GPU Nuclear

GPU Nuclear Corporation
100 Interpace Parkway
Parsippany, New Jersey 07054-1
(201) 263-6500
TELEX 136-482
Writer's Direct Dial Number:

July 30, 1984

Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Crutchfield:

Subject: Oyster Creek Nuclear Generating Station (OCNGS)
Docket No. 50-219
SEP Topic No. VI-7.C.1, Appendix K - Electrical Instrumentation and Control Re-Review

During the integrated assessment of the subject SEP topic, the NRC staff recommended that five (5) automatic bus transfers (ABTs) and two auto-contact transfers (ACTs) in the vital AC distribution system be removed or the circuits be otherwise modified to ensure that faulted loads will not be transferred.

By the letter dated May 28, 1982, GPU Nuclear committed to perform a coordinated load and circuit breaker analysis to assure proper protection of the circuits to and from the existing ABT/ACTs. Accordingly, GPU Nuclear transmitted a report on September 1, 1983 summarizing our study of the protective devices. The study evaluated the adequacy of the protective devices and their coordination for a fault downstream of the ABT/ACTs.

Our subsequent review of the coordination plot for the fault current indicated that the fault cases F2 and F7 described in the report could affect the redundant vital bus systems. In order to maintain the integrity of the power supply to the vital buses, the trip units of the feeder breakers for vital buses VMCC-1A2 and 1B2 will be replaced from the existing Long Time Delay-Instantaneous type to a Long Time Delay-Short Time Delay type manufactured by General Electric.

A035
1/1

The revised re..rt (attached) includes the new coordination plots for faults F1 through F7 which were generated on the basis of the proposed trip units for the feeder breakers for buses VMCC-1A2 and 1B2. These trip units will be installed by the end of the next refueling outage (Cycle XI outage).

Very truly yours,

P. B. Fiedler
Vice President and Director
Oyster Creek

lr/0329e

cc: Administrator
Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, Pa. 19406

NRC Resident Inspector
Oyster Creek Nuclear Generating Station
Forked River, N. J. 08731

SEP Topic No. VI-7.C.1, Appendix K-Electrical
Instrumentation and Control Re-Review

Oyster Creek Nuclear Generating Station
Docket No. 50-219

Table of Contents

1.0 INTRODUCTION

This study was initiated as a result of the Nuclear Regulatory Commission's (NRC) safety evaluation with respect to the Oyster Creek Nuclear Generating Station (OCNGS) SEP Topic V1-7.C.1, Appendix K - "Electrical Instrumentation and Control Re-Reviews." The evaluation issued on June 29, 1981 (Ref. 2.1 and 2.2) contends that because of the presence of automatic bus transfer (ABT/ACT) switches in the vital AC distribution system, OCNGS does not comply with General Design Criterion 17 (GDC-17) or with the acceptable basis for it's implementation. Regulatory Guide 1.6 and IEEE 308-1974.

The study evaluates the adequacy of protective devices for each transfer circuit and the coordination of the protective devices on the load and feeder side of a ABT/ACT, for a fault downstream of the ABT/ACT. The results of the study are evaluated to find the impact of the transfer of a fault downstream of ABT/ACT, on the reliability of the power supply to redundant vital AC busses VMCC-1A2 and 1B2. The impact of the loss of power to the bus/panel downstream of ABT/ACT, as a result of a fault has been addressed separately under references #2.16 & 2.17.

2.0 REFERENCES

2.1 Technical Assessment (Draft) OC SEP Topic V1-7.C-1, Appendix K Electrical Instrumentation and Control Re-Reviews.

2.2 NRC Docket No. 50-219, LS05-81-06-117, Dennis M. Cruthfield's (Chief Operating Reactor Branch No. 5, Division of Licensing) letter, dated June 29, 1981 to I. R. Finfrock, Jr. (Vice President JCP&L).

2.3 GPUNC Calc. #1302-5510-095 "O.C. Vital AC System Short Circuit Calculations."

2.4 G.E. - "Industrial Power Systems Handbook," Section 0.13/pages 9 and 34.

2.5 G.E. - "Instructions-Time Overcurrent Relays" - GEH-1788F/Fig. 3.

2.6 IEEE Std. 242 - 1975 - "Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems" - Ch. 2 and 7.

2.7 G.E. - "Type AK (AK-75) Low-Voltage Power Circuit Breaker, EC-1B Series Trip Device" - GES-6005.

2.8 G.E. - "Type AK (AK-50) Low-Voltage Power Circuit Breaker, EC-1 Series Trip Device" - GES-6000A.

2.9 G.E. - "Molded-Case Circuit Breaker E-100 Line, Type TEF & THEF" - GES-6102C, and Type TED - GES-6119C.

2.10 G.E. - "Molded-Case Circuit Breaker F-225 Line," TFK - GES-6103E.

2.11 G.E. - "Molded-Case Circuit Breaker Q-Line, "TQB" - K215-63C.

2.12 Burns & Roe - "Relay and Breaker Settings" - Dwg. 2299-E-238/Sh. 1, 8, 16 and 17.

2.13 Burns & Roe - "Vital One Line Diagram" - Dwg. 2299-BR-3013/Rev. 20.

2.14 Burns & Roe - "Aux. One Line Diagram" - 2299-BR-3002/Rev. 13.

2.15 "OC - Shutdown Cooling Modifications" - BA No. 403454.

2.16 Response to I.E. Bulletin No 79-27, dated April 25, 1980 - letter from Shepard S. Bartnoff, President, JCP&L to Director, Division of Reactor Operations inspection, Washington, D.C. 20555.

2.17 I.E. Bulletin 79-27 Modifications, B/A #402033

3.0 METHODS

3.1 Calculation

3.1.1 Short circuit (SC) calculations were performed to establish the values of SC currents at various locations on the vital AC distribution system (Attachment No. 8 and 9). The methods outlined in Chapter 2 of Ref. 2.6 were used to perform the calculations. Two cases of fault currents were considered. Offsite power was used as the fault contributing source in Case I, and the Standby Emergency Diesel Generator (D-G) was used as the source for Case II.A conservative approach was used for worst case analysis yielding higher SC values. The effects of feeder circuit cable, bus, breaker and switch impedances in restricting the fault currents have been neglected in the calculations, thus yielding much higher values of fault currents than would actually occur.

3.1.2 The feeder breakers for the buses VMCC-1A2 and 1B2 are air circuit breakers type AK-2A-50M by GE. During the discussions of this study, wherever referred to, the GE type AK-2A-50M breakers shall be implied as the feeder breakers for the buses VMCC-1A2 and 1B2. The present trip units on these breakers are type EC-1 with 1B-3 long time delay (LTD) and instantaneous characteristics. Isolation valves MCC-1AB2 has GE molded case circuit breakers for the valve motors combination starters. These breakers are GE type TED and TEF. There are only two type TEF breakers for valves V-17-19 and V-17-54 which have magnetic only trip units. These breakers are also being replaced with 30A type TED breakers because of larger size valve replacement (Ref. #2-15). Rest of the breakers type TED and TEF are all thermo-magnetic type, with a non-adjustable long delay and instantaneous trip characteristics. For a conservative approach only the highest rated breaker in the distribution circuit power train was considered for the coordination review.

3.1.3 Time-Current (T-C) curve plots were made based upon the methods of Chapter 7 of Ref. 2.6 for the circuit protective, devices for the power train of each "fault" circuit considered. The plots were developed from individual device characteristic curves (References 2.5 and 2.7 through 2.11) according to their settings and/or ratings. Two sets of plots are shown for each power train. Attachment Nos. 1 thru 7 show the coordination of circuit devices with their existing trip units. Attachment Nos. 1A thru 7A show the plots of the devices with the recommended trip units on the vital MCC-1A2 and 1B2 bus feeder breakers GE type AK-2A-50M. This trip unit is type EC-1, with 1A-2C, long-time delay (LTD) and short time delay (STD) characteristics. Also attachment #2A shows the change of circuit breaker type TEF-20 to type TED-30 on the Isolation Valves MCC-1AB2 load feeder. These coordination plots are as listed under the Appendices and are labeled after their transfer switch, e.g. TCC-IT3, TCC-IT4, etc. The calculated values of the SC currents are shown on these plots as dotted lines. Each coordination plot then was analyzed to check the coordination of circuit protective devices upstream and downstream of the ABT and against the maximum available SC current downstream of the ABT.

3.1.4 Attachment #9 lists the SC currents at various locations on the vital AC distribution system for Case I and Case II. Also listed are the protective devices upstream of each fault and their interrupting rating for a ready comparison of the device interrupting capacity verses the fault current it may have to interrupt. These interrupting values have been taken from Ref. 2.4.

3.1.5 Attachment No. 8 shows the basic one line diagram of the vital AC distribution system. Points of incidence of various faults are indicated for Case I and Case II of faults here and under Attachment #9.

4.0 RESULTS

4.1 Interrupting Ratings

Results of the short circuit calculations (Ref. #2-3) for the faults "F1" thru "F7" for Case #1 and Case #2 of the fault and the interrupting rating of the respective protective device are shown in the tabulation of attachment #3.

4.2 Coordination Plots

The T-C coordination curves for each case of fault and the SC currents were reviewed in order to analyze the coordination of the circuit protective devices upstream and downstream of the ABT and against the maximum available SC current downstream of the ABT.

4.2.1 A review of the coordination plots, Nos. TCC-1A2, TCC-PSI TCC-IT4, TCC-VACP1 and TCC-1T3 indicates that the circuit protective devices in the power train of each fault circuit for the faults "F1", "F3", "F4", "F5" and "F6" are coordinated for their respective SC fault current, to the following extent:

4.2.1.1 The fault "F1" will be cleared by the immediate upstream circuit breaker AK-2A-50M, Ref. Attachment #1/1A such that the integrity of the redundant power supply to the MCC bus 1A2/1B2 is not affected.

4.2.1.2 The faults "F3", "F4", "F5" and "F6" will be cleared either by their immediate upstream circuit breakers (TQB-30, TQB-70, TQB-30 and TQB-40, respectively) and/or by their back-up circuit breakers (THEF-100, THEF-70 and THEF-70, and THEF-30 on bus 1A2/1B2, respectively - Ref. Attachment Nos. 3/3A, 4/4A, 5/5A and 6/6A) such that the redundant power- supplies to the rest of the loads of VMCC buses 1A2 or 1B2 remain unaffected.

4.2.2 Ref. attachment #2 and #7, the fault "F2" will be cleared by the immediate circuit breaker TEF-20 (MCC-1AB2) and/or by circuit breaker THEF-100 (VMCC-1A2/B2) and/or by circuit breaker AK-2A-50M-(US-1A2/1B2). Similarly fault "F7" will be cleared by the immediate upstream circuit breaker TEF-70 (Pnl.VLDP-1) and/or by circuit breaker TFK-225(VMCC-1A2/B2) and/or by circuit breaker AK-2A-50M (US-1A2/B2). This could result in the loss of power to both the redundant vital AC buses VMCC-1A2 and 1B2.

Ref. attachment Nos. 2A and 7A show the same coordination plots as in attachment Nos. 2 and 7, but with type EC-1, 1A-2C, trip unit on breaker AK-2A-50M. This trip unit has a LTD-STD characteristics. A review of these plots shows that with the new recommended trip unit and its shown settings, the faults F2 and F7 will be cleared either by their immediate circuit breaker (TED-30/TEF-70) and/or by their back-up circuit breaker (THEF-100/TFK-225). Thus, the integrity of the redundant power to the vital bus VMCC-1A2/1B2 remains unaffected.

4.2.3. Considering a single failure of the breaker immediately upstream of the fault, the faults F2 thru F7 will result in the loss of power to their respective bus/panel.

5.0 <u>CONCLUSIONS</u>

5.1 All the circuit feeder breakers immediately upstream of their respective fault have a higher interrupting rating than the available maximum short circuit fault current.

5.2 After the change of the trip units on breakers AK-2A-50M (recommendation 6.1) each fault on a circuit from the ABT is cleared by a circuit protective device immediately upstream of the fault and/or one above it in the same fault circuit train.

5.3 The vital AC system protective devices upstream of the ABT are well coordinated, such that for the level of SC current available, each fault will be cleared by the protective device "off" bus VMCC-1A2/1B2 and immediately above the ABT, thus maintaining the integrity of the redundant power supply to the rest of the loads "off" bus VMCC-1A2/1B2.

5.4 A review of the attachments #2A thru 7A indicates that considering a single failure, faults F2 thru F7, will result in the loss of power to the rest of their bus/panel loads. Tabulation of attachment #10 shows the panels and buses effected by each fault

The impact of the loss of the redundant power to the buses and instrument panels referred to in sec. 5.4 on the safety of the plant operation and its safe shutdown capability has been separately analyzed under references #2.16 & 2.17.

6.0 RECOMMENDATIONS

As demonstrated by the plots of attachment Nos 2 through 7, the cases of faults "F2" and "F7" will result in the loss of power to both the redundant buses VMCC-1A2 and 1B2. In order to maintain the integrity of the redundant vital AC bus VMCC-1A2/1B2, it is recommended that the present trip unit (EC-1, 1B-3) on the bus feeder breakers AK-2A-50M should be changed to type EC-1, with 1A-2C, LTD AND STD settings as shown in the attachment #1A thru 7A.

7.0 APPENDICES

7.1 Attachment #1 - Coordination Plot Fault F1, with Existing Trip Units

7.2 Attachment #2 - Coordination Plot Fault F2, with Existing Trip Units

7.3 Attachment #3 - Coordination Plot Fault F3, with Existing Trip Units

7.4 Attachment #4 - Coordination Plot Fault F4, with Existing Trip Units

7.5 Attachment #5 - Coordination Plot Fault F5, with Existing Trip Units

7.6 Attachment #6 - Coordination Plot Fault F6, with Existing Trip Units

7.7 Attachment #7 - Coordination Plot Fault F7, with Existing Trip Units

7.8 Attachment #8 - Vital AC System One-Line Diagram (Fig. 1 of Calc. No. 1302-5510-095)

7.9 Attachment #9 - Fault Currents and Breaker Ratings (Tab. No. 1 of Calc. No. 1302-5510-095)

7.10 Attachment #10 - Loads affected by Faults F1 thru F7.

7.11 Attachment #1A - Coordination Plot Fault F1, with Recommended Trip Units

7.12 Attachment #2A - Coordination Plot Fault F2, with Recommended Trip Units

7.13 Attachment #3A - Coordination Plot Fault F3, with Recommended Trip Units

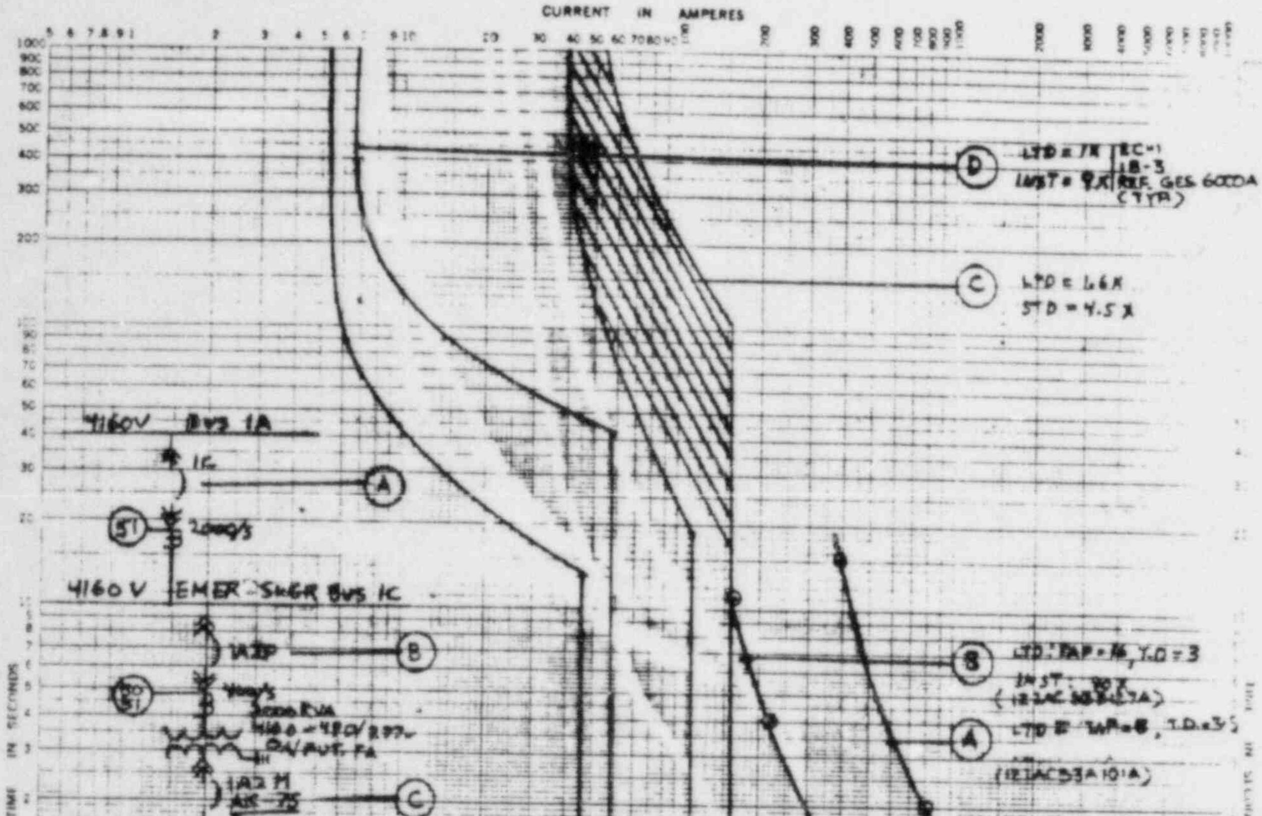
7.14 Attachment #4A - Coordination Plot Fault F4, with Recommended Trip Units

7.15 Attachment #5A - Coordination Plot Fault F5, with Recommended Trip Units

7.16 Attachment #6A - Coordination Plot Fault F6, with Recommended Trip Units

7.17 Attachment #7A - Coordination Plot Fault F7, with Recommended Trip Units

ATTACHMENT NO. 1 TDR. No. 429/REV 0



FAULT 'F1'

...DC - VITAL AC DISTR. SYSTEM

TIME-CURRENT CHARACTERISTIC CURVES

Fuse Links...... In......

BASIS FOR DATA Standards

Dated......

1 Tests made at ...... Volts a/c at ...... p.f., starting at 25C with no initial load

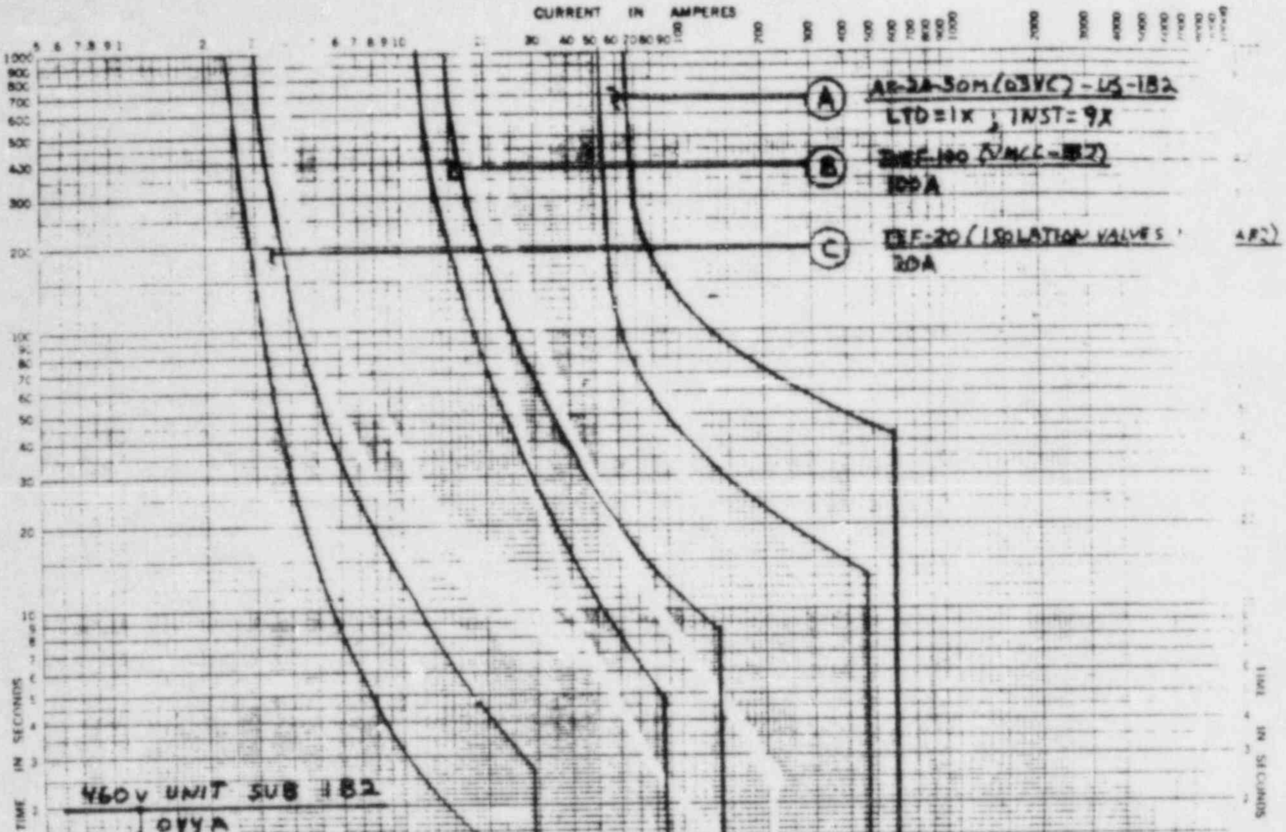
2 Curves are plotted to ...... Test points so variations should be......

No. TCC-1A2

Date 2/-/83/REV 0

TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO.

ATTACHMENT NO. 2 - TDR No. 429/REV - 1



FAULT F2

TIME-CURRENT CHARACTERISTIC CURVES @ 480VAC

For O.C-VITAL A.C DISTR. SYSTEM Fuse Links In

BASIS FOR DATA Standards Dated

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

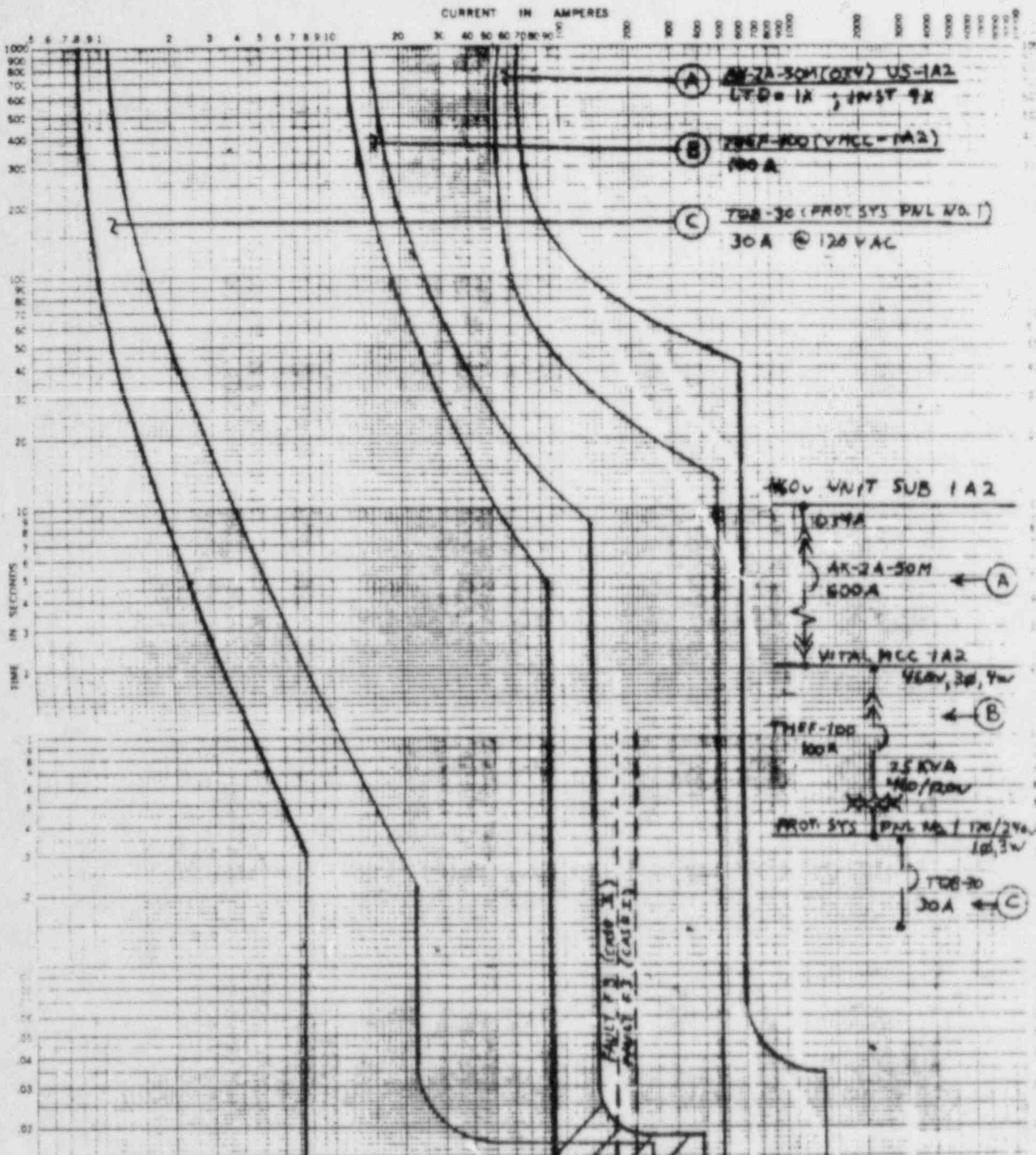
No. TCC-PS1

Date 7/13/83 REV. 1 -

K-E TIME-CURRENT CHARACTERISTIC 48 5258 KEUFFEL & ESSER CO.

REV 1 | CHANGED FAULT DESIG. IN THE PLOT 'F1' TO 'F2'

ATTACHMENT NO. 3 – TDR No. 429 / REV 0



FAULT F3 TIME-CURRENT CHARACTERISTIC CURVES @ 480 VAC

for O.C - VITAL AC DISTR. SYSTEM   Fuse Links   in

BASIS FOR DATA Standards   Dated

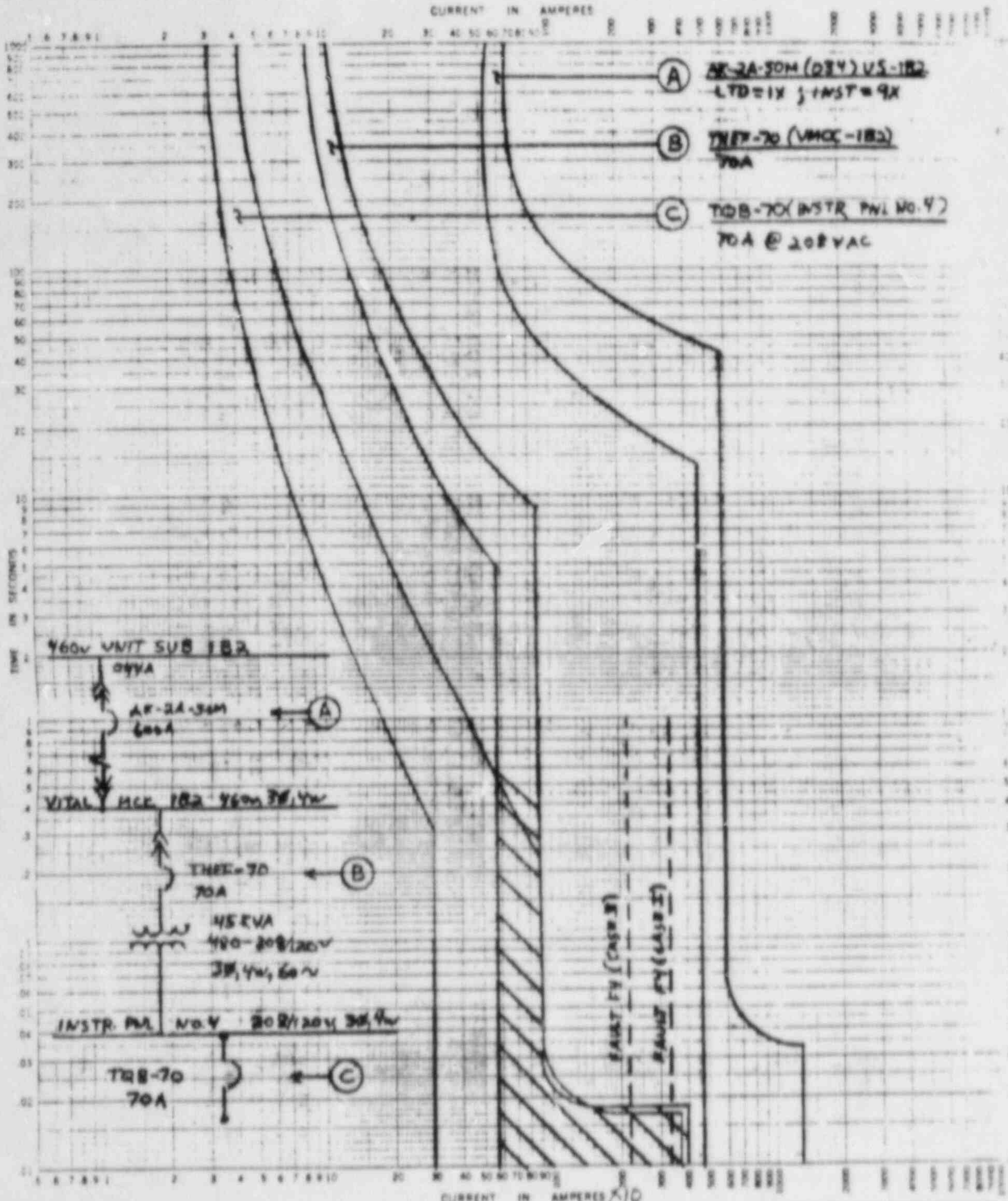
1 Tests made at   Volts a-c at   p.f., starting at 25C with no initial load

2 Curves are plotted to   Test points so variations should be

No. TCC - PS1

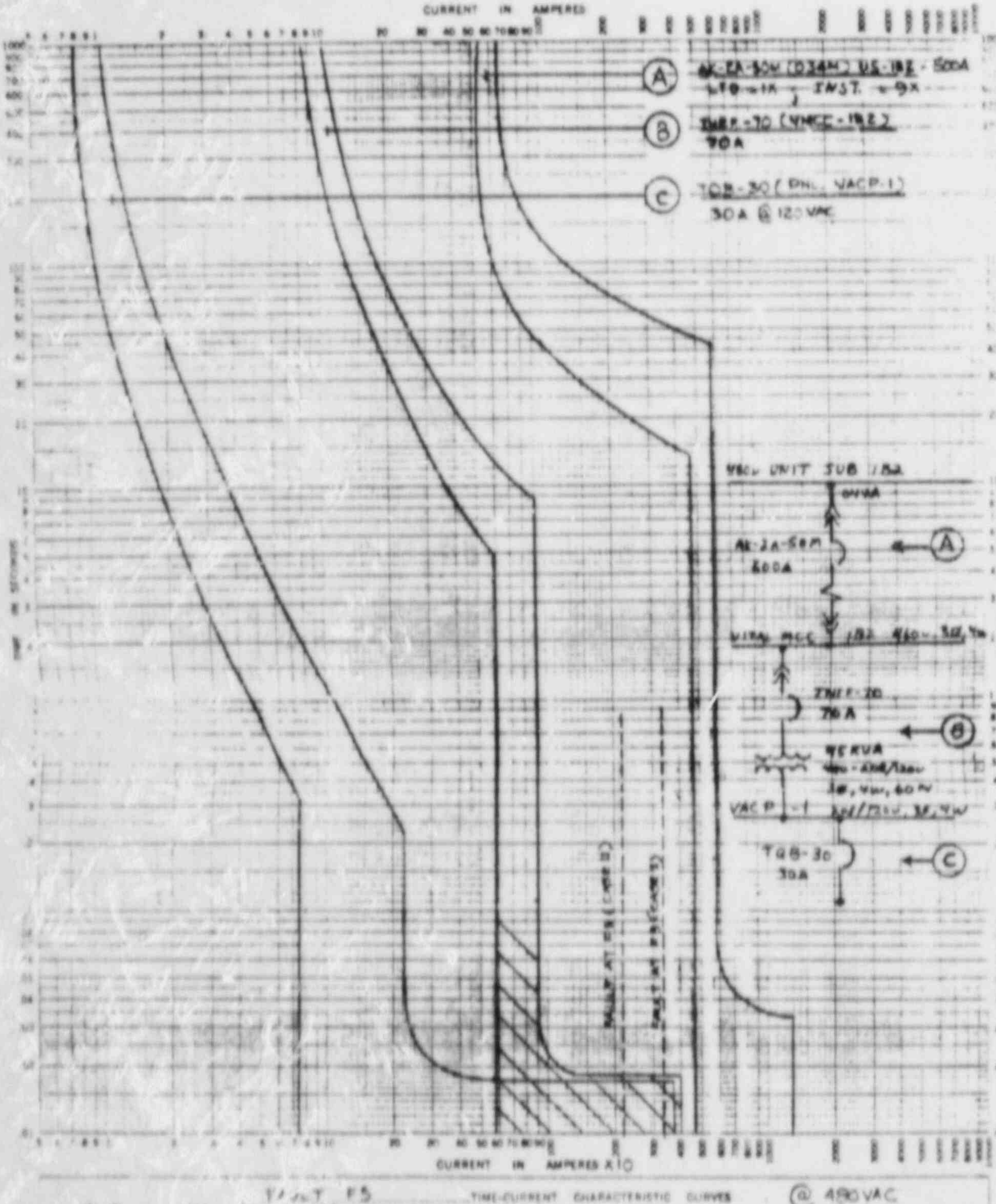
Date 2/21/83

ATTACHMENT NO. 4 – TDR No. 429/Rev-0



FAULT F4 TIME-CURRENT CHARACTERISTIC CURVES @ 480VAC	
For O.C. – VITAL AC DISTR. SYSTEM Fuse Links In	
BASIS FOR DATA Standards ___ Dated ___	No. TCC-114
1. Tests made at ___ Volts a.c. at ___ p.f., starting at 25C with no initial load	Date 3/22/83
2. Curves are plotted to ___ Test points so variations should be ___	

ATTACHMENT NO. 5, TDR NO. 429 Rev. 0



FAULT F5 TIME-CURRENT CHARACTERISTIC CURVES @ 480VAC

O-G. – VITAL AC DISTR. SYSTEM Fuse Links in

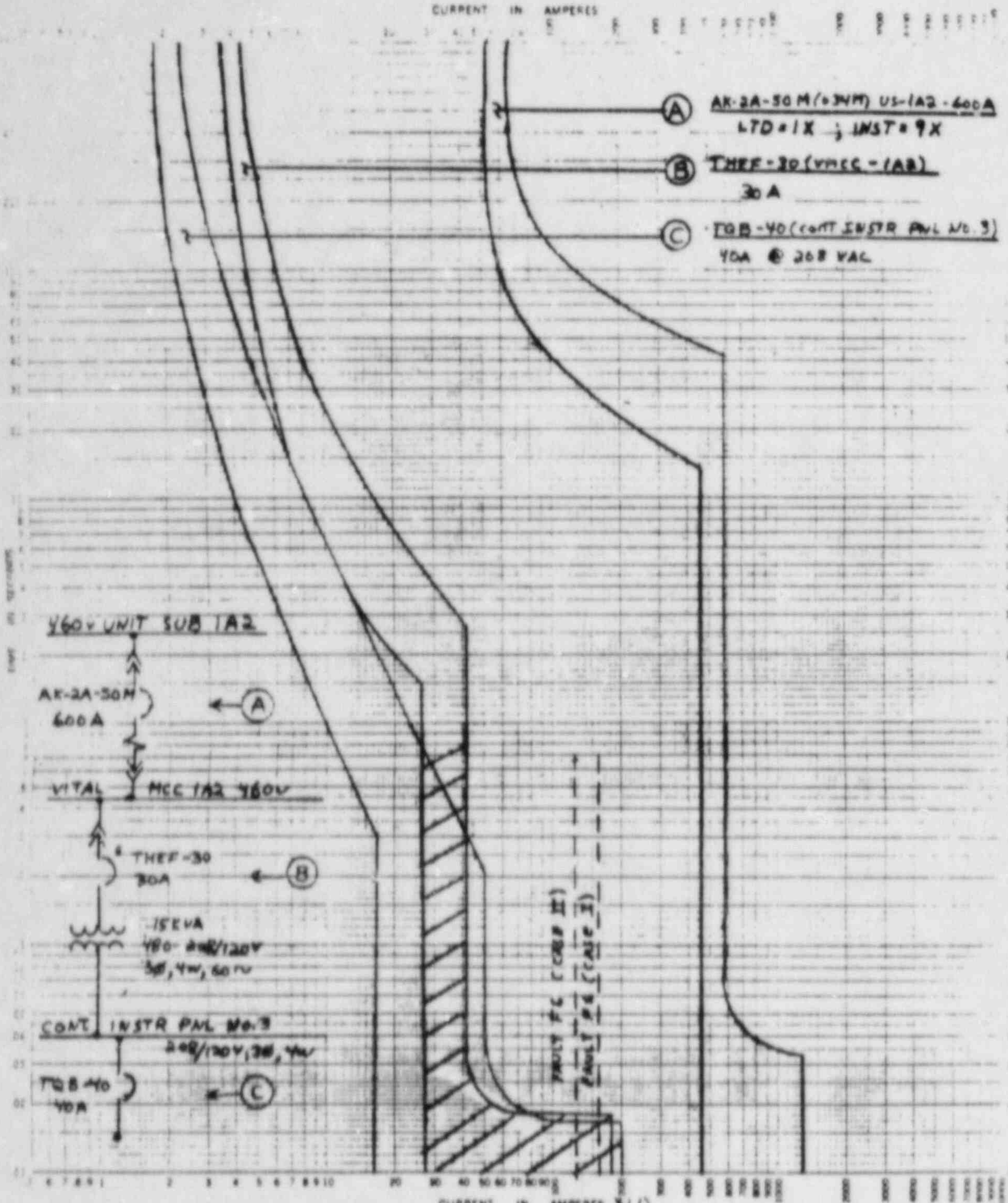
BASIS FOR DATA Standards Dates

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

No. TCC-VACP1

Date 8/22/83

ATTACHMENT No. 6 - TDR No. 929/REV 0



FAULT F6 TIME-CURRENT CHARACTERISTIC CURVES @ 480 VAC

For OC - VITAL AC DISTR. SYSTEM Fuse Links In

BASIS FOR DATA Standards Dated

1 Tests made at Volts a/c at p.f., starting at 25C with no initial load

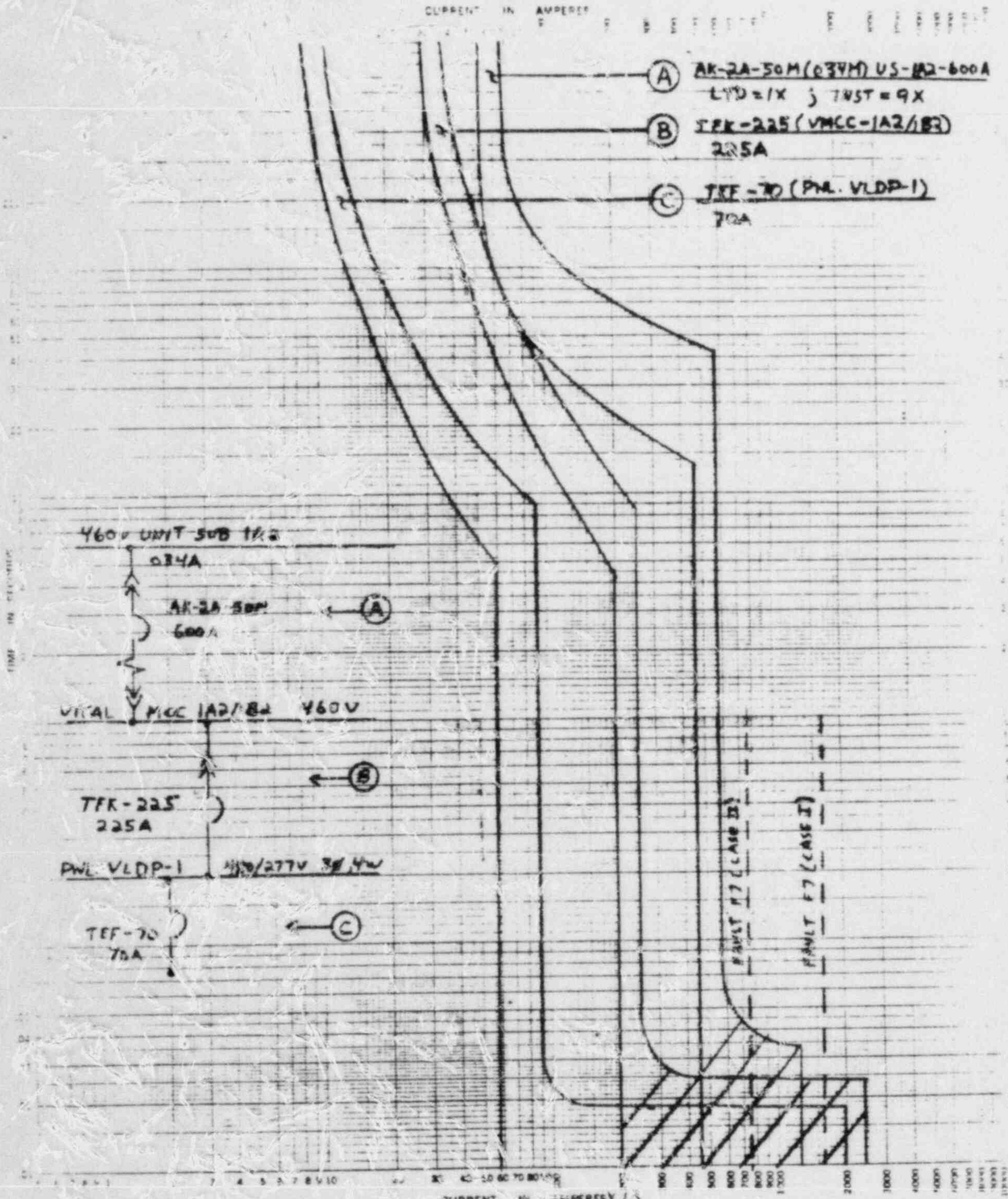
2 Curves are plotted to Test points so variations should be

No. TCC-1T3

Date 3/ /83

K+E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO.

ATTACHMENT NO. 7 - TDR. NO 429/REV 0



FAULT F7 TIME-CURRENT CHARACTERISTIC CURVES @ 480VAC

For ...C VITAL AC DISTR. SYSTEM Fuse Links. In

BASIS FOR DATA Standards ________ Dated ________

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. TCC-VLDP1

Date 2/-/83

K+E TIME CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO.

ATTACHMENT No. 8 (TDR No. 429/Rev. 0)

GPU Nuclear

CALC. NO. 1302-5510-095

SHEET NO. 7 OF 8

DATE 12/82

COMP. BY/DATE H. Shora / 4-11-83

CHK'D. BY/DATE G. R. Granville 5-10-83

SUBJECT OC - Vital AC System Short Circuit Calculations

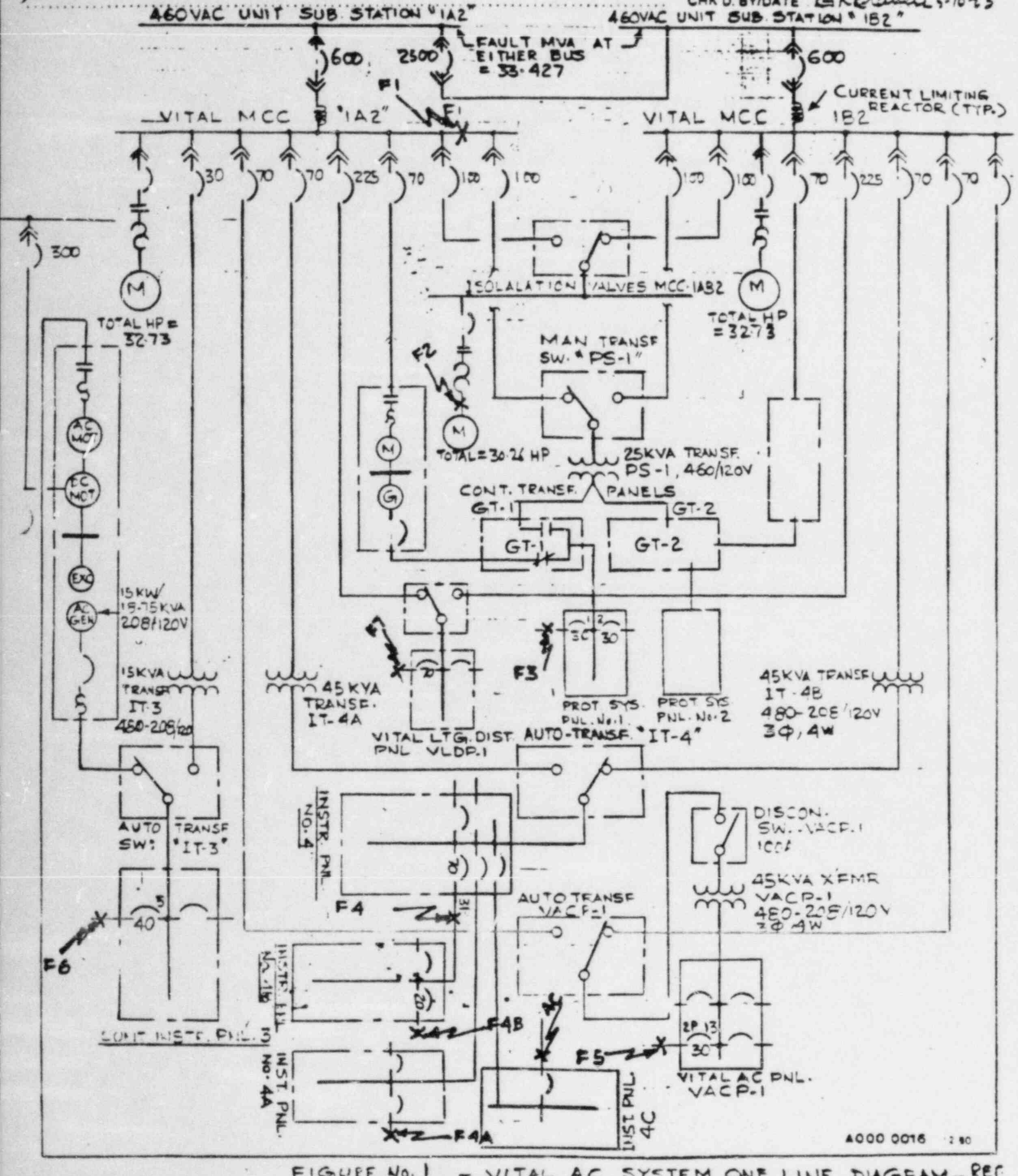


FIGURE No. 1 - VITAL AC SYSTEM ONE LINE DIAGRAM - REF

A000 0016 2/80

ATTACHMENT NO. 9 TDR No. 429 /Rev. 0

Nuclear

CALC. NO. 1302-5510-095
SHEET NO. 8 OF 8
DATE 4-18-83
COMP. BY/DATE [illegible] / 4-18-83
CHK'D. BY/DATE [illegible] 5-0-83

O.C. - VITAL AC DISTR. SYSTEM
SHORT CIRCUIT CALCULATIONS

TABLE No. 1

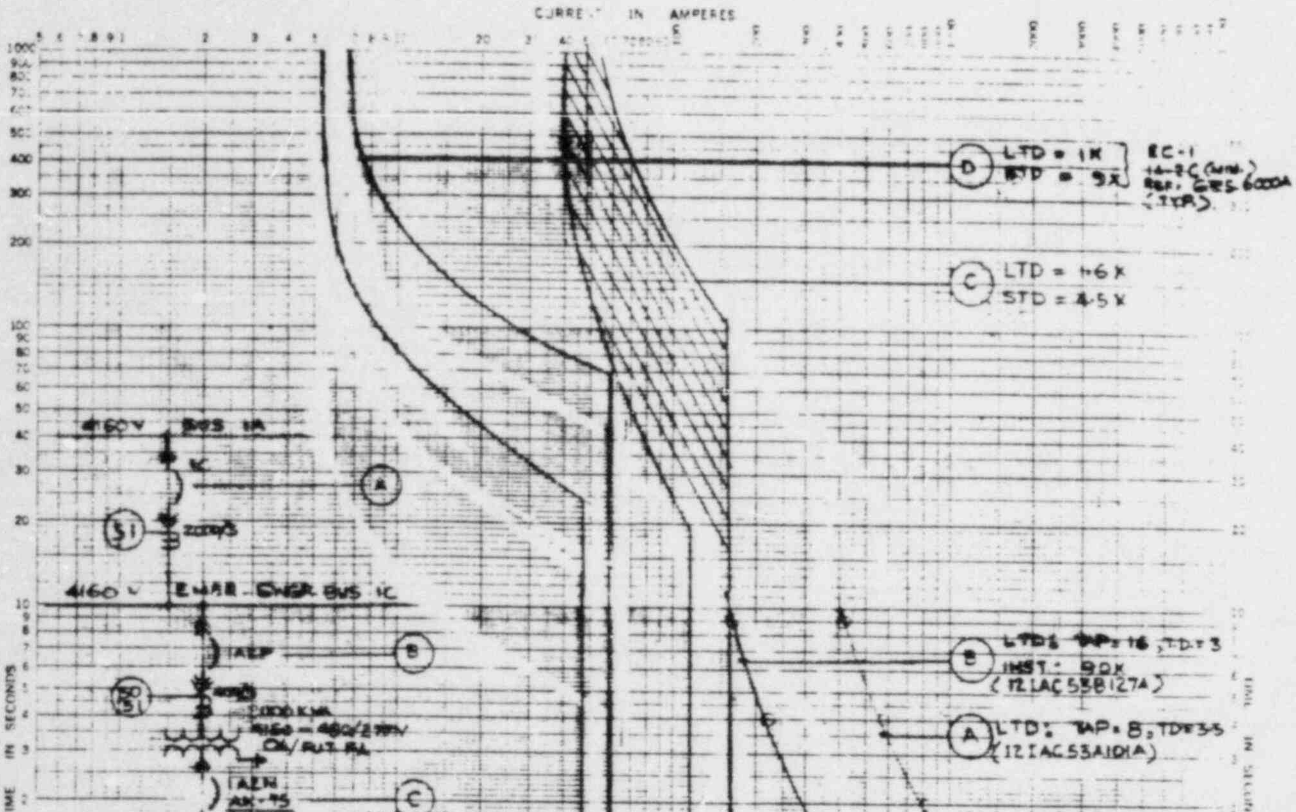
FAULT LOCATION	FAULT CURRENT (AMPS) CASE I (OFFSITE POWER)	CASE II D-G	FDR BKR.-UPSTREAM of FAULT GE BKR. TYPE	INTER. RATING SYM. AMPS	REFERANCE
F1	16,520 A	7613 A	AK-2A-50M 600A	50,000A @ 480VAC	Ref. #2.4 TDR 429
F2	16,520 A	7613 A	TEF 100A	18000A @ 480VAC	"
F3	2,329A	1680 A	TQB 30A	7500A @ 208VAC	"
F4	3,323A	2139 A	TQB 70A	↓	"
F5	3,323A	2139 A	TQB 30A	↓	"
F6	1,608A	1269 A	TQB 40A	↓	"
F7	16,520A	7613 A	TEF 20A	18,000 A @ 480VAC	"

A000 0016 12-80

ATTACHMENT NO. 10

FAULT (CASE I & II)	REF. ATTACH NO.	BREAKER (S) TRIPPED	LOSS OF POWER TO THE BUS/PNL.
F1	1A	AK-2A-50M	VMCC-1A2/1B2
F2	2A	TED-30, THEF-100	ISO. VALVES MCC-1AB2
F3	3A	TQB-30 THEF-100	PNL. PS-1
F4	4A	TQB-70 THEF-70	PNL. IS4 PNL. IS4A PNL. IS4B PNL. IS4C
F5	5A	TQB-30 THEF-70	PNL. VACF-1
F6	6A	TQB-40 THEF-30	CONT. INST. PNL. #3
F7	7A	TEF-70 TFK-225	PNL. VLDP.1

ATTACHMENT NO. 1A TCC. No. 429/Rev 1



FAULT F1

For O.C. - VITAL AC DISTR. SYSTEM TIME-CURRENT CHARACTERISTIC CURVES

Fuse Links. In

BASIS FOR DATA Standards ______ Dated ______

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. TCC-1A2

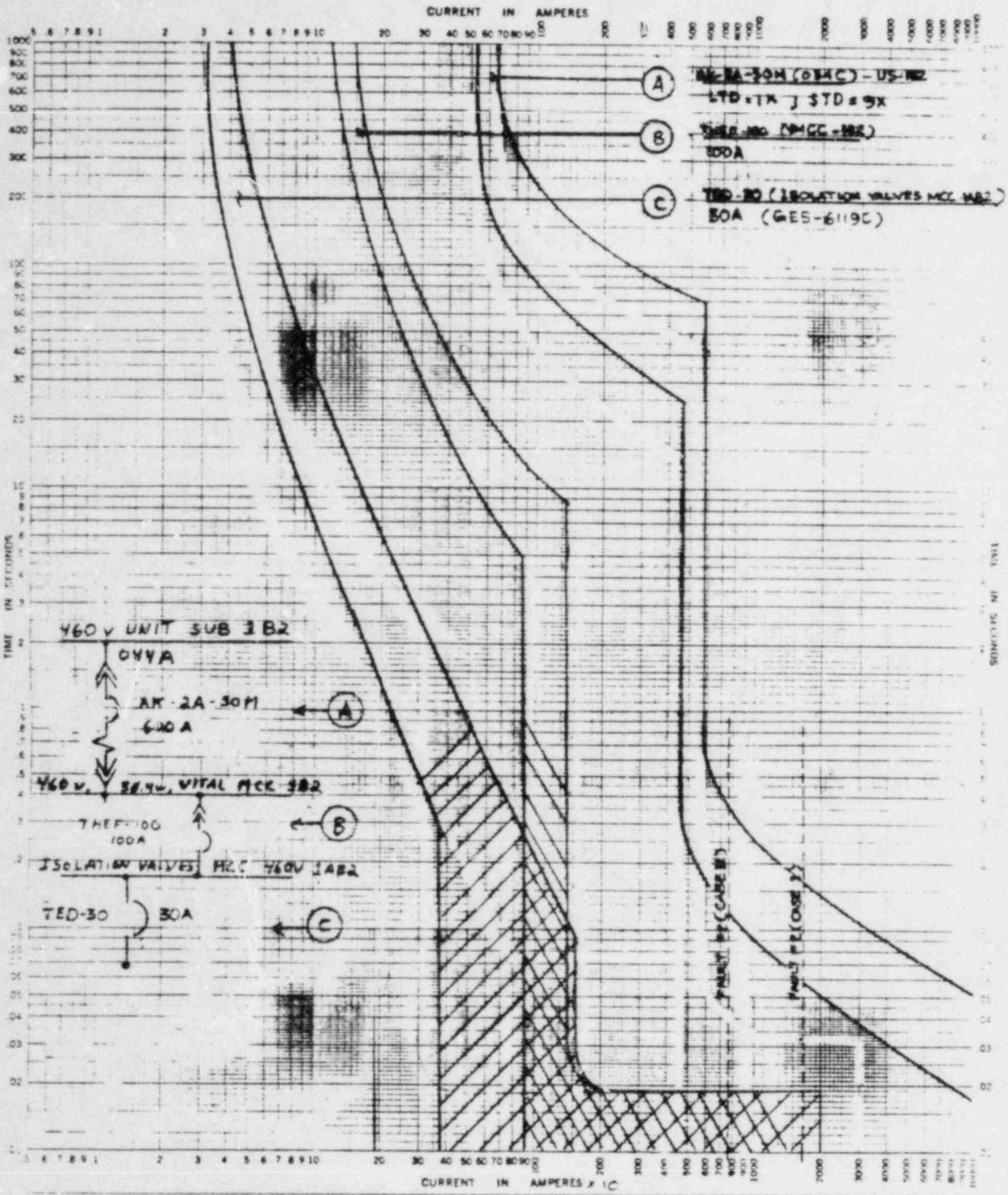
Date 2/-/83/REV. 0

2/11/94 / REV. 1.

K-E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO.

REV 1 CHANGED BKR AK-2A-50M PLOT FROM LTD-INST. TO LTD - STD.

ATTACHMENT NO 2A TCC No 429/Rev 2



FAULT F2 TIME-CURRENT CHARACTERISTIC CURVES @ 480VAC

For OC. - VITAL AC DISTR. SYSTEM Fuse Links In

BASIS FOR DATA Standards Dated

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

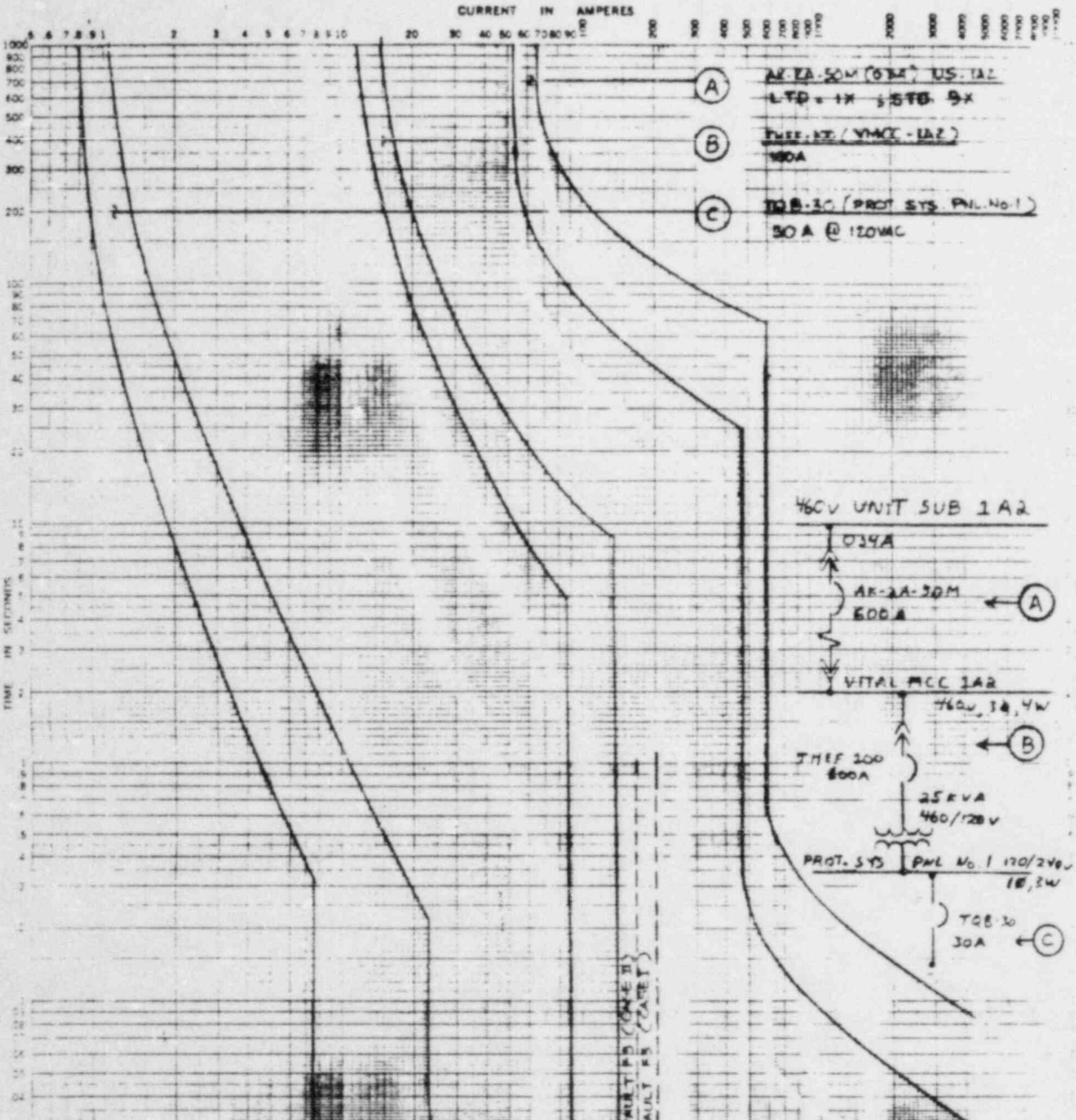
No. TCC-1AB2

Date ~~2/18/83~~ - REV 0
7/13/83 - Rev. 1 - HB
2/11/84 - REV 2 - HB

Rev. 1 7/13/83 | Changed fault design. in the plot 'F1' to 'F2'.

REV 2 2/11/84 | - CHANGED AK-2A-50M BKR CURVE TO LTD - STD from LTD. - INST., and Iso-VALVE BKR TO TED-30

ATTACHMENT No 3A TDR No 429 / Rev 1



For O.C. - VITAL AC DISTRI. SYSTEM FAULT F3 TIME-CURRENT CHARACTERISTIC CURVES @ ABOVE

Fuse Links In

BASIS FOR DATA Standards Dated

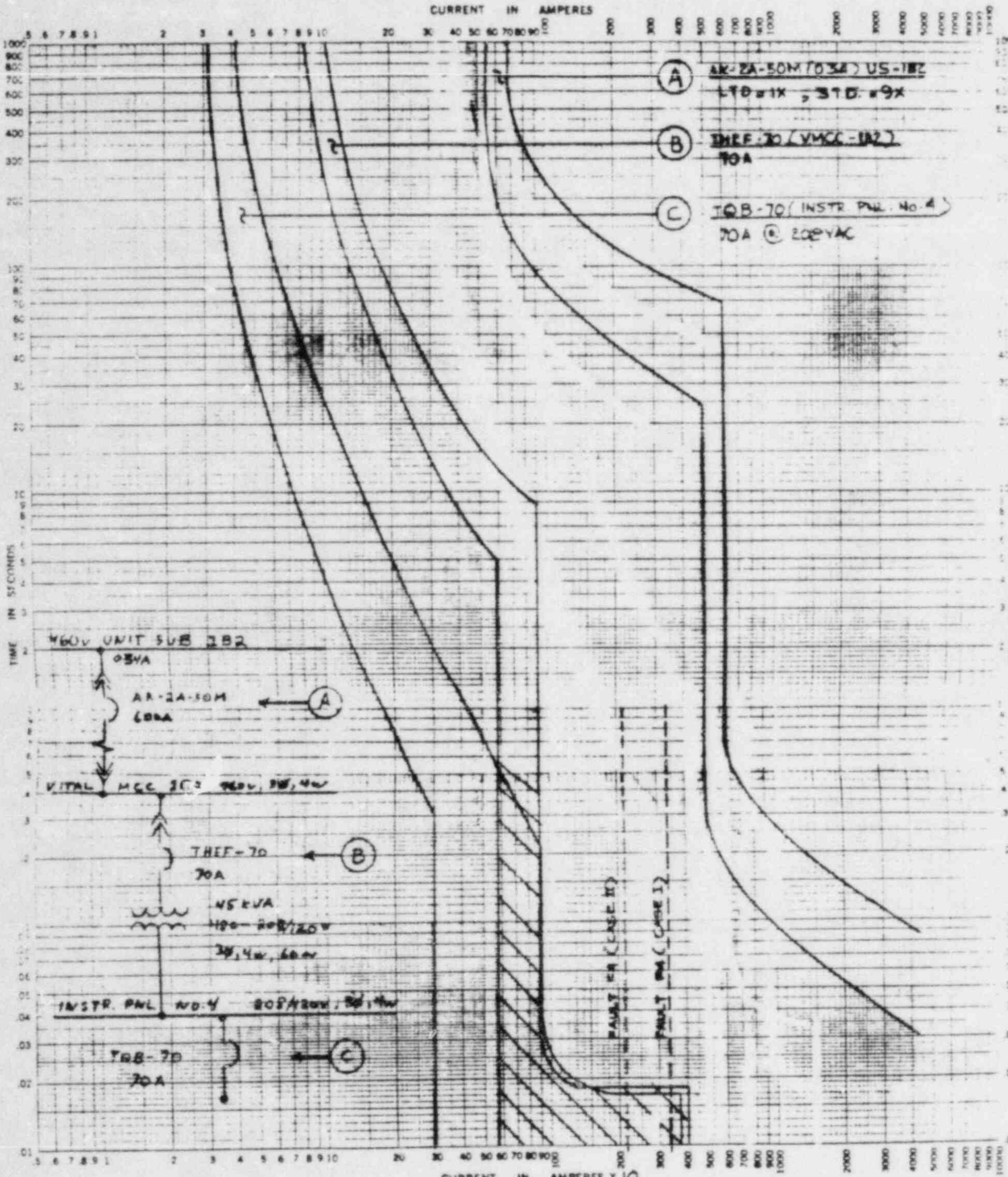
1. Tests made at Volts a/c at p.f., starting at 25C with no initial load

2. Curves are plotted to Test points so variations should be

No. TCC - FS1
Date 2/21/83 - HE

REV. 1 | CHANGED AK-2A-50M BKR. CURVE FROM LTD-INST. TO LTD.-STD
2/ /94

ATTACHMENT No. 4A- TDR No. 429/Rev 1



FAULT F4 TIME-CURRENT CHARACTERISTIC CURVES @ 480VC

For O-C. – VITAL AC DISTR. SYSTEM Fuse Links In

BASIS FOR DATA Standards Dated

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

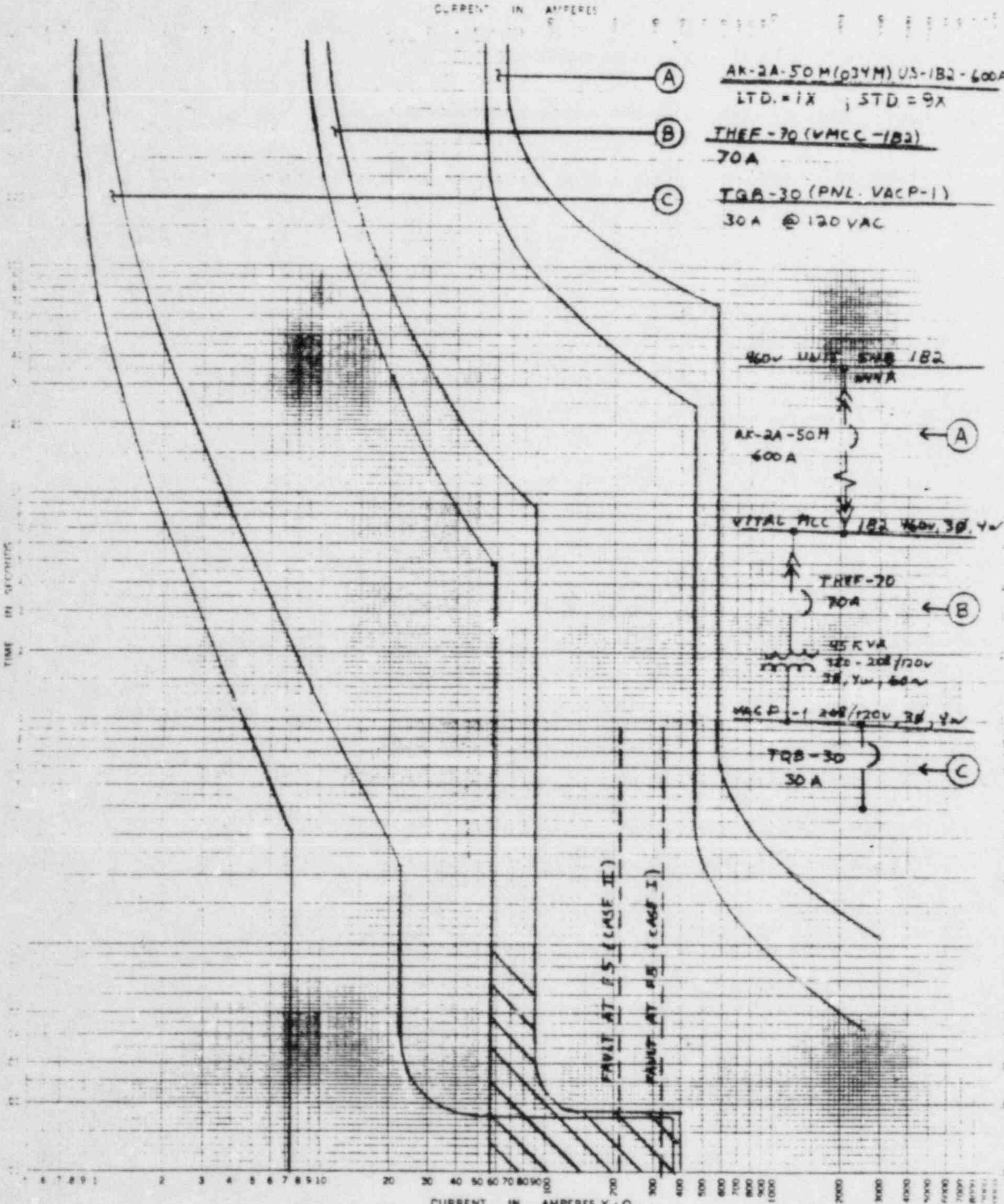
No. TCC-1T4

Date 2/22/83

TIME-CURRENT CHARACTERISTIC 48 5259

REV. 1 2/11/84 CHANGED BKR. AK-2A-50M PLOT FROM LTD.-INST. TO LTD-STD.

ATTACHMENT No. 5A - TDR No. 429 / REV-1



FAULT F5 TIME-CURRENT CHARACTERISTIC CURVES @ 480 VAC

For O-C - VITAL AC DISTR. SYSTEM Fuse Links In

BASIS FOR DATA Standards Dated

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

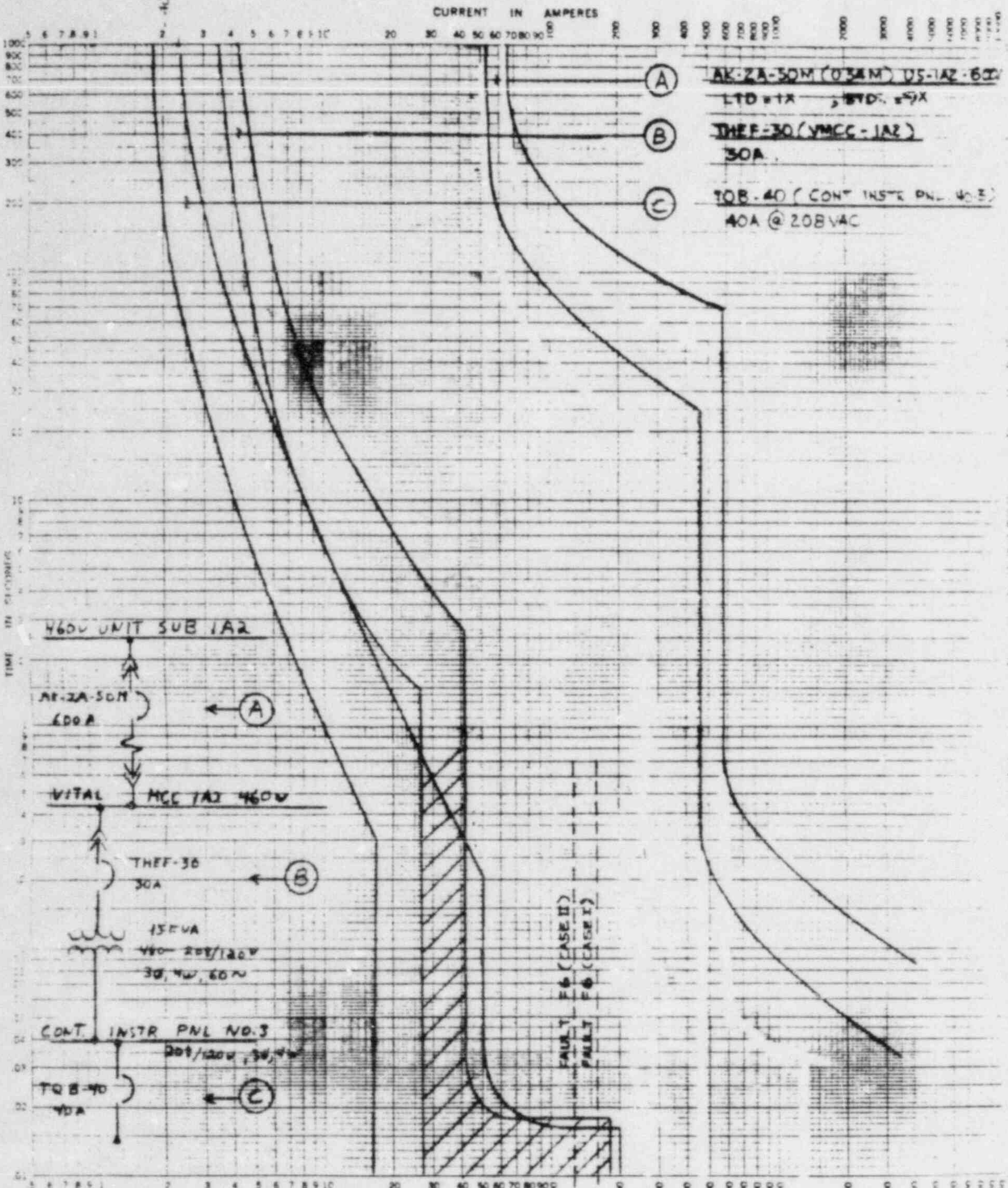
No. TCC-VACP1

Date 2/28/83
2/11/84 REV-1

K-E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO.

REV 1 2/11/84 CHANGED BKR. AK-2A-50M PLOT FROM LTD-INST. TO LTD-STD

ATTACHMENT NO. 6A - TDR No. 429/Rev. 1



FAULT F6 TIME-CURRENT CHARACTERISTIC CURVES @ 480

For O.C. - VITAL AC DISTR. SYSTEM Fuse Links In

BASIS FOR DATA Standards Dated

1. Tests made at Volts a.c. at p.f., starting at 25C with no initial load

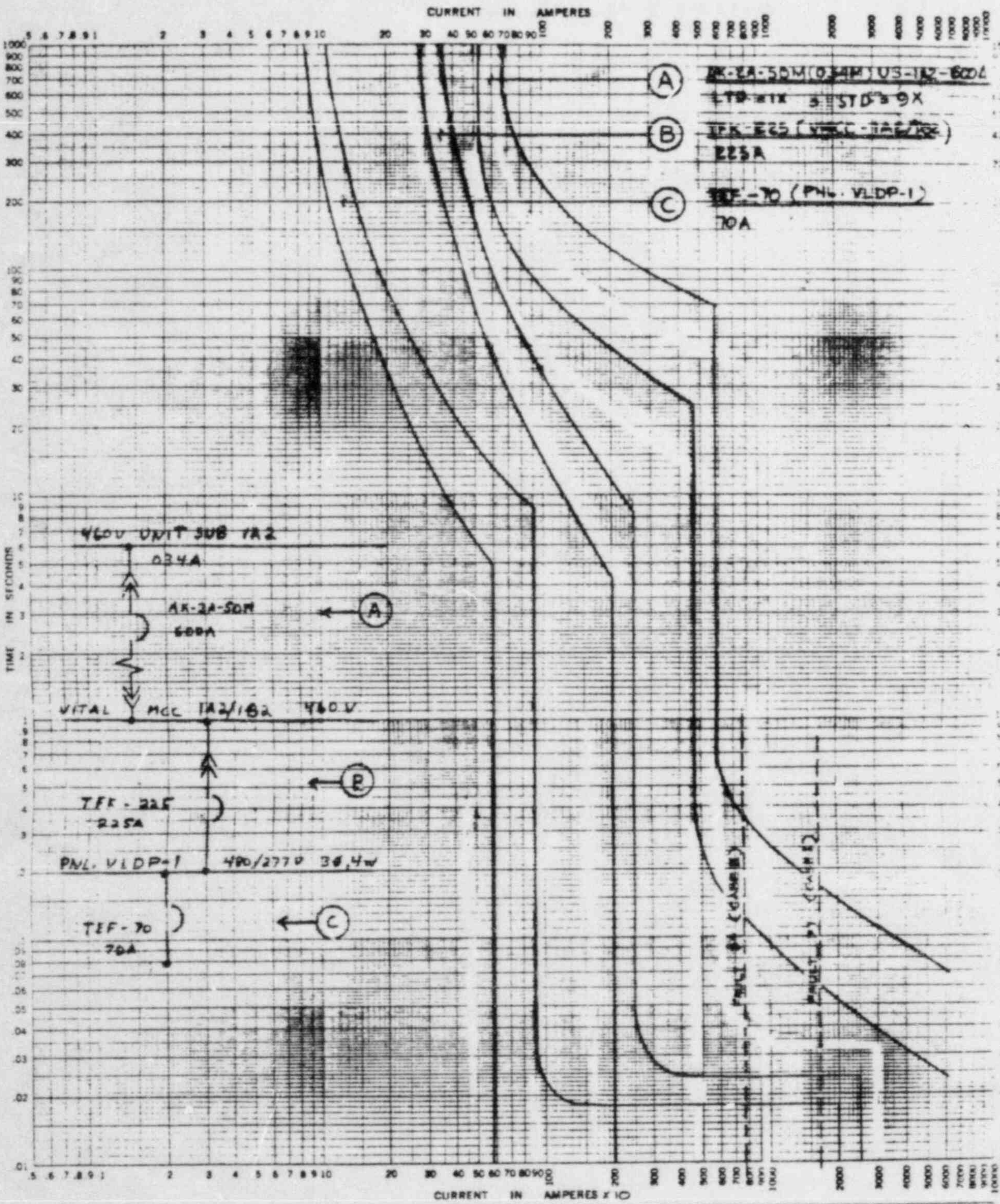
2. Curves are plotted to Test points so variations should be

No. TCC-1T3

Date 2/-/83
2/11/84 - REV. 1 - HE

REV 1 | CHANGED BKR. AK-2A-50M PLOT FROM LTD-INST. TO LTD-STD.

ATTACHMENT NO. 7A - TDR No. 429/Rev. 1



FAULT F7 TIME-CURRENT CHARACTERISTIC CURVES @ 480 VAC

For O.C. – VITAL AC DISTR. SYSTEM. Fuse Links In

BASIS FOR DATA Standards Dated

1. Tests made at Volts a.c. at 480 V p.f., starting at 25C with no initial load

2. Curves are plotted to Test points so variations should be

No. TCC-VLDP1.

Date ~~2/ /83~~ 2/11/84-REV.1-HE

TIME-CURRENT CHARACTERISTIC AE 5255

REV 1 CHANGED BKR. AK-2A-50M PLOT FROM LTD-INST. TO LTD-STD.