

SAFETY EVALUATION REPORT  
ON ENVIRONMENTAL QUALIFICATION  
OF SAFETY RELATED CABLE IN  
SURRY POWER STATION, UNITS 1 AND 2

INTRODUCTION

Virginia Electric and Power Company (VEPCO) by letter dated September 29, 1978, submitted its proposed qualification test program for determining whether certain electrical instrument cables manufactured by Continental Wire and Cable Corporation will function under environmental conditions simulating those expected within the containment of Surry Power Station Units 1 and 2, during a postulated loss of coolant accident (LOCA) or during a main steam line break (MSLB). The test program was intended to include irradiation and additional aging of the cable samples which have been in service at Surry for more than seven (7) years, exposure of the cables to a combined steam and chemical spray while electrically energized, and a comparison of the physical properties of the samples before and after the environmental exposures. Separate tests were proposed to be conducted, one to simulate the LOCA conditions and a second to test the MSLB environment.

The sample cable used in the test program was 300V, two conductor, No. 16 AWG, stranded with cross-linked polyethylene insulation and hypalon jacket (see Figure A for details). The test program required seven (7) test samples to be prepared - three for the LOCA test, three for the MSLB test and one for measuring initial physical and electrical properties.

The acceptance criteria for LOCA and MSLB tests were established as follows:

- A. Short term for safety system initiation following an incident:  
The cable shall be considered acceptable if the current measurement remains between 24 and 26 milliamps during the first five minutes of the test.
- B. Long term for monitoring and operator action following an incident:  
The cable shall be considered acceptable if the current measurement remains between 22 and 28 milliamps throughout the test.

VEPCO by letter dated December 15, 1978, submitted the test report of the environmental qualification performed by Conax Corporation on the Continental Instrument Cable in accordance with the test procedure. Additional information on the test was submitted by letter dated May 5, 1979.

The cable samples supplied by VEPCO were cut into test samples and utilized for testing as shown in Figures B and C. These test samples that had been thermally aged for 60 hours at 100°C and irradiated to 20 MR were installed in the test chamber, connected, instrumented and subjected to the LOCA environment (temperature/pressure/chemical spray environment). The test chamber temperature profile is shown in Figure D. Data was collected

7907110148

of the measurements of voltage and current throughout the 48 hours of the test.

Three test samples, thermally aged for 60 hours at 100°C and irradiated to 20 KR, were installed in the test chamber and subjected to the specified MSLB test environment. The test chamber profile is shown in Figure E. Data was also continuously collected throughout the test period of 48 hours.

#### DISCUSSION

The test procedure and the tests done for qualification of the Continental Instrument Cable followed the general guidelines of IEEE Std. 323-1974.

#### TEST SEQUENCE

The cable samples were thermally aged, irradiated and subjected to steam pressure temperature/chemical spray as outlined in the approved test procedure. The sequence of the test was in line with the sequence of IEEE Std. 323-1974.

#### AGING

The cable samples were subjected to accelerated aging at 60°C for 100 hours to put the samples in a condition equivalent to end-of-life condition. From the Arrhenius curve applicable to the cable and based on the licensee maintaining the containment bulk average temperature at 40°C, it is seen that at 40°C a 150 year life of the cable is indicated and at 45°C a 53 year life is indicated. (The Arrhenius Life Curve is based on retention of 40% of original elongation of the cable insulation material).

#### MARGIN

By comparing the test data and the plant's temperature and pressure profiles of LOCA and MSLB events, it was seen that adequate margin per IEEE Std. 323-1974 was provided. (The temperature peak of 420°F during 20 to 90 second interval of the incident was not obtained during the test; however, the test temperature of 350°F was sustained for a period of 15 minutes to compensate for this. This deviation was found acceptable and was approved in the test procedure itself).

#### RADIATION

The samples were divided into two batches - one for the LOCA test and the other for the MSLB test. The samples for the LOCA tests were irradiated to obtain an integrated gamma dose of 20 MR at 1 MR/hr and the samples used in the MSLB test were irradiated to 20 KR at 1 Kr/hr.

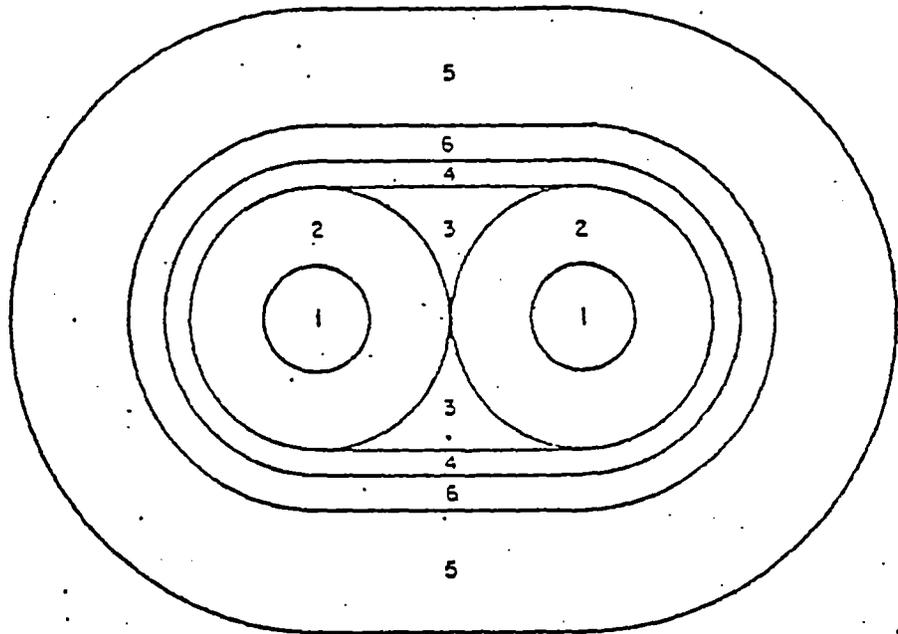
Measurement of electrical and physical properties were made in conformance with applicable industrial standards. The data presented for the test are considered satisfactory for Surry Units 1 and 2 service conditions.

### OPERATION UNDER NORMAL AND ACCIDENT CONDITIONS

The electrical connections made in the test to keep the samples energized supplying simulated loads during the period when the samples were exposed to simulated environmental conditions are satisfactory. The review of the continuous readings of the current and voltage of the samples taken during the test show that the currents were within the required limits of the acceptance criteria (one sample of the three used in the MSLB test had current readings beyond the limits of the acceptance criteria. However, analysis and measurement taken after the test traced this discrepancy to a decrease in resistance of a variable resistor outside the test chamber. Conax Corporation's report has conclusively established that the increased current flow in that particular test sample circuit was directly caused by the resistance decrease in the variable resistor used and in no way was a result of any change in the test cable). Based on this it is concluded that all the cable samples conformed to the acceptance criteria of the test procedure.

### CONCLUSION

Based on our review of the test result we conclude that the instrumentation cable tested can perform its required functions during and following the specified abnormal environmental conditions. The acceptability is on the basis that the tests performed were generally in line with the requirements of Regulatory Guide 1.89 (IEEE Std. 323-1974).



TYPE OF CABLE:

2/C #16 OVERALL SHIELD 25 MILS XLPE INSULATION.

45 MILS OVERALL HYPALON JACKET .38" OVERALL DIAMETER.

REGION:

1) NO.16 AWG. COPPER CONDUCTOR.

2) 25 MILS (.025") XLPE INSULATION.

3) AIR SPACE DIMENSION ASSUMED SMALL.

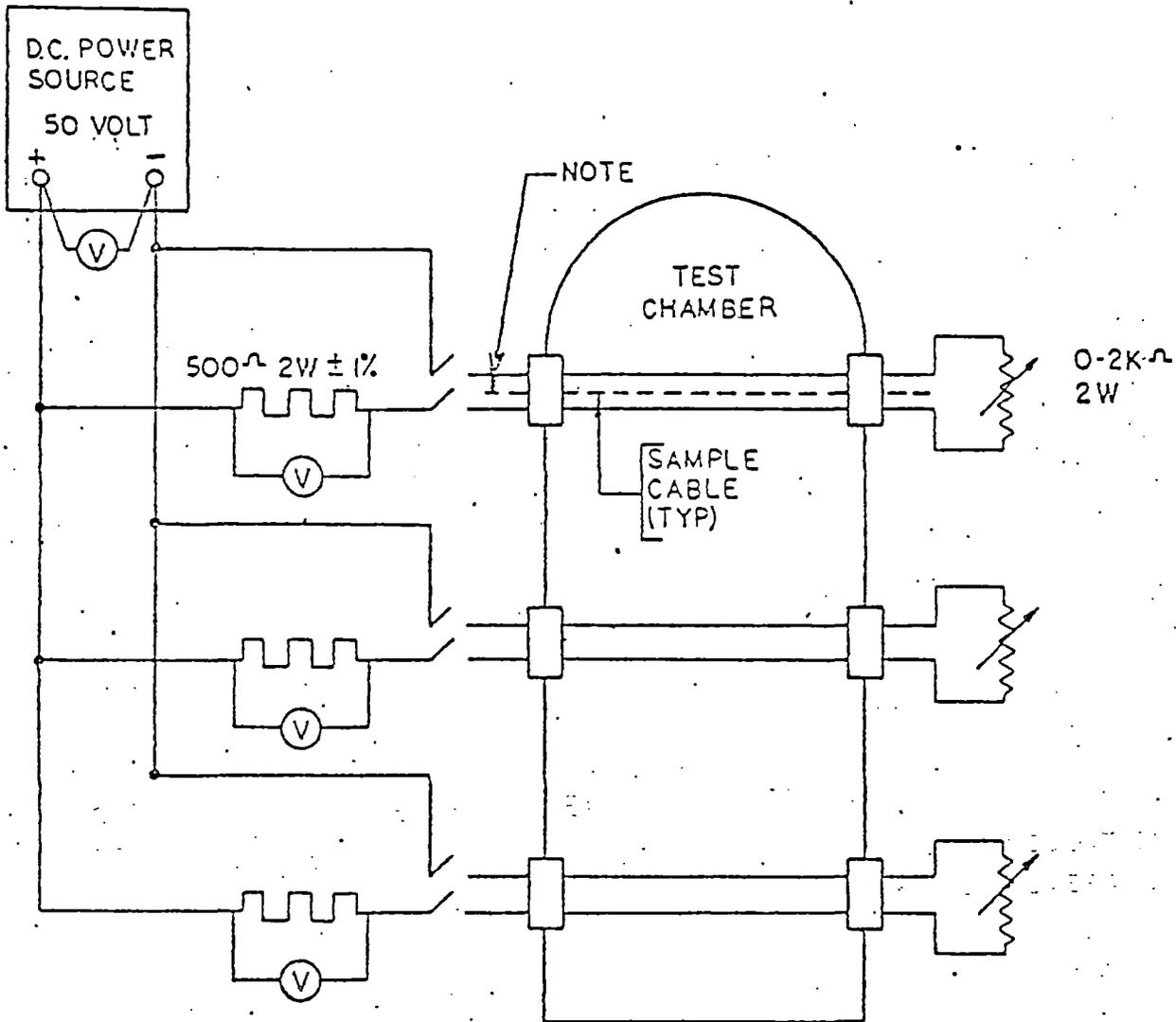
4) OVERALL ALUMINUM FOIL SHIELD - 2 MILS (.0020") THICK.

5) OVERALL HYPALON JACKET - 45 MILS (.045") THICK.

6) ASBESTOS BINDING TAPE 6 MILS (.006").

CROSS SECTION -  
300V INSTRUMENT CABLE  
SURRY POWER STATION  
UNITS 1 AND 2

FIG. NO. A



NOTE: CABLE SHIELD TO BE INSULATED FROM CONDUCTORS AND GROUND.

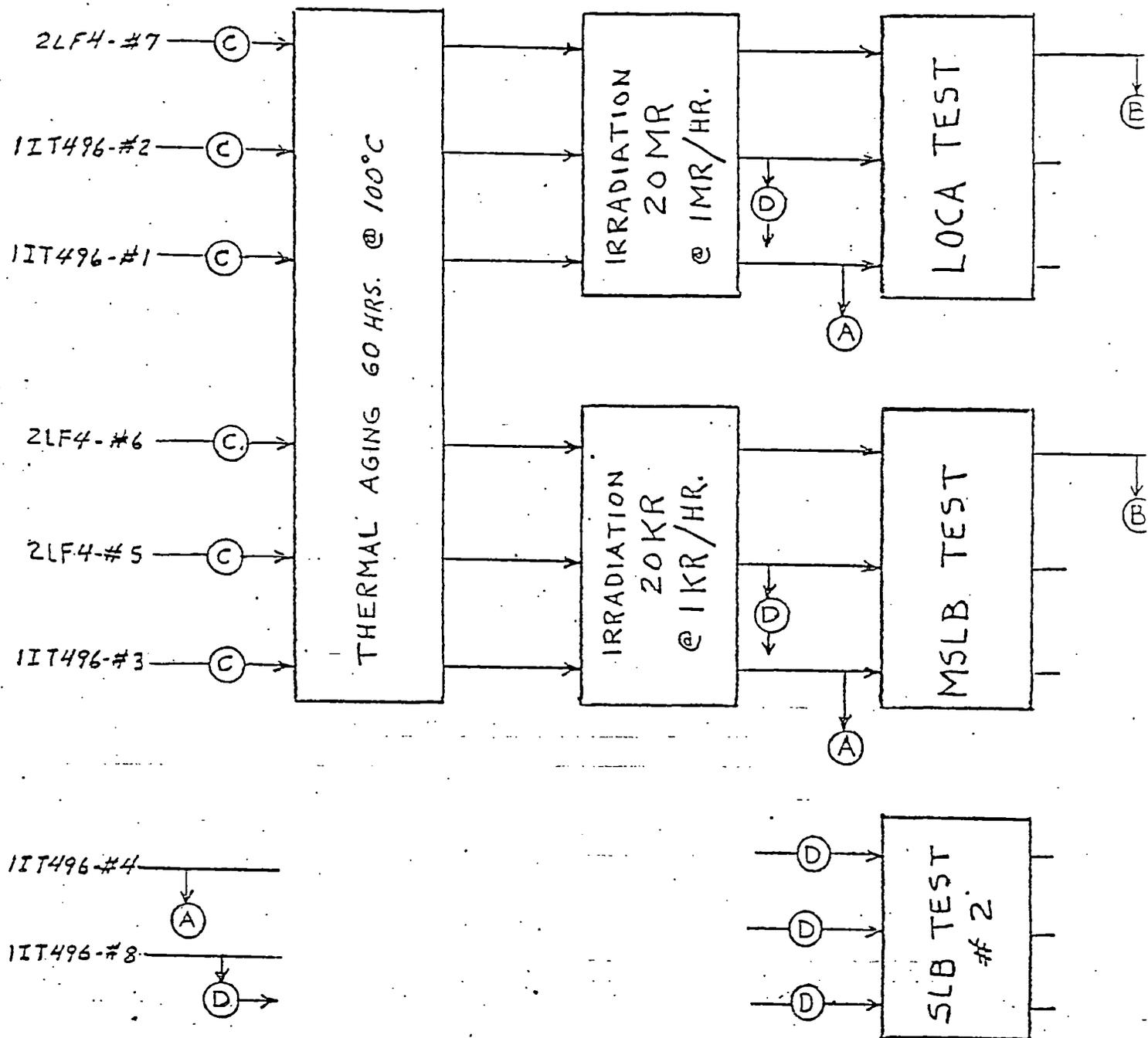
CHEMICAL SPRAY SOLUTION TO BE 2500 PPM BORATED WATER WITH CAUSTIC (Na OH) ADDED.

FIRST TWO HOURS  $9.0 < \text{pH} < 11.0$

TWO TO FORTY EIGHT  $7.0 < \text{pH} < 9.0$

FIG. NO. B

POWER INDUSTRY GROUP		TITLE	SCALE:
CHECKED		SCHEMATIC OF TEST CIRCUIT	DATE:
CORRECT			SKETCH NUMBER
APPROVED			



Ⓐ & Ⓑ - SAMPLE FOR PHYSICAL/ELECTRICAL PROPERTIES

### FIGURE C

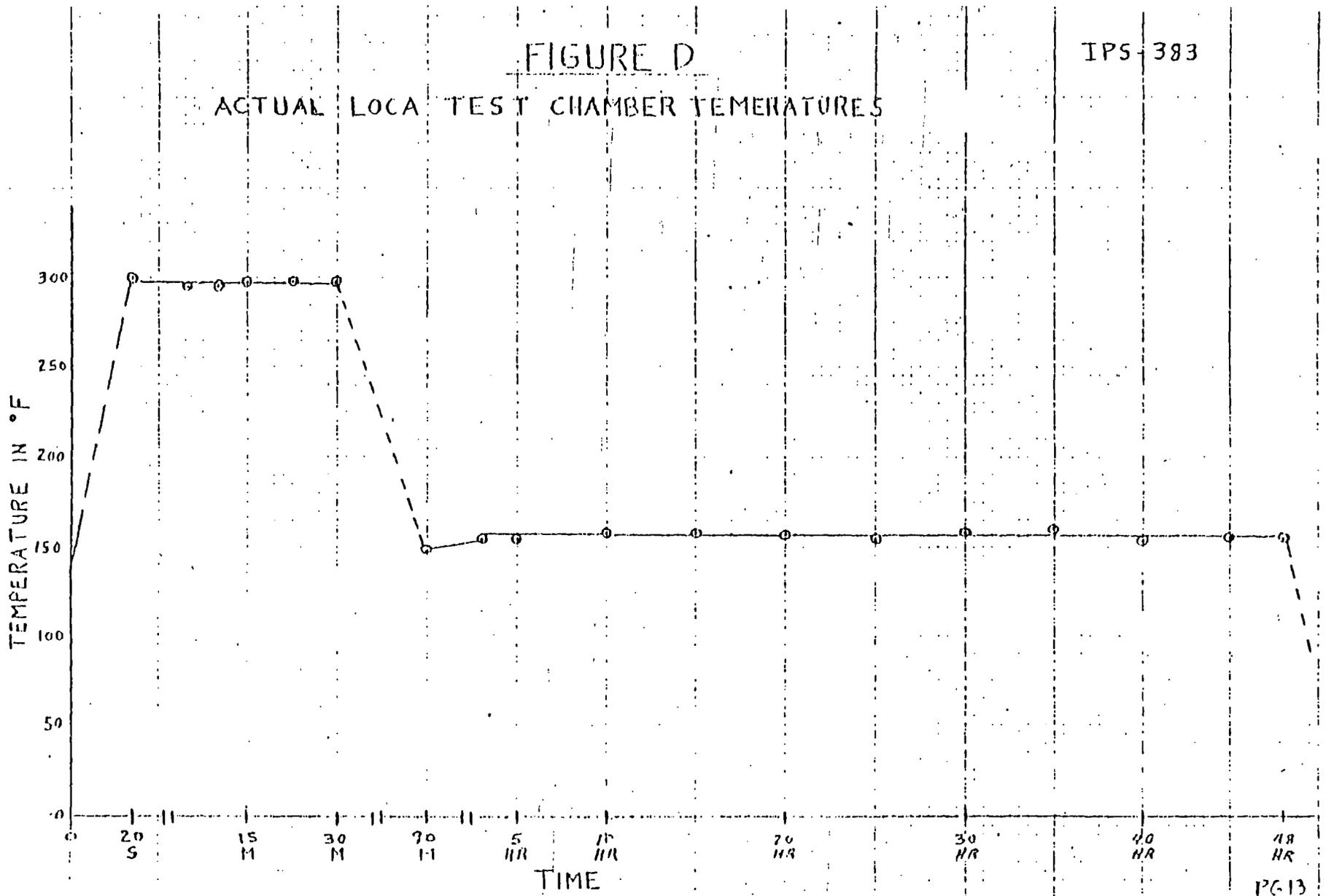
UTILIZATION OF CABLE SAMPLE  
FOR TEST SAMPLES

*Handwritten signature*

# FIGURE D

IPS 383

## ACTUAL LOCA TEST CHAMBER TEMPERATURES



# FIGURE E

IPS-383

## ACTUAL MSLB TEST CHAMBER TEMPERATURES

