S/N N/A
GSI No

Amb. Temp. 66°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-17-85

Test Title Configuration No. 5 Test No. 3
Pre-Test Functional Test

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flash-over with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	800 μA
	1 to 3	810 μA
	2 to 3	790 μA
	1 to Unistrut or Conduit	830 μA
	2 to Unistrut of Conduit	820 μA
	3 to Unistrut or Conduit	850 μA
7/C - 12 AWG	1 to 4	1590 μA
	1 to Unistrut or Conduit	650 μA
	4 to Unistrut or Conduit	710 μA

Tested By [signature] Date: 9/17/85
Witness None Date:
Sheet No. 2 of 2
Approved [signature] 9/17/85

Notice of Anomaly None

DATA SHEET

Customer Stone & Webster

WYLE LABORATORIES

Specimen Cables

Part No. Various

Amb. Temp. 73°F

Job No. 47906

Spec. WLTP 47906-01

Photo Yes

Report No. 47906-02

Para. 3.7.5

Test Med. Air

Start Date 9/17/85

S/N N/A

Specimen Temp. Ambient

GSI No

Test Title Configuration No. 5 Test No. 3 Overcurrent Test

9. Readings with rated current on fault cable

	Voltage (VAC)			Current (amps)		
Target Cable	A-B	B-C	A-C	Phase A	Phase B	Phase C
2 AWG Triplex	577	576	571	39.0	42.0	40.3
7/C - 12 AWG	120.6			10.4		

Fault Cable: 2/0 AWG TRIPLEX

Rated Current: 139 A

Measured Current: 139A

Tested By [signature] Date: 9/17/85

Witness [signature] Date:

Sheet No. 1 of 4

Approved [signature] 9/17/85

Notice of Anomaly ~~None~~ No. 4, No. 5

Wyle Form WH 814A Rev APR 84

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.7.5
S/N N/A
GSI No

Amb. Temp. 73°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 9-17-85

Test Title Configuration No. 5 Test No. ~~4~~ 3 [initials] Overcurrent Test

10. Increasing current to raise fault cable temperature to 189°F - 199°F

FAULT CABLE CURRENT	ELAPSED TIME	CONDUCTOR TEMP/CHANNEL
280A	2100 sec	178°F / 4
270A	300 sec	189°F / 4

12. Readings after fault cable warmup to 189°F - 199°F

Fault cable current: 270A
Conductor temperature: 173°F Channel No. 7
Max temp of Channels 1-6 198°F Channel 4

Tested By [signature] Date: 9/17/85
Witness [signature] Date:
Sheet No. 2 of 4
Approved [signature] 9/19/85

Notice of Anomaly ~~None~~ No. 4, No. 5

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.5
S/N: N/A
GSI: No

Amb. Temp.: 73° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-17-85

Test Title: Configuration No. 5 Test No. 3 Overcurrent Test

14. Initial readings with test current on fault cable:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	578	580	573	22.3	50.0	52.9
7/C -12 AWG	120.7			10.5		

Fault Cable: 2/0 AWG TRIPLEX
~~Rated~~ Test Current: 908A
Measured Current: 908 A

Tested By: [illegible] Date: 9/17/85
Witness: [illegible] Date:
Sheet No. 3 of 4
Approved: [illegible] 9/17/85

Notice of Anomaly: No. 4, No. 5

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.5
S/N: N/A
GSI: No

Amb. Temp.: 73°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-17-85

Test Title: Configuration No. 5 Test No. 3 Overcurrent Test

16. Open circuit on fault cable:
    - Elapsed time: 1202 sec
    - Maximum fault cable temperature: 1759°F Channel 5

17. Stablized temperature on fault cable:
    - Elapsed time (beginning of 15-minute period): N/A
    - Maximum fault cable temperature: N/A
    - Fault cable current: N/A

18. Ignition of fault cable:
    - Elapsed time: N/A
    - Maximum fault cable temperature: N/A
    - Fault cable current: N/A

19. Readings after ~~let through~~ test pac current applied until fault cable open circuits:

Target Cable	Voltage (VAC) A-B	Voltage (VAC) B-C	Voltage (VAC) A-C	Current (amps) Phase A	Current (amps) Phase B	Current (amps) Phase C
2 AWG Triplex	577	577	574	38.9	39.3	37.1
7/C - 12 AWG	119.9			10.5		

Notice of Anomaly: ~~None~~ No. 4, No. 5

Tested By: [signature] Date: 9/17/85
Witness: [signature] Date: /
Sheet No. 4 of 4
Approved: [signature] 9/17/85

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.6
S/N: N/A
GSI: No

Amb. Temp.: 73° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-17-85

Test Title: Configuration No. 5 Test No. 3

~~Pre-test~~ Post-test Functional Test

Insulation Resistance Test

Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	1.0 x10" Ω
	1 to 3	1.6 x10" Ω
	2 to 3	1.3 x10" Ω
	1 to Unistrut or Conduit	1.7 x10" Ω
	2 to Unistrut or Conduit	1.6 x10" Ω
	3 to Unistrut or Conduit	1.3 x10" Ω
7/C - 12 AWG	1 to 4	3.0 x10" Ω
	1 to Unistrut or Conduit	2.8 x10" Ω
	4 to Unistrut or Conduit	1.7 x10" Ω

Tested By: [signature] Date: 9/17/85
Witness: None Date:
Sheet No. 1 of 2
Approved: [signature] 9/17/85

Notice of Anomaly: None

Wyle Form WH 614A Rev. APR 84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.7.6
S/N: N/A
GSI: No

Amb. Temp.: 73° F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 9-17-85

Test Title: Configuration No. 5 Test No. 3
Post-Test Functional Test JJK

High Potential Test

Acceptance Criteria: There shall be no evidence of insulation breakdown or flash-over with a potential of 2200 VAC applied for one minute.

Cable	Test Points	Reading
2 AWG Triplex	1 to 2	780 μA
	1 to 3	790 μA
	2 to 3	770 μA
	1 to Unistrut or Conduit	920 μA
	2 to Unistrut of Conduit	890 μA
	3 to Unistrut or Conduit	900 μA
7/C - 12 AWG	1 to 4	1550 μA
	1 to Unistrut or Conduit	550 μA
	4 to Unistrut or Conduit	610 μA

Tested By: [signature] Date: 9/17/85
Witness: None Date:
Sheet No. 2 of 2
Approved: [signature] 9/17/85

Notice of Anomaly: None

CONFIGURATION NO. 6 TESTS
(Separation Inside Control / Instrument Cabinets)

SECTION VII

CONFIGURATION NUMBER 6 TESTS
(PANEL INTERNAL SEPARATION TEST FOR CONTROL AND INSTRUMENT CABLES)

1.0 REQUIREMENTS

1.1 Acceptance Criteria

1.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6×10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds.

1.1.2 High Potential Test

There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute.

1.1.3 Cable Continuity Test

Energized target specimens shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current
1/0 AWG	Triplex	NJM-34	L	575	139
2 AWG	Triplex	NJM-25	K	575	38.5
12 AWG	7	NJN-37	C	120	10
16 AWG	2/C	NJP-05	X	50	1
12 AWG	5	NJN-36	C	120	10
12 AWG	2	NJN-34	C	120	10
14 AWG	1	NAF-52	C	120	10

1.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, 0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance.

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

---

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

2.0 PROCEDURES

2.1 Test Specimen Preparation

The test assembly was manufactured in accordance with Figure 15 by Wyle technicians. The following guidelines were observed with regard to the materials and construction of the assembly:

1. The cable and terminal blocks inside the enclosure were from NMP2 stock. The enclosure was provided by Wyle Laboratories.
2. The ends of the faulted cable were wrapped from their connection to the Multi-Amp Test Set to the enclosure. This wrap consisted of a single layer of HAVEG Siltemp WT-65 covered with a single layer of 3M No. 69 glass tape. This wrapping was done to ensure that any ignition that occurred was contained within the enclosure.
3. All nonfaulted conductors in the 5/C cable were connected in series as shown in Figure 16 of Section VIII. This circuit was designated Target Conductor Loop No. 1.
4. Both conductors in the 2/C cable were connected in series as shown in Figure 16 of Section VIII. This circuit was designated Target Conductor Loop No. 2.
5. Photographs were taken of the test setup prior to the test.

2.2 Instrumentation Setup

2.2.1 Thermocouple Locations

A total of 18 Type "K" thermocouples were utilized for this test. These thermocouples were mounted as described below:

Channel No.	Location
1 & 2	Mounted to the jacket of the 5/C 12 AWG cable.
3	Mounted to the jacket of the faulted conductor of the 5/C 12 AWG cable.
4 & 5	Mounted to the jacket of the faulted 1/C 14 AWG Type SIS cable.
6 & 7	Mounted to the jacket of the 2/C 12 AWG cable.

2.0 PROCEDURES (Continued)

2.2 Instrumentation Setup (Continued)

2.2.1 Thermocouple Locations (Continued)

Channel No.	Location
8	Mounted to the jacket of the nonfaulted conductor of the 5/C 12 AWG cable.
10-16	Mounted to the jacket of the nonfaulted 1/C 14 AWG Type SIS cable. (Channels 10-14 on 5-conductor bundle. Channels 15 and 16 on 2-conductor bundle.)
17	Mounted to the faulted bare conductor of the 5/C 12 AWG cable.
18	Mounted to the faulted bare conductor of the 1/C 14 AWG Type SIS cable.

2.2.2 Electrical Monitoring

The voltage and current of each target conductor loop and the faulted conductor current were fed into an oscillograph recorder. The oscillograph was operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels were as specified in the following table.

Channel No.	Signal	Location
1	Current	Target Conductor Loop No. 1
2	Voltage	Target Conductor Loop No. 1
3	Current	Target Conductor Loop No. 2
4	Voltage	Target Conductor Loop No. 2
5	Current	Faulted Conductor Loop

A digital multimeter was utilized to measure the phase voltage and current of each target conductor loop prior to, and after the application of the 100 ampere current.

2.3 Baseline Functional Tests

The baseline functional tests consisted of insulation resistance and high potential measurements on both target conductor loops.

2.0 PROCEDURES (Continued)

2.3 Baseline Functional Tests (Continued)

2.3.1 Insulation Resistance Test

1. All power and instrumentation leads from both target conductor loops were disconnected and labeled per Figure 16 of Section VIII.

2. Using a megohmmeter, a potential of 1000 VDC was applied and the minimum insulation resistance indicated after a period of 60 seconds between the following test points was recorded:

Target Conductor Loop No. 1

Phase-to-Phase	Phase-to-Ground
1-1 to 1-2	1-1 to enclosure
	1-2 to enclosure

Target Conductor Loop No. 2

Phase-to-Phase	Phase-to-Ground
3-1 to 3-2	3-1 to enclosure
	3-2 to enclosure

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.3.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC was applied from each conductor to ground for a period of one minute.

Target Conductor Loop No. 1

Phase-to-Phase	Phase-to-Ground
1-1 to 1-2	1-1 to enclosure
	1-2 to enclosure

Target Conductor Loop No. 2

Phase-to-Phase	Phase-to-Ground
3-1 to 3-2	3-1 to enclosure
	3-2 to enclosure

For all performances of this test, the measured values were compared to the acceptance criteria, Paragraph 1.1.1.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test

The overcurrent test was conducted in two sequential steps with no intentional time delay. The first phase consisted of energizing all the conductors with 10 amperes for 15 minutes. The second phase consisted of energizing the fault conductor loop with 100 amperes for a period of 11 seconds.

Each target conductor loop conducted 10 amperes at 120 VAC throughout the overcurrent test. The overcurrent test was conducted using the following procedure:

1. The fault conductor loop was connected to the Multi-Amp Test Set per Figure 16 of Section VIII.

2. The target conductor loops were connected to the instrumentation and power supplies of Figure 15 of Section VIII.

3. Each target conductor loop was energized with 10 amperes at 120 VAC.

4. The fault conductor loop was energized with 10 amperes from the Multi-Amp Test Set.

5. The voltage and current of each target conductor loop and the fault conductor loop current were recorded.

6. The 10 ampere current on the fault conductor loop was maintained for 15 minutes.

7. The fault conductor loop was energized with 100 amperes for a period of 11 seconds. The fact that neither an open circuit nor ignition occurred was recorded.

8. The voltage and current of each target conductor loop were recorded.

9. Each thermocouple temperature that occurred at the following points in the overcurrent test was recorded:

   a. At the beginning of the 15-minute period of application of 10 amperes on the fault conductor loop.

   b. At the end of the 15-minute period of application of 10 amperes on the fault conductor loop.

   c. At the end of the 11-second period of application of 100 amperes on the fault conductor loop.

2.0 PROCEDURES (Continued)

2.4 Overcurrent Test (Continued)

10. Thermocouple readouts on the datalogger were observed until all temperatures were decreasing.

11. The target conductor loops were de-energized.

12. The enclosure was opened and the observed condition of the conductors was recorded.

13. Photographs were taken of the post-test condition.

For the performance of this test, the observed operation of the target conductor loops were compared to the acceptance criteria, Paragraph 1.1.3.

2.5 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 2.3 were repeated.

3.0 RESULTS

Configuration Number 6, Test No. 1 of cables and bundled, insulated conductors terminated on terminal blocks inside an enclosure, was conducted per Paragraph 2.0 and successfully met the requirements of Paragraph 1.0. The fault current of 100 amperes was applied for 11 seconds. No ignition occurred and the faulted conductor loop did not open circuit. After application of the 100-ampere fault current for 11 seconds, the maximum observed temperature (of jacket or insulation) on the faulted conductor loop was 128.1°F which occurred on Thermocouple No. 18.

The capabilities of the target conductors to conduct SWEC-rated current (10 amperes) at 120 VAC was not impaired during this test. The maximum observed temperature on Target Conductor Loop No. 1 was 115.5°F and occurred on Thermocouple No. 16. The maximum observed temperature on Target Conductor Loop No. 2 was 90.5°F which occurred on Thermocouple No. 15. All target conductors successfully completed the Post-Overcurrent Test Functional Test.

Appendix I contains the following data from this test:

1. Photographs VI-1 and VI-2 which show pretest and post-test conditions.

2. A narrative of the test which relates test time, conductor temperatures, and important events.

3. Data Sheets which contain Baseline Functional Test data, Overcurrent Test data, and Post-Overcurrent Test Functional Test data.

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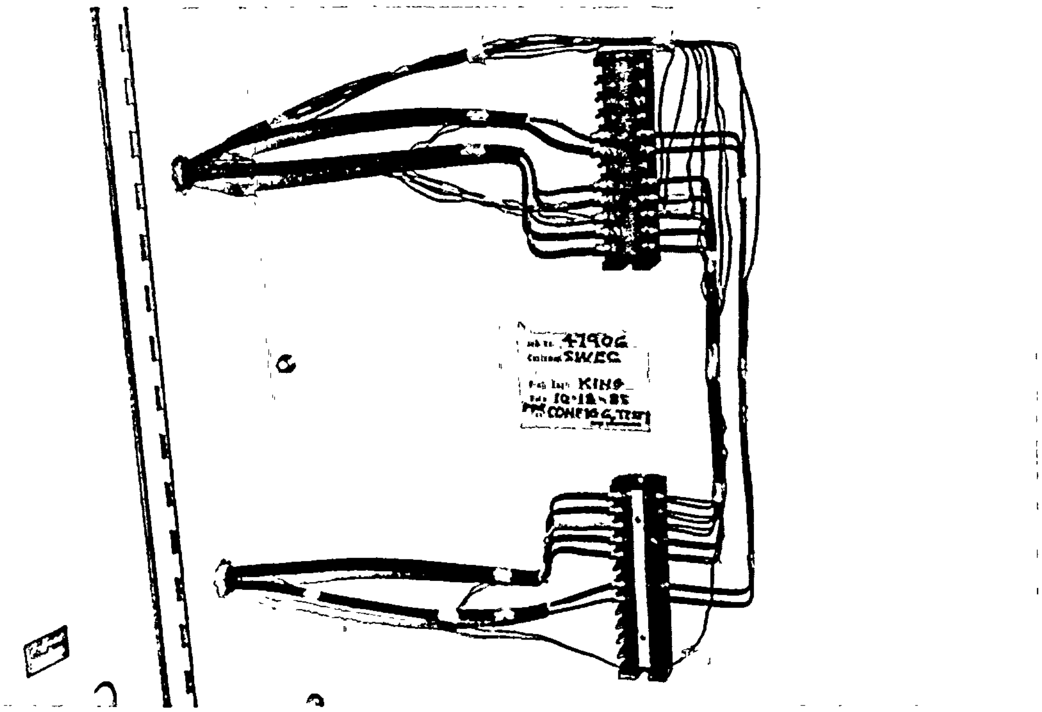
APPENDIX I

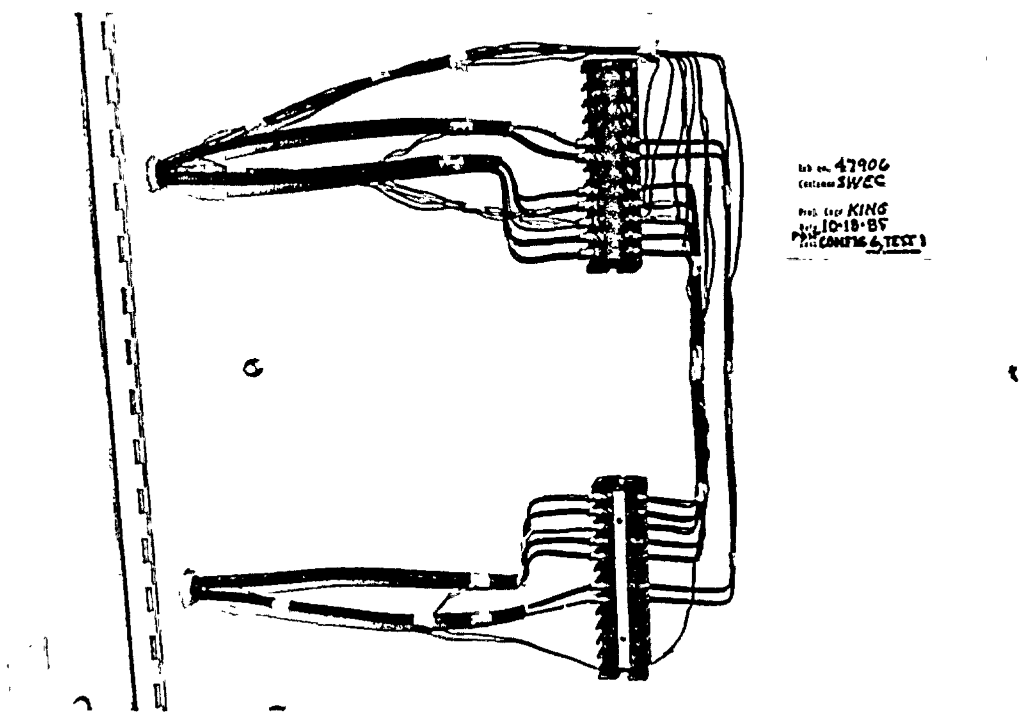
CONFIGURATION NUMBER 6, TEST NO. 1, DATA

CONFIGURATION NUMBER 6, TEST NO. 1



PHOTOGRAPH VII-1

PRETEST VIEW



PHOTOGRAPH VII-2

POST-TEST VIEW

CONFIGURATION NUMBER 6, TEST NO. 1

Approximate Test Time	Approximate Fault Cable Jacket Temperature	Observation
0 Min	69°F	Energized fault conductor loop with 10A
15 Min	93°F	Energized fault conductor loop with 100A
15 Min, 11 Sec	116°F	End of required 11 second period with 100A

DATA SHEET

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.8.4
S/N N/A
GSI No

Amb. Temp. 73°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

WYLE LABORATORIES
Job No. 47906
Report No. 47906-02
Start Date 10/18/85

Test Title Configuration 6, Test No. 1

(Pre-Test) ~~Post-Test~~ Functional Test

INSULATION RESISTANCE TEST		
Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.		
CABLE	TEST POINTS	READING
Target Conductor Loop No. ~~1~~ 2	1-1 to 1-2	2.2 x 10⁹
	1-1 to Enclosure	6.4 x 10⁸
	1-2 to Enclosure	1.6 x 10⁹
Target Conductor Loop No. ~~2~~ 1	3-1 to 3-2	7.4 x 10⁸
	3-1 to Enclosure	1.7 x 10⁸
	3-2 to Enclosure	7.6 x 10⁸
HIGH POTENTIAL TEST		
Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.		
CABLE	TEST POINTS	READING
Target Conductor Loop No. ~~1~~ 2	1-1 to 1-2	263 μA
	1-1 to Enclosure	200 μA
	1-2 to Enclosure	192 μA
Target Conductor Loop No. ~~2~~ 1	3-1 to 3-2	500 μA
	3-1 to Enclosure	365 μA
	3-2 to Enclosure	382 μA

Tested By [signature] Date: 10/18/85
Witness [signature] Date:
Sheet No. 1 of 1
Approved J. D. King 10/18/85

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.8.5
S/N: N/A
GSI: No

Amb. Temp.: 75°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 10-18-85

Test Title: Configuration No. 6, Test No. 1 Overcurrent Test

5. Readings immediately after energizing the fault conductor loop and the nonfaulted conductor loop.

	VOLTAGE	CURRENT
Target Conductor Loop No. 1	121.1	10.14
Target Conductor Loop No. 2	120.6	10.26
Faulted Loop	N/A	10.4

7. Reading after energizing the fault conductor loop with 100 amperes for 11 seconds.

Elapsed time to open circuit: N/A

Elasped time to ignition: N/A

Length of burning period: N/A

8. Reading after energizing the fault conductor loop with 100 amperes for 11 seconds.

	VOLTAGE	CURRENT
Target Conductor Loop No. 1	121.8	10.37
Target Conductor Loop No. 2	121.3	10.43

Tested By: Romanoff Date: 10/18/85
Witness: Moore Date:
Sheet No. 1 of 3
Approved: John D. King 10/18/85

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.8.5
S/N: N/A
GSI: No

Amb. Temp.: 75°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date: 10-18-85

Test Title: Configuration No. 6, Test No. 1 Overcurrent Test

9. Temperatures

THERMOCOUPLE NO.	BEGINNING OF 15-MIN. PERIOD (9a)	END OF 15 MIN. PERIOD (9b)	END OF 11 SEC. PERIOD (9c)
1	83.6°F	85.1°F	84.4
2	81.0	83.1	82.9
3	79.8	83.2	91.1
4	81.0	85.2	93.5
5	87.1	93.3	115.5
6	80.8	81.5	81.1
7	80.0	80.7	80.8
8	85.1	87.1	94.7
10	82.7	83.9	86.5
11	88.8	91.8	93.2
12	89.1	91.7	93.4
13	91.3	94.0	94.0
14	88.8	93.3	93.0
15	88.7	89.2	88.6
16	91.0	91.5	90.5
17	97.5	100.1	115.4
18	92.0	96.8	128.1

Tested By: Romanoff Date: 10/18/85
Witness: None Date:
Sheet No. 2 of 3
Approved: J. R. King 10/18/85

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

WYLE LABORATORIES

Customer: Stone & Webster
Specimen: Cables
Part No.: Various
Spec.: WLTP 47906-01
Para.: 3.8.5
S/N: N/A
GSI: No

Amb. Temp.: 75°F
Photo: Yes
Test Med.: Air
Specimen Temp.: Ambient

Job No.: 47906
Report No.: 47906-02
Start Date:

Test Title: Configuration No. 6, Test No. 1 Overcurrent Test

12. Observed condition of conductors.

Conductors appeared to be in an "as new" condition. There were no apparent changes from the pretest condition.

Notice of Anomaly: None

Tested By: [signature] Date: 10/18/85
Witness: Morell Date:
Sheet No. 3 of 3
Approved: J. B. King 10/18/85

DATA SHEET

WYLE LABORATORIES

Customer Stone & Webster
Specimen Cables
Part No. Various
Spec. WLTP 47906-01
Para. 3.8.6
S/N N/A
GSI No

Amb. Temp. 75°F
Photo Yes
Test Med. Air
Specimen Temp. Ambient

Job No. 47906
Report No. 47906-02
Start Date 10/18/85

Test Title Configuration 6, Test No. 1

~~Pre-Test~~ Post-Test (circled) Functional Test

INSULATION RESISTANCE TEST		
Acceptance Criteria: Measured insulation resistance shall be greater than 1.6 megohms with a potential of 1000 VDC applied for 60 seconds.		
CABLE	TEST POINTS	READING
Target Conductor Loop No. X_2	1-1 to 1-2	$1.8 \times 10^9 \Omega$
	1-1 to Enclosure	$2.0 \times 10^9 \Omega$
	1-2 to Enclosure	$2.0 \times 10^9 \Omega$
Target Conductor Loop No. Z_1	3-1 to 3-2	$9.4 \times 10^8 \Omega$
	3-1 to Enclosure	$1.2 \times 10^9 \Omega$
	3-2 to Enclosure	$1.3 \times 10^9 \Omega$
HIGH POTENTIAL TEST		
Acceptance Criteria: There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC applied for one minute.		
CABLE	TEST POINTS	READING
Target Conductor Loop No. X_2	1-1 to 1-2	271 μA
	1-1 to Enclosure	239 μA
	1-2 to Enclosure	252 μA
Target Conductor Loop No. Z_1	3-1 to 3-2	500 μA
	3-1 to Enclosure	430 μA
	3-2 to Enclosure	420 μA

Tested By [signature] Date: 10/18/85
Witness [signature] Date:
Sheet No. 1 of 1
Approved [signature] 10/18/85

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR '84

WYLE LABORATORIES' TEST PROCEDURE NO. 47906-01, REVISION A

TEST PROCEDURE

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP
P. O. Box 1008, Huntsville, AL 35807,
TWX (910) 997-0886, Phone (205) 837-4411

TEST PROCEDURE NO. 47906-01

DATE: August 14, 1985
Revision A — 11/04/85

**ELECTRICAL RACEWAY
SEPARATION VERIFICATION TESTING
FOR THE
STONE AND WEBSTER ENGINEERING CORPORATION
FOR USE IN
NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT NUCLEAR STATION — UNIT 2**

APPROVED BY PROJECT MANAGER: F. R. Johnson 8/14/85
F. R. Johnson

APPROVED BY QUALITY ENGINEER: G. Wayne Hight 8/14/85 KT 8-14-85
G. Wayne Hight

PREPARED BY PROJECT ENGINEER: J. T. Hazeltine 8/13/85 J King 8/13/85
J. T. Hazeltine

REVISIONS

(jmk) FORM 1054-1 Rev. 4/74

REV. NO.	DATE	PAGES AFFECTED	BY	APP'L.	DESCRIPTION OF CHANGES
A	11/04/85	All pages indicated	JPK	JPK 11/6/85 [illegible] 11/6/85	Incorporate IPR-1 & IPR-2 Changes
				[illegible] 11/6/85	
				KT 11-7-85	
				GWH 11/8/85	

1.0 SCOPE

This document has been prepared by Wyle Laboratories for the Stone and Webster Engineering Company (SWEC) and encompasses the testing of physical separation, with respect to electrical faults, between redundant Class 1E and Class 1E, and non-Class 1E electrical systems in representative configurations at Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station — Unit 2 (NMP2).

1.1 Objectives

The purpose of this procedure is to present the requirements, procedures, and sequence to test the design adequacy of worst case configurations in the following electrical separation situations:

- Free Air Separation without barriers (see Figure 2, 3, and 4)
- Free Air Separation with SILTEMP barriers (see Figures 5 and 6)
- Horizontal cable tray to parallel conduit (see Figures 7 and 8) A
- Conduit to conduit and free air (see Figure 10) A
- Horizontal tray to vertically separated horizontal tray (see Figure 9) A
- Free Air Separation without barriers inside control and instrument cabinets (see Figures 15 and 16) A

1.2 Applicable Documents

1.2.1 Stone and Webster Engineering Corporation Engineering Service Scope of Work (ESSOW) No. E0907.

1.2.2 Wyle Laboratories Technical Proposal for Cable Separation Test Program for Stone and Webster Engineering Corporation, No. 543/3965-2/GH, dated July 26, 1985.

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

1.2.4 IEEE Std. 384-1974, "IEEE Trial Use Standard Criteria for Separation of Class 1E Equipment and Circuits."

1.2.5 United States Nuclear Regulatory Commission Guide 1.75, Revision 2, "Physical Independence of Electric Systems."

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

1.2.7 Code of Federal Regulations, Section 10, Part 21.

1.2.8 Code of Federal Regulations, Section 10, Part 50, Appendix B.

1.2.9 United States Nuclear Regulatory Commission Guide 1.75, Revision 2, "Physical Independence of Electric Systems". A

1.0 SCOPE (Continued)

1.2 Applicable Documents (Continued)

1.2.10 TWX from Stone and Webster Engineering Corporation to Wyle Laboratories, dated 9 October, 1985, Message 12177/22952. A

1.3 Equipment Description

This test procedure encompasses testing of the following IEEE Std. 383-1974 qualified power, control, and instrumentation cables as described below.

Item No.	Description	Cable Type	SWEC I.D. No.	
1	Okonite Triplex 500 MCM Copper	L	NJM-46	
2	Okonite Triplex 350 MCM Copper	L	NJM-45	
3	Okonite Triplex 250 MCM Copper	L	NJM-33	
4	Okonite Triplex 4/0 AWG Copper	L	NJM-31	
5	Okonite Triplex 3/0 AWG Copper	L	NJM-30	
6	Okonite Triplex 2/0 AWG Copper	L	NJM-28	
7	Okonite Triplex 1/0 AWG Copper	L	NJM-34	
8	Okonite Triplex 2 AWG Copper	K	NJM-25	
9	Okonite Triplex 4 AWG Copper	K	NJM-41	
10	Okonite Triplex 6 AWG Copper	K	NJM-40	
11	Okonite 3/C 8 AWG Copper	K	NJM-12	
12	Okonite 3/C 10 AWG Copper	K	NJM-08	
13	Rockbestos 7C 12 AWG Copper	C	NJN-37	
14	Okonite 2/C 16 AWG Copper	X	NJP-05	A
15	Rockbestos 2/C 12 AWG Copper	C	NJN-34	A
16	Rockbestos 5/C 12 AWG Copper	C	NJN-36	A
17	Rockbestos 1/C 14 AWG Type SIS	C	None	A

1.4 Test Sequence

The test program shall be performed in the following sequence or as mutually agreed by SWEC and Wyle Laboratories: A

- Test specimen identification
- Screening tests (fault cable determination)
- Configuration Number 1 Test (Free Air Separation Test without barriers)
- Configuration Number 5 Tests (Conduit to Conduit and Cable in Free Air Tests)
- Configuration Number 2 Test (Free Air Separation Test with Siltemp barriers)
- Configuration Number 3 Tests (Horizontal Tray with parallel conduit)
- Configuration Number 4 Tests (3-Horizontal Tray Stack)
- Configuration Number 6 Tests (Internal Separation Test for Control and Instrument Cables) A

2.0 TEST REQUIREMENTS

2.1 Acceptance Criteria

2.1.1 Insulation Resistance Test

Insulation resistance on all "target cables"* shall be greater than 1.6 x 10^6 ohms with a potential of 1000 VDC (500 VDC 2/C 16 AWG cables) applied for 60 seconds. A

2.1.2 High Potential Test

There shall be no evidence of insulation breakdown or flashover with a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cables) applied for one minute. A

2.1.3 Cable Continuity Test

Energized specimens in the target raceway shall conduct 100% of SWEC-rated currents (see table below) at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) before, during, and after the overcurrent test.

Cable Size	No. Conductors	SWEC I.D. No.	Cable Type	Voltage	Rated Current	
1/0 AWG	Triplex	NJM-34	L	575	139	
2 AWG	Triplex	NJM-25	K	575	38.5	
12 AWG	7	NJN-37	C	120	10	
16 AWG	2/C	NJP-05	X	50	1	A
12 AWG	5	NJN-36	C	120	10	A
12 AWG	2	NJN-34	C	120	10	A
14 AWG	1	NAF-52	C	120	10	A

2.1.4 Tolerances

All target cable voltages specified in this procedure shall be maintained within a ±3% tolerance. The initial setting of target cable currents (with rated current on the fault cable) shall have a tolerance of +10%, 0%. Thereafter, all target cables' currents shall be maintained within a ±10% tolerance. A

All fault cable currents shall be maintained within a ±3% tolerance, if possible.

---

* The term "target cable" refers to energized and monitored nonfault cables used in this program.

3.0 TEST PROGRAM

3.1 Test Specimen Identification

An inspection shall be performed upon receipt of the test specimen components at Wyle Laboratories. This inspection will ensure that the test specimens are as described in Paragraph 1.3. Applicable manufacturer, model, part and serial numbers shall be verified and recorded on a Test Specimen Inspection Sheet. The test specimens shall be labeled to facilitate identification throughout the test program.

3.2 Screening Tests

Twelve tests shall be conducted in free air for various cable loads to determine the cables which, if faulted, would have the most impact on adjacent cables. The first five tests shall be conducted using cables that run from the various motor control centers to smaller motors. The last seven tests shall be conducted using cables that run from the various load centers to various large motors.

3.2.1 Test Specimen Preparation

1. The heat rise tests shall be conducted using a single run of cable supported by a 8-foot galvanized steel cable tray from NMP2 stock. The cable tray shall be filled to its siderails for the first five tests. The cables shall be spaced 3/8 inch apart for the last seven tests. The cable shall be connected to the Multi-Amp Test Set per Figure 11.

2. The ends of the faulted cable from their termination to the edge of the cable tray shall be wrapped with a single layer, 50% overlap, of SILTEMP WT-65 (or any other barrier material specified by SWEC) covered with a single layer, 50% overlap, of 3M No. 69 glass tape. This shall be done to ensure that any ignition that might occur is contained to the cable tray area.

3.2.2 Instrumentation Setup

3.2.2.1 Thermocouple Locations — A total of 33 Type "K" thermocouples shall be utilized for these tests. These thermocouples shall be mounted as described below:

Channel No.	Location
1-10	Mounted directly to the outer cable jacket. The thermocouples shall be mounted approximately ten inches apart.
11 & 12	Mounted to the conductor of the fault cable at the two series connections.
13-33	Mounted in free air and spaced as shown in Figure 1.

These thermocouples shall be monitored using a Fluke Datalogger feeding a high-speed printer. The datalogger shall be operated at its maximum scan rate throughout the screening test.

3.0 TEST PROGRAM (Continued)

3.2 Screening Tests (Continued)

3.2.2 Instrumentation Setup (Continued)

3.2.2.2 Electrical Monitoring — The current to the test specimen shall be recorded with the test time that current was changed. These readings shall be taken using the Multi-Amp Test Set.

3.2.3 Screening Tests

The screening tests shall consist of three sequential phases with no intentional time delay. The first phase shall consist of powering the cable for 10 minutes with full load current. This shall be done to establish normal operating temperatures on this cable. The second phase shall consist of raising the current to reach 90°C ±3°C conductor temperature. The third phase shall consist of energizing the cable with the worst case electrical fault*. The cable shall be subjected to this current level until either the cable open-circuits, the temperatures on the cable stabilize or the test is terminated at the customer's request. A

For Tests No. 1 through 12, should the fault cable temperatures stabilize (temperature rise less than 10°F over 15 minutes) or ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes (indicating that the bare conductors are radiating heat faster than the I^2R input), the fault current shall be increased to 660 amperes (Tests 1 through 5) or 2200 amperes (Tests 6 through 12) until the fault cable open-circuits.

The screening test shall be conducted using the following procedure:

1. Connect the test specimen to the Multi-Amp Test Set output stabs per Figure 11. The cable termination shall be made in series or in parallel if necessary to obtain the required current. A

2. Apply the applicable full load current (FLA) from Table 1 to the test specimen for 10 minutes.

3. Record applied current and initial maximum cable temperature reached after the FLA current application.

4. Slowly increase fault cable current until thermocouple channels 1-11 or 12 indicate 90°C ±3°C (189°-199°F). Each current level shall be maintained for a minimum of 5 minutes and conductor temperature recorded. The current level shall be adjusted to maintain cable temperature 189°-199°F for 15 minutes.

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* The term "worst case electrical fault" refers to the most severe credible electrical fault (as determined by SWEC) at the Nine Mile Point Power Station.

3.0 TEST PROGRAM (Continued)

3.2 Screening Tests (Continued)

3.2.3 Screening Tests (Continued)

5. Record applied current and maximum cable jacket temperature.

6. Apply the applicable test current from Table 1 to the test specimen.

7. Record the test time of application, applied current level and maximum cable jacket temperature.

8. Allow the cable to conduct the test current until either an open circuit occurs, the cable temperatures stabilize, or the test is terminated at the customer's request.

9. If an open circuit occurs, record the elapsed time and maximum cable temperature and proceed to Step 13.

10. If a 15-minute period of stabilized temperature occurs, record the maximum temperature, elapsed time and applied current level, and proceed to Step 12.

11. Should the fault cable ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes, record the maximum temperature, elapsed time and applied current, and proceed to Step 12. A

12. Increase fault cable current to 660 amperes (Tests 1 through 5) or 2200 amperes (Tests 6 through 12) until the fault cable open-circuits or the test is terminated at the customer's request.

13. De-energize the Multi-Amp Test Set output.

NOTE: Skip Steps 6-11 for tests where test current is less than the warmup current required to raise the conductor temperature to 189°F-199°F. A

3.0 TEST PROGRAM (Continued)

3.2 Screening Tests (Continued)

3.2.4 Worst Case Cable (WCC) Selection

TABLE 1

Test No.	Cable Size	SWEC I.D No.	Maximum HP	Maximum Full-Load Current (FLA)	Test Current (Amperes)
1	10 AWG-Cu	NJM-08	5	5.6*	34
2	8 AWG-Cu	NJM-12	10	10.3	51
3	6 AWG-Cu	NJM-40	20	20.6	156
4	4 AWG-Cu	NJM-41	20	20.6	156
5	2 AWG-Cu	NJM-25	40	38.5	264
6	1/0 AWG-Cu	NJM-34	150	139	908
7	2/0 AWG-Cu	NJM-28	150	139	908
8	3/0 AWG-Cu	NJM-30	150	139	908
9	4/0 AWG-Cu	NJM-31	180	159	746
10	250 MCM-Cu	NJM-33	180	159	746
11	350 MCM-Cu	NJM-45	180	159	746
12	500 MCM-Cu	NJM-46	180	159	746

* Initial test current shall be 8 amperes due to Multi-Amp Test Set limitations.

Based on the results of the screening tests, the worst-case cable for the subsequent configuration tests shall be selected using the following criteria:

1. If the cables ignite, a combination of time to ignition, insulation burn time, and observed temperatures shall be utilized to determine the worst-case cable.

2. If no cables ignite, the cable which produces maximum surface temperatures before open-circuiting shall be considered the worst-case cable.

3. If the cables neither ignite nor open-circuit, the cable which produces the maximum surface temperature, when the temperature equilibrium of the conductor/jacket is reached (temperature rise less than 10°F over a 15-minute period), shall be considered to be the worst-case cable.

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests

Configuration Number 1 shall consist of three tests in free air. Test No. 1 shall consist of a test between a horizontal fault cable, a parallel horizontally separated 2/C 16 AWG cable, a parallel vertically separated Triplex 2 AWG cable, and a perpendicular horizontally separated 7/C 12 AWG cable. Test No. 2 shall consist of a test between a vertical fault cable and two perpendicular cables separated horizontally by 6 inches. Test No. 3 shall consist of a test between a horizontal cable in free air and a parallel cable tray vertically separated by 9 inches. A

3.3.1 Purpose

The purpose of the Configuration Number 1 Test is to demonstrate the acceptability of design where two cables in free air pass either 9 inches vertically or 6 inches horizontally from each other or from a cable tray, when the worst case electrical fault occurs to one of these cables. This configuration represents field installation of free air cables going from:

a. Tray to tray
b. Tray to conduit
c. Conduit to conduit
d. Tray/conduit to equipment.

3.3.2 Test Specimen Preparation

The test specimens shall be mounted to the unistrut frame assembly as shown in Figures 2, 3 and 4. This apparatus shall be assembled to the indicated dimensions by Wyle technicians using materials supplied by the customer. The following shall be observed with regard to the materials and construction of the assembly:

1. The faulted cable shall be a WCC* cable from NMP2 stock for all three tests.

2. The ends of the faulted cable from their termination at the copper bus bar to the edge of the unistrut frame shall be wrapped with a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape (or any other barrier material specified by SWEC). This wrapping shall be done to ensure that any ignition that might occur is contained to the test area.

* WCC = Worst Case Cable determined during the Screening Tests of Paragraph 3.1.1.

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.2 Test Specimen Preparation (Continued)

3. For Test No. 1:

- The vertically separated target cable shall be a Triplex 2 AWG cable from NMP2 stock. This cable shall be loosely tied to the unistrut of Figure 2, with ceramic tie cords, such that the cable is 9 inches vertically above the centerline of the faulted cable.
- The horizontally separated target cable shall be a 2/C 16 AWG cable from NMP2 stock. This cable shall be mounted such that the cable is 6 inches horizontally away from the faulted cable. A
- The vertical cable shall be a 7/C 12 AWG cable from NMP2 stock. This cable shall be mounted such that the cable is 6 inches away from the fault cable.

4. For Test No. 2:

- The upper horizontal target cable shall be a Triplex 2 AWG cable from NMP2 stock. This cable shall be loosely tied to the unistrut of Figure 3 such that the cable is located 6 inches horizontally from the perpendicular fault cable and 9 inches above the lower target cable.
- The lower horizontal target cable shall be a 7/C 12 AWG cable from NMP2 stock. This cable shall be loosely tied to the unistrut of Figure 3 such that the cable is located 6 inches from the perpendicular fault cable.

5. For Test No. 3:

- The horizontal cable tray shall be filled to its siderails with K-Type cables from NMP2 stock. The bottom centerline cable shall be a Triplex 2 AWG cable. The cable tray shall be mounted parallel to the centerline of the fault cable such that it is 9 inches vertically above this cable.

6. Photographs shall be taken of the test setup prior to each test.

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.3 Instrumentation Setup

3.3.3.1 Thermocouple Locations

Test No. 1

A total of 26 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the vertically separated target cable. These thermocouples shall be mounted approximately 16 inches apart.
15-20	Mounted to the jacket on the horizontally separated target cable. These thermocouples shall be mounted approximately 16 inches apart.
21-26	Mounted to the jacket on the perpendicular target cable. These thermocouples shall be mounted approximately 10 inches apart. A

Test No. 2

A total of 20 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the upper horizontal target cable. These thermocouples shall be mounted approximately 16 inches apart.
15-20	Mounted to the jacket on the lower horizontal target cable. These thermocouples shall be mounted approximately 10 inches apart. A

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.3.1 Thermocouple Locations (Continued)

Test No. 3

A total of 14 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the target cable. These thermocouples shall be mounted approximately 16 inches apart.

The thermocouples shall be monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger shall be operated at its maximum scan rate throughout the overcurrent test.

3.3.3.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current shall be fed into an oscillograph recorder. The oscillograph shall be operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels shall be as specified in the following tables:

Test No. 1

Channel No.	Signal	Location	
1	Current-Phase A	Triplex 2 AWG	
2	Current-Phase B	Triplex 2 AWG	
3	Current-Phase C	Triplex 2 AWG	
4	Voltage A-B	Triplex 2 AWG	
5	Voltage A-C	Triplex 2 AWG	
6	Voltage B-C	Triplex 2 AWG	
7	Current	7/C 12 AWG (V)	
8	Voltage	7/C 12 AWG (V)	
9	Current	2/C 16 AWG (H)	A
10	Voltage	2/C 16 AWG (H)	A
11	Current	Fault Cable	
12	Skipped	N/A	

H = Parallel Cable
V = Perpendicular Cable

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.3.2 Electrical Monitoring (Continued)

Test No. 2

Channel No.	Signal	Location
1	Current-Phase A	Triplex 2 AWG
2	Current-Phase B	Triplex 2 AWG
3	Current-Phase C	Triplex 2 AWG
4	Voltage A-B	Triplex 2 AWG
5	Voltage A-C	Triplex 2 AWG
6	Voltage B-C	Triplex 2 AWG
7	Current	7/C 12 AWG
8	Voltage	7/C 12 AWG
9	Skipped	N/A
10	Skipped	N/A
11	Current	Fault Cable
12	Skipped	N/A

Test No. 3

Channel No.	Signal	Location
1	Current-Phase A	Triplex 2 AWG
2	Current-Phase B	Triplex 2 AWG
3	Current-Phase C	Triplex 2 AWG
4	Voltage A-B	Triplex 2 AWG
5	Voltage A-C	Triplex 2 AWG
6	Voltage B-C	Triplex 2 AWG
7	Skipped	N/A
8	Skipped	N/A
9	Skipped	N/A
10	Skipped	N/A
11	Current	Fault Cable
12	Skipped	N/A

A digital multimeter shall be utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data shall be recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC (120 VAC for control cables) throughout the overcurrent test.

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.4 Baseline Functional Tests

The baseline functional tests shall consist of insulation resistance and high potential measurements on each of the target cables.

3.3.4.1 Insulation Resistance Test

1. Disconnect all power and instrumentation leads from the target cables and label per Figures 12, 13, and 14.

2. Using a megohmmeter, apply a potential of 1000 VDC (500 VDC for 2/C 16 AWG cables) and record the minimum insulation resistance indicated after a period of 60 seconds between the following test points: A

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut
1 to 3	2 to unistrut
2 to 3	3 to unistrut

Target Control Cable:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to unistrut
	4 to unistrut

Target Instrument Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut*
	2 to unistrut

A

* Shield tied to unistrut

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., greater than 1.6×10^6 ohms.

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.4 Baseline Functional Tests (Continued)

3.3.4.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cable) shall be applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute. A

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or tray
1 to 3	2 to unistrut or tray
2 to 3	3 to unistrut or tray

Target Control Cable:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to unistrut
	4 to unistrut

Target Instrument Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut*
	2 to unistrut

A

* Shield tied to unistrut

2. Reconnect all power and instrumentation leads per Figures 12, 13, and 14.

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.2, i.e., there shall be no evidence of insulation breakdown or flashover.

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.5 Overcurrent Test

The overcurrent test shall be conducted in four sequential steps with no intentional time delay. The first phase consists of energizing the fault cable with SWEC rated current. The second phase consists of increasing the current until fault cable temperatures are within 189°-199°F for 5 minutes. The third phase consists of energizing the fault cable with the worst case electrical fault current until the cable open-circuits, temperature stabilizes or decreases, or the test is terminated at the customer's request. In the event that the fault cable is short-circuited (temperature decreasing and insulation burnt-off) or temperatures stabilized, maximum let-through current shall be simulated. This let-through current shall be assumed at the load, based on the backup circuit breaker, and maintained until the fault cable open circuits. The let-through current shall be either 660 amperes for Cables No. 1 through 5, or 2200 amperes for Cables No. 6 through 12, or the maximum Multi-Amp Test Set output.

The target cables shall conduct SWEC-rated current (see Paragraph 2.1.3) at 575 VAC (power cables) or 120 VAC (control cables) throughout the overcurrent test. The overcurrent test shall be conducted using the following procedure:

1. Connect the WCC fault cable to the copper bus bars per Figure 11 (Tests No. 1, 2, and 3).
2. Install a Triplex 2 AWG target cable per Figure 2 (Test 1), Figure 3 (Test 2), and Figure 4 (Test 3).
3. Install a 7/C 12 AWG target cables per Figure 2 (Test 1) and Figure 3 (Test 2).
4. Install a 2/C 16 AWG target cable per Figure 2 (Test 1). A
5. Connect the Triplex 2 AWG target cable to the instrumentation and power supplies of Figure 12 (Tests 1, 2, and 3).
6. Connect the 7/C 12 AWG target cable to the instrumentation and power supplies of Figure 13 (Tests 1 and 2). A
7. Connect the 2/C 16 AWG target cable to the instrumentation and power supplies of Figure 14 (Test 1).
8. Energize the Triplex 2 AWG target cable with 38.5 amperes at 575 VAC (Tests 1, 2, and 3).
9. Energize the 7/C 12 AWG target cable with 10 amperes at 120 VAC (Tests 1 and 2). A
10. Energize the 2/C 16 AWG target cable with 1 ampere at 50 VAC (Test 1).

3.0 TEST PROGRAM (Continued)

3.3 Configuration Number 1 Tests (Continued)

3.3.5 Overcurrent Test (Continued)

11. Energize the WCC fault cable with rated current from the Multi-Amp Test Set per Table 1. A
12. Record target cable voltages and currents and the fault cable current.
13. Slowly increase fault cable current until thermocouple Channels 7 and/or 8 indicate 90 $\pm$3°C (189-199°F) conductor temperature.
14. Maintain the conductor temperature at 189-199°F for five minutes.
15. Record fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6.
16. Increase the Multi-Amp Test Set output to test current per Table 1. A
17. Record target cable voltages and currents and the fault cable current.
18. Allow the fault cable to conduct test current until either the cable open-circuits, temperatures stabilize or the test is terminated by the customer.
19. If an open circuit occurs, record the elapsed time and maximum cable temperature and proceed to Step 23. A
20. If a. 15-minute period of stabilized temperature occurs, record the maximum temperature, elapsed time and applied current level, and proceed to Step 22. A
21. Should the fault cable ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes, record the maximum temperature, elapsed time and applied current level, and proceed to Step 22. A
22. Increase fault cable current to 660 amperes (Cables 1 through 5) or 2200 amperes (Cables 6 through 12) until the fault cable open-circuits or the test is terminated at the customer's request. A
23. Record target cable voltages and currents. A
24. De-energize the target cables and the Multi-Amp Test Set. A
25. Photograph the post-test condition. A

For all performances of this test, the observed target cable operation shall be compared to the acceptance criteria, Paragraph 2.1.3, i.e., they shall maintain continuity of power.

3.3.6 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 3.3.4 shall be repeated.

3.0 TEST PROGRAM (Continued)

3.4 Configuration Number 2 Tests

Configuration Number 2 shall consist of tests between free air and wrapped cables. For Test No. 1, the faulted cable shall be wrapped and the target cable shall be outside the wrapping. For Test No. 2, the target cable shall be wrapped and the fault cable shall be outside the wrapping.

3.4.1 Purpose

The purposes of the Configuration Number 2 tests are to:

1. Demonstrate the acceptability of design where two cables in free air come in contact with each other when a worst case electrical fault occurs to a bare cable in contact with a wrapped cable. This configuration represents field installations of free air cable drops for cables going from:

   a. Tray to tray

   b. Tray to conduit

   c. Conduit to conduit

   d. Tray/Conduit to equipment.

   e. Tray/Conduit to wall sleeves, etc. A

2. Demonstrate that a fault cable enclosed within SWEC protective wrap does not affect the external cables with zero-inch separation.

3. Demonstrate that a faulted cable external to the SWEC-protected cable wrap does not affect the protected cable with zero-inch separation.

4. Demonstrate the acceptability of the SWEC protective wrap as a thermal barrier during a worst case electrical fault.

3.4.2 Test Specimen Preparation

The test specimen shall be mounted to the unistrut frame assembly per Figure 5. This apparatus shall be assembled to the indicated dimensions by Wyle technicians using materials supplied from NMP2. The following guidelines shall be observed with regard to the materials and construction of the assembly:

1. The faulted cable for both tests shall be a WCC cable from NMP2 stock.

2. For Test No. 1, the faulted cable shall be wrapped using a single layer of SWEC protective wrap using a 400% overlap. For Test No. 2, the ends of the faulted cable from their termination at the copper bus bar to the edge of the unistrut frame shall be wrapped with a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape (or any other barrier material specified by SWEC). This wrapping shall be done to ensure that any ignition that might occur is contained to the test area.

3.0 TEST PROGRAM (Continued)

3.4 Configuration Number 2 Tests (Continued)

3.4.2 Test Specimen Preparation (Continued)

3. The target cable shall be a Triplex 1/0 AWG cable from NMP2 stock.

4. For Test No. 1, the target cable shall be an unwrapped cable. For Test No. 2, the target cable shall be wrapped for the length inside the unistrut test fixture extending approximately two feet on either side as shown in Figure 6. This wrapping shall be done using a 400% overlap of the SWEC protective wrap.

5. Photographs shall be taken of the test setup prior to each test.

3.4.3 Instrumentation Setup

3.4.3.1 Thermocouple Locations

A total of 14 Type "K" thermocouples shall be utilized for these tests. The thermocouples shall be mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 12 inches apart. For Test No. 1, the thermocouples shall be underneath the SWEC protective wrap.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket on the target cable. These thermocouples shall be mounted approximately 12 inches apart and close to the location of Channels 1-6. For Test No. 2, the thermocouples shall be inside the SWEC protective wrap.

The thermocouples shall be monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger shall be operated at its maximum scan rate throughout the overcurrent test.

3.0 TEST PROGRAM (Continued)

3.4 Configuration Number 2 Tests (Continued)

3.4.3 Instrumentation Setup (Continued)

3.4.3.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current shall be fed into an oscillograph recorder. The oscillograph shall be operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels shall be as specified in the following table:

Channel No.	Signal	Cable
1	Current-Phase A	Triplex 1/0 AWG
2	Current-Phase B	Triplex 1/0 AWG
3	Current-Phase C	Triplex 1/0 AWG
4	Voltage A-B	Triplex 1/0 AWG
5	Voltage A-C	Triplex 1/0 AWG
6	Voltage B-C	Triplex 1/0 AWG
7-9	Skipped	N/A
10	Current	Fault Cable
11 & 12	Skipped	N/A

A digital multimeter shall be utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data shall be recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC throughout the overcurrent test.

3.4.4 Baseline Functional Tests

The baseline functional tests shall consist of insulation resistance and high potential measurements on each of the target cables.

3.4.4.1 Insulation Resistance Test

1. Disconnect all power and instrumentation leads from the target cable and label per Figure 12.

2. Using a megohmmeter, apply a potential of 1000 VDC and record the minimum insulation resistance indicated after a period of 60 seconds between the following test points:

3.0 TEST PROGRAM (Continued)

3.4 Configuration Number 2 Tests (Continued)

3.4.4 Baseline Functional Tests (Continued)

3.4.4.1 Insulation Resistance Test (Continued)

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut
1 to 3	2 to unistrut
2 to 3	3 to unistrut

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., greater than 1.6×10^6 ohms.

3.4.4.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC shall be applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Target Power Cable:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut
1 to 3	2 to unistrut
2 to 3	3 to unistrut

2. Reconnect all power and instrumentation leads per Figure 12.

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.2, i.e., there shall be no evidence of insulation breakdown or flashover.

3.0 TEST PROGRAM (Continued)

3.4 Configuration Number 2 Tests (Continued)

3.4.5 Overcurrent Test

The overcurrent test shall be conducted in four sequential steps with no intentional time delay. The first phase consists of energizing the fault cable with SWEC rated current. The second phase consists of increasing the current until fault cable temperatures are within 189°-199°F for 5 minutes. The third phase consists of energizing the fault cable with the worst case electrical fault current until the cable open-circuits, temperature stabilize or decrease, or the test is terminated at the customer's request. In the event that the fault cable is short-circuited (temperature decreasing and insulation burnt-off) or temperatures stabilize, a maximum let-through current shall be simulated. This let-through current shall be assumed at the load, based on the backup circuit breaker, and maintained until the fault cable open circuits. The let-through current shall be either 660 amperes for Cables No. 1 through 5, or 2200 amperes for Cables No. 6 through 12, or the maximum Multi-Amp Test Set output.

The target cables shall conduct SWEC rated current (see Paragraph 2.1.3) at 575 VAC throughout the overcurrent test. The overcurrent test shall be conducted using the following procedure: A

1. Connect the WCC fault cable to the copper bus bars per Figure 10.

   For Test No. 1, this cable is wrapped. For Test No. 2, this cable is unwrapped.

2. Install a Triplex 1/0 AWG target cable per Figure 5 or 6.

   For Test No. 1, this cable is unwrapped. For Test No. 2, this cable is wrapped.

3. Connect the Triplex 1/0 AWG target cable to the instrumentation and power supplies of Figure 12.

4. Energize the Triplex 1/0 AWG target cable with 124 amperes at 575 VAC.

5. Energize the WCC fault cable with rated current from the Multi-Amp Test Set per Table 1. A

6. Record target cable voltages and currents and the fault cable current.

7. Slowly increase fault cable current until thermocouple Channels 7 and/or 8 indicate 90 $\pm 3^{\circ}$C (189-199°F) conductor temperature.

8. Maintain the conductor temperature at 189-199°F for five minutes.

3.0 TEST PROGRAM (Continued)

3.4 Configuration Number 2 Tests (Continued)

3.4.5 Overcurrent Test (Continued)

9. Record fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6.

10. Increase the Multi-Amp Test Set output to test current per Table 1. A

11. Record target cable voltages and currents and the fault cable current.

12. Allow the fault cable to conduct test current until either the cable open-circuits, temperatures stabilize or decrease, or the test is terminated at the customer's request.

13. If an open circuit occurs, record the elapsed time and maximum cable temperature, and proceed to Step 17. A

14. If a 15-minute period of stabilized temperature occurs, record the maximum temperature, elapsed time and applied current level, and proceed to Step 16. A

15. Should the fault cable ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes, record the maximum temperature, elapsed time and applied current level, and proceed to Step 16. A

16. Increase fault cable current to 660 amperes (Cables 1 through 5) or 2200 amperes (Cables 6 through 12) until the fault cable open-circuits or the test is terminated at the customer's request. A

17. Record target cable voltages and currents. A

18. De-energize the target cables and the Multi-Amp Test Set. A

19. Photograph the post-test condition. A

For all performances of this test, the observed target cable operation shall be compared to the acceptance criteria, Paragraph 2.1.3, i.e., they shall maintain continuity of power.

3.4.6 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 3.4.4 shall be repeated.

3.0 TEST PROGRAM (Continued)

3.5 Configuration Number 3 Tests

Configuration Number 3 shall consist of two tests between a horizontal tray and a one-inch conduit mounted parallel to the tray. In Test 1, the faulted cable shall be in the cable tray one inch below the conduit. In Test 2, the faulted cable shall be in the conduit below the cable tray.

3.5.1 Purpose

The purpose of the Configuration Number 3 tests is to demonstrate that target cables enclosed in rigid steel conduit running parallel and one inch above a filled cable tray are not adversely affected by a faulted cable in the tray, and also that target cables in a tray running parallel and immediately above a cable in a rigid steel conduit are not adversely affected when the worst case fault occurs in the conduit.

3.5.2 Test Specimen Preparation

The test specimens shall be mounted to the unistrut frame assembly of Figure 7. This apparatus shall be assembled to the indicated dimensions by Wyle technicians using materials supplied by NMP2. The following guidelines shall be observed with regard to the materials and construction of the assembly:

1. The faulted cable shall be a WCC cable from NMP2 stock.

2. For Test 1, the faulted cable shall be contained inside the cable tray at the centerline of the tray as shown in Figure 7. The cable tray shall be mounted one inch below the conduit. For Test 2, the faulted cable shall be contained inside the conduit below the cable tray as shown in Figure 8.

3. The ends of the faulted cable from their termination at the copper bus bar to the edge of the cable tray or conduit shall be wrapped with a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape (or any other barrier material specified by SWEC). This wrapping shall be done to ensure that any ignition that might occur is contained to the test area.

4. For Test 1, the conduit shall be 1-inch rigid steel. For Test 2, the conduit shall be 4-inch rigid steel. A

5. Photographs shall be taken of the test setup prior to each test.

3.5.3 Instrumentation Setup

3.5.3.1 Thermocouple Locations

A total of 17 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below for both Test 1 and Test 2.

3.0 TEST PROGRAM (Continued)

3.5 Configuration Number 3 Tests (Continued)

3.5.3.1 Thermocouple Locations (Continued)

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-11	Mounted to the outside of the conduit. These thermocouples shall be mounted approximately 16 inches apart and above Channels 3, 4, and 5.
12-17	Mounted to the jacket of the target cable. These thermocouples shall be mounted approximately 16 inches apart and above Channels 1-6.

The thermocouples shall be monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger shall be operated at its maximum scan rate throughout the overcurrent test.

3.5.3.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current shall be fed into oscillograph recorders. The oscillograph shall be operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels shall be as specified in the following table:

Channel No.	Signal	Cable/Location*
1	Current	7/C 12 AWG/C
2	Voltage	7/C 12 AWG/C
3-7	Skipped	N/A
8	Current	Fault Cable/T
9-12	Skipped	N/A

* C = Conduit
T = Tray

For Test 2, in addition to the above, add the below listed thermocouples:

Channel No.	Location
18 & 19	Mounted to the rungs of the cable tray.

3.0 TEST PROGRAM (Continued)

3.5 Configuration Number 3 Tests (Continued)

3.5.3 Instrumentation Setup (Continued)

A digital multimeter shall be utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data shall be recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 120 VAC for the control cables throughout the overcurrent test.

3.5.4 Baseline Functional Tests

The baseline functional tests shall consist of insulation resistance and high potential measurements on each of the target cables.

3.5.4.1 Insulation Resistance Test

1. Disconnect all power and instrumentation leads from the target cables and label per Figures 12 and 13.

2. Using a megohmmeter, apply a potential of 1000 VDC and record the minimum insulation resistance indicated after a period of 60 seconds between the following test points.

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit 4 to conduit

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., greater than 1.6×10^6 ohms.

3.5.4.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC shall be applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit 4 to conduit

3.0 TEST PROGRAM (Continued)

3.5 Configuration Number 3 Tests (Continued)

3.5.4.2 High Potential Test (Continued)

2. Reconnect all power and instrumentation leads per Figures 12 and 13.

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.2, i.e., there shall be no evidence of insulation breakdown or flashover.

3.5.5 Overcurrent Test

The overcurrent test shall be conducted in four sequential steps with no intentional time delay. The first phase consists of energizing the fault cable wtih SWEC rated current. The second phase consists of increasing the current until tault cable temperatures are within 189°-199°F for 5 minutes. The third phase consists of energizing the fault cable with the worst case electrical fault current until the cable open-circuits, temperature stabilize or decrease, or the test is terminated at the customer's request. In the event that the fault cable is short-circuited (temperature decreasing and insulation burnt-off) or temperatures have stabilized, maximum let-through current shall be simulated. This let-through current shall be assumed at the load, based on the backup circuit breaker, and maintained until the fault cable open circuits. The let-through current shall be either 660 amperes for Cables No. 1 through 5, or 2200 amperes for Cables No. 6 through 12, or the maximum Multi-Amp Test Set output.

The target control cable shall conduct SWEC-rated current (see Paragraph 2.1.3) at 120 VAC throughout the overcurrent test. The overcurrent test shall be conducted using the following procedure.

1. Connect the WCC fault cable to the copper bus bars per Figure 11.

2. Install a 7/C 12 AWG target cable per Figure 7 into the conduit (Test 1) or per Figure 8 into the cable tray.

3. Connect the 7/C 12 AWG target cable to the instrumentation and power supplies of Figure 13.

4. Energize the 7/C 12 AWG target cable with 10 amperes at 120 VAC.

5. Energize the WCC fault cable with rated current from the Multi-Amp Test Set per Table 1. A

6. Record target cable voltages and currents and the fault cables current.

3.0 TEST PROGRAM (Continued)

3.5 Configuration Number 3 Tests (Continued)

3.5.5 Overcurrent Test (Continued)

7. Slowly increase fault cable current until Thermocouple Channels 7 and/or 8 indicate 90 $\pm 3^{o}$C (189-199^{o}F) conductor temperature.

8. Maintain the conductor temperature at 189-199^{o}F for five minutes.

9. Record fault cable current, conductor temperature, and the highest of Thermocouple Channels 1 through 6.

10. Increase the Multi-Amp Test Set output to test current per Table 1. A

11. Record target cable voltages, currents and the fault cable current.

12. Allow the fault cable to conduct test current until either the cable open-circuits, temperatures stabilize or decrease, or the test is terminated at the customer's request.

13. If an open circuit occurs, record the elapsed time and maximum cable temperature, and proceed to Step 17. A

14. If a 15-minute period of stabilized temperature occurs, record the maximum temperature, elapsed time and applied current level, and proceed to Step 16. A

15. Should the fault cable ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes, record the maximum temperature, elapsed time and applied current level, and proceed to Step 16. A

16. Increase fault cable current to 660 amperes (Cables 1 through 5) or 2200 amperes (Cables 6 through 12) until the fault cable open-circuits or the test is terminated at the customer's request. A

17. Record target cable voltages and currents. A

18. De-energize the target cables and the Multi-Amp Test Set. A

19. Photograph the post-test condition. A

For all performances of this test, the observed target cable operation shall be compared to the acceptance criteria, Paragraph 2.1.3, i.e., they shall maintain continuity of power.

3.5.6 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 3.5.4 shall be repeated.

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test

Configuration Number 4 shall consist of a test between three vertically separated horizontal cable trays. The faulted cable shall be in the center horizontal cable tray.

3.6.1 Purpose

The purpose of the Configuration Number 4 test is to demonstrate the acceptability of design where three horizontal cable trays are separated by 9 inches (from the top of one tray to the bottom of the next tray) when the worst case electrical fault occurs in the center cable tray.

3.6.2 Test Specimen Preparation

The test specimens shall be mounted into the test assembly of Figure 9. This apparatus shall be manufactured to the indicated dimensions by Wyle technicians using materials supplied by NMP2. The following guidelines shall be observed with regard to the materials and construction of the assembly:

1. The fault cable shall be a WCC cable from NMP2 stock.
2. The faulted cable shall be located at the centerline of Tray T2 as shown in Figure 9.
3. The ends of the fault cable shall be wrapped from their termination on the copper bus bar to the edge of their cable tray. This wrap shall consist of a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape (or any other barrier material specified by SWEC). This wrapping shall be done to ensure that any ignition that might occur is contained to the cable tray test area.
4. The horizontal cable trays shall be mounted such that there are nine inches between the top of the siderail of one tray to the bottom of the siderail to the next higher cable tray.
5. The cable trays shall contain the following cables from NMP2 stock:

Raceway No.	Raceway Cable Fill
T1	Mixture of K-Type cables with one Triplex 2 AWG target cable in the bottom layer at the centerline of the tray.
T2	Mixture of K-Type cables with one WCC fault cable at the top centerline of the tray.
T3	Mixture of C- and X-Type cables with one 7/C 12 AWG and one 2/C 16 AWG target cables at the top centerline of the tray. A

6. Photographs shall be taken of the test setup prior to the test.

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test (Continued)

3.6.3 Instrumentation Setup

3.6.3.1 Thermocouple Locations

A total of 20 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket of the target cable in Tray T1. These thermocouples shall be mounted approximately 16 inches apart.
15-20	Mounted to the jacket of the target cables in Tray T3. These thermocouples shall be mounted approximately 16 inches apart.

The thermocouples shall be monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger shall be operated at it maximum scan rate throughout the overcurrent test.

3.6.3.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current shall be fed into oscillograph recorders. The oscillograph shall be operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels shall be as specified in the following table:

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test (Continued)

3.6.3.2 Electrical Monitoring (Continued)

Oscillograph No. 1

Channel No.	Signal	Cable/Location	
1	Current-Phase A	Triplex 2 AWG/T1	
2	Current-Phase B	Triplex 2 AWG/T1	
3	Current-Phase C	Triplex 2 AWG/T1	
4	Voltage A-B	Triplex 2 AWG/T1	
5	Voltage A-C	Triplex 2 AWG/T1	
6	Voltage B-C	Triplex 2 AWG/T1	
7	Current	7/C 12 AWG/T3	
8	Voltage	7/C 12 AWG/T3	
9	Current	2/C 16 AWG/T3	A
10	Voltage	2/C 16 AWG/T3	A
11	Skipped	N/A	
12	Current	Fault Cable/T2	

A digital multimeter shall be utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data shall be recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC (120 VAC for control cables and 50 VAC for instrument cables) throughout the overcurrent test.

3.6.4 Baseline Functional Tests

The baseline functional tests shall consist of insulation resistance and high potential measurements on each of the target cables.

3.6.4.1 Insulation Resistance Test

1. Disconnect all power and instrumentation leads from the target cables and label per Figures 12, 13, or 14.

2. Using a megohmmeter, apply a potential of 1000 VDC (500 VDC for 2/C 16 AWG cable) and record the minimum insulation resistance indicated after a period of 60 seconds between the following test points: A

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test (Continued)

3.6.4.1 Insulation Resistance Test (Continued)

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or tray
1 to 3	2 to unistrut or tray
2 to 3	3 to unistrut or tray

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to tray or conduit
	4 to tray or conduit

Target Instrument Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to shield*
	2 to shield*

*One end of shield tied to unistrut, tray or conduit.

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., greater than 1.6×10^6 ohms.

3.6.4.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC (1600 VAC for 2/C 16 AWG cable) shall be applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute. A

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to tray
1 to 3	2 to tray
2 to 3	3 to tray

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test (Continued)

3.6.4.2 High Potential Test (Continued)

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit or tray 4 to conduit or tray

Target Instrument Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to shield* 2 to shield*

*One end of shield tied to conduit or tray.

2. Reconnect all power and instrumentation leads per Figure 12, 13, or 14.

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.2, i.e., there shall be no evidence of insulation breakdown or flashover.

3.6.5 Overcurrent Test

The overcurrent test shall be conducted in four sequential steps with no intentional time delay. The first phase consists of energizing the fault cable with SWEC rated current. The second phase consists of increasing the current until fault cable temperatures are within 189°-199°F for 5 minutes. The third phase consists of energizing the fault cable with the worst case electrical fault current until the cable open-circuits, temperature stabilize or decrease, or the test is terminated at the customer's request. In the event that the fault cable is short-circuited (temperature decreasing and insulation burnt-off) or temperatures have stabilized, maximum let-through current shall be simulated. This let-through current shall be assumed at the load, based on the backup circuit breaker, and maintained until the fault cable open circuits. The let-through current shall be either 660 amperes for Cables No. 1 through 5, or 2200 amperes for Cables No. 6 through 12, or the maximum Multi-Amp Test Set output.

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test (Continued)

3.6.5 Overcurrent Test (Continued)

The target control cables shall conduct SWEC-rated current (see Paragraph 2.1.3) at 575 VAC (power cables), 120 VAC (control cables), or 50 VAC (instrument cables) throughout the overcurrent test. The overcurrent test shall be conducted using the following procedure:

1. Connect the WCC fault cable to the copper bus bars per Figure 11.
2. Install a 7/C 12 AWG and a 2/C 16 AWG target cable per Figure 9 into Tray T3. A
3. Install a Triplex 2 AWG target cable per Figure 9 into Tray T1.
4. Connect the Triplex 2 AWG target cable to the instrumentation and power supplies of Figure 12.
5. Connect the 7/C 12 AWG target cables to the instrumentation and power supplies of Figure 13.
6. Connect the 2/C 16 AWG target cable to the instrumentation and power supplies of Figure 14. A
7. Energize the Triplex 2 AWG target cable with 38.5 amperes at 575 VAC.
8. Energize the 7/C 12 AWG target cables with 10 amperes at 120 VAC.
9. Energize the 2/C 16 AWG target cable with one ampere at 50 VAC. A
10. Energize the WCC fault cable with rated current from the Multi-Amp Test Set per Table 1. A
11. Record target cable voltages and currents and the fault cables current.
12. Slowly increase fault cable current until thermocouple Channels 7 and/or 8 indicate 90 $\pm 3^{o}$C (189-199^{o}F) conductor temperature.
13 Maintain the conductor temperature at 189-199^{o}F for five minutes.
14. Record fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6.

3.0 TEST PROGRAM (Continued)

3.6 Configuration Number 4 Test (Continued)

3.6.5 Overcurrent Test (Continued)

15. Increase the Multi-Amp Test Set output to TBD amperes (test current).

16. Record target cable voltages, currents and the fault cable current.

17. Allow the fault cable to conduct test current until either the cable open-circuits, temperatures stabilize or decrease, or the test is terminated at the customer's request.

18. If an open circuit occurs, record the elapsed time and maximum cable temperature, and proceed to Step 22. A

19. If a 15-minute period of stabilized temperature occurs, record the maximum temperature, elapsed time and applied current level, and proceed to Step 21. A

20. Should the fault cable ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes, record the maximum temperature, elapsed time and applied current level, and proceed to Step 21. A

21. Increase fault cable current to 660 amperes (Cables 1 through 5) or 2200 amperes (Cables 6 through 12) until the fault cable open-circuits or the test is terminated at the customer's request. A

22. Record target cable voltages and currents. A

23. De-energize the target cables and the Multi-Amp Test Set. A

24. Photograph the post-test condition. A

For all performances of this test, the observed target cable operation shall be compared to the acceptance criteria, Paragraph 2.1.3, i.e., they shall maintain continuity of power.

3.6.6 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 3.6.4 shall be repeated.

3.0 TEST PROGRAM (Continued)

3.7 Configuration Number 5 Tests

Configuration Number 5 shall consist of tests between flexible conduit, rigid conduit, and cable in free air mounted within 1/4-inch of each other. For Test No. 1, the faulted cable shall be the bare cable. For Test No. 2, the faulted cable shall be in the rigid conduit. For Test No. 3, the faulted cable shall be in the flexible conduit.

3.7.1 Purpose

The purpose of the Configuration Number 5 tests is to demonstrate the acceptability of design where a rigid conduit, flexible conduit, and a cable in free air are separated by less than 1/4-inch from each other (but not in contact), when the worst-case electrical fault occurs in either conduit or to the bare cable.

3.7.2 Test Specimen Preparation

The test specimens shall be mounted into the test assembly of Figure 10. This apparatus shall be manufactured to the indicated dimensions by Wyle technicians using materials supplied by NMP2. The following guidelines shall be observed with regard to the materials and construction of the assembly:

1. The fault cable shall be a WCC cable from NMP2 stock and mounted in Location 3 of Figure 10 for all three tests.

2. The ends of the faulted cable shall be wrapped from their termination on the copper bus bar to the edge of the test assembly. This wrap shall consist of a single layer of HAVEG SILTEMP WT-65 covered with a single layer of 3M No. 69 glass tape (or any other barrier materials specified by SWEC). This wrapping shall be done to ensure that any ignition that might occur is contained to the cable tray test area.

3. A Triplex 2 AWG target power cable from NMP2 stock shall be mounted in Location 2 of Figure 10 for all three tests.

4. A 7/C 12 AWG target control cable from NMP2 stock shall be mounted in Location 1 of Figure 10 for all three tests.

5. The conduits and free air cable shall be orientated as described below:

Test No.	Location 1	Location 2	Location 3
1	Anaconda Flexible Conduit	Rigid Conduit	Free Air Cable
2	Free Air Cable	BOA Flexible Conduit	Rigid Conduit
3	Rigid Conduit	Free Air Cable	Anaconda Flexible Conduit

3.0 TEST PROGRAM (Continued)

3.7 Configuration Number 5 Tests (Continued)

3.7.2 Test Specimen Preparation (Continued)

6. The conduits and cable shall be mounted within 1/4-inch of each other (but not in contact) for all three tests.

7. Photographs shall be taken of the test setup prior to each test.

3.7.3 Instrumentation Setup

3.7.3.1 Thermocouple Locations

A total of 24 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below.

Channel No.	Location
1-6	Mounted to the jacket on the fault cable. These thermocouples shall be mounted approximately 16 inches apart.
7 & 8	Mounted to the conductor of the fault cables at the two series connections.
9-14	Mounted to the jacket of the target cable in Location 1. These thermocouples shall be mounted approximately 16 inches apart.
15-20	Mounted to the jacket of the target cable in Location 2. These thermocouples shall be mounted approximately 16 inches apart.
21 & 22	Mounted to the outside of the flexible conduit on the side towards the rigid conduit.
23 & 24	Mounted to the outside of the rigid conduit on the side towards the flexible conduit.

The thermocouples shall be monitored by a Fluke Datalogger feeding a high-speed printer. The datalogger shall be operated at its maximum scan rate throughout the overcurrent test.

3.0 TEST PROGRAM (Continued)

3.7 Configuration Number 5 Tests (Continued)

3.7.3.2 Electrical Monitoring

All phase-to-phase voltages and phase currents of the target cables and the fault cable current shall be fed into oscillograph recorders. The oscillograph shall be operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels shall be as specified in the following table.

Channel No.	Signal	Cable
1	Current	7/C 12 AWG Target Cable
2	Voltage	7/C 12 AWG Target Cable
3	Current-Phase A	Triplex 2 AWG Target Cable
4	Current-Phase B	Triplex 2 AWG Target Cable
5	Current-Phase C	Triplex 2 AWG Target Cable
6	Voltage A-B	Triplex 2 AWG Target Cable
7	Voltage A-C	Triplex 2 AWG Target Cable
8	Voltage B-C	Triplex 2 AWG Target Cable
9 & 10	Skipped	N/A
11	Current	Fault Cable
12	Skipped	N/A

A digital multimeter shall be utilized to measure all phase-to-phase or phase voltages and phase currents of the target cables prior to, during, and after the overcurrent test. This data shall be recorded to provide accurate evidence of the specimen's capability to conduct SWEC-rated current at 575 VAC (120 VAC for control cables) throughout the overcurrent test.

3.7.4 Baseline Functional Tests

The baseline functional tests shall consist of insulation resistance and high potential measurements on each of the target cables.

3.7.4.1 Insulation Resistance Test

1. Disconnect all power and instrumentation leads from the target cables and label per Figure 12 or 13.

2. Using a megohmmeter, apply a potential of 1000 VDC and record the minimum insulation resistance indicated after a period of 60 seconds between the following test points.

3.0 TEST PROGRAM (Continued)

3.7 Configuration Number 5 Tests (Continued)

3.7.4.1 Insulation Resistance Test (Continued)

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or conduit
1 to 3	2 to unistrut or conduit
2 to 3	3 to unistrut or conduit

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit or unistrut
	4 to conduit or unistrut

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., greater than 1.6×10^6 ohms.

3.7.4.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC shall be applied from each conductor to ground and between conductors on multiconductor cable for a period of one minute.

Target Power Cables:

Phase-to-Phase	Phase-to-Ground
1 to 2	1 to unistrut or conduit
1 to 3	2 to unistrut or conduit
2 to 3	3 to unistrut or conduit

Target Control Cables:

Phase-to-Phase	Phase-to-Ground
1 to 4	1 to conduit or unistrut
	4 to conduit or unistrut

2. Reconnect all power and instrumentation leads per Figure 12 or 13.

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.2, i.e., there shall be no evidence of insulation breakdown or flashover.

3.0 TEST PROGRAM (Continued)

3.7 Configuration Number 5 Tests (Continued)

3.7.5 Overcurrent Test

The overcurrent test shall be conducted in four sequential steps with no intentional time delay. The first phase consists of energizing the fault cable with SWEC rated current. The second phase consists of increasing the current until fault cable temperatures are within 189°-199°F for 5 minutes. The third phase consists of energizing the fault cable with the worst case electrical fault current until the cable open-circuits, temperature stabilize or decrease, or the test is terminated at the customer's request. In the event that the fault cable is short-circuited (temperature decreasing and insulation burnt-off) or temperatures have stabilized, maximum let-through current shall be simulated. This let-through current shall be assumed at the load, based on the backup circuit breaker, and maintained until the fault cable open circuits. The let-through current shall be either 660 amperes for Cables No. 1 through 5, or 2200 amperes for Cables No. 6 through 12, or the maximum Multi-Amp Test Set output.

The target control cables shall conduct SWEC-rated current (see Paragraph 2.1.3) at 575 VAC (power cables) or 120 VAC (control cables) throughout the overcurrent test. The overcurrent test shall be conducted using the following procedure:

1. Connect the WCC fault cable to the copper bus bars per Figure 11.
2. Install a 7/C 12 AWG target cable per Figure 10.
3. Install a Triplex 2 AWG target cable per Figure 10.
4. Connect the Triplex 2 AWG target cable to the instrumentation and power supplies of Figure 12.
5. Connect the 7/C 12 AWG target cables to the instrumentation and power supplies of Figure 13.
6. Energize the Triplex 2 AWG target cable with 34 amperes at 575 VAC.
7. Energize the 7/C 12 AWG target cable with 10 amperes at 120 VAC.
8. Energize the WCC fault cable with rated current from the Multi-Amp Test Set per Table 1. A
9. Record target cable voltages and currents and the fault cables current.
10. Slowly increase fault cable current until thermocouple Channels 7 and/or 8 indicate 90 ± 3°C (189-199°F) conductor temperature.
11. Maintain the conductor temperature at 189-199°F for five minutes.

3.0 TEST PROGRAM (Continued)

3.7 Configuration Number 5 Tests (Continued)

3.7.5 Overcurrent Test (Continued)

12. Record fault cable current, conductor temperature, and the highest of thermocouple Channels 1 through 6.

13. Increase the Multi-Amp Test Set output to test current per Table 1. A

14. Record target cable voltages, currents and the fault cable current.

15. Allow the fault cable to conduct test current until either the cable open-circuits, temperatures stabilize or decrease, or the test is terminated at the customer's request.

16. If an open circuit occurs, record the elapsed time and maximum cable temperature, and proceed to Step 20. A

17. If a 15-minute period of stabilized temperature occurs, record the maximum temperature, elapsed time and applied current level, and proceed to Step 19. A

18. Should the fault cable ignite but not open-circuit and cable jacket/conductor temperatures decrease for 15 minutes, record the maximum temperature, elapsed time and applied current level, and proceed to Step 19. A

19. Increase fault cable current to 660 amperes (Cables 1 through 5) or 2200 amperes (Cables 6 through 12) until the fault cable open-circuits or the test is terminated at the customer's request. A

20. Record target cable voltages and currents. A

21. De-energize the target cables and the Multi-Amp Test Set. A

22. Photograph the post-test condition. A

For all performances of this test, the observed target cable operation shall be compared to the acceptance criteria, Paragraph 2.1.3, i.e., they shall maintain continuity of power.

3.7.6 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 3.7.4 shall be repeated.

3.0 TEST PROGRAM (Continued)

3.8 Configuration Number 6 Tests

Configuration Number 6 shall consist of a test of cables and bundled, insulated conductors terminated on terminal blocks inside an enclosure, wherein a fault occurs on one of the cable conductors.

3.8.1 Purpose

The purpose is to demonstrate the acceptability of design where control and/or instrument cables are bundled together inside any control and/or instrument cabinet when the worst case electrical fault occurs on any control cable.

3.8.2 Test Specimen Preparation

The test assembly shall be manufactured in accordance with Figure 15 by Wyle technicians. The following guidelines shall be observed with regard to the materials and construction of the assembly:

1. The cable and terminal blocks inside the enclosure shall be from NMP2 stock. All other materials shall be provided by Wyle Laboratories.

2. The ends of the faulted cable shall be wrapped from their connection to the Multi-Amp Test Set to the enclosure. This wrap shall consist of a single layer of HAVEG Siltemp WT-65 covered with a single layer of 3M No. 69 glass tape (or any other barrier materials specified by SWEC). This wrapping shall be done to ensure that any ignition that might occur is contained within the enclosure.

3. All nonfaulted conductors in the 5/C cable shall be connected in series as shown in Figure 16. This circuit is designated Target Conductor Loop No. 1.

4. Both conductors in the 2/C cable shall be connected in series as shown in Figure 16. This circuit is designated Target Conductor Loop No. 2.

3.8.3 Instrumentation Setup

3.8.3.1 Thermocouple Locations

A total of 18 Type "K" thermocouples shall be utilized for this test. These thermocouples shall be mounted as described below:

Channel No.	Location
1 & 2	Mounted to the jacket of the 5/C 12 AWG cable.
3	Mounted to the jacket of the faulted conductor of the 5/C 12 AWG cable.

3.0 TEST PROGRAM (Continued)

3.8 Configuration Number 6 Tests (Continued)

3.8.3.1 Thermocouple Locations (Continued)

Channel No.	Location
4 & 5	Mounted to the jacket of the faulted 1/C 14 AWG Type SIS cable.
6 & 7	Mounted to the jacket of the 2/C 12 AWG cable.
8	Mounted to the jacket of the nonfaulted conductor of the 5/C 12 AWG cable.
10-16	Mounted to the jacket of the nonfaulted 1/C 14 AWG Type SIS cable. (Channels 10-14 on 5-conductor bundle. Channels 15 and 16 on 2-conductor bundle.)
17	Mounted to the faulted bare conductor of the 5/C 12 AWG cable.
18	Mounted to the faulted bare conductor of the 1/C 14 AWG Type SIS cable.

3.8.3.2 Electrical Monitoring

The voltage and current of each target conductor loop and the faulted conductor current shall be fed into an oscillograph recorder. The oscillograph shall be operated at the 0.1-inch per minute rate throughout the overcurrent test. The oscillograph channels shall be as specified in the following table.

Channel No.	Signal	Location
1	Current	Target Conductor Loop No. 1
2	Voltage	Target Conductor Loop No. 1
3	Current	Target Conductor Loop No. 2
4	Voltage	Target Conductor Loop No. 2
5	Current	Faulted Conductor Loop

3.8.4 Baseline Functional Tests

The baseline functional tests shall consist of insulation resistance and high potential measurements on the nonfaulted conductor loop.

3.0 TEST PROGRAM (Continued)

3.8 Configuration Number 6 Tests (Continued)

3.8.4 Baseline Functional Tests (Continued)

3.8.4.1 Insulation Resistance Test

1. Disconnect all power and instrumentation leads from the nonfaulted conductor loop and label per Figure 16.

2. Using a megohmmeter, apply a potential of 1000 VDC and record the minimum insulation resistance indicated after a period of 60 seconds between the following test points:

Target Conductor Loop No. 1

Phase-to-Phase	Phase-to-Ground
1-1 to 1-2	1-1 to enclosure
	1-2 to enclosure

Target Conductor Loop No. 2

Phase-to-Phase	Phase-to-Ground
3-1 to 3-2	3-1 to enclosure
	3-2 to enclosure

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., greater than 1.6×10^6 ohms.

3.8.4.2 High Potential Test

1. Using a Hi-Pot Test Set, a potential of 2200 VAC shall be applied from each conductor to ground for a period of one minute.

Target Conductor Loop No. 1

Phase-to-Phase	Phase-to-Ground
1-1 to 1-2	1-1 to enclosure
	1-2 to enclosure

Target Conductor Loop No. 2

Phase-to-Phase	Phase-to-Ground
3-1 to 3-2	3-1 to enclosure
	3-2 to enclosure

For all performances of this test, the measured values shall be compared to the acceptance criteria, Paragraph 2.1.1, i.e., there shall be no evidence of insulation breakdown or flashover.

3.0 TEST PROGRAM (Continued)

3.8 Configuration Number 6 Tests (Continued)

3.8.5 Overcurrent Test

The overcurrent test shall be conducted in two sequential steps with no intentional time delay. The first phase consists of energizing the fault conductor loop with 10 amperes for 15 minutes. The second phase consists of energizing the fault conductor loop with 100 amperes for a period of 11 seconds.

Each target conductor loop shall conduct 10 amperes at 120 VAC throughout the overcurrent test. The overcurrent test shall be conducted using the following procedure:

1. Connect the fault conductor loop to the Multi-Amp Test Set per Figure 16.
2. Connect the target conductor loops to the instrumentation and power supplies of Figure 15.
3. Energize each target conductor loop with 10 amperes at 120 VAC.
4. Energize the fault conductor loop with 10 amperes from the Multi-Amp Test Set.
5. Record voltage and current of each target conductor loop and the fault conductor loop current.
6. Maintain the 10 ampere current on the fault conductor loop for 15 minutes.
7. Energize the fault conductor loop with 100 amperes for a period of 11 seconds. If an open-circuit occurs, record the elapsed time and de-energize the Multi-Amp Test set. If ignition occurs, record the approximate elapsed time to ignite and to stop burning.
8. Record voltage and current of each target conductor loop.
9. Record each thermocouple temperature that occurred at the following points in the overcurrent test:
   a. Before energizing either the faulted or nonfaulted conductor loop.
   b. At the end of the 15-minute period of application of 10 amperes on the fault conductor loop.
   c. At the end of the 11-second period of application of 100 amperes on the fault conductor loop.

3.0 TEST PROGRAM (Continued)

3.8 Configuration Number 6 Tests (Continued)

3.8.5 Overcurrent Test (Continued)

10. Observe thermocouple readouts on the datalogger until the maximum temperature has dropped below 300°F.

11. De-energize the target conductor loops.

12. Open the enclosure and record the observed condition of the conductors.

13. Photograph the post-test condition.

For the performance of this test, the observed operation of the target conductor loops shall be compared to the acceptance criteria, Paragraph 2.1.3, i.e., they shall maintain continuity of power.

3.8.6 Post-Overcurrent Test Functional Test

The functional tests of Paragraph 3.8.4 shall be repeated.

3.9 Quality Assurance

All test equipment and instrumentation to be used in the performance of this test program will be calibrated in accordance with Wyle Laboratories' (Eastern Operations) Quality Assurance Program Manual, which conforms to the applicable portions of ANSI N45.2, 10 CFR 50 Appendix B, 10 CFR 21, and Military Specification MIL-STD-45662. Standards used in performing all calibrations are traceable to the National Bureau of Standards.

3.10 Report

Ten copies of the test report and one reproducible copy shall be issued, describing the test requirements, procedures, and results. The report shall be prepared in accordance with the requirements of Section 8, Documentation, of IEEE Std. 323-1974, as applicable.

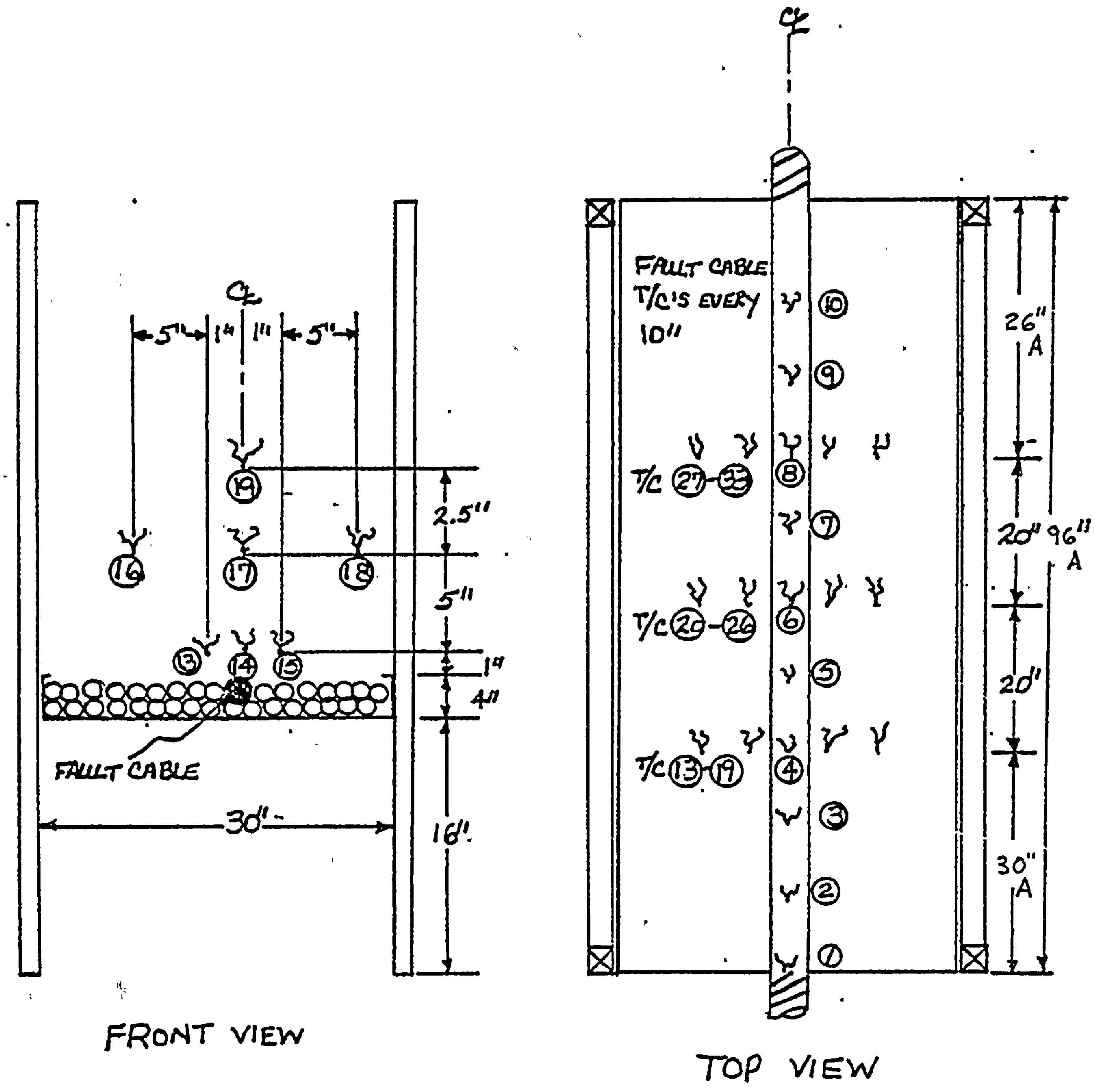


FIGURE 1: SCREENING TEST SETUP

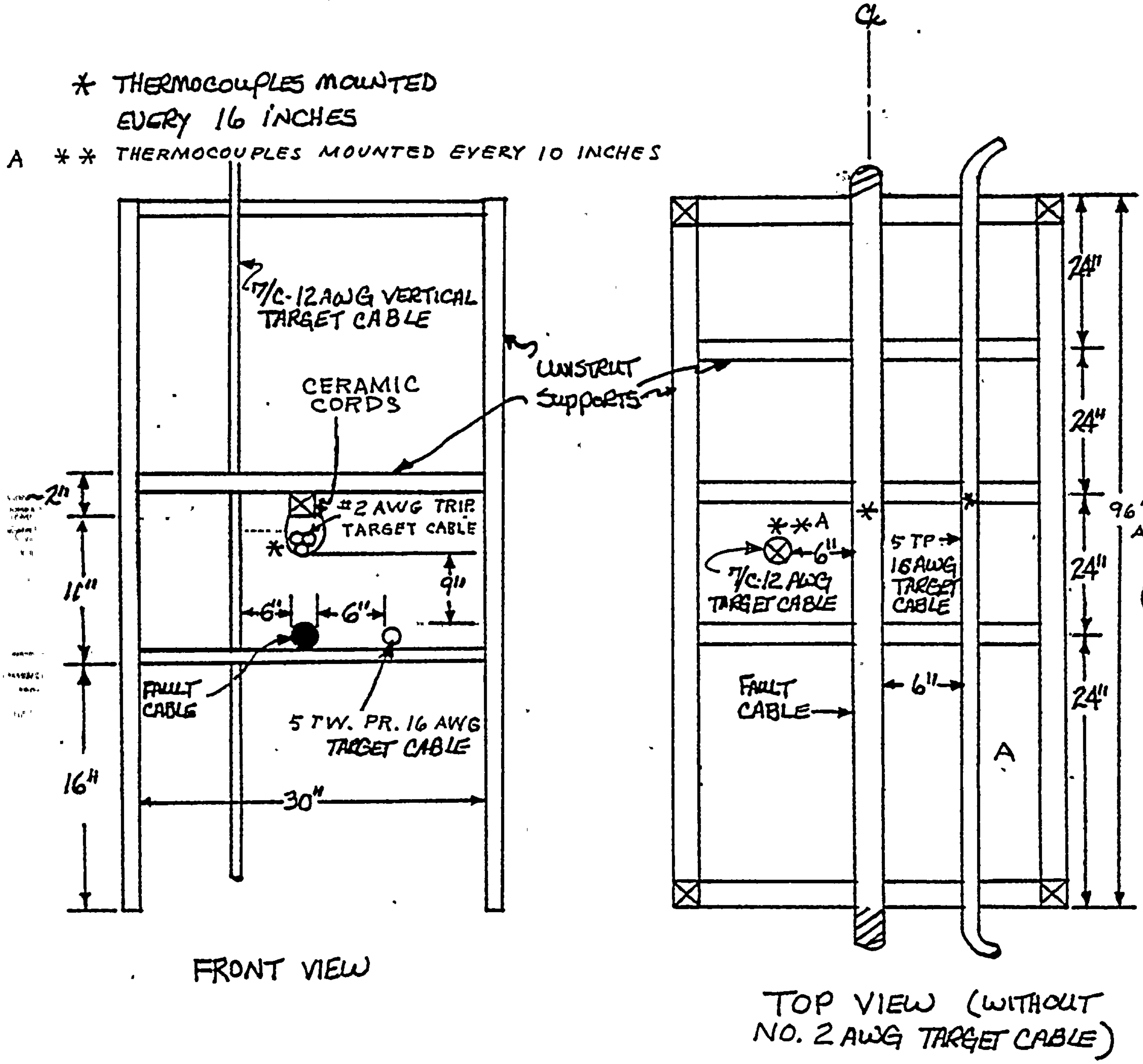


FIGURE 2: CONFIGURATION NO. 1 TEST SETUP

Test No. 1: Cable in Free Air to Cable in Free Air — Fault in Horizontal Cable

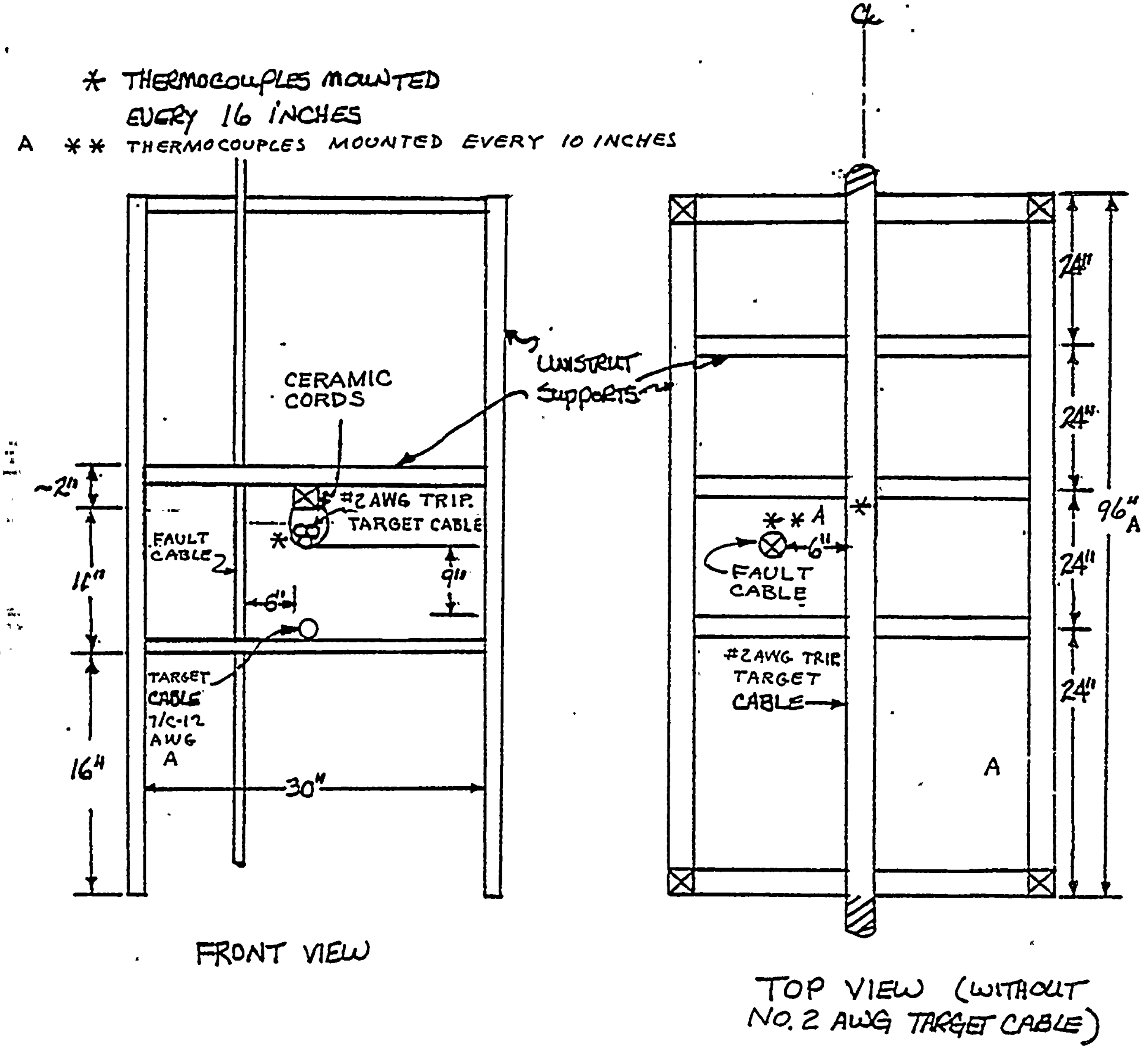


FIGURE 3: CONFIGURATION NO. 1 TEST SETUP

Test No. 2: Cable in Free Air to Cable in Free Air — Fault in Vertical Cable

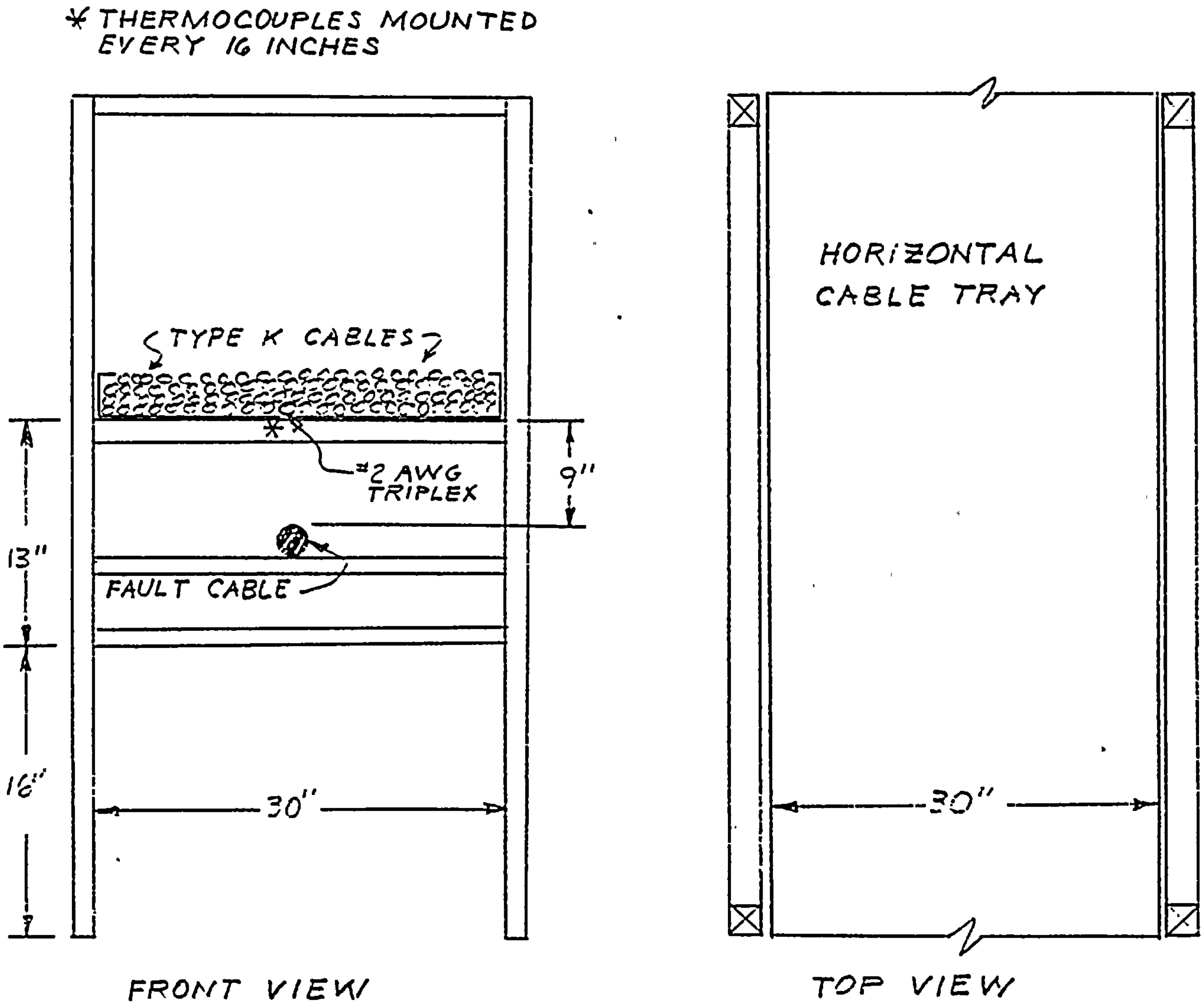


FIGURE 4: CONFIGURATION NO. 1 TEST SETUP

Test No. 3: Cable in Free Air to Cable Tray —
Fault in Horizontal Cable

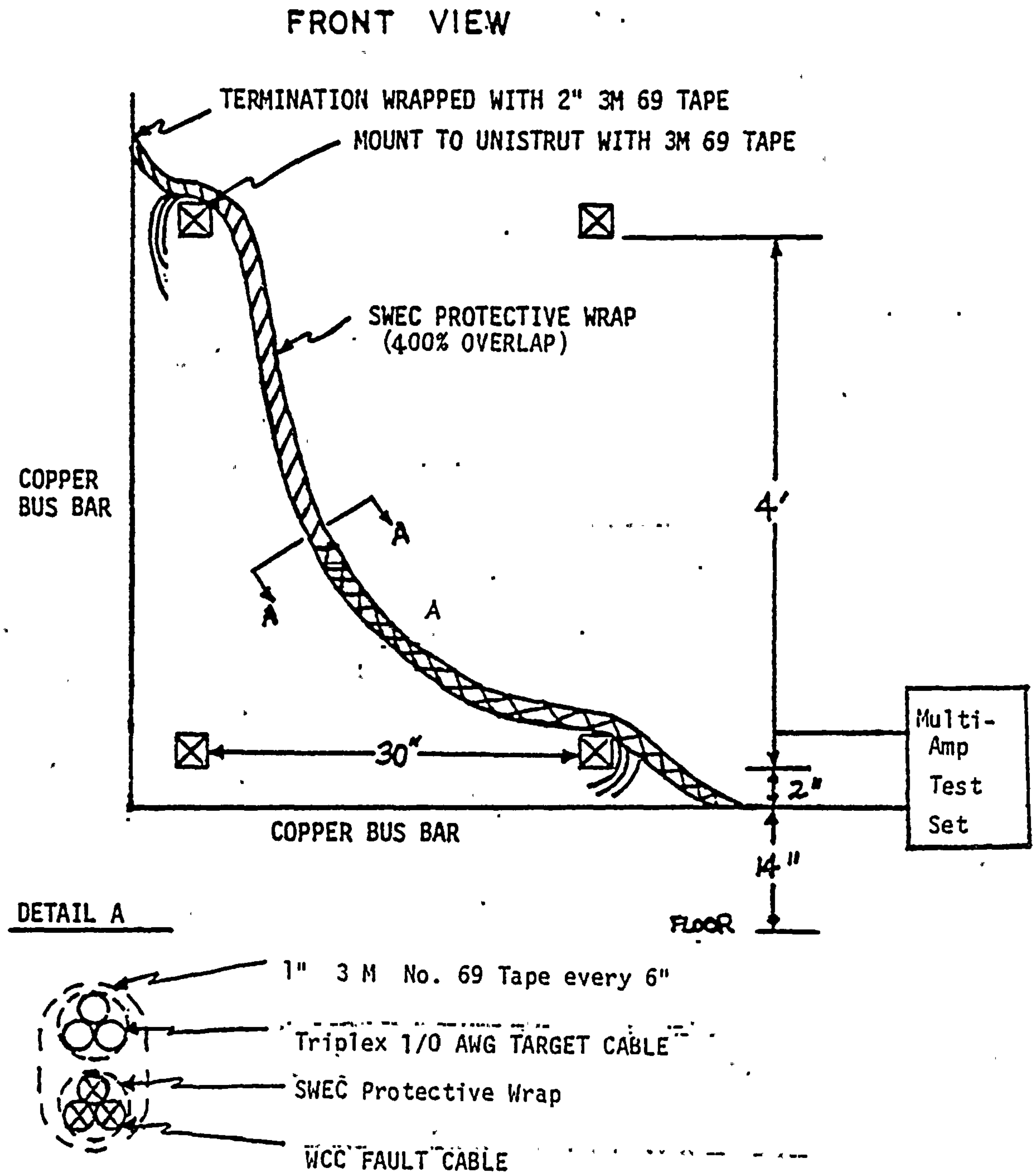


FIGURE 5: CONFIGURATION NO. 2 TEST 1 SETUP

Test No. 1: Wrapped and Unwrapped Cables —
Fault in Wrapped Cable

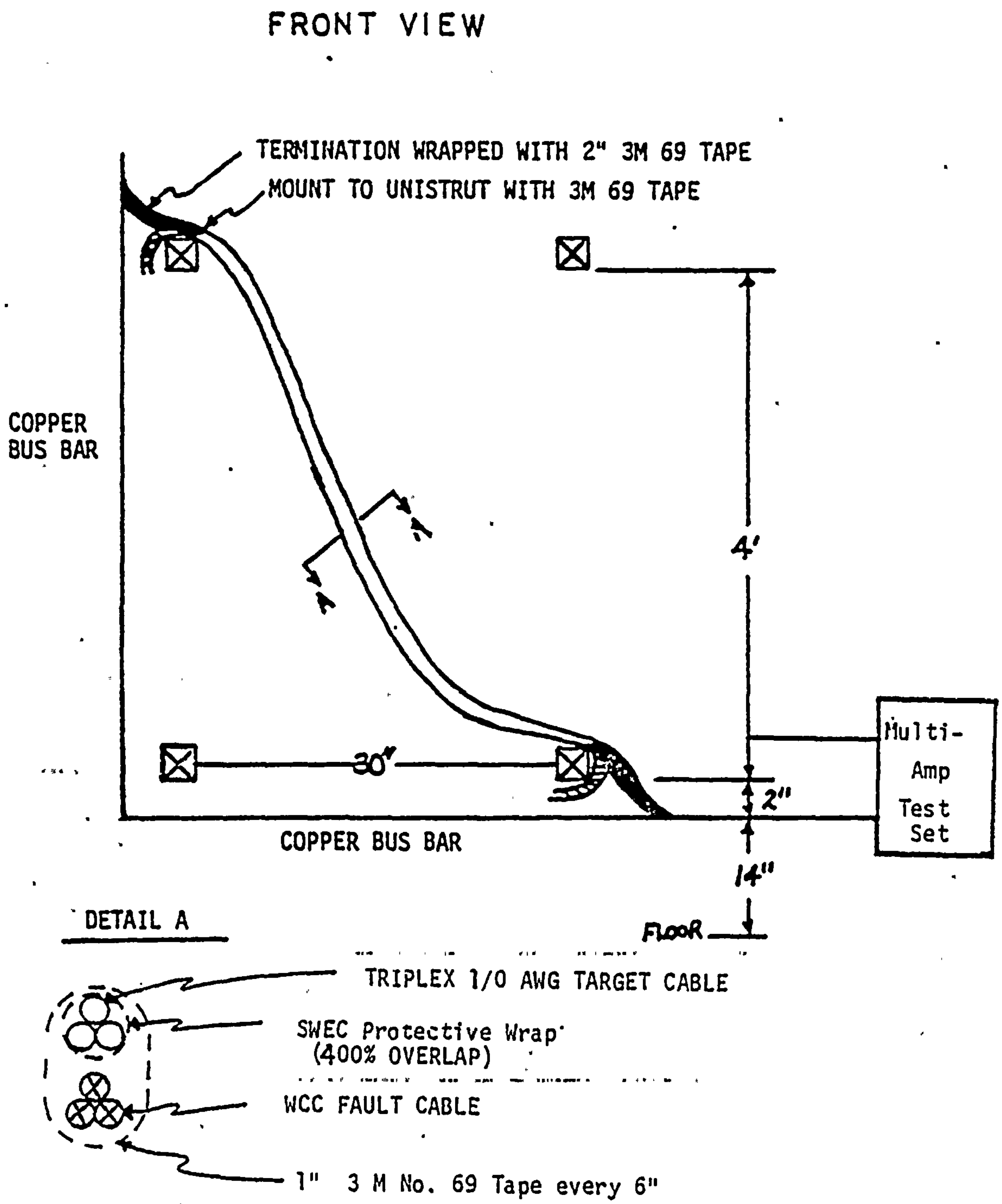


FIGURE 6: CONFIGURATION NO. 2 TEST 2 SETUP

Test No. 2: Wrapped and Unwrapped Cables —
Fault in Unwrapped Cable

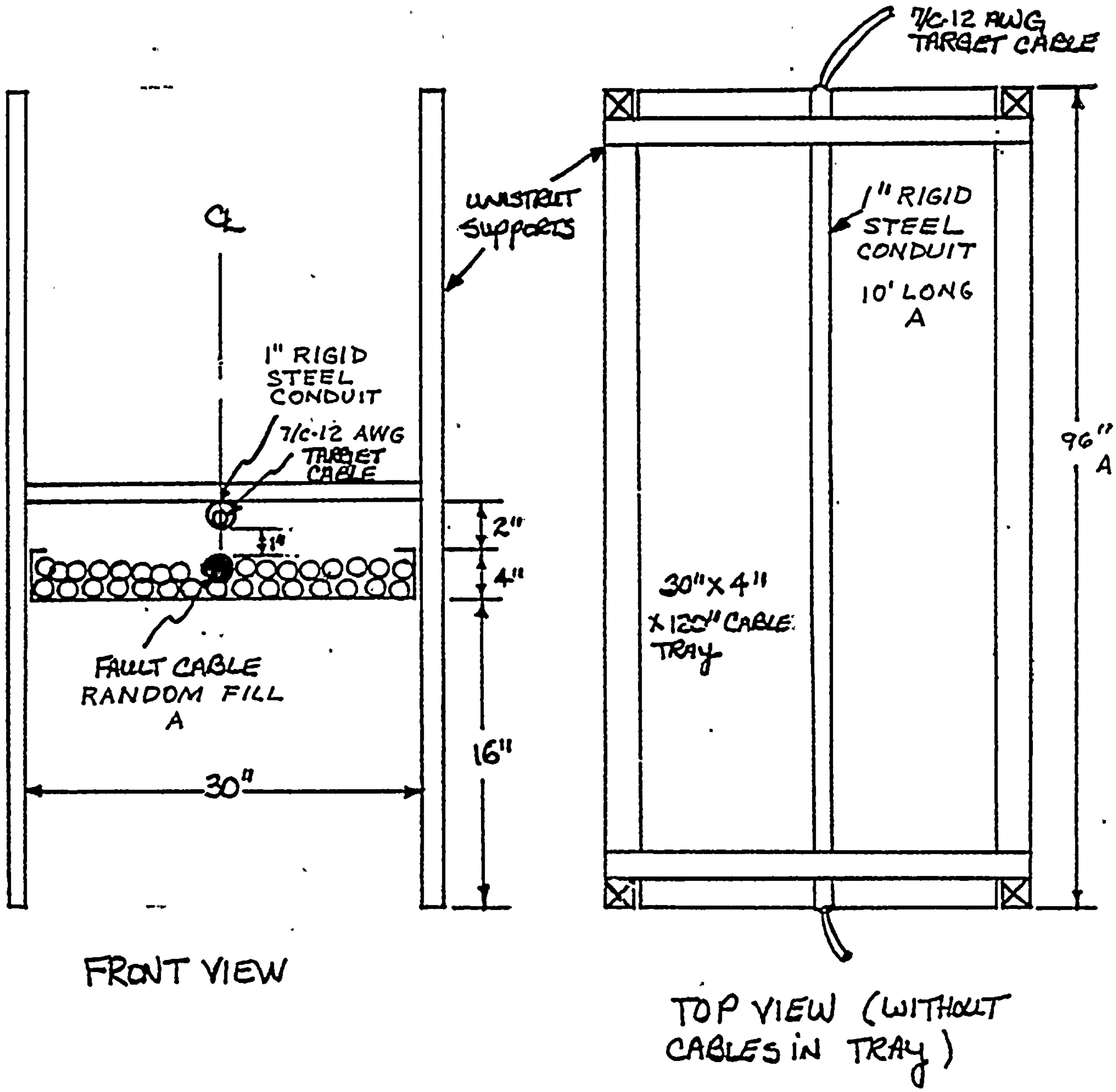


FIGURE 7: CONFIGURATION NO. 3 TEST SETUP

Test No. 1: Horizontal Tray to Horizontal Conduit — Fault in Tray

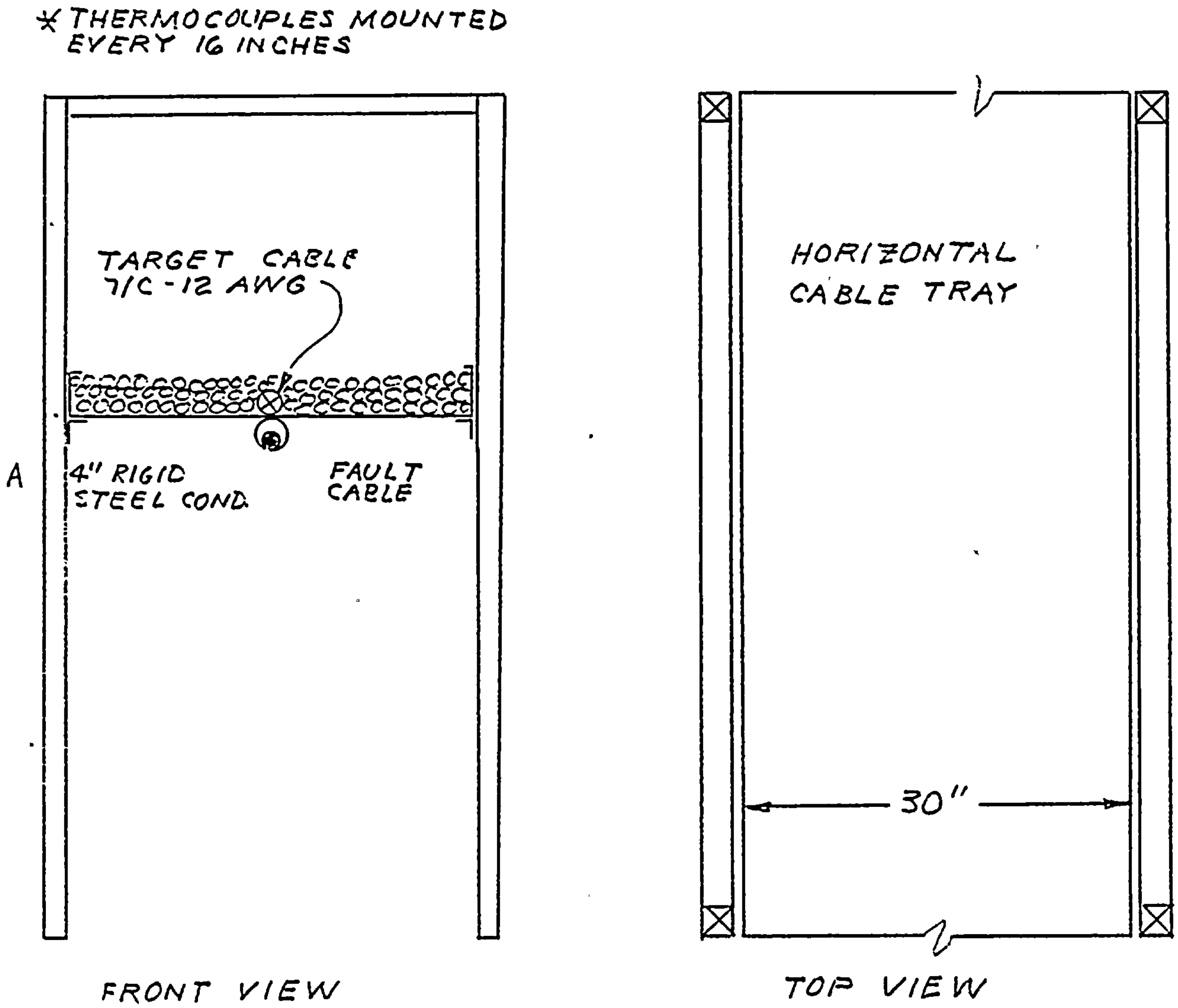


FIGURE 8: CONFIGURATION NO. 3 TEST SETUP

Test No. 2: Horizontal Tray to Horizontal Conduit
Fault in Conduit

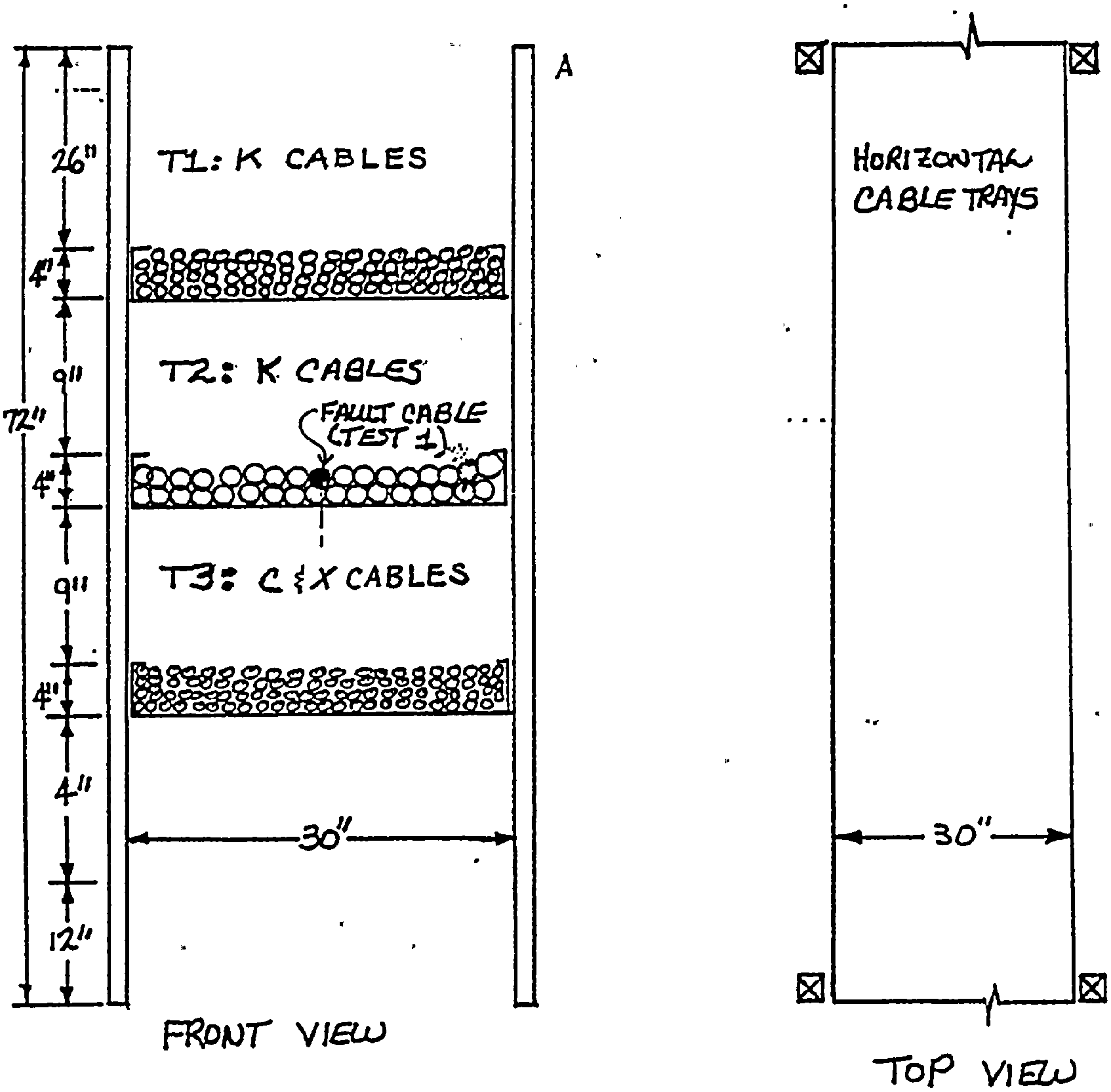
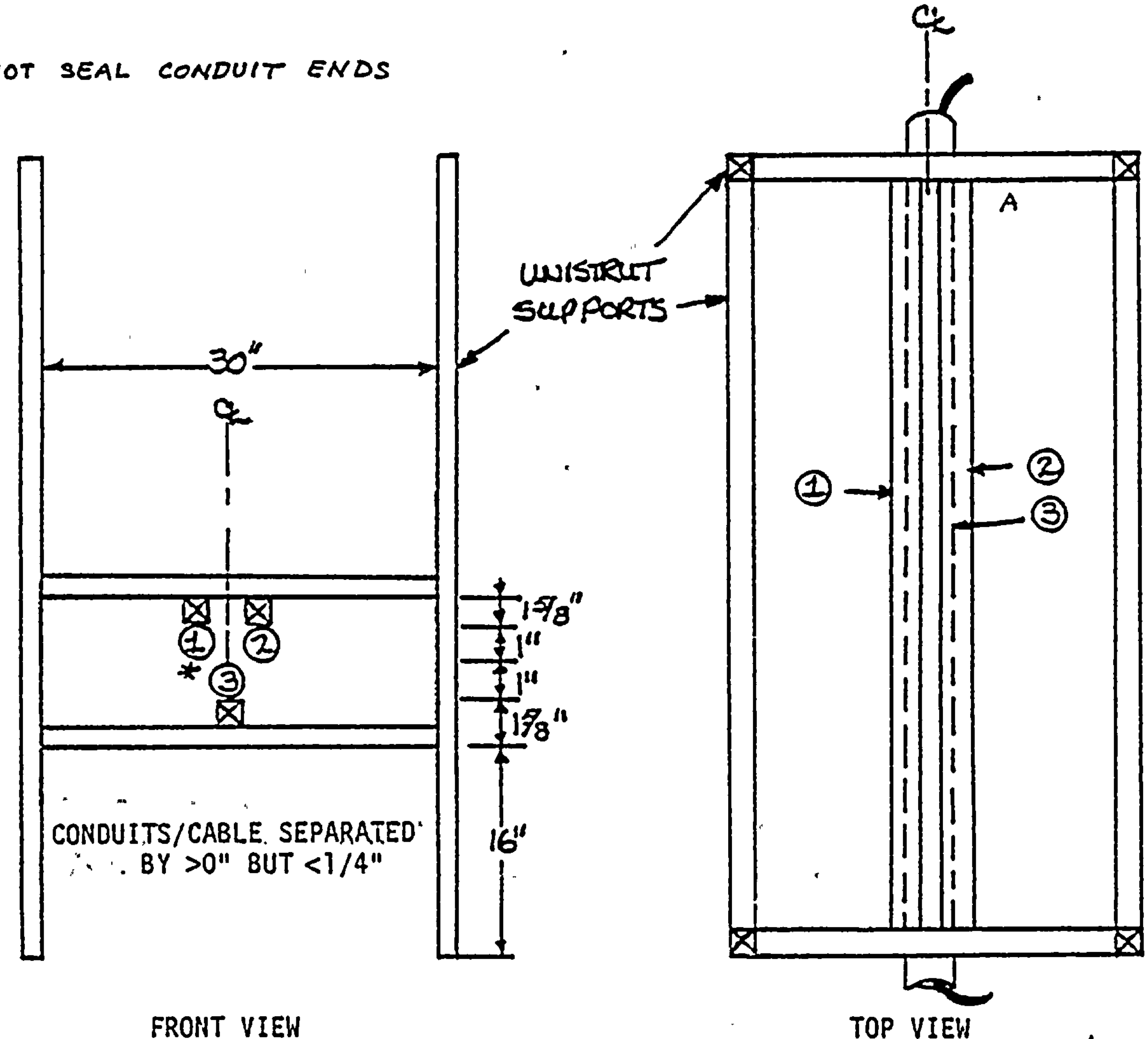


FIGURE 9: CONFIGURATION NO. 4 TEST SETUP

Test No. 1: Horizontal Tray — Vertical Separation

A CONDUITS TO BE APPROX. 10' LONG

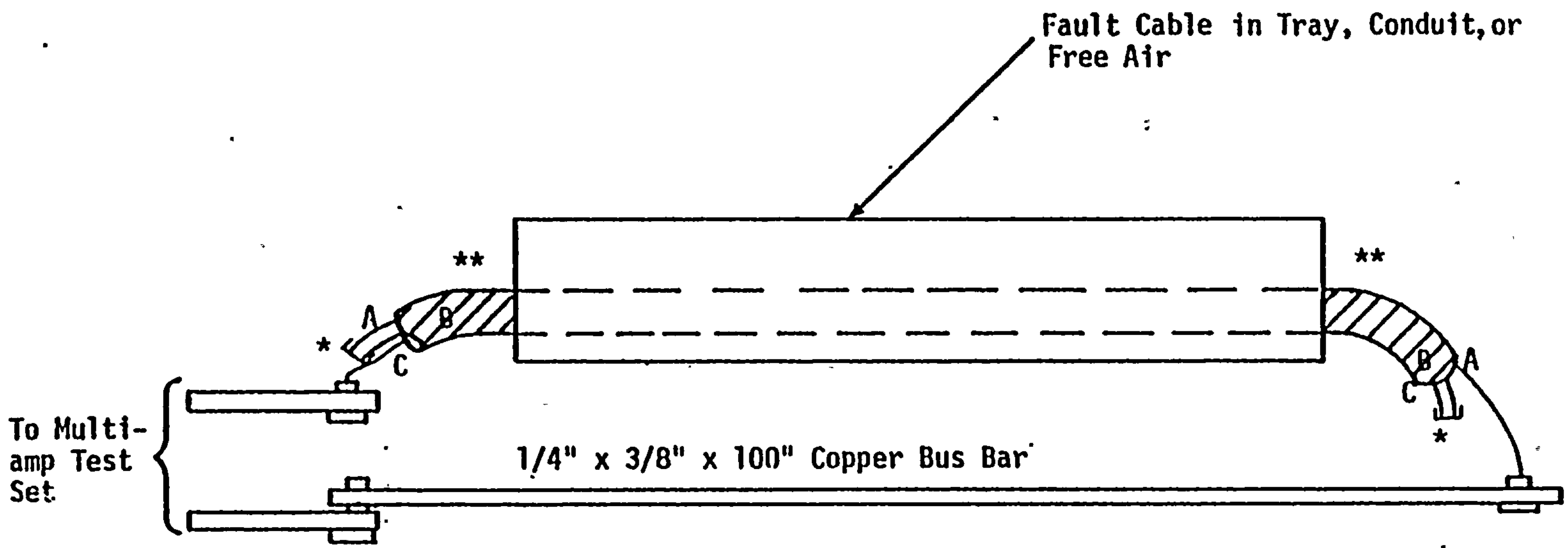
A DO NOT SEAL CONDUIT ENDS



Test No.	Location 1	Location 2	Location 3 (A)
1	Flex Cond, 7/C-12 AWG	Rigid Cond, 2 AWG Trip.	Free Air, WCC
2	Free Air, 7/C-12 AWG	Flex Cond, 2 AWG Trip.	Rigid Cond, WCC
3	Rigid Cond, 7/C-12 AWG & 1 7/C-12 AWG FILLER CABLE (UNENERGIZED) (A)	Free Air, 2 AWG Trip.	Flex Cond, WCC

FIGURE 10: CONFIGURATION NO. 5 TEST SETUP

Flexible Conduit, Rigid Conduit and Cable in Free Air



* The three phases of the fault cable shall be
A connected in series, except for screening tests where the cable shall be connected in parallel when necessary to obtain the desired current.

** The fault cable shall be wrapped with a single
A layer of *Siltemp* No. 65 from the edge of the test area to the bus bar.

FIGURE 11: TYPICAL FAULT CABLE CONNECTIONS

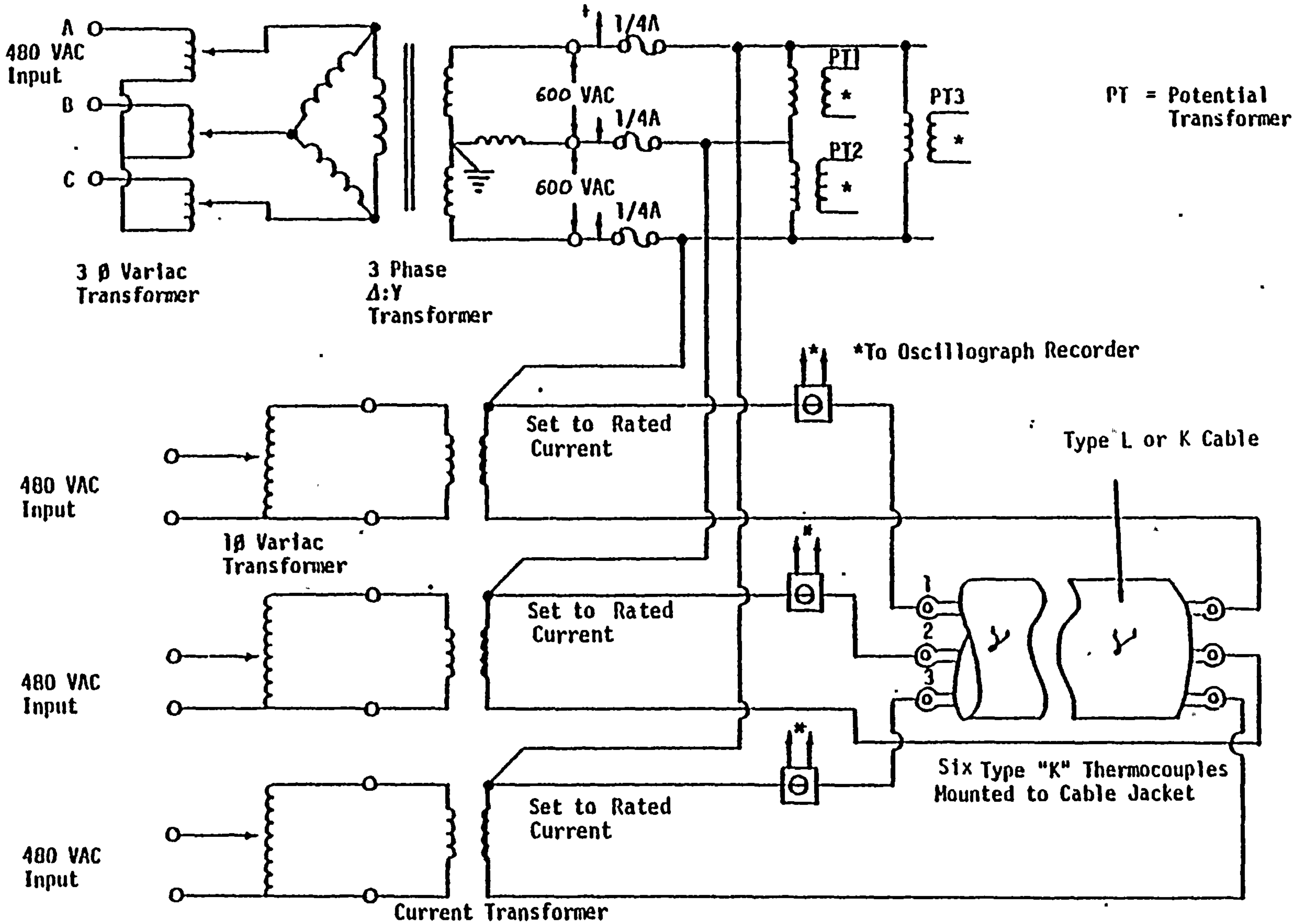


FIGURE 12: ELECTRICAL CONNECTIONS FOR ENERGIZED TYPE L OR K CABLE

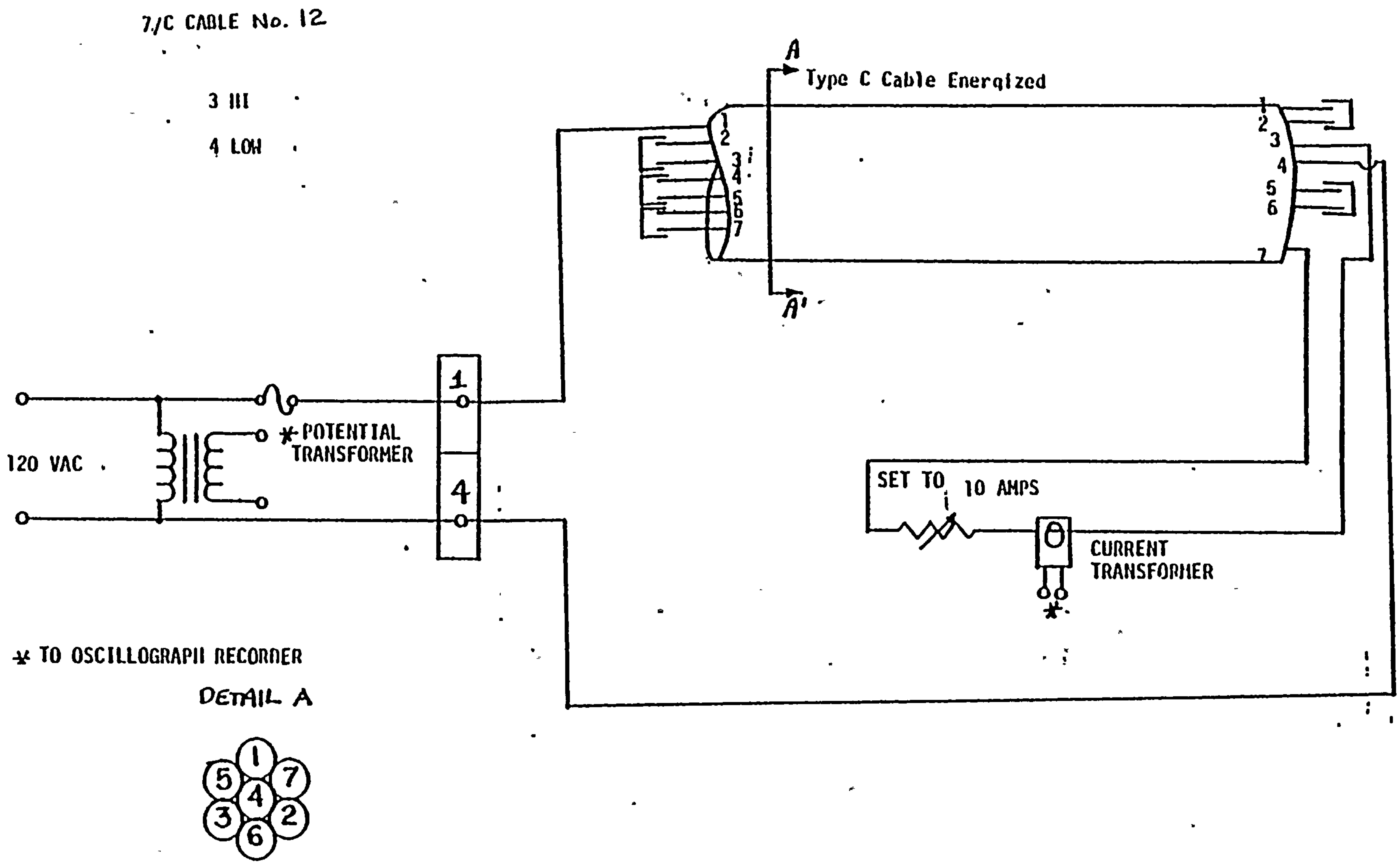


FIGURE 13: ELECTRICAL CONNECTIONS FOR TYPE C CABLES

2 A

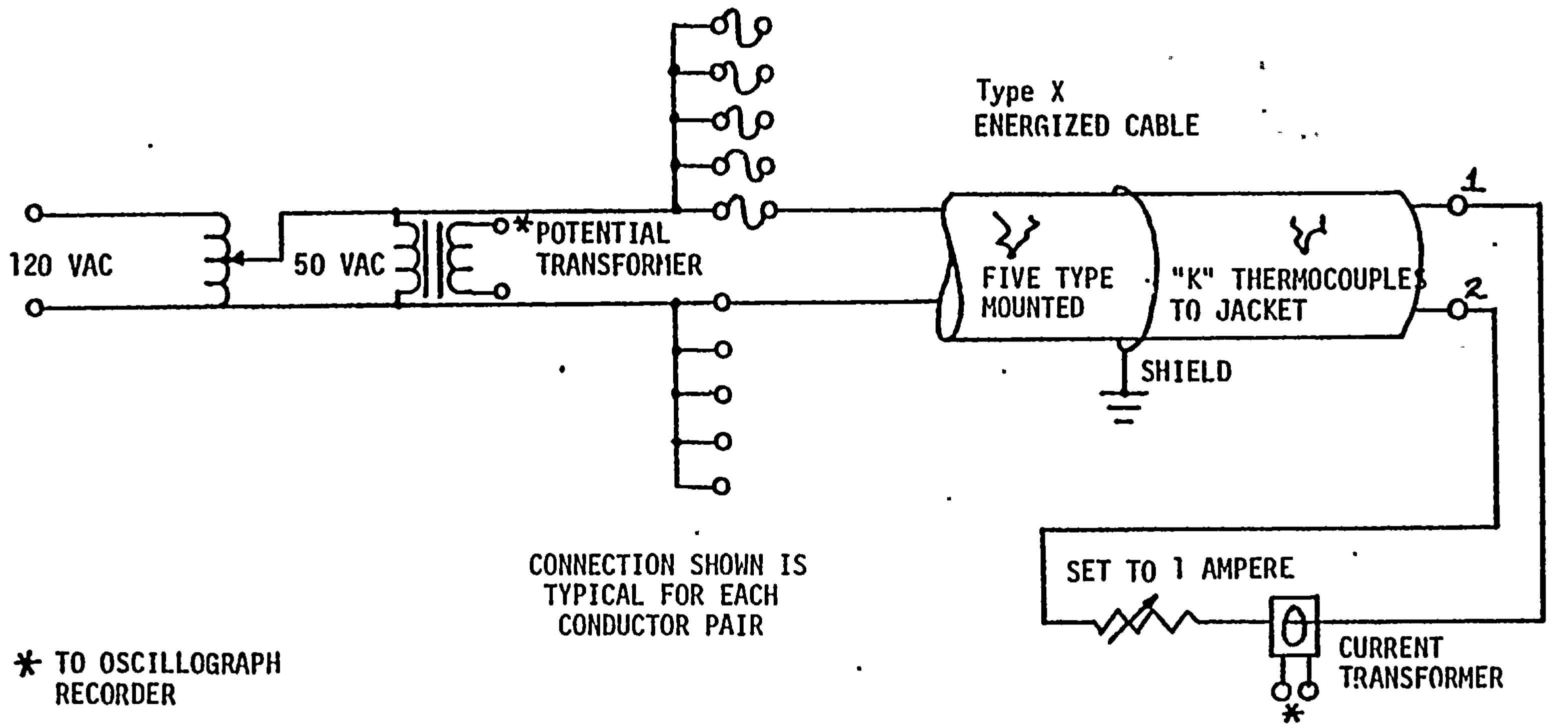


FIGURE 14: ELECTRICAL CONNECTIONS FOR TYPE X CABLES

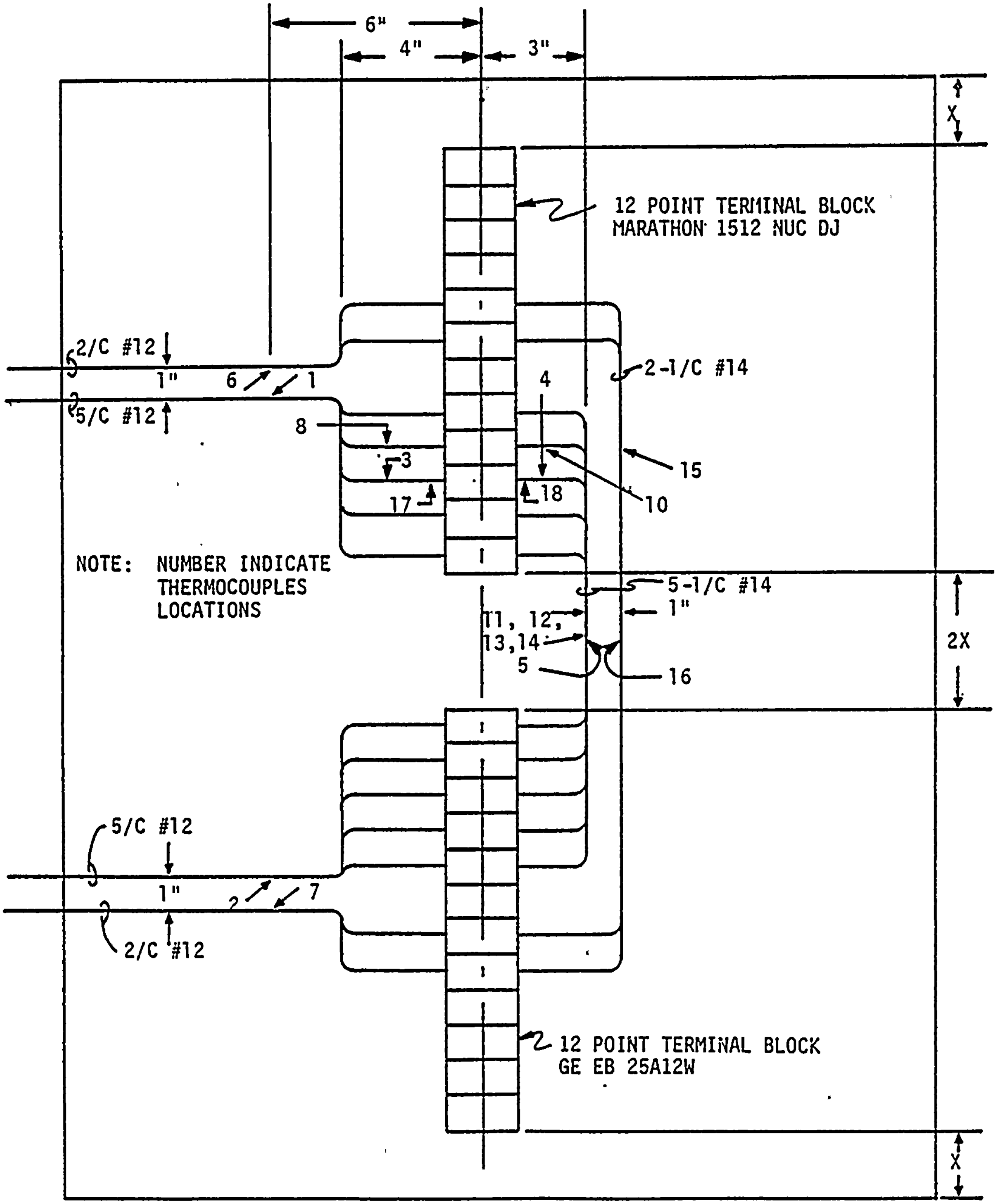


FIGURE 15: CONFIGURATION NO. 6 TEST SETUP

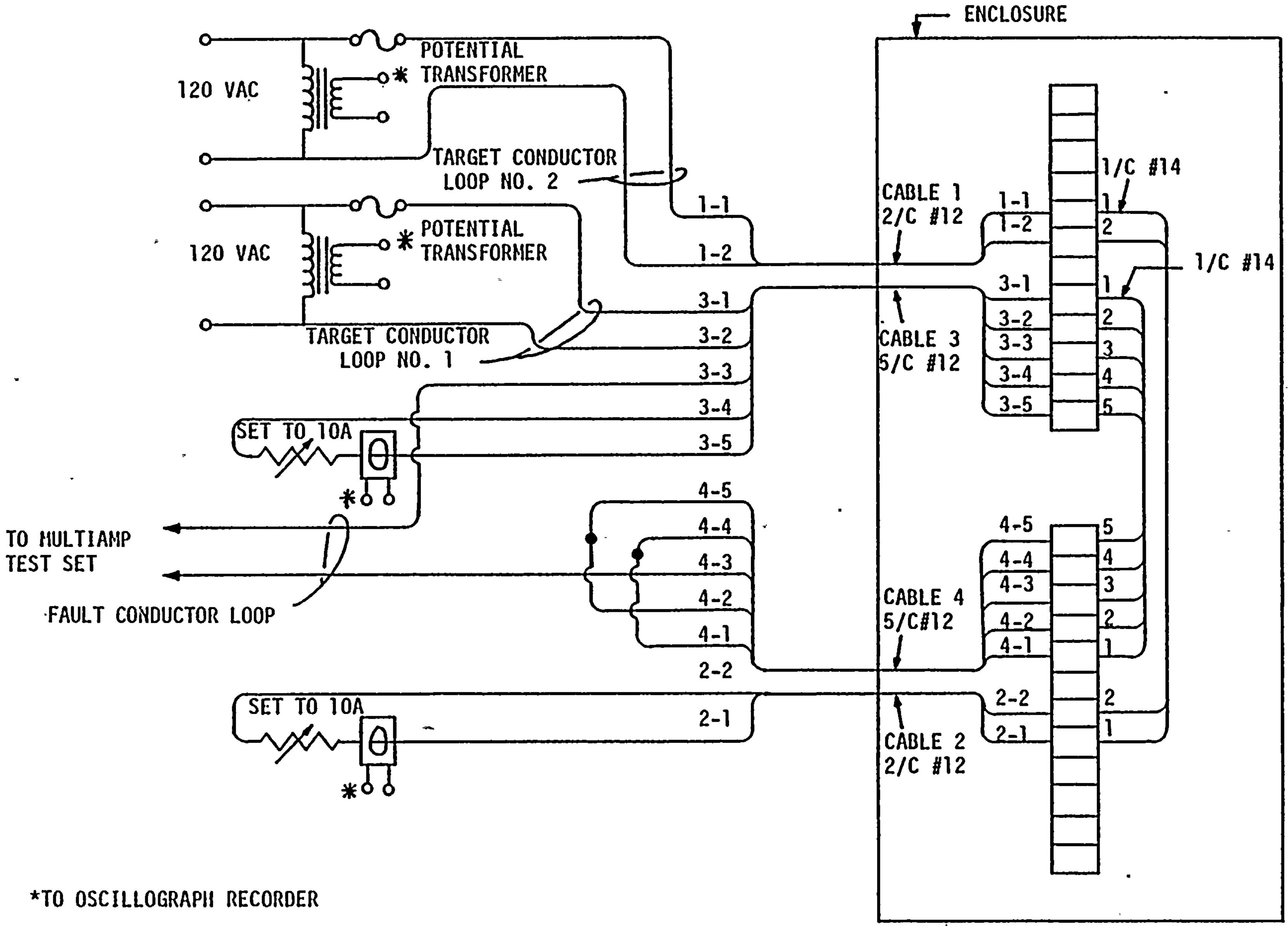


FIGURE 16: ELECTRICAL CONNECTIONS FOR CONFIGURATION 6 TEST

SUMMARY OF INCORPORATED CHANGES

Legend

R = Response to NRC Question or SER Item

E = Editorial or Typographical change that has not effected basis of FSAR.

N = Nonsafety-related change in design, schedule, and/or procedure.

SN = Change to a safety-related item that has no effect on SER.

SS = Change to safety-related item that has an effect on SER.

Pages	Change Code	Description
Pages 1.10-69a, 1.10-69b Fig. 6A.3-43, 6A.3-44	R	Response to staff questions concerning TMI Action Plan II.D.1
Page 3.8-73	R	Response to staff questions concerning visual weld acceptance criteria
Page 6A.4-5a	R	Confirmatory Item 13(a) dynamic reponse of the primary containment structures due to pool swell
Page 6A.4-8	R	Confirmatory Item 13(b) pool swell analysis for pedestal region
Pages 6A.4-12, 6A.4-12a	R	Confirmatory Item 13(d) clarification of computer code for CO load inside pedestal
Page 6A.4-24	R	Confirmatory Item 13(c) to clarify the method of design for the drywell floor multivent lateral loads
Pages 7.3-7, 7.3-9, 7.6-2a Fig. 5.4-13 sheets 1 and 2 of 2, 6.3-7	R	Confirmatory Item 25 low-pressure core spray and injection valves interlock (Letter NMP2L 0523, dated 10/30/85)
Fig. 8.3-8B Sh 13 of 13	R	Response to staff (NRR) question regarding clarification of Figure
Q/R F210.58-1	R	Update to response to question
Q/R F210.62-1, F210.62-2, F210.62-3 Table 210.62-1 page 1 and 2 of 2	R	Revision to question based on new leakage rate limit
Q/R F210.63-1	R	Completed reply to question
Q/R F240.10-2 Table 240.10-1 page 1 of 2	R	To bring FSAR into agreement with designed details
Q/R F250.1-1	R	Update of response to question
Q/R F410.49-1	R	Update of question F410.49
Q/R F421.3-1 and F421.3-2	R	Update of question F421.3

Pages	Change Code	Description
Q/R F421.47 Table 421.47-1 pages 1, 2, 4, 5, 7, 8, 9, and 14 of 17	R	Revision to Q/R F421.47 response to be consistent with revised R.G. 1.75 position
Q/R F430.74-1, F430.74-2	R	To make consistent with FSAR
Q/R F440.16-1, F440.16-2	R	Revision to Q/R F440.16 response due to changes in leak detection design
Q/R F480.37 Table 480.37-1 page 2 of 2	R	Revised response to reflect design conditions
Pages 1.1-3, 1.7-1, 1.10-7, 1.10-11, 1.10-18, 1.10-25, 1.10-27, 1.10-30, 1.10-34, 1.10-36, 1.10-37, 1.10-47, 1.10-48, 1.10-56, 1.10-65, 1.10-66, 1.10-73b, 1.10-73ja, 1.10-74, 1.10-76, 1.10-81, 1.10-85, 1.10-85a, 1.10-85g, 1.10-86, 1.10-88, 1.10-90, 1.10-95, 1.10-97, 1.10-98, 1.10-107, 1.10-108, 1.10-124 Table 1.7-1 pages 1, 2, 3, 57, 58, 58a, 59, 60, 60a and 60b of 60, 1.10-1 page 1.10-3	E	Editorial changes and update of drawing package
Fig. 1.2-15 sheets 1, 2 and 3 of 3	E	Editorial corrections
Table 1.3-8 page 2 of 2, 1.4-1 page 2 of 2, 3.8-6 page 1 of 2	E	Inadvertent omissions to Amendment 21
Pages 3.4-2, 3.4-4, 3.5-19, 3.8-3, 3.8-6, 3.8-16, 3.8-30, 3.8-34, 3.8-37, 3.8-38, 3.8-74, 3B-4, 3B-5, 3.9A-5, 3.9A-13, 3.9A-18, 3.9A-27 Tabel 3.4-1 page 1 of 2, 3.9A-12 pages 1 and 10 of 12	E	Editorial
Pages 3.5-19, 3.9A-5, 3.9A-13, 3.9A-18, 3A.18-1, 3A.18-1a, 3B-2, 3B-4, 3B-5, 3B-6	E	Editorial and typos

Pages	Change Code	Description
Table 3.2-1 page 22 of 26, 3.4-1 page 1 of 2, 3.9A-12 page 1 and 10 of 12 3A.1-1, 3B-1 page 2 of 2, 3B-2, 3B-9, 3B-10 Appendix 3B pages 3B-iv, 3B-v, 3B-vi		
Pages 3.8-1, 3.8-3, 3.8-6, 3.8-7, 3.8-13, 3.8-16, 3.8-28, 3.8-34, 3.8-37, 3.8-38, 3.8-43, 3.8-45, 3.8-49, 3.8-74, 3.8-77 Table 3.8-1 pages 1, 2 and 6 of 6, 3.8-3 pages 1, 2 and 3 of 5, 3.8-4 pages 1, 2 and 3 of 4, 3.8-5 page 1 of 2, 3.8-6 page 1 of 2, 3.8-10 pages 2 and 3 of 3, 3.8-11 pages 2 and 3 of 3, 3.8-12 page 3 of 4, 3.8-13	E	Editorial corrections
Page 4.6-8a Fig. (see Attachment A)	E	Nomenclature clarification
Page 5.2-10 Table 5.2-6	E	Editorial
Pages 5.4-37, 5.4-51	E	Editorial
Pages 6A.2-7, 6A.3-7	E	Editorial
Pages 6A.3-2, 6A.4-4, 6A.4-8, 6A.4-14, 6A.4-20, 6A.4-24a, 6A.4-26, 6A.4-27, 6A.4-28, 6A.4-29, 6A.4-31, 6A.4-37 Table 6A.4-3, Fig. 6A.4-36	E	Editorial changes and correction of references
Page 6A.4-5	E	Editorial
Page 7-xi (List of Figures)	E	Editorial
Pages 7.3-31, 7.4-7	E	Editorial and typographical corrections
Pages 8.2-15, 8.2-16, 8.2-24a, 8.3-11, 8.3-43 8.3-46, 8.3-50a, 8.3-57	E	Editorial

Pages	Change Code	Description
Table 8.2-1 page 1 and 4 of 4, 8.3-8, 8.3-9, 8.3-11, 8.3-12, 8.3-13		
Page 9.2-25	E	Editorial
Page 9.4-22	E	Editorial
Pages 9.5-2 through 9.5-6, 9.5-9	E	Editorial
Pages 9.5-61a, 9.5-61b	E	Editorial replacement of material inadvertently omitted in Amendment 21
Pages 9A-iv, 9A-vi, 9A-vii, 9A.3-11, 9A.3-23, 9A.3-27, 9A.3-30, 9A.3-31, 9A.3-43, 9A.3-48, 9A.3-50, 9A.3-51, 9A.3-55, 9A.3-55a, 9A.3-60	E	Editorial
Page 12.4-1c	E	Editorial
Q/R F440.17-1	E	Typographical correction
Fig. 1.2-2, 1.2-29 sheet 3 of 3, 1.2-32 sheets 1, 2 and 3 of 3, 1.2-33, 1.2-35, 1.2-36, 1.2-40	N	Update arrangement drawings
Fig. 1.7-1 sheets 1 through 5 of 5	N	Update of P&ID symbols
Page 6.2-84	N	Clarification of test program
Pages 9.2-22, 9.2-23, 9.2-24 Fig. 9.2-5a through 9.2-5e	N	Design update of makeup water treatment text and P&IDs
Page 9.2-23	N	Design update for filtered water transfer pumps text
Pages 9.2-25, 9.2-25a, 9.2-26 Fig. 9.2-8a, 9.2-8b	N	Design update of sanitary waste text and domestic water P&IDs
Page 9.3-11f Fig. 9.3-20b	N	Design update of nitrogen system text and P&ID

Pages	Change Code	Description
Pages 9.3-13, 9.3-14, 9.3-15, 9.3-16 Table 9.3-1 pages 5, 8, 9 and 10 of 10	N	Design update of sample system design
Pages 9.3-24, 9.3-27	N	Design update for location of level switch for water buildup
Fig. 9.3-11a through 9.3-11e	N	Design update of radwaste building drains P&IDs
Fig. 9.4-8j	N	Design update of drywell cooling P&ID
Fig. 9.4-10a through 9.4-10e	N	Design update of radwaste building ventilation P&IDs
Pages 9.4-39 through 9.4-42, Table 9.4-5 pages 1 through 17 and 21 of 21 Fig. 9.4-12a through 9.4-12d	N	Design update of turbine building ventilation text and P&IDs
Pages 9.4-69, 9.4-72, 9.4-73 Fig. 9.4-22a through 9.4-22c	N	Design update of plant hot water and glycol heating text and P&IDs
Page 9.5-3	N	Update of yard fire protection design
Fig. 9.1-26a, 9.2-6a, 9.2-9a, 9.2-9b, 9.2-17a, 9.2-17b, 9.2-17c, 9.3-3a, 9.3-3b, 9.3-3c, 9.3-3d, 9.3-3e, 9.3-10a through 9.3-10h, 9.3-10j, 9.3-12a through 9.3-12h, 9.3-12j, 9.3-12k, 9.3-12l, 9.3-9a, 9.3-9b, 9.3-9c, 9.3-9d, 9.3-9e, 9.4-3a through 9.4-3f, 9.5-1a through 9.5-1h, 9.5-52a, 9.5-52b, 9.5-52c	N	P&IDs design update for: •Decontamination •Makeup water storage •Sanitary plumbing •Condensate storage and transfer •Breathing air •Turbine building drains •Miscellaneous floor drains •Reactor building equipment/floor drains •Chilled water and normal switchgear building ventilation •Fire protection water •Auxiliary boiler
Fig. 10.1-7a through 10.1-7h, 10.1-7j through 10.1-7n, 10.1-7q through 10.1-7u, 10.1-7w	N	Design update for feedwater heater and extraction steam
Fig. 10.4-2a	N	Design update of condenser air removal P&ID
Fig. 10.4-7a through 10.4-7h	N	Design update of circulating water, acid and hypochlorite P&IDs

Pages	Change Code	Description
Pages 13.5-1 through 13.5-7 Table 13.1-3 pages 1 through 7 of 7 13.1-4 page 1 of 5, 13.5-1 pages 1 and 2 of 2, 13.5-1a, 13.5-2, 13.5-3 pages 1 through 3 of 3, 13.5-4, 13.5-5, 13.5-6 pages 1 through 8 of 8, 13.5-7 Fig. 13.5-1	N	Update of plant procedures
Pages 1.2-19, 1.2-33, 1.2-39	SN	Design update for plant electrical systems
Pages 1.12-14, 1.12-15	SN	Design update for diesel generators
Table 1.3-9 pages 8 and 10 of 10	SN	Design update of table 1.3-9 data
Table 1.7-1 pages 18, 19, 19a and 20 through 54 of 60	SN	Design update to agree with current plant arrangement
Table 1.8-1 pages 5, 31, 33 89 and 89a of 169	SN	Clarification of Regulatory Guide positions
Table 1.9-1 page 6 of 11, Attach 1.9-52, 1.9-61 page 2 of 4	SN	Design update of electrical components
Table 2.1-1	SN	Clarification update of table
Table 3.2-1 pages 13 and 15 of 26	SN	Clarification of construction details
Table 3.4-7	SN	Confirmation of waterstop specification requirements
Page 3.5-19a Table 3.5-21, 3.5-22	SN	Update design of tornado missile protection for diesel generator exhaust penetrations and clarification of valve enclosure
Page 3.6A-37 Table 3.4-7, 3.6A-1 pages 1, 3 and 4 of 5, 3.6A-28 page 2 of 8, 3.6A-34	SN	Update based on current plant design

Pages	Change Code	Description
page 3 of 18, 3.6A-41 page 2 of 4, 3.6A-44 page 7 and 8 of 28		
Pages 3.6B-3, 3.6B-21, 3.7B-3, 3.7B-7, 3.7B-8, 3.7B-13, 3.7B-14, 3.7B-15, 3.7B-17, 3.7B-18, 3.7B-22, 3.7B-23, 11.1-15 Table 3.2-1 pages 1, 2, 3, 8, 9 and 13a of 26, 3.2-2, 3.2-3, 3.7B-1 Fig. 3.6B-1, 3.7B-3	SN	Update based on current plant design
Pages 3.7A-2, 3.7A-3, 3.7A-5, 3.7A-6, 3.7A-7a, 3.7A-8, 3.7A-19, 3.7A-23, 3.7A-25, 3.8-37, 3.9A-5, 3.9A-14	SN	Corrections based on current plant design
Page 3.8-65	SN	Clarification of the design of dolosse used in revetment ditch
Pages 3.8-67, 3.8-71	SN	Design update and revision to agree with design specification for threadbar and reinforcing steel
Pages 3A-iv, 3A-2, 3A-33, Table 3A.32-1, 3A.32-2	SN	Design update for trunnion diameter to pipe diameter
Pages 3A.31-1, 3A.31-2	SN	Addition of SNUFFE computer program
Pages 3.7A-29, 3.7A-30, 3.7A-32	SN	To agree with equipment physical location
Fig. 3.7A-18, 3.7A-21, 3.7A-22, 3.7A-23, 3.7A-24, 3.7A-25, 3.7A-26, 3.7A-32	SN	Update various building acceleration profiles to the designed values
Pages 3.9A-2, 3.9A-2a, 3.9A-24, 3.9A-24a	SN	Design update of code and specification requirements
Pages 3.9A-20, 3.9A-21, 3.9A-21b	SN	Design clarification based on specification documents for valve accelerations
Page 3.9A-25	SN	Design update of snubber test results
Table 3.9B-2u pages 1, 2 and 3 of 3	SN	Design update of new loads
Pages 3.9A-24, 3.9B-8, 3.9B-15, 3.9B-16, 3.9B-20	SN	Corrections based on current plant design

Pages	Change Code	Description
Pages 3B-6, 6.2-2a, 6.2-6, 6.2-15, 6.2-16, 6.2-35, 6A.4-5, 6A.4-24a Table 3B-2, 3B-9, 3B-10, 6.2-3 page 1 of 2, 6.2-51 Fig. 6.2-33 sheets 1 through 8 of 8, 6.2-54, 6.2-56 sheets 2 through 10 of 10, 6.2-60, 6.2-71a, 6.2-71b	SN	Design update based on revised calculations and design changes
Table 4.4-8	SN	Update of sensor locations to be consistent with design specification
Pages 5.2-31, 5.2-32, 5.2-37, 5.2-38	SN	Design update of building monitors
Pages 5.2-33a, 5.3-2 5.3-17, 5.3-19, 5.4-10, 5.4-11, 5.4-12, 5.4-14, 5.4-36, 5.4-37, 5.4-41 Tables 5.2-1 page 1 of 8, 5.2-5 pages 2 and 6 of 6, 5.4-2 Fig. 5.2-4, 5.4-2 sheets 1 and 2 of 2, 5.4-9 sheets 1 and 2 of 2, 5.4-13 sheets 1 and 2 of 2, 5.4-16, 5.4-17 sheet 2 of 3 5.4-18, 5.4-19	SN	Corrections based on current plant design
Page 5.4-4 Table 3.2-4 page 2 of 2	SN	To identify compliance with ASME III code requirements for the recirculation piping system
Page 5.4-22	SN	Update of RCIC turbine electronic trip design
Table 5.2-1 pages 2, 3, 6, 6a, 6b, 8a1 and 8b of 8	SN	Update of Code Cases Nos. 1644-2, 1644-3, 1644-5 and 1644-6 including N-318 (Note: N-318 updated to Regulatory Guide 1.84, Revision 22)
Pages 5.4-22, 5.4-25, 5.4-29 Fig. (See Attachment A)	SN	Design update of text and figures based on current plant design
Pages 5.4-36, 5.4-37, 5.4-37a, 5.4-38, 5.4-38a, 5.4-39, 5.4-41	SN	Design update of residual heat removal system

Pages	Change Code	Description
Pages 6.2-2a, 6.2-3, 6.2-5, 6.2-8, 6.2-9, 6.2-15, 6.2-37, 6.2-38, 6.2-43a, 6.2-44, 6.2-47, 6.2-48, 6.2-57d, 6.2-62a, 6.2-86, 6.2-86a, 6.3-6, 6.3-8c, 6.5-9, 6A.1-5, 6A.2-9, 6A.2-11, 6A.2-14, 6A.3-19, 6A.4-2, 6A.4-4, 6A.4-24, 6A.4-24a, 6A.9-12, 6B-3, 6B-4, 6B-6, 6B-7 Table 6.2-3 page 2 of 2, 6.2-52, 6A.2-2 pages 1 and 2 of 2, 6A.2-3 page 2 of 3 6A.4-14, 6A.9-1	SN	Update based on current plant design
Page 6.2-6a	SN	Clarification of test results for the vacuum breakers mounted in piping that connects the drywell and suppression chamber
Pages 6.2-46a, 7.3-18	SN	Update based on fission product removal clarification for BWR plant
Pages 6.2-47, 6.2-61a	SN	Design update for residual heat removal pump
Pages 6.2-57, 6.2-57a, 6.2-57c Fig. 6.2-76, 6.2-77	SN	Design update of containment heat rates
Pages 6.2-83, 6.2-84 Fig. 6.2-72a, 6.2-72b, 6.2-73a	SN	Design update for hydrogen recombiner and containment leakage monitoring text and/or P&IDs
Pages 6.3-8a, 6.3-8b, 6.3-8c, 6.3-12, 6.3-14, 6.3-14a, 6.3-15, 6.3-16, 6.3-17, 6.3-20a Table 6.1-2 pages 1 and 2 of 2	SN	Design update based on current plant design
Pages 6.4-3, 9.4-2, 9.4-4, 9.4-10	SN	Design update for control building HVAC text
Pages 6.5-6, 6.5-7 Fig. 9.4-8k, 9.4-81	SN	Design update for standby gas treatment text and P&IDs
Table 6.2-56 pages 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 22 and 23 of 24	SN	Design update based on current plant design to agree with technical specification and editorial corrections

Pages	Change Code	Description
Fig. 6.2-70 sheets 42 of 43 Table 6.2-56 pages 7 and 20 of 24	SN	Design update for traversing incore probe for leak testing
Pages 6A.2-12, 6A.7-5, 6A.7-6, 6A.7-7 Table 6A.4-7 page 2 of 2, 6A.5-1, 6A.5-2 pages 1 and 2 of 2, 6A.5-3, 6A.5-4 page 1 of 2, 6A.5-6 page 1 of 2, 6A.6-1 page 1 of 2, 6A.6-2 pages 1 and 2 of 2, 6A.7-2 Fig. 6A.2-23, 6A.2-27, 6A.5-12, 6A.5-26 through 6A.5-31, 6A.5-33, 6A.5-34, 6A.5-37 through 6A.5-43	SN	Design update of section for Design Assessment Report for hydrodynamic loads
Table 6A.9-3, 6A.9-4, 6A.9-5, 6A.9-6 Fig. 6A.9-1, 6A.9-2, 6A.9-3	SN	Design update to comply with final stress analysis including editorial corrections
FSAR Logic Diagrams Figures (See Attachment B)	SN	Design update of listed logic diagrams
Pages 7-ii, 7.3-4, 7.7-27, 7.7-29, 9.1-18, 9.1-41, 9.1-42, 9.1-43	SN	Design update of high pressure core spray pump and refueling operation changes
Pages 7.1-2, 7.2-1, 7.3-3, 7.3-12, 7.3-29, 7.3-31, 7.4-3, 7.4-13, 7.4-14, 7.4-15, 7.4-21, 7.4-22, 7.4-23 Table 7.1-2 page 1 of 3, 7.3-1, 7.3-2, 7.3-3, 7.3-4, 7.3-5 pages 1 and 2 of 2, 7.3-6, 7.3-7, 7.4-1, 8.3-10	SN	Update based on current plant design
Pages 7.2-12, 7.5-6, 7.6-12 Table 7.3-8, 7.5-1 page 3 of 14	SN	Corrections incorporated based on current plant design

Pages	Change Code	Description
Pages 7.3-16, 7.3-17, 7.3-24, 7.3-25, 7.4-8, 7.4-11, 7.4-12, 7.4-13, 7.5-6, 7.5-7, 7.6-9, 9.3-10 Table 7.3-2	SN	Design update of various systems to agree with plant arrangements
Pages 8.1-2, 8.1-6, 8.2-2, 8.2-4, 8.2-6, 8.2-10, 8.2-12, 8.2-14, 8.2-15, 8.2-16, 8.2-18, 8.2-19, 8.2-20, 8.2-21, 8.2-22, 8.2-23, 8.3-4, 8.3-6, 8.3-7, 8.3-9a, 8.3-10, 8.3-12, 8.3-21, 8.3-30, 8.3-33, 8.3-34, 8.3-39, 8.3-43, 8.3-44, 8.3-46, 8.3-49a, 8.3-60 Tables 8.3-1 pages 1, 6, 7, 9 through 12 of 19, 8.3-4 pages 3 and 37 of 60 Fig. 8.2-1 8.3-6 sheets 4 through 26 of 28	SN	Update based on current plant design and update of Regulatory Guide positions
Pages 8.3-12, 8.3-18a, 8.3-18b, 8.3-20, 8.3-28, 8.3-29, 8.3-30, 8.3-31, 8.3-49, 8.3-51, 8.3-55, 8.3-58, 8.3-63, 8.3-64, 8.3-70	SN	Design update for electrical components
Table 8.3-1 pages 1 through 14 and 16 through 19 of 19 8.3-2 pages 1, 2, 4 through 15, 16 and 18 of 18, 8.3-5, 8.3-6, 8.3-8, 8.3-9, 8.3-11, 8.3-12, 8.3-13 Fig. 8.3-1, 8.3-2, 8.3-3 sheets 1 and 2 of 2, 8.3-4, 8.3-5, 8.3-9	SN	Design update to agree with plant design
Page 9.1-11	SN	Revision to loss of pool level in reactor cavity
Fig. 9.1-5a through 9.1-5d	SN	Design update for spent fuel pool cooling and cleanup P&IDs
Pages 9.2-3, 9.2-6, 9.2-7, 9.2-7a, 9.2-8, 9.2-19, 9.2-28 9.2-44, 9.2-45	SN	Design update consisting of the following:

Pages	Change Code	Description
Table 9.2-1 page 1 of 2, 9.2-2 pages 1 and 2 of 2, 9.2-4 page 1 of 2 Fig. 9.2-11 through 9.2-13, 9.3-9f		•Diesel Generators (D-G) Divisions I, II, and III design •Service water supplies to Division III D-G •High pressure core spray pump room unit cooler isolation •Update of tankage and pump capacities •Update of intake structures, tunnels and diffuser and screenwell layout •Editorial changes
Pages 9.2-11, 9.2-13, 9.2-14, 9.2-17, 9.4-3, 9.4-4, 9.4-7, 9.4-8, 9.4-45 through 9.4-58, 9.4-58a, 9.4-58b, 9.4-59, 9.4-60 Table 9.2-3 pages 1 and 2 of 2, 9.2-4 pages 1 and 2 of 2, 9.4-6, 9.4-7 pages 1 and 2 of 2, 9.4-8 pages 1 through 5 of 5, 9.4-9, 9.4-10 pages 1 and 2 of 2 Fig. 9.2-1a through 9.2-1h, 9.2-1j through 9.2-1n, 9.2-1p, 9.2-1q, 9.2-3a through 9.2-3g	SN	Design update of P&IDs and/or text for: •Service water •Reactor building closed loop cooling water •Miscellaneous HVAC
Page 9.2-50 Fig. 9.2-19a through 9.2-19f	SN	Design update of turbine building closed loop cooling text and P&IDs
Pages 9.3-1 through 9.3-4, 9.3-6 through 9.3-11a, 9.3-11g, 9.3-13, 9.3-31 Table 9.3-2 page 2 of 2	SN	Update based on current plant design
Pages 9.4-15, 9.4-28, 9.4-30, 9.4-36, 9.4-65, 9.4-72 Table 9.4-1 page 1 of 3, 9.4-3 page 3 of 11 Fig. 9.4-8a through 9.4-8h, 9.4-8j, 9.4-8k, 9.4-8e	SN	Design update to agree with current plant design
Fig. 9.4-15a	SN	Design update of diesel generator building HVAC P&ID

Pages	Change Code	Description
Pages 9.5-2, 9.5-9, 9.5-18, 9.5-19, 9.5-20a, 9.5-21, 9.5-22, 9.5-22a, 9.5-23, 9.5-24, 9.5-39, 9.5-40 Table 9.5-1 pages 5, 6 and 8 of 9, 9.5-2 page 3 of 8	SN	Update to agree with plant design, and technical specification
Page 9.5-25	SN	Design update for diesel generator day tanks to as-built conditions
Pages 9.5-53, 9.5-55, 9.5-59 and 9.5-61 Table 9.5-1 pages 5, 6, and 8 of 9 9.5-2 page 3 of 8	SN	Corrections based on current plant design including updating the logic diagrams for cooling water system for Division III diesel generator and auxiliary boiler system
Fig. 9.5-2a, 9.5-2b	SN	Design update of fire protection foam P&IDs
Fig. 9.5-3a	SN	Design update of fire protection CO_2 P&ID
Fig. 9.5-4a	SN	Design update of fire protection halon P&ID
Pages 9A.2-3, 9A.2-6, 9A.2-7, 9A.3-13, 9A.3-26, 9A.3-28, 9A.3-43, 9A.3-46, 9A.3-51, 9A.3-60 Table 9B.8-2 page 33 of 38	SN	Update based on current plant design and as-built conditions
Fig. 10.1-3a through 10.1-3h, 10.1-3j, 10.1-3k	SN	Update of P&IDs to present design
Pages 10.2-8, 10.3-3, 10.3-5, 10.4-3	SN	Update based on current plant design
Pages 11.2-1, 11.2-3, 11.2-6, 11.2-8, 11.2-9 through 11.2-15, 11.2-17, 11.3-2, 11.3-2a, 11.3-3, 11.3-4, 11.3-6, 11.3-7, 11.4-3a, 11.4-4, 11.4-5, 11.5-1 through 11.5-12, 11.5-12a, 11.5-13, 11.5-14 Table 11.1-2, 11.4-4 page 1 of 2, 11.5-1 pages 1 and 2 of 2	SN	Design update of text and/or P&IDs for: •Radioactive liquid waste •Radioactive solid waste •Offgas •Radiation monitors

Pages	Change Code	Description
Fig. 11.21a through 11.2-1h, 11.21j through 11.2-1m, 11.3-1a through 11.3-1c, 11.4-1a through 11.4-1h		
Fig. 11.5-4, 11.5-7	SN	Design update to reflect current design
Page 12.2-5	SN	Design udpate of startup sources
Table 12.3-2 pages 1, 2, and 3 of 3 Fig. 12.3-1 through 12.3-66	SN	Design update to current design
Pages 15.2-16, 15.6-14, 15.6-15, 15.7-3, 15.7-10 Table 15.6-6 page 2 of 2	SN	Update based on current plant design and analysis
Pages 15.6-8, 15.6-11, 15.6-12c, 15.6-13, 15.6-14, 15.7-13 Table 15.6-13 pages 9 and 11 of 11 15.6-14, 15.6-15a, 15.6-15b, 15.6-16a, 15.6-16b, 15.7-8 page 1 of 2, 15.7-9 pages 1 and 2 of 2, 15.7-16 page 1 of 2, 15.7-17	SN	Update based on current plant design and as-built conditions
Table 1.9-1 page 5 of 11, Attach 1.9-47	SS	Revised design to conform with containment isolation requirements
Pages 1.10-62, 1.10-64c, 1.10-64d, 1.10-64m, 1.10-64n	SS	Update sample system to reflect design
Pages 1.10-73a, 1.10-73b, 1.10-73d, 1.10-73e, 1.10-73g, 1.10-73k	SS	Update of containment dependability study
Page 2.2-6 Table 2.2-7, 2.2-8	SS	Update of control room habitability
Pages 2.3-6, 2.3-33, 2.3-39, 2.3-40, 2.3-43, 2.3-46, 2.3-47, 2.3-51	SS	To update meteorological data text and tables to agree with latest information

Pages	Change Code	Description
Table 2F-1 pages 1, 2 and 4 of 4, 2F-2a, b, c, 2F-3, 2F-6 pages 4 through 12 of 12, 2F-8, 2F-11 pages 3 through 9 of 9, 2G-6, 2G-7, 2G-7A, 2G-8		
Pages 2.4-4, 2.4-4a, 2.4-5, 2.4-6, 2.4-16 Table 2.4-3 Fig. 2.4-1	SS	Update of probable maximum precipitation and analyses
Pages 2.4-6, 2.5-194 Fig. 2.4-1, 2.5-128, 2.5-209	SS	Update of flood control berm
Pages 2.5-171, 2.5-171a	SS	Reactor dewatering system design change due to constructability
Pages 3.8-26, 3.8-39, 3.8-50 Table 3.8-15	SS	Update of containment test requirements
Page 3.8-73 Table 3.9A-15 page 2 of 2	SS	Clarification of inspection welding acceptance and procedures
Pages 7.3-2, 7.3-5, 7.3-6	SS	Update of automatic depressurization system logic based on NUREG 0737 - TMI Item II.K.3.18
Pages 8.3-50, 8.3-50a, 8.3-51, 8.3-52, 8.3-52a	SS	To update electrical separation to current plant design (Letter NMP2L 0588 dated 12/10/85)
Page 9.1-8a Fig. 9.1-3, 9.1-4	SS	Design of spent fuel storage racks relative to installation tolerances
Fig. 9.5-42	SS	Update of diesel generator cooling water
Pages 9A.3-6, 9A.3-7, 9A.3-8, 9A.3-16,9A.3-17, 9A.3-18, 9A.3-20 Table 9A.3-16 Fig. 9A.3-16	SS	Update of plant design for fire protection
Page 9A.3-23	SS	Revision of cable trays based on Appendix R audit

Pages	Change Code	Description
Page 9A.3-55	SS	Update of fire protection/detection based on Appendix R audit
Table 9A.3-1, 9A.3-2, 9A.3-3, 9A.3-4, 9A.3-5, 9A.3-6, 9A.3-7, 9A.3-8, 9A.3-9, 9A.3-10, 9A.3-11, 9A.3-12 and 9A.3-41	SS	Design update of fire protection and penetration seals position
Fig. 9A.3-1, 9A.3-2, 9A.3-3, 9A.3-4, 9A.3-5, 9A.3-6, 9A.3-7, 9A.3-8, 9A.3-9, 9A.3-10, 9A.3-11, 9A.3-12, 9A.3-13	SS	Update of fire protection arrangement
Pages 9B-i, 9B-ii, 9B-iii, 9B.1-1, 9B.3-1, 9B.5-5, 9B.6-3, 9B.7-1, 9B.8-1, 9B.12-1 Table 9B.6-1 pages 2 through 6 of 6, 9B.6-3 pages 1, 3 and 7 of 9, 9B.8-2 pages 29, 29a through 29f of 38, 9B.8-1 pages 1, 7, 26 through 29, 34, 36 through 50, 53 through 55, 58 through 61, 66, 67, 71, 72, 74 and 75 of 75, 9B.8-2 pages 1, 19, 20, 21, 27, 28, 29 through 29f, 33, 34, 35, 36 and 38 of 38, 9B.8-3 pages 1 through 18 of 18	SS	To incorporate design changes meeting the requirements of Appendix R

Attachment A
FSAR NSSS P&IDs, Process and Control Diagrams

FSAR Fig. No.	Sheet(s)
4.6-5	1 through 3
4.6-7	1 and 2
5.1-2	1 through 3
5.4-2	1 and 2
5.4-9	1 and 2
5.4-10	1 and 2
5.4-13	1 and 2
5.4-14	1 through 3
5.4-16	1
5.4-17	3
5.4-18	1
5.4-19	1
6.3-1	1 and 2
6.3-2	1
6.3-6	1
6.3-7	1
7.2-1	1 through 5
7.6-1	1 and 2
7.7-2	1 through 35
7.7-8	1
9.3-17	1
IIB.3-1	1 and 2

Attachment B
FSAR Logic Diagrams

FSAR Fig. No.	Sheet(s)	FSAR Fig. No.	Sheet(s)
6.2-38	1 through 12	10.4-1	1 through 5
6.2-72k	1 through 5	10.4-3	1 through 6
6.5-1	1 through 8	10.4-8	1 through 6
7.3-10	1 and 2	10.4-9	1 through 9
8.3-6	1 through 28	10.4-10	1 through 22
9.1-6	1 through 8	10.4-11	1 through 8
9.2-2	1 through 20	10.4-12	1 through 7
9.2-4	1 through 9	10.4-13	1 through 8
9.2-7	1 through 13		
9.2-18	1 through 4		
9.2-20	1 through 5		
9.3-2	1 through 10		
9.3-4	1 and 2		
9.3-6	1 through 4		
9.3-7	1 through 6		
9.3-8	1 through 3		
9.3-13	1 through 10		
9.3-14	1 through 3		
9.3-15	1		
9.3-16	1 through 7		
9.4-4	1 through 9		
9.4-5	1 through 7		
9.4-6	1 through 7		
9.4-7	1 through 13		
9.4-9	1 through 19		
9.4-11	1 through 5		
9.4-13	1 through 12		
9.4-14	1 through 3		
9.4-16	1 through 6		
9.4-17	1 through 10		
9.4-18	1 and 2		
9.4-19	1 through 3		
9.4-20	1 through 5		
9.4-21	1 and 2		
9.4-23	1 through 5		
9.5-41	1 through 11		
9.5-53	1 through 5		

NINE MILE POINT NUCLEAR STATION UNIT 2
NIAGARA MOHAWK POWER CORPORATION

FSAR AMENDMENT RECEIPT ACKNOWLEDGEMENT

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INSERTION INSTRUCTIONS

The following instructions are for the insertion of the current amendment into the Nine Mile Point Unit 2 FSAR.

Remove pages, tables, and/or figures listed in the REMOVE column and replace them with the pages, tables, and/or figures listed in the INSERT column. Dashes (---) in either column indicate no action required.

Vertical bars have been placed in the margins of inserted pages and tables to indicate revision locations.

INSERTION INSTRUCTIONS

VOLUME 1

Remove	Insert
1-vii/viii	1-vii/viii
1-ix/x	1-ix/x
1.1-3/-	1.1-3/-
1.2-33/33a	1.2-33/33a
1.2-39/40	1.2-39/40
F 1.2-2	F 1.2-2
F 1.2-15 (1 through 3 of 3)	F 1.2-15 (1 through 3 of 3)
F 1.2-17 (1, 5 and 6 of 6)	F 1.2-17 (1, 5 and 6 of 6)
F 1.2-18	F 1.2-18
F 1.2-29 (3 of 3)	F 1.2-29 (3 of 3)
F 1.2-32 (1 and 3 of 3)	F 1.2-32 (1 and 3 of 3)
F 1.2-35	F 1.2-35
F 1.2-40	F 1.2-40
T 1.3-8 (2 of 2)	T 1.3-8 (2 of 2)
T 1.3-9 (8 of 10)	T 1.3-9 (8 of 10)
T 1.3-9 (10 of 10)	T 1.3-9 (10 of 10)
---	T 1.3-9 (10a of 10)
T 1.4-1 (2 of 2)	T 1.4-1 (2 of 2)
1.7-1/-	1.7-1/-
T 1.7-1 (1 of 60)	T 1.7-1 (1 of 60)
T 1.7-1 (2 of 60)	T 1.7-1 (2 of 60)
T 1.7-1 (3 of 60)	T 1.7-1 (3 of 60)
T 1.7-1 (18 of 60)	T 1.7-1 (18 of 60)
T 1.7-1 (19 of 60)	T 1.7-1 (19 of 60)
T 1.7-1 (19a of 60)	T 1.7-1 (19a of 60)
T 1.7-1 (20 of 60)	T 1.7-1 (20 of 60)
T 1.7-1 (21 of 60)	T 1.7-1 (21 of 60)
T 1.7-1 (22 of 60)	T 1.7-1 (22 of 60)
T 1.7-1 (23 of 60)	T 1.7-1 (23 of 60)
---	T 1.7-1 (23a of 60)
T 1.7-1 (24 of 60)	T 1.7-1 (24 of 60)
T 1.7-1 (25 of 60)	T 1.7-1 (25 of 60)
T 1.7-1 (26 of 60)	T 1.7-1 (26 of 60)
T 1.7-1 (27 of 60)	T 1.7-1 (27 of 60)
T 1.7-1 (28 of 60)	T 1.7-1 (28 of 60)
T 1.7-1 (29 of 60)	T 1.7-1 (29 of 60)
T 1.7-1 (30 of 60)	T 1.7-1 (30 of 60)
T 1.7-1 (31 of 60)	T 1.7-1 (31 of 60)
T 1.7-1 (32 of 60)	T 1.7-1 (32 of 60)
T 1.7-1 (33 of 60)	T 1.7-1 (33 of 60)

INSERTION INSTRUCTIONS

VOLUME 1 (Cont)

Remove	Insert
T 1.7-1 (34 of 60)	T 1.7-1 (34 of 60)
T 1.7-1 (35 of 60)	T 1.7-1 (35 of 60)
T 1.7-1 (36 of 60)	T 1.7-1 (36 of 60)
T 1.7-1 (37 of 60)	T 1.7-1 (37 of 60)
T 1.7-1 (38 of 60)	T 1.7-1 (38 of 60)
T 1.7-1 (39 of 60)	T 1.7-1 (39 of 60)
T 1.7-1 (40 of 60)	T 1.7-1 (40 of 60)
T 1.7-1 (41 of 60)	T 1.7-1 (41 of 60)
T 1.7-1 (42 of 60)	T 1.7-1 (42 of 60)
T 1.7-1 (43 of 60)	T 1.7-1 (43 of 60)
T 1.7-1 (44 of 60)	T 1.7-1 (44 of 60)
---	T 1.7-1 (44a of 60)
T 1.7-1 (45 of 60)	T 1.7-1 (45 of 60)
T 1.7-1 (46 of 60)	T 1.7-1 (46 of 60)
T 1.7-1 (47 of 60)	T 1.7-1 (47 of 60)
T 1.7-1 (48 of 60)	T 1.7-1 (48 of 60)
T 1.7-1 (49 of 60)	T 1.7-1 (49 of 60)
T 1.7-1 (50 of 60)	T 1.7-1 (50 of 60)
T 1.7-1 (51 of 60)	T 1.7-1 (51 of 60)
T 1.7-1 (52 of 60)	T 1.7-1 (52 of 60)
T 1.7-1 (53 of 60)	T 1.7-1 (53 of 60)
---	T 1.7-1 (53a of 60)
T 1.7-1 (54 of 60)	T 1.7-1 (54 of 60)
T 1.7-1 (57 of 60)	T 1.7-1 (57 of 60)
---	T 1.7-1 (57a of 60)
T 1.7-1 (58 of 60)	T 1.7-1 (58 of 60)
T 1.7-1 (58a of 60)	T 1.7-1 (58a of 60)
T 1.7-1 (59 of 60)	T 1.7-1 (59 of 60)
---	T 1.7-1 (59a of 60)
T 1.7-1 (60 of 60)	T 1.7-1 (60 of 60)
T 1.7-1 (60a of 60)	T 1.7-1 (60a of 60)
T 1.7-1 (60b of 60)	T 1.7-1 (60b of 60)
---	T 1.7-1 (60c of 60)
F 1.7-1 (1 through 5 of 5)	F 1.7-1 (1 through 5 of 5)

INSERTION INSTRUCTIONS

VOLUME 2

Remove	Insert
T 1.8-1 (5 of 169)	T 1.8-1 (5 of 169)
T 1.8-1 (31 of 169)	T 1.8-1 (31 of 169)
---	T 1.8-1 (31a of 169)
T 1.8-1 (33 of 169)	T 1.8-1 (33 of 169)
T 1.8-1 (89 of 169)	T 1.8-1 (89 of 169)
T 1.8-1 (89a of 169)	T 1.8-1 (89a of 169)
T 1.8-1 (169 of 169)	T 1.8-1 (169 of 169)
T 1.9-1 (5 and 6 of 11)	T 1.9-1 (5 and 6 of 11)
Att 1.9-47	Att 1.9-47
Att 1.9-51	Att 1.9-51
Att 1.9-52	Att 1.9-52
Att 1.9-61 (2 of 4)	Att 1.9-61 (2 of 4)
1.10-3/3a	1.10-3/3a
1.10-7/8	1.10-7/8
1.10-11/12	1.10-11/12
1.10-17/18	1.10-17/18
1.10-25/26	1.10-25/26
1.10-27/28	1.10-27/27a
---	1.10-27b/28
1.10-29/30	1.10-29/30
1.10-30a/30b	1.10-30a/30b
1.10-33b/34	1.10-33b/34
1.10-35b/36	1.10-35b/36
1.10-37/38	1.10-37/38
1.10-47/47a	1.10-47/47a
1.10-47b/48	1.10-47b/48
1.10-55/56	1.10-55/56
1.10-61/62	1.10-61/62
1.10-64c/64d	1.10-64c/64d
1.10-64m/64n	1.10-64m/64n
F II.B.3-1 (1 and 2 of 2)	F II.B.3-1 (1 and 2 of 2)
1.10-65/66	1.10-65/66
1.10-69/69a	1.10-69/69a
1.10-69b/69c	1.10-69b/69b.1
---	1.10-69b.2/69c
1.10-73/73a	1.10-73/73a
---	1.10-73a1/73a2
1.10-73b/73c	1.10-73b/73c
1.10-73d/73e	1.10-73d/73e
1.10-73f/73g	1.10-73f/73g
1.10-73j/73ja	1.10-73j/73ja
1.10-73jb/73k	1.10-73jb/73k
1.10-73n/74	1.10-73n/74
1.10-75/76	1.10-75/76

INSERTION INSTRUCTIONS

VOLUME 2 (Cont)

Remove	Insert
1.10-81/82	1.10-81/82
1.10-85/85a	1.10-85/85.1
---	1.10-85.2/85a
---	1.10-85a1/85a2
1.10-85f/85g	1.10-85f/85g
1.10-85h/86	1.10-85h/86
1.10-87/88	1.10-87/88
1.10-89/90	1.10-89/90
1.10-95/96	1.10-95/96
1.10-97/98	1.10-97/98
1.10-107/108	1.10-107/108
1.10-109/110	1.10-109/110
1.10-111/112	1.10-111/112
1.10-113/114	1.10-113/114
1.10-115/116	1.10-115/116
1.10-117/118	1.10-117/118
1.10-119/120	1.10-119/120
1.12-13/14	1.12-13/14
1.12-15/16	1.12-15/16

INSERTION INSTRUCTIONS

VOLUME 3

Remove	Insert
2-iii/iv	2-iii/iv
T 2.1-1	T 2.1-1
2.2-5b/6	2.2-5b/6
T 2.2-7	T 2.2-7
T 2.2-8	T 2.2-8
2.3-5b/6	2.3-5b/6
2.3-33/34	2.3-33/33a
---	2.3-33b/34
2.3-39/40	2.3-39/40
2.3-43/44	2.3-43/44
2.3-45/46	2.3-45/46
2.3-47/48	2.3-47/48
2.3-51/52	2.3-51/51a
---	2.3-51b/52
2.4-3b/4	2.4-3b/4
2.4-4a/4b	2.4-4a/4b
2.4-5/6	2.4-5/5a
---	2.4-5b/6
2.4-15/16	2.4-15/16
---	2.4-16a/16b
2.4-47/38	2.4-37/38
T 2.4-3	T 2.4-3
F 2.4-1	F 2.4-1
2.5-171/171a	2.5-171/171a

INSERTION INSTRUCTIONS

VOLUME 4

Remove	Insert
F 2.5-128	F 2.5-128
F 2.5-209	F 2.5-209

INSERTION INSTRUCTIONS

VOLUME 6

Remove	Insert
2F-i/ii	2F-i/ia
---	2F-ib/ii
T 2F-1 (1 and 2 of 2)	T 2F-1 (1 through 3 of 3)
---	T 2F-2a (1 and 2 of 2)
---	T 2F-2b
---	T 2F-2c (1 and 2 of 2)
T 2F-3	T 2F-3
T 2F-6 (4 of 12)	T 2F-6 (4 of 12)
T 2F-6 (6 through 12 of 12)	T 2F-6 (6 through 12 of 12)
T 2F-8	T 2F-8
T 2F-11 (3 through 9 of 9)	T 2F-11 (3 through 9 of 9)
2G-i/-	2G-i/-
T 2G-6	T 2G-6
T 2G-7	T 2G-7
---	T 2G-7a
T 2G-8	T 2G-8

INSERTION INSTRUCTIONS

VOLUME 8

Remove	Insert
3-xiii/xiv	3-xiii/xiv
3-xxxiiib/xxxiv	3-xxxiiib/xxxiv
3-xxxiva/xxxivb	3-xxxiva/xxxivb
T 3.2-1 (1 through 3 of 26)	T 3.2-1 (1 through 3 of 26)
T 3.2-1 (8 of 26)	T 3.2-1 (8 of 26)
T 3.2-1 (13 and 13a of 26)	T 3.2-1 (13 and 13a of 26)
T 3.2-1 (15 of 26)	T 3.2-1 (15 of 26)
T 3.2-1 (22 of 26)	T 3.2-1 (22 of 26)
T 3.2-1 (26d of 26)	T 3.2-1 (26d of 26)
T 3.2-3	T 3.2-3
T 3.2-4 (2 of 2)	T 3.2-4 (2 of 2)
3.4-1b/2	3.4-1b/2
3.4-3b/4	3.4-3b/4
T 3.4-1 (1 of 2)	T 3.4-1 (1 of 2)
T 3.4-7	T 3.4-7

INSERTION INSTRUCTIONS

VOLUME 9

Remove	Insert
3.5-19/19a	3.5-19/19a
T 3.5-21	T 3.5-21
T 3.5-22 (1 of 1)	T 3.5-22 (1 and 2 of 2)
3.6A-37/38	3.6A-37/38
T 3.6A-1 (1, 3, and 4 of 5)	T 3.6A-1 (1, 3, and 4 of 5)
T 3.6A-28 (2 of 12) → 8	T 3.6A-28 (2 of 12) → 8
T 3.6A-34 (3 of 18)	T 3.6A-34 (3 of 18)
T 3.6A-41 (2 of 4)	T 3.6A-41 (2 of 4)
T 3.6A-44 (7 and 8 of 28)	T 3.6A-44 (7 and 8 of 28)

INSERTION INSTRUCTIONS

VOLUME 10

Remove	Insert
3.6B-3/4	3.6B-3/4
3.6B-21/-	3.6B-21/-
3.7A-1/2	3.7A-1/2
3.7A-3/3a	3.7A-3/3a
3.7A-5/5a	3.7A-5/5a
3.7A-5b/6	3.7A-5b/6
3.7A-7/7a	3.7A-7/7a
3.7A-7b/8	3.7A-7b/8
3.7A-19/20	3.7A-19/20
3.7A-23/24	3.7A-23/24
3.7A-25/26	3.7A-25/26
3.7A-29/30	3.7A-29/30
3.7A-31/32	3.7A-31/32
F 3.7A-18	F 3.7A-18
F 3.7A-21	F 3.7A-21
F 3.7A-22	F 3.7A-22
F 3.7A-23	F 3.7A-23
F 3.7A-24	F 3.7A-24
F 3.7A-25	F 3.7A-25
F 3.7A-26	F 3.7A-26
F 3.7A-32	F 3.7A-32
3.7B-3/4	3.7B-3/4
3.7B-7/8	3.7B-7/8
3.7B-13/14	3.7B-13/14
3.7B-15/16	3.7B-15/16
3.7B-21/22	3.7B-21/22
3.7B-23/24	3.7B-23/24
T 3.7B-1	T 3.7B-1
3.8-1/2	3.8-1/2
3.8-25d/26	3.8-25d/26
---	3.8-26a/26b
3.8-37/38	3.8-37/38
3.8-39/40	3.8-39/40
3.8-43/43a	3.8-43/43a
3.8-49/50	3.8-49/50
3.8-65/65a	3.8-65/65a
3.8-67/68	3.8-67/68
3.8-71/71a	3.8-71/71a

INSERTION INSTRUCTIONS

VOLUME 10 (Cont)

Remove	Insert
3.8-73/73a	3.8-73/73a
3.8-73b/74	3.8-73b/74
3.8-77/78	3.8-77/78
T 3.8-1 (1, 2, and 6 of 6)	T 3.8-1 (1, 2, and 6 of 6)
T 3.8-10 (2 and 3 of 3)	T 3.8-10 (2 and 3 of 3)
T 3.8-11 (2 and 3 of 3)	T 3.8-11 (2 and 3 of 3)
T 3.8-12 (3 of 4)	T 3.8-12 (3 of 4)
T 3.8-13	T 3.8-13
---	T 3.8-15 (1 and 2 of 2)

INSERTION INSTRUCTIONS

VOLUME 12

Remove	Insert
3A-iii/iv	3A-iii/iv
3A-vii/vii	3A-vii/viii
3A-1/2	3A-1/2
T 3A.1-1	T 3A.1-1
3A.18-1/1a	3A.18-1/1a
---	3A.32-1/2
---	3A.33-1/2
---	T 3A.33-1
---	T 3A.33-2
3B-iii/iv	3B-iii/iv
3B-v/vi	3B-v/vi
3B-1/2	3B-1/2
3B-3/4	3B-3/4
3B-5/6	3B-5/6
T 3B-1 (2 of 2)	T 3B-1 (2 of 2)
T 3B-2	T 3B-2
T 3B-9	T 3B-9
T 3B-10	T 3B-10
T 4.4-8	T 4.4-8
4.6-8a/8b	4.6-8a/8b
F 4.6-5 (1 through 3 of 3)	F 4.6-5 (1 through 3 of 3)
F 4.6-7 (1 and 2 of 2)	F 4.6-7 (1 through 3 of 3)

INSERTION INSTRUCTIONS

VOLUME 13

Remove	Insert
F 5.1-2 (1 through 3 of 3)	F 5.1-2 (1 through 3 of 3)
5.2-9b/10	5.2-9b/10
5.2-31/32	5.2-31/32
5.2-32a/32b	5.2-32a/32b
5.2-37/38	5.2-37/37a
---	5.2-37b/38
T 5.2-1 (1, 2, and 3 of 8)	T 5.2-1 (1, 2, and 3 of 8)
---*	T 5.2-1 (3a of 8)
T 5.2-1 (6, 6a, and 6b of 8)	T 5.2-1 (6, 6a, and 6b of 8)
T 5.2-1 (8a1 of 8)	T 5.2-1 (8a1 of 8)
T 5.2-1 (8b of 8)	T 5.2-1 (8b and 8b1 of 8)
T 5.2-5 (2 and 6 of 6)	T 5.2-5 (2 and 6 of 6)
T 5.2-6	T 5.2-6
F 5.2-4 (1 of 1)	F 5.2-4 (1 and 2 of 2)
5.3-1/2	5.3-1/2
5.3-17/18	5.3-17/18
5.3-19/20	5.3-19/20
5.4-3/4	5.4-3/4
---	5.4-4a/4b
5.4-9/10	5.4-9/10
5.4-11/12	5.4-11/12
5.4-13/14	5.4-13/14
5.4-21b/22	5.4-21b/22
5.4-25/26	5.4-25/26
5.4-29/30	5.4-29/30
5.4-35/36	5.4-35/36
5.4-37/37a	5.4-37/37a
5.4-37b/38	5.4-37b/38
5.4-38a/38b	5.4-38a/38b
5.4-39/40	5.4-39/40
5.4-41/42	5.4-41/42
5.4-51/51a	5.4-51/51a
T 5.4-2	T 5.4-2
F 5.4-2 (1 and 2 of 2)	F 5.4-2 (1 and 2 of 2)
F 5.4-9 (1 and 2 of 2)	F 5.4-9 (1 and 2 of 2)
F 5.4-10 (1 and 2 of 2)	F 5.4-10 (1 and 2 of 2)
F 5.4-13 (1 and 2 of 2)	F 5.4-13 (1 and 2 of 2)

*Place new page 3a of 8 ahead of existing 3a of 8.

INSERTION INSTRUCTIONS

VOLUME 13 (Cont)

Remove	Insert
F 5.4-14 (1 through 3 of 3)	F 5.4-14 (1 through 3 of 3)
F 5.4-16	F 5.4-16
F 5.4-17 (2 of 3)	F 5.4-17 (2 of 3)
F 5.4-18	F 5.4-18
F 5.4-19	F 5.4-19
T 6.1-2 (1 and 2 of 2)	T 6.1-2 (1 and 2 of 2)

INSERTION INSTRUCTIONS

VOLUME 14

Remove	Insert
6.2-2a/2b	6.2-2a/2b
6.2-5/6	6.2-5/6
6.2-6a/6b	6.2-6a/6b
6.2-7/8	6.2-7/8
6.2-9/10	6.2-9/10
6.2-15/16	6.2-15/16
6.2-35/35a	6.2-35/35a
6.2-37/37a	6.2-37/37a
6.2-43/43a	6.2-43/43a
---	6.2-46a/46b
6.2-47/47a	6.2-47/47a
6.2-57/57a	6.2-57/57a
6.2-57b/57c	6.2-57b/57c
6.2-57d/58	6.2-57d/58
6.2-61/61a	6.2-61/61a
6.2-61b/62	6.2-61b/62
6.2-62a/62b	6.2-62a/62b
6.2-83/84	6.2-83/83a
---	6.2-83b/84
---	6.2-84a/84b
6.2-85b/86	6.2-85b/86
6.2-86/86b	6.2-86a/86b
T 6.2-3 (1 of 2)	T 6.2-3 (1 of 2)
T 6.2-51	T 6.2-51
T 6.2-56 (1 of 24)	T 6.2-56 (1 of 24)
T 6.2-56 (3 and 4 of 24)	T 6.2-56 (3 and 4 of 24)
T 6.2-56 (6 through 10 of 24)	T 6.2-56 (6 through 10 of 24)
T 6.2-56 (16, 17 and 18 of 24)	T 6.2-56 (16, 17, 17a and 18 of 24)
T 6.2-56 (20 of 24)	T 6.2-56 (20 of 24)
T 6.2-56 (22 and 23 of 24)	T 6.2-56 (22 and 23 of 24)
F 6.2-33 (1 through 8 of 8)	F 6.2-33 (1 of 8)
F 6.2-38 (1 through 12 of 12)	F 6.2-38 (1 through 12 of 12)
F 6.2-54	F 6.2-54
F 6.2-56 (2 through 10 of 10)	F 6.2-56 (2 through 10 of 10)
F 6.2-60	F 6.2-60
F 6.2-70 (42 of 43)	F 6.2-70 (42 of 43)
F 6.2-71A	F 6.2-71A
F 6.2-71B	F 6.2-71B
F 6.2-72A	F 6.2-72A
F 6.2-72B	F 6.2-72B
F 6.2-72K (1 through 5 of 5)	F 6.2-72K (1 through 5 of 5)
F 6.2-73A	F 6.2-73A
F 6.2-76	F 6.2-76
F 6.2-77	F 6.2-77

INSERTION INSTRUCTIONS

VOLUME 15

Remove	Insert
6.3-5/6	6.3-5/6
6.3-8a/8aa	6.3-8a/8aa
6.3-8ab/8b	6.3-8ab/8b
6.3-8c/8d	6.3-8c/8d
6.3-11/12	6.3-11/12
6.3-13/14	6.3-13/14
6.3-14a/14b	6.3-14a/14b
6.3-15/16	6.3-15/16
6.3-17/18	6.3-17/18
6.3-20a/20b	6.3-20a/20b
F 6.3-1 (1 and 2 of 2)	F 6.3-1 (1 and 2 of 2)
F 6.3-2	F 6.3-2
F 6.3-6	F 6.3-6
F 6.3-7	F 6.3-7
6.4-3/4	6.4-3/4
6.5-5/6	6.5-5/6
6.5-7/8	6.5-7/7a
---	6.5-7b/8
F 6.5-1 (1 through 8 of 8)	F 6.5-1 (1 through 8 of 8)
6B-3/4	6B-3/4
6B-5/6	6B-5/6
6B-7/8	6B-7/8
7-i/ii	7-i/ii
7-xi/xii	7-xi/xii
7.1-1/2	7.1-1/2
T 7.1-2 (1 of 3)	T 7.1-2 (1 of 3)
7.2-1/2	7.2-1/2
7.2-11/12	7.2-11/12
F 7.2-1 (1 through 4 of 4)	F 7.2-1 (1 through 5 of 5)
7.3-1/2	7.3-1/2
7.3-3/4	7.3-3/4
7.3-5/6	7.3-5/6
7.3-7/7a	7.3-7/7a
7.3-9/9a	7.3-9/9a
7.3-11/12	7.3-11/12
7.3-15/16	7.3-15/16
7.3-17/18	7.3-17/18
7.3-23/24	7.3-23/24

INSERTION INSTRUCTIONS

VOLUME 15 (Cont)

Remove	Insert
7.3-25/26	7.3-25/26
7.3-29/30	7.3-29/30
7.3-31/31a	7.3-31/31a
T 7.3-1	T 7.3-1
T 7.3-2	T 7.3-2
T 7.3-3	T 7.3-3
T 7.3-4	T 7.3-4
T 7.3-5 (1 and 2 of 2)	T 7.3-5 (1 and 2 of 2)
T 7.3-6	T 7.3-6
T 7.3-7	T 7.3-7
T 7.3-8	T 7.3-8
F 7.3-2 (1 through 3 of 3)	F 7.3-2 (1 through 3 of 3)
F 7.3-3 (1 through 3 of 3)	F 7.3-3 (1 through 3 of 3)
F 7.3-4 (1 through 5 of 5)	F 7.3-4 (1 through 5 of 5)
F 7.3-5 (1 and 2 of 2)	F 7.3-5 (1 and 2 of 2)
F 7.3-6 (1 through 5 of 5)	F 7.3-6 (1 through 5 of 5)
F 7.3-7	F 7.3-7
F 7.3-10 (1 and 2 of 2)	F 7.3-10 (1 and 2 of 2)

INSERTION INSTRUCTIONS

VOLUME 16

Remove	Insert
7.4-3/4	7.4-3/4
7.4-7/8	7.4-7/8
7.4-11/12	7.4-11/11a
---	7.4-11b/12
7.4-13/13a	7.4-13/13a
7.4-13b/14	7.4-13b/14
7.4-15/16	7.4-15/16
7.4-21/22	7.4-21/22
---	7.4-22a/22b
7.4-23/24	7.4-23/23a
---	7.4-23b/24
T 7.4-1	T 7.4-1
F 7.4-1 (1 through 5 of 5)	F 7.4-1 (1 through 6 of 6)
F 7.4-2	F 7.4-2
7.5-5/6	7.5-5/6
7.5-7/-	7.5-7/-
T 7.5-1 (3 of 14)	T 7.5-1 (3 of 14)
7.6-2a/2b	7.6-2a/2b
7.6-9/9a	7.6-9/9a
7.6-11/12	7.6-11/12
F 7.6-1 (1 and 2 of 2)	F 7.6-1 (1 and 2 of 2)
F 7.6-3 (1 and 2 of 2)	F 7.6-3 (1 and 2 of 2)
F 7.6-6 (1 through 7 of 7)	F 7.6-6 (1 through 7 of 7)
F 7.6-9 (1 through 10 of 10)	F 7.6-9 (1 through 10 of 10)
7.7-27/28	7.7-27/27a
---	7.7-27b/28
7.7-29/30	7.7-29/30
F 7.7-1 (1 through 9 of 9)	F 7.7-1 (1 through 7 of 7)
F 7.7-2 (1 of 1)	F 7.7-2 (1 through 35 of 35)
F 7.7-6 (1 through 7 of 7)	F 7.7-6 (1 through 7 of 7)
F 7.7-8	F 7.7-8
8.2-5b/6	8.2-5b/6
8.2-9/10	8.2-9/10
8.2-11/12	8.2-11/12
8.2-13/14	8.2-13/14
8.2-15/16	8.2-15/16
8.2-19/20	8.2-19/20
8.2-21/22	8.2-21/22
8.2-23/23a	8.2-23/23a
8.2-24a/24b	8.2-24a/24b
F 8.2-1	F 8.2-1

INSERTION INSTRUCTIONS

VOLUME 16 (Cont)

Remove	Insert
8.3-3/4	8.3-3/4
8.3-5/16	8.3-5/6
8.3-9/9a	8.3-9/9a
8.3-9b/10	8.3-9b/10
8.3-11/11a	8.3-11/11a
8.3-11b/12	8.3-11b/12
---	8.3-12a/12b
8.3-18a/18b	8.3-18a/18b
8.3-19/20	8.3-19/20
---	8.3-20a/20b
8.3-27b/28	8.3-27b/28
8.3-29/30	8.3-29/30
8.3-31/32	8.3-31/32
8.3-33/34	8.3-33/34
8.3-35/36	8.3-35/36
8.3-43/44	8.3-43/44
8.3-45b/46	8.3-45b/46
8.3-49/49a	8.3-49/49a
8.3-49b/50	8.3-49b/50
8.3-50a/50b	8.3-50a/50b
8.3-51/52	8.3-51/51a
---	8.3-51b/52
8.3-52a/52b	8.3-52a/52b
8.3-55/56	8.3-55/56
8.3-57b/58	8.3-57b/58
8.3-59/60	8.3-59/60
8.3-63/64	8.3-63/64
8.3-69/70	8.3-69/70
T 8.3-1 (1 through 19 of 19)	T 8.3-1 (1 through 13 of 13)
T 8.3-2 (1 through 18 of 18)	T 8.3-2 (1 through 11 of 11)
T 8.3-5	T 8.3-5
T 8.3-6	T 8.3-6
T 8.3-8	T 8.3-8
T 8.3-9	T 8.3-9
T 8.3-10 (1 of 1)	T 8.3-10 (1 and 2 of 2)
T 8.3-11	T 8.3-11
T 8.3-12	T 8.3-12
T 8.3-13	T 8.3-13
F 8.3-1	F 8.3-1
F 8.3-3 (1 and 2 of 2)	F 8.3-3 (1 and 2 of 2)
F 8.3-4	F 8.3-4
F 8.3-5	F 8.3-5
F 8.3-6 (1 through 28 of 28)	F 8.3-6 (1 through 30 of 30)
F 8.3-8b (13 of 13)	F 8.3-8B (13 of 13)

INSERTION INSTRUCTIONS

VOLUME 16 (Cont)

Remove	Insert
F 8.3-9 (1 of 2)	F 8.3-9 (1 of 2)
F 8.3-10	F 8.3-10
F 8.3-11	F 8.3-11
9-vii/viii	9-vii/viia
---	9-viib/viii
9-ix/x	9-ix/x
9-xi/xii	9-xi/xii
9.1-8a/8b	9.1-8a/8b
9.1-11/11a	9.1-11/11a
9.1-11b/12	9.1-11b/12
9.1-13/14	9.1-13/14
9.1-15/15a	9.1-15/15a
9.1-17/18	9.1-17/18
9.1-41/42	9.1-41/42
9.1-43/44	9.1-43/44
F 9.1-3	F 9.1-3
F 9.1-4	F 9.1-4
F 9.1-5a	F 9.1-5a
F 9.1-5b	F 9.1-5b
F 9.1-5c	F 9.1-5c
F 9.1-5d	F 9.1-5d
F 9.1-6 (1 through 8 of 8)	F 9.1-6 (1 through 8 of 8)
F 9.1-26a	F 9.1-26a
9.2-5b/6	9.2-5b/6
9.2-7/8	9.2-7/7a
---	9.2-7b/8
9.2-11/12	9.2-11/11a
---	9.2-11b/12
9.2-13/14	9.2-13/14
9.2-17/18	9.2-17/18
9.2-21/22	9.2-21/22
9.2-23/24	9.2-23/23a
---	9.2-23b/24
9.2-25/25a	9.2-25/25a
9.2-25b/26	9.2-25b/26
9.2-26a/26b	9.2-26a/26b
9.2-27/28	9.2-27/28
9.2-43/44	9.2-43/44
9.2-45/46	9.2-45/46
9.2-49/50	9.2-49/50
T 9.2-1 (1 of 2)	T 9.2-1 (1 of 2)
T 9.2-2 (1 and 2 of 2)	T 9.2-2 (1 and 2 of 2)

INSERTION INSTRUCTIONS

VOLUME 18

Remove	Insert
T 9.2-3 (1 and 2 of 2)	T 9.2-3 (1 and 2 of 2)
T 9.2-4 (1 and 2 of 2)	T 9.2-4 (1 through 3 of 3)
F 9.2-1a	F 9.2-1a
F 9.2-1b	F 9.2-1b
F 9.2-1c	F 9.2-1c
F 9.2-1d	F 9.2-1d
F 9.2-1e	F 9.2-1e
F 9.2-1f	F 9.2-1f
F 9.2-1g	F 9.2-1g
F 9.2-1h	F 9.2-1h
F 9.2-1j	F 9.2-1j
F 9.2-1k	F 9.2-1k
F 9.2-1l	F 9.2-1l
F 9.2-1m	F 9.2-1m
F 9.2-1n	F 9.2-1n
F 9.2-1p	F 9.2-1p
F 9.2-1q	F 9.2-1q
F 9.2-2 (1 through 20 of 20)	F 9.2-2 (1 through 25 of 25)
F 9.2-3a	F 9.2-3a
F 9.2-3b	F 9.2-3b
F 9.2-3c	F 9.2-3c
F 9.2-3d	F 9.2-3d
F 9.2-3e	F 9.2-3e
---	F 9.2-3f
---	F 9.2-3g
F 9.2-4 (1 through 9 of 9)	F 9.2-4 (1 through 12 of 12)
F 9.2-5a	F 9.2-5a
F 9.2-5b	F 9.2-5b
F 9.2-5c	F 9.2-5c
F 9.2-5d	F 9.2-5d
F 9.2-5e	F 9.2-5e
F 9.2-6a	F 9.2-6a
F 9.2-7 (1 through 13 of 13)	F 9.2-7 (1 through 12 of 12)
F 9.2-8a	F 9.2-8a
F 9.2-8b	F 9.2-8b
F 9.2-9a	F 9.2-9a
F 9.2-9b	F 9.2-9b
F 9.2-11	F 9.2-11
F 9.2-12	F 9.2-12
F 9.2-17a	F 9.2-17a
F 9.2-17b	F 9.2-17b
F 9.2-17c	F 9.2-17c
F 9.2-18 (1 through 4 of 4)	F 9.2-18 (1 through 4 of 4)
F 9.2-19a	F 9.2-19a

INSERTION INSTRUCTIONS

VOLUME 18 (Cont)

Remove	Insert
F 9.2-19b	F 9.2-19b
F 9.2-19c	F 9.2-19c
F 9.2-19d	F 9.2-19d
F 9.2-19e	F 9.2-19e
F 9.2-19f	F 9.2-19f
F 9.2-20 (1 through 5 of 5)	F 9.2-20 (1 through 5 of 5)

INSERTION INSTRUCTIONS

VOLUME 19

Remove	Insert
9.3-1/2	9.3-1/2
9.3-3/4	9.3-3/4
9.3-7/8	9.3-7/8
9.3-9/10	9.3-9/10
9.3-11/11a	9.3-11/11a
9.3-11f/11g	9.3-11f/11g
9.3-13/14	9.3-13/14
9.3-15/16	9.3-15/16
9.3-23b/24	9.3-23b/24
9.3-27/28	9.3-27/28
9.3-31/32	9.3-31/32
T 9.3-1 (5 of 10)	T 9.3-1 (5 and 5a of 10)
T 9.3-1 (8 of 10)	T 9.3-1 (8 of 10)
T 9.3-1 (9 and 9a of 10)	T 9.3-1 (9 and 9a of 10)
T 9.3-1 (10 of 10)	T 9.3-1 (10 of 10)
T 9.3-2 (2 of 2)	T 9.3-2 (2 of 2)
F 9.3-2 (1 through 10 of 10)	F 9.3-2 (1 through 11 of 11)
F 9.3-3a	F 9.3-3a
F 9.3-3b	F 9.3-3b
F 9.3-3c	F 9.3-3c
F 9.3-3d	F 9.3-3d
F 9.3-3e	F 9.3-3e
F 9.3-4 (1 and 2 of 2)	F 9.3-4 (1 and 2 of 2)
F 9.3-6 (1 through 4 of 4)	F 9.3-6 (1 through 4 of 4)
F 9.3-7 (1 through 6 of 6)	F 9.3-7 (1 through 8 of 8)
F 9.3-8 (1 through 3 of 3)	F 9.3-8 (1 through 3 of 3)
F 9.3-9a	F 9.3-9a
F 9.3-9b	F 9.3-9b
F 9.3-9c	F 9.3-9c
F 9.3-9d	F 9.3-9d
F 9.3-9e	F 9.3-9e
F 9.3-9f	F 9.3-9f
F 9.3-10a	F 9.3-10a
F 9.3-10b	F 9.3-10b
F 9.3-10c	F 9.3-10c
F 9.3-10d	F 9.3-10d
F 9.3-10e	F 9.3-10e
F 9.3-10f	F 9.3-10f
F 9.3-10g	F 9.3-10g
F 9.3-10h	F 9.3-10h
F 9.3-10j	F 9.3-10j
F 9.3-11a	F 9.3-11a
F 9.3-11b	F 9.3-11b
---	F 9.3-11c
---	F 9.3-11d

INSERTION INSTRUCTIONS

VOLUME 19 (Cont)

Remove	Insert
---	F 9.3-11e
F 9.3-12a	F 9.3-12a
F 9.3-12b	F 9.3-12b
F 9.3-12c	F 9.3-12c
F 9.3-12d	F 9.3-12d
F 9.3-12e	F 9.3-12e
F 9.3-12f	F 9.3-12f
F 9.3-12g	F 9.3-12g
F 9.3-12h	F 9.3-12h
F 9.3-12j	F 9.3-12j
F 9.3-12k	F 9.3-12k
F 9.3-12l	F 9.3-12l
F 9.3-13 (1 through 10 of 10)	F 9.3-13 (1 through 10 of 10)
F 9.3-14 (1 through 3 of 3)	F 9.3-14 (1 through 3 of 3)
F 9.3-15	F 9.3-15
F 9.3-16 (1 through 7 of 7)	F 9.3-16 (1 through 7 of 7)
---	F 9.3-20a
---	F 9.3-20b

INSERTION INSTRUCTIONS

VOLUME 20

Remove	Insert
9.4-1/2	9.4-1/2
9.4-3/4	9.4-3/4
9.4-7/8	9.4-7/8
9.4-9/10	9.4-9/10
9.4-21b/22	9.4-21b/22
9.4-27/28	9.4-27/28
9.4-29/30	9.4-29/30
9.4-35/36	9.4-35/36
9.4-39/40	9.4-39/40
9.4-41/42	9.4-41/42
9.4-45/46	9.4-45/46
9.4-47/48	9.4-47/48
9.4-49/50	9.4-49/50
9.4-51/52	9.4-51/52
9.4-53/54	9.4-53/54
---	9.4-54a/54b
9.4-55/56	9.4-55/56
---	9.4-56a/56b
9.4-57/58	9.4-57/57a
---	9.4-57b/58
9.4-58a/58b	9.4-58a/58b
9.4-59/60	9.4-59/59a
---	9.4-59b/60
9.4-63/64	9.4-63/64
9.4-65/66	9.4-65/66
9.4-71/72	9.4-71/72
---	9.4-72a/72b
9.4-73/-	9.4-73/-
T 9.4-3 (3 of 11)	T 9.4-3 (3 of 11)
T 9.4-5 (1 through 3 of 21)	T 9.4-5 (1 through 3 of 21)
---	T 9.4-5 (3a of 21)
T 9.4-5 (4 of 21)	T 9.4-5 (4 of 21)
---	T 9.4-5 (4a and 4b of 21)
T 9.4-5 (5 through 15 of 21)	T 9.4-5 (5 through 15 of 21)
---	T 9.4-5 (15a of 21)
T 9.4-5 (16 and 17 of 21)	T 9.4-5 (16 and 17 of 21)
T 9.4-5 (21 of 21)	T 9.4-5 (21 of 21)
T 9.4-6	T 9.4-6
T 9.4-7 (1 and 2 of 2)	T 9.4-7 (1 and 2 of 2)
T 9.4-8 (1 through 5 of 5)	T 9.4-8 (1 through 6 of 6)
T 9.4-9	T 9.4-9
T 9.4-10 (1 and 2 of 2)	T 9.4-10 (1 and 2 of 2)
F 9.4-2a	F 9.4-2a
---	F 9.4-2b

INSERTION INSTRUCTIONS

VOLUME 20 (Cont)

Remove	Insert
---	F 9.4-2c
---	F 9.4-2d
---	F 9.4-2e
F 9.4-3a	F 9.4-3a
---	F 9.4-3b
---	F 9.4-3c
---	F 9.4-3d
---	F 9.4-3e
---	F 9.4-3f
F 9.4-4 (1 through 9 of 9)	F 9.4-4 (1 through 9 of 9)
F 9.4-5 (1 through 7 of 7)	F 9.4-5 (1 through 8 of 8)
F 9.4-6 (1 through 7 of 7)	F 9.4-6 (1 through 7 of 7)
F 9.4-7 (1 through 13 of 13)	F 9.4-7 (1 through 14 of 14)
F 9.4-8a	F 9.4-8a
F 9.4-8b	F 9.4-8b
F 9.4-8c	F 9.4-8c
F 9.4-8d	F 9.4-8d
F 9.4-8e	F 9.4-8e
F 9.4-8f	F 9.4-8f
F 9.4-8g	F 9.4-8g
F 9.4-8h	F 9.4-8h
F 9.4-8j	F 9.4-8j
F 9.4-8k	F 9.4-8k
F 9.4-8l	F 9.4-8l

INSERTION INSTRUCTIONS

VOLUME 21

Remove	Insert
F 9.4-9 (1 through 19 of 19)	F 9.4-9 (1 through 24 of 24)
F 9.4-10a	F 9.4-10a
F 9.4-10b	F 9.4-10b
F 9.4-10c	F 9.4-10c
F 9.4-10d	F 9.4-10d
F 9.4-10e	F 9.4-10e
F 9.4-11 (1 through 5 of 5)	F 9.4-11 (1 through 17 of 17)
F 9.4-12a	F 9.4-12a
F 9.4-12b	F 9.4-12b
F 9.4-12c	F 9.4-12c
F 9.4-12d	F 9.4-12d
F 9.4-13 (1 through 12 of 12)	F 9.4-13 (1 through 12 of 12)
F 9.4-14 (1 through 3 of 3)	F 9.4-14 (1 through 3 of 3)
F 9.4-15a	F 9.4-15a
F 9.4-16 (1 through 6 of 6)	F 9.4-16 (1 through 9 of 9)
F 9.4-17 (1 through 10 of 10)	F 9.4-17 (1 through 12 of 12)
F 9.4-18 (1 and 2 of 2)	F 9.4-18 (1 through 4 of 4)
F 9.4-19 (1 through 3 of 3)	F 9.4-19 (1 through 3 of 3)
F 9.4-20 (1 through 5 of 5)	F 9.4-20 (1 through 5 of 5)
F 9.4-21 (1 and 2 of 2)	F 9.4-21 (1 through 4 of 4)
F 9.4-22a	F 9.4-22a
F 9.4-22b	F 9.4-22b
F 9.4-22c	F 9.4-22c
F 9.4-22d	F 9.4-22d
---	F 9.4-22e
F 9.4-23 (1 through 5 of 5)	F 9.4-23 (1 through 7 of 7)
9.5-1/2	9.5-1/2
9.5-3/4	9.5-3/4
9.5-5/6	9.5-5/6
9.5-9/10	9.5-9/10
9.5-11/12	9.5-11/12
---	9.5-12a/12b
9.5-17b/18	9.5-17b/18
---	9.5-18a/18b
9.5-19/20	9.5-19/20
9.5-20a/20b	9.5-20a/20b
9.5-21/22	9.5-21/22
9.5-22a/22a1	9.5-22a/22a1
9.5-23/23a	9.5-23/23a
9.5-23b/24	9.5-23b/24
9.5-25/25a	9.5-25/25a
9.5-39/40	9.5-39/40
9.5-53/54	9.5-53/54
9.5-55/55a	9.5-55/55a
9.5-59/60	9.5-59/60

INSERTION INSTRUCTIONS

VOLUME 21 (Cont)

Remove	Insert
9.5-61/61a	9.5-61/61a
9.5-61b/62	9.5-61b/62
9.5-65/66	9.5-65/66
T 9.5-1 (5 and 6 of 9)	T 9.5-1 (5 and 6 of 9)
T 9.5-1 (8 of 9)	T 9.5-1 (8 of 9)
T 9.5-2 (3 of 8)	T 9.5-2 (3 of 8)

INSERTION INSTRUCTIONS

VOLUME 22

Remove	Insert
F 9.5-1a	F 9.5-1a
F 9.5-1b	F 9.5-1b
F 9.5-1c	F 9.5-1c
F 9.5-1d	F 9.5-1d
F 9.5-1e	F 9.5-1e
F 9.5-1f	F 9.5-1f
F 9.5-1g	F 9.5-1g
---	F 9.5-1h
F 9.5-2a	F 9.5-2a
F 9.5-2b	F 9.5-2b
F 9.5-3a	F 9.5-3a
F 9.5-4a	F 9.5-4a
F 9.5-41 (1 through 11 of 11)	F 9.5-41 (1 through 5 of 5)
F 9.5-42	F 9.5-42
F 9.5-52a	F 9.5-52a
F 9.5-52b	F 9.5-52b
F 9.5-52c	F 9.5-52c
F 9.5-53 (1 through 5 of 5)	F 9.5-53 (1 through 7 of 7)

INSERTION INSTRUCTIONS

VOLUME 23

Remove	Insert
9A-i/ii	9A-i/ii
9A-iii/iv	9A-iii/iv
9A-v/vi	9A-v/vi
9A-vii/-	9A-vii/-
9A.2-3/4	9A.2-3/4
9A.3-5/6	9A.3-5/6
9A.3-7/8	9A.3-7/8
9A.3-11/12	9A.3-11/12
9A.3-13/14	9A.3-13/14
9A.3-15/16	9A.3-15/16
9A.3-17/18	9A.3-17/17a
---	9A.3-17b/18
9A.3-19/20	9A.3-19/20
---	9A.3-20a/20b
9A.3-23/24	9A.3-23/24
9A.3-25/26	9A.3-25/26
9A.3-27/28	9A.3-27/28
9A.3-29/30	9A.3-29/30
9A.3-31/31a	9A.3-31/31a
9A.3-41/42	9A.3-41/41a
---	9A.3-41b/42
9A.3-43/44	9A.3-43/44
9A.3-45b/46	9A.3-45b/46
9A.3-47/48	9A.3-47/48
9A.3-49/49a	9A.3-49/49a
9A.3-49b/50	9A.3-49b/50
9A.3-51/51a	9A.3-51/51a
9A.3-55/55a	9A.3-55/55a
9A.3-59/60	9A.3-59/60
T 9A.3-1 (1 through 4 of 4)	T 9A.3-1 (1 through 4 of 4)
T 9A.3-2 (1 through 3 of 3)	T 9A.3-2 (1 through 3 of 3)
T 9A.3-3	T 9A.3-3
T 9A.3-4 (1 through 6 of 6)	T 9A.3-4 (1 through 6 of 6)
T 9A.3-5	T 9A.3-5
T 9A.3-6 (1 through 5 of 5)	T 9A.3-6 (1 through 5 of 5)
T 9A.3-7 (1 of 1)	T 9A.3-7 (1 and 2 of 2)
T 9A.3-8 (1 and 2 of 2)	T 9A.3-8 (1 and 2 of 2)
T 9A.3-9 (1 of 1)	T 9A.3-9 (1 through 3 of 3)
T 9A.3-10 (1 and 2 of 3)	T 9A.3-10 (1 and 2 of 2)

INSERTION INSTRUCTIONS

VOLUME 23 (Cont)

Remove	Insert
T 9A.3-11	T 9A.3-11
T 9A.3-12	T 9A.3-12
T 9A.3-16	T 9A.3-16
F 9A.3-1	F 9A.3-1
F 9A.3-2	F 9A.3-2
F 9A.3-3	F 9A.3-3
F 9A.3-4	F 9A.3-4
F 9A.3-5	F 9A.3-5
F 9A.3-6	F 9A.3-6
F 9A.3-7	F 9A.3-7
F 9A.3-8	F 9A.3-8
F 9A.3-9	F 9A.3-9
F 9A.3-10	F 9A.3-10
F 9A.3-11	F 9A.3-11
F 9A.3-12	F 9A.3-12
F 9A.3-13	F 9A.3-13
F 9A.3-16 (2 of 2)	F 9A.3-16 (2 of 2) Not submitted
F 10.1-3a	F 10.1-3a
F 10.1-3b	F 10.1-3b
F 10.1-3c	F 10.1-3c
F 10.1-3d	F 10.1-3d
F 10.1-3e	F 10.1-3e
F 10.1-3f	F 10.1-3f
F 10.1-3g	F 10.1-3g
F 10.1-3h	F 10.1-3h
F 10.1-3j	F 10.1-3j
F 10.1-3k	F 10.1-3k
F 10.1-7a	F 10.1-7a
F 10.1-7b	F 10.1-7b
F 10.1-7c	F 10.1-7c
F 10.1-7d	F 10.1-7d
F 10.1-7e	F 10.1-7e
F 10.1-7f	F 10.1-7f
F 10.1-7g	F 10.1-7g
F 10.1-7h	F 10.1-7h
F 10.1-7j	F 10.1-7j
F 10.1-7k	F 10.1-7k
F 10.1-7l	F 10.1-7l
F 10.1-7m	F 10.1-7m
F 10.1-7n	F 10.1-7n
F 10.1-7p	F 10.1-7p
F 10.1-7q	F 10.1-7q
F 10.1-7r	F 10.1-7r

INSERTION INSTRUCTIONS

VOLUME 23 (Cont)

Remove	Insert
F 10.1-7s	F 10.1-7s
F 10.1-7t	F 10.1-7t
F 10.1-7u	F 10.1-7u
F 10.1-7w	F 10.1-7w
10.2-7/8	10.2-7/8

INSERTION INSTRUCTIONS

VOLUME 24

Remove	Insert
10.3-3/3a	10.3-3/3a
10.3-5/-	10.3-5/-
F 10.4-1 (1 through 5 of 5)	F 10.4-1 (1 through 5 of 5)
F 10.4-2a	F 10.4-2a
F 10.4-3 (1 through 6 of 6)	F 10.4-3 (1 through 5 of 5)
F 10.4-7a	F 10.4-7a
F 10.4-7b	F 10.4-7b
F 10.4-7c	F 10.4-7c
F 10.4-7d	F 10.4-7d
F 10.4-7e	F 10.4-7e
F 10.4-7f	F 10.4-7f
F 10.4-7g	F 10.4-7g
F 10.4-7h	F 10.4-7h
F 10.4-8 (1 through 6 of 6)	F 10.4-8 (1 through 9 of 9)
F 10.4-9 (1 through 9 of 9)	F 10.4-9 (1 through 10 of 10)
F 10.4-10 (1 through 22 of 22)	F 10.4-10 (1 through 22 of 22)
F 10.4-11 (1 through 8 of 8)	F 10.4-11 (1 through 9 of 9)
F 10.4-12 (1 through 7 of 7)	F 10.4-12 (1 through 7 of 7)
F 10.4-13 (1 through 8 of 8)	F 10.4-13 (1 through 8 of 8)
11-i/ii	11-i/ii
---	11-iia/iib
11-iii/iv	11-iii/iv
11-v/vi	11-v/vi
11.1-15/-	11.1-15/-
T 11.1-2	T 11.1-2
11.2-1/2	11.2-1/2
11.2-3/4	11.2-3/3a
---	11.2-3b/4
11.2-5b/6	11.2-5b/6
11.2-7/8	11.2-7/8
11.2-9/10	11.2-9/10
11.2-11/12	11.2-11/12
11.2-13/14	11.2-13/14
---	11.2-14a/14b
11.2-15/16	11.2-15/16
11.2-17/18	11.2-17/18
F 11.2-1a	F 11.2-1a
F 11.2-1b	F 11.2-1b
F 11.2-1c	F 11.2-1c
F 11.2-1d	F 11.2-1d

INSERTION INSTRUCTIONS

VOLUME 24 (Cont)

Remove	Insert
F 11.2-1e	F 11.2-1e
F 11.2-1f	F 11.2-1f
F 11.2-1g	F 11.2-1g
---	F 11.2-1h
---	F 11.2-1j
---	F 11.2-1k
---	F 11.2-1l
---	F 11.2-1m

INSERTION INSTRUCTIONS

VOLUME 25

Remove	Insert
11.3-2a/2b	11.3-2a/2b
11.3-3/4	11.2-3/4
11.3-5b/6	11.3-5b/6
F 11.3-1a	F 11.3-1a
F 11.3-1b	F 11.3-1b
F 11.3-1c	F 11.3-1c
11.4-3b/4	11.4-3b/4
---	11.4-4a/4b
11.4-5/6	11.4-5/6
T 11.4-4 (1 of 2)	T 11.4-4 (1 of 2)
F 11.4-1a	F 11.4-1a
F 11.4-1b	F 11.4-1b
F 11.4-1c	F 11.4-1c
F 11.4-1d	F 11.4-1d
F 11.4-1e	F 11.4-1e
F 11.4-1f	F 11.4-1f
F 11.4-1g	F 11.4-1g
---	F 11.4-1h
11.5-1/2	11.5-1/2
---	11.5-2a/2b
11.5-3/4	11.5-3/3a
---	11.5-3b/4
11.5-5/6	11.5-5/5a
---	11.5-5b/6
11.5-7/8	11.5-7/8
11.5-9/10	11.5-9/10
---	11.5-10a/10b
11.5-11/12	11.5-11/11a
---	11.5-11b/12
11.5-13/14	11.5-13/14
T 11.5-1 (1 and 2 of 2)	T 11.5-1 (1, 2, and 2a of 2)
F 11.5-4	F 11.5-4
F 11.5-7	F 11.5-7
12.2-5/6	12.2-5/6
T 12.3-2 (1 through 3 of 3)	T 12.3-2 (1 through 3 of 3)
F 12.3-1	F 12.3-1
F 12.3-2	F 12.3-2
F 12.3-3	F 12.3-3
F 12.3-4	F 12.3-4
F 12.3-5	F 12.3-5
F 12.3-6	F 12.3-6

INSERTION INSTRUCTIONS

VOLUME 25 (Cont)

Remove	Insert
F 12.3-7	F 12.3-7
F 12.3-8	F 12.3-8
F 12.3-9	F 12.3-9
F 12.3-10	F 12.3-10
F 12.3-11	F 12.3-11
F 12.3-12	F 12.3-12
F 12.3-13	F 12.3-13
F 12.3-14	F 12.3-14
F 12.3-15	F 12.3-15
F 12.3-16	F 12.3-16
F 12.3-17	F 12.3-17
F 12.3-18	F 12.3-18
F 12.3-19	F 12.3-19
F 12.3-20	F 12.3-20
F 12.3-24	F 12.3-24
F 12.3-25	F 12.3-25
F 12.3-26	F 12.3-26
F 12.3-27	F 12.3-27
F 12.3-28	F 12.3-28
F 12.3-29	F 12.3-29
F 12.3-30	F 12.3-30
F 12.3-31	F 12.3-31
F 12.3-32	F 12.3-32
F 12.3-33	F 12.3-33
F 12.3-34	F 12.3-34
F 12.3-35	F 12.3-35
F 12.3-36	F 12.3-36
F 12.3-37	F 12.3-37
F 12.3-38	F 12.3-38
F 12.3-39	F 12.3-39
F 12.3-40	F 12.3-40
F 12.3-41	F 12.3-41
F 12.3-42	F 12.3-42
F 12.3-43	F 12.3-43
F 12.3-44	F 12.3-44
F 12.3-45	F 12.3-45
F 12.3-46	F 12.3-46
F 12.3-47	F 12.3-47
F 12.3-48	F 12.3-48
F 12.3-49	F 12.3-49
F 12.3-50	F 12.3-50
F 12.3-51	F 12.3-51
F 12.3-52	F 12.3-52
F 12.3-53	F 12.3-53
F 12.3-57	F 12.3-57
F 12.3-58	F 12.3-58

INSERTION INSTRUCTIONS

VOLUME 25 (Cont)

Remove	Insert
F 12.3-59	F 12.3-59
F 12.3-60	F 12.3-60
F 12.3-61	F 12.3-61
F 12.3-62	F 12.3-62
F 12.3-63	F 12.3-63
F 12.3-64	F 12.3-64
F 12.3-65	F 12.3-65
F 12.3-66	F 12.3-66

INSERTION INSTRUCTIONS

VOLUME 26

Remove	Insert
12.4-1b/1c	12.4-1b/1c
T 13.1-3 (1, 3, 3a, 4, 5 of 7)	T 13.1-3 (1, 3, 3a, 4, 5 of 7)
T 13.1-4 (1 of 5)	T 13.1-4 (1 of 5)
13.5-1/2	13.5-1/2
13.5-3/3a	13.5-3/3a
13.5-7/-	13.5-7/-
T 13.5-1a	T 13.5-1a
T 13.5-2	T 13.5-2
T 13.5-3 (1 through 3 of 3)	T 13.5-3 (1 and 2 of 2)
T 13.5-6 (1 through 5 of 5)	T 13.5-6 (1 through 5 of 5)
T 13.5-7	T 13.5-7

INSERTION INSTRUCTIONS

VOLUME 27

Remove	Insert
15-xiii/xiv	15-xiii/xiv
15-xxi/xxii	15-xxi/xxii
15.2-15/16	15.2-15/16
15.6-7/8	15.6-7/8
15.6-11/12	15.6-11/12
15.6-12c/12d	15.6-12c/12d
15.6-13/13a	15.6-13/13a
15.6-13b/14	15.6-13b/14
T 15.6-6 (2 of 2)	T 15.6-6 (2 of 2)
T 15.6-13 (9 and 11 of 11)	T 15.6-13 (9 and 11 of 11)
T 15.6-15a	T 15.6-15a
T 15.6-15b	T 15.6-15b
T 15.6-16a	T 15.6-16a
T 15.6-16b	T 15.6-16b
15.7-3/4	15.7-3/4
15.7-13/14	15.7-13/14
T 15.7-8 (1 of 2)	T 15.7-8 (1 of 2)
T 15.7-9 (1 and 2 of 2)	T 15.7-9 (1 and 2 of 2)
T 15.7-16 (1 of 2)	T 15.7-16 (1 of 2)
T 15.7-17	T 15.7-17

INSERTION INSTRUCTIONS

QUESTIONS AND RESPONSES

VOLUME 1

Remove	Insert
Q&R F210.58-1/-	Q&R F210.58-1/2
Q&R F210.62-1/2	Q&R F210.62-1/2
Q&R F210.62-3/-	Q&R F210.62-3/-
T 210.62-1 (1 and 2 of 2)	T 210.62-1 (1 and 2 of 2)
Q&R F210.63-1/-	Q&R F210.63-1/-
Q&R F240.10-1/2	Q&R F240.10-1/2
T 240.10-1 (1 of 2)	T 240.10-1 (1 of 2)
Q&R F250.1-1/-	Q&R F250.1-1/2
---	T 250.1-1 (1 through 17 of 17)

INSERTION INSTRUCTIONS

QUESTIONS AND RESPONSES

VOLUME 2

Remove	Insert
Q&R F410.49-1/-	Q&R F410.49-1/-
Q&R F421.3-1/2	Q&R F421.3-1/2
T 421.47-1 (1, 3, and 4 of 17)	T 421.47-1 (1, 3, and 4 of 17)
T 421.47-1 (5 of 17)	T 421.47-1 (5 of 17)
T 421.47-1 (7 through 9 of 17)	T 421.47-1 (7 through 9 of 17)
T 421.47-1 (14 of 17)	T 421.47-1 (14 of 17)
Q&R F430.74-1/2	Q&R F430.74-1/2

INSERTION INSTRUCTIONS

QUESTIONS AND RESPONSES

VOLUME 3

Remove	Insert
Q&R F440.16-1/2	Q&R F440.16-1/2
Q&R F440.17-1/-	Q&R F440.17-1/-
T 480.37-1 (2 of 2)	T 480.37-1 (2 of 2)

INSERTION INSTRUCTIONS

DESIGN ASSESSMENT REPORT

APPENDIX 6A

Remove	Insert
6A.1-5/-	6A.1-5/-
6A.2-7/8	6A.2-7/8
6A.2-9/10	6A.2-9/10
6A.2-11/12	6A.2-11/12
6A.2-13/14	6A.2-13/14
T 6A.2-2 (1 through 3 of 3)	T 6A.2-2 (1 through 3 of 3)
T 6A.2-3 (2 of 3)	T 6A.2-3 (2 of 3)
F 6A.2-23	F 6A.2-23
F 6A.2-27	F 6A.2-27
---	F 6A.3-43
---	F 6A.3-44
6A.4-1/2	6A.4-1/2
6A.4-3/4	6A.4-3/4
6A.4-5/5a	6A.4-5/5a
6A.4-7/8	6A.4-7/8
6A.4-8a/8b	6A.4-8a/8b
6A.4-11/12	6A.4-11/12
6A.4-12a/12b	6A.4-12a/12b
6A.4-13/14	6A.4-13/14
6A.4-19b/20	6A.4-19b/20
6A.4-23/24	6A.4-23/24
6A.4-24a/24b	6A.4-24a/24b
6A.4-25b/26	6A.4-25b/26
6A.4-27/28	6A.4-27/28
6A.4-29/30	6A.4-29/30
6A.4-31/32	6A.4-31/32
6A.4-37/37a	6A.4-37/37a
T 6A.4-3	T 6A.4-3
T 6A.4-7 (2 of 2)	T 6A.4-7 (2 of 2)
F 6A.4-36	F 6A.4-36
T 6A.5-1	T 6A.5-1
T 6A.5-2 (1 and 2 of 2)	T 6A.5-2 (1 and 2 of 2)
T 6A.5-3	T 6A.5-3
T 6A.5-4 (1 of 2)	T 6A.5-4 (1 of 1)*
T 6A.5-6 (1 of 2)	T 6A.5-6 (1 of 1)*
F 6A.5-12	F 6A.5-12
F 6A.5-26	F 6A.5-26
F 6A.5-27	F 6A.5-27
F 6A.5-28	F 6A.5-28
F 6A.5-29	F 6A.5-29

*New pagination is incorrect. Do not remove existing 2 of 2.

INSERTION INSTRUCTIONS

APPENDIX 6A (Cont)

Remove	Insert
F 6A.5-30	F 6A.5-30
F 6A.5-31	F 6A.5-31
F 6A.5-33	F 6A.5-33
F 6A.5-34	F 6A.5-34
F 6A.5-37	F 6A.5-37
F 6A.5-38	F 6A.5-38
F 6A.5-39	F 6A.5-39
F 6A.5-40	F 6A.5-40
F 6A.5-41	F 6A.5-41
F 6A.5-42	F 6A.5-42
F 6A.5-43	F 6A.5-43
T 6A.6-1 (1 and 2 of 2)	T 6A.6-1 (1 of 1)
T 6A.6-2 (1 and 2 of 2)	T 6A.6-2 (1 and 2 of 2)
6A.7-5/5a	6A.7-5/5a
6A.7-5b/6	6A.7-5b/6
6A.7-7/-	6A.7-7/-
T 6A.7-2	T 6A.7-2
6A.9-11f/12	6A.9-11f/12
T 6A.9-1	T 6A.9-1
T 6A.9-3	T 6A.9-3
T 6A.9-4	T 6A.9-4
T 6A.9-5	T 6A.9-5
T 6A.9-6	T 6A.9-6
F 6A.9-1	F 6A.9-1
F 6A.9-2	F 6A.9-2
F 6A.9-3	F 6A.9-3

INSERTION INSTRUCTIONS

APPENDIX R REVIEW

APPENDIX 9B

Remove	Insert
9B-i/ii	9B-i/ia
---	9B-ib/ii
9B-iii/iv	9B-iii/iv
9B.1-1/-	9B.1-1/-
9B.3-1/-	9B.3-1/-
9B.5-5/-	9B.5-5/-
9B.6-3/4	9B.6-3/4
T 9B.6-1 (2 and 3 of 6)	T 9B.6-1 (2 and 3 of 6)
T 9B.6-1 (5 and 6 of 6)	T 9B.6-1 (5 and 6 of 6)
T 9B.6-3 (1 of 9)	T 9B.6-3 (1 of 9)
T 9B.6-3 (3 of 9)	T 9B.6-3 (3 of 9)
T 9B.6-3 (7 of 9)	T 9B.6-3 (7 and 7a of 9)
9B.7-1/-	9B.7-1/-
9B.8-1/-	9B.8-1/2
---	9B.8-3/4
---	9B.8-5/6
---	9B.8-7/-
T 9B.8-1 (7 of 75)	T 9B.8-1 (7 of 75)
T 9B.8-1 (26 of 75)	T 9B.8-1 (26 of 75)
T 9B.8-1 (27 of 75)	T 9B.8-1 (27 of 75)
T 9B.8-1 (28 of 75)	T 9B.8-1 (28 of 75)
T 9B.8-1 (29 of 75)	T 9B.8-1 (29 of 75)
T 9B.8-1 (34 of 75)	T 9B.8-1 (34 of 75)
T 9B.8-1 (36 of 75)	T 9B.8-1 (36 of 75)
T 9B.8-1 (37 of 75)	T 9B.8-1 (37 of 75)
T 9B.8-1 (38 of 75)	T 9B.8-1 (38 of 75)
T 9B.8-1 (39 of 75)	T 9B.8-1 (39 of 75)
T 9B.8-1 (40 of 75)	T 9B.8-1 (40 of 75)
T 9B.8-1 (41 of 75)	T 9B.8-1 (41 of 75)
T 9B.8-1 (42 of 75)	T 9B.8-1 (42 of 75)
T 9B.8-1 (43 of 75)	T 9B.8-1 (43 of 75)
T 9B.8-1 (44 of 75)	T 9B.8-1 (44 of 75)
T 9B.8-1 (45 of 75)	T 9B.8-1 (45 of 75)
T 9B.8-1 (46 of 75)	T 9B.8-1 (46 of 75)
T 9B.8-1 (47 of 75)	T 9B.8-1 (47 of 75)
T 9B.8-1 (48 of 75)	T 9B.8-1 (48 of 75)
T 9B.8-1 (49 of 75)	T 9B.8-1 (49 of 75)
T 9B.8-1 (50 of 75)	T 9B.8-1 (50 of 75)

INSERTION INSTRUCTIONS

APPENDIX 9B (Cont)

Remove	Insert
T 9B.8-1 (53 of 75)	T 9B.8-1 (53 of 75)
T 9B.8-1 (54 of 75)	T 9B.8-1 (54 of 75)
T 9B.8-1 (55 of 75)	T 9B.8-1 (55 of 75)
T 9B.8-1 (60 of 75)	T 9B.8-1 (60 of 75)
T 9B.8-1 (61 of 75)	T 9B.8-1 (61 of 75)
T 9B.8-1 (66 of 75)	T 9B.8-1 (66 of 75)
T 9B.8-1 (67 of 75)	T 9B.8-1 (67 of 75)
T 9B.8-1 (71 of 75)	T 9B.8-1 (71 of 75)
T 9B.8-1 (72 of 75)	T 9B.8-1 (72 of 75)
T 9B.8-2 (1 of 38)	T 9B.8-2 (1 of 38)
T 9B.8-2 (19, 20, 21 of 38)	T 9B.8-2 (19, 20, 21 of 38)
T 9B.8-2 (27 through 29f of 38)	T 9B.8-2 (27 through 29f of 38)
T 9B.8-2 (33 of 38)	T 9B.8-2 (33 and 33a of 38)
T 9B.8-2 (34 of 38)	T 9B.8-2 (34 of 38)
T 9B.8-2 (36 of 38)	T 9B.8-2 (36 of 38)
T 9B.8-2 (38 of 38)	T 9B.8-2 (38 and 38a of 38)
---	T 9B.8-3 (1 through 14 of 14)
9B.12-1/-	9B.12-1/-

INSERTION INSTRUCTIONS

LIST OF EFFECTIVE PAGES

Remove	Insert
EP 1-1 through EP 1-8	EP 1-1 through EP 1-8
EP 2-1 through EP 2-19	EP 2-1 through EP 2-20
EP 3-1 through EP 3-14	EP 3-1 through EP 3-14
EP 4-1 and EP 4-2	EP 4-1 and EP 4-2
EP 5-1 through EP 5-3	EP 5-1 through EP 5-3
EP 6-1 through EP 6-6	EP 6-1 through EP 6-6
EP 7-1 through EP 7-3	EP 7-1 through EP 7-4
EP 8-1 through EP 8-3	EP 8-1 through EP 8-3
EP 9-1 through EP 9-10	EP 9-1 through EP 9-11
EP 10-1 and 10-2	EP 10-1 and 10-2
EP 11-1 and 11-2	EP 11-1 and 11-2
EP 12-1 through EP 12-3	EP 12-1 through EP 12-3
EP 13-1 through EP 13-4	EP 13-1 through EP 13-4
EP 15-1 through EP 15-4	EP 15-1 through EP 15-4
Q&R-1 through Q&R-14	Q&R-1 through Q&R-14
DAR-1 through DAR-8	DAR-1 through DAR-8
SSA-1 through SSA-2	SSA-1 and SSA-2

NMP2 FSAR DRAWING PACKAGE

INSERTION INSTRUCTIONS

The following instructions are for the insertion of the current amendment into the Nine Mile Point Unit 2 FSAR Drawing Package.

Remove drawings listed in the REMOVE column and replace them with the drawings listed in the INSERT column. Dashes (---) in either column indicate no action required.

Vertical bars have been placed in the margins of the index to indicate revision locations.

NMP2 FSAR DRAWING PACKAGE

INSERTION INSTRUCTIONS

VOLUME 1

Remove	Insert
Entire contents of Volume 1	Volume 1 index sheet
	807E153TY Sh 1-6
	807E155TY Sh 1-15
	807E156TY Sh 1, 2
	807E152TY Sh 1-15
	761E791TY Sh 1-30
	791E406TY Sh 1-34
	807E159TY Sh 1, 2
	807E160TY Sh 1-6
	807E161TY Sh 1-5
	807E164TY Sh 1-5
	807E162TY Sh 1-12

NMP2 FSAR DRAWING PACKAGE

INSERTION INSTRUCTIONS

VOLUME 2

Remove	Insert
Entire contents of Volume 2	Volume 2 index sheet
	807E163TY 1-50
	807E166TY 1-19
	115D6268TY Sh 1, 2
	807E179TY Sh 1-3
	807E168TY Sh 1, 2
	807E170TY Sh 1-23
	807E171TY Sh 1-7
	807E172TY Sh 1-7
	807E183TY Sh 1-14
	807E154TY Sh 1-14
	807E173TY Sh 1-13
	807E175TY Sh 1-5
	731E302AF Sh 1-4
	807E165TY Sh 1-5
	828E255TY Sh 1-14

NMP2 FSAR DRAWING PACKAGE

INSERTION INSTRUCTIONS

VOLUME 5

Remove	Insert
Entire contents of Volume 5	Volume 2 index sheet
	12177-ESK-2A
	12177-ESK-2B
	12177-ESK-2C
	12177-ESK-2D
	12177-ESK-2H
	12177-ESK-2J
	12177-ESK-2K
	12177-ESK-2L
	12177-ESK-2M
	12177-ESK-3A
	12177-ESK-3B
	12177-ESK-3C
	12177-ESK-3D
	12177-ESK-3E
	12177-ESK-3F
	12177-ESK-3G
	12177-ESK-3H
	12177-ESK-3J
	12177-ESK-4CEC01 Sh 1, 2
	12177-ESK-4CEC02 Sh 1, 2
	12177-ESK-4CEC13A Sh 1, 2
	12177-ESK-4CEC13B
	12177-ESK-4CEC14A Sh 1, 2
	12177-ESK-4CEC14B Sh 1, 2
	12177-ESK-4CEC15 Sh 1, 2
	12177-ESK-4CEC19
	12177-ESK-4CEC20 Sh 1, 2
	12177-ESK-4CEC22 Sh 1, 2
	12177-ESK-4CEC23
	12177-ESK-4CEC24A Sh 1, 2
	12177-ESK-4CEC25A Sh 1, 2
	12177-ESK-4CEC26A Sh 1, 2
	12177-ESK-4CEC29A Sh 1, 2
	12177-ESK-4CEC30A Sh 1, 2
	12177-ESK-4CEC35 Sh 1, 2
	12177-ESK-5CSL01
	12177-ESK-5EGP01 Sh 1, 2
	12177-ESK-5EGP03 Sh 1, 2
	12177-ESK-5EGP05

INSERTION INSTRUCTIONS

VOLUME 5 (Cont)

Remove	Insert
	12177-ESK-5EGP06
	12177-ESK-5EJS01
	12177-ESK-5EJS02
	12177-ESK-5EJS03
	12177-ESK-5EJS04
	12177-ESK-5ENS02
	12177-ESK-5ENS03
	12177-ESK-5ENS05
	12177-ESK-5ENS07
	12177-ESK-5ENS08
	12177-ESK-5ENS09
	12177-ESK-5ENS11
	12177-ESK-5ENS12
	12177-ESK-5ENS13
	12177-ESK-5ENS14
	12177-ESK-5ENS15
	12177-ESK-5ENS16
	12177-ESK-5ENS17
	12177-ESK-5ENS18
	12177-ESK-5ENS19
	12177-ESK-5ENS20
	12177-ESK-5ENS21 Sh 1, 2
	12177-ESK-5ENS22 Sh 1, 2
	12177-ESK-5ENS23
	12177-ESK-5RHS01
	12177-ESK-5RHS02
	12177-ESK-5RHS03
	12177-ESK-5RHS04
	12177-ESK-5RHS05
	12177-ESK-5SFC01 Sh 1, 2
	12177-ESK-5SFC02 Sh 1, 2
	12177-ESK-5SWP01 Sh 1, 2
	12177-ESK-5SWP02 Sh 1, 2
	12177-ESK-5SWP03 Sh 1, 2
	12177-ESK-5SWP04 Sh 1, 2
	12177-ESK-5SWP05 Sh 1, 2
	12177-ESK-5SWP06 Sh 1, 2
	12177-ESK-5SWP07 Sh 1, 2
	12177-ESK-5SWP08 Sh 1, 2
	12177-ESK-5SWP09 Sh 1, 2
	12177-ESK-5SWP10 Sh 1, 2
	12177-ESK-5SWP11 Sh 1, 2
	12177-ESK-5SWP12 Sh 1, 2
	12177-ESK-6CCP07
	12177-ESK-6CCP09

INSERTION INSTRUCTIONS

VOLUME 5 (Cont)

Remove	Insert
	12177-ESK-6CCP11 Sh 1, 2
	12177-ESK-6CCP12
	12177-ESK-6CCP13
	12177-ESK-6CCP16 Sh 1, 2
	12177-ESK-6CCP17 Sh 1, 2
	12177-ESK-6CCP18
	12177-ESK-6CCP19
	12177-ESK-6CCP20
	12177-ESK-6CCP21 Sh 1, 2
	12177-ESK-6CCP22
	12177-ESK-6CSH01
	12177-ESK-6CSH02
	12177-ESK-6CSH03
	12177-ESK-6CSH04
	12177-ESK-6CSH05
	12177-ESK-6CWS01
	12177-ESK-6CSL01
	12177-ESK-6CSL02
	12177-ESK-6CSL03
	12177-ESK-6DER01
	12177-ESK-6DER02
	12177-ESK-6DFR07
	12177-ESK-6DFR11
	12177-ESK-6EGA01
	12177-ESK-6EGA02
	12177-ESK-6EGF01
	12177-ESK-6EGF02
	12177-ESK-6EGF03

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INSERTION INSTRUCTIONS

VOLUME 6

Remove	Insert
Entire contents of Volume 6	Volume 6 index sheet
	12177-ESK-6EJS01
	12177-ESK-6EJS02
	12177-ESK-6EJS03
	12177-ESK-6EJS04
	12177-ESK-6EJS05
	12177-ESK-6FWS07
	12177-ESK-6GTS01
	12177-ESK-6GTS02
	12177-ESK-6GTS03 Sh 1, 2
	12177-ESK-6GTS04 Sh 1, 2
	12177-ESK-6GTS05
	12177-ESK-6HCS01 Sh 1, 2
	12177-ESK-6HCS02 Sh 1, 2
	12177-ESK-6HCS03 Sh 1, 2
	12177-ESK-6HCS04 Sh 1, 2
	12177-ESK-6HCS05 Sh 1, 2
	12177-ESK-6HCS06 Sh 1, 2
	12177-ESK-6HCS07
	12177-ESK-6HCS08
	12177-ESK-6HCS09
	12177-ESK-6HCS10
	12177-ESK-6HCS11
	12177-ESK-6HVC01
	12177-ESK-6HVC02
	12177-ESK-6HVC03 Sh 1, 2
	12177-ESK-6HVC04
	12177-ESK-6HVC05
	12177-ESK-6HVC06
	12177-ESK-6HVC09
	12177-ESK-6HVC10
	12177-ESK-6HVC11
	12177-ESK-6HVC12
	12177-ESK-6HVC13
	12177-ESK-6HVK01 Sh 1, 2
	12177-ESK-6HVK02
	12177-ESK-6HVK03
	12177-ESK-6HVK04
	12177-ESK-6HVP01 Sh 1, 2
	12177-ESK-6HVP02 Sh 1, 2
	12177-ESK-6HVP03 Sh 1, 2
	12177-ESK-6HVP06
	12177-ESK-6HVR01
	12177-ESK-6HVR02
	12177-ESK-6HVR11

Remove	Insert
	12177-ESK-6HVR12
	12177-ESK-6HVR13
	12177-ESK-6HVR14
	12177-ESK-6HVR15
	12177-ESK-6HVR16
	12177-ESK-6HVR17
	12177-ESK-6HVR18
	12177-ESK-6HVR19
	12177-ESK-6HVR20
	12177-ESK-6HVR21
	12177-ESK-6HVR22
	12177-ESK-6HVR23
	12177-ESK-6HVR24
	12177-ESK-6HVR25
	12177-ESK-6HVR26
	12177-ESK-6HVR27
	12177-ESK-6HVR28
	12177-ESK-6HVR29
	12177-ESK-6HVR30
	12177-ESK-6HVY12
	12177-ESK-6HVY13
	12177-ESK-6ICS01
	12177-ESK-6ICS02
	12177-ESK-6ICS03
	12177-ESK-6ICS04
	12177-ESK-6MSS08
	12177-ESK-6MSS20
	12177-ESK-6RHS01
	12177-ESK-6RHS02
	12177-ESK-6RHS03
	12177-ESK-6RHS04
	12177-ESK-6RHS05
	12177-ESK-6RHS06
	12177-ESK-6RHS07
	12177-ESK-6RHS08
	12177-ESK-6RHS09
	12177-ESK-6RHS10
	12177-ESK-6RHS11
	12177-ESK-6RHS12
	12177-ESK-6RHS13
	12177-ESK-6RHS14
	12177-ESK-6RHS15
	12177-ESK-6RHS16

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INSERTION INSTRUCTIONS

VOLUME 6 (Cont)

Remove	Insert
	12177-ESK-6RHS17
	12177-ESK-6RHS18
	12177-ESK-6RHS19
	12177-ESK-6RHS20
	12177-ESK-6RHS21
	12177-ESK-6RHS22
	12177-ESK-6RHS23
	12177-ESK-6RHS24
	12177-ESK-6RHS25
	12177-ESK-6RHS26
	12177-ESK-6RHS27
	12177-ESK-6RHS28
	12177-ESK-6RHS29
	12177-ESK-6RHS30
	12177-ESK-6RHS31
	12177-ESK-6RHS32
	12177-ESK-6RHS33
	12177-ESK-6RHS34
	12177-ESK-6RHS35
	12177-ESK-6RHS36
	12177-ESK-6RHS37
	12177-ESK-6RHS38
	12177-ESK-6RHS39
	12177-ESK-6RHS40
	12177-ESK-6RHS41
	12177-ESK-6RHS42
	12177-ESK-6SLS01 Sh 1, 2
	12177-ESK-6SLS02 Sh 1, 2
	12177-ESK-6RHS03 Sh 1, 2

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INSERTION INSTRUCTIONS

VOLUME 7

Remove	Insert
Entire contents of Volume 7	Volume 7 index sheet
	12177-ESK-6SWP01
	12177-ESK-6SWP05
	12177-ESK-6SWP06
	12177-ESK-6SWP07
	12177-ESK-6SWP08
	12177-ESK-6SWP09
	12177-ESK-6SWP10
	12177-ESK-6SWP11
	12177-ESK-6SWP12 Sh 1, 2
	12177-ESK-6SWP13 Sh 1, 2
	12177-ESK-6SWP14
	12177-ESK-6SWP16
	12177-ESK-6SWP17
	12177-ESK-6SWP18 Sh 1, 2
	12177-ESK-6SWP19 Sh 1, 2
	12177-ESK-6SWP20 Sh 1, 2
	12177-ESK-6SWP21 Sh 1, 2
	12177-ESK-6SWP22 Sh 1, 2
	12177-ESK-6SWP23 Sh 1, 2
	12177-ESK-6SWP24
	12177-ESK-6SWP25 Sh 1, 2
	12177-ESK-6SWP26
	12177-ESK-6SWP27
	12177-ESK-6SWP28
	12177-ESK-6SWP32
	12177-ESK-6SWP33
	12177-ESK-6SWP34
	12177-ESK-6SWP35
	12177-ESK-6SWP36
	12177-ESK-6SWP37
	12177-ESK-6SWP38
	12177-ESK-6SWP39
	12177-ESK-6SWP40
	12177-ESK-6WCS03
	12177-ESK-6WCS11
	12177-ESK-7BYS01
	12177-ESK-7CCP01
	12177-ESK-7CCP03
	12177-ESK-7CCP04
	12177-ESK-7CCP05
	12177-ESK-7CCP06
	12177-ESK-7CCP07
	12177-ESK-7CMS01
	12177-ESK-7CMS02

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INSERTION INSTRUCTIONS

VOLUME 7 (Cont)

Remove	Insert
	12177-ESK-7CMS03
	12177-ESK-7CMS04
	12177-ESK-7CMS05
	12177-ESK-7CMS06
	12177-ESK-7CMS07
	12177-ESK-7CMS08
	12177-ESK-7CMS09
	12177-ESK-7CMS10
	12177-ESK-7CMS11
	12177-ESK-7CMS12
	12177-ESK-7CMS13
	12177-ESK-7CMS15
	12177-ESK-7CMS16
	12177-ESK-7CMS17
	12177-ESK-7CMS18
	12177-ESK-7CMS19
	12177-ESK-7CMS20
	12177-ESK-7CMS21
	12177-ESK-7CMS22
	12177-ESK-7CPS01
	12177-ESK-7CPS02
	12177-ESK-7CPS03
	12177-ESK-7CPS04
	12177-ESK-7CPS06
	12177-ESK-7DER02
	12177-ESK-7DER03
	12177-ESK-7DRF03
	12177-ESK-7DFR06
	12177-ESK-7DRS01
	12177-ESK-7EGF01
	12177-ESK-7EGF02
	12177-ESK-7EGF03
	12177-ESK-7EGP01 Sh 1, 2
	12177-ESK-7EJS01
	12177-ESK-7ENS01
	12177-ESK-7ENS02 Sh 1, 2
	12177-ESK-7ENS03
	12177-ESK-7ENS04 Sh 1, 2
	12177-ESK-7FPW04
	12177-ESK-7FPW05
	12177-ESK-7GTS01 Sh 1, 2
	12177-ESK-7GTS02
	12177-ESK-7GTS03
	12177-ESK-7GTS04
	12177-ESK-7HCS01
	12177-ESK-7HCS02

INSERTION INSTRUCTIONS

VOLUME 7 (Cont)

Remove	Insert
	12177-ESK-7HCS03
	12177-ESK-7HCS04
	12177-ESK-7HVC01
	12177-ESK-7HVC02
	12177-ESK-7HVC03
	12177-ESK-7HVC04
	12177-ESK-7HVC05
	12177-ESK-7HVC08 Sh 1, 2
	12177-ESK-7HVC11
	12177-ESK-7HVC12
	12177-ESK-7HVC13
	12177-ESK-7HVC14
	12177-ESK-7HVC15
	12177-ESK-7HVC18
	12177-ESK-7HVC19
	12177-ESK-7HVC20 Sh 1, 2
	12177-ESK-7HVC22 Sh 1, 2
	12177-ESK-7HVK01
	12177-ESK-7HVK02
	12177-ESK-7HVK03 Sh 1, 2
	12177-ESK-7HVP01
	12177-ESK-7HVP02
	12177-ESK-7HVP03
	12177-ESK-7HVP06
	12177-ESK-7HVP07
	12177-ESK-7HVP08 Sh 1, 2, 3
	12177-ESK-7HVR01
	12177-ESK-7HVR02
	12177-ESK-7HVR05
	12177-ESK-7HVR06 Sh 1, 2, 3
	12177-ESK-7HVR07
	12177-ESK-7HVR08
	12177-ESK-7HVR09 Sh 1, 2
	12177-ESK-7HVR10

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INSERTION INSTRUCTIONS

VOLUME 8

Remove	Insert
Entire contents of Volume 8	Volume 8 index sheet
	12177-ESK-7HVY05
	12177-ESK-7HVY06
	12177-ESK-7HVY08
	12177-ESK-7IAS01
	12177-ESK-7IAS02 Sh 1, 2
	12177-ESK-7IAS03
	12177-ESK-7IAS04
	12177-ESK-7IAS07
	12177-ESK-7IAS08
	12177-ESK-7IAS09
	12177-ESK-7ISC01
	12177-ESK-7LMS02
	12177-ESK-7MSS10
	12177-ESK-7MSS11
	12177-ESK-7MSS12
	12177-ESK-7MSS13
	12177-ESK-7MSS14
	12177-ESK-7MSS15
	12177-ESK-7MSS16
	12177-ESK-7MSS17
	12177-ESK-7MSS18
	12177-ESK-7MSS19
	12177-ESK-7MSS20
	12177-ESK-7SCI01
	12177-ESK-7SCI02
	12177-ESK-7SCI03
	12177-ESK-7SCI04
	12177-ESK-7SCI05
	12177-ESK-7SCI06
	12177-ESK-7SCI07
	12177-ESK-7SCI08
	12177-ESK-7SCI09
	12177-ESK-7SCI10
	12177-ESK-7SCI11
	12177-ESK-7SCI12
	12177-ESK-7SCI13
	12177-ESK-7SCI14
	12177-ESK-7SCI15
	12177-ESK-7SCI16
	12177-ESK-7SCI17
	12177-ESK-7SCI18
	12177-ESK-7SCI19
	12177-ESK-7SCI20
	12177-ESK-7SCI21

VOLUME 8 (Cont)

Remove	Insert
	12177-ESK-7SCI22
	12177-ESK-7SCI23
	12177-ESK-7SCI24
	12177-ESK-7SCI25
	12177-ESK-7SCI26
	12177-ESK-7SCI27
	12177-ESK-7SCI28
	12177-ESK-7SCI29
	12177-ESK-7SCI30
	12177-ESK-7SCI31
	12177-ESK-7SCI32
	12177-ESK-7SCI36
	12177-ESK-7SCI37
	12177-ESK-7SCI38
	12177-ESK-7SCI39
	12177-ESK-7SCI40
	12177-ESK-7SCI41
	12177-ESK-7SCI42
	12177-ESK-7SCI43
	12177-ESK-7SCI44
	12177-ESK-7SCI45
	12177-ESK-7SCI46
	12177-ESK-7SFC01
	12177-ESK-7SFC02
	12177-ESK-7SFC04
	12177-ESK-7SFC05
	12177-ESK-7SFC07
	12177-ESK-7SFC08
	12177-ESK-7SFC09
	12177-ESK-7SFC10
	12177-ESK-7SWP03
	12177-ESK-7SWP04
	12177-ESK-7SWP05
	12177-ESK-7SWP06
	12177-ESK-7SWP07
	12177-ESK-7SWP08
	12177-ESK-7SWP09
	12177-ESK-7SWP10
	12177-ESK-7SWP11
	12177-ESK-7SWP12
	12177-ESK-7SWP13
	12177-ESK-7SWP14
	12177-ESK-7SWP15
	12177-ESK-7SWP16
	12177-ESK-7SWP17 Sh 1, 2

INSERTION INSTRUCTIONS

VOLUME 8 (Cont)

Remove	Insert
	12177-ESK-7SWP18 12177-ESK-7SWP19 12177-ESK-8BYS06 12177-ESK-8BYS12 12177-ESK-8BYS13 12177-ESK-8BYS14 12177-ESK-8EGP01 Sh 1, 2, 3 12177-ESK-8EGP02 12177-ESK-8EGP03 Sh 1, 2, 3 12177-ESK-8EGP04 12177-ESK-8EGP05 12177-ESK-8EGP06 Sh 1, 2 12177-ESK-8EGP07 12177-ESK-8EGP08 Sh 1, 2 12177-ESK-8EGP09 12177-ESK-EGP10

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INSERTION INSTRUCTIONS

VOLUME 9

Remove	Insert
Volume 9 index sheets	Volume 9 index sheets
12177-ESK-8EGS01	12177-ESK-8EGS01
12177-ESK-8EGS02	12177-ESK-8EGS02 Sh 1, 2
12177-ESK-8ENS01 Sh 1, 2	12177-ESK-8ENS01 Sh 1, 2
12177-ESK-8ENS02 Sh 1, 2	12177-ESK-8ENS02 Sh 1, 2
12177-ESK-8ENS03	12177-ESK-8ENS03
12177-ESK-8ENS04	12177-ESK-8ENS04 Sh 1, 2
12177-ESK-8SYD01	12177-ESK-8SYD01
12177-ESK-8SYD02	---
12177-ESK-10IHA01	12177-ESK-10IHA01
12177-ESK-10IHA10	12177-ESK-10IHA10
12177-ESK-10IHA11	12177-ESK-10IHA11
12177-ESK-10IHA12	12177-ESK-10IHA12
12177-ESK-10IHA20	12177-ESK-10IHA20
12177-ESK-10IHA21	12177-ESK-10IHA21
12177-ESK-10IHA22	12177-ESK-10IHA22
12177-ESK-10IHA30	12177-ESK-10IHA30
12177-ESK-10IHA31	12177-ESK-10IHA31
12177-ESK-10IHA100A	12177-ESK-10IHA100A
12177-ESK-10IHA100B	12177-ESK-10IHA100B
12177-ESK-10IHA101A	12177-ESK-10IHA101A
12177-ESK-10IHA101B	12177-ESK-10IHA101B
12177-ESK-10IHA102A	12177-ESK-10IHA102A
12177-ESK-10IHA102B	12177-ESK-10IHA102B
12177-ESK-10IHA103A	12177-ESK-10IHA103A
12177-ESK-10IHA103B	12177-ESK-10IHA103B
12177-ESK-10IHA104A	12177-ESK-10IHA104A
12177-ESK-10IHA104B	12177-ESK-10IHA104B
12177-ESK-10IHA105A	12177-ESK-10IHA105A
12177-ESK-10IHA105B	12177-ESK-10IHA105B
12177-ESK-10IHA106A	12177-ESK-10IHA106A
12177-ESK-10IHA106B	12177-ESK-10IHA106B
12177-ESK-10IHA107A	12177-ESK-10IHA107A
12177-ESK-10IHA107B	12177-ESK-10IHA107B
12177-ESK-10IHA108A	12177-ESK-10IHA108A
12177-ESK-10IHA109A	12177-ESK-10IHA109A
12177-ESK-10IHA109B	12177-ESK-10IHA109B
12177-ESK-10IHA110A	12177-ESK-10IHA110A
12177-ESK-10IHA110B	12177-ESK-10IHA110B
12177-ESK-10IHA200A	12177-ESK-10IHA200A
12177-ESK-10IHA200B	12177-ESK-10IHA200B
12177-ESK-10IHA201A	12177-ESK-10IHA201A
12177-ESK-10IHA201B	12177-ESK-10IHA201B
12177-ESK-10IHA202A	12177-ESK-10IHA202A
12177-ESK-10IHA202B	12177-ESK-10IHA202B

INSERTION INSTRUCTIONS

VOLUME 9 (Cont)

Remove	Insert
12177-ESK-10IHA203A	12177-ESK-10IHA203A
12177-ESK-10IHA203B	12177-ESK-10IHA203B
12177-ESK-10IHA204A	12177-ESK-10IHA204A
12177-ESK-10IHA204B	12177-ESK-10IHA204B
12177-ESK-10IHA205A	12177-ESK-10IHA205A
12177-ESK-10IHA205B	12177-ESK-10IHA205B
12177-ESK-10IHA206A	12177-ESK-10IHA206A
12177-ESK-10IHA206B	12177-ESK-10IHA206B
12177-ESK-10IHA207A	12177-ESK-10IHA207A
12177-ESK-10IHA207B	12177-ESK-10IHA207B
12177-ESK-10IHA208A	12177-ESK-10IHA208A
12177-ESK-10IEGA01	12177-ESK-10IEGA01
12177-ESK-10IEGA02	12177-ESK-10IEGA02
12177-ESK-10IEGA03	12177-ESK-10IEGA03
12177-ESK-11IAS01	12177-ESK-11IAS01
12177-ESK-11ICS01	12177-ESK-11ICS01
12177-ESK-11ICS02	12177-ESK-11ICS02
12177-ESK-11ICS03	12177-ESK-11ICS03
12177-ESK-11ICS04	12177-ESK-11ICS04
12177-ESK-11ICS05	12177-ESK-11ICS05
12177-ESK-11ICS06	12177-ESK-11ICS06
12177-ESK-11ICS07	12177-ESK-11ICS07
12177-ESK-11ICS09	12177-ESK-11ICS09
12177-ESK-11ICS10	12177-ESK-11ICS10
12177-ESK-11ICS11	12177-ESK-11ICS11
12177-ESK-11ICS12	12177-ESK-11ICS12
12177-ESK-11ICS13	12177-ESK-11ICS13 Sh 1, 2
12177-ESK-11ISC01	12177-ESK-11ISC01
12177-ESK-11ISC02	12177-ESK-11ISC02
12177-ESK-11ISC03	12177-ESK-11ISC03
12177-ESK-11ISC04	12177-ESK-11ISC04
12177-ESK-11ISC05	12177-ESK-11ISC05
12177-ESK-11ISC06	12177-ESK-11ISC06
12177-ESK-11MSS05	12177-ESK-11MSS05

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INSERTION INSTRUCTIONS

VOLUME 9A

Remove	Insert
Volume 9A index sheets	Volume 9A index sheets
12177-EE-1A-6	12177-EE-1A-7
12177-EE-1B-8	12177-EE-1B-10
12177-EE-1C-8	12177-EE-1C-10
12177-EE-1D-8	12177-EE-1D-10
12177-EE-1F-6	12177-EE-1F-9
12177-EE-1G-6	12177-EE-1G-8
12177-EE-1H-6	12177-EE-1H-10
12177-EE-1J-5	12177-EE-1J-7
12177-EE-1K-7	12177-EE-1K-10
12177-EE-1L-5	12177-EE-1L-8
12177-EE-1M-5	12177-EE-1M-8
12177-EE-1N-5	12177-EE-1N-8
12177-EE-1P-4	12177-EE-1P-6
12177-EE-1Q-5	12177-EE-1Q-9
12177-EE-1R-5	12177-EE-1R-8
12177-EE-1T-10	12177-EE-1T-12
12177-EE-1U-7	12177-EE-1U-10
12177-EE-1V-9	12177-EE-1V-11
12177-EE-1W-8	12177-EE-1W-10
12177-EE-1X-7	12177-EE-1X-9
12177-EE-1Y-6	12177-EE-1Y-8
12177-EE-1Z-7	12177-EE-1Z-9
12177-EE-1AA-3	12177-EE-1AA-4
12177-EE-1AB-3	12177-EE-1AB-5
12177-EE-1AD-3	12177-EE-1AD-6
12177-EE-1AE-3	12177-EE-1AE-5
12177-EE-1AF-1	12177-EE-1AF-4
12177-EE-1AG-3	12177-EE-1AG-4
12177-EE-1AH-3	12177-EE-1AH-4
12177-EE-1AK-3	12177-EE-1AK-4
12177-EE-1AL-3	12177-EE-1AL-4
12177-EE-1AM-3	12177-EE-1AM-4
12177-EE-1AN-3	12177-EE-1AN-4
12177-EE-1AQ-3	12177-EE-1AQ-4
12177-EE-1AR-3	12177-EE-1AR-8
12177-EE-1AS	---
12177-EE-1AT-3	12177-EE-1AT-5
12177-EE-1AU-3	12177-EE-1AU-4
12177-EE-1AV-3	12177-EE-1AV-4
12177-EE-1AW-3	12177-EE-1AW-6
12177-EE-1AX-3	12177-EE-1AX-6
12177-EE-1AY-3	12177-EE-1AY-4
12177-EE-1AZ-1	12177-EE-1AZ-2

NMP2 FSAR DRAWING PACKAGE

INSERTION INSTRUCTIONS

VOLUME 9A (Cont)

Remove	Insert
12177-EE-1BH-2	12177-EE-1BH-3
12177-EE-1BR-5	12177-EE-1BR-7
12177-EE-1CA-4	12177-EE-1CA-6
12177-EE-1CB-5	12177-EE-1CB-6
12177-EE-1CC-4	12177-EE-1CC-5
12177-EE-1CM-5	12177-EE-1CM-9
12177-EE-1CN-5	12177-EE-1CN-9
12177-EE-1CP-1	12177-EE-1CP-2
12177-EE-1CT-1	12177-EE-1CT-2
---	12177-EE-1CX-5
---	12177-EE-1CY-6
---	12177-EE-1CZ-4
12177-EE-1EA-8	12177-EE-1EA-9
---	12177-1FA-8
---	12177-1FB-3
---	12177-1FC-2
---	12177-1FD-1
12177-EE-2B-4	12177-EE-2B-5
12177-EE-2C-2	12177-EE-2C-3
12177-EE-2E-3	12177-EE-2E-4
12177-EE-2F-2	12177-EE-2F-3
12177-EE-2G-3	12177-EE-2G-4
12177-EE-2J-3	12177-EE-2J-4
12177-EE-2R-2	12177-EE-2R-4
12177-EE-2U-2	12177-EE-2U-3
12177-EE-2W-3	12177-EE-2W-5