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SADDOCK,H.G. ROCHESTER GAS & ELECTRIC CORP.
RECIP.NAME RECIPIENT AFFILIATION
ZIEMANN,D.L. OPERATING REACTORS BRANCH 2

SYSTEMATIC EVALUATION PROGRAM.

SUBJECT: FORWARDS INFO REQUESTED ON 781208 RE TOPIC VIII-4, "ELECTRICAL PENETRATIONS OF REACTOR CONTAINMENT." W/19 OVERSIZED DRAWINGS ENCL.

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ROCHESTER GAS AND ELECTRIC CORPORATION • 89 EAST AVENUE, ROCHESTER, N.Y. 14649

HARRY G. SADDOCK
VICE PRESIDENT

TELEPHONE
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April 12, 1979

Director of Nuclear Reactor Regulation
ATTN: Mr. Dennis L. Ziemann, Chief
Operating Reactors Branch No. 2
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Systematic Evaluation Program
Topic VIII-4, "Electrical Penetrations of Reactor Containment"
R. E. Ginna Nuclear Power Plant, Unit No. 1
Docket No. 50-244

Dear Mr. Ziemann:

Enclosed is the information regarding electrical penetrations of the reactor containment at the R. E. Ginna Station, as requested in your December 8, 1978 letter.

Very truly yours,

Harry G. Saddock

Harry G. Saddock

Enclosure

A001
S 1/1
1 SET DRWG &
3 ENCL TO:
D McDONALD

7904230168

Rochester Gas & Electric Corporation

R. E. Ginna Nuclear Power Plant

SEP TOPIC VIII-4

ELECTRICAL PENETRATIONS of
Reactor Containment
DOCKET NO. 50-244

Table of Contents

1.0 Objective

The purpose of this submission is to provide the additional information requested in Mr. Ziemann's letter dated December 8, 1978, concerning electrical penetrations. It will also be shown that the electrical penetrations presently in service at Ginna are capable of maintaining containment integrity during the worst case short-circuit current conditions. The worst case conditions are also taken coincident with the failure of the primary overload protection devices. Failures could result from either loss of control power or a stuck breaker.

2.0 Analysis

2.1 There are presently seven different types or configurations of electrical penetrations in use at Ginna Station. These penetrations were manufactured by the Crouse-Hinds Corporation and are identified by configuration types A through G. Details of each penetration can be seen on the Crouse-Hinds drawings enclosed as Appendix C of this submission. In addition to the original seven types, a Westinghouse type WX-32714 was installed as part of the in containment T.V. modification. This penetration was designed for multi-purposed, low voltage power, control and instrumentation applications and conforms to IEEE 317, 1972. Design details are shown on the Westinghouse penetration drawings included in Appendix C.

2.2 Typical circuits representating each of the seven different electrical configurations were selected. These circuits are identified by their penetration numbers and are tabulated on Column 2 of Table 1. Appendix A contains block diagrams for each typical circuit selected, showing the primary and backup protection devices (breakers or fuses) and all cable information. All breaker and/or fuse information are also shown on Table 1 Columns 9 & 11.

2.3 Maximum fault currents were calculated for each circuit selected and these values are shown on the respective Block Diagrams. The worst case current values as seen by each electrical penetration and tabulated on column 7 of Table 1. A postulated three phase bolted fault is assumed at each penetration.

2.4 The manufacturer (Crouse-Hinds) has tested two of the seven electrical penetrations. The test shows the maximum short circuit current that the two "power" penetrations configurations A and E can withstand without mechanical damage. This data is shown in Table 1, column 4 as "max-current withstand RMS Amps". The withstand values for the remaining five configurations were derived from manufacturer's calculations using a ten to one safety factor.

2.5 The I^2t values for each type penetration are shown in Table 1, column 5. These values were obtained from either manufacture's calculations or from IPCEA P-32-382 Short Circuit Characteristics Of Insulated Cable whichever was more conservative.

Once the I^2t values were established, they were used to determine the maximum allowable time that the penetration can withstand the actual fault current. These time values are then compared against the backup breaker clearing times for each circuit and shown in column 8 of Table 1.

2.6 The trip curves (current versus time) for both the primary and backup clearing devices are enclosed in Appendix B. The curve numbers are referenced on each block diagram. The actual clearing times are shown on column 10 and 12 for each circuit.

3.0 Penetration Testing

The manufacturer has performed Short Circuit Testing on their power penetrations (types A & E). The objective of these tests was to investigate the short circuit current capabilities of each penetration type. The results of this testing indicated that the #2 AWG penetration withstood 37.4 KA (rms) for 3 cycles, and the 750 mcm penetration withstood 80 KA for 10 cycles. No visible damage or gas leakage resulted.

4.0 Conclusion

The penetration must retain structural integrity when subject to mechanical stresses caused by the maximum available momentary fault current. The withstand values are shown in column 4 and the corresponding maximum momentary fault current is shown in column 6. For those withstand currents determined by analysis, a safety factor of 3.3 was used. Thus although the maximum momentary current in penetration AE-5 (3500 A) is above the tabulated withstand current (1400 A), it is well below the current at which mechanical damage is expected to occur (4662 A).

TABLE-1

TYPE	NUMBER	DESCRIP-TION	MAX. CURRENT WITH-STAND RMS AMPS	MAX. CURRENT WITH-STAND I^2t	MAX. CURRENT WITH-STAND CONT. CURRENT RATING	MAX.(ISC) AVAIL. SHORT CKT CURRENT DENETRATION RMS	MAX. ALLOWABLE TIME FOR ISC. SECONDS	PRIMARY BKR. #	PRIMARY CLEARING TIMES SECONDS	BACK UP BKR #	BACK UP CLEARING TIMES SECONDS	CKT. TYPE	REMARKS
A	CE-18	#2 AWG 21 PIN	30 KA *	2.3×10^7	95	270 A	3.16	50A AMP TRAP FUSE	.18	150 AMP FUSE	.576	POWER TO LIFT COIL	⚠1
A	AE-6	#2 AWG 21 PIN	30 KA *	2.3×10^7	95	9.6 KA	.23	4K	.018	22C	.1	LOW VOLTAGE POWER 480 VOLTS	⚠1
B	AE-10	#16 SHLD TWISTED PRS & QUADS	100 +	290×10^3	12	.050	CONT.	—	—	—	—	LOW VOLTAGE I & C	FOXBORO 694 R-C CONVERTER CURRENT LIMITED TO 50 MA. NO SHORT CONDITION ⚠1
C	CE-1	#16 28 SHLD. QUADS	100 +	290×10^3	12	.050	CONT.	—	—	—	—	LOW VOLTAGE I & C	FOXBORO 694 R-C CONVERTER CURRENT LIMITED TO 50 MA. NO SHORT CKT. CONDITIONS △
D	CE-17	#8 AWG 60 PIN	1400 +	1.05×10^6	40	260	15.5	BUSSMAN FUSE 2432B59	.0004	AMP TRAP FUSE A60X30	.0043	ROD DRIVE CKT.	⚠1
D	AE-5	#8 AWG 60 PIN	1400 +	1.05×10^6	40	3500	.086	4A	.018	A50P200	.002	LOW VOLTAGE POWER CKT.	⚠1
E	CE-21	500MCM 3 PIN	44 KA *	13×10^8	320	20 KA	3.25	23C	.045	18B	.50	LOW VOLTAGE POWER CKT'S	⚠1
E	CE-25 CE-27	750MCM 3 PIN	65 KA *	28×10^8	450	36.8 KA	2.0	(81) 11A	.018	(10)	.17	5 KV PWR TO RCP 1A	⚠1
F	CE-23	#10 AWG 144 PIN	1,250 +	421×10^3	30	600	1.17	FUSE 2	.014	FUSE 4	700	125 V & C PWR CKT.	BACK UP FUSE WILL RESPOND IN ≈ 700 SECONDS
G	CE-8	12 CABLE TRIAXIAL	I ** BAL.	200×10^3	10	1A	CONT.	—	—	—	—	POWER RANGE DETECTOR	POWER LIMITED ⚠1 TO LESS THAN 200 WATTS EQUIP. WOULD FAIL BEFORE PENETRATION
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭

* DETERMINED BY TEST

\+ DETERMINED BY ANALYSIS

** CURRENT BALANCED TO PROVIDE ZERO NET EXTERNAL FORCE

⚠1 MEETS THE SHORT CKT OBJECTIVES OF IEEE 317

ELECTRICAL PENETRATION FAULT DATA SUMMARY SHEET

ROCHESTER GAS & ELECTRIC CORP. ROCHESTER, NEW YORK

FACILITY GINNA

SCALE NONE

DRAWING NO.

REV.

JOB NO.

SEP VIII-4

ENG. MANGR.

RESP. ENG.

CHECKED

DRAWN BY

INITIAL

DATE

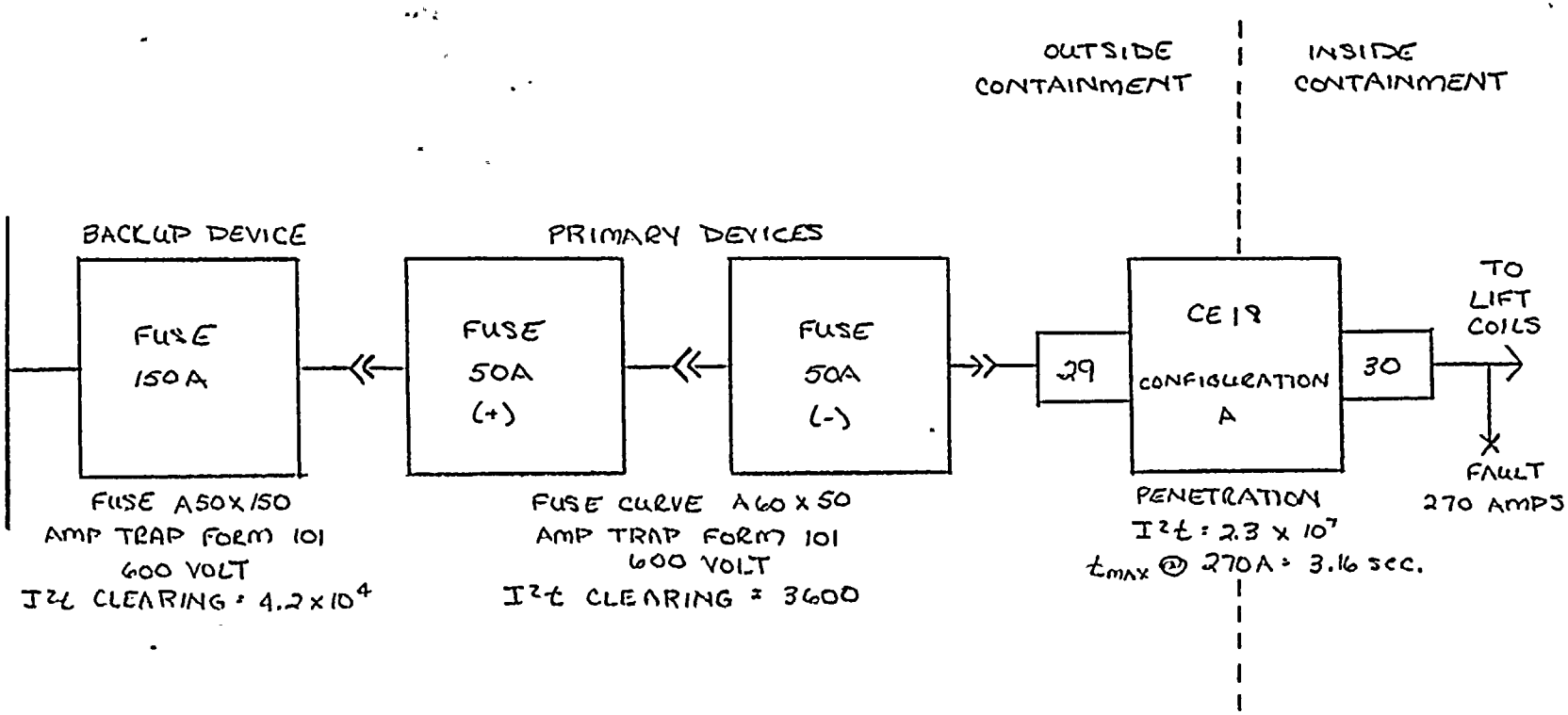
ORIGINAL

REVISION

NUMBER

Appendix A

Block Diagrams



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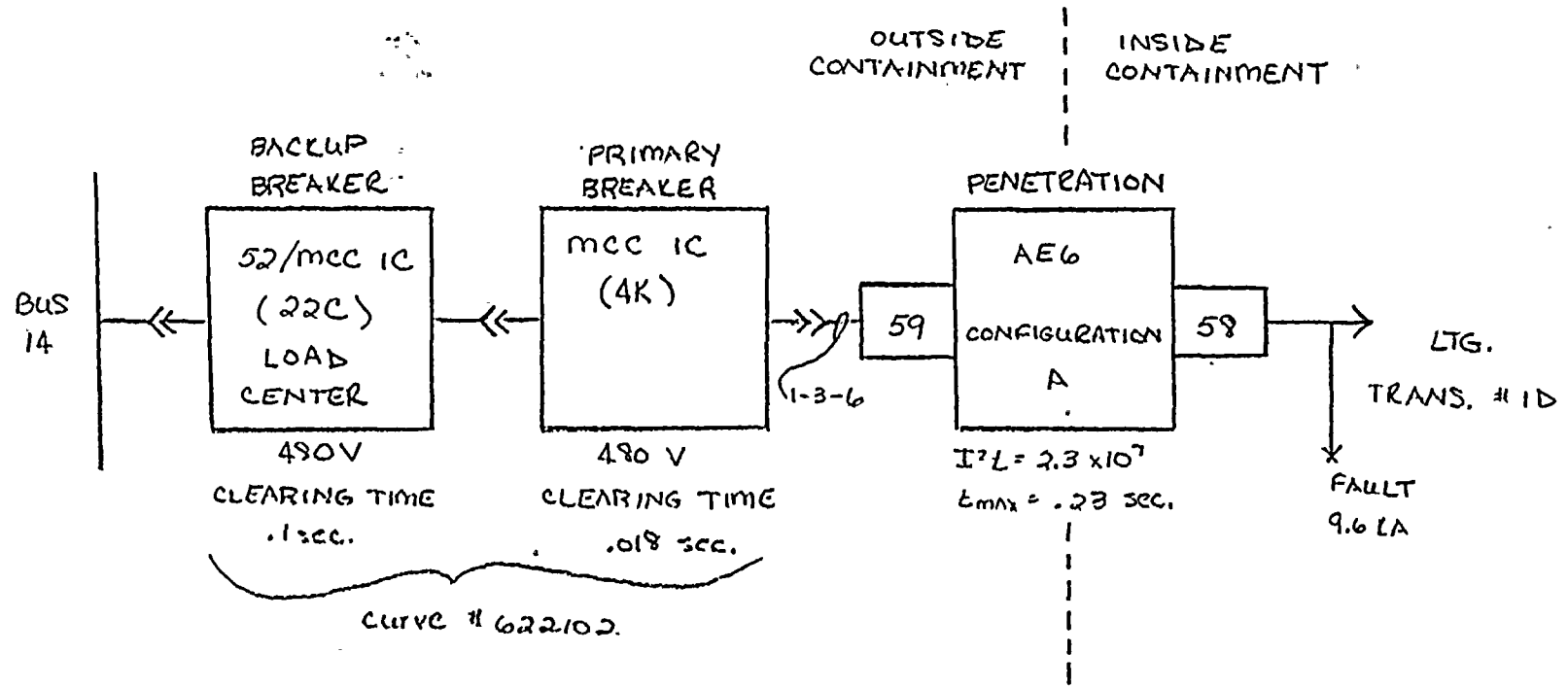
ROCHESTER, NEW YORK

CE-19

SCALE

NO. SEP VIII-4 SHT 1

H.H.S. 191130



BLOCK DIAGRAM

			ENG. MANG'R.	SCALE	
			RESP. ENG.	NO. SEP VIII-4	SHT. 2
			CHECKED BY		
			DRAWN BY	AE-6	
	INITIAL DATE	REVISION			
O	ORIGINAL				
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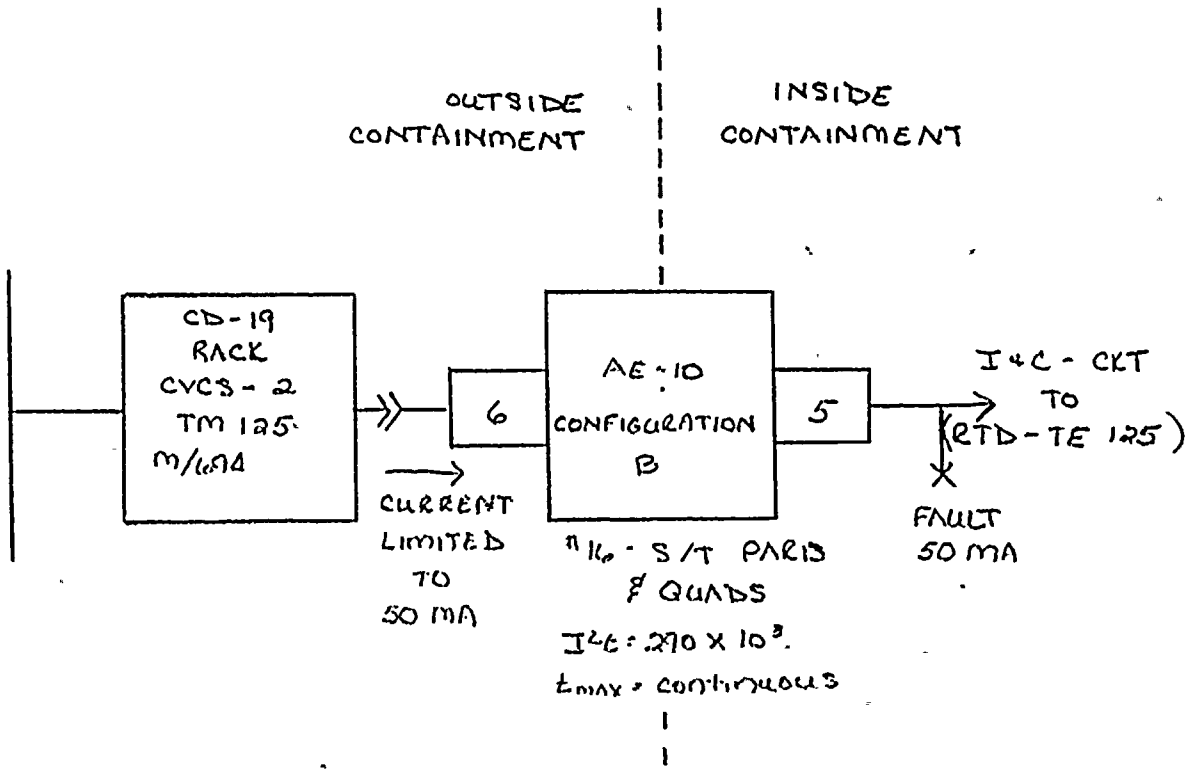
H.H.S. 191153.



NO CURVE REQUIRED

NUMBER	REVISION	INITIAL DATE	DRAWN BY	CHECKED BY	RESP. ENG.	ENG. MANG'R.
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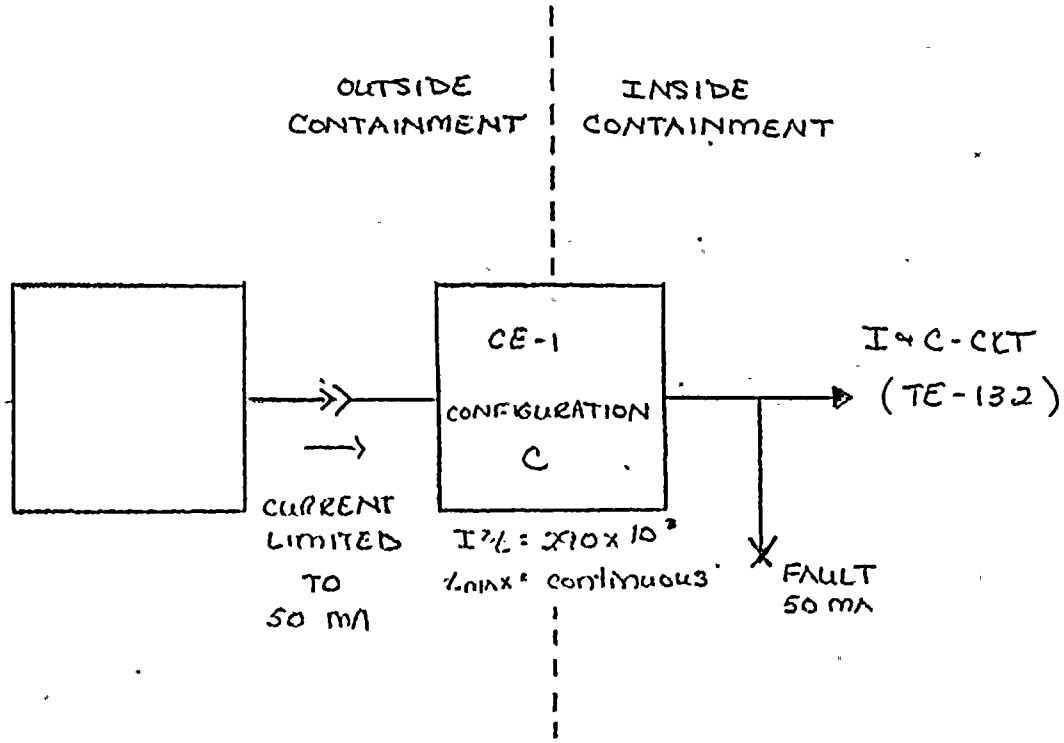
ROCHESTER GAS & ELECTRIC CORP.
ROCHESTER, NEW YORK

AE-10

SCALE

NO. 3EP VIII-4 SHT 3

H.M.S. 191153e



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ROCHESTER GAS & ELECTRIC CORP.
ROCHESTER, NEW YORK

CE-1

SCALE

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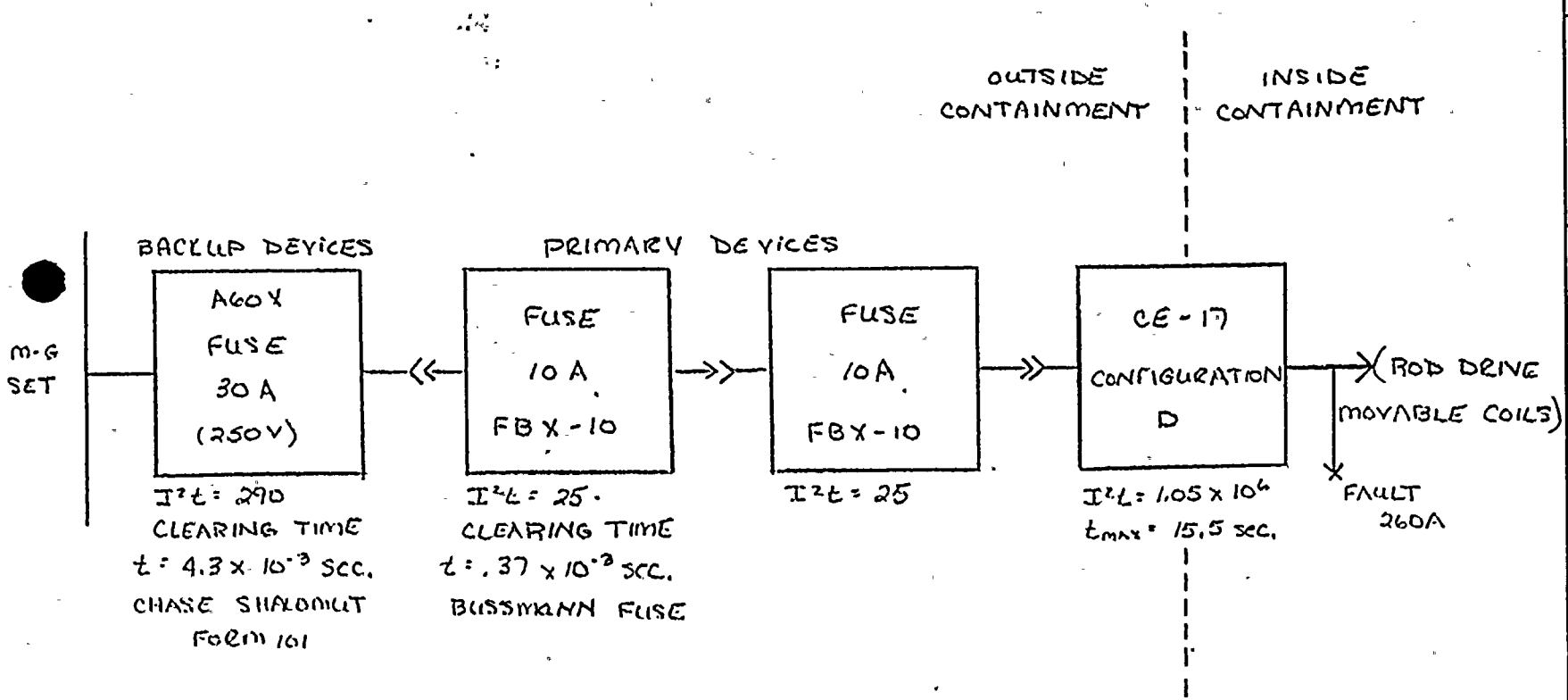
H.H.S. 191139



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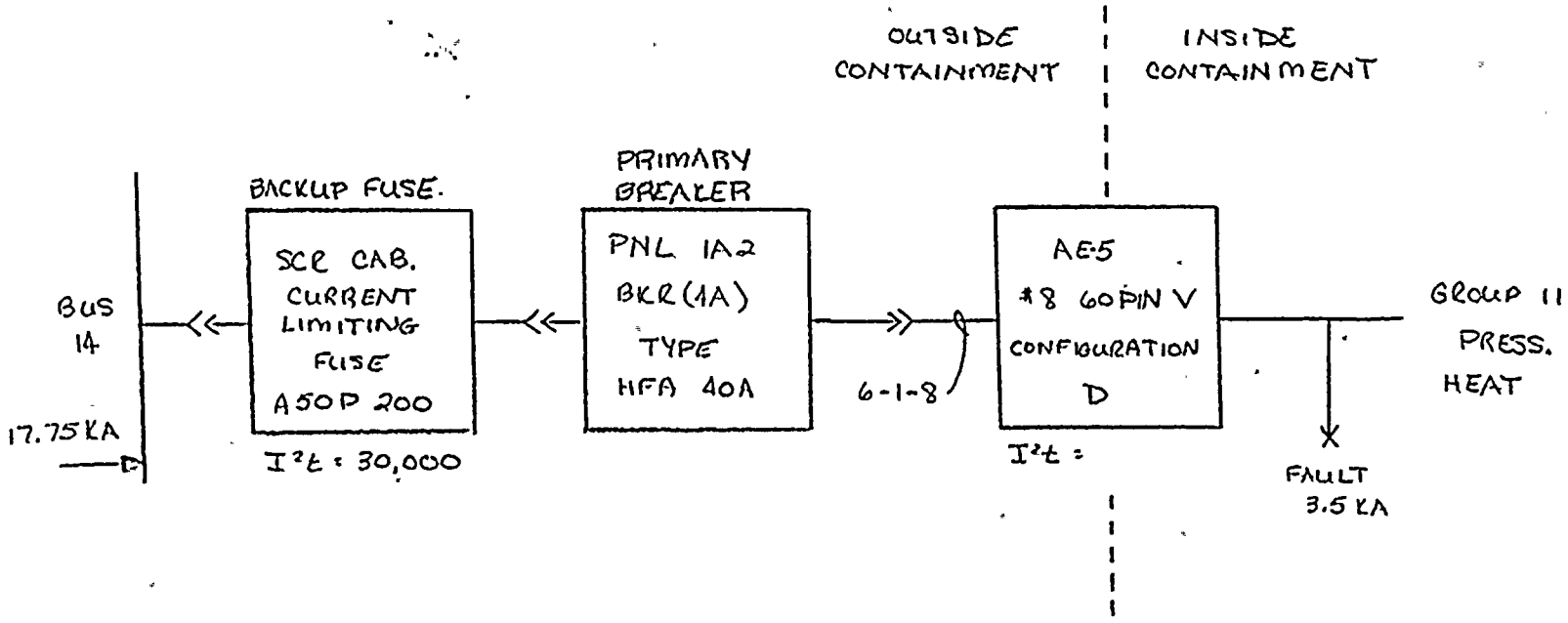
H.H.S. 191153



CLEARING TIME

200A FUSE - .002 SEC.
BRK 4A - .018 SEC.

NUMBER	REVISION	INITIAL DATE
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AE-5

SCALE

NO. SEP VIII - 4 SHT. 6

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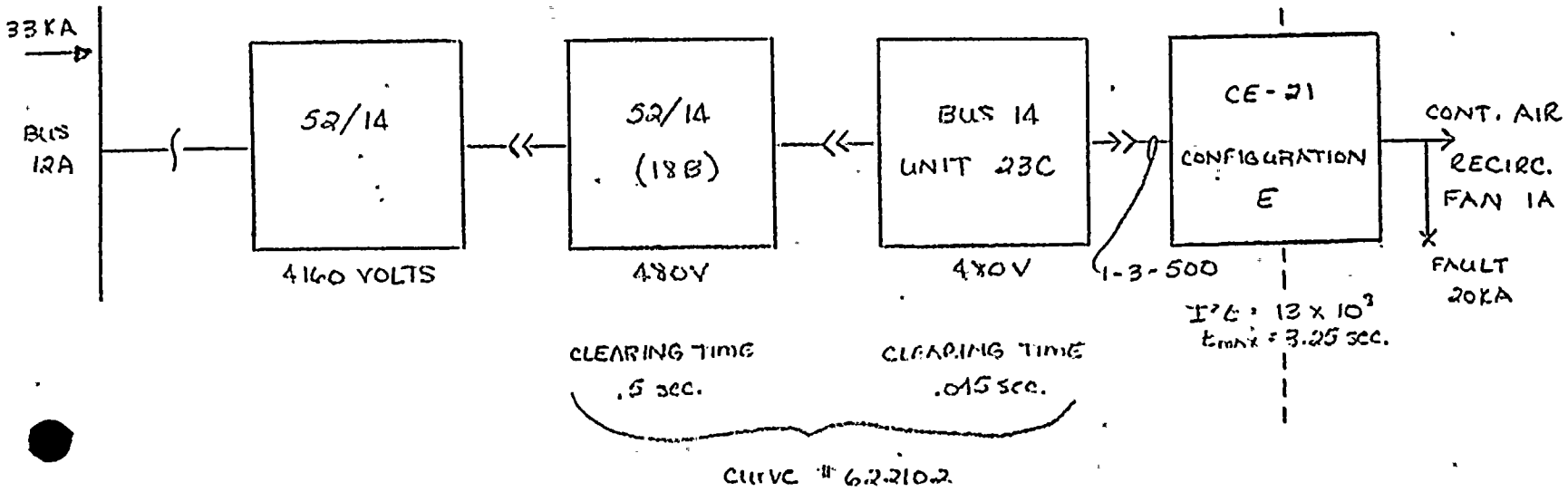

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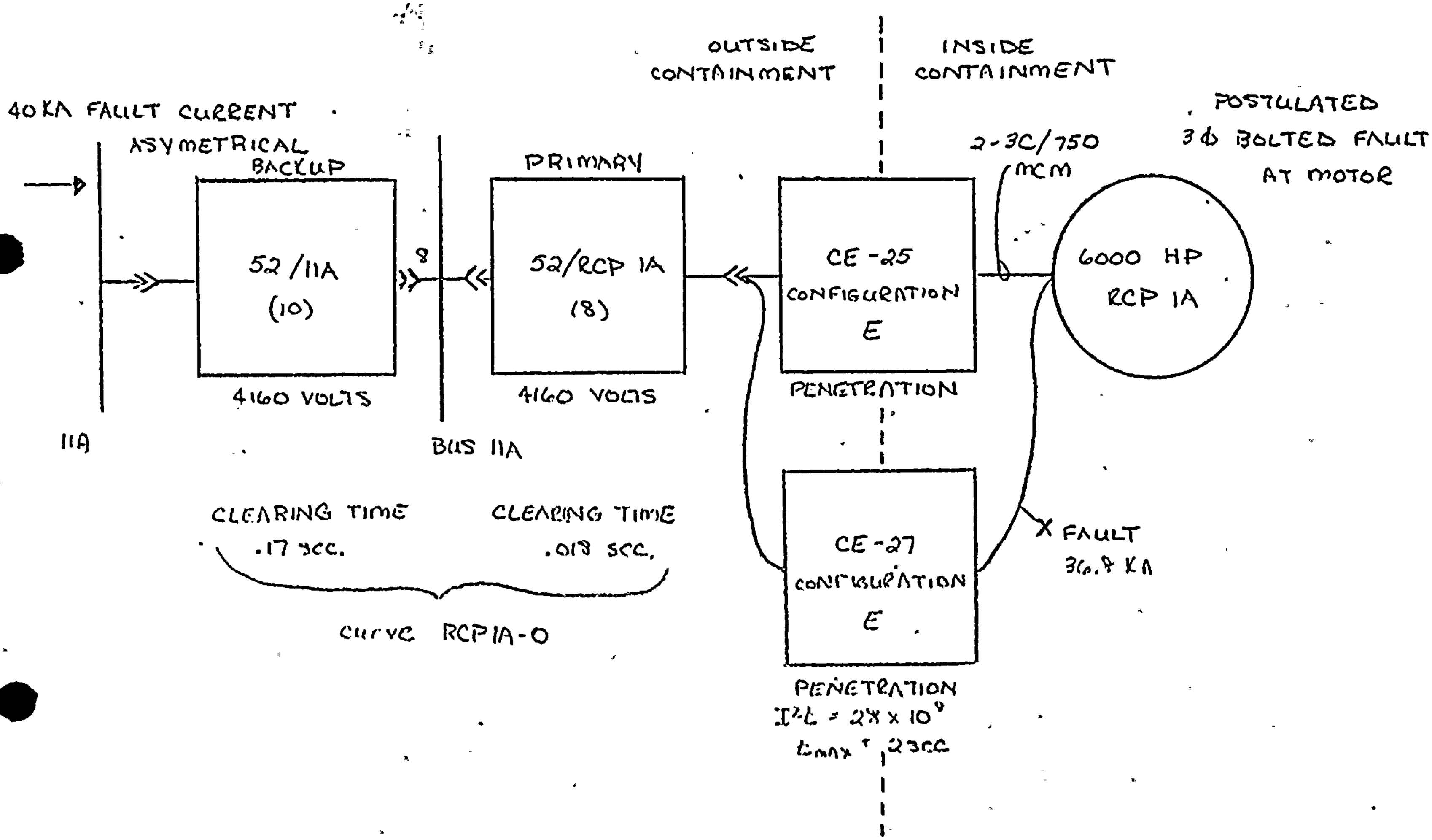
			CHECKED BY	CE-21		
			DRAWN BY			
	INITIAL DATE					
O	ORIGINAL	REVISION				
NUMBER			ROCHESTER GAS & ELECTRIC CORP. ROCHESTER, NEW YORK			

H.H.S. 191130



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NUMBER	REVISION	INITIAL DATE		
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CE-25 & CE-27

NO. SEP VIII-4 SHT. 9

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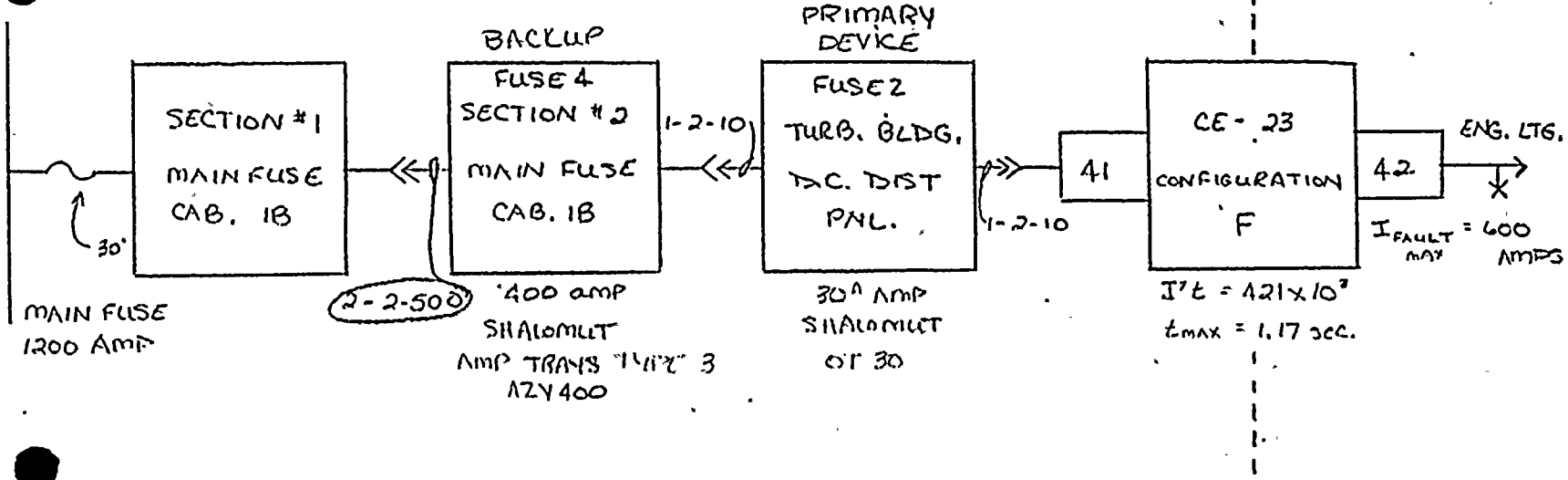
ROCHESTER, NEW YORK

H.H.S. 19 1153



CLEARING TIMES

FUSE 2 — .014 Seconds
FUSE 4 — 1000 Seconds

NUMBER	REVISION	INITIAL DATE	DRAWN BY	CHECKED BY	RESP. ENG.	ENG. MANG'R.
O	ORIGINAL					

ROCHESTER GAS & ELECTRIC CORP.
ROCHESTER, NEW YORK

SCALE

NO. SEP VIII-4 SHT. 9

CE-23

H.M.S. 19 11530

NO CURVE REQUIRED

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ROCHESTER, NEW YORK

CE-8

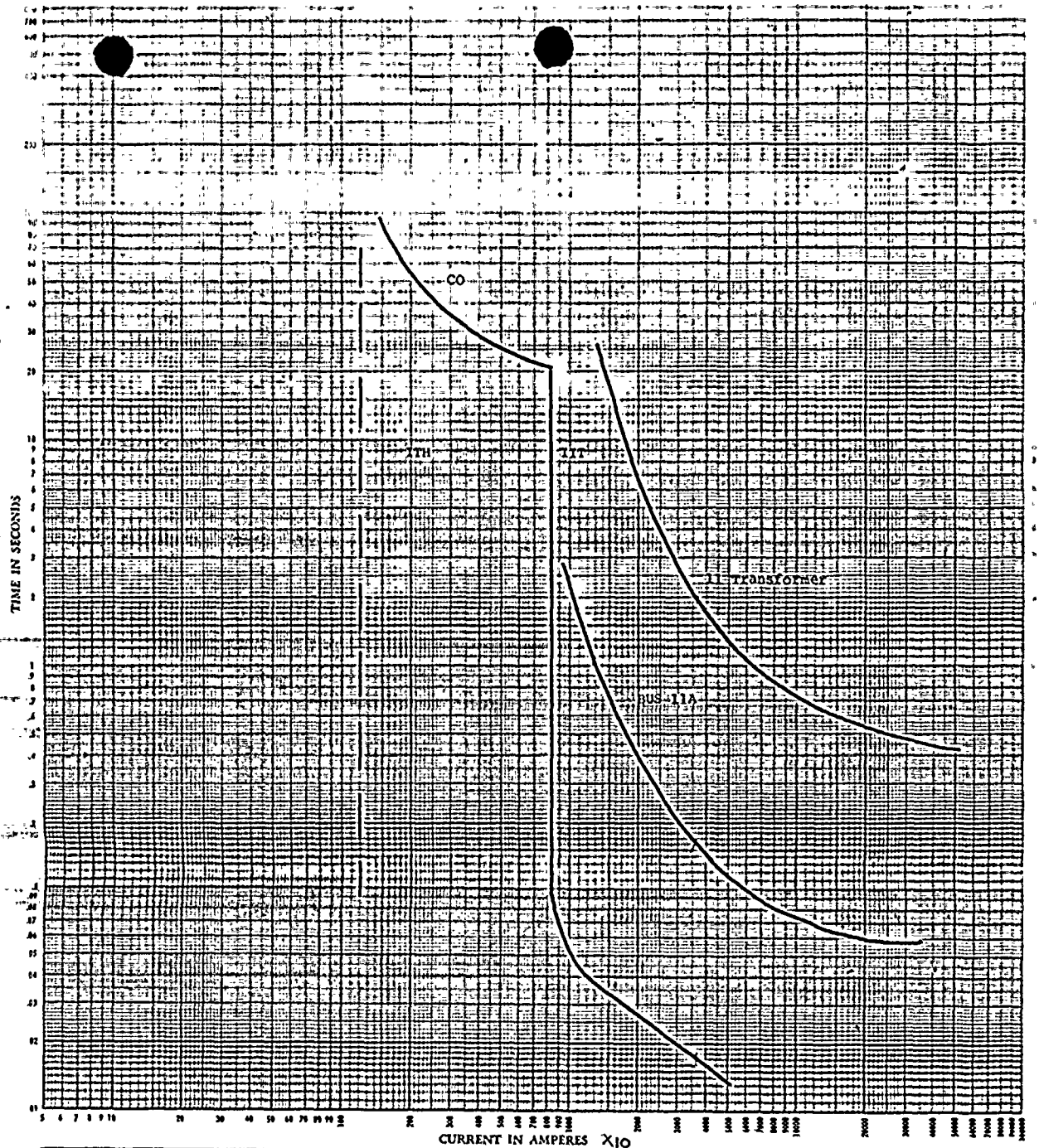
SCALE

NO. SEP VIII-4 SHT. 10

Appendix B

Characteristic Curves

Identification		Circuit No.
1.	RCP1A-1	CE-25, 27
2.	G22102	AE-6
3.	Case Shawmut A50P FORMIOI AMP-TRAP	AE-5
4.	BUSSMANN FBX 10 AMP 250V	CE-17
5.	FA - MOLDED CASE BKR. 40A (548103)	AE-5
6.	Case Shawmut A60X - FORM 101 AMP - TRAP	CE-17 CE-18
7.	Case Shawmut A2X 400 FORM 101	CE-23



REACTOR COOLANT PUMP 1A ..... TIME-CURRENT CHARACTERISTIC CURVES PHASE PROTECTION

For GINNA STATION ..... 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. Rcp. 1A-O

Date .....

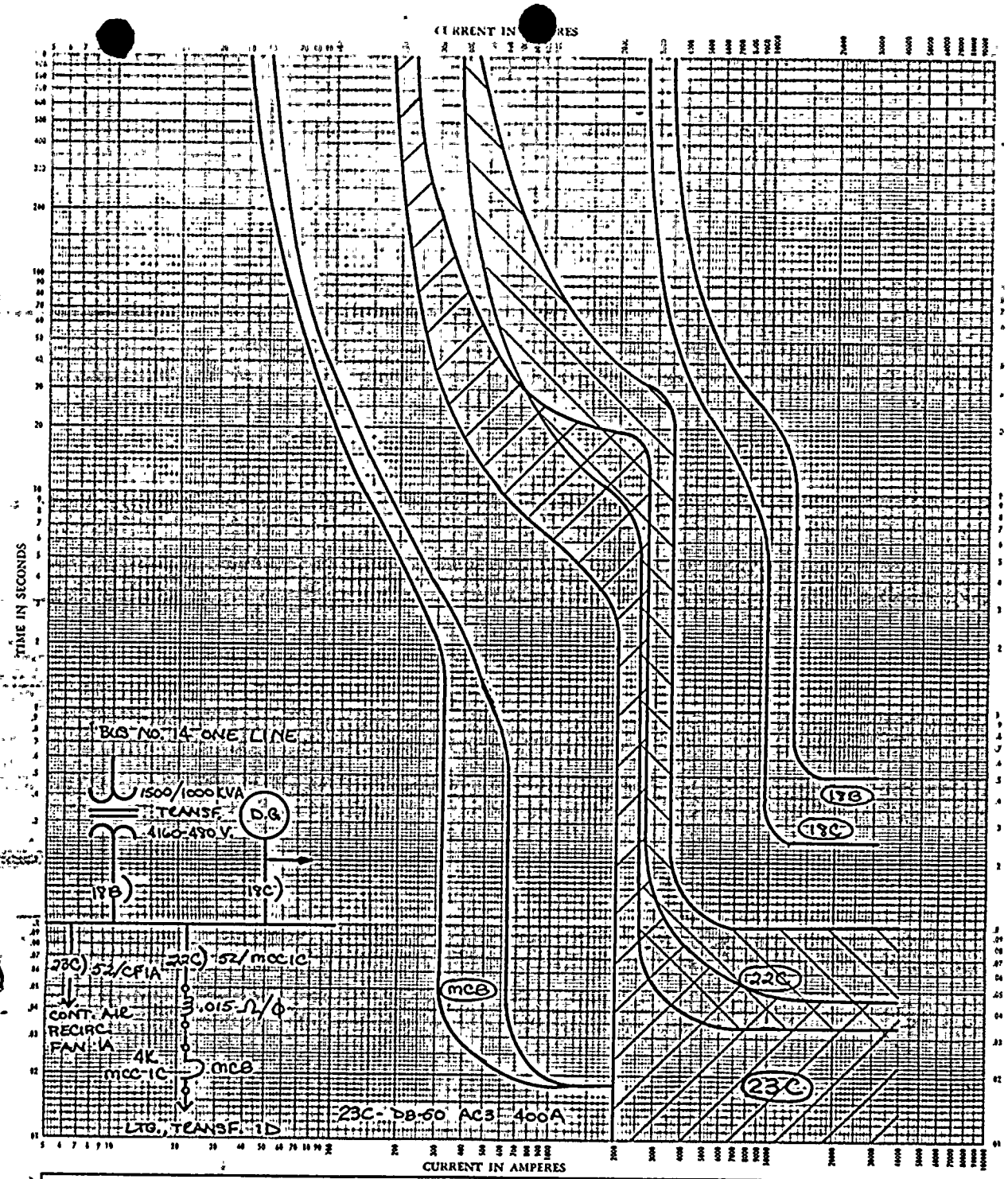
K•E TIME-CURRENT CHARACTERISTIC KEUFFEL & ESSER CO. 46 5257

Sta. 13 " " 3/7/79
Reactor Cooling Pump 1A
4 kV 6000 H.P.
1200/5 CT's
COM-5 Model #289B355A12
51 - 2/6 AMP 4. AMP - 8 TLS
50M - 20/80 AMP 35 AMP
50L - 4/8 AMP 5 AMP

Bus 11A ~4 kV
3000/5 CT's
CO-8 Model #1875267A 4/12 AMP
51/11A 12. AMP - ½ TLS
CO-8 Model #1875265A .5/2.5 AMP
51N/11A 0.5 AMP - ½ TLS

#11 Trans. 19 kV/4 kV
1200/5 19 kV O.C.
51/11T CO-8 Model #1875267A 4/12 AMP
10A - 3 TLS

Ref. CE-25
CE-27



TIME-CURRENT CHARACTERISTIC CURVES

For ..... 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. 622102 Rev. 1

Date 3-13-79

K•E TIME-CURRENT CHARACTERISTIC 48 5257

KEUFFEL & ESSER CO.

MCB Molded case BKR HFA-40 600 v. 3 pole

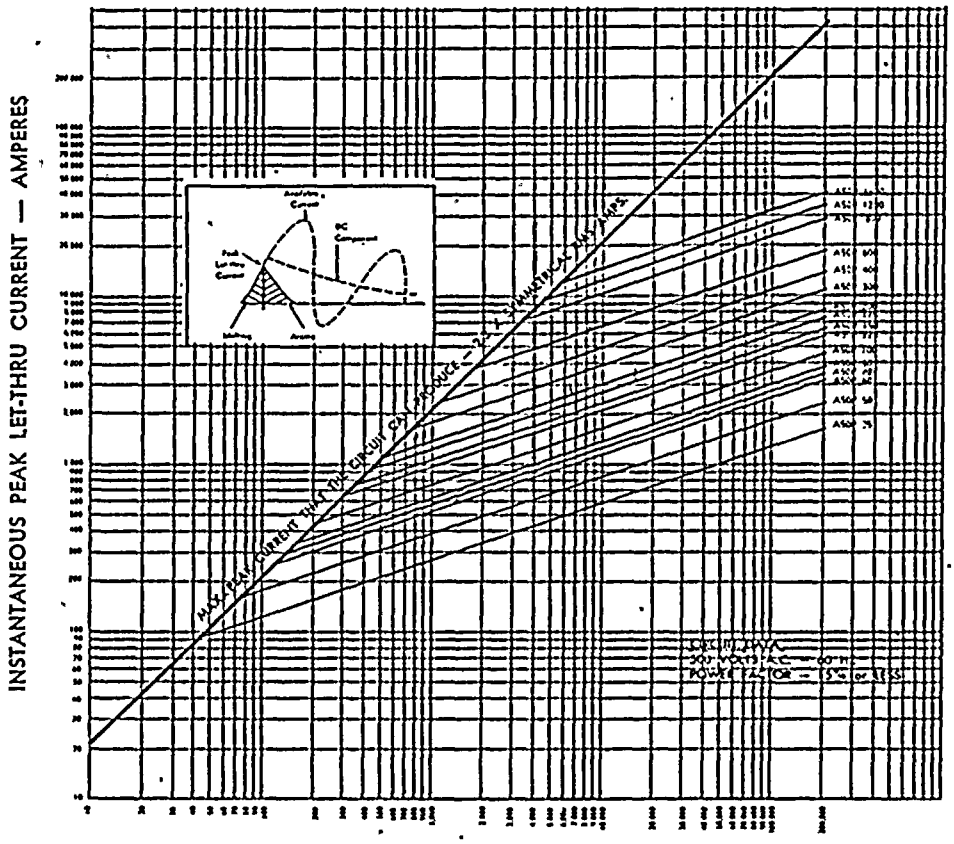
480 V. BREAKER TRIP SETTINGS

BUS NO.	CELL NO.	BREAKER TYPE	CONTINUOUS CURRENT RATING AMPERES	PICK-UP IN AMPERES LONG DELAY	PICK-UP IN AMPERES SHORT DELAY	INST.	TIME DELAY LONG DELAY (SEC)	TIME DELAY SHORT DELAY (CYCLES)	CURVE
14	18B,C	DB-75	3000	3000	12,000		70	30	622102
14	22C	DB-50	400	350	3000		30	6	622102
14	23C	DB-50	500	425		4000	20		622102

Ref. AE-6

Ref. AE-5

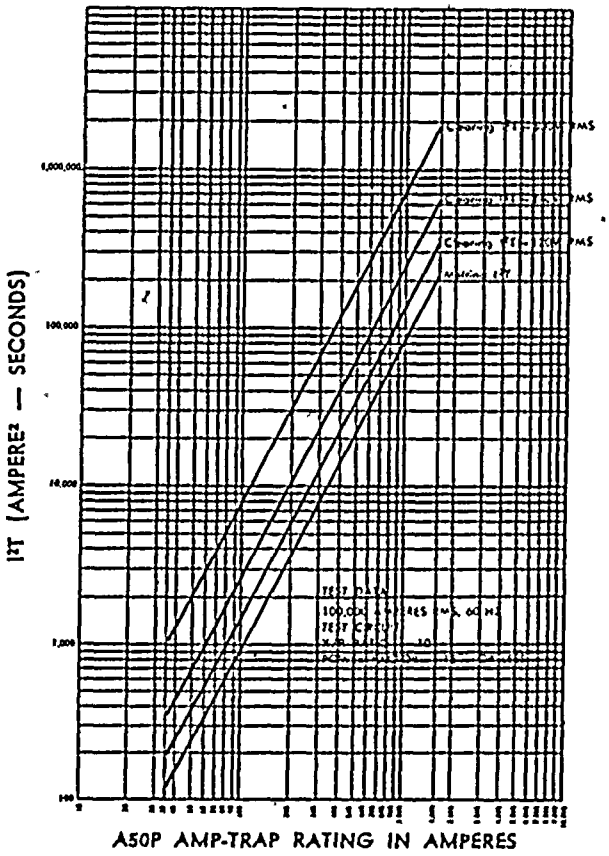
MAXIMUM PEAK LET-THRU CURRENT
500 VOLT FORM 101 AMP-TRAP



RESISTANCE OF A50P FORM 101 AMP-TRAP FUSES

Rating (Amps)	Cold Ohms	Hot Ohms
35	.00400	.00550
40	.00332	.00450
50	.00276	.00360
60	.00225	.00300
70	.00212	.00256
80	.00188	.00225
90	.00166	.00201
100	.00145	.00172
125	.00120	.00140
150	.00103	.00117
200	.00775	.00875
250	.000620	.000710
300	.000532	.000585
350	.000457	.000505
400	.000375	.000438
500	.000270	.000350
600	.000220	.000266
800	.000160	.000202
1000	.000133	.000169
1200	.000107	.000134
1400	.000094	.000123
1600	.000080	.000102

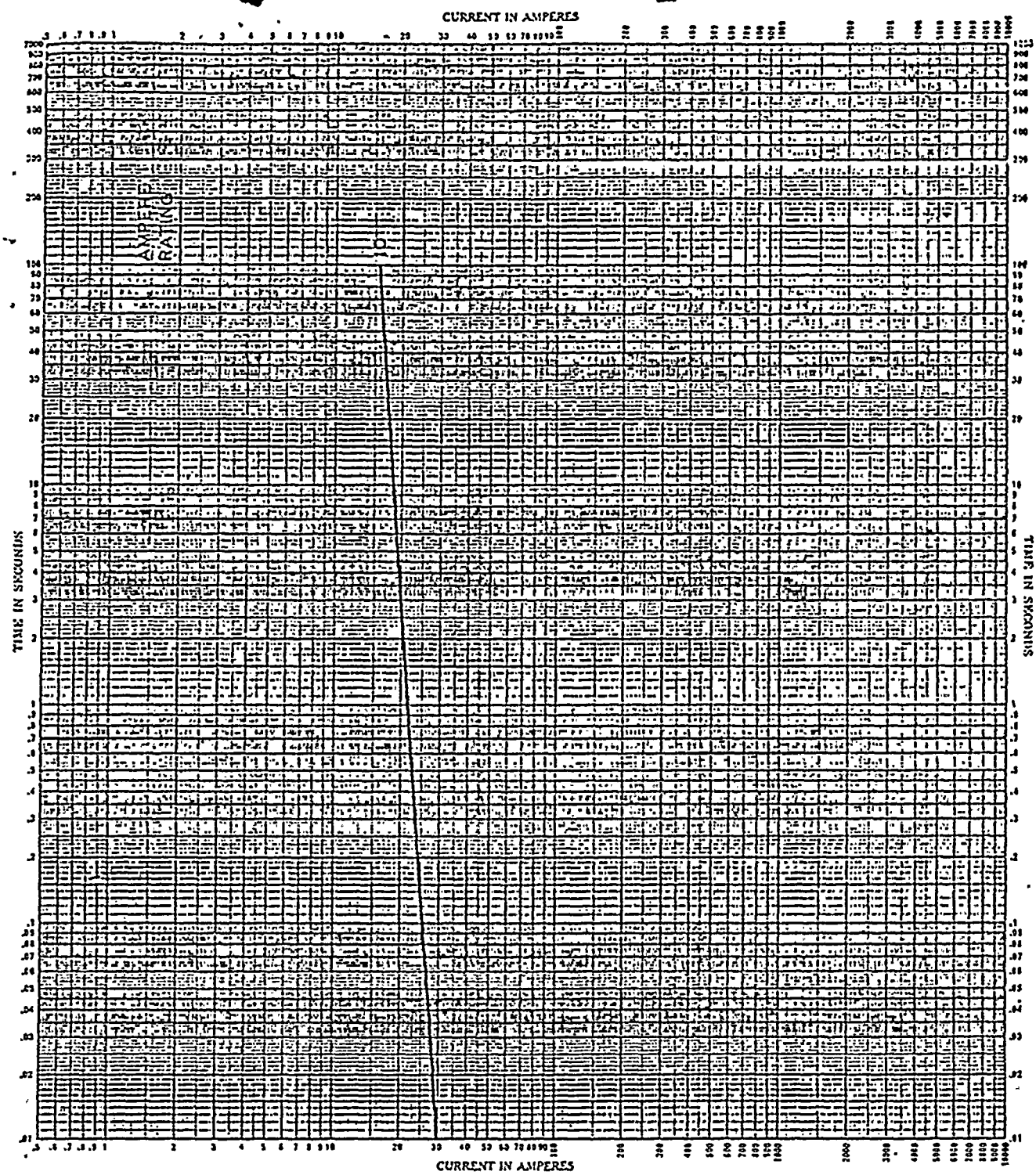
CLEARING I^2T CURVES
A50P FORM 101 AMP-TRAP



I^2t and I_p FOR BUSSMANN 250 VOLT 10 AMP SEMICONDUCTOR FUSE

		Available Current			
		48 Amp	2500 Amp	10,000 Amp	105,000 Amp
FBX 10	I^2t	15	25	35	38
	I_p	70	260	460	810

Ref. CE-17



AVERAGE MELTING TIME-CURRENT CHARACTERISTIC CURVES BUSSMANN MFG. DIVISION

For FBX SEMICONDUCTOR FUSE 250 V Fuse Links In McGraw-Edison Co. St. Louis, Mo. 63107

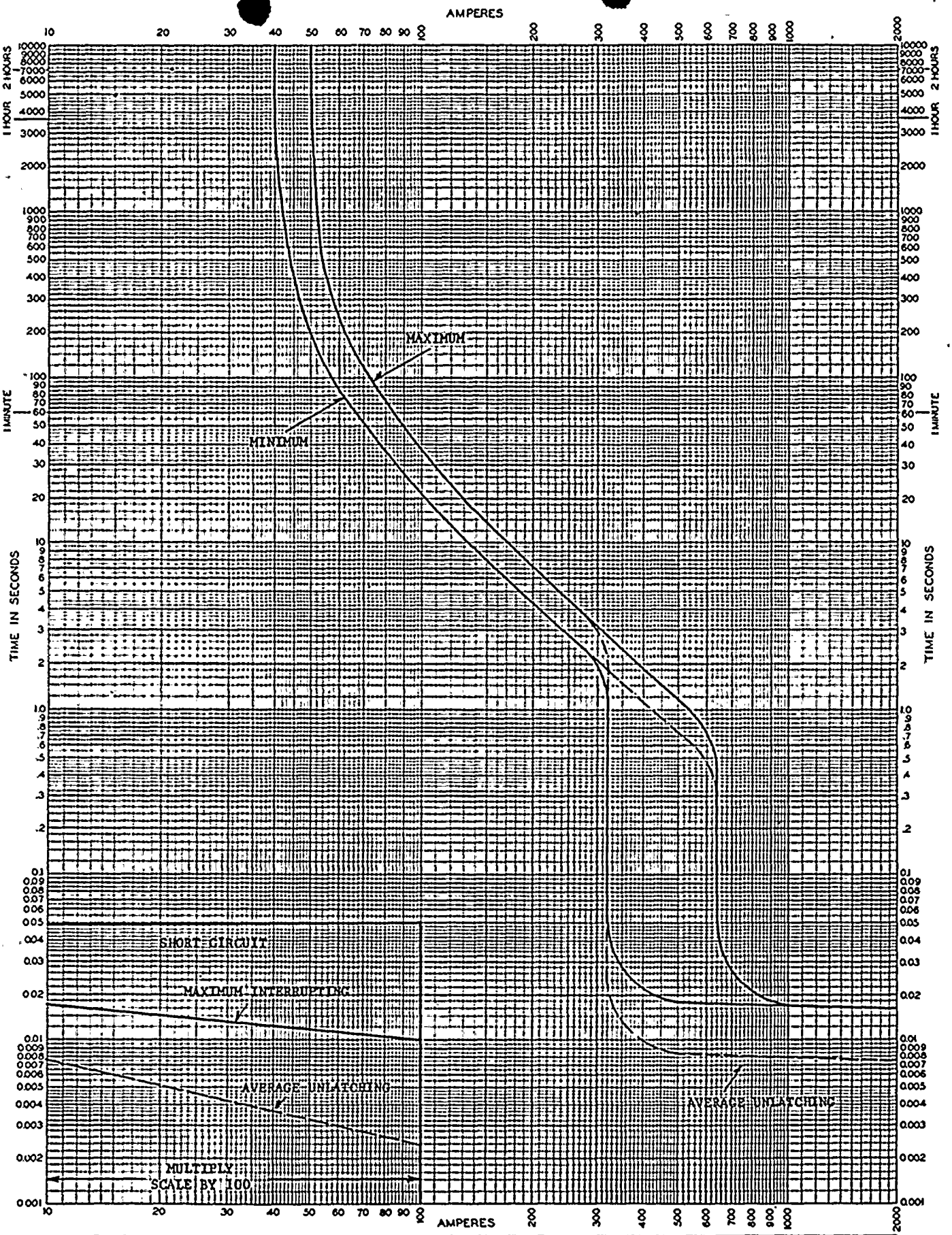
BASIS FOR DATA Standards ..... Dated .....

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 .....

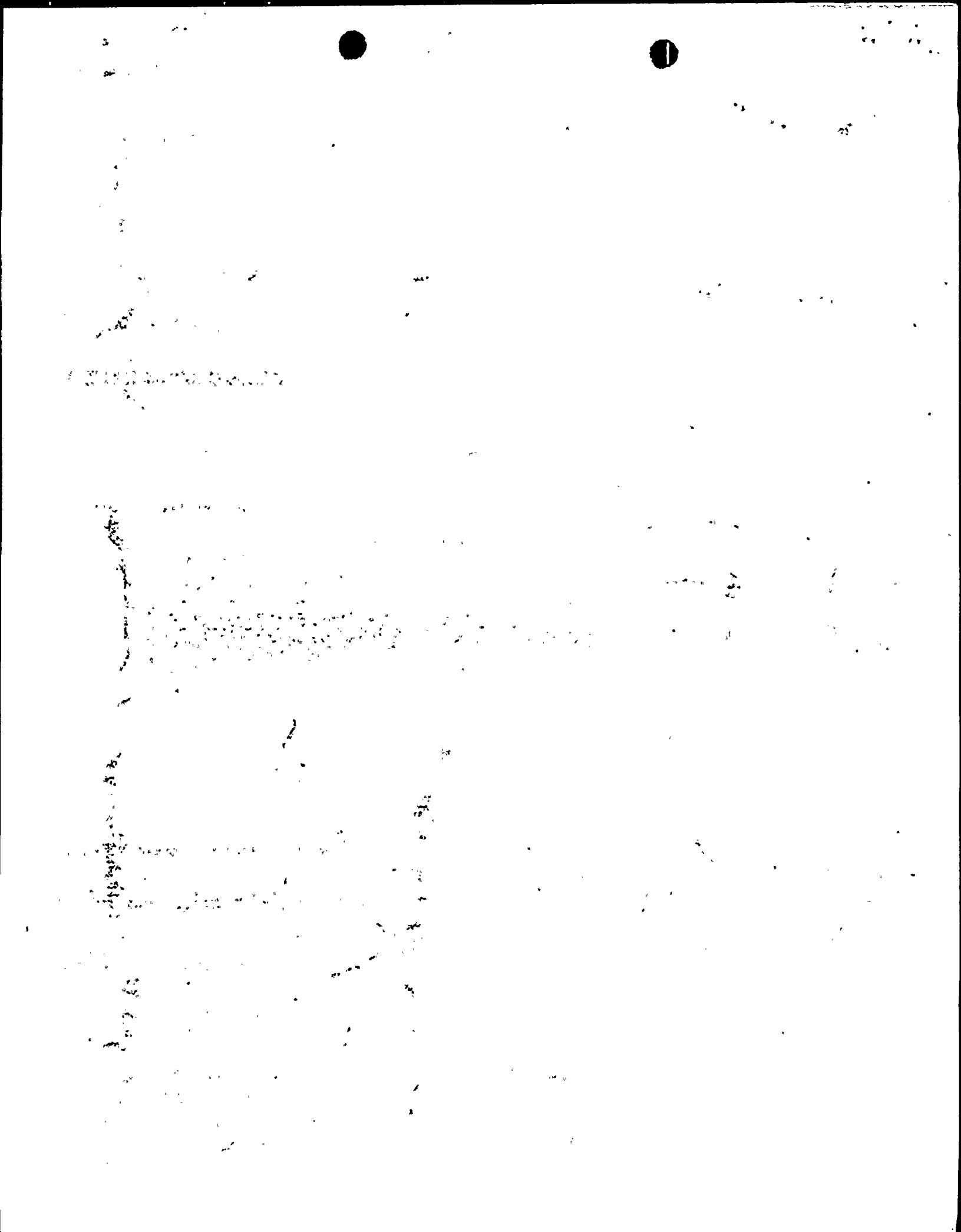
No. .....

Date 12-4-75

Ref. AE-5



WESTINGHOUSE ELECTRIC CORPORATION	CURVE NO. 548103
AB DE-ION BREAKERS - TYPE FA - THERMAL MAGNETIC 600 VAC 250 VDC 2 Pole 40 Amp. S#368D451G04 Cat. No. FA2040 600 VAC 3 Pole 40 Amp. S#368D451G20 Cat. No. FA3040 CURVES BASED ON AMBIENT TEMP. 40°C COLD START	BY J.E. Ellsworth DATE 3-2-64 APP _____ DATE _____ DWG. NO. SHEET NO. REV.



Ref. · CE-17
CE-18

OUTLINE DIMENSIONS

600 VOLT FORM 101 AMP-TRAP

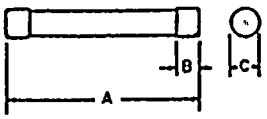


FIG. 1 – TYPE 1

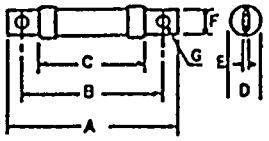
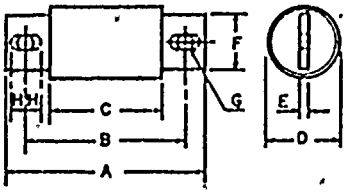


FIG. 2 — TYPE 4 — FIG. 3



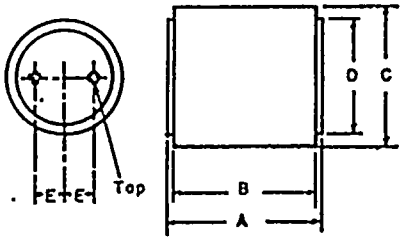
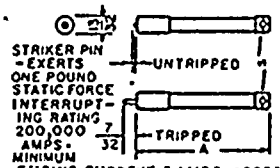


FIG. 4 — TYPE 128 — FIG. 5



FUSING CURRENT 5 AMPS. APPROX.

CAT. NO.	VOLTS	A
TI-130	0-130	2
TI-600	0-600	2
TI-1500	0-1500	3 1/2

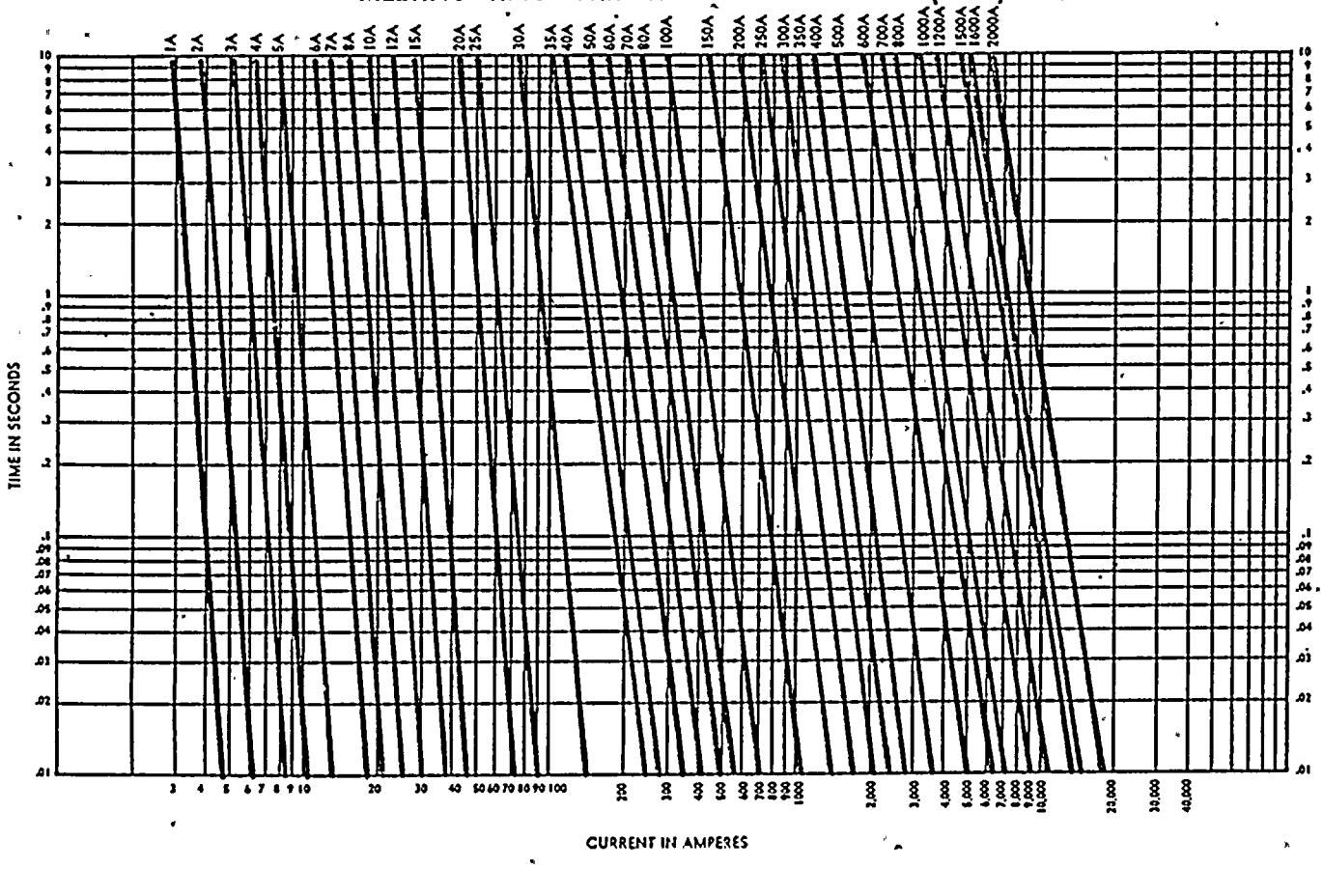
SHAWMUT TRIGGERS

I²T-600 VOLTS OR LESS			
A60X or A60Z	MELTING I²T	CLEARING I²T (250 V CIRCUIT)	CLEARING I²T (600V CIRCUIT)
1	.04	.09	.11
2	.22	.36	.45
3	.90	1.4	1.8
5	1.4	2.2	2.8
6	2.0	3.2	4.0
7	2.7	4.3	5.4
8	3.6	5.7	7.1
10	20	39	52
12	30	48	64
15	45	70	100
20	80	130	170
25	130	210	275
30	180	290	400
35	600	1200	1850
40	780	1600	2400
50	1200	2400	3600
60	1800	3600	5400
70	2400	4800	7200
80	3100	6200	9300
100	4900	9800	1.5×10^4
150	1.4×10^4	2.8×10^4	42
200	2.6 "	.52 "	7.8 "
250	4.0 "	8.0 "	12.0 "
300	5.8 "	12 "	18 "
350	7.8 "	16 "	24 "
400	10 "	20 "	30 "
600	36 "	72 "	110 "
800	64 "	130 "	190 "
1000	120 "	240 "	360 "
1200	170 "	340 "	510 "
1500	—	—	—
1600	310 "	620 "	930 "
1800	390 "	780 "	1200 "
2000	480 "	960 "	1400 "

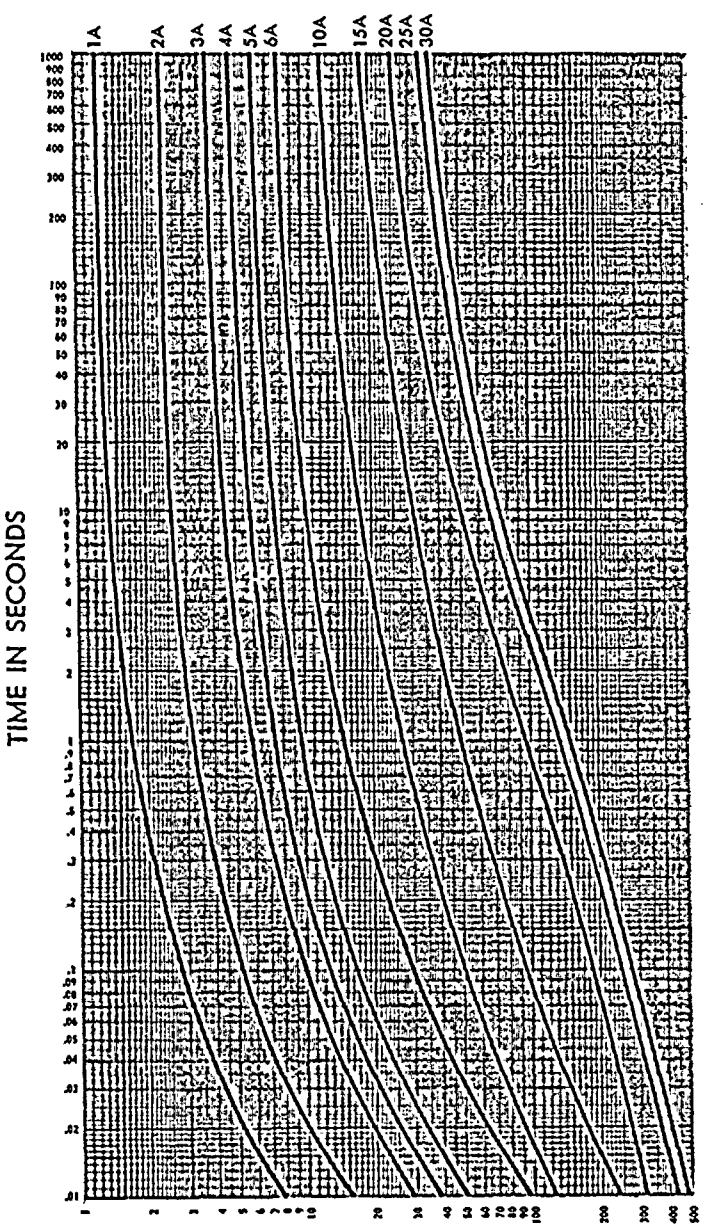
DIMENSIONS:

FIG.	CATALOG NO.	TYPE	A	B	C	D	E	F	G	H	TAP
1	A60X 1-30	1	5	5/8	13/16						
2	A60X 35-60	4	4 3/8	3 5/8	2 3/4	13/16	1/8	23/32	11/32		
3	A60X 65-100	4	413/32	321/32	229/32	1	1/8	3/4	5/16		
3	A60X 125-200	4	413/32	321/32	229/32	17/32	3/16	1	5/16		
3	A60X 225-400	4	5 1/8	4 1/16	27/8	11/2	1/4	1	13/32		
3	A60X 450-600	4	5 1/8	4 1/16	27/8	2	1/4	1 1/2	13/32		
3	A60X 700-800	4	7 1/4	5 1/4	3	2 1/2	3/8	2	17/32	39/64	
4	A60X 700-800	128	4	3 3/4	3	2 1/2	3/4				3/8-24 1/2 Deep
5	A60X 1000-1200	128	4	3 3/4	31/2	3	3/4	3/4			3/8-24 1/2 Deep
5	A60X 1600-2000	128	4	3 3/4	41/2	3 3/4	3/4	3/4			1/2-20 1/2 Deep

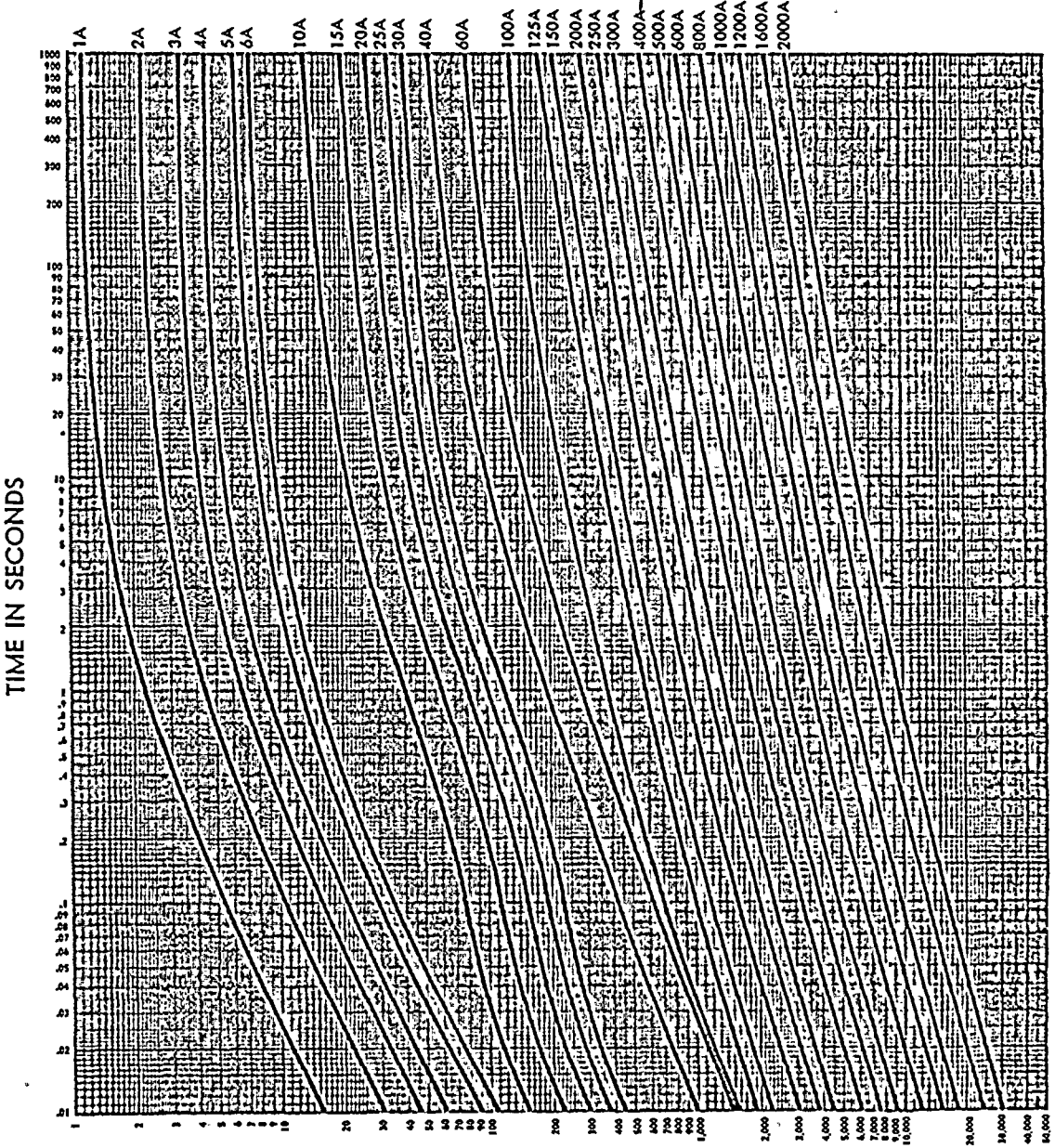
MELTING TIME-CURRENT CHARACTERISTICS (A60X)



FORM 600 AMP-TRAP FUSE
MELTING TIME-CURRENT CURVES
A6Y1-30 TYPE 2 (600 VOLTS)



FORM 600 AMP-TRAP FUSE
MELTING TIME-CURRENT CURVES
A2Y OR A6Y1-600 TYPES 1, 3, 4 OR 5 (250 OR 600 VOLTS)
A6Y650-2000 TYPES 4 OR 5 (600 VOLTS)



Ref. CE-23

Appendix C

Crouse Hinds Drawings/Numbers

0100350	Sheets 1 through 3
0100044	Sheet 1 of 1
0100251	Sheet 1 of 1
0100252	Sheet 1 of 1
0100253	Sheet 1 of 1
0100254	Sheet 1 of 1
0100259	Sheet 1 of 1
0100261	Sheet 1 of 1
0100308	Sheet 1 of 1
0100314	Sheet 1 of 1
0100334	Sheet 1 of 1
0100342	Sheet 1 of 2
0100411	Sheet 1 of 1
0100416	Sheet 1 of 1
0100696	Sheet 1 of 1

Westinghouse Drawings

E 2802 Rev. C

E 2850 Rev. B