**Omaha Public Power District**

1623 HARNEY ▪ OMAHA, NEBRASKA 68102 ▪ TELEPHONE 536-4000 AREA CODE 402

October 7, 1981

Mr. K. V. Seyfrit, Director
U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region IV
611 Ryan Plaza Drive
Suite 1000
Arlington, Texas 76011



Reference: Docket No. 50-285

Dear Mr. Seyfrit:

The District's letter dated June 15, 1981 provided the test specification to be used for the environmental qualification of Conax electrical penetrations. As a result of information presented by the Commission at the July 7-10, 1981 meeting with utilities concerning electrical equipment qualification, the District has revised the aging and design basis accident test specifications and added test specifications for short time current overload testing and short circuit current testing. Additionally, an electrical penetration test sample splice procedure is attached. The attached Conax electrical penetration test specification revision supersedes the June 15, 1981 submittal. Please note that the referenced drawing 2325-7684 was transmitted with the June 15, 1981 submittal.

The District intends to commence the qualification testing of the Conax electrical penetrations by November 1, 1981 and provide the test results to the Commission by June 30, 1982.

Sincerely,

W. C. Jones
Division Manager
Production Operations



WCJ/KJM/TLP/RWS:jmm

Attachments

cc: U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Washington, D.C. 20555

LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036



IE31

1.00 SCOPE

The scope of this specification is to define the testing requirements for the Fort Calhoun Station Conax Electrical Penetration in accordance with Regulatory Guide 1.63 and IEEE 317-1976 as modified by the requirements of the District's electrical penetration contract specification and the requirements of IE Bulletin 79-01B, which states that as an operating plant Fort Calhoun Station must meet the DOR Guidelines.

Based on these modifications to IEEE 317-1976 the following test sections are not included as outlined in type test section 6.4, Type Test.

6.4.6 Partial Discharge Test - all penetrations to be tested are 600 V class insulation

6.4.7 Rated Continuous Current

6.4.8 Cycling and Aging Test

6.4.12 Rated Continuous Current

6.4.14 Rated Maximum Duration of Rated Short Circuit Current Test

This test is only for those penetrations which were manufactured using teflon seals and teflon lead wire insulation.

The equipment shall remain functional during the environmental conditions specified.

1.1 Scope of Supply

The District will provide the test sub-assemblies, 3-7/C #10AWG sub-assembly No. 2325-7780-13, 3-12/C #12 Sub-assembly No. 2325-7780-03, and 3-16/C #14 sub-assembly No. 2325-7780-15. Each type of sub-assembly (7 C#10, 12 C#12, and 16 C#14) will be made up into the three different test configurations. The District will also provide nine sets of midlock assemblies No. 2308-03 for attachment to the test specimen and canister. The test laboratory is to provide a test canister.

The District will supply splicing material and a short length of cable for connection to the penetration after aging is complete. The District will supply a procedure for splicing.

It will be the testing facilities responsibility to provide connections and splices for the test equipment.

2.0 APPLICABLE DOCUMENTS, CODES, STANDARDS

2.1 10CFR 21 - Reporting of Defects and Non-Compliance

2.2 10CFR50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plant

2.3 ANSI Standard N45.2, Quality Assurance Program Requirements for Nuclear Power Plants

2.4 ANSI Standard N45.2.13, Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants

2.5 IEEE Standard 317-1976, Electrical Penetration Assemblies In Containment Structure For Nuclear Power Generating Stations

2.6 IEEE Standard 344-1975, Recommended Practices for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations

2.7 Regulatory Guide 1.100, Seismic Qualification of Electric Equipment for Nuclear Power Plants

2.8 Regulatory Guide 1.63, Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants

3.0 DESCRIPTION

3.1 The Fort Calhoun Station Electrical Penetrations manufactured by the Conax Corporation are penetrations used on low voltage power and instrument applications to provide both a primary seal to the containment atmosphere and an electrical pathway to containment mounted equipment. The penetration manufacturer used TFE virgin teflon as the seal material and FEP teflon as the conductor insulation. The area between the fittings is filled with dry nitrogen at 15 psig.

3.2 Oxygen is known to effect the capability of teflon to withstand radiation. Simultaneously with the testing of 3 [illegible] a similar penetration will be tested with DOW CORNING 3145 clear RTV coated lead wires and exposed seals which will be in contact with the LOCA environment. This will simulate the coating of the lead wires in containment. A third sample will use Raychem Heat Shrink Tubing Type WCSF-N and RTV-3145 clear as an oxygen boundary, see attached Figure 1.

3.3 Following the accelerated aging the penetration leads will be spliced with Rockbestos cable to simulate installation. The "as is" and RTV sample will be spliced with a double layer heat shrink as is presently installed at the Fort Calhoun Station. The "Raychem" test sample will be spliced with WSCF-N splice. Preparation of these splices is to be conducted per the attached Splice Procedure.

4.0 TEST REQUIREMENTS

The penetration will be demonstrated to fully function as an electrical conductor and as a seal at the completion of the environmental stress testing as defined in Section 5.

5.0 TEST SPECIFICATION

5.1 The environmental and electrical stresses outlined shall be applied to demonstrate the ability of the test specimens to meet the applicable electrical and leakage acceptance criteria. Each step is to be completed in order. Consult the attached Test Schedule for an outline of the test.

5.0 TEST SPECIFICATIONS (Continued)

5.1.1 Leakage Pressure Test - The leakage rate of a penetration canister assembly shall not exceed $1.5 \times 10^{-6}$ standard CC of helium per second when tested at 69 psig for a period of 10 minutes. The leakage to be measured is out of the test canister past the teflon seal.

5.1.2 Continuity Test - Each conductor of each feedthrough shall be verified for continuity.

5.1.3 Voltage Withstand Test - Each feedthrough assembly shall be subjected to a voltage withstand test between each conductor and all other conductors and sheath connected together of 2,200 V 60 HZ for not less than one minute.

5.1.4 Insulation Resistance Test - The insulation resistance of each conductor to the other conductors and sheath shall be measured at 500 VDC. The minimum insulation resistance shall be $10^4$ megohms.

5.1.5 Aging - The sub-components of the penetrations shall be pre-aged. The aging time shall be 100 hours at 190°C, for the assembly tested "as is". Aging time for the "RTV" coated and the "Raychem Heat Shrink Cover" assembly shall be 468 hours at 190°C per Table 1.

5.1.6 Rated Short Time Overload - The feed through assemblies used for power and control applications shall be subjected to a short time overload test. The sub-assemblies shall be subjected to continuous rated load for a period of not less than 4 hours at the end of which the assemblies shall be subjected to a short time overload. The test shall be conducted in accordance with the following table:

| Subassembly | Load Current | Overload Current | Time for Overload Current |
|---|---|---|---|
| 7/C #10[1] | 32 amps | 230 amps | 10 seconds |
| 12/C #12[2] | 22 amps | 160 amps | 10 seconds |
| 16/C #14 | - Not Required Instrument Service Only | | |

1 60 Hz AC current
2 DC current

5.1.7 Short Circuit Current: Each subassembly shall be subjected to a short circuit current (current calculated for each lead) per the following table.

| Subassembly | Short Circuit Current | Clearing Time |
|---|---|---|
| 7/C #10 | 2300 amp 60 Hz | .033 seconds |
| 12/C #12 | 400 amps DC | clearing time for Buss 10 amp MIN or NON whichever is longer |
| 16/C #14 | Not Required Instrument Only | |

5.1.8 Seismic - Seismic testing of the electrical penetrations shall be done in accordance with IEEE Standard 344-1975 and Regulatory Guide 1.100. Penetration canisters are rigidly mounted in the containment with the sub-assemblies mounted in the canisters as shown in drawing 2325-7684 attached. During a seismic event the motion experienced by the penetrations will be the same as the structure Figures XB 545 S-38 and S-39 showing the structure accelerations. For purposes of testing, acceleration of the 1050'-0" elevation shall be used. A 1.5 multiplication factor shall be used for the test accelerations. The test shall consist of 5 OBE and then followed by 1 DBE events. Step 5.1.1, 5.1.2, 5.1.3, and 5.1.4 shall be completed following the seismic testing. From Figures F-1 and F-2 attached, the natural frequencies are 3 hertz horizontal and 9 hertz vertical. The absolute containment vertical acceleration is given in Figure XB 545 S-38 and S-39 through the entire spectrum.

5.1.9 Radiation - Penetrations are to be irradiated to $2 \times 10^7$R total integrated gamma dose. Repeat 5.1.1, 5.1.2, and 5.1.3 each $2 \times 10^6$R increment.

5.1.10 Design Basis Accident - The assemblies shall be subjected to the following accident conditions, as outlined in the attached test profile.

| | |
|---|---|
| 305 | °F |
| 74 | psig |
| 2500 | ppm boron chemical spray buffered with sodium hydroxide for a ph of 9.0 at 0.6 GPM per square foot |

While the subassemblies are at the second DBA peak the subassemblies shall be subjected to a rated maximum short circuit current test in accordance with the following table:

| Subassembly | Short Circuit Current | Clearing Time |
|---|---|---|
| 7/C #10 | 2300 amps 60 Hz | .033 seconds |
| 12/C #12 | 400 amps DC | Clearing time of Buss MIN or NON 10 amp whichever is greater |
| 16/C #14 | Instrumentation, Not Required | |

After completion of the environmental exposure repeat Sections 5.1.1, 5.1.2, 5.1.3, and 5.1.4.

6.00 REPORTING

6.1 Visual Inspection - Visual inspection shall be performed following the completion of 5.1.5, 5.1.8, 5.1.9, 5.1.10 and a receipt inspection. Results shall be documented in the final report.

6.2 Failure Analysis - A failure analysis shall be performed on each penetration assembly which fails to meet one of the accepted criteria. The results of the failure analysis shall be documented in the final report.

6.3 All test instruments and measurements shall be tabulated and included in the final report.

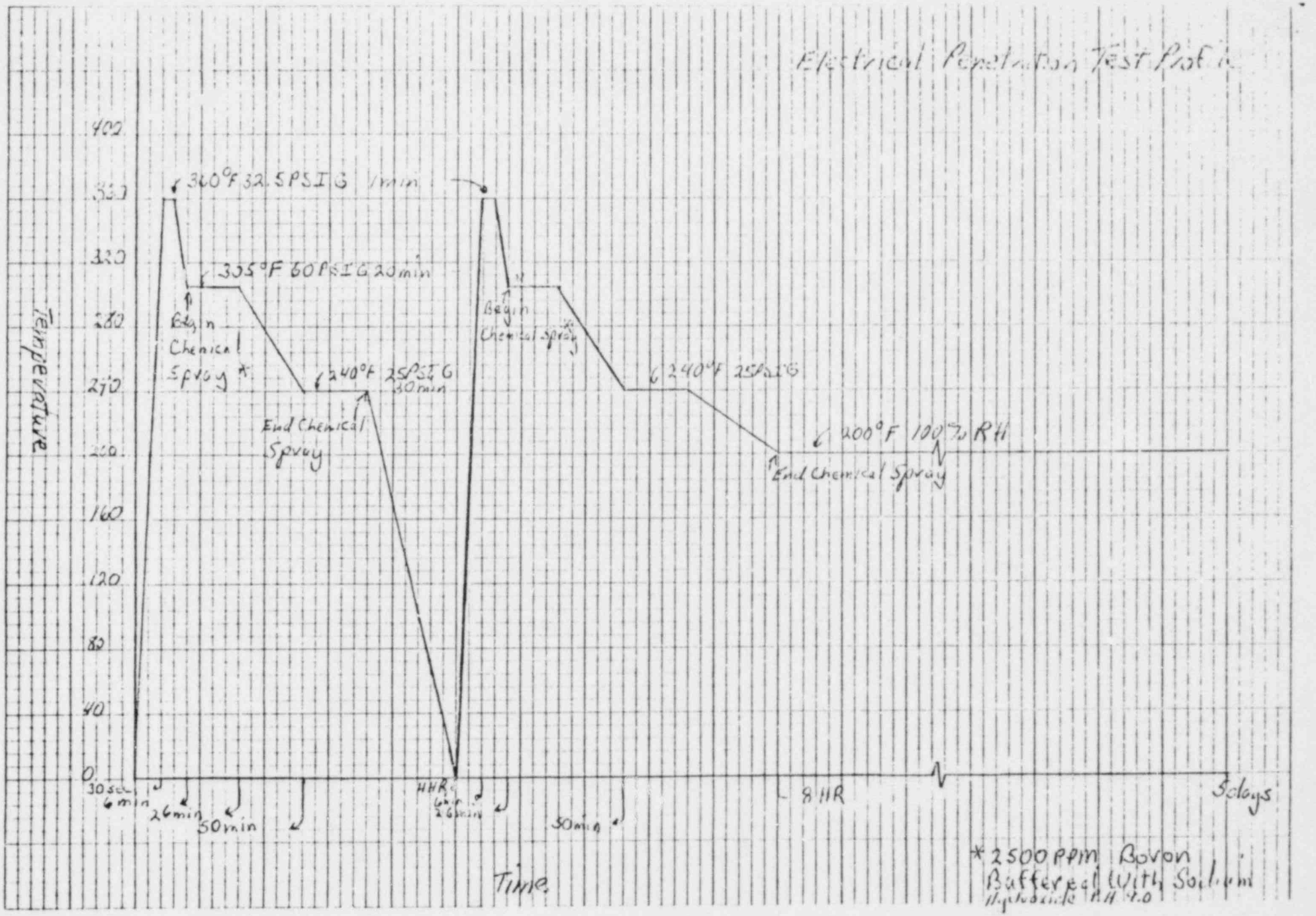
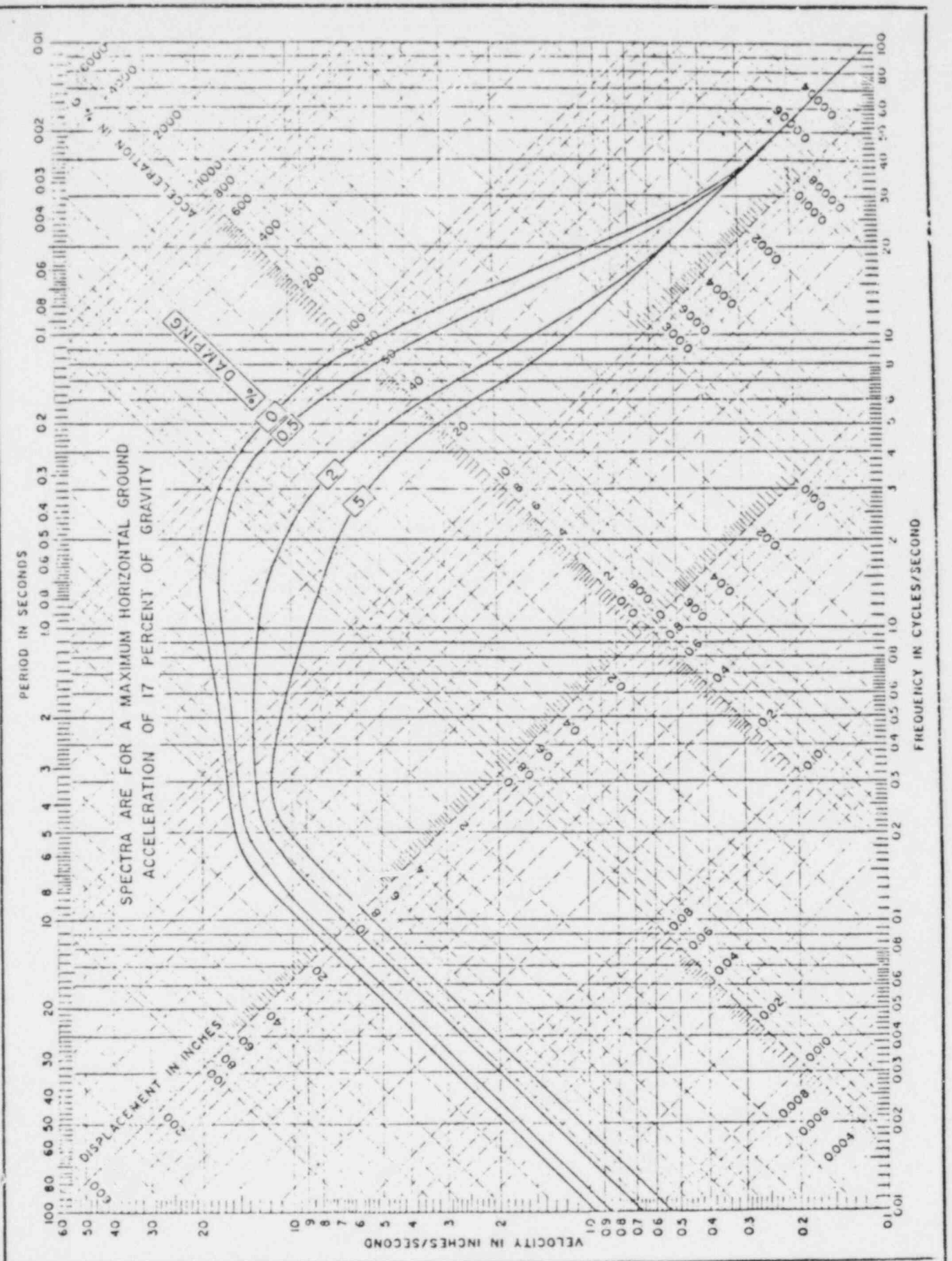

Electrical Penetration Test Plot
Temperature
Time
400
360
320
280
240
200
160
120
80
40
0
340°F 32.5PSIG
335°F 60PSIG 20min
240°F 25PSIG 30min
240°F 25PSIG
200°F 100% RH
Begin Chemical Spray *
End Chemical Spray
Begin Chemical Spray *
End Chemical Spray
30sec
6min
26min
50min
HHR
6min
26min
50min
8HR
3days
* 2500 PPM Boron Buffered With Sodium Hydroxide PH 9.0

Table 1

CONAX PENETRATIONS

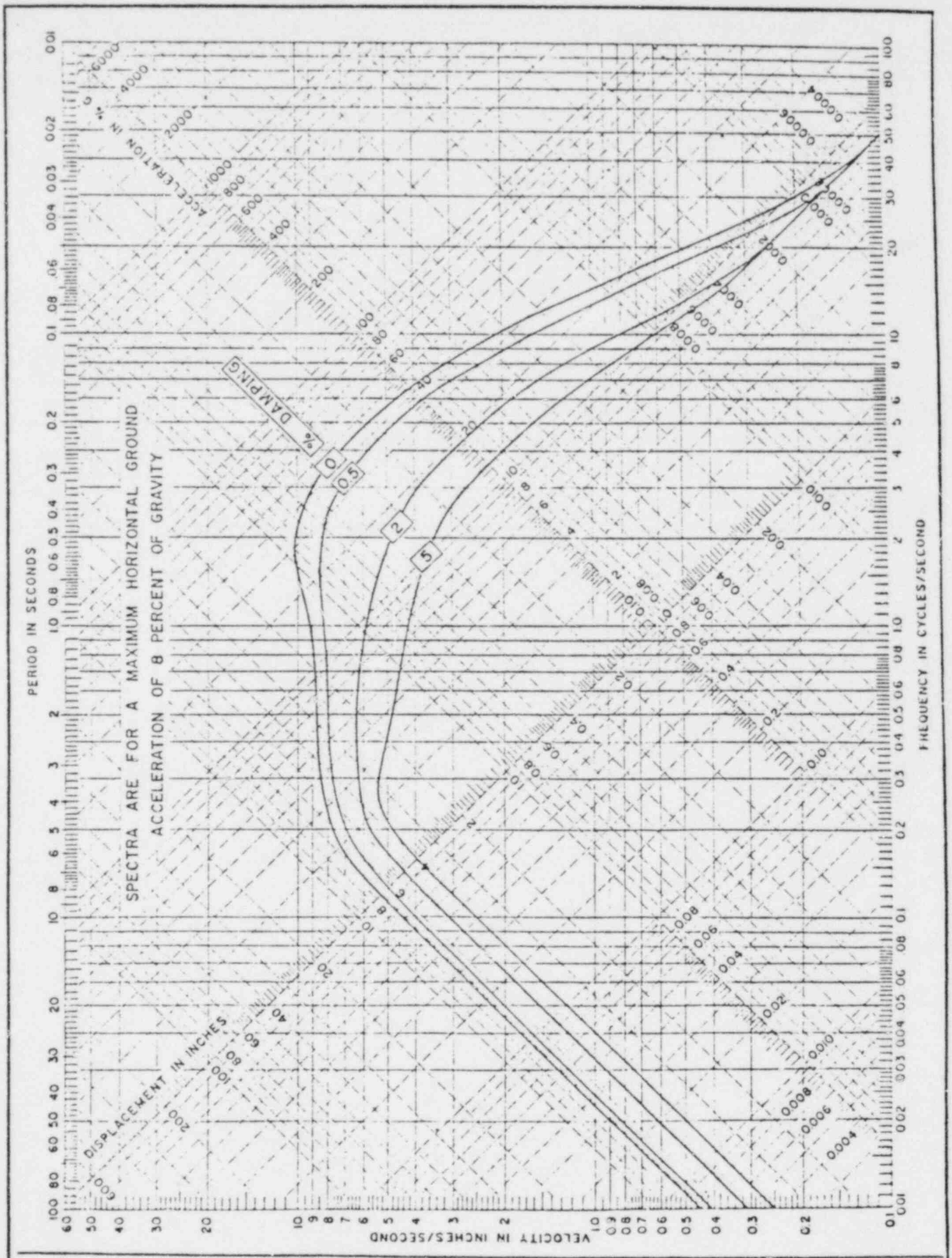
| ITEM NO. | ITEM AND IDENTIFICATION | MANUFACTURER RATINGS | SERVICE ENVIRONMENT CONDITIONS | NON-METALLIC MATERIALS | AGING MECHANISMS THRESHOLD LEVEL FOR RADIATION DAMAGE (PADS) | RADIATION (PADS) | TIME/ TEMP. | ELECTRO/ MECHAN. CYCLING | QUALIFIED LIFE (YEARS) |
|---|---|---|---|---|---|---|---|---|---|
| 1.0 | Penetration Sub-Assemblies (All Types) | | | | | | | N/A | |
| 1.1 | Primary Seal For Conductors | MIL-W-168780 260°C | 66°C R.H. 20%-100% | TFE Teflon | $8.7 \times 10^3$ | $2.0 \times 10^7$ | 100 Hrs. @ 133°C | | 40 @ 74°C |
| 1.2 | Conductor Insulation | MIL-W-168780 260°C | 66°C R.H. 20%-100% | FEP Teflon | $8.7 \times 10^3$ | $2.0 \times 10^7$ | 100 Hrs. @ 127°C | | 40 @ 74°C |
| 1.3 | Coating for Lead Wires and Exposed Seals | 205°C | 66°C R.H. 20%-100% | RTV Dow Corning #3145 | $1.0 \times 10^6$ | $2.0 \times 10^7$ | 468 Hrs. @ 190°C | | 40 @ 74°C |
| 1.4 | Heat Shrink Tubing (Splice) | 90°C | 66°C R.H. 20%-100% | Polyolefin | $5.0 \times 10^8$ | $2.0 \times 10^7$ | 100 Hrs. @ 150°C | | 40 @ 74°C |
| 1.5 | Insulation Tape (Splice) | 260°C | 66°C R.H. 20%-100% | Silicone Rubber | $1.3 \times 10^6$ | $2.0 \times 10^7$ | 100 Hrs. @ 130°C | | 40 @ 74°C |
| 1.6 | Covering for Insulation Tape (Splice) | 205°C | 66°C R.H. 20%-100% | RTV | $1.0 \times 10^6$ | $2.0 \times 10^7$ | 468 Hrs. @ 190°C | | 40 @ 74°C |
| 1.7 | Jacket Over Conductor Insulation (Splice) | 90°C | 66°C R.H. 20%-100% | Neoprene | $1.0 \times 10^6$ | $2.0 \times 10^7$ | 355 Hrs. @ 160°C | | 40 @ 74°C |




OMAHA PUBLIC POWER DISTRICT FORT CALHOUN STATION - UNIT NO. 1

## RESPONSE SPECTRA
## MAXIMUM HYPOTHETICAL EARTHQUAKE

FIG. F-2

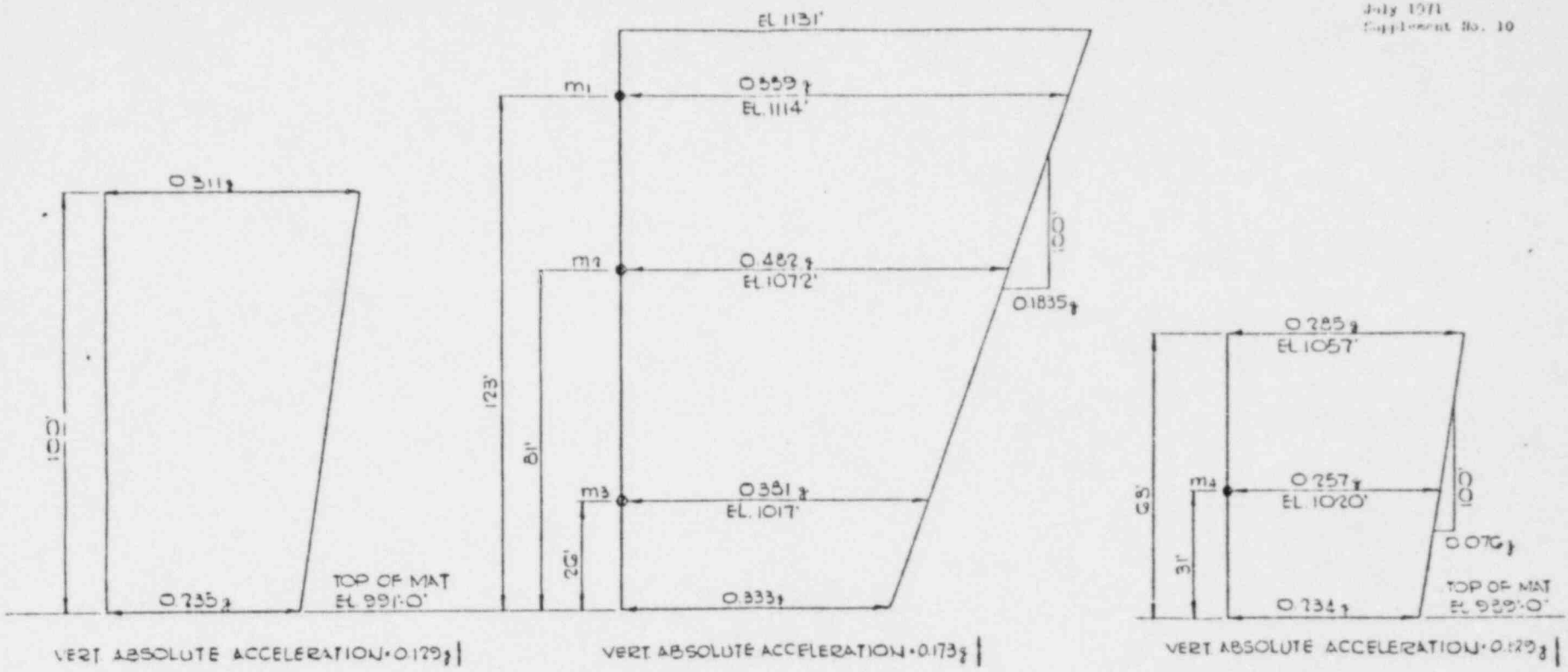



OMAHA PUBLIC POWER DISTRICT FORT CALHOUN STATION - UNIT NO.1

**RESPONSE SPECTRA**
**DESIGN EARTHQUAKE**

FIG. F-1

July 1971
Supplement No. 10




INTERNAL STRUCTURE WITHIN CONTAINMENT & MAT

CONTAINMENT SHELL

AUXILIARY BUILDING & MAT

HORIZONTAL & VERTICAL ABSOLUTE ACCELERATIONS INDUCED BY MAXIMUM HYPOTHETICAL EARTHQUAKE GROUND ACCELERATION OF 17% g HORIZONTAL & 11.33% g VERTICAL.
DAMPING FACTOR ASSUMED · 5% FOR INTERNAL STRUCTURE WITHIN CONTAINMENT.
2% FOR CONTAINMENT SHELL
5% FOR AUXILIARY BUILDING & MAT

NOTE:
FOR HORIZONTAL & VERTICAL ABSOLUTE ACCELERATIONS INDUCED BY DESIGN EARTHQUAKE SEE DWG NO. XB-545-S-38

HORIZONTAL ABSOLUTE ACCELERATIONS AT LEVELS OTHER THAN THOSE SHOWN MAY BE DETERMINED BY DIRECT PROPORTIONING.

| NO | REVISIONS | DATE | BY |
|---|---|---|---|
| | | | |

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION UNIT No. 1

HORIZONTAL & VERTICAL ABSOLUTE ACCELERATIONS INDUCED BY MAX. HYPOTHETICAL EARTHQUAKE (DBE)

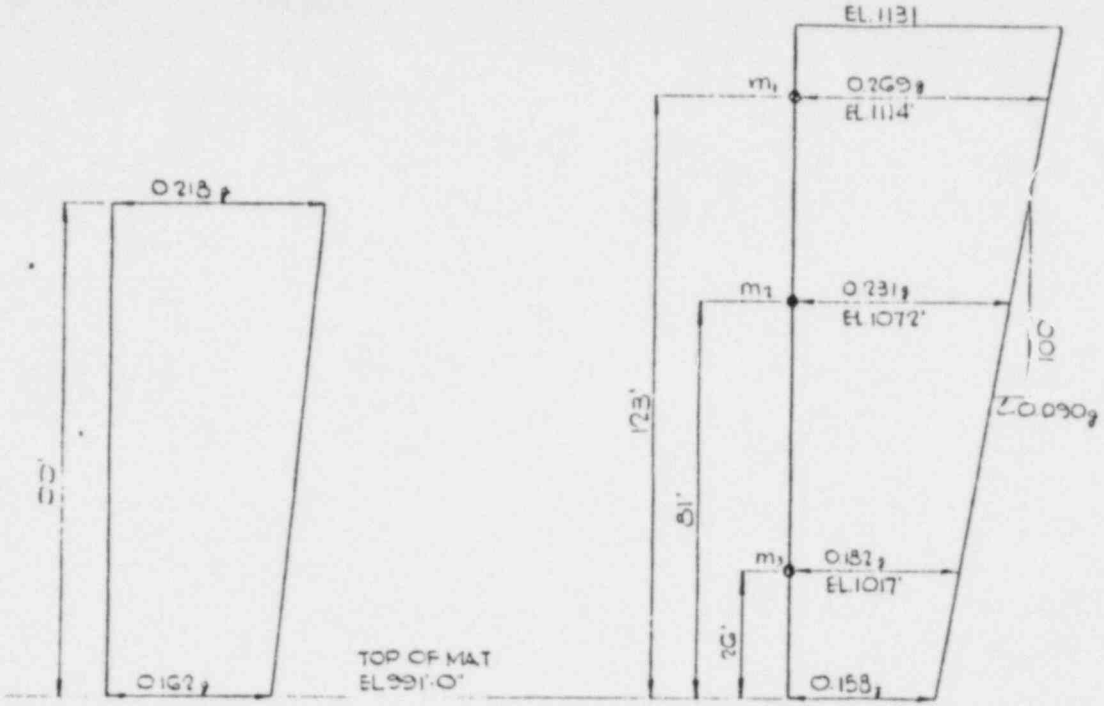
DESIGNED
DETAILED MC CHECKED
DATE 2-27-68
APPROVED

GIBBS, HILL, DURHAM & RICHARDSON, INC.
CONSULTING ENGINEERS
OMAHA, NEBRASKA

PROJECT NO 11405
DRAWING NO XB-545-S-39

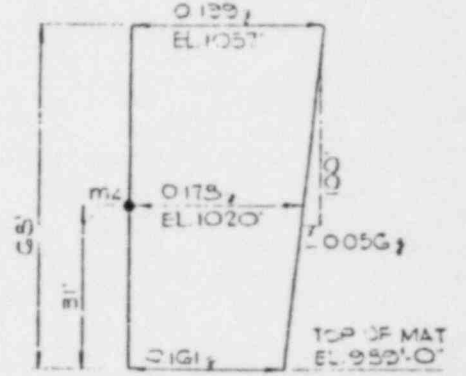
Figure F-9

July 1971
Supplement No. 10




INTERNAL STRUCTURE
WITHIN CONTAINMENT
℄ MAT

CONTAINMENT SHELL




AUXILIARY BUILDING
℄ MAT

HORIZONTAL ℄ VERTICAL ABSOLUTE ACCELERATIONS INDUCED BY DESIGN EARTHQUAKE GROUND ACCELERATION OF 8% HORIZONTAL (5.33% VERTICAL. DAMPING FACTOR ASSUMED 7% FOR ALL STRUCTURES.

NOTE:
FOR HORIZONTAL ℄ VERTICAL ABSOLUTE ACCELERATIONS INDUCED BY MAXIMUM HYPOTHETICAL EARTHQUAKE SEE DWG NO KB-545-S-39

HORIZONTAL ABSOLUTE ACCELERATIONS AT LEVELS OTHER THAN THOSE SHOWN MAY BE DETERMINED BY DIRECT PROPORTIONING

| NO | REVISIONS | DATE | BY |
|---|---|---|---|

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION UNIT NO 1

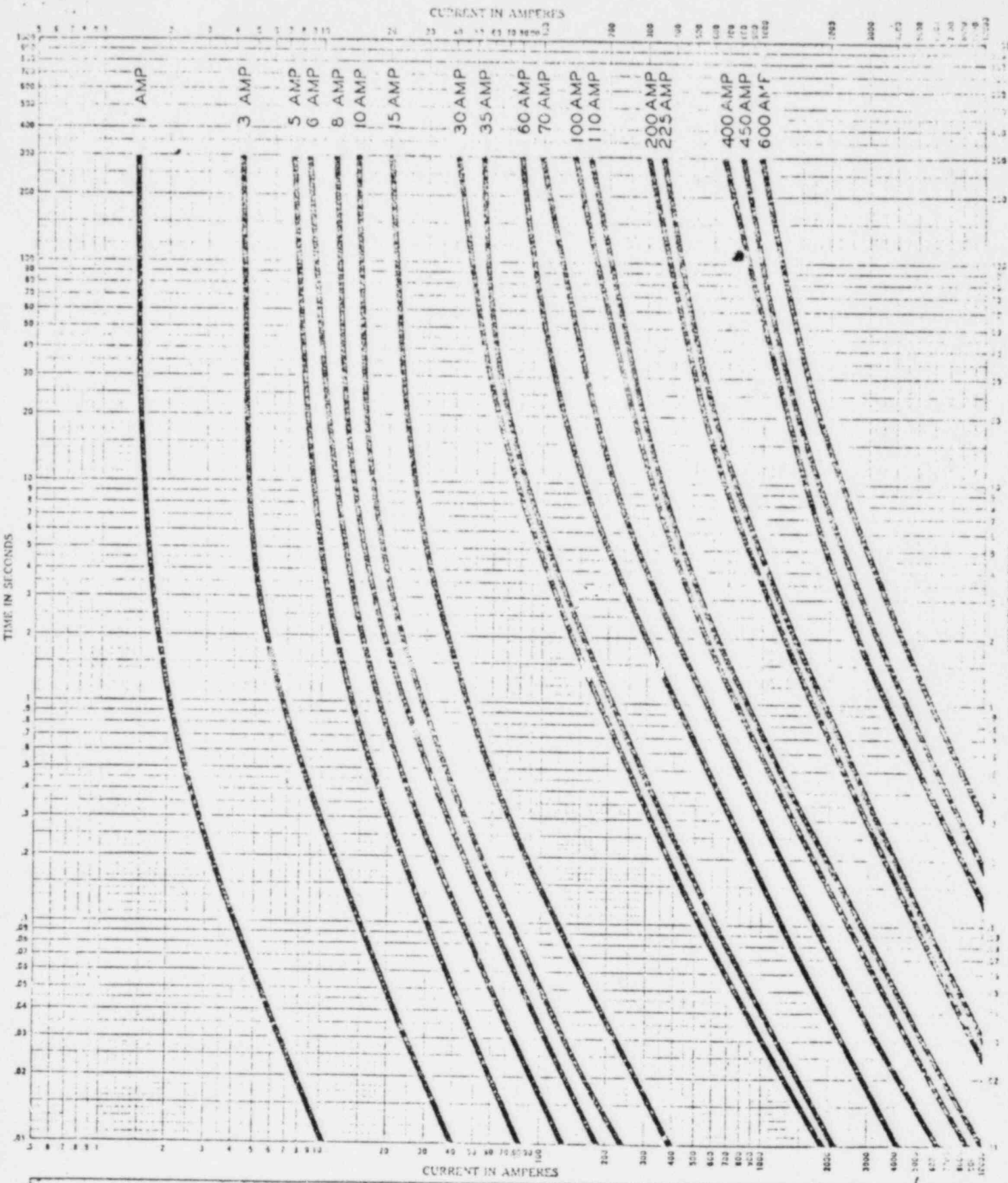
HORIZONTAL ℄ VERTICAL ABSOLUTE ACCELERATIONS INDUCED BY DESIGN EARTHQUAKE (OBE)

DESIGNED _____ CHECKED _____
DETAILED M.C. DATE 7-27-68
APPROVED _____

GIBBS, HILL, DURHAM & RICHARDSON, INC.
CONSULTING ENGINEERS OMAHA, NEBRASKA

PROJECT NO 11305
DRAWING NO KB-545-S-38

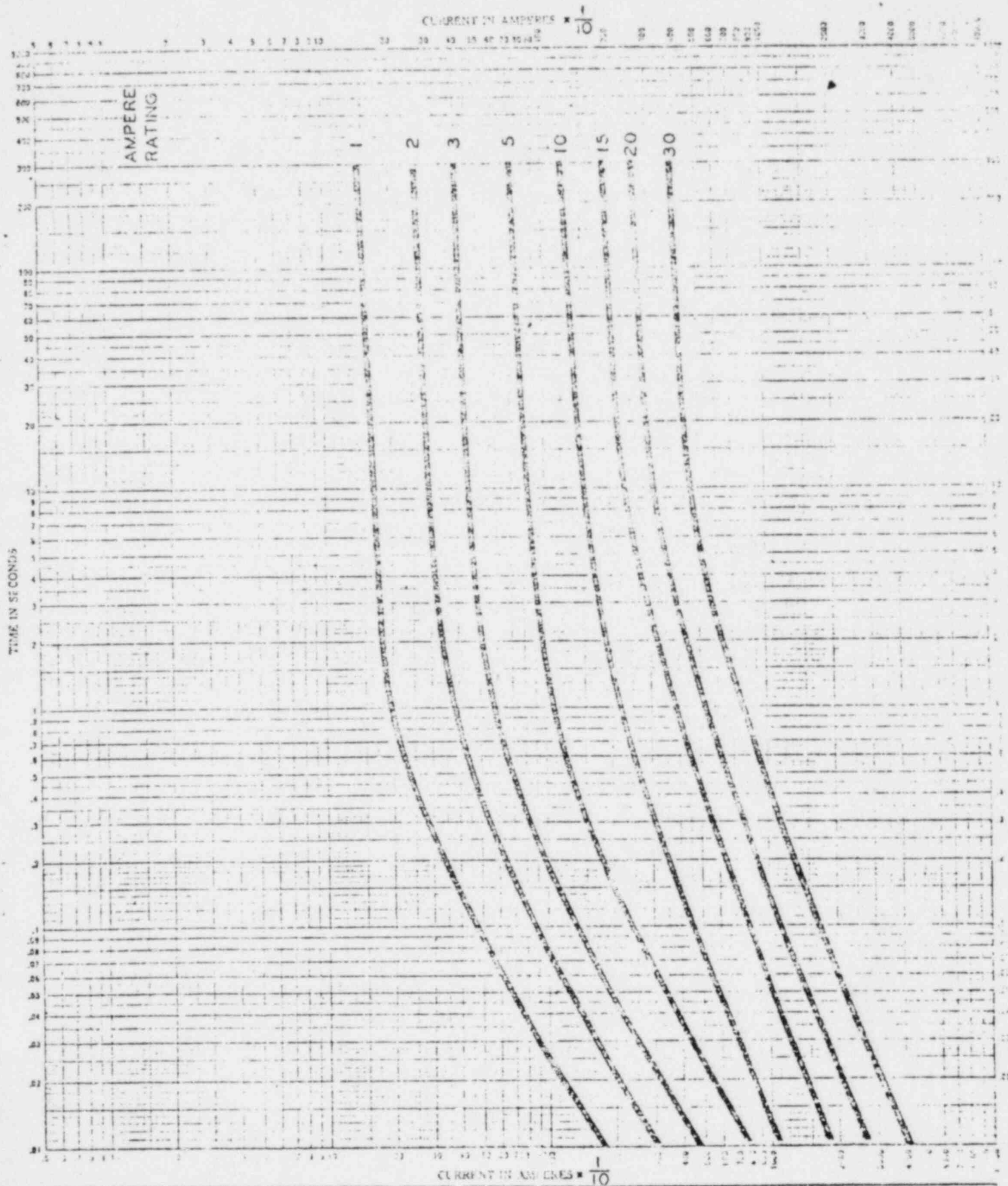
Figure F-28




TOTAL CLEARING TIME-CURRENT CHARACTERISTIC CURVES
for
BUSS ONE-TIME FUSES
Type NOS 600 Volt

BUSSMANN MFG. DIVISION
McGraw-Edison Co. St. Louis 7, Mo.

No. FORM 152
Date 4-27-67




AVERAGE MELTING TIME-CURRENT CHARACTERISTIC CURVES

BUSSMANN MFG. DIVISION
McGraw-Edison Co. St. Louis 7, Mo.

For MIC, MIJ & MIN INDICATING Fuse Links In

BASIS FOR DATA Standards Data

1. Tests made at Volts a.c. at p.f. Starting at 25C with no initial load
2. Curves are plotted to Test points so variations should be

No. 50640
Date 8-14-74