APCo Exhibit 58

SENSOR PRODUCTS

A-58
-50-348/364-CIVP
2/20/92

ENGINEERING MEMO

NUMBER 994-75-011

QUALIFICATION TEST SUMMARY REPORT

BY

M. G. Luria

M. G. LURIA

DATE

MARCH 27, 1975

REVIEWED BY:

R. M. SOLUSTER

APPROVED BY:

J. H. TERHUNE

NUCLEAR REGULATORY COMMISSION

Docket No. 50-348/364 Civil — Exhibit No. 58

In the matter of Alabama Power Company

Staff ✓ — IDENTIFIED 2:26 p.m. 3/26/92

Applicant — RECEIVED 3/26/92

Intervenor — REJECTED

Cont'g Org. —

Contractor — DATE

Other — WITNESS

Reporter L. Gilman

GENERAL ELECTRIC

994-75-011

CONT ON SHEET 1 SH NO. 14

TITLE QUALIFICATION SUMMARY

FIRST MADE FOR 100 SERIES ELECTRIC PENETRATIONS

QUALIFICATION TEST

SUMMARY

100 SERIES ELECTRIC PENETRATION

PREPARED BY N.G. Luria 4/23/75

REVIEWED BY [signature] 4/29/75

MADE BY	APPROVALS			
N.G. LURIA, Feb. 28, 1975		BWRS / SAN JOSE		994-75-011 CONT ON SHEET 1

0063503 58

994-75-011
SHEET 2 OF 14

TITLE: QUALIFICATION SUMMARY

FIRST MADE FOR 100 SERIES ELECTRIC PENETRATIONS

REVISIONS

TABLE OF CONTENTS

0035 0635

PRINTS TO

TITLE QUALIFICATION SUMMARY

994-75-011 SHEET 3 OF 14

FIRST MADE FOR 100 SERIES ELECTRIC PENETRATIONS

REVISIONS

1.0 INTRODUCTION

This document summarizes the design verification of the 100 Series Electric Penetration. The 100 Series electric penetrations are qualified for installation and service in nuclear containment buildings where the environmental and electrical loading conditions do not exceed those limits established by analysis and/or testing, as summarized herein.

Only modules (Low Voltage) constructed with XR5126 & XR5237 customer epoxy and all High Voltage and Medium Voltage penetrations are qualified per this document.

Millstone 2 modules, constructed with M229 customer epoxy are qualified to environments, as specified in para. (4.5*)

2.0 References

The subject penetrations are in compliance with the following documents:

2.1 Design Review Report 24BA9263

2.2 IEEE Std 317-1972, Standard for Electric Penetrations

2.3 ASME Boiler & Pressure Vessel Code, Section III, Subsection NE

2.4 IEEE Std 344-1971, Standard for Seismic Qualification

3.0 Qualified Configuration

3.1 General

The 100 Series electric penetrations qualified by this document are defined generically by the following drawings:

Low Voltage	18B89747, PL 386X200
Medium Voltage	13309408, PL 386X193
High Voltage	17489302, PL 328X397

Other drawings, tailored to specific requisitions may exist, but these variations must be limited to length, nozzle size, wire terminations, and general accessories. Nozzle size variations must be analyzed in the appropriate Plant Stress Analysis Report.

0063503600

PRINTS TO

3.2 Identification of Test Hardware

The following identifies the qualification hardware:

3.2.1 Medium & High Voltage

Name	S/N	DWG	Construction Comments
MV Vib	6574127	127D1643	
LV Vib	6574047	159C4519G001	
HV Qual.	6574036	174B9302G001	
HV Feedthru	TZCY2-1	157C4869G001	
MV Qual.	6477788	163C1055G001	
MV Feedthru	TZCGO-1	159C4679G001	

3.2.2 LV Qualification Modules

Name	S/N	DWG	Construction Comments
#4/0	Y7257-38	157C4837G012	R229 Customer Epoxy
# 2	Y7257-23	157C4837G014	" "
# 6	Y7257-152	157C4837G019	" "
#10	Y7156-140	174B9103G013	" "
T/C	Y7257-36	157C4864G012	" "
RG-59	Y7156-84	174B9060G003	" "

3.2.3 LV Qualification Modules

Name	S/N	DWG	Construction Comments
T/C	Y7156-381	163C1068G003	XRS126 Customer Epoxy
SRM	Y7257-135	195B9476G001	" "
16	Y7257-169	195B9474G001	" "
10	Y7257-251	195B9474G002	" "
10	Y7257-211	195B9474G002	Modified per ECN NE47750
#4/0	Y7257-454	195B9474G004	XRS237 Epoxy & Scotchkote
#4/0	Y7257-392	195B9474G004	XRS126 Customer Epoxy

0 0 6 3 5 0 3 6 1

3.3 Other Qualification Data

Cables qualified for use in electric penetrations are as follows:

Cable	Dwg Nos.
GE Vulkane SIS™	175A7293, 209A4108
Raychem Flamtrol™	17489404
Raychem Coaxial	225A4706
Raychem Multiconductor	15704853

Terminal blocks qualified for use on electric penetrations, except for fault current loads, are as follows:

Block	Drawing No.
GE CR 151	8558624, 8568208
States type M.T.	225A4707

Multipin connectors were not tested for electrical operation during a LOCA event.

Signal (coaxial) type connectors were not tested for electrical operation during a LOCA event.

4.0 Qualification Summary

4.1 General

This section of the document summarizes the operating limit for which the product has been tested or analyzed.

Hardware identified by para. 3.2.2 has been subjected to the following sequential testing:

1 Thermal cycle

2 Gamma exposure

3 Loss of coolant accident, transient, simultaneous with

3a Short circuit
3b Short time overload
3c Rated current

Hardware identified by para. 3.2.3 has been subjected to the following sequential testing:

1 Thermal cycle
2 Gamma exposure
3 Loss of coolant accident, transient, simultaneous with
  3a Operating current
  3b Operating voltage
4 Post LOCA environmental conditions

HV and MV qualification units identified by para. 3.2.1 have been subjected to the following sequential testing:

1 Corona testing (HV only)
2 Gamma exposure
3 Loss of coolant accident simultaneous with
  3a Short circuit
  3b Short time overload
  3c Rated current
4 Post LOCA environmental conditions

HV and MV feedthru identified by para. 3.2.1 has been subjected to the following sequential testing:

1 Thermal cycle
2 Gamma exposure
3 Impulse test

MV feedthru identified by para. 3.2.1 has been subjected to the following sequential testing:

1 Thermal cycle
2 Impulse testing

4.2 Thermal Cycle

The following exposure simulates plant startup and shutdown:

Temperature	:	80 to 150°F to 80°F
Cycle frequency	:	4 cycles per day
Relative humidity	:	40% @ 80°F, 96%* @ 150°F
Number of cycles	:	120

4.3 Gamma Exposure

The electric penetrations are qualified for the following containment level gamma exposures:

1×10^7 RAD	Normal Service Environment
1×10^8 RAD	Total Integrated Dose (normal and LOCA)
3.5×10^5 r/hr	Rate during normal service

4.4 Loss of Coolant Accident (LOCA)

The electric penetrations are qualified for the following containment environment with respect to pressure integrity. Events 1 thru 5 are defined as transient conditions.

Event	1	2	3	4	5
Temperature	340°F	325°F	260°F	250°F	225°F
Pressure	103 psig	81 psig	23 psig	16 psig	20 psig
Relative humidity	100%	100%	100%	100%	100%
Containment pH	8.4	8.0	7.5	7.5	-
Duration	4 hrs	3 hrs	18 hrs	168 hrs	1 year
Outside temperature	150°F	150°F	130°F	120°F	80°F

4.5 Rated Current and Rated Voltage During LOCA

Electric penetrations have been tested on selected generic cable sizes, such as 4/0, #10AWG. Using the rules of the National Electrical Code, ratings were calculated for other wire sizes in the same generic design categories (low voltage power, low voltage control).

* 100% RH is practically not attainable in test chambers.

Wire/Cable Size (AWG)	Current (AMPS)	Voltage (VAC)
4/0 *	95	460
2/0 *	70	460
2 *	45	460
4 *	34	460
6 *	26	460
8 *	16	460
10	3	460
12	3	460
14	3	460
16	1	125
18	1	125

*Limited to six months post LOCA for PWR (events 1 - 4) for environments not to exceed the following:

Event	1	2	3	4	5
Temperature, °F	289	250	220	160	160
Pressure, psig	54	40	20	5	5
Humidity, % RH	100	100	100	100	100
Duration	15 min	45 min	23 hrs	6 mos	6 mos
pH	8.4	8.4	7.8	(neutral)	(neutral)

*Limited to 30 days for BWR (environment per 4.4)

4.6 Rated Current & Rated Voltage During Normal Service

The electric penetrations are rated for the following levels during normal service environments not to exceed 135°F.

The rules of the National Electrical Code are to be used to determine the current capacity of the electric penetration. The maximum applied voltage is in accordance with the insulation rating less 20%.

Total penetration heat dissipation from conductors are qualified for 56 Watts/ft of penetration nozzle length.

For the above limits, the penetration assembly, as installed, will not create a condition where the containment concrete temperature will reach 150°F.

Also refer to Fig. 1 for current - time rating.

4.7 Fault Current (single failure criterion)

Short Time Overload

For both normal service and loss of coolant accident conditions, the electric penetration is qualified for the following current/time relationships. (Also refer to Fig. 1 for current-time rating).

4.7.1 Fault Current - Single Phase RMS Peak for a Three Phase Circuit

Cable Size (AWG)	Asym AMPS	Sym AMPS	Duration Seconds
1000 MCM	80,000	63,000	.0132
4/0	42,000	32,000	.0132
2/0	26,000	19,550	.0132
2	13,000	10,000	.0132
4	8,100	6,100	.0132
6	5,200	4,000	.0132
8	3,300	2,480	.0132
10	1,000	900	.0132

4.7.2 Short Time Overload

Cable Size (AWG)	Current AMPS	Duration Seconds
1000 MCM	4300	45
4/0	1050	45
2/0	725	45
2	470	45
4	350	45
6	280	45
8	170	45
10	120	45

4.8 Corona Extinction

The high voltage penetration exhibits the following corona extinction level:

5 pico coulombs @ 11.5

4.9 Basic Impulse Level (BIL)

The high and medium voltage penetrations are capable of the following crest voltage:

High 110KV (Wave shape - 1.5 x 40 microseconds)
Medium 75KV

4.10 Seismic Vibration Test

The medium voltage and low voltage penetrations were seismically tested. The high voltage penetration is verified thru analysis only, since structurally, this configuration has a higher stiffness than those of medium and low voltage penetrations. Testing is in compliance with IEEE Std 344-1971.

All penetrations have a structural natural frequency greater than 50 HZ.

During the low voltage vibration test, conductor continuity was maintained.

The low electric penetrations are qualified for installations where building acceleration levels, at the point of attachment, do not exceed 2.8g (horizontal) and 2.5g (vertical).

The medium voltage penetration is qualified for dual axis input of 1.6g (horizontal) and 1.2g (vertical).

4.11 Field Weld Simulation Test

Based on the worst case low voltage penetration, where conductors are in the closest proximity to the field weld joint, all penetrations are qualified for field welding in accordance with the instruction manual.

Specifically, the penetrations may be welded to schedule 80 (max) pipe. The recorded maximum temperature at the steel body of the module was 161°F. Directly below the weld area, the module surface maximum temperature was 203°F. The maximum allowable temperature is established by the cables, which is 195°F continuous.

4.12 Thermocouple Calibraton

The electric penetration thermocouple modules are qualified for a system error (thermocouple and extension leads) with ± 4°F, for containment temperatures (applied to the penetration) not to exceed 290°F. The system error reduces as the containment temperature is lowered.

4.13 Flammability of non Metallic Materials

All non metallic materials, except for EPR in high and medium voltage used in the construction of the penetration seal, are self extinguishing per ASTM-D635 except that all test samples passed the flame test.

4.14 Junction Box Pressure Test

The junction box defined by drawing #115D6588 or equivalent, is qualified for an overpressure of 62 psig in 10 seconds without any damage.

The junction box defined by drawing #115D6631 or equivalent when subject to 62 psig in 10 seconds will:

a) collapse when completely sealed, but maintain electrical circuit integrity

b) sustain without damage with a vent hole 1 1/4 inch in diameter.

4.15 Area Flame Test

Low voltage power and control modules containing GE Vulkene wire and Raychem Flamtrol Wire Leads, and a low voltage signal module with Raychem 10483 Coaxial Leads were subjected to an area flame of 21,000 BTU/hr from a 10 inch ribbon burner on one end of the modules for 10 minutes. In no case did the flame propogate to the opposite redundant seal, or were any of the wire and cables damaged at the opposite end. All flames extinguished within 5 minutes after the ribbon burner was turned off.

4.16 Terminal Block Test

Autoclave qualification tests simulating LOCA defined in para. 4.4 events 1 thru 4 were conducted on General Electric CR 151 and States Co. type N.T. and recorded a minimum insulation resistance 2 x 10^{9} ohms @ 500 VDC. This is the general value of saturated steam.

4.17 Structural Integrity

All penetrations are certified to be in accordance with the requirements of the ASME Boiler & Pressure Vessel Code, Section III Class MC on a per requisition basis. The analysis includes jet force calculations, seismic calculations in addition to the normal structural analyses required in Vessel Design. Refer to reference 2.1 for specific information. Generally, the penetrations are analyzed for the following loadings:

a)	Temperature	340°F	
b)	Pressure	80 psig	
c)	Cycles	120	
d)	Steam Line Break where	Temperature	600°F
		Pressure	1250 psig
		Distance from penetration	3.5 ft
e)	Acceleration where	Vertical	1.0g
		Horizontal	1.5g

4.18 Missile Impact Loads

Where missile objects are specified to originate within the containment building, the penetration must be installed on the outside wall of the building. This installation location precludes any missile forces from affecting the integrity of the penetration.

An analysis for missile or jet force loads on the penetration is provided as part of Stress Report 248A9004 TA for low voltage, #248A9005 TL for high voltage, and #299A1424 TA for medium voltage. However, no testing has been performed to verify the calculations.

4.19 Pressure Transient

Low voltage penetrations are qualified for a transient pressure of 80 psig in 10 seconds without violation of the pressure integrity.

4.20 Triaxial (RG-11) Impedance Mismatch Test

The RG-11 type triax cable assembly (defined by module drawing No. 174891020005) can perform with a waveform distortion less

than that caused by a 65 ohm termination on a 75 ohm cable down to a pulse rise time of 1.0 nanosecond.

4.21 Installation

The electric penetrations were tested in a manner which simulates outside containment installation. This is the worst case arrangement and, therefore, the penetrations are qualified for inside or outside horizontal mounting in the containment building.

5.0 Acceptance Criteria

Electric penetrations and modules, after completion of the specified testing, have met the following acceptance criteria:

1) Helium leak tight thru entire assembly at less than 1×10^{-6} cc/sec at 1 atm of pressure (all hardware)

2) Insulation resistance greater than 1×10^{8} ohms @ 500 VDC at ambient temperature. (Hardware identified in para. 3.2, 3.2.3)

3) Hipot withstand voltage at 2 times rated voltage of cable insulation plus 1000 volts for one minute. (Hardware identified by para. 32.1, 3.2.3)

4) No loss of continuity as a result of the qualification test. (For hardware identified by para. 3.2.1 and 3.2.3)

GENERAL ELECTRIC

994-75-011

SHEET 14 OF 14

TITLE QUALIFICATION SUMMARY

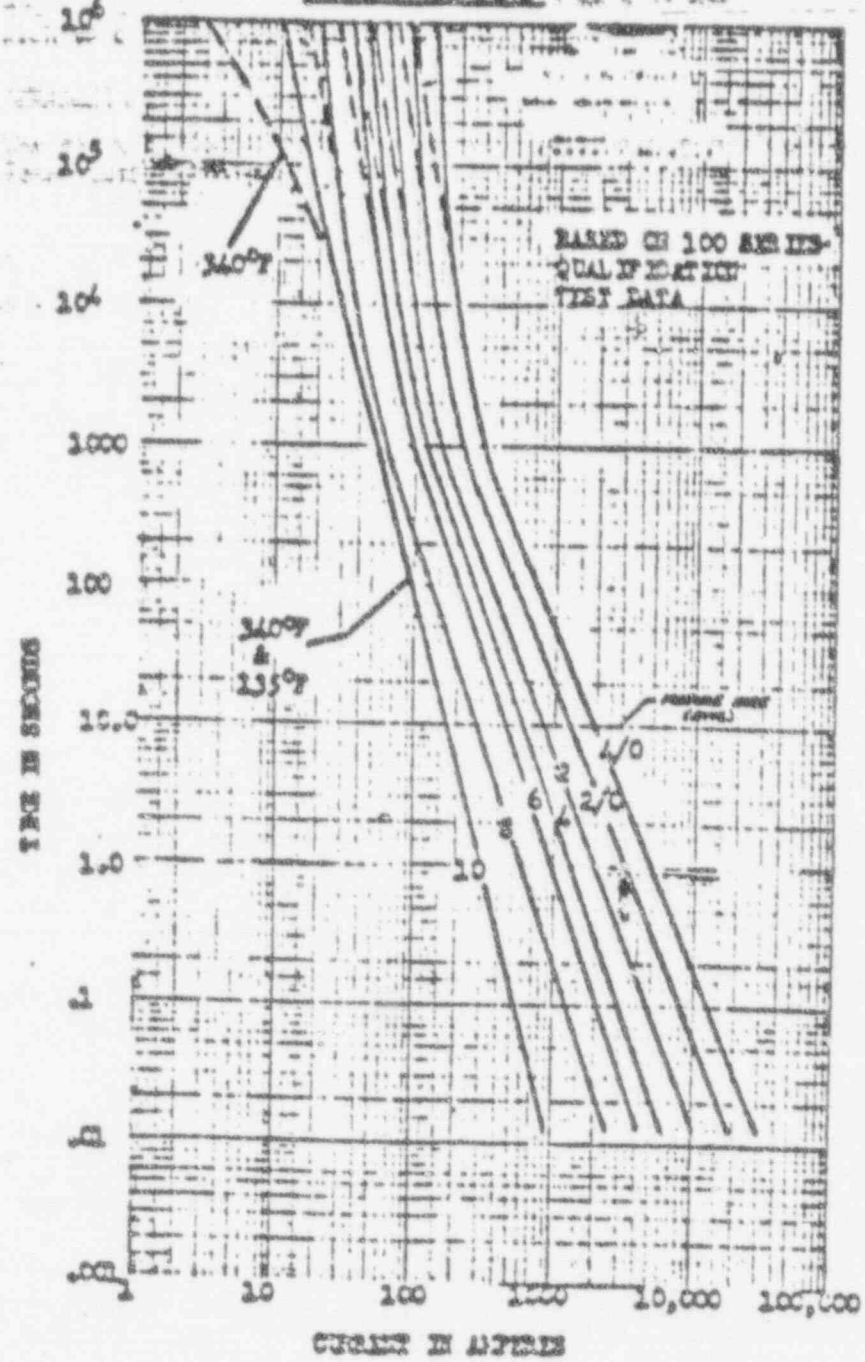
994-75-011

SHEET 14 OF 14

FIRST MADE FOR 100 SERIES ELECTRIC PENETRATIONS

LOW VOLTAGE [illegible] PENETRATION

[illegible] TEST



REVISIONS

PRINTS TO

M.C. LURIA, Feb.28, 1975

ISSUED

APPROVED

BWRS

SAN JOSE

994-75-011

SHEET 14 OF 14

0 0 6 3 5 0 3 7 1