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RECIP.NAME RECIPIENT AFFILIATION
CRUTCHFIELD,D. Operating Reactors Branch 5

SUBJECT: Forwards rept on SEP Topic VIII-4, "Electrical Penetrations of Reactor Containment." Penetrations have been identified as typical circuits.

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JOHN E. MAIER
VICE PRESIDENT

TELEPHONE
AREA CODE 716 546-2700

June 9, 1981

Director of Nuclear Reactor Regulation
Attention: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: SEP Topic VIII-4, Electrical Penetrations
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Crutchfield:

In response to your March 30, 1981 letter requesting a detailed report on the subject SEP topic, RG&E is enclosing a copy of its report which assesses Ginna Station's ability to withstand and clear, low magnitude fault currents on its electrical penetrations. Specifically, the penetrations identified in the Draft Technical Evaluation have been evaluated as typical circuits and recommendations for improved backup relay protection have been proposed.

In addition, all similar penetration circuits with the potential to cause a seal failure due to various levels of fault current will be evaluated and modifications to improve the backup breaker relay characteristics will be made as required.

Once all the engineering for the proposed modifications is completed, we will inform your office of our intended corrective actions only if they depart from the generic corrective actions contained in our report.

This report and the resulting modifications completes our response to SEP Topic VIII-4.

Very truly yours,

J. E. Maier

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P

ROCHESTER GAS & ELECTRIC CORPORATION

R. E. GINNA NUCLEAR POWER PLANT

EVALUATION OF SELECTED PENETRATIONS
TO WITHSTAND LOW MAGNITUDE FAULTS

SEP TECHNICAL EVALUATION
TOPIC VIII-4

ELECTRICAL PENETRATIONS OF REACTOR CONTAINMENT
DOCKET NO. 50-244

JUNE 3, 1981

CONTENTS

[illegible]

SEP TECHNICAL EVALUATION

TOPIC VIII-4

ELECTRICAL PENETRATIONS OF REACTOR CONTAINMENT

R. E. GINNA NUCLEAR POWER PLANT

1.0 SUMMARY

This evaluation looked at the protection schemes of five electrical penetrations, AE-6, CE-21, CE-23, CE-25 and CE-27, which do not meet present design criteria under the systematic evaluation program (SEP) Topic VIII-4.

SEP Topic VIII-4 requires the electrical penetration be protected under the following conditions:

1. A loss of cooling accident (LOCA).
2. An electrical fault has occurred in containment.
3. Primary protective device fails to clear the fault.

Under the above conservative assumptions, it was found that the backup protection for the five penetrations might fail to clear low magnitude fault currents before these currents could potentially damage the penetration.

The response curves of the different protective devices were plotted with the I^2t curve for each penetration. The curves were analyzed to verify where additional secondary protection was desirable and what improvements were needed. The primary protective devices were also reviewed to insure adequate coverage.

Recommendations are made for the installation of additional protective devices. These, in conjunction with devices already in operation, will provide a backup protective system capable of

clearing any value of available fault current while maintaining the integrity of the electrical penetration. All the remaining issues for this part of the SEP Topic VIII-4 will be resolved when these improvements are implemented.

2.0 INTRODUCTION

This report will review and address the coverage by the backup overcurrent protective devices used on some of the sample electrical penetrations previously analyzed for the Systematic Evaluation Program. Inadequacies in the coverage might cause the penetration seal to fail due to overheating before the fault current could be cleared. The penetration seal fails when the solder or brazing used in the penetrations' construction melts, resulting in damage to its hermetic seal.

There are presently seven different types of electrical penetrations used at Ginna Station that were manufctured by Crouse-Hinds. They are classified by conductor size, number and configuration of conductors, voltage class and their use. A sample of each type of penetration and its descriptions are listed in Table I - Penetration Data; Section 4. The same sample penetrations listed were used in the original evaluation.

For the purpose of the SEP Topic evaluation, the following was postulated; the containment penetrations would be uniformly at LOCA temperatures concurrent with a random failure of the circuits primary protective device. The effects of both high and low magnitude fault currents were then analyzed to review the performance of the backup protective device(s).

Under these conditions, backup circuit protective devices on low voltage penetrations AE-6, CE-21 and medium voltage penetrations CE-25 and CE-27 were found to have problems clearing low magnitude faults prior to potential failure of the penetration seal. In

addition, CE-23's backup device failed to protect the penetration for all values of fault current in case the primary device, a fuse, failed to open.

This report determines where additional backup protection is needed. It also recommends what modifications or equipment additions should be made to provide a backup protection system which adequately protects the penetrations for available fault current levels during the conditions postulated in the SEP Topic VIII-4.

3.0 ASSUMPTIONS AND CRITERIA

I^2t curves for each penetration under evaluation were required to accurately analyze the characteristics of the protective devices in the circuit. These I^2t curves were established using the following criteria:

1. The melting point of soft solder is 356°F or 180°C. Soft solder was used in construction of penetrations AE-5, AE-6, AE-10, CE-1, CE-8, CE-17, CE-18 and CE-23.
2. The melting point of silver brazing is 1100°F or 600°C. Silver brazing was used in construction of penetrations CE-21, CE-25 and CE-27.
3. The initial temperature of the penetration was assumed to be 140°C based on the conditions found during a loss of coolant accident (LOCA).
4. The following formula was used to calculate I^2t values based on the penetration conductor size and whether soft solder or silver brazing was used during its manufacturer.

$$I^2t = (0.0297)(A)^2 \log\left(\frac{T_2 + 234}{T_1 + 234}\right) \quad \text{(Formula 1)}$$

where t = time allowed for the short circuit in seconds

I = short circuit current in amperes

A = conductor area in circular mils

T_1 = maximum operating temperature (140°C, LOCA condition)

T_2 = maximum short circuit temperature of penetration (180°C temperature for melting solder or 600°C for melting silver brazing).

This formula is based upon the heating effect of the current in the conductor and assumes that the heating process is adiabatic. (See Reference 4, Attachment 4.)

This formula was used to determine the I^2t values because it provided a more conservative value than the test and calculated data supplied by Crouse-Hinds. Although operating the protective devices under such a restricted curve may limit what devices may be used, it was considered good engineering practice to do so. This insures a more consistant standard on which to base decisions for penetration protection improvement.

Guidelines established by IEEE Standard 317-1976--"Standard for Electrical Penetrations Assemblies" and U.S. NRC Regulatory Guide 1.63--were used in evaluating the performance of both the primary and secondary devices pertinent to the penetration under study.

SECTION 4

PENETRATION DATA

PENETRATION Number	PENETRATION Type	Maximum Current Withstand RMS Amp	Maximum Current Withstand I^2t	Current Rating	Maximum Isc Available	Maximum Allowable Time for Isc (Sec)	Clearing Time for Pri. Device (Sec)	Clearing Time for Sec. Device (Sec)	Clearing Time for Backup Device (Sec)	Circuit Type
AE-6	#2 AWG 21 PIN 600 V	30KA	$57.7X10^{5}$	95	9,600	0.06	0.01	0.02	0.1	Light Trans. 480 V
AE-5	#8 AWG 60 PIN 600 V	1400+	$3.6X10^{5}$	40	3,500	0.029	0.018	0.002	Not Req.	Low Voltage Power 480 V
CE-21	500 MCM 3 PIN	64KA	$25.8X10^{8}$	1000	20,000	6.5	0.045	26.0	0.5	Contain-ment Air Recir. Fan 480 V
CE-25 CE-27	750 MCM 3 PIN	64KA	$58.2X10^{8}$	1000	36,800	4.3	0.017	0.184	0.15	Reactor Coolant Pump 4160 V
CE-18	#2 AWG 21 Pin 5KV	30KA	$57.7X10^{5}$	95	270	79.2	0.18	0.576	Not Req.	Rod Drive Lift Coils 125V DC
CE-17	#8 AWG 60 Pin 5KV	1400+	$3.6X10^{5}$	40	260	5.28	0.0004	0.0043	Not Req.	Rod Drive Gripper Coils 125V DC
CE-23	#10 AWG 144 PIN 600 V	1250+	$14.1X10^{4}$	30	600	0.392	<0.001	<0.001	>700	Emerg. Light 125V DC

Table 1 - Penetration Data

PENETRATION Number	Type	Maximum Current Withstand RMS Amp	I2t	Current Rating	Maximum Isc Available	Maximum Allowable Time for ISC (Sec)	Clearing Time for Pri. Device (Sec)	Clearing Time for Sec. Device (Sec)	Clearing Time for Backup Device (Sec)	Circuit Type
AE-10	#16 SHLD Twisted Prs & Quads	100+	$8.7X10^3$	12	0.05	Cont.			Not Req.	Inst. Current Loops
CE-1	#16 28 SHLD Quads	100+	$8.7X10^3$	12	0.05	Cont.			Not Req.	Inst. Current Loop
CE-8	Triaxial	I. Bal.	$40X10^3$	10	1	Cont.			Not Req.	Power Range De- tector

Table 1 - Penetration Data

5.0 PENETRATION EVALUATIONS AND RECOMMENDATIONS

Procedure for the penetration study consisted of the following:

a. Establishment of circuit single line diagrams.

b. Acquisition of protective device settings and response characteristics.

c. Calculation of I^2t values.

d. Plotting of time-current curves.

e. Review of primary device fault current response.

f. Review of secondary device fault current response.

g. Determination where additional fault protection was needed.

h. Selection and recommendation of what device was best suited to correct coverage inadequacies.

5.1 Review of Satisfactory Penetrations. Penetrations AE-5, CE-17 and CE-18 were deemed suitable under all postulated environmental conditions during the first review for the SEP Topic VIII-4. The I^2t values were recalculated for these penetrations to reflect the 140^oC initial temperature found in a LOCA condition. Maximum allowable short circuit current (Isc) times were also recalculated and compared to the clearing times for the primary and secondary protective devices. The systems were capable of clearing all faults under the conditions postulated in Section 3.

Penetrations CE-1, CE-8 and AE-10 were also found suitable because their available Isc was less than the continuous rating of the penetration.

5.2 Penetration Number AE-6. The AE-6 penetration has 21-#2 AWG conductors and is classified as low voltage (0-1000VAC). This particular penetration is used to supply 480VAC to a 30 KVA lighting transformer. A single line diagram for this penetration is shown on page 11. The continuous current rating of this penetration is 95 amperes. Soft solder, with a melting point of 180°C was used in its construction. Maximum short circuit current (Isc) available to this penentration is 9600 amperes.

Based on these conditions using Formula 1:

I^2t at short circuit current (9,600 amps) is:

$$I^2t = .0297 \times (66360)^2 \log \left(\frac{180 + 234}{140 + 234} \right)$$

$$I^2t = 57.7 \times 10^5 \text{ (ampere)}^2 \text{ seconds}$$

t = 0.0626 seconds at 9600 amperes

t = 0.23 seconds at 5000 amperes

t = 5.77 seconds at 1000 amperes.

The time-current characteristic curves for the AE-6 penetration are shown on page 13. Analysis shows that the primary protective device 4K (Curve #5), a molded case breaker located in a motor control center, will clear fault currents from 60 amperes up to and including the Isc of 9600 amperes. Primary clearing time at Isc is 0.01

[illegible]

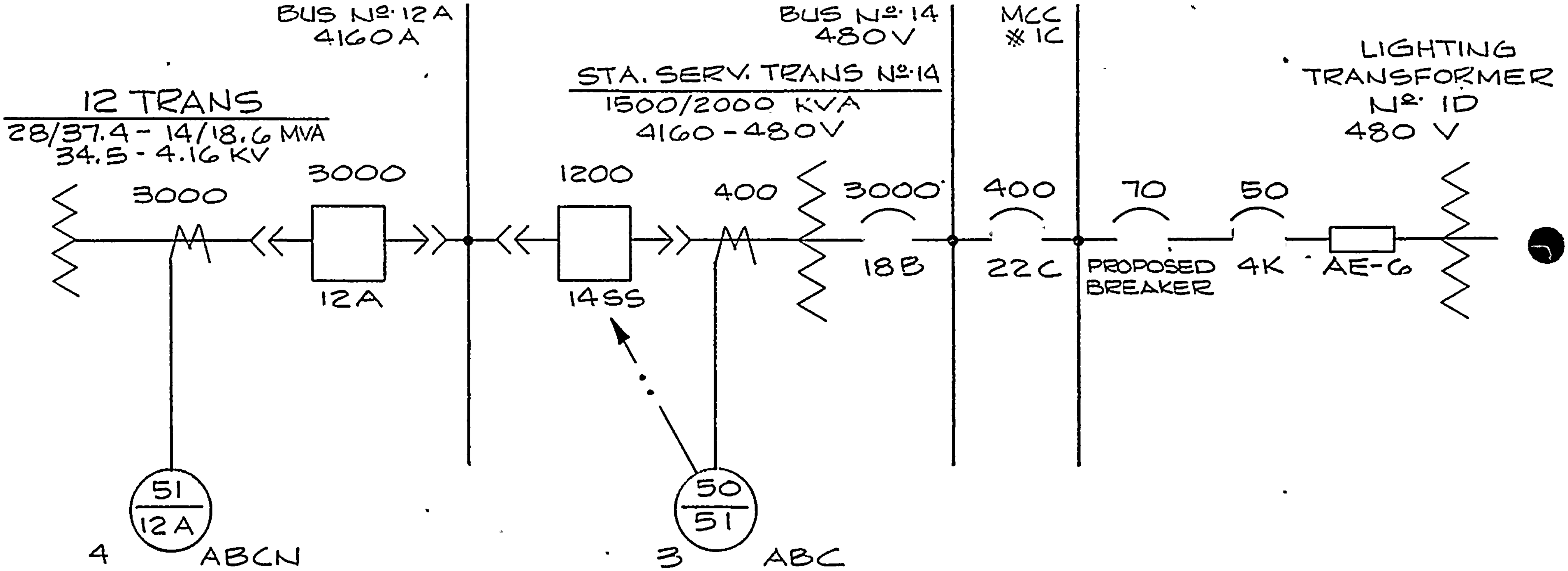
[illegible]

[illegible]

seconds. Backup device 22C (Curve #4) will not clear fault currents up to 3000 amperes or between 7000 and 9600 amps before the I^2t value is exceeded. Any of these fault current could result in seal damage.

Recommendation

Improved backup protection will be accomplished by the installation of a 70 ampere backup breaker installed at the motor control center. This device will exhibit the characteristic curve #6 shown on the time-current curve for the AE-6 penetration. This will provide backup protection for all fault currents and has a Isc clearing time of 0.017 seconds.



I^2t = 57.7×10^5
SHORT CIRCUIT CURRENT = 9,600 AMP
MAXIMUM ALLOWABLE
TIME FOR I_{sc} = 0.06 SEC.

CLEARING TIMES FOR I_{sc}

1. PRIMARY BREAKER = 0.018 SEC.
2. SECONDARY BREAKER = 0.02 SEC.
3. BACKUP BREAKER = 0.1 SEC.

5.2.1

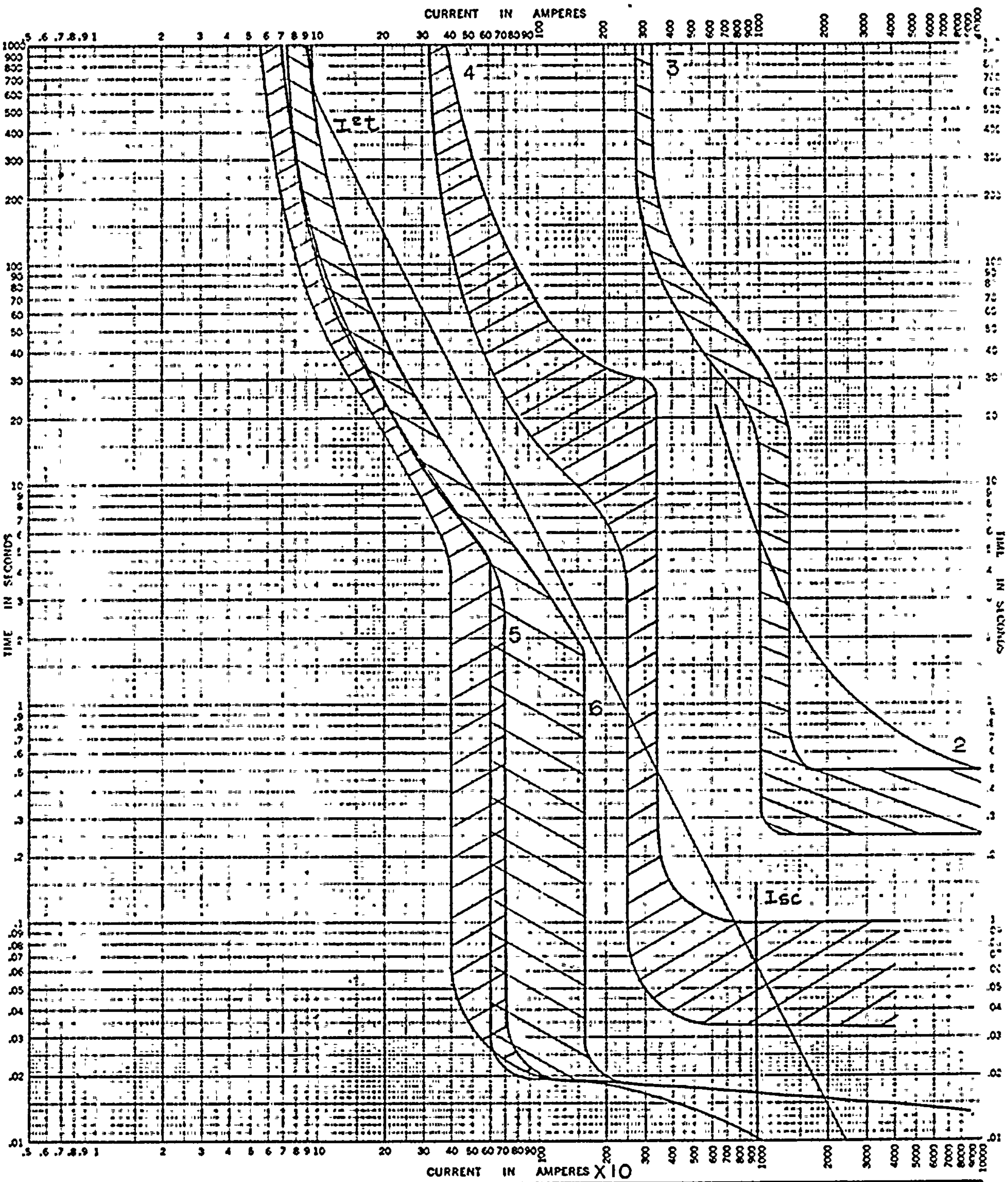
DRAWN BY: BARRAGATO	STA. 13 AE-6
ENGR. MOHAMMED, ZAHEER	SINGLE LINE

5.2.2
PROTECTIVE DEVICE SETTINGS

AE-6

Ref. No. on Graph	Circuit	Device	Relay Type	CT Ratio	Range	Setting
1	12A BUS	51/12A	CO-8	3000/5	4-12A	12A-1TLS
	12A BUS	51N/12A	CO-8	3000/5	0.5-2.5A	0.5A-0.5TLS
2	14 STA. SERV. TRANSFORMER	50/51	CO-8	400/5	4-12TOC 40-160IOC	7A-3TLS 70A
	14 STA. SERV. TRANSFORMER	50G	ITH	100/5	1-2A	1A

	Circuit	Cell #	Bkr. Type	Continuous Current Rating Amps	Pick-Up in Amps Long Delay	Pick-Up in Amps Short Delay	Inst	Time Delay Long Delay(sec)	Time Delay Short Delay(cyc)
3	14 BUS	18B	DB-75	3000	3000	12000		70	30
4	LIGHTING TRANS. NO.1D	22C	DB-50	400	350	3000		30	6
5	LIGHTING TRANS. NO.1D	4K	HFA	50					
6	LIGHTING TRANS. NO.1D		HFB	70					



For AE-6 ______ 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. 5.2.3

Date ______

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

5.3 Penetration Number CE-21. The CE-21 penetration has three 500 KCM conductors and is classified as a low voltage (0-1000VAC) type. The penetration is used to supply 480VAC to Containment Air Recirculating Fan 1A. The circuit single line is shown on page 16. The continuous rating of this penetration is 1000 amperes. Silver brazing, with a melting point of 600°C was used in its construction. Maximum short circuit current (Isc) available to the penetration is 20,000 amperes.

Based on these conditions using Formula 1:

I^2t at short circuit current (20,000 amps) is:

$$I^2t = .0297 \times (500,000)^2 \log\left(\frac{600 + 234}{140 + 234}\right)$$

$$I^2t = 25.8 \times 10^8 \text{ (ampere)}^2 \text{ seconds}$$

t = 6.5 seconds at 20,000 amperes

t = 2.87 seconds at 30,000 amperes

t = 25.9 seconds at 10,000 amperes

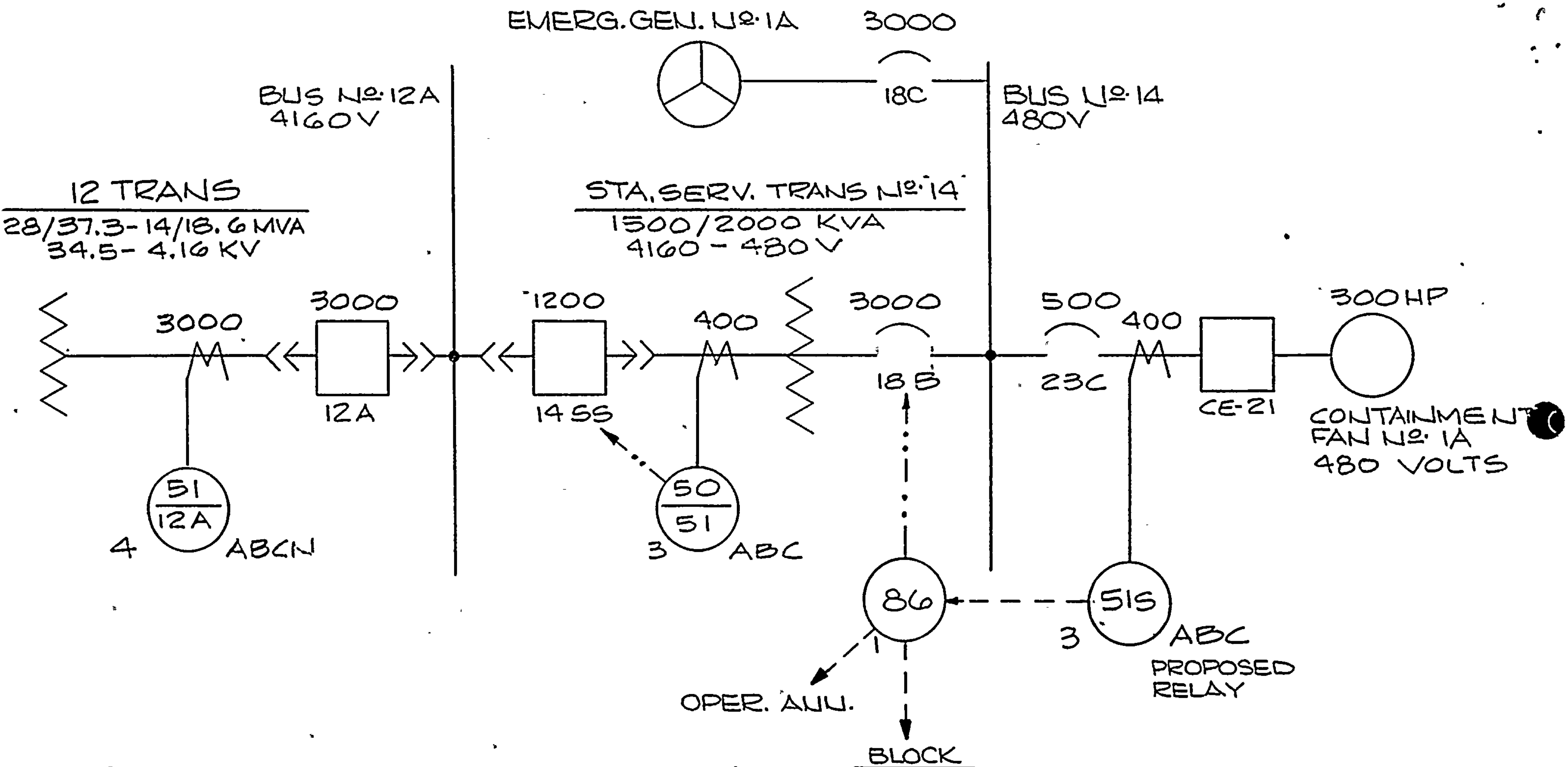
The time-current characteristic curves for the CE-21 penetration are shown on page 18. Analysis shows that the primary protective device, 23C (Curve #5), will clear all values of fault current from its long term setting of 450 amperes to Isc of 20,000 amperes. Clearing time for the primary device at Isc is 0.045 seconds. The existing backup devices, breaker 18B (Curve #4) and relay 50/51 (Curve #2), will clear fault currents between 3000 amperes

and Isc of 20,000 amperes. However, the backup devices fail to clear low magnitude faults up to 3000 amperes. It is between these low magnitudes of fault current that seal overheating and damage may occur.

Recommendation

To improve the low level protection, an additional secondary relay, 51S, will be installed to trip the low side breaker 18B of transformer #14. The relay's response curve #3 is shown on the time-current curves for the CE-21. A set of current transformers which will be used to operate 51S will be installed on the power cables prior to penetration. The generator, No. 1A, will not be blocked for conditions other than the penetration fault.

The addition of this secondary relay will provide a reliable backup protection scheme which will insure the clearing of all fault currents in this circuit prior to penetration damage.



I²t = 25.8 × 10⁸
SHORT CIRCUIT CURRENT = 20,000 AMPS
MAXIMUM ALLOWABLE TIME FOR Isc = 6.5 SEC.

I^2t	$= 25.8 \times 10^8$
SHORT CIRCUIT CURRENT	= 20,000 AMPS
MAXIMUM ALLOWABLE TIME FOR I_{sc}	= 6.5 SEC.

CLEARING TIMES FOR I_{sc}

1. PRIMARY BREAKER = 0.045 SEC.
2. SECONDARY RELAY = 26.0 SEC. OPERATED @ 6,000 AMPS.
3. BACKUP BREAKER = 0.5 SEC.

5.3.1

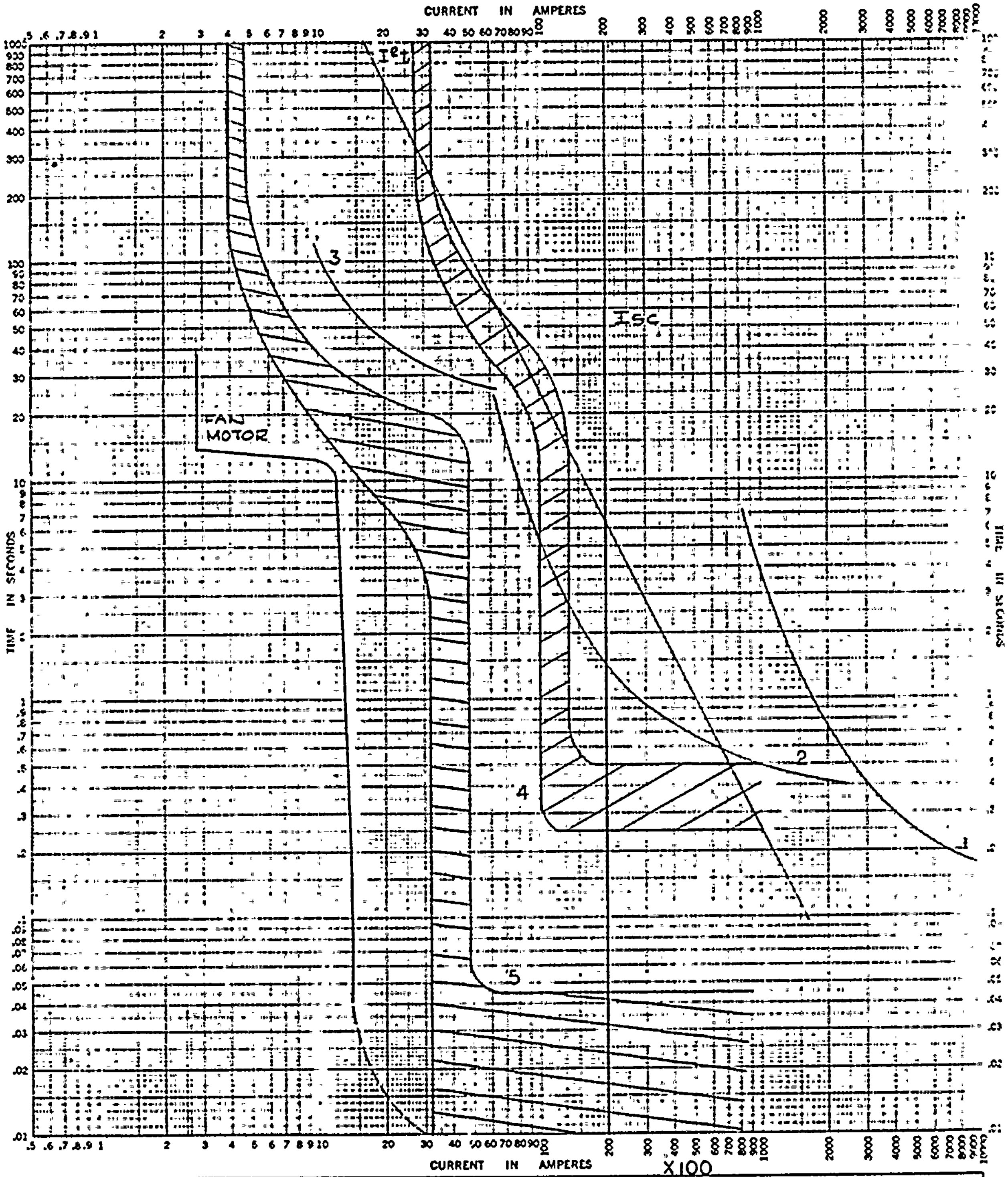
DRAWN BY: BARRAGATO	STA. 13 CE - 21
ENGR. MOHAMMED, ZAHEER	SINGLE LINE

5.3.2
PROTECTIVE DEVICE SETTINGS

CE-21

Ref. No. on Graph	Circuit	Device	Relay Type	CT Ratio	Range	Setting
1	12A BUS	51/12A	CO-8	3000/5	4-12A	12A-1TLS
	12A BUS	51N/12A	CO-8	3000/5	0.5-2.5A	0.5A-0.5TLS
2	14 STA. SERV. TRANSFORMER	50/51	CO-8	400/5	4-12TOC 40-160IOC	7A-3TLS 70A
	14 STA. SERV. TRANSFORMER	50G	ITH	100/5	1-2A	1A
3	CONTAINMENT FAN FAN NO. 1A	51S	CO-5	400/5	4-12TOC	8A-11TLS

	Circuit	Cell #	Bkr. Type	Continuous Current Rating Amps	Pick-Up in Amps Long Delay	Pick-Up in Amps Short Delay	Inst	Time Delay Long Delay(sec)	Time Delay Short Delay(cyc)
4	14 BUS	18B	DB-75	3000	3000	12000		70	30
5	CONTAINMENT FAN NO. 1A	23C	DB-50	500	425		4000	20	



For CE-21 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. 5.3.3
Date

5.4 <u>Penetration Numbers CE-25 and CE-27</u>. These penetrations have three 750 KCM conductors and are classified as a medium voltage ($>$1000VAC) penetration. They are used in parallel to supply 4160VAC to one 6000 horsepower (HP) reactor coolant pump (RCP). The RCP elementary and single line diagrams are provided on pages 21 and 22 respectively. The continuous current rating of these penetrations is 1000 amperes. Silver brazing with a melting point of 600°C was used in their construction. Maximum fault current available to the penetrations is 36,800 amperes.

Based on these conditions using Formula 1:

I^2t at short circuit current (36,800 amps) is:

$$I^2t = (0.029)(750{,}000)^2 \log\left(\frac{600 + 234}{140 + 234}\right)$$

$$I^2t = 58.2 \times 10^8 \text{ (amperes)}^2 \text{ seconds}$$

$t = 4.3$ seconds at 36,800 amperes

$t = 9.31$ seconds at 25,000 amperes

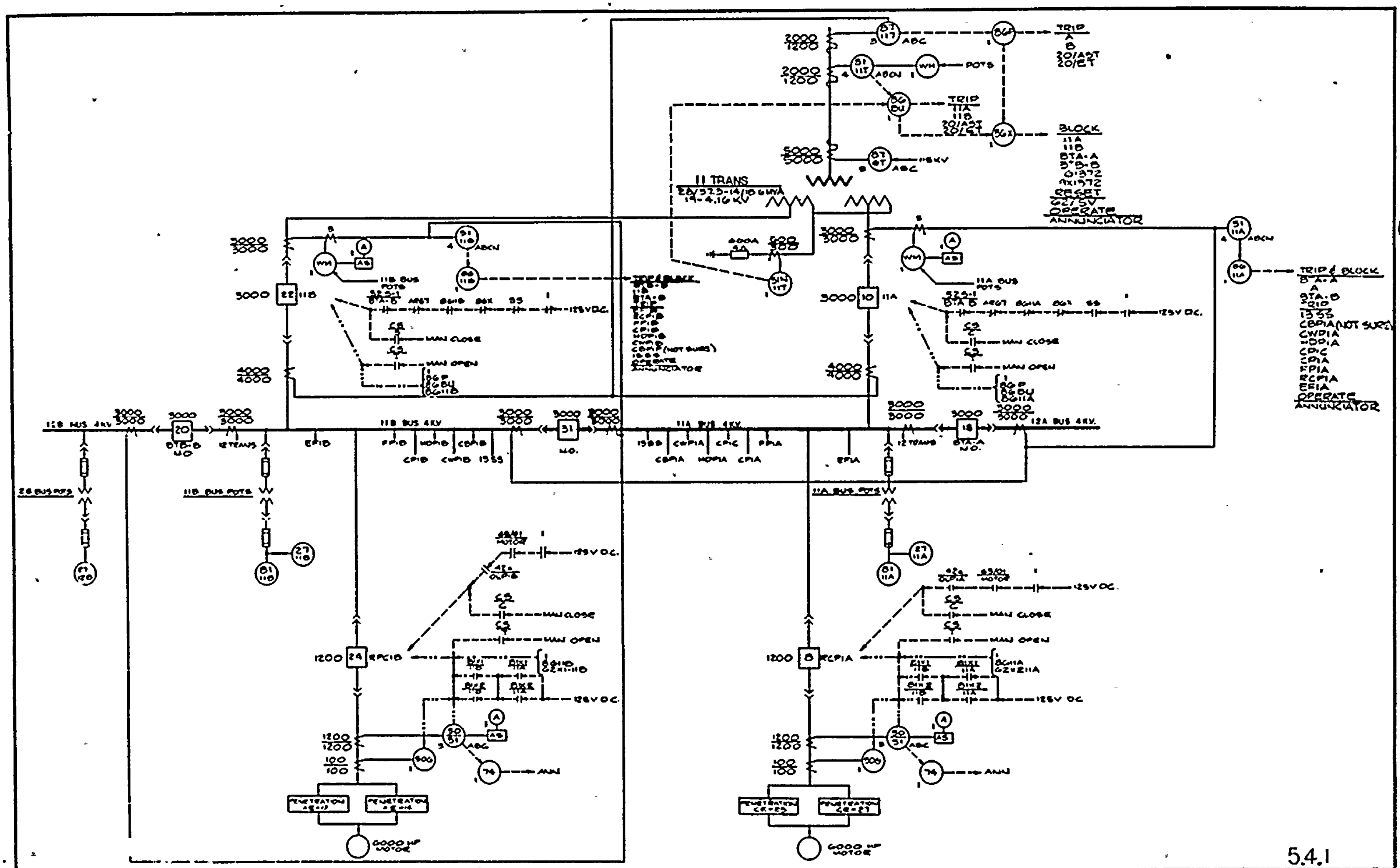
$t = 25.86$ seconds at 15,000 amperes

The time-current characteristic curves for the CE-25 and CE-27 penetrations are shown on page 24. Analysis shows that the primary protective relay, 50P/51P (Curve #4), will protect for all levels of fault current and will clear Isc in 0.017 seconds. Backup relay 51/11A (Curve #2) will also clear fault currents above 9000 amps and

clear Isc in .15 seconds. However, the backup relay will not clear lower magnitude faults between 1000 and 9000 amperes. The 51/11T relay (Curve #1) on the primary side of 11 Transformer will not provide low fault protection either. It is at these low fault current levels where there is a potential for seal damage.

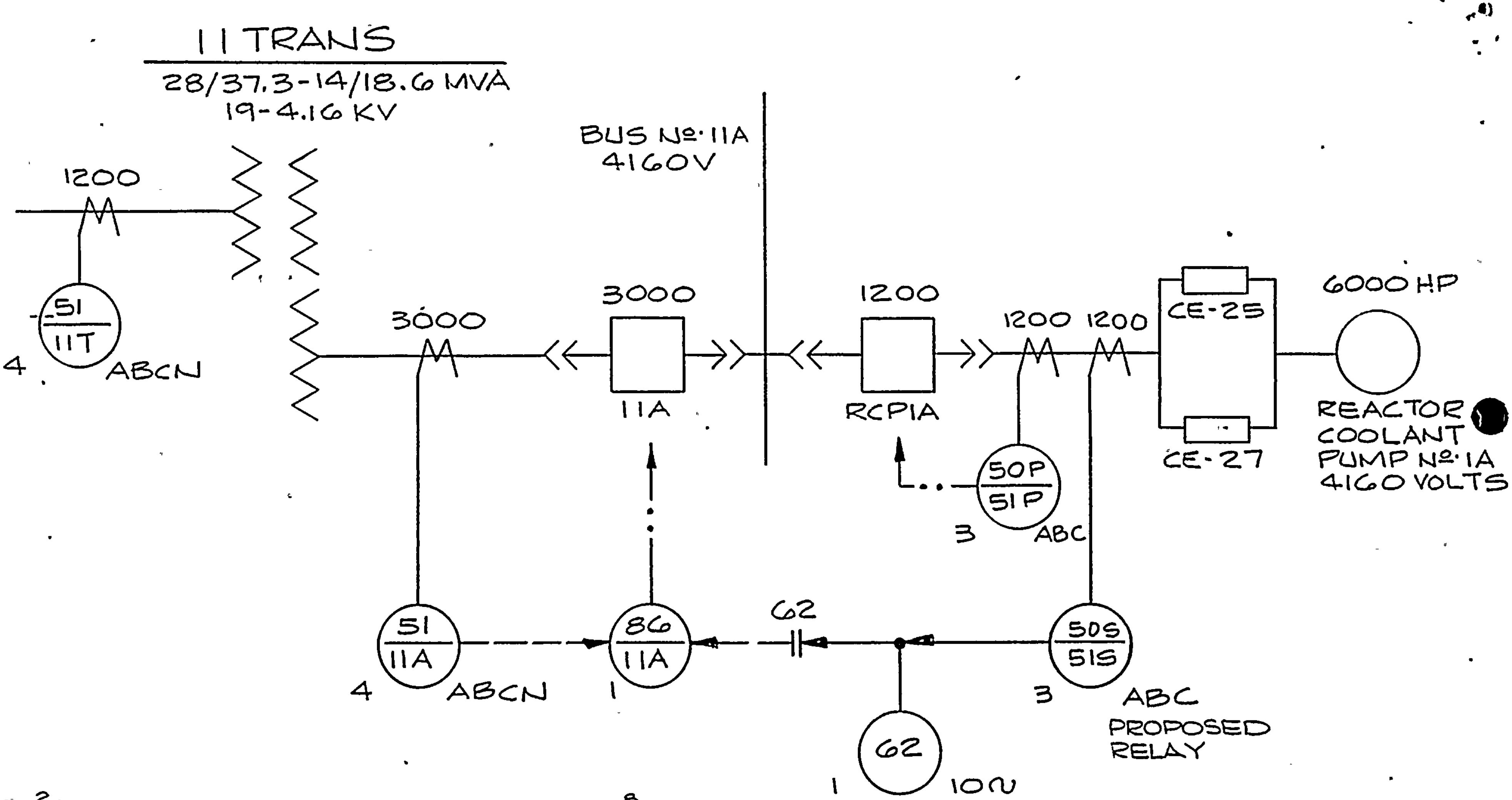
Recommendation

To improve the secondary relay protection for low magnitude faults, an additional relay 50S/51S will be installed with a response characteristic as shown on the time-current curves as curve 3. This relay will be connected to a new set of current transformers installed on the power cables prior to penetration. The new current transformers will give total redundancy in that the new secondary protective device has no dependency on any component in the primary scheme. This new relay will add the additional protection needed to provide adequate clearing times for the backup protective devices to prevent seal damage under the conditions postulated.



5.4.1

STA. 13	RCPIA & RCPIB
ELEMENTARY	
	NO. 21



I^2t	=	58.2×10^8
SHORT CIRCUIT CURRENT	=	36,800 AMPS
MAXIMUM ALLOWABLE TIME FOR Isc	=	4.3 SEC.

CLEARING TIMES FOR Isc

1. PRIMARY RELAY	=	0.017 SEC.
2. SECONDARY RELAY	=	0.184 SEC.
3. BACKUP RELAY	=	0.15 SEC.

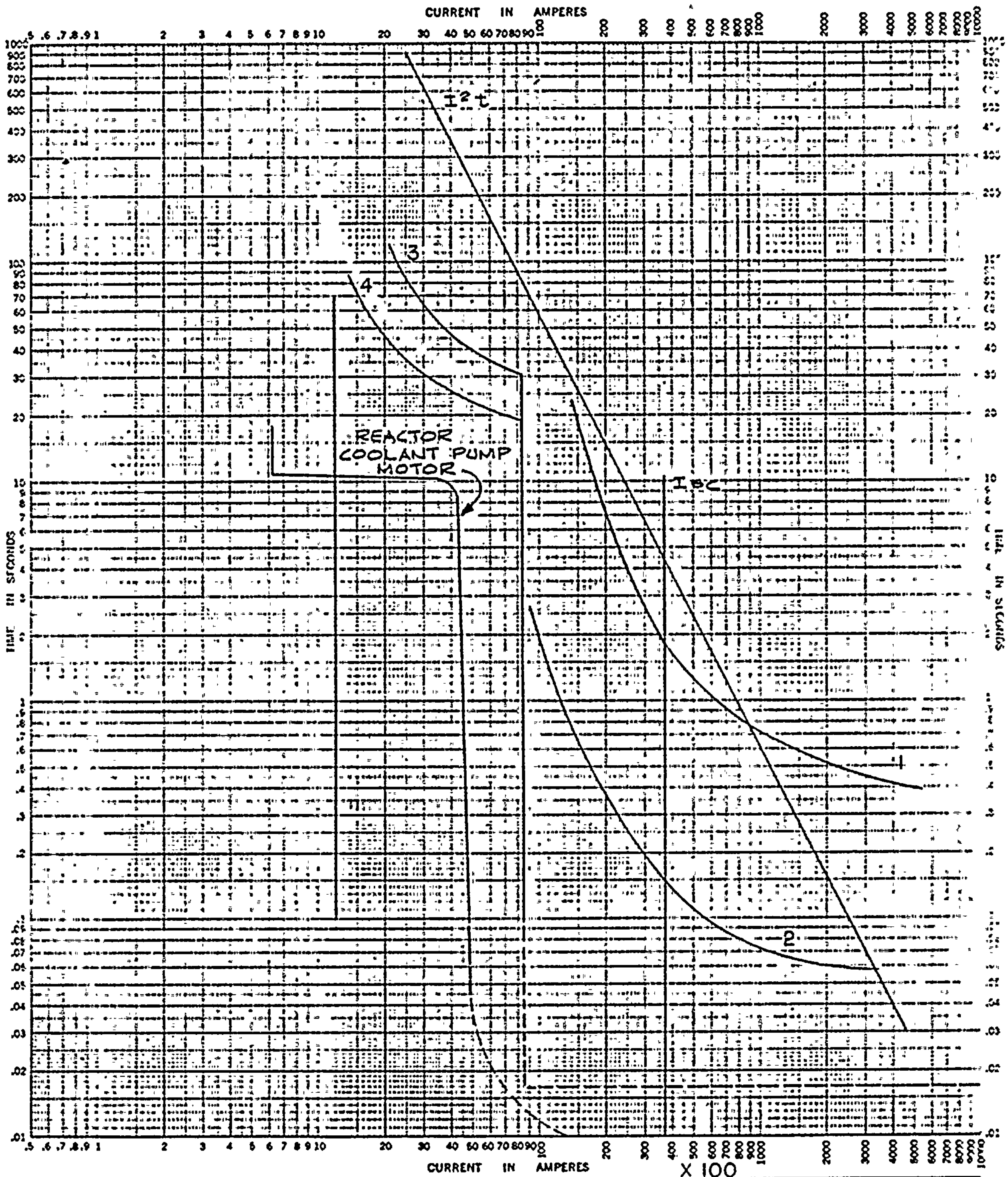
5.4.2

DRAWN BY: BARRAGATO	STA. 13 · CE-25 & CE-27
ENGR. MOHAMMED, ZAHEER	SINGLE LINE

5.4.2
PROTECTIVE DEVICE SETTINGS

CE-25 & CE-27

Ref. No. on Graph	Circuit	Device	Relay Type	CT Ratio	Range	Setting
1	11 TRANSFORMER	51/11T	CO-8	1200/5	4-12A	10A-3TLS
	11 TRANSFORMER	51N/11T	CO-8	300/5	0.5-2.5A	1A-6TLS
2	11A BUS	51/11A	CO-8	3000/5	4-12A	12A-0.5TLS
	11A BUS	51N/11A	CO-8	3000/5	0.5-2.5A	0.5A-0.5TLS
3	REACTOR COOLANT PUMP NO. 1A	50S/51S	CO-5	1200/5	4-12TOC 20-80IIT	6A-11TLS 35A
4	REACTOR COOLANT PUMP NO. 1A	50P/51P	COM-5	1200/5	2-6TOC 4-8ITH 20-8IIT	4A-8TLS 5A 35A
	REACTOR COOLANT PUMP NO. 1A	50G	ITH	100/5	1-2A	1A



For CE-25 & CE-27 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. 5.4.4

Date ____

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

5.5 Penetration Number CE-23. This penetration has 144-#10 conductors and is classified a direct current (125VDC) type. This particular penetration is used to supply 125VDC for emergency lighting. The single line is shown on page 27. The continuous current rating of the penetration is 30 amperes. Soft solder with a melting point of 180°C was used in the construction of the penetration. Maximum short circuit current (Isc) available to the penetration is 600 amperes DC.

Based on these conditions using Formula 1:

I^2t at short circuit current (600 amps) is:

$$I^2t = (0.0297)(10380)^2 \log\left(\frac{180 + 234}{140 + 234}\right)$$

$$I^2t = 14.1 \times 10^4 \text{ (ampere)}^2 \text{ seconds}$$

$t = 0.392$ seconds at 600 amperes

$t = 0.883$ seconds at 400 amperes

$t = 3.53$ seconds at 200 amperes

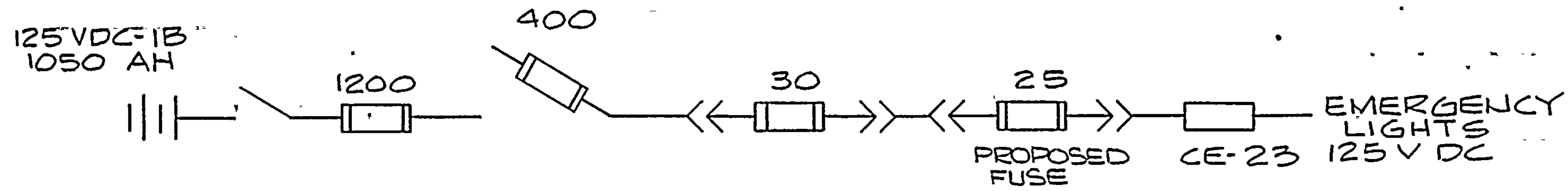
The time-current characteristic curves for the CE-23 penetration are shown on page 29. Analysis shows that the, primary protective device, an amptrap OT30 fuse (Curve #2) will clear Isc (600 amps) and all values above continuous current rating. However, the circuit backup device, a amptrap A2Y-400 ampere fuse (Curve #1), will not clear for any value of fault current up to and including Isc.

Failure of the primary protective device, however remote, could result in damage to the seal should a fault occur.

Recommendation

To insure adequate backup protection, an additional fuse - an OT-25, will be installed as a new primary device. The OT-30 will become the backup fuse. The 25 amp fuse curve is labeled #3 on the time-current characteristic curve for the CE-23 penetration.

The addition of the 25 amp fuse will provide the primary and backup protection required to insure seal protection for all postulated fault conditions.



I^2t = 14.1×10^4

SHORT CIRCUIT CURRENT = 600 AMPS

MAXIMUM ALLOWABLE TIME FOR I_{sc} = 0.392 SEC.

CLEARING TIMES FOR I_{sc}

1. PRIMARY FUSE = $<$ 0.001 SEC.
2. SECONDARY FUSE = $<$ 0.001 SEC.
3. BACKUP FUSE = $>$ 700 SEC.

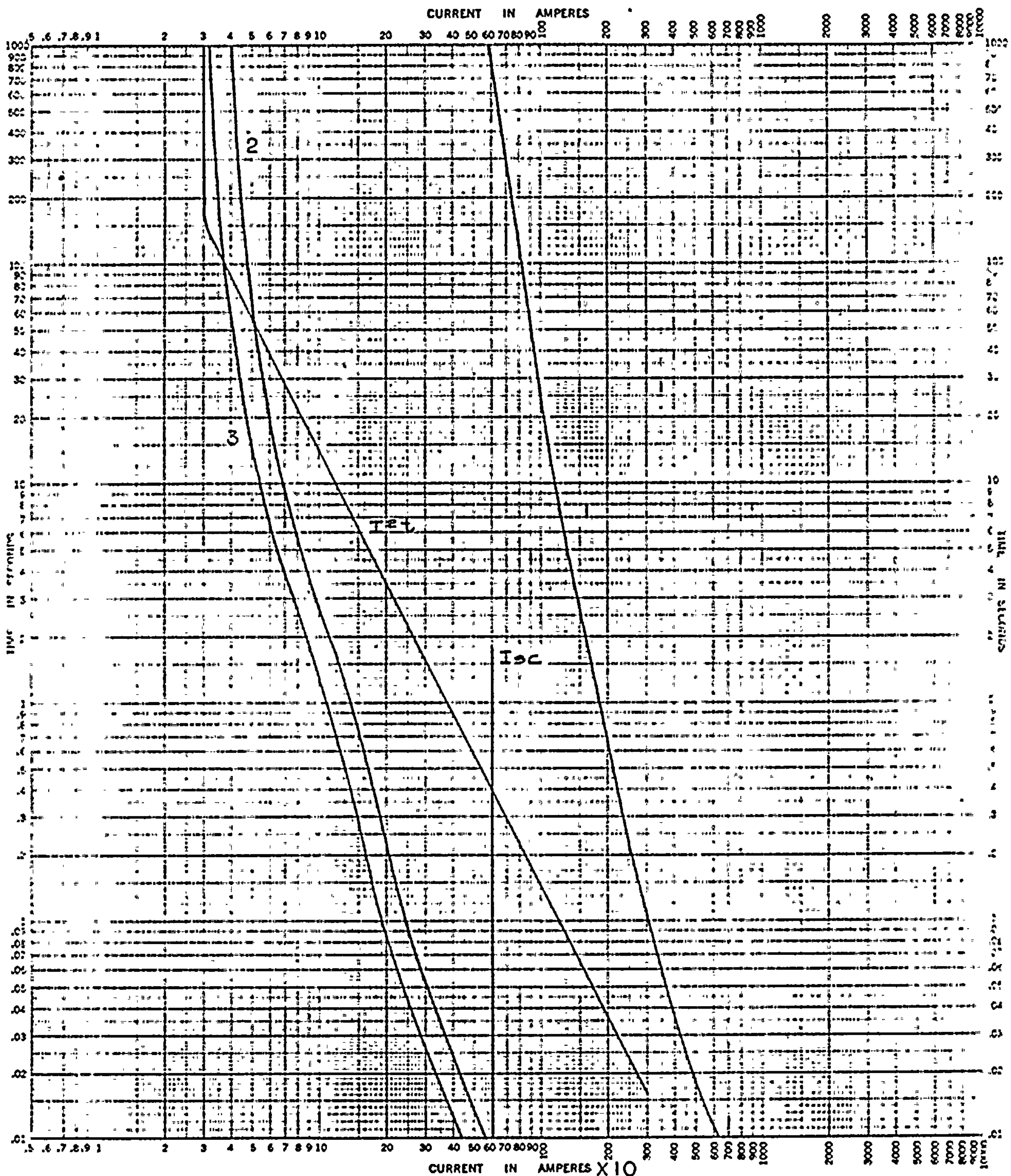
5.5.1

DRAWN BY: BARRAGATO	STA. 13 CE-23
ENGR. MOHAMMED, ZAHEER	SINGLE LINE

5.5.2
PROTECTIVE DEVICE SETTINGS

CE-23

Ref. No. on Graph	Circuit	Location	Fuse Type	Continuous Rating
1	Emergency Lights		Shawmut Form-600 Type 3 A2Y	400
2	Emergency Lights		Shawmut OT Class K-5	30
3	Emergency Lights		Shawmut OT Class K-5	25



For CE-23 ____________ 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. 5.5.3

Date ____________

K·E TIME-CURRENT CHARACTERISTIC 46 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

6.0 REFERENCES

1. NRC letter, Dennis L. Ziemann to Mr. Leon D. White, Jr., Vice President RG&E, SEP Topic VIII-4, Request for Information, Docket No. 50-244, Dec. 8, 1978.

2. RG&E letter, Harry G. Saddock, Systematic Evaluation Program Topic VIII-4, "Electrical Penetrations of Reactor Containment", R. E. Ginna Nuclear Power Plant, Unit No. 1, Docket No. 50-244, April 12, 1979.

3. NRC letter, Dennis L. Ziemann to Mr. Leon D. White, Jr., Vice President RG&E, "SEP Topic VIII-4 - Electrical Penetration of Reactor Containment", March 24, 1980.

4. RG&E letter, L. D. White, Jr., to Director of Nuclear Reactor Regulations, U.S. NRC, "SEP Topic VIII-4 - Electrical Penetration of Reactor Containment", July 21, 1980.

5. NRC letter to Mr. John E. Maier, Vice President RG&E, "SEP Technical Evaluation - Topic VIII-4 - Electrical Penetrations of Reactor Containment, Final Draft, R. E. Ginna Unit No. 1 Docket No. 50-244", November, 1980.

6. IPCEA Publication P-32-382, "Short Circuit Characteristics of Insulated Cable".

7. General Design Criterion 16, "Containment Design" of Appendix A, "General Design Criteria of Nuclear Power Plants", 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities".

8. Nuclear Regulatory Commission Standfard Review Plan, Section 8.3.1, "AC Power Systems (onsite)".

9. Regulatory Guide 1.63, Revision 2, "Electrical Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants".

10. IEEE Standard 317-1976, "IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations".