

ATTACHMENT 3

**CALCULATION FOR COORDINATION BETWEEN UNDERVOLTAGE
AND OVERCURRENT PROTECTION**

9206050157 920602
PDR ADCK 05000250
P PDR

100

101

102

103

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

119

120

121

122

123

124

125

126

127

128

129

130



100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130



CALCULATION COVER SHEET

PROJECT Turkey Point Unit 3	JOB NO. 21701-523	CALC NO. 21701-523-E-02	SHEET 1
SUBJECT Verification of Degraded Voltage Relay Protection for Safety Related		TOTAL NO. OF SHEETS 12	LAST SHEET NO. 12
Equipment (Coordination between U/V and Overcurrent Protection)		DISCIPLINE Electrical	

CALCULATION STATUS DESIGNATION	PRELIMINARY []	COMMITTED []	CONFIRMED [X]	SUPERSEDED []	CANCELED []
--------------------------------------	--------------------	------------------	--------------------	-------------------	-----------------

COMPUTER PROGRAM	SCP []	MAP []	NCP []	NONE [X]	PROGRAM NO.(S) Not Applicable	VERSION/RELEASE NO. Not Applicable
---------------------	------------	------------	------------	---------------	----------------------------------	---------------------------------------

Attachments

1. Figures 1 - 28 associated with this calculations verification of degraded voltage relay protection. (28 pages)
2. PC/M 91-036, Input Data Ref. No. 8 (excerpt), Motor Data and Safe Heating curves. (9 pages)
3. Miscellaneous Motor Data Sheets and Safe Heating curves. (10 pages)
4. ITE G30 Heater Selection Tables and Overload Tripping Characteristics. (4 pages)
5. Westinghouse F-Series Heater Selection and Trip Curve. (2 pages)
6. Asea Brown Boveri (ABB) OD61 Breaker Information. (3 pages)
7. ITE Circuit Breaker Curve for HF frame breaker (1 page)
8. Asea Brown Boveri Breaker Characteristics of SS-3 device (1 page)
9. Asea Brown Boveri Overcurrent Relay Characteristics of ITE-51IM relay. (1 page)
10. General Electric Overcurrent Relay Characteristics for IAC66 relay. (1 page)
11. Square D Overload Relay Time Current Characteristics. (1 page)
12. General Electric Motor Starter Heater Time Current Curves. (2 pages)
13. Qualified Air Corp/General Electric Motor Data. (4 pages)
14. General Electric Time-Voltage curves for IAV Relays. (2 pages)
15. Copeland Letter Dated 3/25/92 for compressor motor data. (2 pages)
16. REA No. 91-289 with ABB Test Report Data for trip device settings. (6 pages)

0	ISSUED FOR USE	<i>[Signature]</i>	3/27/92	<i>RRZ</i>	3/27/92	<i>FJG</i>	3/27/92		
No.	Reason for Revision	By	Date	Checked	Date	Approved	Date	Accepted	Date



CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 2
ORIGINATOR <i>Paul J. Slink</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

<u>Table of Contents</u>	<u>Sheet</u>
1.0 Purpose/Objective	3
2.0 Scope	3
3.0 Assumptions/Bases	3
4.0 References	4
5.0 Methodology	5
6.0 Calculation	10
7.0 Results	11
8.0 Conclusion	12
Appendix A	20 pages



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100



CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 3
ORIGINATOR <i>Paul J. Snick</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

1.0 PURPOSE:

The purpose of this calculation is to demonstrate that the settings of undervoltage relays, 327I (ITE) and 327T (IAV) are adequate to protect and ensure the operability of safety related equipment connected to the AC distribution system. Specifically this calculation will demonstrate that the undervoltage relays will trip and separate the distribution system from offsite power before either equipment is damaged from the effects of low voltage or rendered inoperable due to the operation of other protective devices.

2.0 SCOPE:

The scope of this calculation includes all safety related loads on the 4.16kV vital switchgear, 480V Load Centers and 480V Motor Control centers except as noted below. Loads which are not susceptible to either damage or tripping through overcurrent devices due to undervoltage have been excluded for the following reasons;

- Motor operated valves and dampers, being intermittent loads will likely not be operating during a degraded voltage transient. The design, application, and overcurrent protection for motor operated valves also allows for extended overload or stalled conditions.
- Battery chargers and resistive loads may become inoperable during exposure to lower than rated voltage but these effects will only last as long as the voltage transient. These loads are not subject to overheating at low voltages nor will they draw current to the extent that overcurrent device actuation is a concern.

The remaining safety related loads consist of 4kV and 480 Volt motors supplied at the switchgear, load center and motor control center levels.

3.0 ASSUMPTIONS/ BASES:

The following assumptions and bases were used in the performance of this calculation;

- 3.1 Motor breakdown torques were assumed equal to the NEMA Standard MG 1 (Ref. 4.2), section MG 1-12.39, minimum values unless motor specific values were available.
- 3.2 Thermal damage curves or safe time curves are not available for motors supplied from Motor Control Centers. Thermal overloads on MCC motors were assumed sized to adequately protect the motors. Motors in this range follow standard designs and overload relays settings are generally based on a percentage of motor full load current. As noted in ANSI Standard C37.96 (Ref. 4.8), overload relays are normally adequate to protect motors in this horsepower range. The NEC, (Ref. 4.3), indicates that overload relays with trip currents up to 140% of motor full load current are adequate to prevent overheating for motors with a 1.15 service factor. Motors applied at the MCC level have a service factor of 1.15 or greater per NEMA MG-1 (Ref. 4.2) and Specification 5610-E-6B (Ref. 4.5). This service factor increases the allowable current which a motor can withstand without damage. The ratios between motor full load amps and overload pickup were reviewed to confirm this assumption.





CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 4
ORIGINATOR <i>Paul J. Snink</i>	DATE 03/27/92	CHECKED <i>Robert R. Loran</i>	DATE 3/27/92

3.3 The voltage drops across individual feeders were calculated neglecting the relative phase between the current and feeder impedance. This simplifying assumption introduces a small conservatism since voltage drops calculated in this manner will be greater than those derived in a more rigorous fashion.

3.4 Motor power factor and efficiency were assumed equal to 0.85 and 0.92 (Ref. 4.1) respectively in the absence of specific motor data, except for motors at and below 2 HP where the following values will be used;

2 HP .85 pf .65 eff.
1 HP .85 pf .61 eff.
3/4 HP .85 pf .59 eff.

The use of these factors provide motor full load currents which are close to typical values provided in the NEC Table 430-150, Reference 4.3. Since the phase angle of the motor current is not being used in this calculation, the adjustment of the efficiency to obtain the target full load amps rather than the power factor is of no concern.

3.5 The voltage seen on the 4.16kV buses was assumed equal to that registered by the undervoltage relays on the 480V loads centers adjusted by the LC transformer turns ratio (including 2.5% boost). By neglecting the voltage drop across the LC transformer, the voltage used for the 4.16kV bus at a given load center voltage is lower than would actually exist. This assumption adds a slight conservatism in the evaluation of the effects of undervoltage on the 4kV motors.

3.6 Disturbances in the offsite power network are considered to be either prolonged undervoltage at levels slightly below the design minimum values, short term voltage excursions (<1 second) caused by system faults, or total system collapse. The setpoint of the ITE relay is selected to prevent motor stalls at prolonged degraded voltages. The second case, short term dips caused by external faults, are of such a limited duration that operating motors will remain at near full speed. System undervoltages of the third type, severe drops which persist for more than a few seconds, are considered to be indicative of a system collapse and the fact that motors may stall under these conditions is not a concern since undervoltage relaying will eventually trip the buses. This calculation is intended only to show that no motor damage will occur in the period before the buses are tripped, not that the distribution system can experience severe undervoltages for several seconds and return to normal operation.

4.0 REFERENCES:

4.1 Calculation EC-145, Rev. 5, "PSB-1, Voltage Analysis for Electrical Auxiliary System". This calculation was used as a source for motor data, cable impedances, and load center to MCC voltage drops. Where more specific motor data was available, such data was used in lieu of the EC-145 information.



CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 5
ORIGINATOR <i>Paul J. Snink</i>	DATE 03/27/92	CHECKED <i>Robert R. Lensen</i>	DATE 3/27/92

- 4.2 NEMA Standard MG 1-1987, Rev. 1, "Motors and Generators", Section MG 1-12.39, "Breakdown Torque of Single Speed Polyphase Squirrel Cage Medium Motors with Continuous Ratings", Table 12-2, "Service Factor"
- 4.3 National Electrical Code, 1990, Table 430-150, "Full Load Current Three-Phase Alternating-Current Motors", Section 430-34, "Selection of Overload Relay"
- 4.4 Project drawings as referenced throughout the calculation.
- 4.5 Specification 5610-E-6B, "Specifications for Station Auxiliary Motors", Rev. 6.
- 4.6 Motor Data Sheets, Attachments 2, 3, 13, 15.
- 4.7 Calculation 21701-523-E-01, Rev. 0, "Unit 3 Load Center's Undervoltage Relay Setpoints".
- 4.8 ANSI Standard C37.96-1988, "IEEE Guide for AC Motor Protection".
- 4.9 Electric Power Research Institute Power Plant Electrical Reference Series, Volume 6, "Motors".
- 4.10 Relay Coordination Study, FLO 53-20.5004, Rev. 11.
- 4.11 PC/M 90-211, "Replacement of Control RM. HVAC Condensing Sections" Rev. 1.

5.0 METHODOLOGY:

5.1 General Methodology

The methodology employed to demonstrate that the undervoltage relays adequately protect the safety related motors consists of determining the motor current corresponding to various voltages on the undervoltage relay characteristic curves and plotting that current as a function of the undervoltage relay trip time for the specific voltage. A typical current vs. voltage plot for an undervoltage condition is shown in Figure A. Since the voltage seen at the motor terminals will vary from the bus voltage sensed by the undervoltage relays (relays are located at the Load Center level), the calculation takes the voltage drop across bus to bus and individual motor feeder circuits into account. The exact treatment of feeder voltage differs between voltage classes and is addressed in detail later in this calculation.

Once the motor currents are calculated and correlated to undervoltage relay operating times, these values are plotted on a time vs. current scale along with the motor overcurrent device characteristics and motor safe heating curves where available.

Motors at the 480V level, particularly smaller horsepower rating are not typically furnished with safe heating curves. Since motors applied at the motor control center level generally follow standard frame size and designs, overcurrent protection for these motors is selected using standard pickup to FLA ratios between 115 and 140%. For motors where safe heating

1. The first

2. The second

3. The third

4. The fourth



CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 6
ORIGINATOR <i>Paul J. Snink</i>	DATE 03/27/92	CHECKED <i>Robert T. Larsen</i>	DATE 3/27/92

curves are not available the undervoltage induced current curves will be plotted against thermal overload curves only with the assumption that thermal overloads are sized adequately to protect the motors.

The calculation of motor overcurrent induced by undervoltage is based on the motor acting as a constant power device, ie. the motor current increases inversely to the decrease in motor terminal voltage. This treatment is valid until the voltage reaches a point where the motor

can no longer develop sufficient torque to drive the attached load, at which point the motor begins to stall. The voltage at which stall occurs, referred to as "Stall Voltage" in the calculation is related to the breakdown torque of the motor. The motor torque developed varies as the square of the applied voltage, therefore for a reduction in applied voltage of 20%, the developed torque is 0.8^2 or 0.64 per unit. The maximum torque developed by a motor at rated voltage, the breakdown torque, is similarly reduced with voltage. The stall voltage, that voltage where the breakdown torque equals the rated torque, can then be calculated given the breakdown torque. This stall voltage represents the highest voltage at which a motor may stall, however the motor may continue to run at lower voltages.

Breakdown torque information specific to individual motors has been used where available. For other cases the minimum breakdown torque for the motor frame size from NEMA Standard MG 1, (Ref. 4.2), Section MG 1-12.39, (200% for NEMA Design A & B, 190% for NEMA Design C) will be used. This approach has added conservatism in that it ignores the margin between motor rated horsepower and load brake horsepower.

Once the voltage at the motor terminals falls below the stall voltage discussed above, one of two things happen, the motor may stall, drawing locked rotor current, or may continue to spin due to the combined effects of inertia, motor vs. load torque margin. Since a motor under locked rotor conditions is essentially a fixed impedance, the current drawn at low voltages will decrease proportionally with the voltage. In order to address either possibility, both the stall point and operating points will be plotted below the stall voltage.

The motor will be deemed adequately protected by the bus undervoltage protection if the undervoltage induced overcurrent is shown to persist for less time than the motor protection takes to trip. In other terms, if the motor overcurrent due to undervoltage curve does not intersect the overcurrent protection or thermal damage curves the motor is considered adequately protected.

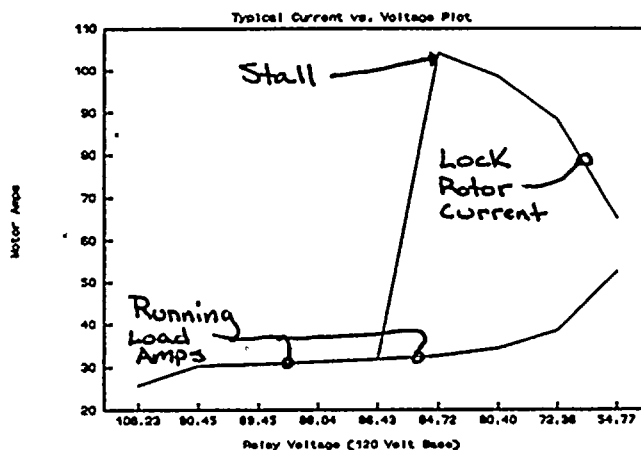


FIGURE A





CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 7
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Lensen</i>	DATE 3/27/92

5.2 Calculations Equations

The calculation of motor currents for selected undervoltage relay setpoint was calculated using a spreadsheet. The calculation inputs required are as follows;

Per Switchgear Bus, Load Center or MCC

- U/V Relay Setpoints for Connected Load Center
- Cable Drop data for MCCs only

Per Motor Load

- Horsepower
- Power Factor
- Efficiency
- Feeder Cable Resistance
- Feeder Cable Reactance
- Locked Rotor/Full Load Amps ratio
- Percent Stall Torque (Breakdown Torque)

The results and intermediate values were derived as follows;

Switchgear, Load Center or MCC values

Relay Voltage = ITE Relay Setpoint for Dropout at 60 Seconds
= IAV Relay Setpoint · Time Dial 5 Curve (Ref. 4.7 and Attachment 14)

Attachment 1 figures are plotted to the ITE dropout value of 60 secs in addition to a 6.5 sec relay tolerance and a 1 sec sequencer time delay per drawing 5610-T-L1, Sh. 13 Rev. 9.

The IAV relay tolerances will not be accounted for in the actual data. However, this margin will be addressed in section 8.0, the conclusion section of this calculation.

Voltage at Load Center = V_{LC} = Relay Voltage · 480/120

Voltage at Switchgear = V_{SG} = $V_{LC} \cdot 4160/(480 \cdot 1.025)$

Voltage at MCC = V_{MCC} = V_{LC} - MCC Feeder Drop

MCC Feeder Drop = VD_{MCC} = $V_{LC} - V_{MCC} = V_{LC} - I_{MCC} \cdot Z_{C_{MCC}}$

I_{MCC} = MCC Load Current = $P_{m_{MCC}}/V_{MCC}$
 $Z_{C_{MCC}}$ = MCC Feeder Cable Impedance
 $P_{m_{MCC}}$ = MCC Load (KVA)

$$V_{LC} = V_{MCC} + P_{m_{MCC}} / V_{MCC} \cdot Z_{C_{MCC}}$$

12

13

14

15

16

17

18

19

20

21



CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 8
ORIGINATOR <i>Paul J. Snink</i>	DATE 03/27/92	CHECKED <i>Robert R. Loren</i>	DATE 3/27/92

$$V_{MCC}^2 - V_{MCC} \cdot V_{LC} + P_{MCC} \cdot Z_{C_{MCC}} = 0$$

This equation is a quadratic of the form $ax^2 + bx + c = 0$ whose solution is

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For this application the proper solution is

$$V_{MCC} = \frac{V_{LC} + \sqrt{V_{LC}^2 - 4 \cdot P_{MCC} \cdot Z_{C_{MCC}}}}{2}$$

The value $P_{MCC} \cdot Z_{C_{MCC}}$ is derived from values of V_{LC} and V_{MCC} obtained from Calculation EC-145, (Ref. 4.1), which resulted in the lowest voltage for a particular MCC bus.

$$P_{MCC} \cdot Z_{C_{MCC}} = V_{LC} \cdot V_{MCC} - V_{MCC}^2$$

The Bus Per Unit Voltage is expressed on a motor voltage base,

$$\begin{aligned} V_{PU} &= V_B / 4000 \text{ for 4kV motors} \\ &= V_B / 460 \text{ for MCC and LC motors} \end{aligned}$$

Motor Values

$$\text{Motor KVA} = \text{HP} \cdot .746 / (\text{Power Factor} \cdot \text{Efficiency})$$

$$\text{Motor Base Amps} = \text{Motor KVA} / (\sqrt{3} \cdot \text{Motor Base Volts})$$

$$\text{Cable Impedance} = \sqrt{(\text{Cable Resistance}^2 + \text{Cable Reactance}^2)}$$

$$\text{PU Impedance} = \text{Cable Impedance} \cdot \text{Motor KVA} / \text{Motor Base Volts}^2$$

$$\text{Full Load Torque} = \text{Breakdown Torque} \cdot V_{P.U. \text{ Stall Voltage}}^2$$

$$\% \text{ Breakdown Torq} = \text{Breakdown Torq} / \text{Full Load Torq}$$

Therefore,

$$\text{PU Stall Voltage} = \sqrt{1 / (\text{Percent Stall Torque} / 100)}$$



CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 9
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

$$\text{Motor Amps (pu)} = I_M = P_M / V_M = (V_B - V_M) / Z_{C_M}$$

$$V_B = V_M + I_M \cdot Z_{C_M} = P_M / I_M + I_M \cdot Z_{C_M}$$

$$I_M = \text{Motor Amps (pu)}$$

$$P_M = \text{Motor KVA (pu)} = 1$$

$$V_M = \text{Motor Voltage (pu)}$$

$$V_B = \text{Bus Voltage (pu) Swgr, LC, or MCC}$$

$$Z_{C_M} = \text{Motor Cable Impedance (pu)}$$

All per unit values are determined on a motor KVA base

$$I_M^2 - V_B / Z_{C_M} \cdot I_M + P_M / Z_{C_M} = 0$$

Solving the quadratic equation:

$$I_M = \frac{V_B / Z_{C_M} + \sqrt{(V_B / Z_{C_M})^2 - 4 \cdot P_M / Z_{C_M}}}{2}$$

$$\text{Running Amps} = I_M \cdot \text{Motor Base Amps}$$

$$\text{Motor Volts} = V_M = V_B - I_M \cdot Z_{C_M}$$

$$\text{Cable Drop} = V_B - V_M$$

Locked Rotor Amps are calculated when the motor voltage falls below the calculated stall voltage. The locked rotor current is calculated using the combined impedance of the motor feeder cable and the motor locked rotor impedance.

In Per Unit

$$I_{LRC} = V_B / (1 / \text{LRC Ratio} + \text{Cable Impedance})$$

In Amps

$$\text{Locked Rotor Current} = I_{LRC} \cdot \text{Motor Base Amps}$$

Since the stall voltage calculated represents the maximum voltage at which the motor may stall, both the running amps and locked rotor amps will be plotted for voltages below the calculated stall voltage.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

1

2

3





CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 10
ORIGINATOR <i>Paul J. Smink</i>	DATE 03/27/92	CHECKED <i>Robert R. Lansen</i>	DATE 3/27/92

6.0 CALCULATION

Appendix A provides a listing of the tag numbers for the loads examined, relay settings and overload heater sizes, as well as references for this data.

6.1 4.16 kV Buses 3A, 3B, and 3D

The safety related loads examined for these buses consisted of the following motors;

		Figures
•	RHR Pump 3P210A & B	3
•	SI Pump 3P215A & B	1
•	ICW Pump 3P9A,B & C	2 & 6
•	CCW Pump 3P211A,B & C	4 & 5

Since the A & B pumps have identical protective device settings, they have been combined on one plot with the highest motor currents for each case.

The motor currents on bus 3D were examined for two cases, supply from 3A and supply from 3B.

Overcurrent plots for these motors include the motor overcurrent caused by varying levels of undervoltage, the motor protective relay curves and the motor safe heating curves.

6.2 480 V Load Centers 3B01, 3B02, 3B50

The following loads were examined at the load center level;

		Figures
•	Charging Pump 3P201A,B & C	7 & 8
•	Cont. Spray Pump 3P214A & B	9

The motor current on LC 3H (3B50) was examined for two cases, supply from 3A (3B01) and 3B (3B02).

Since the A & B pumps have identical protective device settings, they have been combined on one plot with the highest motor currents for each case.

Settings for 3P214A & B and 3P201A & B are based on ABB Test Reports (Attachment 16). Where different settings for like equipment is used, the most conservative settings (ie. lowest) were utilized.

Overcurrent plots for these motors include the motor overcurrent caused by varying levels of undervoltage, the trip device curves and the motor safe heating curves (where available).





CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 11
ORIGINATOR <i>Paul J. Inink</i>	DATE 03/27/92	CHECKED <i>Robert R. Linsen</i>	DATE 3/27/92

6.3 480 V Motor Control Centers 3B05, 3B06, 3B07, 3B08, 3B52

The following loads were examined at the MCC level;

		Figures
•	EMERG CONT CLR FAN 3V30A,B & C	10
•	EMERG CONT FILTER FAN 3V3A,B & C	11
•	EDG FO XFER PUMP 3P10A & B	14 & 15
•	EDG ROOM VENT FAN 3V34A & B	16 & 17
•	CONTROL ROOM A/C AHU E16A & C	12 & 13
•	SWGR 3D ROOM SUPPLY FAN 3V65A & B	18
•	COMPUTER ROOM CHILLER S74B	21 & 22
•	COMPUTER ROOM CHILLER S75B	19
•	COMPUTER ROOM A/C AHU S77B	19
•	COMPUTER ROOM A/C AHU S78B	19
•	CNTRL RM EMERG FLTR FAN V29B	20
•	ELECT EQPT ROOM AHU V77/E231	24, 25, 26
•	AIR,PART & GAS MONITOR 3V36	23

The motor currents for MCC 3B08 (3D) were examined both for the case of supply from Load Center 3B03 and Load Center 3B04 via Load Center 3H.

Plots for motors at the MCC level include only the voltage induced motor overcurrent and the thermal overload characteristics. Safe heating or thermal damage curves are not generally available for these motors. Plots obtained from vendors for the Emergency Containment Filter Fans and the Emergency Containment Cooler Fans were included.

The Control Room HVAC units E16/E17 include several motors fed from a common molded case breaker. These motors are individually thermally protected by internal devices. The effect on the feeder breaker of overloading all motors simultaneously is examined for this case.

7.0 RESULTS

As shown by the individual time vs. current plots, the motor current induced by degraded system will not persist long enough to cause spurious tripping of motors due to overcurrent devices, nor will any of the established safe heating times be exceeded for those motors which safe heating curves have been supplied by the manufacturer.

The motor overload curves overlap the safe heating curves for the Emergency Containment Cooler and Emergency Containment Filter Fans. Although this is not a concern for the purposes of this calculation, the juxtaposition of these two curves suggests that a problems exists with the overcurrent protection for these motors. Further review of the overload heater selection indicates that each is applied within the guidelines for their application. The motor vendor (Reliance) was contacted concerning the application of the thermal damage curves. Reliance indicated that these curves represented the time and current which would cause the motor to reach





CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO. 12
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Lensen</i>	DATE 3/27/92

215°C, a temperature indicative of accelerated thermal aging rather than catastrophic failure. Furthermore these curves were calculated assuming no heat transfer from the motor, and neglects the additional cooling effects of the vane-axial fan installation. Given the degree of conservatism which was used in the generation of the thermal damage curve and the importance of continued operation of these motors in accident conditions the present overload settings for these fans is prudent.

Likewise, the Containment Spray Pump safe heating curve is shown to underlay its breaker tripping protection (OD61 trip device). However, there is an alarm which will notify the operator of an overload.

8.0 CONCLUSIONS

On review of Attachment 1, the margin between U/V protection and overload protection is substantial in relation to the IAV operating margin. Therefore, the degraded voltage relaying provided on the 480V load center buses will operate and trip the 4.16kV and 480V distribution buses in adequate time to preclude damage to safety related motors and to prevent spurious tripping of those motors.

The adequacy of the 480V motor control center overload relays was reviewed by comparison of the OL relay pickup to the motor full load currents. The ratio between OL trip setting and motor full load amps was below 140% for all MCC motors except for the 3/4 HP EDG Fuel Oil Transfer Pumps and the Electrical Equipment Room AHU. Since the service factor for these motors are 1.15 or higher, all overload relays in this range should provide adequate motor protection. The full load current for motors in the 3/4 HP range may vary widely and the higher ratio for these pumps may be necessary. The undervoltage/overcurrent curve for the EDG F.O. Transfer Pumps was also reviewed against an overload curve sized for a lower motor FLA and was shown to coordinate with that curve as well (Figure 27 & 28), indicating that the U/V protection would protect these motors. The AHU unit overloads are sized according to vendor specifications and are considered reasonable for this application.





CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 1 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Linsen</i>	DATE 3/27/92

MOTOR CONTROL CENTER LOADS

*Note: Also Ref. 5613-E-10 Sh. 1 & 2 Rev. 0

	TAG	RATED HP	MCC	OL HTR SIZE	# OF HTRS	STARTER SIZE	OL MIN FLA	OL TRIP SETTING	LOAD FLA	OL TO FLA RATIO	REFERENCE
*EMERG CONT CLR FAN	3V30A	30	3B06	G30T52	2	3	40	50	38.46	1.30	5613-E-25/SH. 11B Rev. 2
	3V30B	30	3B08	G30T52	2	3	40	50	38.46	1.30	5613-E-25/SH. 11D Rev. 2
	3V30C	30	3B07	G30T52	2	3	40	50	38.46	1.30	5613-E-25/SH. 11F Rev. 2
*EMERG CONT FILTER FAN	3V3A	75	3B06	G30T60	2	4	90	112.5	87.69	1.28	5613-E-25/SH. 11A Rev. 2
	3V3B	75	3B08	G30T59	3	4	80	100.0	87.69	1.14	5613-E-25/SH. 11C Rev. 2
	3V3C	75	3B07	G30T60	2	4	90	112.5	87.69	1.28	5613-E-25/SH. 11E Rev. 2
*EDG FO XFER PUMP	3P10A	0.75	3B05	G30T23	2	1	1.65	2.0625	1.4	1.47	5613-E-27/SH. 11B Rev. 1
	3P10B	0.75	3B52	FH22	2	2	1.63	2.0375	1.4	1.46	5613-E-27/SH. 11A Rev. 1
*EDG ROOM VENT FAN	3V34A	5	3B05	G30T36	2	1	6.07	7.5875	5.99	1.27	5613-E-27/SH. 8A Rev. 0
	3V34B	5	3B52	FH37	3	2	6.5	8.125	5.99	1.36	5613-E-27/SH. 8B Rev. 0
CONTROL ROOM A/C AHU	E16A/E17A	34	3B06	50A bkr (HF3-B050)					38.3		5610-E-1433 Rev. 4 and
	E16C/E17C	34	3B08	50A bkr (HF3-B050)					38.3		5613-E-8-8 Rev.1 & PC/M 90-211 (Ref. 4.11)
*SWGR 3D ROOM SUPPLY FAN	3V65A	2	3B07	FH27	3	2	2.59	3.2375	2.68	1.21	5613-E-27/SH. 8C Rev. 0
	3V65B	2	3B52	FH27	3	2	2.59	3.2375	2.68	1.21	5613-E-27/SH. 8D Rev. 0
COMPUTER ROOM CHILLER	S74B	65	3B08								5613-E-27/SH. 31B Rev. 1
COMPRESSOR		50		CR123F772B	3	3	63.3	79.125	62	1.28	5177-206-M724-31-3 &
FAN 1		5		CR123C778A	3	1	7.2	9	6.8	1.32	5177-206-M724-27-4 &
FAN 2		5		CR123C778A	3	1	7.2	9	6.8	1.32	5177-206-M724-43-1
CHILLER PUMP		5		CR123C778A	3	1	7.2	9	6.8	1.32	
*COMPUTER ROOM CHILLER	S75B	5	3B08	FH37	3	2	6.5	8.125	6.8	1.20	5610-E-27/SH. 32D Rev.0 & 5177-206-M711-34-1
*COMPUTER ROOM A/C AHU	S77B	5	3B08	FH37	3	2	6.5	8.125	6.8	1.20	5610-E-27/SH. 32E Rev. 0 & 5177-206-M711-34-1
*COMPUTER ROOM A/C AHU	S78B	5	3B08	FH37	3	2	6.5	8.125	6.8	1.20	5610-E-27/SH. 32F Rev. 0 & 5177-206-M711-34-1
*CNTRL RM EMERG FLTR FAN	V29B	5	3B08	G30T37	3	1	6.3	7.875	6.8	1.16	5610-E-27/SH. 45F Rev. 5 & 5177-349-M713-10-1
ELECT EQPT ROOM AHU	V77/E231	36	3B08								5613-E-27/SH. 95A Rev. 0
AHU				B15.5	3	0	11.1	13.875	9.3	1.49	Vendor Man. V000475 & Attachment 13
COMP				B32.	3	1	23.0	28.75	17.3	1.66	V000475 & 5610-M-38-24 Sh.1 Rev. 0
FAN				B10.2	3	0	7.32	9.15	6.3	1.45	V000475 & Attachment 13
*AIR PART. & GAS MONITOR	3V36	2	3B06	G30T26	2	1	2.27	2.8375	2.7	1.05	5613-E-25/SH. 26A Rev. 0 & Attach. 3



第





CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Larkin</i>	DATE 3/27/92

APPENDIX <u>A</u>
JOB <u>21701-523</u>
CALC. <u>21701-523-E-02</u>
SHT <u>2</u> OF <u>20</u>

4.16 KV SWITCHGEAR LOADS

	TAG	RATED HP	RELAY MODEL	TAP	TIME DIAL	NORMAL DROPOUT PU AMPS	REFERENCE
COMPONENT COOLING WATER PP	3P211A	450	IAC66K	4.5	4	40	5613-E-315/91-036 SH. 21 Rev. 0 & Attachment 2
	3P211B	450	IAC66K	4.5	4	40	SH. 46 Rev. 0 & Attachment 2
	3P211C	450	ITE-511M	5	3	45.6	SH. 75 Rev. 0 & Attachment 2
INTAKE COOLING WATER PUMP	3P9A	325	IAC66K	3.5	2.5	40	SH. 28 Rev. 0 & Attachment 2
	3P9B	325	IAC66K	3.5	2.5	40	SH. 50 Rev. 0 & Attachment 2
	3P9C	325	ITE-511M	3.75	2	39.2	SH. 76 Rev. 0 & Attachment 2
SAFETY INJECTION PUMP	3P215A	350	IAC66K	4	2.5	40	SH. 22 Rev. 0 & Attachment 2
	3P215B	350	IAC66K	4	2.5	40	SH. 45 Rev. 0 & Attachment 2
RESIDUAL HEAT REMOVAL PUM	3P210A	300	IAC66K	3.1	3.5	30	SH. 24 Rev. 0 & Attachment 2
	3P210B	300	IAC66K	3.1	3.5	30	SH. 48 Rev. 0 & Attachment 2

LOAD CENTER LOADS

	TAG	RATED HP	BREAKER MODEL	SENSOR TAP	LONG TIME TAP	TIME BAND	INST. TAP	REFERENCES
CHARGING PUMP	3P201A	150	0061	225	1.9	INTERMEDIATE	10.0	ATTACHMENTS 6 & 16, 5613-E-5 Rev. 0
	3P201B	150	0061	225	1.55	MAXIMUM	10.0	ATTACHMENTS 6 & 16, 5613-E-5 Rev. 0
	3P201C	150	SS-3	400	1.0	MINIMUM	5.0	FLO 53-20.5004 REV. 11 (Ref. 4.10) & 5613-E-5 Rev. 0
CONTAINMENT SPRAY PUMP	3P214A	250	0061	300	2.2	INTERMEDIATE	12.5	ATTACHMENTS 6 & 16, 5613-E-5 Rev. 0
	3P214B	250	0061	300	2.5	MAXIMUM	10.0	ATTACHMENTS 6 & 16, 5613-E-5 Rev. 0

100-100000

100-100000

100-100000

100-100000

1

2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200

201

202

203

204

205

206

207

208

209

210

211

212

213

214

215

216

217

218

219

220

221

222

223

224

225

226

227

228

229

230

231

232

233

234

235

236

237

238

239

240

241

242

243

244

245

246

247

248

249

250

251

252

253

254

255

256

257

258

259

260

261

262

263

264

265

266

267

268

269

270

271

272

273

274

275

276

277

278

279

280

281

282

283

284

285

286

287

288

289

290

291

292

293

294

295

296

297

298

299

300

301

302

303

304

305

306

307

308

309

310

311

312

313

314

315

316

317

318

319

320

321

322

323

324

325

326

327

328

329

330

331

332

333

334

335

336

337

338

339

340

341

342

343

344

345

346

347

348

349

350

351

352

353

354

355

356

357

358

359

360

361

362

363

364

365

366

367

368

369

370

371

372

373

374

375

376

377

378

379

380

381

382

383

384

385

386

387

388

389

390

391

392

393

394

395

396

397

398

399

400

401

402

403

404

405

406

407

408

409

410

411

412

413

414

415

416

417

418

419

420

421

422

423

424

425

426

427

428

429

430

431

432

433

434

435

436

437

438

439

440

441

442

443

444

445

446

447

448

449

450

451

452

453

454

455

456

457

458

459

460

461

462

463

464

465

466

467

468

469

470

471

472

473

474

475

476

477

478

479

480

481

482

483



CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 4 OF 20

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
21701-523	21701-523-E-02	0	
ORIGINATOR	DATE	CHECKED	DATE
Paul J. Snijk	03/27/92	Robert R. Larsen	3/27/92

SWGR 3B 4.16KV
LC Supply: 3B02 IAV controls voltage

Swgr voltage assumed equal to LC voltage
times xfmr turns ratio including 2.5 % tap
Drop across xfmr ignored for conservatism

Time		ITE Relay-- -----IAV RELAY Pickup Setting: 100.5 V -----									
		PU - 60	60-14	13	12	11	10	8	6	4	
Relay Voltage	106.22	90.45	89.45	88.04	86.43	84.72	80.40	72.36	54.77		
Voltage @LC	424.9	361.8	357.8	352.2	345.7	338.9	321.6	289.4	219.1		
Voltage @ Swgr	3774.4	3214.0	3178.3	3128.3	3071.1	3010.4	2856.9	2571.2	1946.2		
pu V (4KV Base)	0.9436	0.8035	0.7946	0.7821	0.7678	0.7526	0.7142	0.6428	0.4866		

Motor: 3P215B SI Pump
Horsepower 350 Cable Impedance 0.0494
PF 0.88 P.U. Impedance 0.0010
Efficiency 0.94 Base KVA 315.6
Cable Rest. 0.0371 Motor Base Amps 45.6
Cable React 0.0326
LRC/FLA 6.40
Stall Torq% 266 Stall Volts 0.613

TIME (sec)		PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0010	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0015	0.0020
MTR VOLTS(pu)	0.9426	0.8023	0.7933	0.7808	0.7665	0.7513	0.7129	0.6413	0.4846	
AMPS(pu)	1.0609	1.2464	1.2605	1.2807	1.3046	1.3310	1.4028	1.5594	2.0638	
RUNNING AMPS	48.3	56.8	57.4	58.3	59.4	60.6	63.9	71.0	94.0	
LRC AMPS	----	----	----	----	----	----	----	----	141.0	
CURVE POINTS	48.3	56.8	57.4	58.3	59.4	60.6	63.9	71.0	141.0	

Motor: 3P9B ICM Pump
Horsepower 325 Cable Impedance 0.0598
PF 0.82 P.U. Impedance 0.0012
Efficiency 0.928 Base KVA 318.6
Cable Rest. 0.0449 Motor Base Amps 46.0
Cable React 0.0395
LRC/FLA 5.80
Stall Torq% 230 Stall Volts 0.659

TIME (sec)		PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0013	0.0015	0.0015	0.0015	0.0016	0.0016	0.0016	0.0017	0.0019	0.0025
MTR VOLTS(pu)	0.9423	0.8020	0.7931	0.7805	0.7662	0.7510	0.7125	0.6409	0.4841	
AMPS(pu)	1.0612	1.2469	1.2609	1.2812	1.3051	1.3315	1.4034	1.5602	2.0657	
RUNNING AMPS	48.8	57.3	58.0	58.9	60.0	61.2	64.5	71.8	95.0	
LRC AMPS	----	----	----	----	----	----	----	170.3	128.9	
CURVE POINTS	48.8	57.3	58.0	58.9	60.0	61.2	64.5	170.3	128.9	

Motor: 3P211B CCW Pump
Horsepower 450 Cable Impedance 0.0494
PF 0.9 P.U. Impedance 0.0012
Efficiency 0.93 Base KVA 401.1
Cable Rest. 0.0371 Motor Base Amps 57.9
Cable React 0.0326
LRC/FLA 4.74
Stall Torq% 200 Stall Volts 0.707

TIME (sec)		PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0013	0.0015	0.0016	0.0016	0.0016	0.0016	0.0016	0.0017	0.0019	0.0026
MTR VOLTS(pu)	0.9423	0.8020	0.7930	0.7805	0.7662	0.7510	0.7125	0.6409	0.4840	
AMPS(pu)	1.0613	1.2470	1.2610	1.2813	1.3052	1.3316	1.4035	1.5604	2.0661	
RUNNING AMPS	61.4	72.2	73.0	74.2	75.6	77.1	81.3	90.3	119.6	
LRC AMPS	----	----	----	----	----	----	----	175.4	132.7	
CURVE POINTS	61.4	72.2	73.0	74.2	75.6	77.1	81.3	175.4	132.7	

Motor: 3P210B RHR Pump
Horsepower 300 Cable Impedance 0.0457
PF 0.89 P.U. Impedance 0.0008
Efficiency 0.934 Base KVA 269.2
Cable Rest. 0.0343 Motor Base Amps 38.9
Cable React 0.0302
LRC/FLA 6.22
Stall Torq% 270 Stall Volts 0.609

TIME (sec)		PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0008	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0011	0.0012	0.0016
MTR VOLTS(pu)	0.9428	0.8025	0.7936	0.7811	0.7668	0.7516	0.7131	0.6416	0.4850	
AMPS(pu)	1.0607	1.2460	1.2601	1.2803	1.3041	1.3305	1.4022	1.5586	2.0620	
RUNNING AMPS	41.2	48.4	49.0	49.8	50.7	51.7	54.5	60.6	80.1	
LRC AMPS	----	----	----	----	----	----	----	----	117.1	
CURVE POINTS	41.2	48.4	49.0	49.8	50.7	51.7	54.5	60.6	117.1	

10

10

10

10

10

10

10

10

10

10

10

10



CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 5 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Loren</i>	DATE 3/27/92

SWGR 3D 4.16KV Tied to Bus 3A Degraded Voltage Protection: LC 3B01 via 3A 3A - 3D tie cable=.0072+j.016 ohms= 0.0175				- ITE Relay-- -----IAV RELAY Pickup Setting: 98.75 V -----									
3D Bus Loading				Time	PU - 60	60-14	13	12	11	10	8	6	4
ICW 318.6				IAV Dial 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545
CCW 401.1				Relay Voltage	105.48	88.88	87.89	86.51	84.93	83.25	79.00	71.10	53.82
3D Total 719.7				Voltage @LC	421.9	355.5	351.6	346.0	339.7	333.0	316.0	284.4	215.3
				Voltage @ 3A	3748.1	3158.0	3122.9	3073.8	3017.7	2958.0	2807.1	2526.4	1912.4
				Voltage @ 3D	3742.3	3151.1	3116.0	3066.7	3010.5	2950.7	2799.4	2517.8	1900.9
				pu V (4KV Base	0.9356	0.7878	0.7790	0.7667	0.7526	0.7377	0.6998	0.6295	0.4752
Motor: 3P9C ICW Pump													
Horsepower 325 Cable Impedance 0.0397				TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF 0.82 P.U. Impedance 0.0008				CABLE DROP(pu)	0.0008	0.0010	0.0010	0.0010	0.0011	0.0011	0.0011	0.0013	0.0017
Efficiency 0.928 Base KVA 318.6				MTR VOLTS(pu)	0.9347	0.7868	0.7780	0.7657	0.7516	0.7366	0.6987	0.6282	0.4736
Cable Rest. 0.0298 Motor Base Amps 46.0				AMPS(pu)	1.0698	1.2710	1.2854	1.3061	1.3306	1.3576	1.4312	1.5919	2.1116
Cable React 0.0262				RUNNING AMPS	49.2	58.5	59.1	60.1	61.2	62.4	65.8	73.2	97.1
LRC/FLA 5.80				LRC AMPS	----	----	----	----	----	----	----	167.1	126.2
Stall Torq% 230 Stall Volts 0.659				CURVE POINTS	49.2	58.5	59.1	60.1	61.2	62.4	65.8	167.1	126.2
Motor: 3P211C CCW Pump													
Horsepower 450 Cable Impedance 0.0509				TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF 0.9 P.U. Impedance 0.0013				CABLE DROP(pu)	0.0014	0.0016	0.0016	0.0017	0.0017	0.0017	0.0018	0.0020	0.0027
Efficiency 0.93 Base KVA 401.1				MTR VOLTS(pu)	0.9342	0.7862	0.7774	0.7650	0.7509	0.7359	0.6980	0.6274	0.4725
Cable Rest. 0.0382 Motor Base Amps 57.9				AMPS(pu)	1.0704	1.2720	1.2864	1.3072	1.3317	1.3588	1.4326	1.5938	2.1162
Cable React 0.0336				RUNNING AMPS	62.0	73.6	74.5	75.7	77.1	78.7	82.9	92.3	122.5
LRC/FLA 4.74				LRC AMPS	----	----	----	----	----	----	190.9	171.7	129.6
Stall Torq% 200 Stall Volts 0.707				CURVE POINTS	62.0	73.6	74.5	75.7	77.1	78.7	190.9	171.7	129.6

2

1000

1000

1000

1000

1000

1000



CALCULATION SHEET

APPENDIX A

IOB 21701-523

CALC. 21701-523-E-02

SHT 6 OF 20

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
21701-523	21701-523-E-02	0	
ORIGINATOR	DATE	CHECKED:	DATE
Paul L. Smith	03/27/92	Robert R. Larsen	3/27/92

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20





CALCULATION SHEET

APPENDIX AJOB 21701-523CALC. 21701-523-E-02SHT 7 OF 20

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
21701-523	21701-523-E-02	0	
ORIGINATOR	DATE	CHECKED	DATE
<i>Paul J. Snipek</i>	03/27/92	<i>Robert R. Larsen</i>	3/27/92

LC 3B01

3A

		ITE Relay					IAV RELAY Pickup Setting:					98.75 V			
Time	PU - 60	60-14	13	12	11	10	8	6	4						
IAV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545						
Relay Voltage	105.48	88.88	87.89	86.51	84.93	83.25	79.00	71.10	53.82						
Voltage @MCC	421.9	355.5	351.6	346.0	339.7	333.0	316.0	284.4	215.3						
P.U. Voltage	0.9172	0.7728	0.7642	0.7522	0.7385	0.7239	0.6870	0.6183	0.4680						

Motor: 3P201A Charging Pump
Horsepower 150 Cable Impedance 0.0374
PF 0.9 P.U. Impedance 0.0238
Efficiency 0.925 Motor Base KVA 134.41
Cable Rest. 0.0254 Motor Base Amps 168.71
Cable React. 0.0275
LRC/FLA 5.80
Stall Torq% 230 Stall Volts 0.659

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0267	0.0321	0.0325	0.0331	0.0337	0.0345	0.0366	0.0412	0.0580
MTR VOLTS(pu)	0.8905	0.7407	0.7317	0.7192	0.7047	0.6894	0.6504	0.5771	0.4100
AMPS(pu)	1.1229	1.3500	1.3666	1.3905	1.4190	1.4506	1.5375	1.7329	2.4391
RUNNING AMPS	189.5	227.8	230.6	234.6	239.4	244.7	259.4	292.4	411.5
LRC AMPS	----	----	----	----	----	----	590.7	531.7	402.4
CURVE POINTS	189.5	227.8	230.6	234.6	239.4	244.7	590.7	531.7	402.4

Motor: 3P214A Cont. Spray Pump
Horsepower 250 Cable Impedance 0.0163
PF 0.9 P.U. Impedance 0.0170
Efficiency 0.94 Motor Base KVA 220.45
Cable Rest. 0.0065 Motor Base Amps 276.70
Cable React. 0.015
LRC/FLA 6.18
Stall Torq% 200 Stall Volts 0.707

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0190	0.0227	0.0230	0.0234	0.0238	0.0243	0.0258	0.0289	0.0398
MTR VOLTS(pu)	0.8983	0.7501	0.7413	0.7288	0.7146	0.6995	0.6612	0.5894	0.4282
AMPS(pu)	1.1133	1.3331	1.3490	1.3720	1.3993	1.4295	1.5124	1.6967	2.3353
RUNNING AMPS	308.0	368.9	373.3	379.6	387.2	395.5	418.5	469.5	646.2
LRC AMPS	----	----	----	----	----	1119.9	1062.8	956.5	724.0
CURVE POINTS	308.0	368.9	373.3	379.6	387.2	1119.9	1062.8	956.5	724.0

CALCULATION SHEET

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR D. O. L. Smith	DATE 03/27/92	CHECKED Robert R. Larsen	DATE 3/27/92

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 8 OF 20

LC 3802	3B				Time	ITE Relay--	-----IAV RELAY Pickup Setting:	100.5 V	-----	-----	-----	-----	-----
					PU - 60	60-14	13	12	11	10	8	6	4
				IAV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545
				Relay Voltage	106.22	90.45	89.45	88.04	86.43	84.72	80.40	72.36	54.77
				Voltage @MCC	424.9	361.8	357.8	352.2	345.7	338.9	321.6	289.4	219.1
				P.U. Voltage	0.9237	0.7865	0.7778	0.7655	0.7516	0.7367	0.6991	0.6292	0.4763
Motor:	3P201B	Charging Pump											
Horsepower	150	Cable Impedance	0.0479	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.9	P.U. Impedance	0.0304	CABLE DROP(pu)	0.0342	0.0408	0.0413	0.0421	0.0429	0.0439	0.0466	0.0528	0.0760
Efficiency	0.925	Motor Base KVA	134.41	MTR VOLTS(pu)	0.8894	0.7457	0.7365	0.7235	0.7086	0.6928	0.6525	0.5764	0.4002
Cable Rest.	0.0325	Motor Base Amps	168.71	AMPS(pu)	1.1243	1.3410	1.3578	1.3822	1.4112	1.4435	1.5326	1.7348	2.4985
Cable React.	0.0352			RUNNING AMPS	189.7	226.2	229.1	233.2	238.1	243.5	258.6	292.7	421.5
LRC/FLA	5.80			LRC AMPS	----	----	----	----	----	----	581.5	523.3	396.1
Stall Torq%	230	Stall Volts	0.659	CURVE POINTS	189.7	226.2	229.1	233.2	238.1	243.5	581.5	523.3	396.1
Motor:	3P214B	Cont. Spray Pump											
Horsepower	250	Cable Impedance	0.0194	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.905	P.U. Impedance	0.0201	CABLE DROP(pu)	0.0223	0.0264	0.0268	0.0272	0.0278	0.0284	0.0300	0.0337	0.0468
Efficiency	0.94	Motor Base KVA	219.23	MTR VOLTS(pu)	0.9014	0.7601	0.7510	0.7383	0.7238	0.7083	0.6691	0.5955	0.4295
Cable Rest.	0.0077	Motor Base Amps	275.17	AMPS(pu)	1.1094	1.3156	1.3315	1.3544	1.3816	1.4117	1.4945	1.6793	2.3283
Cable React.	0.0178			RUNNING AMPS	305.3	362.0	366.4	372.7	380.2	388.5	411.2	462.1	640.7
LRC/FLA	6.18			LRC AMPS	----	----	----	----	----	----	1057.6	951.8	720.5
Stall Torq%	200	Stall Volts	0.707	CURVE POINTS	305.3	362.0	366.4	372.7	380.2	388.5	1057.6	951.8	720.5

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25





CALCULATION SHEET

APPENDIX <u>A</u>
JOB <u>21701-523</u>
CALC. <u>21701-523-E-02</u>
SHT <u>9</u> OF <u>20</u>

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

LC 3H (3850)
LC Supply: 3803

EC-145 Ref.
PSB-1 LC Volts: 366 App. 11 Case 9
PSB-1 MCC V 353 App. 11 Case 9
PSB-1 V Drop 13
Calculated PmZc 4589

ITE Relay		IAV RELAY Pickup Setting:									
Time	PU - 60	60-14	13	12	11	10	8	6	4	98 V	
IAV TD 5	---	0.90	0.89	0.88	0.86	0.84	0.80	0.72	0.55		
Relay Voltage	108.31	88.20	87.22	85.85	84.28	82.61	78.40	70.56	53.41		
Voltage @LC	433.2	352.8	348.9	343.4	337.1	330.5	313.6	282.2	213.6		
Voltage @MCC	422.4	339.3	335.2	329.5	322.9	315.9	298.2	264.9	189.4		
P.U. Voltage	0.9182	0.7376	0.7287	0.7162	0.7020	0.6868	0.6483	0.5759	0.4118		

Motor: 3P201C Charging Pump
Horsepower 150 Cable Impedance 0.0333
PF 0.9 P.U. Impedance 0.0213
Efficiency 0.92 Motor Base KVA 135.14
Cable Rest. 0.0226 Motor Base Amps 169.63
Cable React. 0.0245
LRC/FLA 5.80
Stall Torq% 230 Stall Volts 0.659

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0238	0.0301	0.0305	0.0311	0.0318	0.0325	0.0347	0.0397	0.0606
MTR VOLTS(pu)	0.8944	0.7075	0.6982	0.6852	0.6702	0.6543	0.6136	0.5362	0.3511
AMPS(pu)	1.1181	1.4135	1.4323	1.4595	1.4921	1.5284	1.6297	1.8650	2.8479
RUNNING AMPS	189.7	239.8	243.0	247.6	253.1	259.3	276.4	316.3	483.1
LRC AMPS	----	----	----	----	----	601.4	567.7	504.3	360.6
CURVE POINTS	189.7	239.8	243.0	247.6	253.1	601.4	567.7	504.3	360.6

H

A

A

A

A

P

A

A

A

A

A

A

A

A

A

A

A

A

3)



CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 10 OF 20

JOB NO. 21701-523		CALC. NO. 21701-523-E-02		REV. NO. 0	SHEET NO.
ORIGINATOR Paul I. Snick		DATE 03/27/92	CHECKED Robert R. Larsen		DATE 3/27/92

LC 3H (3B50)			- ITE Relay-- -----IAV RELAY Pickup Setting: 98 V-----										
LC Supply: 3B04 EC-145 Ref.			Time	PU - 60	60-14	13	12	11	10	8	6	4	
			IAV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545	
PSB-1 LC Volts:	371 App. 9 Case 10		Relay Voltage	108.22	88.20	87.22	85.85	84.28	82.61	78.40	70.56	53.41	
PSB-1 MCC V	358 App. 9 Case 10		Voltage @LC	432.9	352.8	348.9	343.4	337.1	330.5	313.6	282.2	213.6	
PSB-1 V Drop	13		Voltage @MCC	421.8	339.1	335.0	329.3	322.7	315.7	298.0	264.7	189.0	
Calculated PmZc	4654		P.U. Voltage	0.9171	0.7371	0.7282	0.7158	0.7015	0.6863	0.6478	0.5753	0.4109	

Motor:	3P201C	Charging Pump											
Horsepower	150	Cable Impedance	0.0333	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.9	P.U. Impedance	0.0213	CABLE DROP(pu)	0.0238	0.0301	0.0305	0.0311	0.0318	0.0326	0.0347	0.0397	0.0608
Efficiency	0.92	Motor Base KVA	135.14	MTR VOLTS(pu)	0.8932	0.7070	0.6977	0.6847	0.6697	0.6538	0.6131	0.5356	0.3501
Cable Rest.	0.0226	Motor Base Amps	169.63	AMPS(pu)	1.1195	1.4144	1.4332	1.4605	1.4931	1.5296	1.6312	1.8671	2.8563
Cable React.	0.0245			RUNNING AMPS	189.9	239.9	243.1	247.7	253.3	259.5	276.7	316.7	484.5
LRC/FLA	5.80			LRC AMPS	----	----	----	----	----	601.0	567.3	503.8	359.8
Stall Torq%	230	Stall Volts	0.659	CURVE POINTS	189.9	239.9	243.1	247.7	253.3	601.0	567.3	503.8	359.8

8

10

12

14

16

18

20

22

24

26

28

30

32

34

36

38

40

42

44

46

48

50





CALCULATION SHEET

APPENDIX <u>A</u>
JOB <u>21701-523</u>
CALC. <u>21701-523-E-02</u>
SHT <u>11</u> OF <u>20</u>

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

MCC 3A (3805)
LC Supply: 3801

EC-145 Ref.

PSB-1 LC Volts: 369.5 App. 11 Case 9
PSB-1 MCC V 369 App. 11 Case 9
PSB-1 V Drop 0.5
Calculated PmZc 184.5

ITE Relay		IAV RELAY Pickup Setting: 98.75 V									
Time	PU - 60	60-14	13	12	11	10	8	6	4		
IAV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545		
Relay Voltage	105.48	88.88	87.89	86.51	84.93	83.25	79.00	71.10	53.82		
Voltage @LC	421.9	355.5	351.6	346.0	339.7	333.0	316.0	284.4	215.3		
Voltage @MCC	421.5	355.0	351.0	345.5	339.2	332.4	315.4	283.7	214.4		
P.U. Voltage	0.9163	0.7717	0.7631	0.7511	0.7373	0.7227	0.6857	0.6168	0.4661		

Motor: 3P10A EDG FO XFER
Horsepower 0.75 Cable Impedance 0.5613
PF 0.85 P.U. Impedance 0.0030
Efficiency 0.59 Motor Base KVA 1.12
Cable Rest. 0.5612 Motor Base Amps 1.40
Cable React. 0.0122
LRC/FLA 6.00
Stall Torq% 190 Stall Volts 0.725

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0032	0.0039	0.0039	0.0040	0.0040	0.0041	0.0043	0.0048	0.0064
MTR VOLTS(pu)	0.9130	0.7678	0.7592	0.7471	0.7333	0.7186	0.6813	0.6120	0.4597
AMPS(pu)	1.0953	1.3024	1.3172	1.3385	1.3638	1.3917	1.4677	1.6340	2.1754
RUNNING AMPS	1.5	1.8	1.8	1.9	1.9	1.9	2.1	2.3	3.0
LRC AMPS	---	---	---	---	---	6.0	5.7	5.1	3.8
CURVE POINTS	1.5	1.8	1.8	1.9	1.9	6.0	5.7	5.1	3.8

Motor: 3V34A EDG ROOM VENT FAN
Horsepower 5 Cable Impedance 0.4808
PF 0.85 P.U. Impedance 0.0108
Efficiency 0.92 Motor Base KVA 4.77
Cable Rest. 0.4807 Motor Base Amps 5.99
Cable React. 0.0104
LRC/FLA 6.00
Stall Torq% 190 Stall Volts 0.725

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0120	0.0143	0.0145	0.0147	0.0150	0.0153	0.0162	0.0181	0.0245
MTR VOLTS(pu)	0.9043	0.7574	0.7486	0.7363	0.7223	0.7074	0.6695	0.5987	0.4416
AMPS(pu)	1.1059	1.3203	1.3358	1.3581	1.3845	1.4137	1.4937	1.6702	2.2646
RUNNING AMPS	6.6	7.9	8.0	8.1	8.3	8.5	8.9	10.0	13.6
LRC AMPS	---	---	---	---	24.9	24.4	23.1	20.8	15.7
CURVE POINTS	6.6	7.9	8.0	8.1	24.9	24.4	23.1	20.8	15.7

6

CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC 21701-523-E-02
SHT 12 OF 20

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
21701-523	21701-523-E-02	0	
ORIGINATOR	DATE	CHECKED	DATE
<i>Paul J. Smith</i>	03/27/92	<i>Robert R. Linsen</i>	3/27/92

MCC 3B (3B06)
LC Supply: 3B02

EC-145 Ref.

PSB-1 LC Volts: 385 App. 5 Case 10
PSB-1 MCC V 379 App. 5 Case 10
PSB-1 V Drop 6
Calculated PmZc 2274

I- ITE Relay--I-----IAV RELAY Pickup Setting:

100.5 V -----I

Time	PU - 60	60-14	13	12	11	10	8	6	4
IAV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545
Relay Voltage	106.22	90.45	89.45	88.04	86.43	84.72	80.40	72.36	54.77
Voltage @LC	424.9	361.8	357.8	352.2	345.7	338.9	321.6	289.4	219.1
Voltage @MCC	419.5	355.4	351.3	345.6	339.0	332.0	314.4	281.4	208.2
P.U. Voltage	0.9119	0.7726	0.7637	0.7512	0.7370	0.7218	0.6834	0.6116	0.4525

Motor: 3V30A EMERG CONT CLR FAN
Horsepower 30 Cable Impedance 0.1956
PF 0.808 P.U. Impedance 0.0283
Efficiency 0.904 Motor Base KVA 30.64
Cable Rest. 0.1939 Motor Base Amps 38.46
Cable React. 0.0256
LRC/FLA 6.18
Stall Torq% 263 Stall Volts 0.617

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0322	0.0386	0.0391	0.0398	0.0407	0.0416	0.0443	0.0505	0.0750
MTR VOLTS(pu)	0.8797	0.7340	0.7246	0.7114	0.6963	0.6802	0.6391	0.5612	0.3775
AMPS(pu)	1.1368	1.3623	1.3800	1.4056	1.4361	1.4702	1.5647	1.7820	2.6489
RUNNING AMPS	43.7	52.4	53.1	54.1	55.2	56.5	60.2	68.5	101.9
LRC AMPS	---	---	---	---	---	---	---	123.7	91.5
CURVE POINTS	43.7	52.4	53.1	54.1	55.2	56.5	60.2	123.7	91.5

Motor: 3V3A EMERG CONT FILT FAN
Horsepower 75 Cable Impedance 0.0387
PF 0.862 P.U. Impedance 0.0128
Efficiency 0.929 Motor Base KVA 69.87
Cable Rest. 0.032 Motor Base Amps 87.69
Cable React. 0.0218
LRC/FLA 6.30
Stall Torq% 247 Stall Volts 0.636

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0142	0.0169	0.0171	0.0174	0.0178	0.0182	0.0192	0.0217	0.0303
MTR VOLTS(pu)	0.8976	0.7557	0.7466	0.7338	0.7192	0.7037	0.6642	0.5900	0.4223
AMPS(pu)	1.1141	1.3233	1.3394	1.3627	1.3904	1.4212	1.5057	1.6950	2.3682
RUNNING AMPS	97.7	116.0	117.5	119.5	121.9	124.6	132.0	148.6	207.7
LRC AMPS	---	---	---	---	---	---	---	312.7	231.4
CURVE POINTS	97.7	116.0	117.5	119.5	121.9	124.6	132.0	312.7	231.4

Motor: E16A/E17A CONT ROOM A/C AHU
Horsepower 34 Cable Impedance 0.1316
PF 0.85 P.U. Impedance 0.0202
Efficiency 0.92 Motor Base KVA 32.43
Cable Rest. 0.1308 Motor Base Amps 40.71
Cable React. 0.0143 Base Amps & LRC are total
LRC/FLA 4.53 for 4 Motors. (Ref. 4.11)
Stall Torq% 190 Stall Volts 0.725

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0227	0.0271	0.0274	0.0279	0.0285	0.0291	0.0309	0.0350	0.0501
MTR VOLTS(pu)	0.8892	0.7456	0.7363	0.7234	0.7085	0.6927	0.6525	0.5767	0.4024
AMPS(pu)	1.1246	1.3413	1.3581	1.3824	1.4114	1.4436	1.5326	1.7341	2.4850
RUNNING AMPS	45.8	54.6	55.3	56.3	57.5	58.8	62.4	70.6	101.2
LRC AMPS	---	---	---	126.9	124.5	122.0	115.5	103.4	76.5
CURVE POINTS	45.8	54.6	55.3	126.9	124.5	122.0	115.5	103.4	76.5

Motor: 3V36 AIR,PART.&GAS MONITOR
Horsepower 2 Cable Impedance 0.9103
PF 0.88 P.U. Impedance 0.0092
Efficiency 0.79 Motor Base KVA 2.15
Cable Rest. 0.9101 Motor Base Amps 2.70
Cable React. 0.0198 NOTE: Cable not in EC-145
LRC/FLA 6.00 407' #12 per C&R schedule
Stall Torq% 190 Stall Volts 0.725

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0102	0.0121	0.0123	0.0125	0.0127	0.0130	0.0138	0.0155	0.0214
MTR VOLTS(pu)	0.9016	0.7605	0.7514	0.7387	0.7242	0.7088	0.6696	0.5962	0.4311
AMPS(pu)	1.1091	1.3150	1.3308	1.3536	1.3808	1.4108	1.4934	1.6774	2.3195
RUNNING AMPS	3.0	3.6	3.6	3.7	3.7	3.8	4.0	4.5	6.3
LRC AMPS	---	---	---	---	11.3	11.1	10.5	9.4	6.9
CURVE POINTS	3.0	3.6	3.6	3.7	11.3	11.1	10.5	9.4	6.9

Note: FLA based on PC/M 89-587 which replaced the motor. (See Attachment 3)

22

100

100

100

100

100

100

100

CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 13 OF 20

PAS
3/22/92

JOB NO. 21701-523		CALC. NO. 21701-523-E-02		REV. NO. 0	SHEET NO.
ORIGINATOR Paul L. Smith		DATE 03/27/92	CHECKED Robert R. Larsen		DATE 3/27/92

MCC 3C (3807)				I-AV RELAY Pickup Setting: 98 V									
LC Supply: 3803				EC-145 Ref.									
				Time	PU - 60	60-14	13	12	11	10	8	6	4
PSB-1 LC Volts: 366 App. 11 Case 9				I-AV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545
PSB-1 MCC V 355 App. 11 Case 9				Relay Voltage	108.22	88.20	87.22	85.85	84.28	82.61	78.40	70.56	53.41
PSB-1 V Drop 11				Voltage @LC	432.9	352.8	348.9	343.4	337.1	330.5	313.6	282.2	213.6
Calculated PmZc 3905				Voltage @MCC	423.7	341.4	337.3	331.6	325.1	318.2	300.6	267.7	193.5
				P.U. Voltage	0.9210	0.7421	0.7333	0.7209	0.7068	0.6917	0.6535	0.5818	0.4206
Motor: 3V30C EMERG CONT COOLER FAN													
Horsepower	30	Cable Impedance	0.2636	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.808	P.U. Impedance	0.0382	CABLE DROP(pu)	0.0435	0.0556	0.0564	0.0575	0.0589	0.0605	0.0648	0.0753	0.1325
Efficiency	0.904	Motor Base KVA	30.64	MTR VOLTS(pu)	0.8775	0.6865	0.6769	0.6634	0.6479	0.6312	0.5887	0.5065	0.2881
Cable Rest.	0.2617	Motor Base Amps	38.46	AMPS(pu)	1.1396	1.4567	1.4773	1.5074	1.5436	1.5842	1.6987	1.9743	3.4712
Cable React.	0.0312			RUNNING AMPS	43.8	56.0	56.8	58.0	59.4	60.9	65.3	75.9	133.5
LRC/FLA	6.18			LRC AMPS	----	----	----	----	----	----	125.7	111.9	80.9
Stall Torq%	263	Stall Volts	0.617	CURVE POINTS	43.8	56.0	56.8	58.0	59.4	60.9	125.7	111.9	80.9
Motor: 3V3C EMERG CONT. FILTER FAN													
Horsepower	75	Cable Impedance	0.0433	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.862	P.U. Impedance	0.0143	CABLE DROP(pu)	0.0158	0.0198	0.0200	0.0204	0.0208	0.0213	0.0226	0.0257	0.0373
Efficiency	0.929	Motor Base KVA	69.87	MTR VOLTS(pu)	0.9052	0.7223	0.7132	0.7005	0.6859	0.6704	0.6309	0.5562	0.3833
Cable Rest.	0.0358	Motor Base Amps	87.69	AMPS(pu)	1.1047	1.3844	1.4021	1.4275	1.4579	1.4917	1.5852	1.7980	2.6091
Cable React.	0.0243			RUNNING AMPS	96.9	121.4	123.0	125.2	127.8	130.8	139.0	157.7	228.8
LRC/FLA	6.30			LRC AMPS	----	----	----	----	----	----	331.2	294.9	213.2
Stall Torq%	247	Stall Volts	0.636	CURVE POINTS	96.9	121.4	123.0	125.2	127.8	130.8	331.2	294.9	213.2
Motor: 3V65A SWGR 3D ROOM SUPPLY FAN													
Horsepower	2	Cable Impedance	0.8554	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.808	P.U. Impedance	0.0086	CABLE DROP(pu)	0.0095	0.0118	0.0120	0.0122	0.0124	0.0127	0.0135	0.0152	0.0216
Efficiency	0.865	Motor Base KVA	2.13	MTR VOLTS(pu)	0.9115	0.7303	0.7213	0.7087	0.6943	0.6790	0.6400	0.5666	0.3989
Cable Rest.	0.855	Motor Base Amps	2.68	AMPS(pu)	1.0970	1.3694	1.3864	1.4110	1.4402	1.4728	1.5625	1.7649	2.5068
Cable React.	0.0272			RUNNING AMPS	2.9	3.7	3.7	3.8	3.9	3.9	4.2	4.7	6.7
LRC/FLA	7.63			LRC AMPS	----	----	----	----	----	----	----	----	8.1
Stall Torq%	358	Stall Volts	0.529	CURVE POINTS	2.9	3.7	3.7	3.8	3.9	3.9	4.2	4.7	8.1





CALCULATION SHEET

APPENDIX A
 JOB 21701-523
 CALC. 21701-523-E-02
 SHT 14 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Snijck</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

MCC 3D (3808)
LC Supply: 3803

EC-145 Ref.
PSB-1 LC Volts: 366 App. 11
PSB-1 MCC V 348 Case 9
PSB-1 V Drop 18
Calculated PmZc 6264

		ITE Relay--					IAV RELAY Pickup Settings:					98 V			
	Time	PU - 60	60-14	13	12	11	10	8	6	4		10	8	6	4
IAV TD 5	---	---	0.90	0.89	0.88	0.86	0.84	0.80	0.72	0.55		0.84	0.80	0.72	0.55
Relay Voltage	108.31	88.20	87.22	85.85	84.28	82.61	78.40	70.56	53.41			82.61	78.40	70.56	53.41
Voltage @LC	433.2	352.8	348.9	343.4	337.1	330.5	313.6	282.2	213.6			330.5	313.6	282.2	213.6
Voltage @MCC	418.2	334.0	329.9	324.1	317.4	310.3	292.2	258.0	178.6			310.3	292.2	258.0	178.6
P.U. Voltage	0.9092	0.7262	0.7172	0.7045	0.6900	0.6745	0.6351	0.5608	0.3882			0.6745	0.6351	0.5608	0.3882

Motor: 3V3B EMERG CONT FILTER FAN
Horsepower 75 Cable Impedance 0.0458
PF 0.862 P.U. Impedance 0.0151
Efficiency 0.929 Motor Base KVA 69.87
Cable Rest. 0.0379 Motor Base Amps 87.69
Cable React. 0.0258
LRC/FLA 6.30
Stall Torq% 247 Stall Volts 0.636

	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0170	0.0215	0.0218	0.0222	0.0227	0.0232	0.0232	0.0248	0.0284	0.0440
MTR VOLTS(pu)	0.8922	0.7047	0.6954	0.6823	0.6673	0.6512	0.6103	0.5323	0.3442	
AMPS(pu)	1.1208	1.4190	1.4380	1.4656	1.4986	1.5355	1.6385	1.8785	2.9054	
RUNNING AMPS	98.3	124.4	126.1	128.5	131.4	134.7	143.7	164.7	254.8	
LRC AMPS	---	---	---	---	---	---	320.3	282.8	195.8	
CURVE POINTS	98.3	124.4	126.1	128.5	131.4	134.7	320.3	282.8	195.8	

Motor: 3V30B EMERG CONT COOLER FAN
Horsepower 30 Cable Impedance 0.2507
PF 0.808 P.U. Impedance 0.0363
Efficiency 0.904 Motor Base KVA 30.64
Cable Rest. 0.249 Motor Base Amps 38.46
Cable React. 0.0294
LRC/FLA 6.18
Stall Torq% 263 Stall Volts 0.617

	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0419	0.0540	0.0548	0.0560	0.0574	0.0590	0.0635	0.0747	0.1572	
MTR VOLTS(pu)	0.8673	0.6722	0.6623	0.6485	0.6326	0.6155	0.5716	0.4861	0.2310	
AMPS(pu)	1.1530	1.4877	1.5098	1.5420	1.5808	1.6247	1.7494	2.0572	4.3286	
RUNNING AMPS	44.3	57.2	58.1	59.3	60.8	62.5	67.3	79.1	166.5	
LRC AMPS	---	---	---	---	---	130.9	123.3	108.9	75.3	
CURVE POINTS	44.3	57.2	58.1	59.3	60.8	130.9	123.3	108.9	75.3	

Motor: S74B COMPUTER ROOM CHILLER UNIT
Horsepower 65 Cable Impedance 0.0759
PF - P.U. Impedance 0.0236
Efficiency - Motor Base KVA 65.65
Cable Rest. 0.0691 Total Load Amps 82.40
Cable React. 0.0315 Compressor Amps 62
LRC/FLA 5.48/6.44 Fan/Pump A ea. 6.8
Stall Torq% 230/274 Stall Volts .659/.604
Note: S74B consists of 2 fans, 1 pump & 1 comp. mtr
Total Load Amps equals sum of all loads
Motor FLA Ref. 5177-206-M724-27-4, also
LRC and Stall Torq% data available via
Ref. 5177-206-M724-43-1. Worst case Stall Torq%
and LRC used for the Pump/Fan combination.

	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0267	0.0340	0.0345	0.0352	0.0360	0.0370	0.0396	0.0457	0.0753	
MTR VOLTS(pu)	0.8825	0.6922	0.6826	0.6693	0.6539	0.6375	0.5956	0.5150	0.3129	
AMPS(pu)	1.1332	1.4448	1.4649	1.4941	1.5292	1.5685	1.6791	1.9416	3.1963	
RUN AMPS COMP.	70.3	89.6	90.8	92.6	94.8	97.2	104.1	120.4	198.2	
LRC AMPS COMP.	---	---	---	---	---	207.6	203.0	191.1	168.7	
COMP. CURVE PT	70.3	89.6	90.8	92.6	207.6	203.0	191.1	168.7	116.8	
RUN AMPS P/FAN	7.7	9.8	10.0	10.2	10.4	10.7	11.4	13.2	21.7	
LRC AMPS P/FAN	---	---	---	---	---	---	24.1	21.3	14.8	
PUMP/FAN PTS	7.7	9.8	10.0	10.2	10.4	10.7	24.1	21.3	14.8	

2.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.

1.





CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 15 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert R. Linsen</i>	DATE 3/27/92

Motor: S75B COMPUTER ROOM CHILLER
Horsepower 5 Cable Impedance 0.6391
PF 0.84 P.U. Impedance 0.0164
Efficiency 0.82 Motor Base KVA 5.42
Cable Rest. 0.6388 Motor Base Amps 6.80
Cable React. 0.0203
LRC/FLA 6.04
Stall Torq% 274 Stall Volts 0.604

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0184	0.0233	0.0236	0.0240	0.0246	0.0252	0.0269	0.0309	0.0481
MTR VOLTS(pu)	0.8908	0.7029	0.6936	0.6804	0.6654	0.6493	0.6082	0.5299	0.3401
AMPS(pu)	1.1226	1.4226	1.4418	1.4696	1.5029	1.5401	1.6441	1.8871	2.9405
RUNNING AMPS	7.6	9.7	9.8	10.0	10.2	10.5	11.2	12.8	20.0
LRC AMPS	----	----	----	----	----	----	----	21.0	14.5
CURVE POINTS	7.6	9.7	9.8	10.0	10.2	10.5	11.2	21.0	14.5

Motor: S77B COMPUTER ROOM AC-AHU
Horsepower 5 Cable Impedance 0.8077
PF 0.84 P.U. Impedance 0.0207
Efficiency 0.82 Motor Base KVA 5.42
Cable Rest. 0.8073 Motor Base Amps 6.80
Cable React. 0.0257
LRC/FLA 6.04
Stall Torq% 274 Stall Volts 0.604

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0233	0.0297	0.0301	0.0307	0.0314	0.0322	0.0344	0.0397	0.0637
MTR VOLTS(pu)	0.8858	0.6965	0.6871	0.6738	0.6586	0.6423	0.6007	0.5211	0.3245
AMPS(pu)	1.1289	1.4357	1.4555	1.4841	1.5184	1.5569	1.6647	1.9190	3.0820
RUNNING AMPS	7.7	9.8	9.9	10.1	10.3	10.6	11.3	13.0	20.9
LRC AMPS	----	----	----	----	----	----	23.2	20.5	14.2
CURVE POINTS	7.7	9.8	9.9	10.1	10.3	10.6	23.2	20.5	14.2

Motor: S78B COMPUTER ROOM AC-AHU
Horsepower 5 Cable Impedance 0.7164
PF 0.84 P.U. Impedance 0.0183
Efficiency 0.82 Motor Base KVA 5.42
Cable Rest. 0.716 Motor Base Amps 6.80
Cable React. 0.0228
LRC/FLA 6.04
Stall Torq% 274 Stall Volts 0.604

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0206	0.0262	0.0265	0.0271	0.0277	0.0284	0.0303	0.0349	0.0550
MTR VOLTS(pu)	0.8885	0.7000	0.6906	0.6774	0.6623	0.6461	0.6048	0.5259	0.3331
AMPS(pu)	1.1254	1.4286	1.4480	1.4762	1.5099	1.5477	1.6534	1.9014	3.0017
RUNNING AMPS	7.6	9.7	9.8	10.0	10.3	10.5	11.2	12.9	20.4
LRC AMPS	----	----	----	----	----	----	----	20.7	14.3
CURVE POINTS	7.6	9.7	9.8	10.0	10.3	10.5	11.2	20.7	14.3

Motor: V29B CONT.ROOM EMERG FILTER FAN
Horsepower 5 Cable Impedance 0.5338
PF 0.85 P.U. Impedance 0.0137
Efficiency 0.81 Motor Base KVA 5.42
Cable Rest. 0.5335 Motor Base Amps 6.80
Cable React. 0.017
LRC/FLA 6.44
Stall Torq% 307 Stall Volts 0.571

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0153	0.0193	0.0196	0.0200	0.0204	0.0209	0.0223	0.0255	0.0392
MTR VOLTS(pu)	0.8939	0.7069	0.6976	0.6845	0.6696	0.6536	0.6128	0.5352	0.3490
AMPS(pu)	1.1187	1.4147	1.4336	1.4609	1.4935	1.5300	1.6318	1.8683	2.8652
RUNNING AMPS	7.6	9.6	9.7	9.9	10.2	10.4	11.1	12.7	19.5
LRC AMPS	----	----	----	----	----	----	----	22.6	15.6
CURVE POINTS	7.6	9.6	9.7	9.9	10.2	10.4	11.1	22.6	15.6

23

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26





CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 16 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Snijk</i>	DATE 03/27/92	CHECKED <i>Robert H. Larsen</i>	DATE 3/27/92

Motor: E16C/E17C CONT ROOM AC-AHU
Horsepower 34 Cable Impedance 0.1539
PF - P.U. Impedance 0.0222
Efficiency - Load Base KVA 30.48
Cable Rest. 0.153 Load Base Amps 38.30
Cable React. 0.0167 Base amps & LRC are total
LRC/FLA 4.53 for 4 Motors. (Ref. 4.11)
Stall Torq% 190 Stall Volts 0.725

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0251	0.0319	0.0324	0.0330	0.0338	0.0346	0.0371	0.0428	0.0696
MTR VOLTS(pu)	0.8841	0.6943	0.6848	0.6715	0.6562	0.6398	0.5981	0.5180	0.3186
AMPS(pu)	1.1311	1.4404	1.4603	1.4893	1.5240	1.5629	1.6721	1.9306	3.1389
RUNNING AMPS	43.3	55.2	55.9	57.0	58.4	59.9	64.0	73.9	120.2
LRC AMPS	----	114.5	113.1	111.1	108.8	106.3	100.1	88.4	61.2
CURVE POINTS	43.3	114.5	113.1	111.1	108.8	106.3	100.1	88.4	61.2

Motor: V77/E231 ELECT EQPT ROOM AHU
Horsepower 36 Cable Impedance 0.0786
PF - P.U. Impedance 0.0098
Efficiency - Load Base KVA 26.45
Cable Rest. 0.0773 Load Base Amps 33.20
Cable React. 0.0142 Comp Amps 17.3
LRC/FLA - AHU Amps 9.3
Condenser Fan 6.3
Stall Torq% - Stall Volts -

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0109	0.0138	0.0140	0.0142	0.0145	0.0149	0.0159	0.0181	0.0272
MTR VOLTS(pu)	0.8982	0.7124	0.7032	0.6903	0.6754	0.6596	0.6193	0.5427	0.3610
AMPS(pu)	1.1133	1.4037	1.4221	1.4488	1.4806	1.5161	1.6148	1.8427	2.7704
COMP RUN AMPS	19.1	24.1	24.4	24.8	25.3	25.9	27.6	31.4	46.2
COMP LRC AMPS	----	----	----	70.9	69.5	67.9	64.0	56.5	39.1
COMP CURVE PTs	19.1	24.1	24.4	70.9	69.5	67.9	64.0	56.5	39.1
AHU RUN AMPS	10.4	13.1	13.2	13.5	13.8	14.1	15.0	17.1	25.7
AHU LRC AMPS	----	----	----	----	----	----	37.8	33.4	23.1
AHU CURVE PTs	10.4	13.1	13.2	13.5	13.8	14.1	37.8	33.4	23.1
COND FAN RUN A	7.0	8.8	9.0	9.1	9.3	9.5	10.2	11.6	17.4
COND FAN LRC A	----	----	----	----	----	----	----	24.1	16.7
COND FAN CURVE	7.0	8.8	9.0	9.1	9.3	9.5	10.2	24.1	16.7

Note: Motor Data for the AHU and Condenser Fan
can be referenced in Attachment 13
Curve Pts calculated seperately for each

The 200% stall torque assumed for the compressor is based on Attachment 15. The FLA of 17.3 will give a torque value of 43 ft-lbs, compared with a max. torque value of 114 ft-lbs giving us a breakdown torque % of 265. Therefore, our 200% assumption is extremely conservative.





CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC. 21701-523-E-02
SHT 17 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Snijk</i>	DATE 03/27/92	CHECKED <i>Robert K. Zinser</i>	DATE 3/27/92

MCC 3D (3808)
LC Supply: 3804

EC-145 Ref.

PSB-1 LC Volts: 371 App. 9 Case 10
PSB-1 MCC V 354 App. 9 Case 10
PSB-1 V Drop 17
Calculated PmZc 6018

ITE Relay		IAV RELAY Pickup Setting:					98 V			
Time	PU - 60	60-14	13	12	11	10	8	6	4	
IAV TD 5	---	0.90	0.89	0.88	0.86	0.84	0.80	0.72	0.55	
Relay Voltage	108.22	88.20	87.22	85.85	84.28	82.61	78.40	70.56	53.41	
Voltage aLC	432.8	352.8	348.9	343.4	337.1	330.5	313.6	282.2	213.6	
Voltage aMCC	418.4	334.8	330.7	324.9	318.2	311.1	293.1	259.0	180.3	
P.U. Voltage	0.9096	0.7279	0.7189	0.7062	0.6918	0.6763	0.6371	0.5631	0.3919	

Motor: 3V3B EMERG CONT FILTER FAN
Horsepower 75 Cable Impedance 0.0458
PF 0.862 P.U. Impedance 0.0151
Efficiency 0.929 Motor Base KVA 69.87
Cable Rest. 0.0379 Motor Base Amps 87.69
Cable React. 0.0258
LRC/FLA 6.30
Stall Torq% 247 Stall Volts 0.636

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0170	0.0214	0.0217	0.0221	0.0226	0.0232	0.0247	0.0283	0.0435
MTR VOLTS(pu)	0.8926	0.7065	0.6972	0.6841	0.6691	0.6532	0.6124	0.5347	0.3484
AMPS(pu)	1.1203	1.4155	1.4344	1.4618	1.4945	1.5310	1.6330	1.8701	2.8702
RUNNING AMPS	98.2	124.1	125.8	128.2	131.1	134.3	143.2	164.0	251.7
LRC AMPS	---	---	---	---	---	---	321.3	284.0	197.6
CURVE POINTS	98.2	124.1	125.8	128.2	131.1	134.3	321.3	284.0	197.6

Motor: 3V30B EMERG CONT COOLER FAN
Horsepower 30 Cable Impedance 0.2507
PF 0.808 P.U. Impedance 0.0363
Efficiency 0.904 Motor Base KVA 30.64
Cable Rest. 0.249 Motor Base Amps 38.46
Cable React. 0.0294
LRC/FLA 6.18
Stall Torq% 263 Stall Volts 0.617

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0418	0.0539	0.0547	0.0558	0.0572	0.0588	0.0633	0.0743	0.1503
MTR VOLTS(pu)	0.8678	0.6740	0.6642	0.6504	0.6345	0.6175	0.5738	0.4888	0.2416
AMPS(pu)	1.1524	1.4836	1.5055	1.5375	1.5759	1.6193	1.7427	2.0459	4.1397
RUNNING AMPS	44.3	57.1	57.9	59.1	60.6	62.3	67.0	78.7	159.2
LRC AMPS	---	---	---	---	---	---	123.7	109.3	76.1
CURVE POINTS	44.3	57.1	57.9	59.1	60.6	62.3	123.7	109.3	76.1

Motor: S74B COMPUTER ROOM CHILLER UNIT
Horsepower 65 Cable Impedance 0.0759
PF - P.U. Impedance 0.0236
Efficiency - Motor Base KVA 65.65
Cable Rest. 0.0691 Motor Base Amps 82.40
Cable React. 0.0315 Compressor Amps 62
LRC/FLA 5.48/6.44 Fan Amps 6.8
Stall Torq% 230/274 Stall Volts .659/.604

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0267	0.0340	0.0344	0.0351	0.0359	0.0368	0.0394	0.0455	0.0742
MTR VOLTS(pu)	0.8829	0.6939	0.6844	0.6711	0.6558	0.6395	0.5977	0.5175	0.3177
AMPS(pu)	1.1326	1.4411	1.4610	1.4900	1.5248	1.5638	1.6731	1.9323	3.1477
RUN AMPS COMP.	70.2	89.3	90.6	92.4	94.5	97.0	103.7	119.8	195.2
LRC AMPS COMP.	---	---	---	---	208.2	203.5	191.7	169.4	117.9
COMP. CURVE PT	70.2	89.3	90.6	92.4	208.2	203.5	191.7	169.4	117.9
RUN AMPS P/FAN	7.7	9.8	9.9	10.1	10.4	10.6	11.4	13.1	21.4
LRC AMPS P/FAN	---	---	---	---	---	---	24.2	21.4	14.9
PUMP/FAN PTS	7.7	9.8	9.9	10.1	10.4	10.6	24.2	21.4	14.9

Notes: S74B consists of 2 fans, 1 pump & 1 comp mtr
Total Load Amps Equals Sum of all loads
Motor FLA Ref. 5177-206-M724-27-4, also
LRC and Stall Torq% data available via
Ref. 5177-206-M724-43-1. Worst case Stall Torq%
and LRC used for the Pump/Fan combination.

02

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19





CALCULATION SHEET

APPENDIX AJOB 21701-523CALC. 21701-523-E-02SHT 18 OF 20

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
21701-523	21701-523-E-02	0	
ORIGINATOR	DATE	CHECKED	DATE
<i>Paul J. Smith</i>	03/27/92	<i>Robert R. Loren</i>	3/27/92

Motor: S75B COMPUTER ROOM CHILLER

Horsepower	5 Cable Impedance	0.6391	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.84 P.U. Impedance	0.0164	CABLE DROP(pu)	0.0184	0.0232	0.0235	0.0240	0.0245	0.0251	0.0268	0.0307	0.0475
Efficiency	0.82 Motor Base KVA	5.42	MTR VOLTS(pu)	0.8913	0.7047	0.6953	0.6823	0.6672	0.6512	0.6103	0.5323	0.3444
Cable Rest.	0.6388 Motor Base Amps	6.80	AMPS(pu)	1.1220	1.4191	1.4381	1.4657	1.4987	1.5356	1.6385	1.8785	2.9040
Cable React.	0.0203		RUNNING AMPS	7.6	9.6	9.8	10.0	10.2	10.4	11.1	12.8	19.7
LRC/FLA	6.04		LRC AMPS	----	----	----	----	----	----	----	21.0	14.6
Stall Torq%	274 Stall Volts	0.604	CURVE POINTS	7.6	9.6	9.8	10.0	10.2	10.4	11.1	21.0	14.6

Motor: S77B COMPUTER ROOM AC-AHU

Horsepower	5 Cable Impedance	0.8077	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.84 P.U. Impedance	0.0207	CABLE DROP(pu)	0.0233	0.0296	0.0300	0.0306	0.0313	0.0321	0.0343	0.0395	0.0628
Efficiency	0.82 Motor Base KVA	5.42	MTR VOLTS(pu)	0.8863	0.6983	0.6889	0.6756	0.6605	0.6442	0.6028	0.5236	0.3290
Cable Rest.	0.8073 Motor Base Amps	6.80	AMPS(pu)	1.1283	1.4321	1.4517	1.4801	1.5141	1.5522	1.6589	1.9099	3.0392
Cable React.	0.0257		RUNNING AMPS	7.7	9.7	9.9	10.1	10.3	10.6	11.3	13.0	20.7
LRC/FLA	6.04		LRC AMPS	----	----	----	----	----	----	23.3	20.5	14.3
Stall Torq%	274 Stall Volts	0.604	CURVE POINTS	7.7	9.7	9.9	10.1	10.3	10.6	23.3	20.5	14.3

Motor: S78B COMPUTER ROOM AC-AHU

Horsepower	5 Cable Impedance	0.7164	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.84 P.U. Impedance	0.0183	CABLE DROP(pu)	0.0206	0.0261	0.0265	0.0270	0.0276	0.0283	0.0302	0.0347	0.0543
Efficiency	0.82 Motor Base KVA	5.42	MTR VOLTS(pu)	0.8890	0.7018	0.6924	0.6792	0.6642	0.6480	0.6069	0.5284	0.3375
Cable Rest.	0.716 Motor Base Amps	6.80	AMPS(pu)	1.1249	1.4250	1.4443	1.4722	1.5057	1.5431	1.6477	1.8927	2.9626
Cable React.	0.0228		RUNNING AMPS	7.6	9.7	9.8	10.0	10.2	10.5	11.2	12.9	20.1
LRC/FLA	6.04		LRC AMPS	----	----	----	----	----	----	----	20.8	14.5
Stall Torq%	274 Stall Volts	0.604	CURVE POINTS	7.6	9.7	9.8	10.0	10.2	10.5	11.2	20.8	14.5

Motor: V29B CONT.ROOM EMERG FILTER FAN

Horsepower	5 Cable Impedance	0.5338	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
PF	0.85 P.U. Impedance	0.0137	CABLE DROP(pu)	0.0153	0.0193	0.0195	0.0199	0.0204	0.0208	0.0222	0.0254	0.0387
Efficiency	0.81 Motor Base KVA	5.42	MTR VOLTS(pu)	0.8943	0.7086	0.6993	0.6863	0.6714	0.6555	0.6149	0.5376	0.3532
Cable Rest.	0.5335 Motor Base Amps	6.80	AMPS(pu)	1.1182	1.4112	1.4299	1.4570	1.4894	1.5256	1.6264	1.8600	2.8316
Cable React.	0.017		RUNNING AMPS	7.6	9.6	9.7	9.9	10.1	10.4	11.1	12.6	19.3
LRC/FLA	6.44		LRC AMPS	----	----	----	----	----	----	----	22.7	15.8
Stall Torq%	307 Stall Volts	0.571	CURVE POINTS	7.6	9.6	9.7	9.9	10.1	10.4	11.1	22.7	15.8

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30





CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC 21701-523-E-02
SHT 19 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Snipe</i>	DATE 03/27/92	CHECKED <i>Robert R. Larsen</i>	DATE 3/27/92

Motor:	E16C/E17C	CONT ROOM AC-AHU																	
Horsepower	34	Cable Impedance	0.1539	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4						
PF	-	P.U. Impedance	0.0222	CABLE DROP(pu)	0.0251	0.0319	0.0323	0.0329	0.0337	0.0345	0.0369	0.0426	0.0686						
Efficiency	-	Load Base KVA	30.48	MTR VOLTS(pu)	0.8845	0.6960	0.6866	0.6733	0.6581	0.6418	0.6002	0.5205	0.3233						
Cable Rest.	0.153	Load Base Amps	38.30	AMPS(pu)	1.1305	1.4367	1.4565	1.4852	1.5196	1.5581	1.6662	1.9214	3.0933						
Cable React.	0.0167	Base amps & LRC are total		RUNNING AMPS	43.3	55.0	55.8	56.9	58.2	59.7	63.8	73.6	118.5						
LRC/FLA	4.53	for 4 motors. (Ref. 4.11)		LRC AMPS	----	114.8	113.3	111.3	109.1	106.6	100.4	88.8	61.8						
Stall Torq%	190	Stall Volts	0.725	CURVE POINTS	43.3	114.8	113.3	111.3	109.1	106.6	100.4	88.8	61.8						

Motor:	V77/E231	ELECT EQPT ROOM AHU																	
Horsepower	36	Cable Impedance	0.0786	TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4						
PF	-	P.U. Impedance	0.0098	CABLE DROP(pu)	0.0109	0.0138	0.0139	0.0142	0.0145	0.0149	0.0158	0.0180	0.0269						
Efficiency	-	Load Base KVA	26.45	MTR VOLTS(pu)	0.8987	0.7141	0.7049	0.6920	0.6772	0.6615	0.6213	0.5450	0.3649						
Cable Rest.	0.0773	Load Base Amps	33.20	AMPS(pu)	1.1128	1.4003	1.4186	1.4450	1.4766	1.5118	1.6096	1.8348	2.7402						
Cable React.	0.0142	Comp Amps	17.3	COMP RUN AMPS	19.1	24.0	24.3	24.8	25.3	25.9	27.5	31.2	45.7						
LRC/FLA	-	AHU Amps	9.3	COMP LRC AMPS	----	----	----	71.1	69.7	68.1	64.2	56.7	39.5						
	-	Condenser Fan	6.3	COMP CURVE PTs	19.1	24.0	24.3	71.1	69.7	68.1	64.2	56.7	39.5						
Stall Torq%	-	Stall Volts	-	AHU RUN AMPS	10.3	13.0	13.2	13.4	13.7	14.1	15.0	17.1	25.5						
Note: Motor data for the AHU and Condenser Fan				AHU LRC AMPS	----	----	----	----	----	----	37.9	33.5	23.3						
can be referenced in Attachment 13 &				AHU CURVE PTs	10.3	13.0	13.2	13.4	13.7	14.1	37.9	33.5	23.3						
Attachment 15 for compressor data.				COND FAN RUN A	7.0	8.8	8.9	9.1	9.3	9.5	10.1	11.6	17.3						
Curve Pts calculated separately for each				COND FAN LRC A	----	----	----	----	----	----	----	24.2	16.8						
				COND FAN CURVE	7.0	8.8	8.9	9.1	9.3	9.5	10.1	24.2	16.8						

The 200% stall torque assumed for the compressor is based on Attachment 15. The FLA of 17.3 will give a torque value of 43 ft-lbs, compared with a max. torque value of 114 ft-lbs giving us a breakdown torque % of 265. Therefore, our 200% assumption is extremely conservative.

4

10

20

30

40

50

60

70

80

90

100

110

120

130

140

150

160

170

180

190

200

210

220

230



CALCULATION SHEET

APPENDIX A
JOB 21701-523
CALC 21701-523-E-02
SHT 20 OF 20

JOB NO. 21701-523	CALC. NO. 21701-523-E-02	REV. NO. 0	SHEET NO.
ORIGINATOR <i>Paul J. Smith</i>	DATE 03/27/92	CHECKED <i>Robert K. Larsen</i>	DATE 3/27/92

MCC 3K (3B52)
LC Supply: 3B04

EC-145 Ref.

PSB-1 LC Volts: 371 App. 5 Case 10
PSB-1 MCC V 370.5 App. 5 Case 10
PSB-1 V Drop 0.5
Calculated PmZc 185.25

ITE Relay		IAV RELAY Pickup Setting:									
Time	PU - 60	60-14	13	12	11	10	8	6	4	98 V	
IAV TD 5	---	0.900	0.890	0.876	0.860	0.843	0.800	0.720	0.545		
Relay Voltage	108.22	88.20	87.22	85.85	84.28	82.61	78.40	70.56	53.41		
Voltage @LC	432.9	352.8	348.9	343.4	337.1	330.5	313.6	282.2	213.6		
Voltage @MCC	432.5	352.3	348.3	342.9	336.6	329.9	313.0	281.6	212.8		
P.U. Voltage	0.9401	0.7658	0.7573	0.7453	0.7317	0.7172	0.6805	0.6121	0.4625		

Motor: 3V34B EDG ROOM VENT FAN
Horsepower 5 Cable Impedance 0.0209
PF 0.85 P.U. Impedance 0.0005
Efficiency 0.92 Motor Base KVA 4.77
Cable Rest. 0.0208 Motor Base Amps 5.99
Cable React. 0.0023
LRC/FLA 6.00
Stall Torq% 190 Stall Volts 0.725

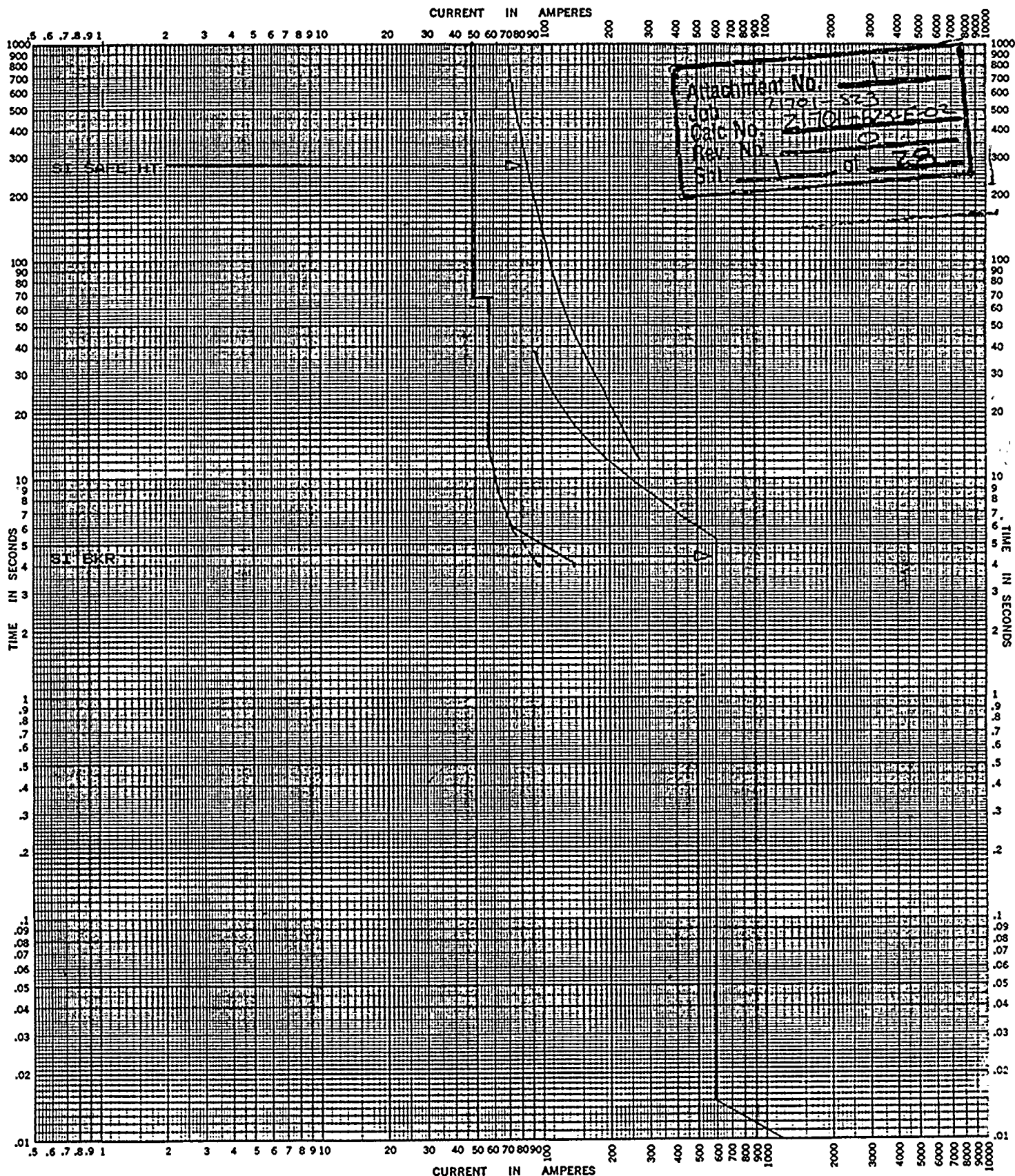
TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0005	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	0.0008	0.0010
MTR VOLTS(pu)	0.9396	0.7652	0.7567	0.7447	0.7310	0.7165	0.6798	0.6114	0.4615
AMPS(pu)	1.0643	1.3069	1.3216	1.3428	1.3679	1.3957	1.4711	1.6357	2.1668
RUNNING AMPS	6.4	7.8	7.9	8.0	8.2	8.4	8.8	9.8	13.0
LRC AMPS	---	---	---	---	---	25.7	24.4	21.9	16.6
CURVE POINTS	6.4	7.8	7.9	8.0	8.2	25.7	24.4	21.9	16.6

Motor: 3P10B EDG FO XFER PMP
Horsepower 0.75 Cable Impedance 0.1616
PF 0.85 P.U. Impedance 0.0009
Efficiency 0.59 Motor Base KVA 1.12
Cable Rest. 0.1615 Motor Base Amps 1.40
Cable React. 0.0051
LRC/FLA 6.00
Stall Torq% 190 Stall Volts 0.725

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0009	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0014	0.0018
MTR VOLTS(pu)	0.9392	0.7647	0.7562	0.7442	0.7305	0.7160	0.6792	0.6107	0.4607
AMPS(pu)	1.0647	1.3077	1.3225	1.3438	1.3689	1.3967	1.4723	1.6374	2.1706
RUNNING AMPS	1.5	1.8	1.9	1.9	1.9	2.0	2.1	2.3	3.0
LRC AMPS	---	---	---	---	---	6.0	5.7	5.1	3.9
CURVE POINTS	1.5	1.8	1.9	1.9	1.9	6.0	5.7	5.1	3.9

Motor: 3V65B SWGR 3D ROOM SUPPLY FAN
Horsepower 2 Cable Impedance 1.0035
PF 0.85 P.U. Impedance 0.0090
Efficiency 0.92 Motor Base KVA 1.91
Cable Rest. 1.003 Motor Base Amps 2.39
Cable React. 0.0319
LRC/FLA 6.00
Stall Torq% 358 Stall Volts 0.529

TIME (sec)	PU - 60	60-14	13	12	11	10	8	6	4
CABLE DROP(pu)	0.0097	0.0120	0.0121	0.0123	0.0126	0.0128	0.0136	0.0152	0.0205
MTR VOLTS(pu)	0.9304	0.7538	0.7451	0.7330	0.7191	0.7043	0.6669	0.5970	0.4421
AMPS(pu)	1.0748	1.3266	1.3420	1.3643	1.3906	1.4198	1.4995	1.6751	2.2621
RUNNING AMPS	2.6	3.2	3.2	3.3	3.3	3.4	3.6	4.0	5.4
LRC AMPS	---	---	---	---	---	---	---	---	6.3
CURVE POINTS	2.6	3.2	3.2	3.3	3.3	3.4	3.6	4.0	6.3

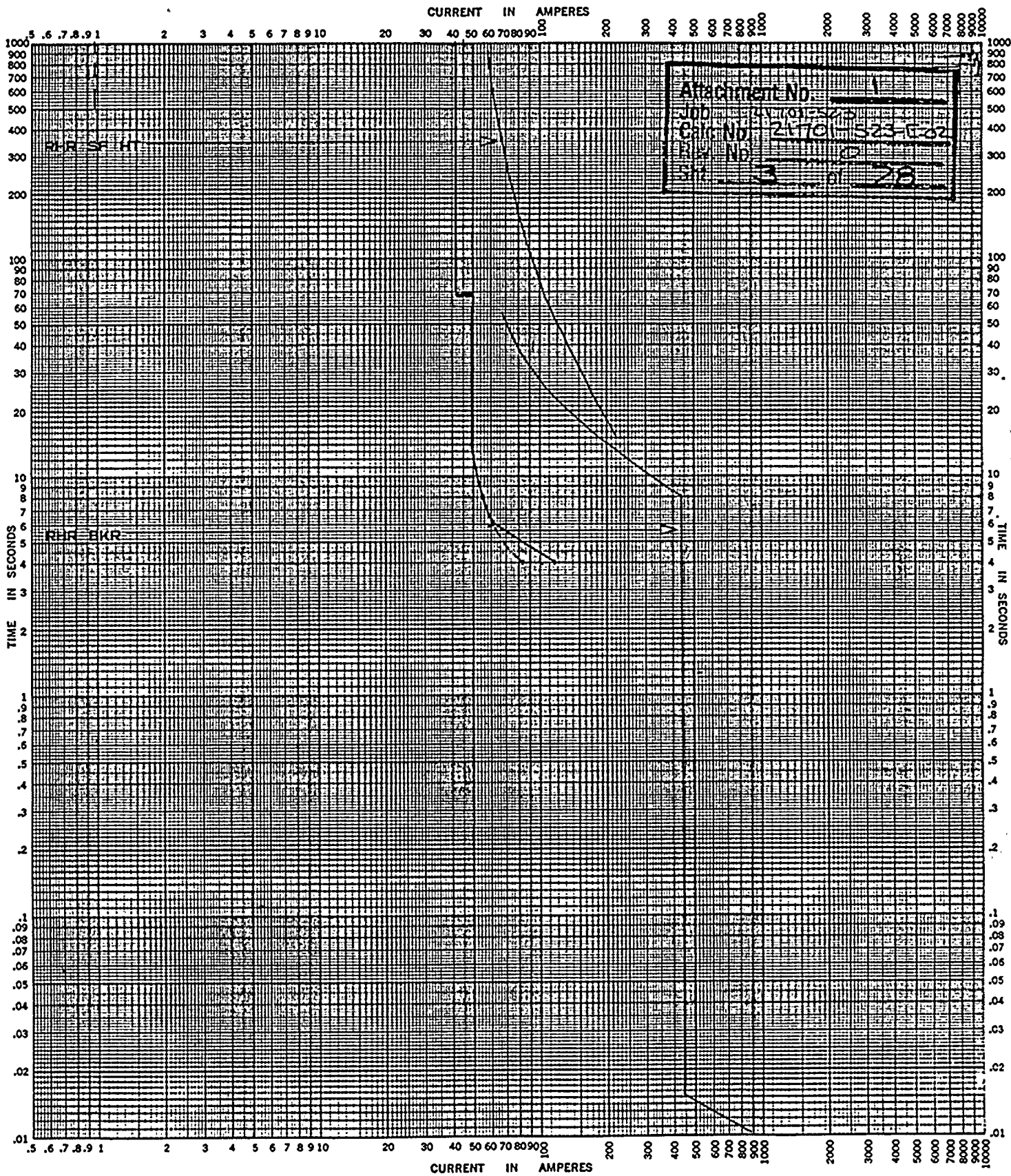


SI PUMP 3P215A		TIME-CURRENT CHARACTERISTIC CURVES	
For _____ Fuse Links. In _____		Dated _____	
BASIS FOR DATA Standards _____			
1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load _____		No. FIGURE 1	
2. Curves are plotted to _____ Test points so variations should be _____		Date 3/10/92	

PLA 3/27/12
0722 3/27/92







RHR PUMP 3P218A

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 _____

FIGURE 3

No. _____

Date **3/18/92**

Handwritten: 3/27/92
PRX 3/27/92


$$J_{-1}$$

五

[illegible]

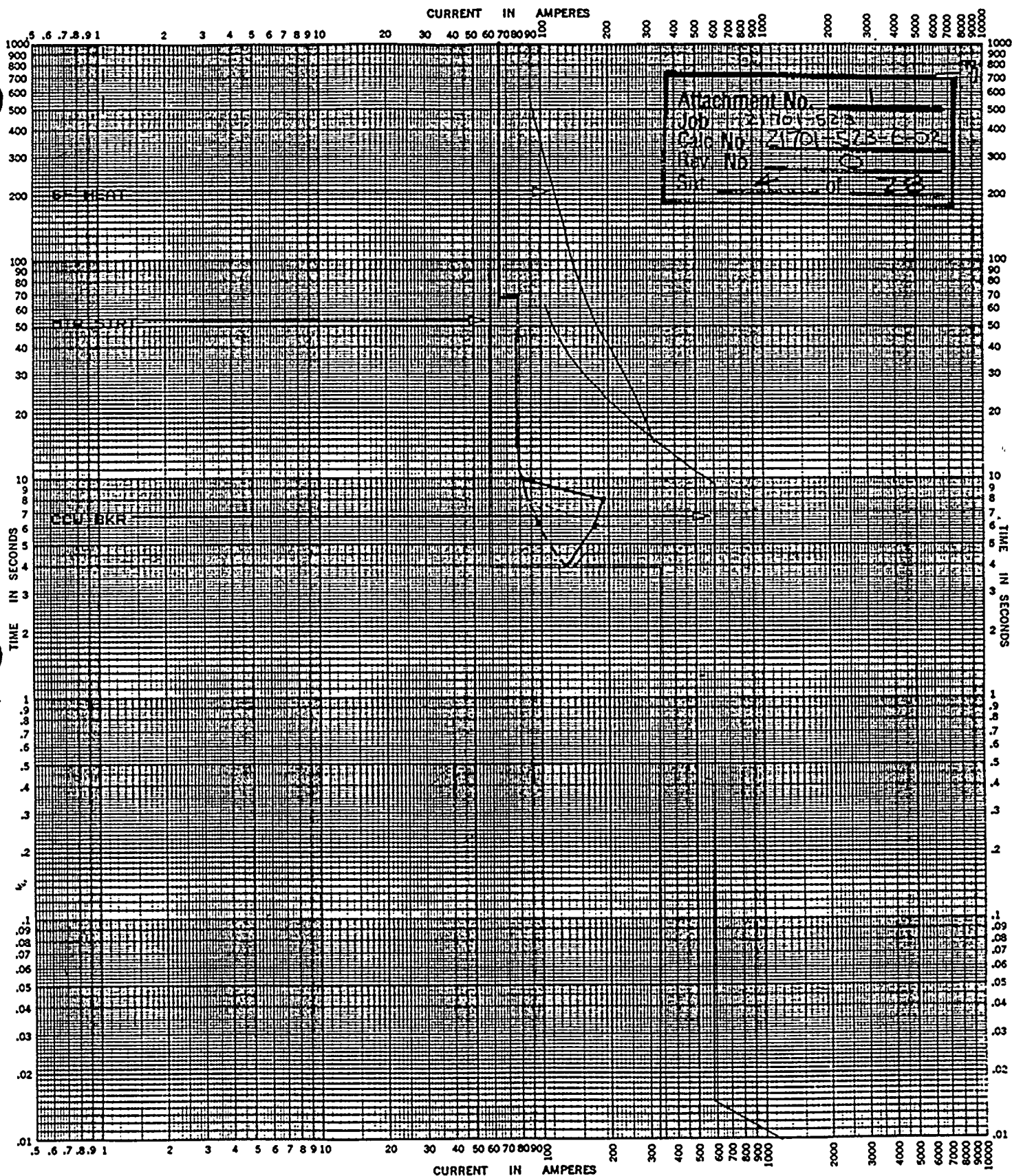
22



Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The number of transformed cells was determined by the number of colonies obtained on the selective medium. The results are the mean of three independent experiments. Error bars represent standard deviation.

11. 12. 13.

[illegible]



CCW PUMP 3P211 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 4160 U Test points so variations should be _____

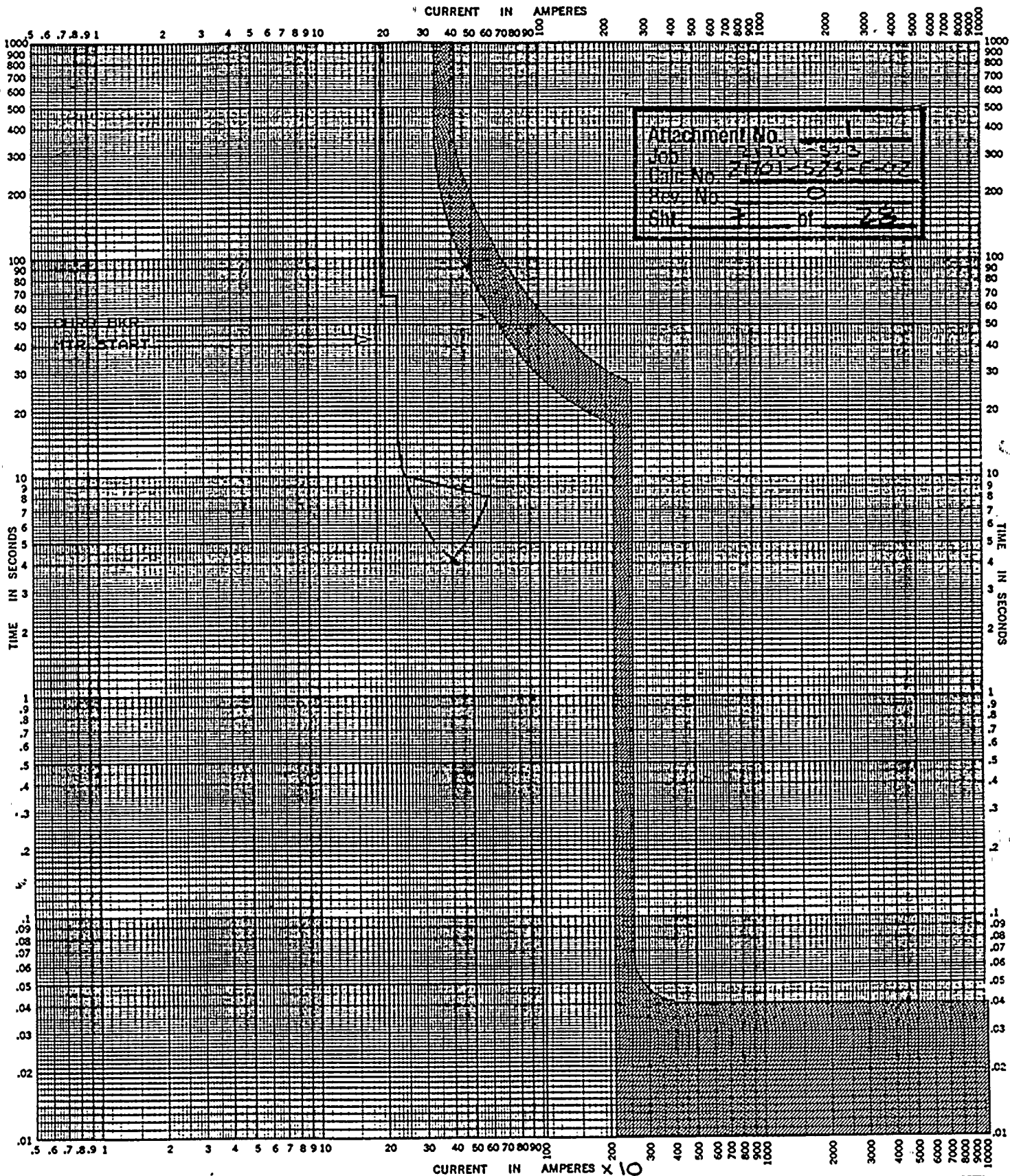
No. **FIGURE 4**

Date **3/10/92**









Attachment No.	1
Job	31701-523
Cal. No.	21701-523-1-22
Rev. No.	0
SW	3 of 23

CHARGING PUMP		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 _____		

FIGURE 7
No. _____
Date 3/17/92

PA 3/27/92
PRX 3/27/92

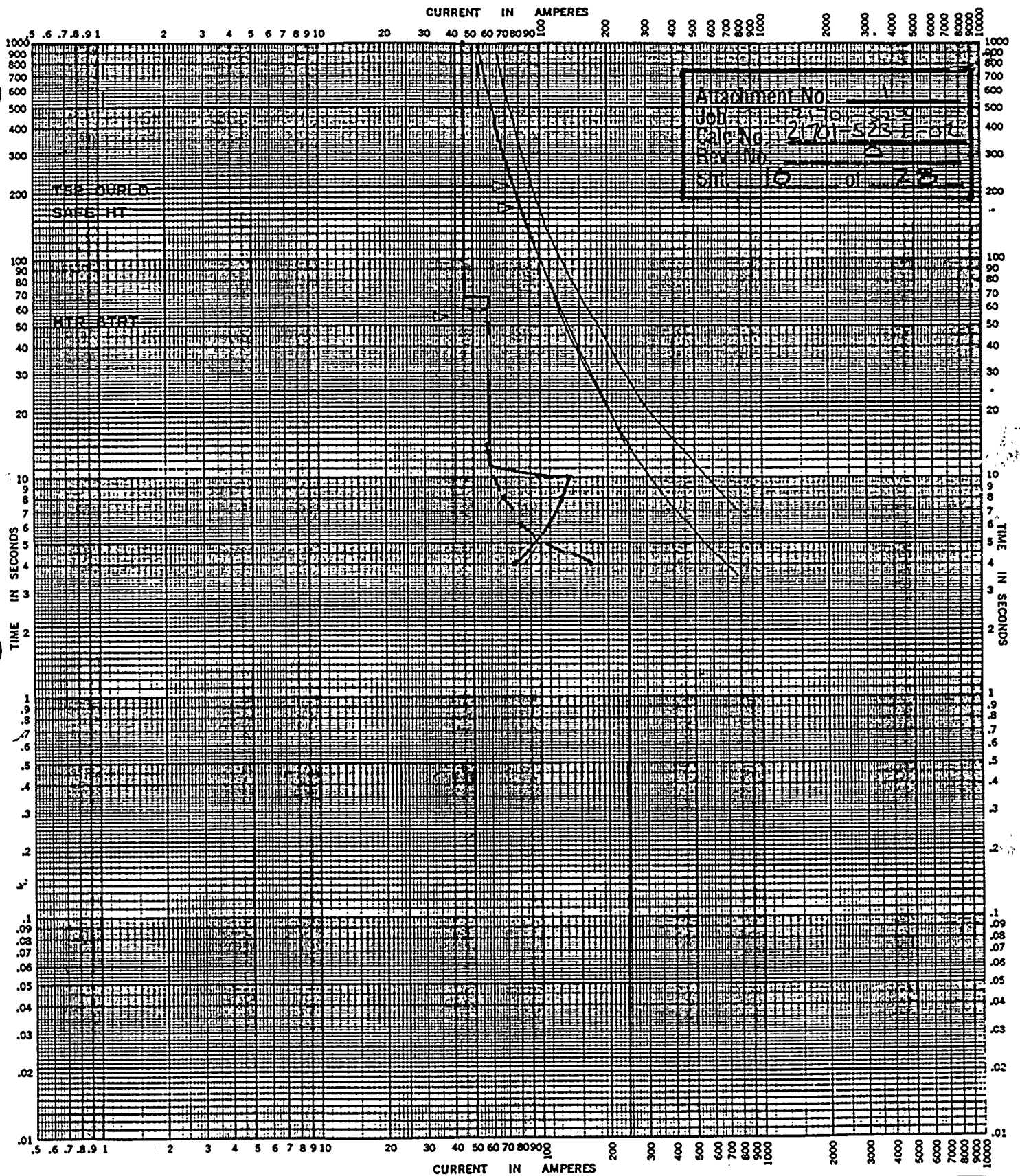


Attachment No.	1
Job	21701-523-E-2
Order No.	0
Rev. No.	0
Shl	9

CNTMT SPRAY PUMP		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.		No. FIGURE 9
2. Curves are plotted to _____ Test points so variations should be _____		Date 3/17/92

716 3127112
072X 3/27/92





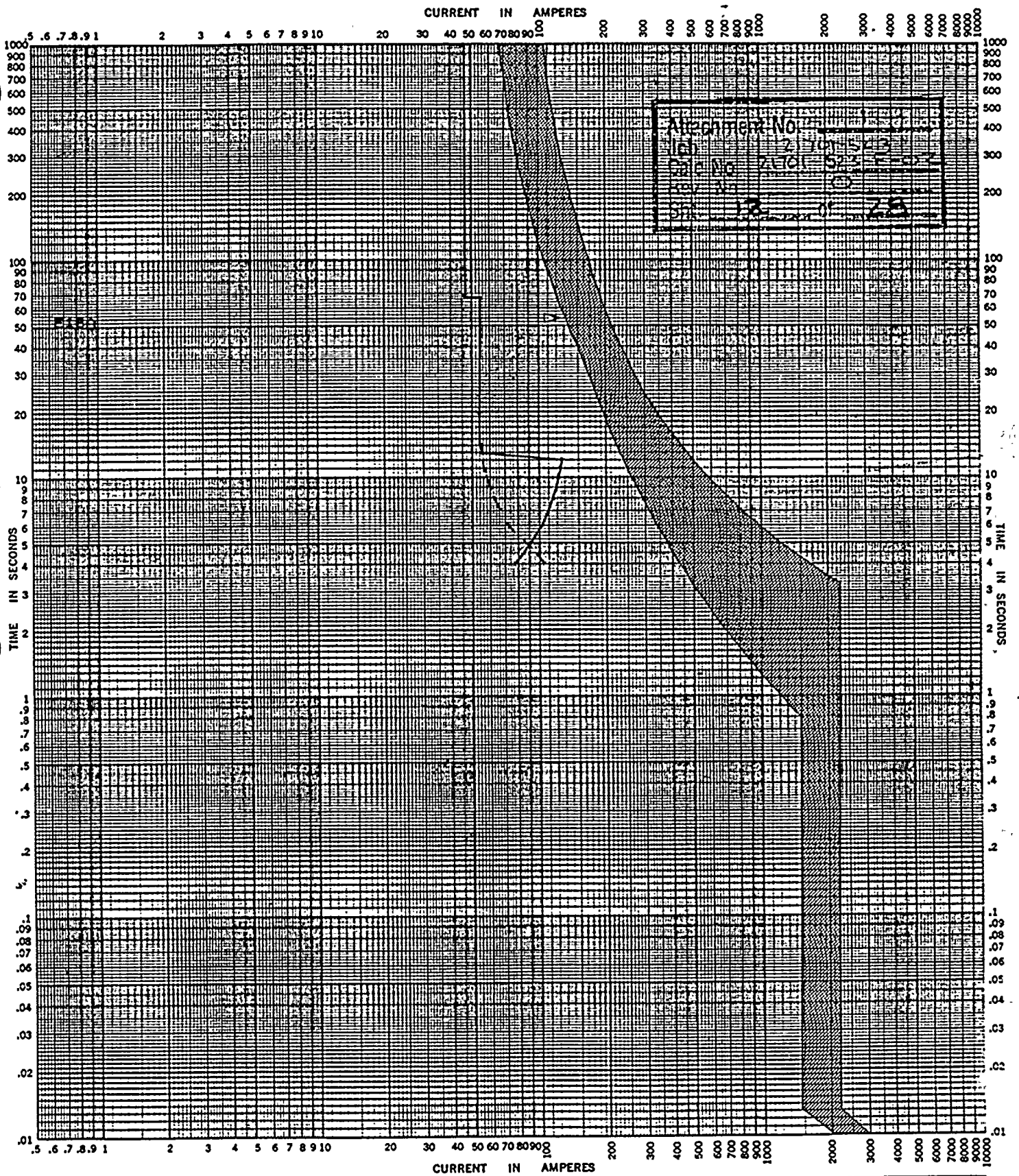
EMERG. CONT. FILT FAN TIME-CURRENT CHARACTERISTIC CURVES

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 480V Test points so variations should be _____

No. FIGURE 11
 Date 3/10/92

FL 3127192
 0722 2/27/92





A/C CHARACTER NO. _____	
IN	2101-542
DATE NO.	2401-523
TEST NO.	12
DATE	3/27/92

<u>CONTROL ROOM A/C</u> 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 <u>480 V</u> Test points so variations should be _____	
No. <u>FIGURE 12</u>	Date <u>3/10/92</u>

Attachment No. _____
 Job No. _____
 Site No. 2101-32-30-02
 Rev. No. _____
 Sm. 13 of 13

CONTROL ROOM A/C TIME-CURRENT CHARACTERISTIC CURVES

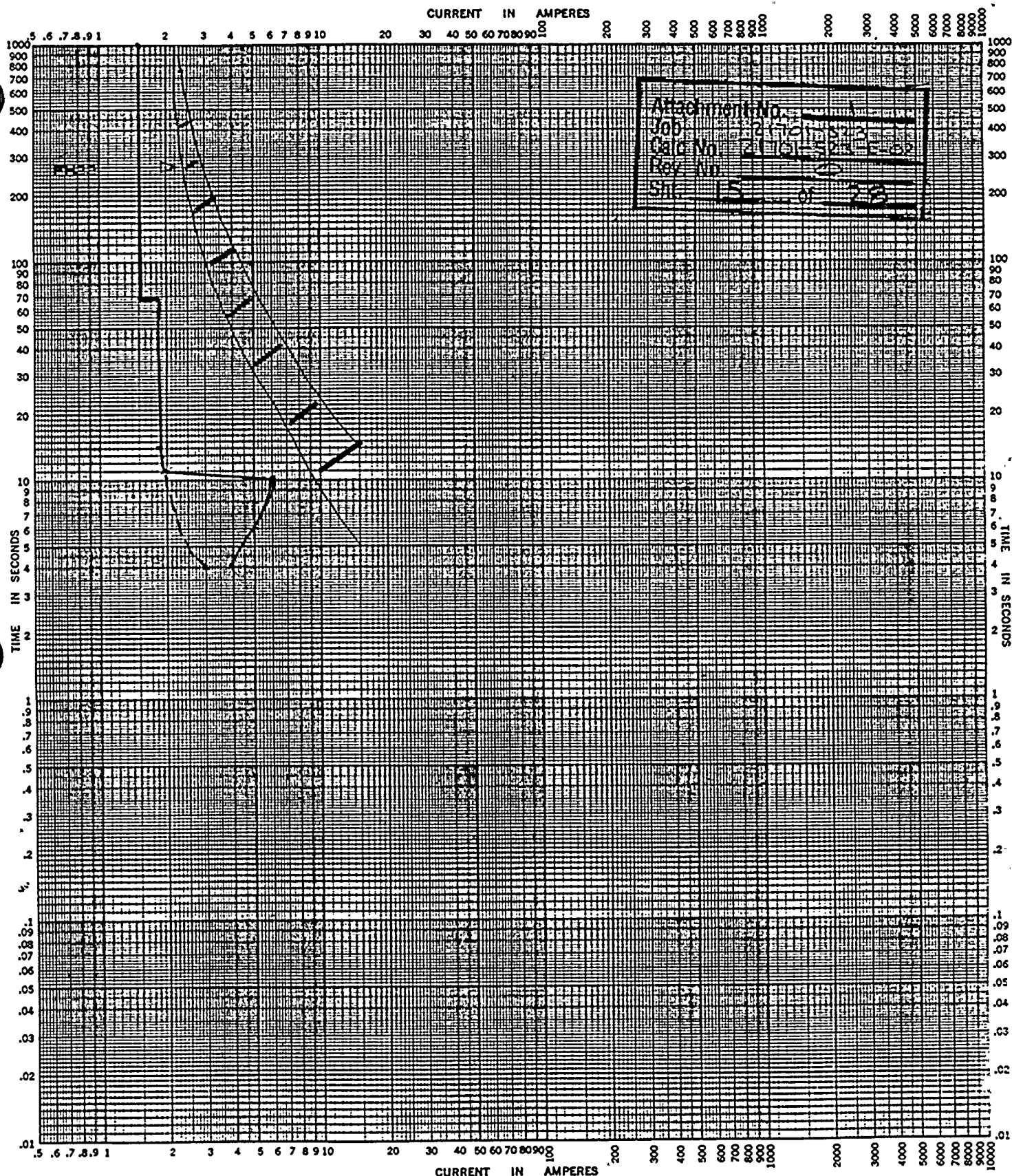
For _____ Fuse Links In _____
 BASIS FOR DATA Standards _____ Dated _____
 1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load.
 2. Curves are plotted to 480 V. Test points so variations should be _____

No. **FIGURE 13**
 Date **3/10/92**

3127/92
722 3/27/92







EDG FUEL OIL XFER 38	
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. FIGURE 15	Date 3/10/92

7/3/27/92
0722 3/27/92

11-11-11

11-11-11

11-11-11

11-11-11

11-11-11

11-11-11

11-11-11

EDG RM VENT FAN 38		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 _____		No. FIGURE 17 Date 3/10/92
2. Curves are plotted to 480 V Test points so variations should be _____		

3/27/92
KX 3/27/92





SWGR 3D RM SUPPLY FN

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. **FIGURE 18**
Date **3/18/92**

3127192
0722 3/27/92

1. The first part of the document is a list of names and addresses of the members of the committee.

2.

3.

4.

5.

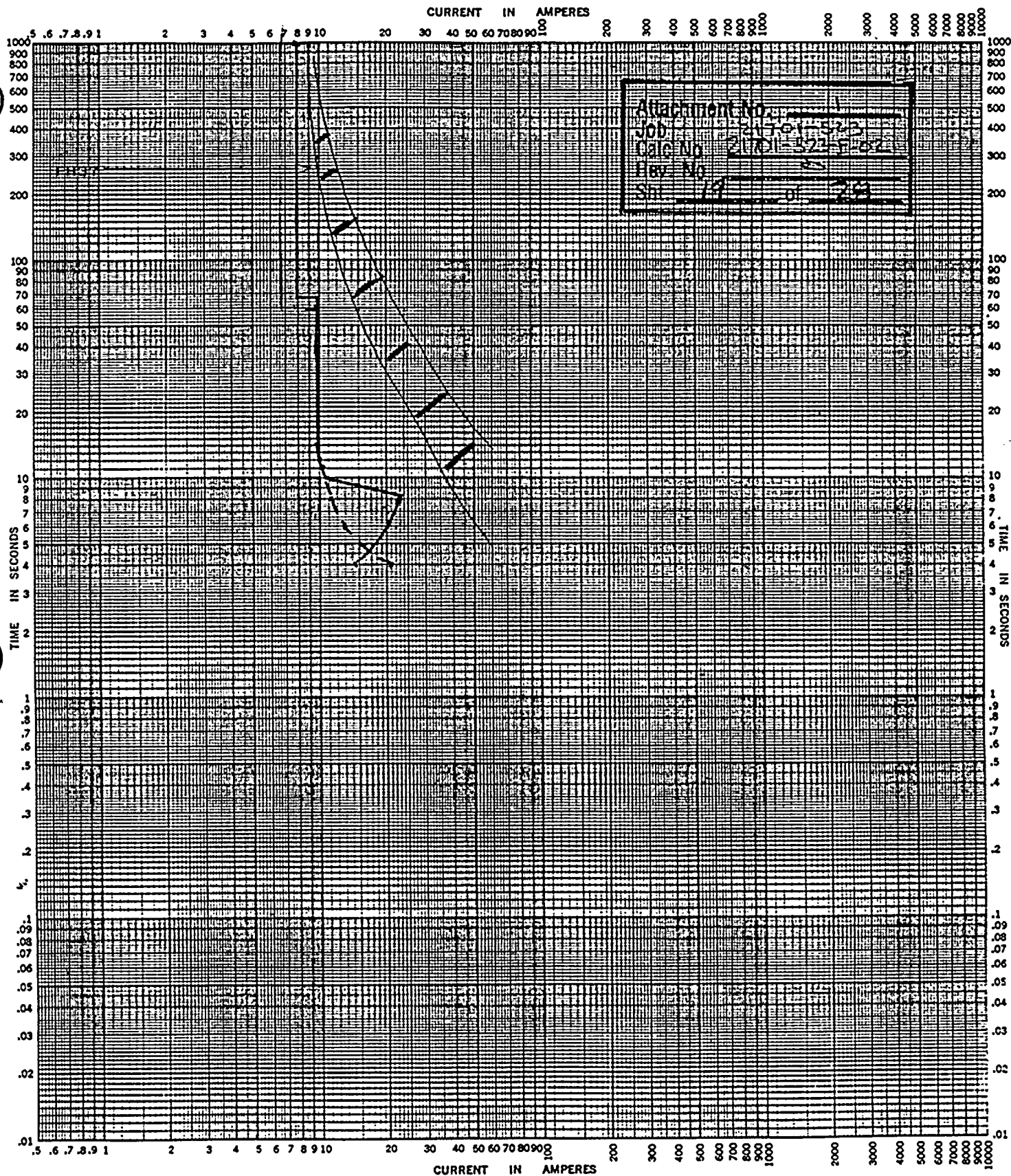
6.

7.

8.

9.

10.



Attachment No. 1
 Job No. 217-01-523
 Calc No. 217-01-523-02
 Rev No. 1
 Sh. 19 of 23

COMPUTER RM CHILLER TIME-CURRENT CHARACTERISTIC CURVES

For 1 AHU 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 480 V Test points so variations should be _____

No. FIGURE 19
 Date 3/10/92

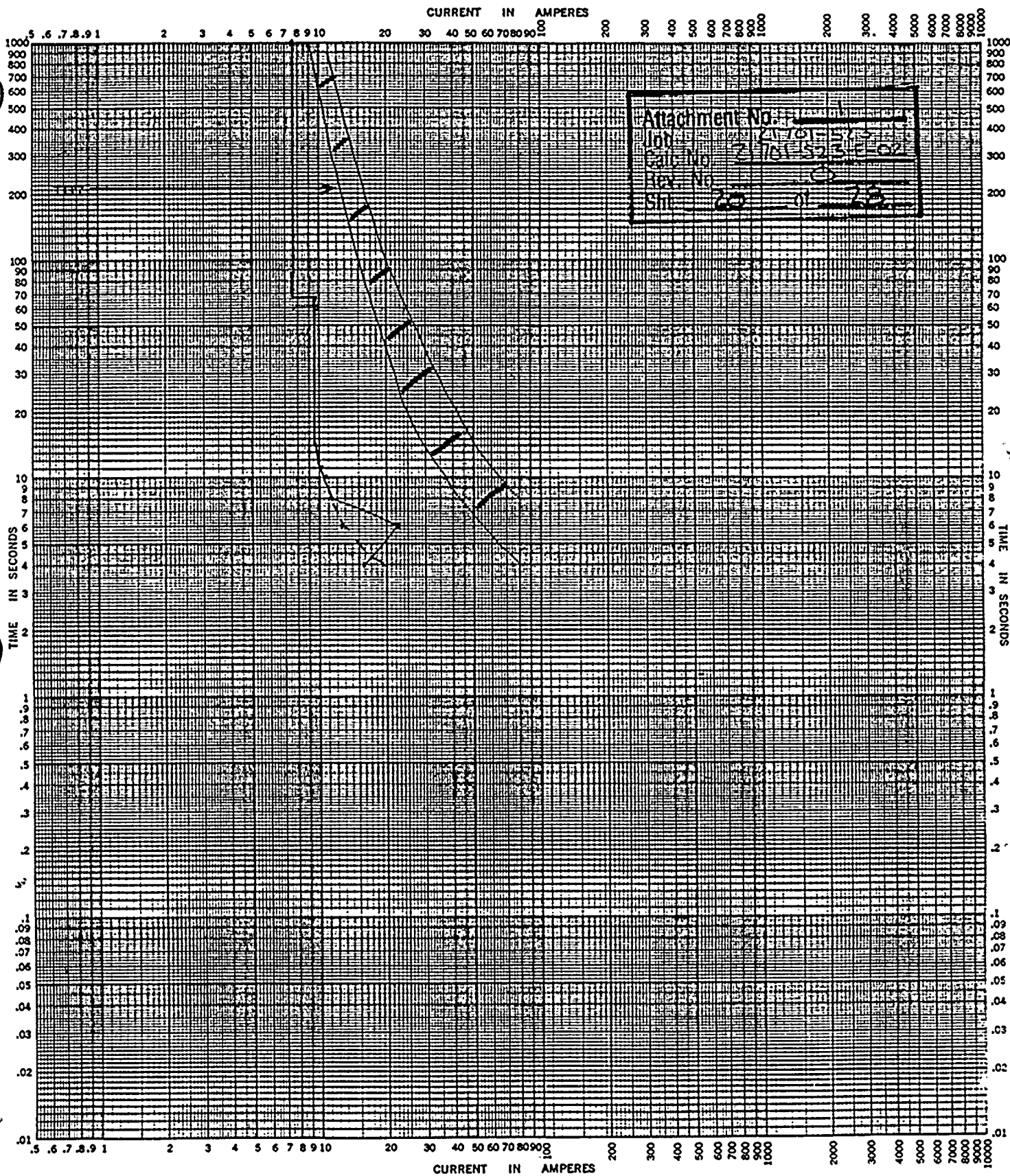
7/0 3/27/92
 272 3/27/92

Attachment No. 1
 Job 10153
 Calc. No. 3101523-E-02
 Rev. No. 0
 Sht. 20 of 20

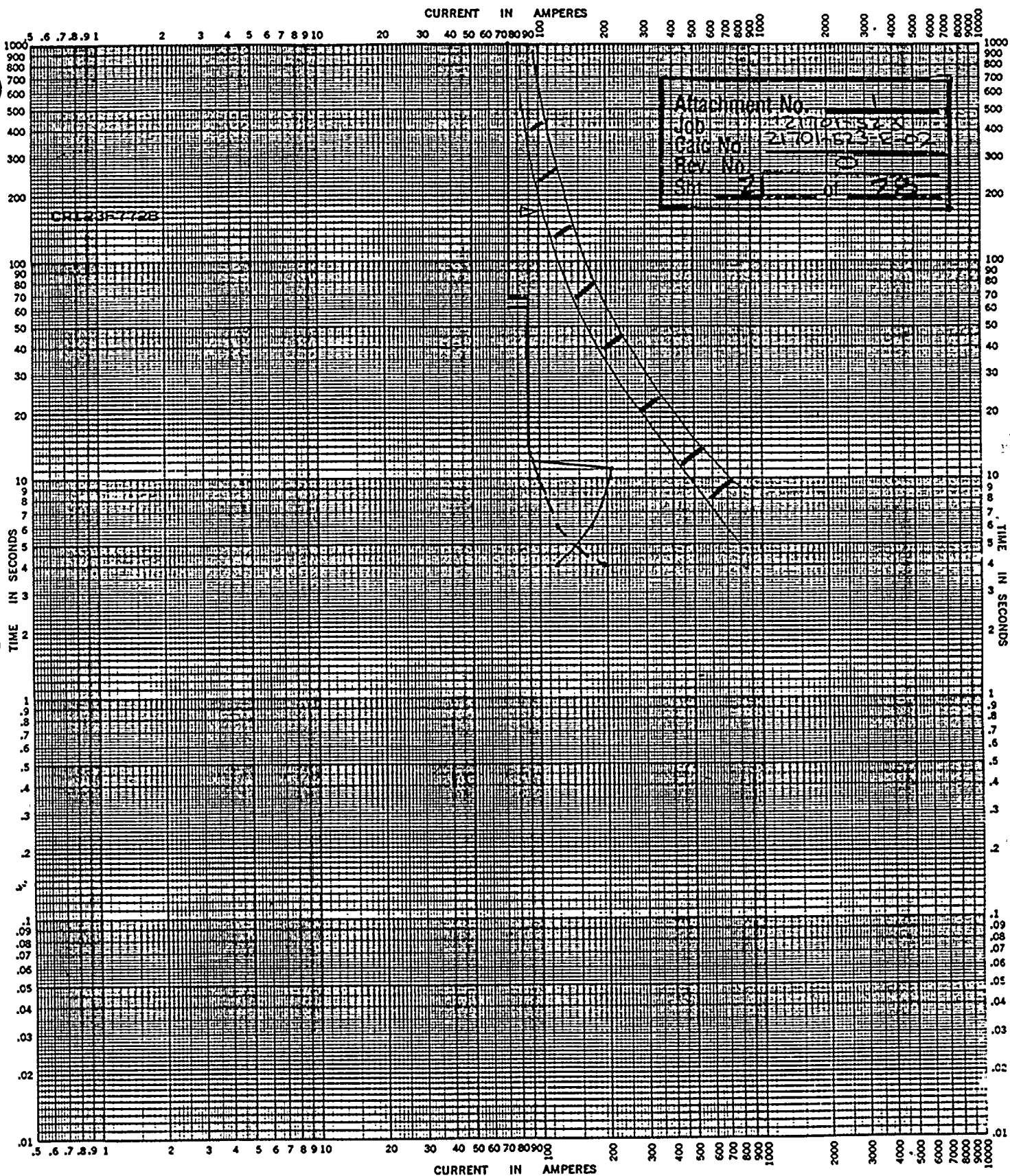
CONTRL RM EM.FLT.FAN

For _____ 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. **FIGURE 20**
 Date **3/18/92**

Handwritten: 3/27/92
 272 3/27/92



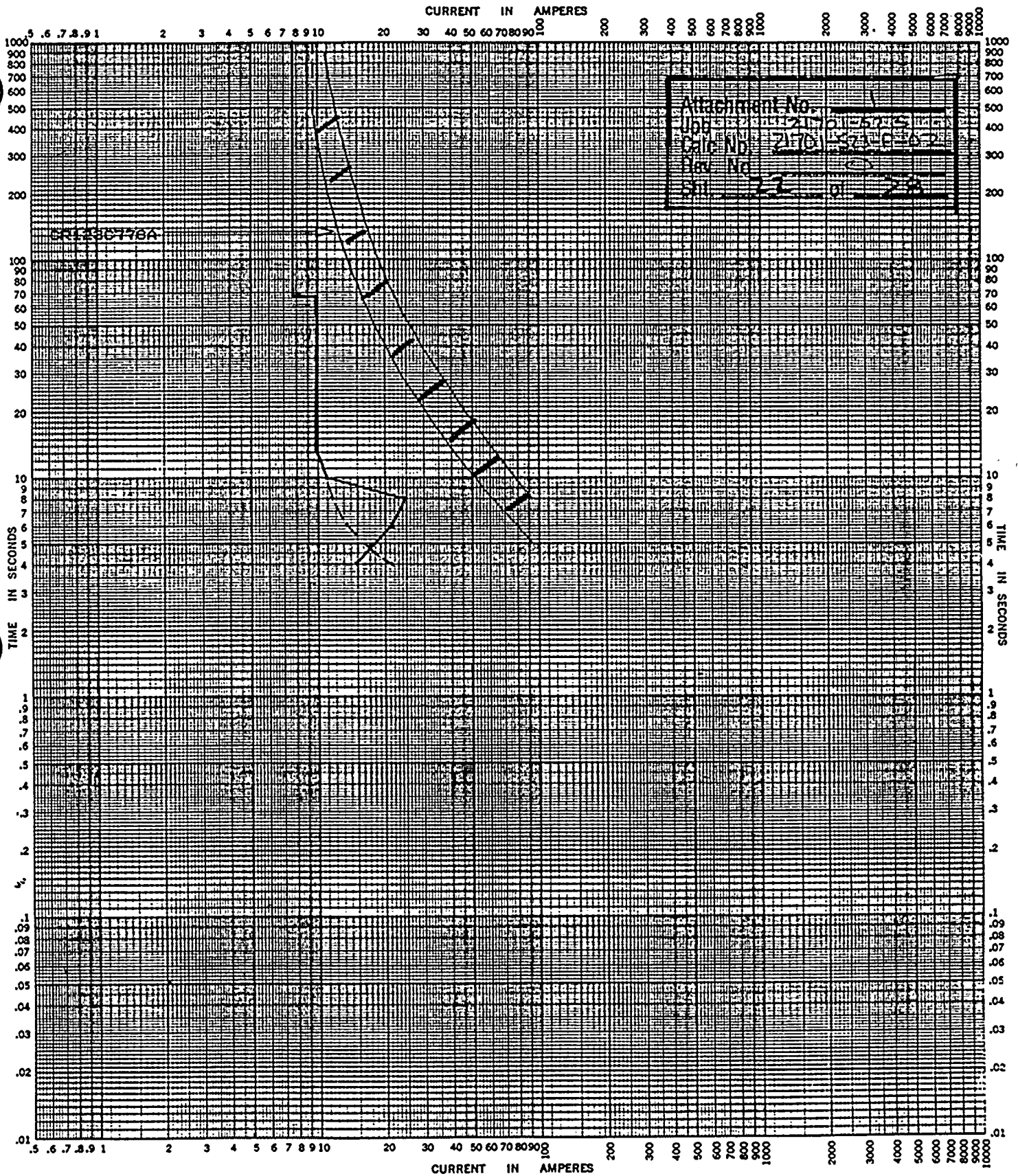


Attachment No.	1
Job	21701573-8-02
Calc No.	21701573-8-02
Rev No.	0
Shr	21 0 78

COMP RM CHILLER CMPS	
TIME-CURRENT CHARACTERISTIC CURVES	
For	Fuse Links. In
BASIS FOR DATA Standards	
1. Tests made at	Dated
2. Curves are plotted to	Test points so variations should be

No.	FIGURE 21
Date	3/17/92

3127192
07RX 3/27/92



COMP RM CHILLER FAN

TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Unks. 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 _____

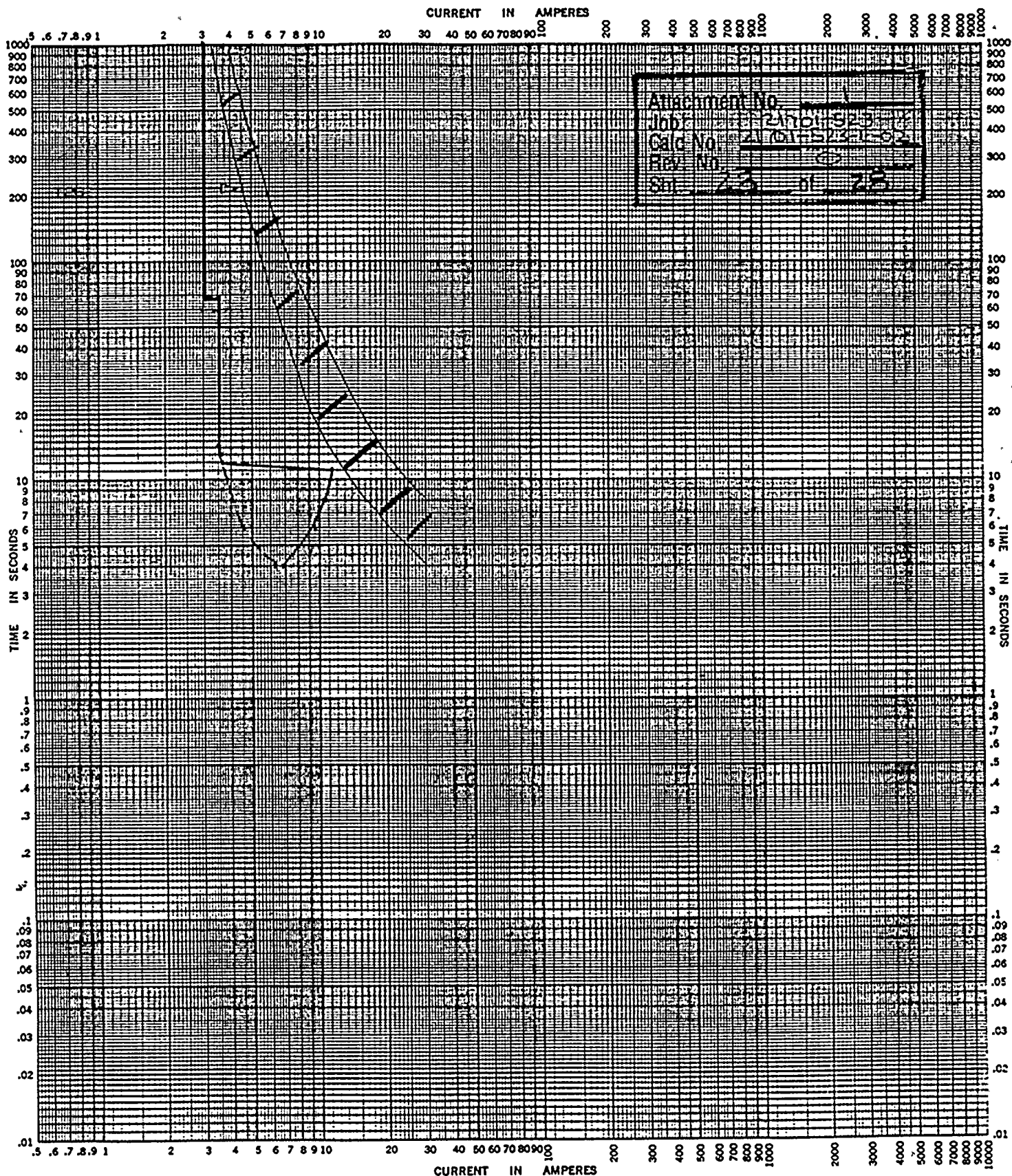
FIGURE 22

No. _____

Date 3/17/92

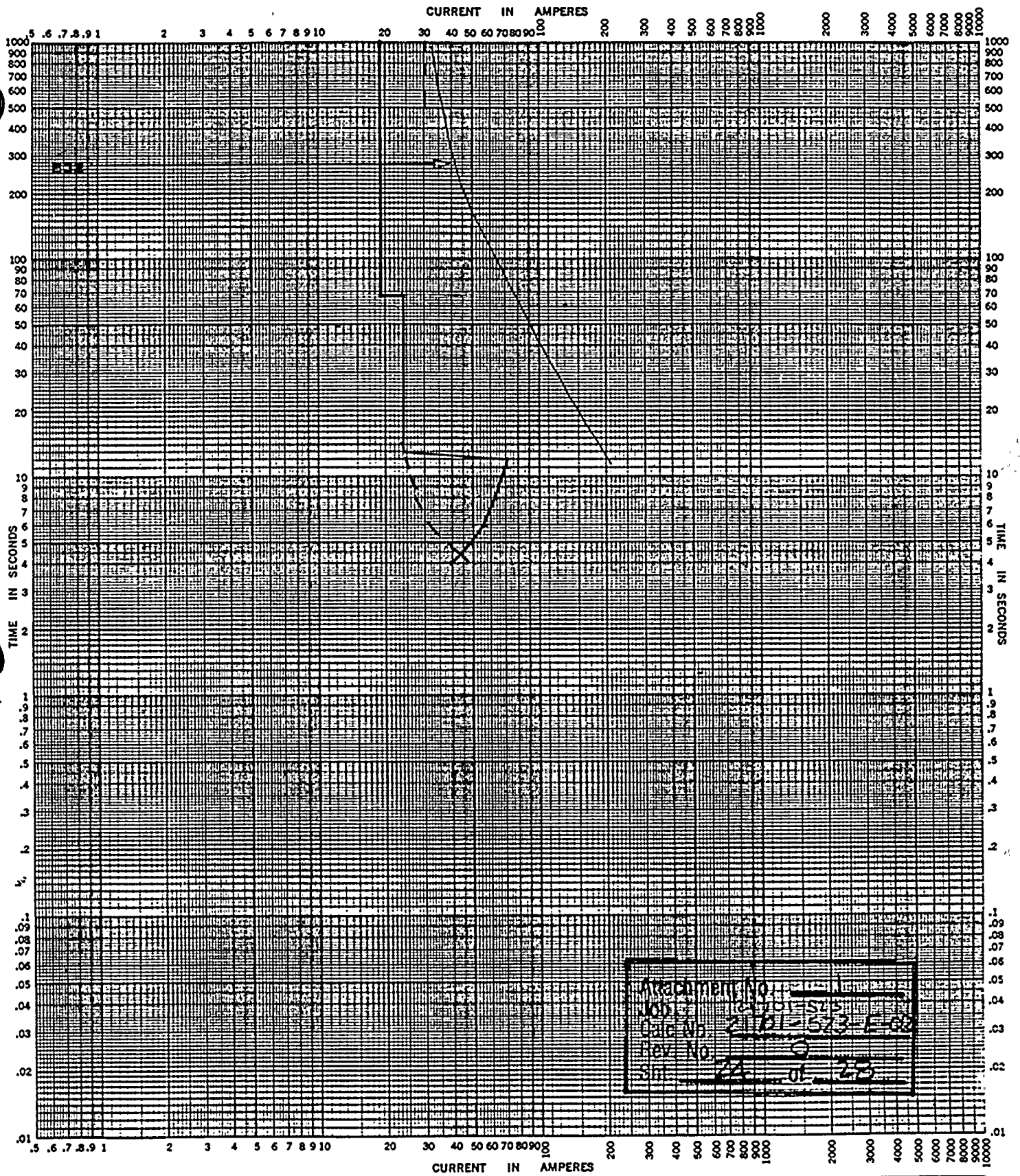
7A 3/27/92
RXX 3/27/92





AIR PART & GAS MONTR	
TIME-CURRENT CHARACTERISTIC CURVES	
For _____ Fuse Links. In _____	
BASIS FOR DATA Standards _____ Dated _____	
1. Tests made at _____ Volts a-c at _____ p-l., starting at 25C with no initial load _____	
2. Curves are plotted to _____ Test points so variations should be _____	
	FIGURE 23 No. _____ Date <u>3/18/92</u>

Handwritten: 3/27/92
722 3/27/92



Attachment No. 24
 Job No. 2101-523-E-68
 Date No. 3
 Rev. No. 3
 Sm. 24 of 28

ELEC EQ RM COMPRESSOR

TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Links. In _____

BASIS FOR DATA Standards _____ Dated _____

1. Tests made at 480 Volts a-c at _____ p-f., starting at 25C with no Initial load _____

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

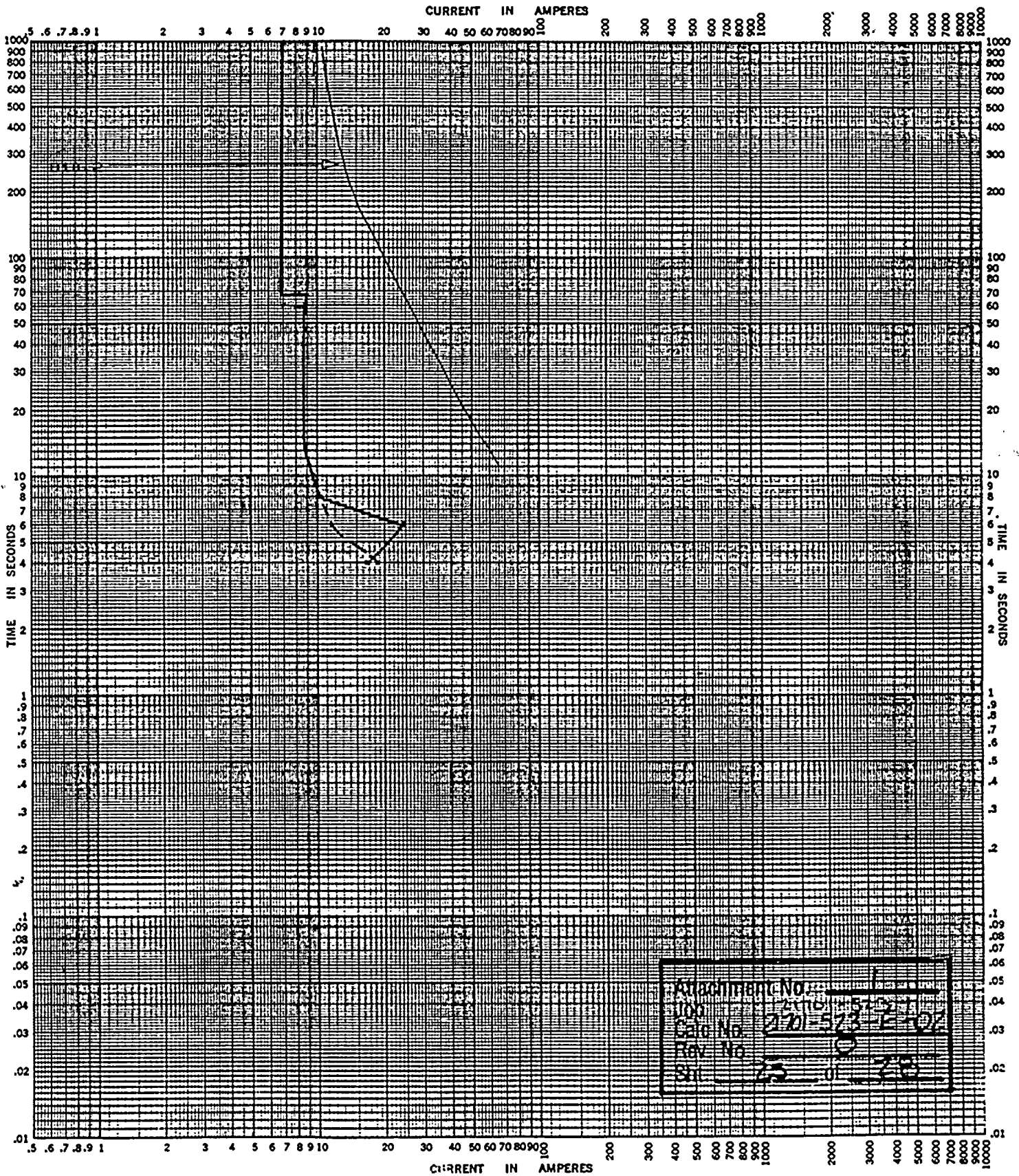
FIGURE 24

No. 3/17/92

Date _____

3/27/92
 722 3/27/92





ELEC EQ RM COND PAN

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 _____

FIGURE 25

No. _____

Date 3/17/92

Handwritten: PJ 3/27/92
222 3/27/92

Attachment No. 21701-523-1-02
 Rev. No. 0
 Date 3/27/92

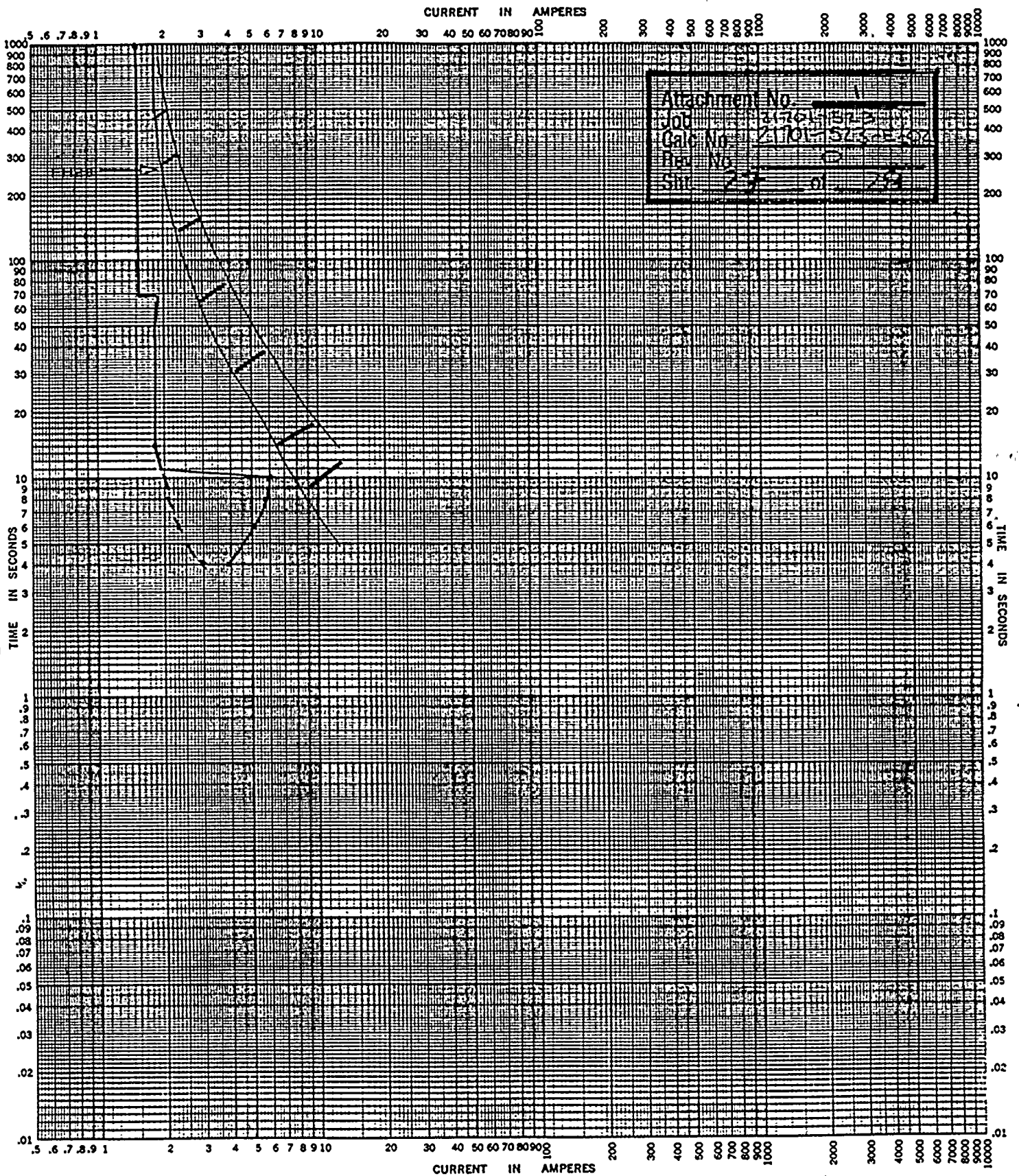
ELEC EQ RM AHU

TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Unks. 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. FIGURE 26
 Date 3/17/92





EDG FUEL OIL XFER PP 38	
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 <u>480 V</u> Test points so variations should be _____	

No. FIGURE 27
Date 3/10/92

Paul Smith 3/27/92
722 3/27/92





FLORIDA POWER & LIGHT
INTER-OFFICE CORRESPONDENCE

PC/M 91-036(UNIT 4)
PAGE 17 OF 40
INPUT DATA REF. NO. 8
SHEET 1 OF 14

TO: Mr. W. E. Coe
FROM: W. H. Rogers, Jr./J. B. Olmstead
SUBJECT: TURKEY POINT UNIT 3
4 KV MOTOR DATA

DATE August 11, 1970

COPIES TO J. R. Bensen w/ enclosure
C. R. Stone w/ enclosure

Attached is the information requested in your August 4, 1970, memo less the items noted in the Bechtel letter.

JBO/mm

W.H. Rogers Jr.

Attachment No.	2
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	1 of 9



COURTESY WINS FRIENDS ...FOR FLORIDA...FOR YOUR COMPANY...FOR YOU!



FLORIDA POWER & LIGHT
INTER-OFFICE CORRESPONDENCE

PC/M 91-036 (UNIT 4)
PAGE 18 OF 40
INPUT DATA REF. No. 8
SHEET 2 OF 14

TO Mr. W. H. Rogers, Jr.

DATE October 12, 1970

FROM W. H. Rogers, Jr./S. G. Brain

COPIES TO E. L. Bivans w/enc.
Herb Paul w/enc.
J. W. Williams, Jr. w/enc. (1)
J. R. Bensen w/enc.

SUBJECT: TURKEY POINT UNITS #3 & #4
TIME CURRENT CURVES

Enclosed are the time current curves for Turkey Point #3 & #4, safety injection pumps, component cooling pumps and residual heat removal pumps.

W. H. Rogers, Jr.

SGB/mm

Enclosures

Attachment No.	2
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	2 of 9





Florida Power & Light Company
POWER PLANT ENGINEERING
DATE RECEIVED
AUG 10 1970

PC/M 91-036 (UNIT 4)
PAGE 19 OF 40
INPUT DATA REF. NO. 8
SHEET 3 OF 14

Routing		Initials	Routing		Initials
	Rodgers			Green	
	Bedharat			Spain	
1	Olmstead	1	2	Spain	
	O'Neal			Kent	
	Stepow			Hall	
	Soyers			Stato	
CORR FILES			PRINT FILES		
FILE REF.					
CORR - 12					

Post Office Box 607
190 Shady Grove Road
Gaithersburg, Maryland 20760



August 6, 1970

Mr. W. H. Rogers, Jr.
Power Plant Engineering Manager
Florida Power & Light Company
P. O. Box 3100
Miami, Florida 33101

Attachment No. 2
Job 21701-523
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 3 of 9

Dear Mr. Rogers:

Subject: Florida Power & Light Company
Turkey Point, Units No. 3 & 4
Bechtel Job 5610
4160V. Motor Data
Bechtel File: 5700
FB-1201

Our Project Superintendent has forwarded to us your request for 4160 volt motor data for the benefit of relay settings.

We attach two sets of the following data:

Motor Data Sheets 25.11-1 and -2 covering all 4160 volt motors.

Safe Time/Current curves on:

- Steam Generator Feed Pump Motor -
- Condensate Pump Motor -
- Turbine Plant Cooling Water Pump Motor -
- Circulating Water Pump Motor -
- Intake Cooling Water Pump Motor -
- Heater Drain Pump Motor -

The remaining four motors are part of the NSSS and we do not have their safe time/current curves. We are writing to Westinghouse requesting that they promptly send you these curves.

Very truly yours,

ORIGINAL SIGNED BY

N. BHATIA

N. K. Bhatia

Project Engineer

JTP:tst

Enclosures (2 sets)

cc: G. Kinsman, J. Coughlin, B. H. Werry, J. W. Keck/J. C. Walden,
J. W. Williams, E. L. Bivans, J. R. Bensen.

1. The first part of the document is a list of names and addresses of the members of the committee. The names are listed in alphabetical order, and the addresses are listed below each name. The list includes the names of the members of the committee, the names of the members of the subcommittee, and the names of the members of the advisory committee. The addresses are listed in the same order as the names.

	4	4	6	4	8
	Heater Drain Pp	Turb. Pft. Cl. WtrPp	Intake Cl. WtrP	Condens. Pump	Circ. W Pum.
MANUFACTURER	LA	LA	LA	LA	W
TYPE	WPX	WPX	WPX	WPX	CS
FRAME DESIGNATION	687 P	648 SU	589	809 PT	75.5
HORSEPOWER OUTPUT	800	400	325	2250	1250
TIME RATING/TEMP. RISE °C	Ct./60	Ct./60	Ct./60	Ct./60	Ct./60
RPM AT FULL LOAD	1785	1785	890	1190	236
VOLTAGE	4000	4000	4000	4000	4000
FULL LOAD AMPS	101	54	45	276	188
*ENCLOSURE	WP II	WP II	WP II	WP II	WP II
VERTICAL OR HORIZONTAL	V	H	V	V	V
BEARINGS (SLEEVE OR BALL)	Ball	Sleeve	Ball	Ball	Kings.
TYPE OF LUBRICATION	Oil	Oil	Oil	Oil	Oil
INSULATION CLASS	B	B	B	B	B
ROTATION (VIEWED FROM END OPP. SHFT)	CCW	CW	Either	CW	CCW
FULL LOAD TORQUE	2333	1175	1900	9843	28,000
STARTING TORQUE-% OF FULL LOAD	112	102	101	118	73
EFFICIENCY - 100% LOAD	94.4	93.8	92.8	95.8	
- 75% LOAD	94.2	93.8	93.0	95.8	
- 50% LOAD		93.0	92.2	95.5	
SERVICE FACTOR	1.15	1.15	1.15	1.15	1.15
IS THERMAL PROTECTION PROVIDED				No	
WEIGHT	6900	3350	5500	15,000	23,200
PHASE	3	3	3	3	3
FREQUENCY	60	60	60	60	60
LOCKED ROTOR CURRENT	600	275	261	1950	860
POWERFACTOR - 100% LOAD	88.7	85	82.2	90.0	
- 75% LOAD	87.0	81	78.0	88.9	
- 50% LOAD		72	66.2	85.1	
NEMA DESIGN LETTER					
SECONDARY AMPS @ FULL LOAD					
SECONDARY VOLTAGE					
SECONDARY OHMS					
BREAKDOWN OR PULLOUT TORQUE-%			230	265	
RATED FIELD CURRENT					
RATED EXCITER VOLTAGE					
RATED POWER FACTOR					
PULL IN TORQUE - % OF FULL LOAD					
TYPE OF WINDING					
SHUNT FIELD CURRENT					
ALLOWABLE W ² OF LOAD	100	35.8	270	1050	41,000
SPACE HEATERS - WATTS/VOLTS	320/120	270/120	540/120	540/120	3000/12
TWO SPEED MOTORS-NO OF WINDINGS					
TORQUE					
THRUST BEARING CAPACITY-UP (LBS)	---	---	30%	6000	
CAPACITY-DOWN (LBS)	16,000	---	18,590	19,500	42,000

Attachment No. 2
Job 21701-525
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 4 of 9

*ENCLOSURE; DRIPPROOF (DP), SPLASHPROOF (SP), WEATHER PROTECTED (WP), TOTALLY ENCLOSED NON-VENTILATED (TENV), TOTALLY ENCLOSED FAN COOLED (TEFC), TOTALLY ENCLOSED PIPE VENTILATED (TEPV) ETC., EXPLOSIONPROOF XP, TO INDICATE GUARDED ADD "G".

BECHTEL CORPORATION



POWER DIVISION
ENGINEERING

ELECTRIC MOTOR DATA SHEET

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT UNITS 3 & 4

J03 No 5610

25.11-1

REV.

0

1. The first part of the document is a list of names and addresses of the members of the committee.

	6	4	4	4	6
	Reactor Cl. Pp.	Strm. Gen. Feed Pp.	Residual Heat Rem. Pp.	Safety Inj. Pp.	Comp. Cl. F
MANUFACTURER	W	GE	W	W	W
TYPE	CS	K			CSP
FRAME DESIGNATION	62 SPL	8600	509 UPZ	590 IIS	686.:
HORSEPOWER OUTPUT	6000	7000	300	350	450
TIME RATING/TEMP. RISE °C	Ct./ 70	Ct./ 60		Ct./ 60	
RPM AT FULL LOAD	1189	3575	1781	3566	1180
VOLTAGE	4000	4000	4000	4000	4000
FULL LOAD AMPS	760	873	37.6	45.3	57.2
*ENCLOSURE	DP	WP II	WP I	WP I	WP I
VERTICAL OR HORIZONTAL	V	H	V	H	H
BEARINGS (SLEEVE OR BALL)	Kings.	Sleeve		Ball	Ball
TYPE OF LUBRICATION	Oil	Oil			
INSULATION CLASS	B	B	B	B	
ROTATION (VIEWED FROM END OPP. SHFT)	CCW	CW		CW	
FULL LOAD TORQUE		10,300			
STARTING TORQUE-% OF FULL LOAD		70	128	108	
EFFICIENCY - 100% LOAD		95.9	93.4	94.0	
• 75% LOAD		95.3	93.4	93.7	
• 50% LOAD		93.3	92.5	92.4	
SERVICE FACTOR		1.15	1.15	1.15	
IS THERMAL PROTECTION PROVIDED		Yes			
WEIGHT	68,700		3400		4200
PHASE	3	3	3	3	3
FREQUENCY	60	60	60	60	60
LOCKED ROTOR CURRENT	4800	5670	234	290	270
POWERFACTOR - 100% LOAD		90	88.5	88.3	
• 75% LOAD		88	86.1	86.1	
• 50% LOAD		83	79.3	79.7	
NEMA DESIGN LETTER				B	
SECONDARY AMPS @ FULL LOAD					
SECONDARY VOLTAGE					
SECONDARY OHMS					
BREAKDOWN OR PULLOUT TORQUE-%		200	270	266	
RATED FIELD CURRENT					
RATED EXCITER VOLTAGE					
RATED POWER FACTOR					
PULL IN TORQUE - % OF FULL LOAD					
TYPE OF WINDING					
SHUNT FIELD CURRENT					
ALLOWABLE WK ² OF LOAD					
SPACE HEATERS - WATTS/VOLTS	2500/208	2400/240		200/120	
TWO SPEED MOTORS-NO OF WINDINGS					
TORQUE					
THRUST BEARING CAPACITY-UP (LBS)		---			
CAPACITY-DOWN (LBS)		---			

ENCLOSURE; DRIPPROOF (DP), SPLASHPROOF (SP), WEATHER PROTECTED (WP), TOTALLY ENCLCS.
NON-VENTILATED (TENV), TOTALLY ENCLOSED FAN COOLED (TEFC), TOTALLY ENCLOSED PIPE V
ILATED (TEPV) ETC., EXPLOSIONPROOF XP, TO INDICATE GUARDED ADD "G".

BECHTEL
CORPORATION



POWER DIVISION
ENGINEERING

ELECTRIC MOTOR DATA SHEET

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT UNITS 3 & 4

JCS No 5610

25.11-2

RE

THIS DATA IS FOR REFERENCE ONLY, UNLESS OTHERWISE INDICATED

INTAKE COOLING WATER PUMP MOTOR

PC/M 91-036 (UNIT 4)
PAGE 24 OF 40
INPUT DATA REF. NO. 8
SHEET 8 OF 14

TYPE	DE
FRAME	30
HP	325
PM	26
VOLTS	600
PHASE	3
FREQ	60
CODE	15
EL SPEC	15
CURVE	16150-2A
CODE	

SAFE OPER. TIME (seconds)

Attachment No.	2
Job	21701-523-500
Date No.	21701-523-500
Rev. No.	0
Shr	6 of 9



TRUCKY BRANT UNIT 3 E-4

TIME - CURRENT CURVE

NY-35820-17 - 68 F 15106

ELA 37.2 300HP S.F. 1.15 1781 RPM

RESIDUAL HEAT REMOVAL

~~PC/M 91-036 (UNIT 4)
PAGE 28 OF 40
INPUT DATA REF. NO. 8
SHEET 12 OF 14~~

Attachment No.	2
Job	21701-1212
Calc. No.	2101-1212-1-02
Rev. No.	0
Sh.	7 of 9

Manual
to 10/170

PERCENT F.L. CURRENT



TURKEY POINT UNITS 3 & 4

SAFETY INJECTION PUMPS

TIME - CURRENT CURVE

NA-34714-L7-167F62573

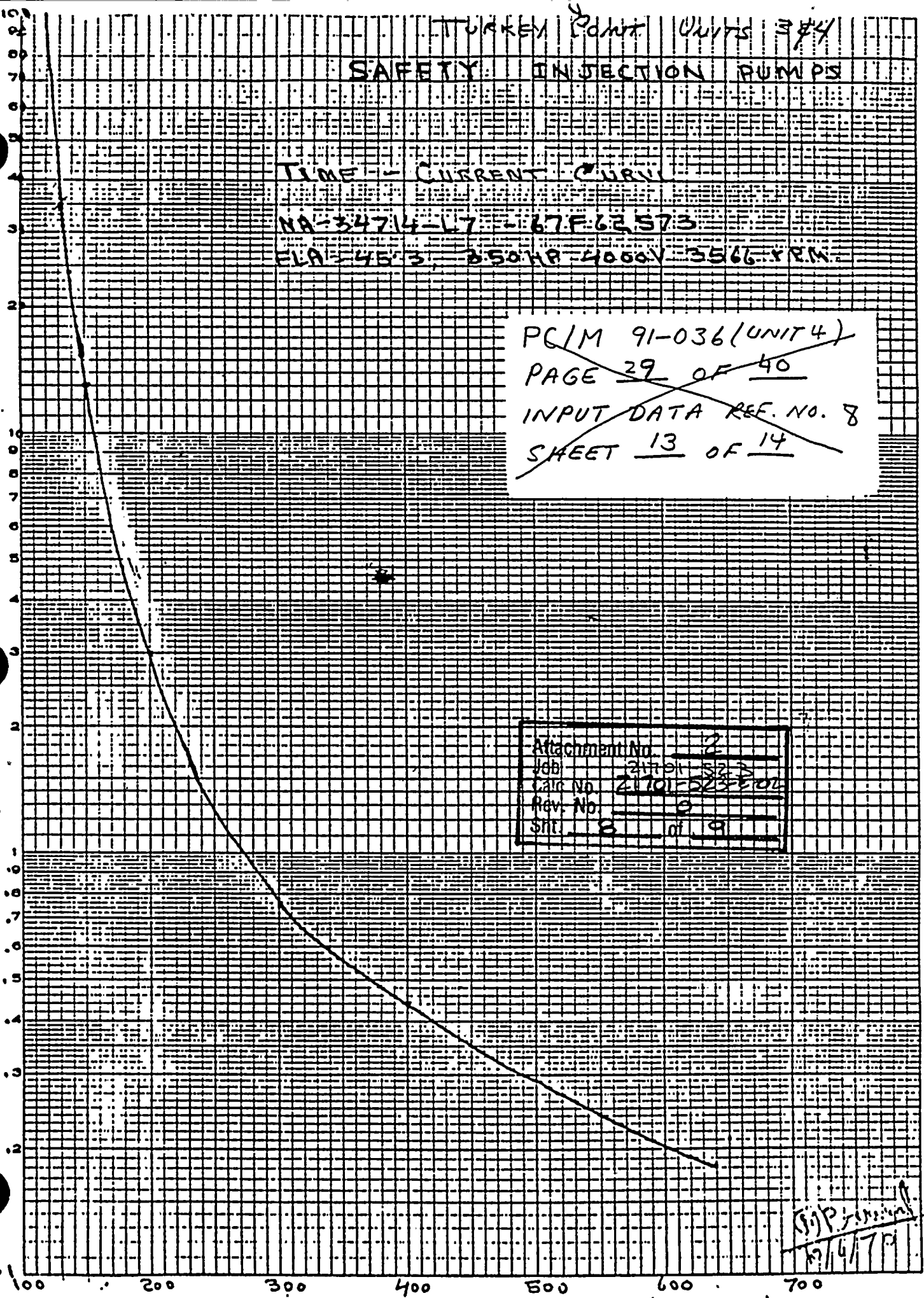
FLA-453-350HP-4000V-3566-RPM

~~PC/M 91-036 (UNIT 4)
PAGE 29 OF 40
INPUT DATA REF. NO. 8
SHEET 13 OF 14~~

Attachment No.	2
Job	21701-523
Case No.	21701-523-104
Rev. No.	0
Sht.	8 of 9

Signature
6/6/78

3 CYCLES X 10 DIVISIONS PER INCH
TIME MINUTES



TURKEY POINT UNITS 3/4

TIME - CURRENT CURVE

NA 53843-L7 5.00A 368V

FLA 57.2 1.05 F 4.50-4P 4.50A 1185 RPM

PC/M 91-036 (UNIT 4)
 PAGE 30 OF 40
 INPUT DATA REF. NO. 8
 SHEET 14 OF 14

Minutes

Attachment No.	2
Job	2170-1325
Chart No.	2170-522-E-01
Rev. No.	0
Shr.	9 of 9

Handwritten signature
 10/11/76

100 200 300 400 500 600 700



MOTOR DATA SHEET

CALCULATION JPU-PTP-89-2534-E1
SH. 4 OF 21

QUANTITY	EXISTING	PROPOSED BY VENDOR
Service	Component Cooling Water	
Manufacturer	Pump Motor	
Type	Westinghouse	
Frame	CSP-Squirrel Cage Induction	
Horsepower	686.5S	
Time Rating/Temp. Rise °C	450	
RPM at Full Load	Continuous/90°C	
Voltage	1184	
Full Load AMPS	4000	
Enclosure	58	
Vertical or Horizontal	Drip-proof-WPI(WPII Specified)	
Bearings (Sleeve or Ball)	Horizontal	
Type of Lubrication	Ball	
Insulation Class	Oil	
Rotation (Viewed From End Opposite From Shaft)	B (F specified)	
Full Load Torque	CW	
Starting Torque, % of Full Load	60	
Efficiency 100% Load	93.0	
75% Load	92.5	
50% Load	92.0	
Service Factor	1.15	
Is Thermal Protection Provided	No	
Weight	4200 lbs.	
Phase	3	
Frequency	60 Hz.	
Locked Rotor Current	320	
Power Factor 100% Load	90.0	
75% Load	88.5	
50% Load	84.0	
NEMA Design Letter	B	
Rated Power Factor		
Pullout Torque, % of Full Load	200	
Pull in Torque, % of Full Load		
Type of Winding	Form Coil	
Allowable WK of Load	Appendix B Curves	
Space Heaters Watts/Volts	300/120	
Max. NO. of Starts Per Hour & Min.	Spec. Section 12.15	
Length of time between starts	Spec. Section 12.15	
Power Cable/Ground Cable Size	3-1/C #4/0AWG/#4AWG	

Attachment No.	<u>3</u>
Job	<u>21701-523</u>
Calc No.	<u>21701-523-E-02</u>
Rev. No.	<u>0</u>
Sht.	<u>1</u> of <u>10</u>



PERFORMANCE DATA SHEET

INDUCTION MOTOR

NAMEPLATE DATA

FRAME	HP	TYPE FORM	PHASE HERTZ	RPM	VOLTS	AMPERES	DUTY	TEMP. RISE °C	DESIGN LETTER	CODE LETTER	ENC
EC444	75	P/BE	3/60	1185	460	88	Cont.	-	-	G	TEA

DESIGN DATA

U/S	ROTOR	DESIGN NUMBER	TEST ON SALES ORDER	TEST DATE	STATOR RESISTANCE AT: (BETWEEN LINES) OHMS
597318	604882-1-R	-	X-324253	1/27/71	.1114

PERFORMANCE

LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY	KW INPUT
NO LOAD	0	28	1199	5.6	0	1.24
1/4	19	37	1197	56.1	89.6	15.9
2/4	38	50	1195	77.0	92.0	30.8
3/4	57	69	1192	83.2	92.8	45.7
4/4	75	88	1189	86.2	92.9	60.6
5/4	94	110	1185	86.3	92.5	75.8

SPEED TORQUE

	RPM	TORQUE % FULL LOAD	TORQUE LB. FT.	AMPERES
LOCKED ROTOR	0	134	446	554
PULL UP	200	111	369	545
BREAKDOWN	1150	247	820	289
FULL LOAD	1189	—	333	88

ALL DATA ON 460 VOLTAGE CONNECTION. AMPERES AT OTHER VOLTAGES WILL VARY INVERSELY WITH T VOLTAGE.

REMARKS: $WR^2 = 39.4$

APPROVED BY _____ DATE 3/15/71

1

2

3

4

5

6

7

8



Attachment No.	<u>3</u>
Job	<u>21701-523</u>
Calc No.	<u>21701-523-E-02</u>
Rev. No.	<u>0</u>
Sht.	<u>3</u> of <u>10</u>

-RPA #631066285
Attachment B
Page 1 of 3

MOTOR DATA SHEET

QUANTITY

EXISTING

PROPOSED BY VENDOR

Service	ECC Fan
Manufacturer	Reliance Electric
Type	Induction
Frame	364TCZ
Horsepower	30
Time Rating/Temp. Rise °C	Cont/220°F (105°C)
RPM at Full Load	1175
Voltage	460
Full Load AMPS	39
Enclosure	TEAO
Vertical or Horizontal	Vertical
Bearings (Sleeve or Ball)	Ball
Type of Lubrication	Grease
Insulation Class	H (SPCL)
Rotation (Viewed Looking Down From Top)	CW Looking Down
Full Load Torque	134 Lb-Ft
Starting Torque, % of Full Load	155%
Efficiency 100% Load	90.4%
75% Load	90.3%
50% Load	88.3%
Service Factor	1.15
Thermal Protection	No
Weight	708 Lbs
Phase	3
Frequency	60
Locked Rotor Current	241 Amps
Power Factor 100% Load	80.8%
75% Load	74.6%
50% Load	64.3%
NEMA Design Letter	A
Pull out Torque, % of Full Load	216%
Pull in Torque, % of Full Load	150%
Type of Winding	Random Squirrel Cage
Allowable WK ² of Load	341 Lb-Ft ²
Space Heaters Watts/Volts	175/120
Max No of Starts Per Hour	1 Start/Min
Length of time between starts	
Power Cable/Ground Cable Size	
Thrust Bearing:	
Capacity Up (lbs.)	1600
Capacity Down (lbs.)	1600
Minimum Starting Voltage	80%
Seismic Qualifications	Not Effected



Attachment No. 3
Job 21701-523
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 4 of 10

RPA #631066352
Attachment C
Page 1 of 3

MOTOR DATA SHEET

<u>QUANTITY</u>	<u>EXISTING</u>	<u>PROPOSED BY VENDOR</u>
Service	ECF Fan	
Manufacturer	Reliance Electric	
Type	Induction	
Frame	444TCZ	
Horsepower	75	
Time Rating/Temp. Rise °C	Cont/-	
RPM at Full Load	1185	
Voltage	460	
Full Load AMPS	88	
Enclosure	TEAO	
Vertical or Horizontal	Vertical	
Bearings (Sleeve or Ball)	Ball	
Type of Lubrication	Grease	
Insulation Class	Class H Type RN	
Rotation (Viewed Looking Down From Top)	CW Looking Down	
Full Load Torque	333 Lb-Ft	
Starting Torque, % of Full Load	134%	
Efficiency 100% Load	92.9%	
75% Load	92.8%	
50% Load	92.0%	
Service Factor	1.15	
Thermal Protection	No	
Weight	1300 Lbs	
Phase	3	
Frequency	60	
Locked Rotor Current	554 Amps	
Power Factor 100% Load	86.2%	
75% Load	83.2%	
50% Load	77.0%	
NEMA Design Letter	B	
Pull up Torque, % of Full Load	111%	
Breakdown Torque, % of Full Load	247%	
Type of Winding	Random Squirrel Cage	
Allowable WK ² of Load	904 Lb-Ft ² (min)	
Space Heaters Watts/Volts	264 W/120/1/60	
Max No of Starts Per Hour	2 Cold/1 Hot per NEMA	
Length of time between starts		
Power Cable/Ground Cable Size	#4/#4 AWG	
Thrust Bearing:		
Capacity Up (lbs.)		
Capacity Down (lbs.)		
Minimum Starting Voltage	80%	

Rich Wilson - Reliance. Elect.



REL. S.O.	FRAME	HP	TYPE	PHASE/ HERTZ	RPM	VOLTS
SYZ-00344	145T	2	P	3/60	1740	460
AMPS	DUTY	AMB°C/ INSUL.	S.F.	NEMA DESIGN	CODE LETTER	ENCL.
2.7	CONT	40/H*	1.15	B	K	TEAO
E/S	ROTOR	TEST S.O.	TEST DATE	STATOR RES. @25°C OHMS (BETWEEN LINES)		
536030	602482-09-AE	---	---	7.79		
PERFORMANCE						
LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY	
NO LOAD	0	1.3	1800	8.67	0	
1/4	.50	1.4	1786	42.3	79.7	
2/4	1.00	1.7	1772	64.2	86.1	
3/4	1.50	2.1	1757	75.6	87.1	
4/4	2.00	2.7	1741	80.8	86.5	
5/4	2.50	3.3	1722	82.7	85.0	
SPEED TORQUE						
	RPM	TORQUE % FULL LOAD	TORQUE LB.-FT.	AMPERES		
LOCKED ROTOR	0	255	15.4	20.6		
PULL UP	250	253	15.2	20.6		
BREAKDOWN	1375	358	21.6	13.0		
FULL LOAD	1741	100	6.04	2.7		
AMPERES SHOWN FOR 460. VOLT CONNECTION. IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE. The motor is capable of starting with 75% of rated voltage. REMARKS: TYPICAL DATA *TYPE RH INSULATION P.O. 116647, E+W CODE K0388						
RELIANCE ELECTRIC CLEVELAND, OHIO 44117 U.S.A.		DR. BY <u>C.D.</u> CK. BY <u>H.W. WILSON</u> APP. BY <u>J.S. FOKELSEK</u> DATE <u>04/20/90</u>		A-C MOTOR E2001A-A-001 PERFORMANCE DATA ISSUE DATE 04/20/90		

SWGR 3D Room Supply Fan 3V65A
 Vendor Manual V000477

Attachment No.	3
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	5 of 10

File W79258

K0388-8
 RE 1
 PAGE 18

DATE		APPROVALS		MATERIAL		SUPPLY		CHECK		DRAWING		ENGINEERING		
XXXXXX TOTAL QUANTITY										3	3	6	2	4
SERVICE										Screen Wash Pp.	Inst. Air Comp.	Charging Pump	Spt. Fuel Pit Pump	Cont. Sy Pump
MANUFACTURER										W	LA	W	W	W
TYPE										CS	CJX			
FRAME DESIGNATION										445 UPY	444 U	444 TS		449 TS
HORSEPOWER OUTPUT										100	75	150	100	250
TIME RATING/TEMP. RISE °C										Ct./55	Ct./55			Ct./
RPM AT FULL LOAD										1780	1775	1770	1775	3550
VOLTAGE										460	460	460	460	460
FULL LOAD AMPS										118	93	169		275
ENCLOSURE										TEFC	TEFC	DP		WP I
VERTICAL OR HORIZONTAL										V	H	H	H	H
BEARINGS (SLEEVE OR BALL)										Ball	Ball			Ball
TYPE OF LUBRICATION														
INSULATION CLASS										B	B	B		B
ROTATION (VIEWED FROM END OPP. SHFT)										CCW				
FULL LOAD TORQUE										293				
STARTING TORQUE-% OF FULL LOAD										125		120		50
EFFICIENCY - 100% LOAD										90.5		92.5		94.0
. 75% LOAD										90.0		92.6		93.6
. 50% LOAD										88.0		91.9		93.0
SERVICE FACTOR										1.15	1.15	1.15		1.15
IS THERMAL PROTECTION PROVIDED										NO	NO	NO	NO	NO
WEIGHT										2070				1850
PHASE										3	3	3	3	3
FREQUENCY										60	60	60	60	60
LOCKED ROTOR CURRENT										725	558	981		1800
POWERFACTOR - 100% LOAD										89.0		90.1		90.5
. 75% LOAD										88.0		88.7		90.0
. 50% LOAD										83.5		83.8		87.5
NEMA DESIGN LETTER										B	B			
SECONDARY AMPS @ FULL LOAD														
SECONDARY VOLTAGE														
SECONDARY OHMS														
BREAKDOWN OR PULLOUT TORQUE-%										200		230		200
RATED FIELD CURRENT														
RATED EXCITER VOLTAGE														
RATED POWER FACTOR														
PULL IN TORQUE - % OF FULL LOAD														
TYPE OF WINDING														
SHUNT FIELD CURRENT														
ALLOWABLE WK ² OF LOAD														
SPACE HEATERS - WATTS/VOLTS										/	150/120	/	/	100/120
TWO SPEED MOTORS-NO OF WINDINGS														
TORQUE														
THRUST BEARING CAPACITY-UP (LBS)														
CAPACITY-DOWN (LBS)										3213				
ENCLOSURE; DRIPPROOF (DP), SPLASHPROOF (SP), WEATHER PROTECTED (WP), TOTALLY ENCLOSED NON-VENTILATED (TENV), TOTALLY ENCLOSED FAN COOLED (TEFC), TOTALLY ENCLOSED PIPE VENT- ILATED (TEPV) ETC., EXPLOSIONPROOF XP. TO INDICATE GUARDED ADD "G".														

Attachment No. 3
 Job 21701-S-23
 Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 6 of 10

BECHTEL CORPORATION



POWER DIVISION
ENGINEERING

ELECTRIC MOTOR DATA SHEET

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT UNITS 3 & 4

JOB No 5610

11-3

REV. 0

5-104
6-17-57

Attachment No. 3

Job

Calc No. 21701-523Rev. No. 0Sht. 7 of 10 PS 3/27/92

IEEE 620 →

STATOR LIMITED @ 215°C Total Temp.

300' motor life several

0 heat dissipation
Doesn't include wind loss

REL. S.O. SYZ-00423

FRAME 444TCZ

HP 75

TYPE P

PHASE/HERTZ 3/60

RPM 1180

VOLTS 460

AMPS 88.3

DUTY CONT

AMB°C/INSUL 50/H°

S.F. 1.0

NEMA DESIGN B

CODE LETTER H

ENCLOSURE TEAO

E/S 497211

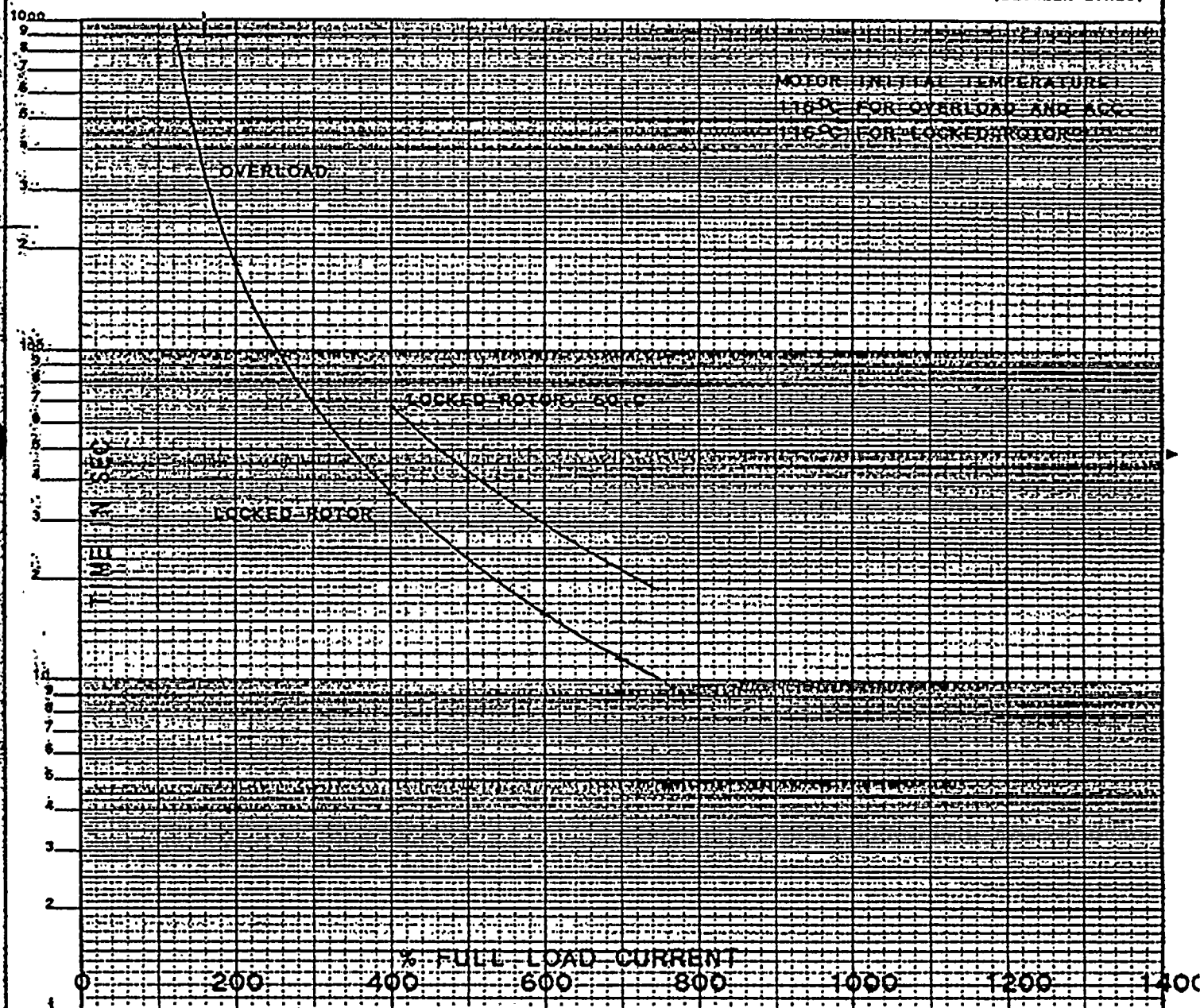
ROTOR 414957-72-GE

TEST S.O. TYPICAL DATA

TEST DATE ---

STATOR RES. @ 25°C .117

OHMS (BETWEEN LINES)



THERMAL LIMIT CURVE

REMARKS:

*TYPE RM INSULATION

P.O.# NG8812. JOY P/N 600276-7R

AMPERES SHOWN FOR 460 VOLT CONNECTION. OF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE.

RELIANCE
ELECTRIC

CLEVELAND, OHIO 44117 U.S.A.

 DR. BY C.D.
 CK. BY T. ROZANO
 APP. BY R.W. WILSON (R.W.)
 DATE 02/26/92

 A-C MOTOR
 PERFORMANCE
 CURVES

E8268A-A-001

ISSUE DATE 02/26/92

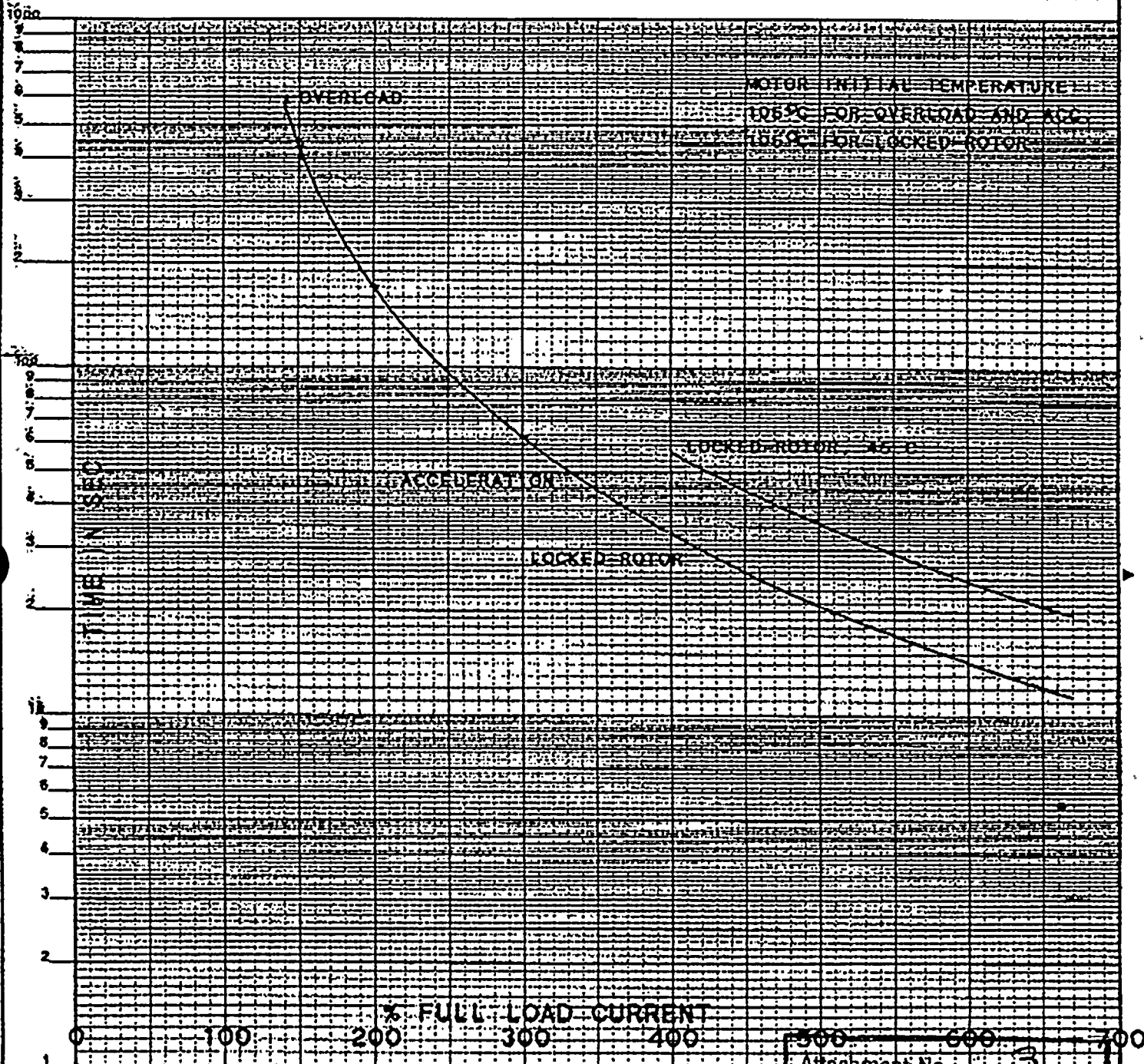


REL. S.O. SYZ-00393
 FRAME 364TCZ
 HP 30
 TYPE P
 PHASE/HERTZ 3/60

RPM 1175
 VOLTS 460
 AMPS 39.0
 DUTY CONT
 AMB°C/INSUL 45/H*

S.F. 1.15
 NEMA DESIGN A
 CODE LETTER H
 ENCLOSURE TEAO
 E/S 591242

ROTOR 417032-1-BPF
 TEST S.O. TYPICAL DATA
 TEST DATE ---
 STATOR RES. @ 25°C .394
 OHMS (BETWEEN LINES)



REMARKS:

THERMAL LIMIT CURVE
 *TYPE RN INSULATION
 P.O. NG8339, P/N 600276-8R

Attachment No. 1701-523
 Job 21701-523
 Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 8 of 10

AMPERES SHOWN FOR 460 VOLT CONNECTION, OF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE.

RELIANCE
ELECTRIC
 CLEVELAND, OHIO 44117 U.S.A.

DR. BY C.D.
 CK. BY T. RODANO
 APP. BY R.V. WILSON RUM
 DATE 02/28/92

A-C MOTOR
 PERFORMANCE E5237A-A-001
 CURVES
 ISSUE DATE 02/26/92

100

100

100

100

100

100



CURVE: JB20591A

G.O. JBD20591

ANALYSIS SHOP ORDER
NUMBER JB205911

THERMAL LIMIT CURVE

MOTOR INITIAL TEMPERATURE:

A. 40°C AMBIENT TEMP.

B. 110°C FULL-LOAD
OPERATING TEMP.

APPLICABLE TO MOTOR

SHOP ORDER NUMBERS:

68C16316 Cont. Spray Pump

79C52636

Attachment No.	3
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	9 of 10

R. M. Seiler
3/17/92

% FULL LOAD CURRENT



Attachment No.	3
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	10 of 10

PCM 89-587
 REV. 0
 ATTACHMENT 5
 PAGE 3 of 5

SEISMIC ANALYSIS REQUIREMENTS

Data For
 3V36

EQUIPMENT QUALIFIED: ELECTRIC MOTOR

EQUIPMENT DESCRIPTION:

<u>2.0</u> HP	1730 RPM
145T FRAME	TEFC-SXT ENCLOSURE
1.15 SERVICE FACTOR	460/3/60 Volts/Phases/Frequency
<u>2.7</u> FULL LOAD AMPS	613062-14 MOTOR D/S No.
	2.4 MAX. BRAKE HP

TYPE OF ANALYSIS

Seismic analysis has been performed utilizing a proprietary computer program No. 831 and supported by a number of other proprietary computer programs and hand calculations.

COMPUTER RUNS: 2100.044; 2100.0441

FUNCTIONAL REQUIREMENTS:

The equipment is required to operate without damage to itself and surrounding equipment during and after the events specified.

EXTERNAL LOADS: Motor sheave weight, 15 lbs. Located at end of shaft. Belt pull of 111 lbs.

EVENT(s) ANALYZED:

OBE Analyzed	Yes	Number of Events: One
SSE Analyzed	Yes	

SEISMIC LOADING: (G Level)

Horizontal E-W	SSE 6.0	OBE 4.8
Horizontal N-S	6.0	4.8
Vertical	6.0	4.8

SOURCE OF DATA: Motor Seismic Qualification - Input Data

DATA FURNISHED BY: Westinghouse Electric Corporation

ACCEPTANCE CRITERIA:

The equipment will operate without damage to itself or surrounding equipment before, during, and after the events analyzed with the safe limits of the materials and functional design.

MARGIN:

Margin is specifically given for each material in the Summary of Results found in this Section.

Report No. 89b-R-42

[illegible]

19

100

100

5

4



Attachment No. 4
 Job No. 21701-523
 Part No. 21701-523-E-02
 Rev. No. 0
 Sht. 1 of 4

CLASS G 30 HEATER SELECTION TABLES

Class A20 FVNR, Class A22 Two-Speed, Class A21 Reversing

HEATER REQUIREMENTS BY OPERATING CONDITIONS

Motor Continuous Rating °C Rise	Ambient Same At Starter And Motor	Ambient Higher At Starter Than At Motor	Ambient Higher At Starter Than At Motor
40	As specified from tables	One size larger than specified for each 15°C difference.	One size smaller than specified for each 15°C difference.
50-55	One size smaller than 40°C. above	One size smaller than 40°C above	One size smaller than 40°C above

The current at which heaters will trip the overload relay with the knob at 100% mark in an ambient of 40°C. is 1.25 times the minimum full load motor current in the table. Heaters so selected give 125% protection.

NEMA SIZE 0-1 STARTERS

HEATER CAT NO.	FULL LOAD MOTOR CURRENT			
	2 OL RELAYS		3 OL RELAYS	
	MIN.	MAX.	MIN.	MAX.
G30T6	.32	.34	.29	.31
G30T7	.35	.38	.32	.34
G30T8	.39	.42	.35	.37
G30T9	.43	.45	.38	.41
G30T10	.46	.49	.42	.45
G30T11	.50	.56	.46	.50
G30T12	.57	.61	.51	.56
G30T13	.62	.70	.57	.63
G30T14	.71	.77	.64	.70
G30T15	.78	.86	.71	.78
G30T16	.87	.96	.79	.87
G30T17	.97	1.06	.88	.96
G30T18	1.07	1.14	.97	1.04
G30T19	1.15	1.25	1.05	1.11
G30T20	1.26	1.39	1.12	1.24
G30T21	1.40	1.52	1.25	1.35
G30T22	1.53	1.64	1.36	1.46
G30T23	1.65	1.81	1.47	1.62
G30T24	1.82	2.04	1.63	1.83
G30T25	2.05	2.26	1.84	2.02
G30T26	2.27	2.47	2.03	2.20
G30T27	2.48	2.73	2.21	2.44
G30T28	2.74	3.07	2.45	2.74
G30T29	3.08	3.41	2.75	3.05

NEMA SIZE 0-1 STARTERS

HEATER CAT NO.	FULL LOAD MOTOR CURRENT			
	2 OL RELAYS		3 OL RELAYS	
	MIN.	MAX.	MIN.	MAX.
G30T30	3.42	3.84	3.06	3.47
G30T31	3.85	4.31	3.48	3.89
G30T32	4.32	4.80	3.90	4.33
G30T33	4.81	5.05	4.34	4.62
G30T34	5.06	5.55	4.63	5.03
G30T35	5.56	6.06	5.04	5.54
G30T36	6.07	6.89	5.55	6.29
G30T37	6.90	7.79	6.30	7.04
G30T38	7.80	8.71	7.05	7.85
G30T39	8.72	9.74	7.86	8.81
G30T40	9.75	10.8	8.82	9.84
G30T41	10.9	12.1	9.85	10.9
G30T42	12.2	12.7	11.0	11.6
G30T43	12.8	14.2	11.7	12.3
G30T44	14.3	15.1	12.4	13.6
G30T45	15.2	16.6	13.7	14.7
G30T46	16.7	18.7	14.8	16.7
G30T47	18.8	20.1	16.8	18.0
G30T48	20.2	22.2	18.1	19.4
G30T49	22.3	25.4	19.5	21.6
G30T50	25.5	28.2	21.7	24.3
G30T51	28.3	30.0	24.4	27.7
G30T52	-	-	27.8	30.0





CLASS G30 HEATER SELECTION TABLES

NEMA SIZE 2

HEATER CAT NO.	FULL LOAD MOTOR CURRENT			
	2 OL RELAYS		3 OL RELAYS	
	MIN.	MAX.	MIN.	MAX.
G30T36	6.42	7.22	6.16	6.94
G30T37	7.23	7.86	6.95	7.56
G30T38	7.87	8.92	7.57	8.55
G30T39	8.93	10.0	8.56	9.71
G30T40	10.1	11.5	9.72	10.6
G30T41	11.6	12.7	10.7	11.9
G30T42	12.8	13.5	12.0	13.0
G30T43	13.6	14.6	13.1	14.0
G30T44	14.7	15.2	14.1	14.7
G30T45	15.3	16.6	14.8	16.0
G30T46	16.7	18.3	16.1	17.7

NEMA SIZE 2

HEATER CAT NO.	FULL LOAD MOTOR CURRENT			
	2 OL RELAYS		3 OL RELAYS	
	MIN.	MAX.	MIN.	MAX.
G30T47	18.4	19.2	17.8	18.4
G30T48	19.3	22.2	18.5	21.3
G30T49	22.3	25.2	21.4	24.2
G30T50	25.3	28.2	24.3	27.1
G30T51	28.3	30.3	27.2	29.1
G30T52	30.4	34.1	29.2	32.4
G30T53	34.2	37.6	32.5	36.2
G30T54	37.7	41.0	36.3	39.4
G30T55	41.1	47.0	39.5	45.1
G30T56	47.1	53.5	45.2	50.3

NEMA SIZE 3

HEATER CAT NO.	FULL LOAD MOTOR CURRENT			
	2 OL RELAYS		3 OL RELAYS	
	MIN.	MAX.	MIN.	MAX.
G30T46	20.8	23.9	19.2	21.5
G30T47	24.0	26.3	21.6	24.7
G30T48	26.4	27.9	24.8	25.3
G30T49	28.0	32.7	25.4	30.3
G30T50	32.8	35.1	30.4	32.7
G30T51	35.2	39.9	32.8	37.6
G30T52	40.0	45.5	37.7	40.7
G30T53	45.6	50.3	40.8	46.4
G30T54	50.4	52.7	46.5	49.6
G30T55	52.8	61.5	49.7	57.4
G30T56	61.6	68.7	57.5	63.9
G30T57	68.8	75.1	64.0	70.4
G30T58	75.2	83.3	70.5	78.4
G30T59	83.4	89.9	78.5	85.5
G30T60	90.0	100.0	85.6	95.1
G30T61	-	-	95.2	100.0

NEMA SIZE 4

HEATER CAT NO.	FULL LOAD MOTOR CURRENT			
	2 OL RELAYS		3 OL RELAYS	
	MIN.	MAX.	MIN.	MAX.
G30T51	35.2	39.9	32.8	37.6
G30T52	40.0	45.5	37.7	40.7
G30T53	45.6	50.3	40.8	46.4
G30T54	50.4	52.6	46.5	49.6
G30T55	52.7	61.5	49.7	57.4
G30T56	61.6	68.7	57.5	64.7
G30T57	68.8	75.1	64.8	71.1
G30T58	75.2	83.3	71.2	79.9
G30T59	83.4	89.9	80.0	85.5
G30T60	90.0	101.0	85.6	95.2
G30T61	102.0	113.0	95.3	103.0
G30T62	114.0	124.0	104.0	114.0
G30T63	125.0	132.0	115.0	129.0
G30T64	133.0	150.0	130.0	133.0
G30T65	-	-	133.0	150.0

NEMA SIZE 5

HEATER CAT NO.	HEATER CODE MARKING	HEATER RATING 2 or 3 OL	MOTOR CURRENT	
			MIN.	MAX.
1597771	CA	93	74.4	83.9
1597772	CB	105	84.0	93.4
1597773	CC	117	93.5	104
1597774	CD	133	105	120
1597775	CE	152	121	136
1597776	CF	172	137	152
1597777	CG	192	153	168
1597778	CH	212	169	185
1597779	CI	233	186	199
1597780	CJ	250	200	211
1745083	CG - CG	265	212	239
1745084	CH - CH	300	240	259

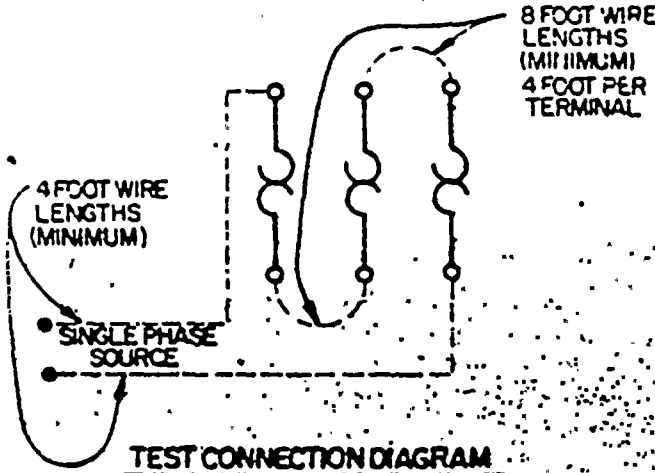
Attachment No. 4
 Job 21701-523
 Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 2 of 4

MULTIPLES OF OVERLOAD RELAY CURRENT ELEMENT RATING

(REF. TEST REQUIREMENT #3)

TEST REQUIREMENTS

1. OVERLOAD RELAY TIME-CURRENT CHARACTERISTICS AT 40°C (104°F).
2. 3 POLES IN SERIES TEST.
3. CURRENT ELEMENT RATING-125% OF MINIMUM HEATER CURRENT VALUE.
4. DURING FIELD TESTS EMPLOY THE 300% TO 600% TEST RANGES. REFER TO NEMA I.C.S. 2-222 DESIGN & TEST PROCEDURES.
5. DISCONNECT POWER SOURCE IMMEDIATELY AFTER OVERLOAD RELAY TRIPS.



ADJUSTABLE NON-COMPENSATED TYPE
NEMA SIZE 0, 1 & 2 OVERLOAD RELAYS
L10/E20 STYLE (2 PIECE BIMETAL
CONSTRUCTION, BLUE ADJUSTMENT KNOB)

RECHTEL POWER COMPONENTS	
SUPPLIER DOCUMENTATION REVIEW STATUS	
STATUS	1 X Mark any present.
1 0	Noted and required. Mark any present subject to transportation.
1 0	Noted and required. Mark any present.
1 0	Noted and required. Mark any present.
1 0	Noted and required. Mark any present.

Particulars to include: date and location of inspection of design, construction, assembly, and materials in accordance with the supplier and data and other applicable standards and specifications.

DATE	BY	REV.	DATE	BY	REV.
11/19/87					

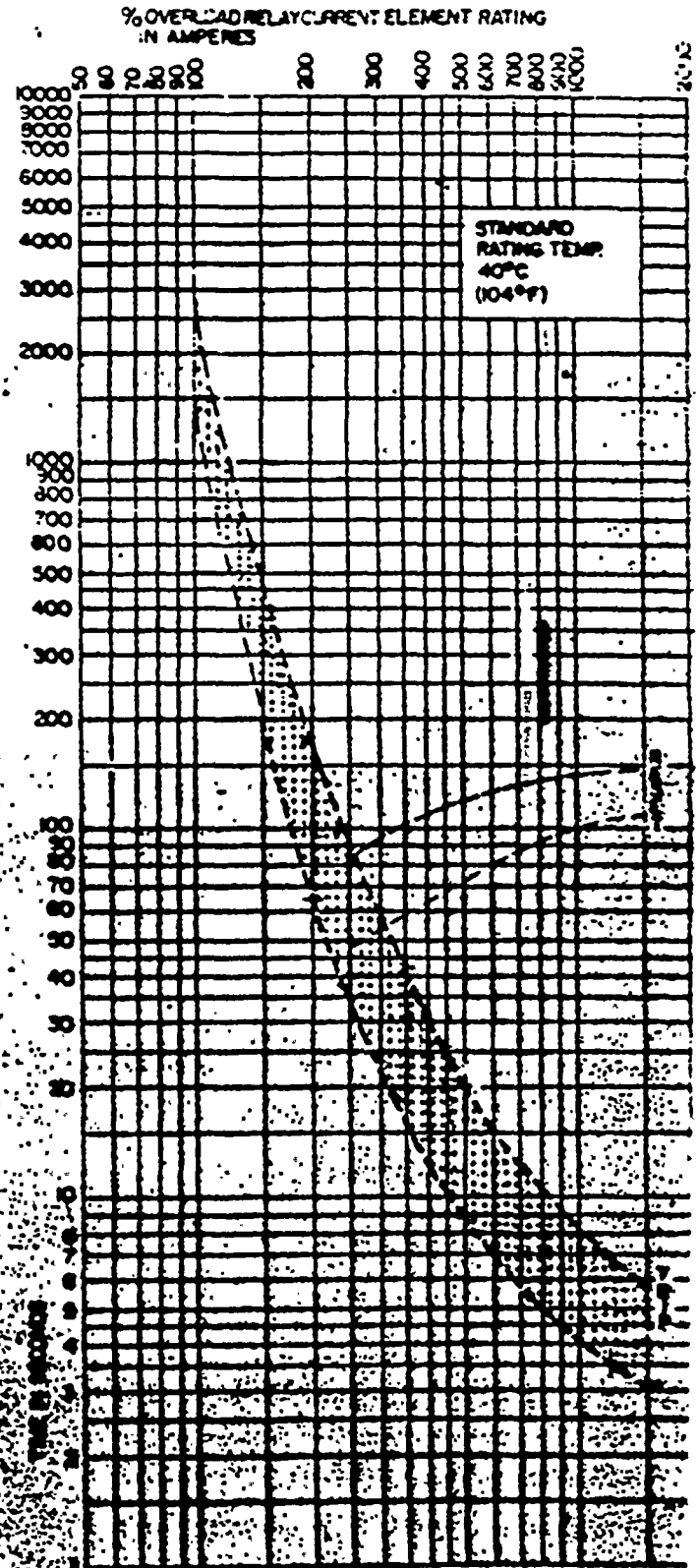
Attachment No. 4

Job No. 21701-523

Calc No. 21701-523-E-02

Rev. No. 0

3 of 4



5177-349-E-818-10-1

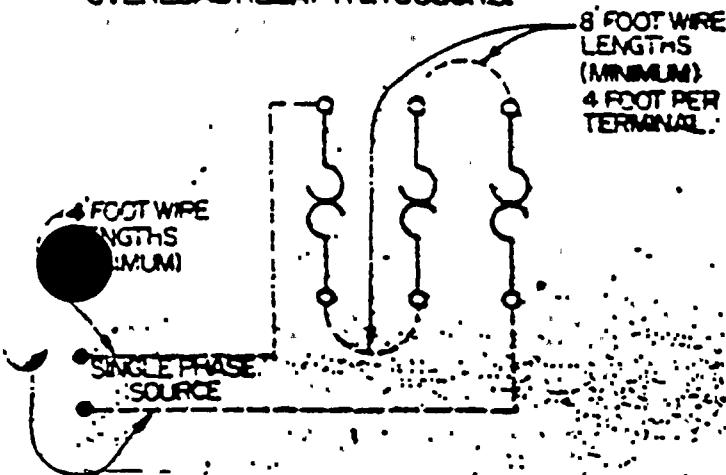
MULTIPLES OF OVERLOAD RELAY CURRENT ELEMENT RATING

(REF TEST REQUIREMENT #3)

% OVERLOAD RELAY CURRENT ELEMENT RATING
IN AMPERES

TEST REQUIREMENTS

1. OVERLOAD RELAY TIME-CURRENT CHARACTERISTICS AT 40°C (104°F).
2. 3 POLES IN SERIES TEST.
3. CURRENT ELEMENT RATING-125% OF MINIMUM HEATER CURRENT VALUE.
4. DURING FIELD TEST EMPLOY THE 300% TO 600% TEST RANGES. REFER TO NEMA I.C.S. 2-222 DESIGN 8 TEST PROCEDURES.
5. DISCONNECT POWER SOURCE IMMEDIATELY AFTER OVERLOAD RELAY TRIP OCCURS.



TEST CONNECTION DIAGRAM

ADJUSTABLE NON-COMPENSATED TYPE
NEMA SIZE 3B4 OVERLOAD RELAYS
L10/E20 STYLE (3 PIECE BIMETAL CONSTRUCTION
BLACK ADJUSTMENT KNOB)

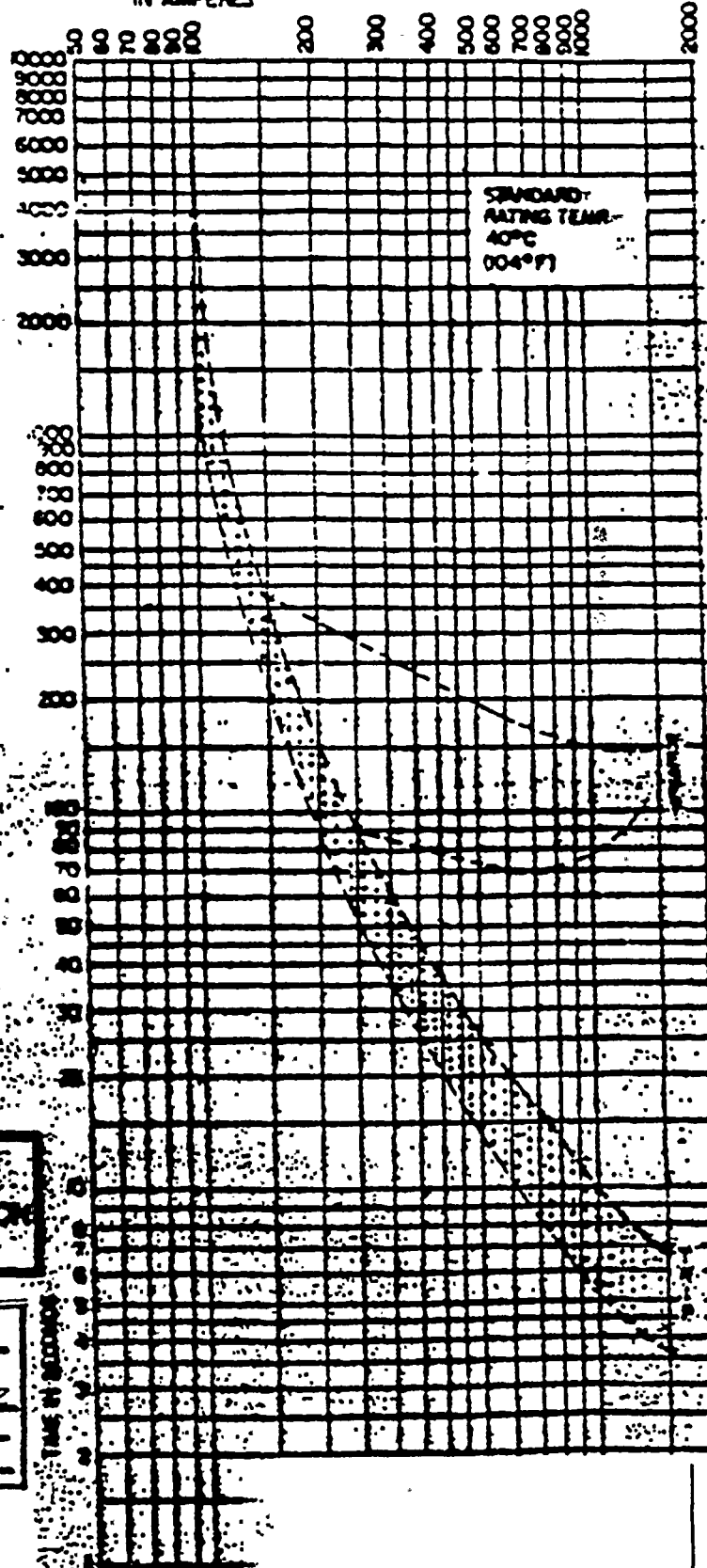
BECHTEL POWER CORPORATION		JOB NO. 5177	
SUPPLIER DOCUMENT REVIEW STATUS			
STATUS NO.			
1. DESIGN AND CONSTRUCTION: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
2. MATERIALS: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
3. TESTING: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
4. ASSEMBLY: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
5. SHIPPING: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
6. STORAGE: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
7. DELIVERY: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
8. INSTALLATION: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
9. MAINTENANCE: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
10. DISPOSAL: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
11. REPAIR: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
12. REPLACEMENT: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
13. OTHER: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
14. COMMENTS: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
15. SIGNATURE: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
16. DATE: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
17. LOCATION: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
18. PROJECT: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
19. CLIENT: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
20. CONTRACT: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
21. ORDER: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
22. INVOICE: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
23. RECEIPT: CHECK FOR COMPLIANCE WITH REQUIREMENTS			
24. OTHER: CHECK FOR COMPLIANCE WITH REQUIREMENTS			

Attachment No. 4
Job 21701-523
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 34 of 4

5177-349-E-818-8-1

5177-349-E-818-8-1 J39 1/14/87

1/14/87





Σ



HEATERS

Heaters are not included with the overload relay and must be ordered separately per the heater selection table and the information listed below. When installing heaters be sure that connecting surfaces are clean and heaters are attached securely to the relay in the proper location with the screws provided. The trip rating of a heater in a 40°C Ambient is 125% of the minimum full load current shown in Table V. When tested at 600 percent of its trip rating, the relay will trip in 20 seconds or less (class 20).

Heaters should be selected on the basis of the actual full load current and service factor as shown on the motor nameplate or in the manufacturer's published literature. When the service factor of the motor is 1.15 to 1.25, select heaters from the heater application table. If the service factor of the motor is 1.0, or there is no service factor shown, or a maximum of 115% protection is desired, select one size smaller heater than indicated. When motor and overload relay are in different ambients and when using non-compensated overload relays, select heaters from the table using adjusted motor currents as follows: decrease rated motor current 1% for each °C motor ambient exceeds controller ambient. Increase rated motor current 1% for each °C controller ambient exceeds motor ambient. For ambient compensated overload relays no adjustment in heater selection is necessary for normal variations in ambient temperatures.

SHORT CIRCUIT PROTECTION

The relay will provide protection against abnormal load conditions to current values exceeding normal locked rotor current; however, to protect the relay from short circuit currents, branch circuit protection must be provided per the National Electric Code. Protective device ratings should not exceed the maximum values listed in the heater application table. The relays, as protected, are suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 600 volts maximum.

MAINTENANCE

Other than the normal tightening of all wire and heater connections, no maintenance should be attempted on the unit. Complete replacement of the unit must be made in the event of damage.

WARNING: To provide continued protection against fire and shock hazard, the complete overload relay must be replaced if burnout of a current element occurs. See Table I.

TABLE V — F SERIES HEATER SELECTION

For compensated OLR's in any size enclosure; and non-compensated OLR's in enclosures with volume not less than 5500 cu. in. Wire with 75°C wire.

For Use With Three Heaters Only

Code Marking	Full Load Current of Motor (Amperes) (40°C Ambient)	Max. Protect. Device (Amp)	Load Wire Size
FH03	.25 — .27	1*	#14
FH04	.28 — .31	1*	#14
FH05	.32 — .34	1*	#14
FH06	.35 — .38	1*	#14
FH07	.39 — .42	1*	#14
FH08	.43 — .46	2*	#14
FH09	.47 — .50	2*	#14
FH10	.51 — .55	2*	#14
FH11	.56 — .62	3*	#14
FH12	.63 — .68	3*	#14
FH13	.69 — .75	3*	#14
FH14	.76 — .83	3*	#14
FH15	.84 — .91	3*	#14
FH16	.92 — 1.00	3*	#14
FH17	1.01 — 1.11	3*	#14
FH18	1.12 — 1.22	3*	#14
FH19	1.23 — 1.34	5*	#14
FH20	1.35 — 1.47	6*	#14
FH21	1.48 — 1.62	6*	#14
FH22	1.63 — 1.78	6*	#14
FH23	1.79 — 1.96	6*	#14
FH24	1.96 — 2.15	6*	#14
FH25	2.16 — 2.36	10*	#14
FH26	2.36 — 2.58	10*	#14
FH27	2.59 — 2.83	10*	#14
FH28	2.84 — 3.11	15	#14
FH29	3.12 — 3.42	15	#14
FH30	3.43 — 3.73	15	#14
FH31	3.74 — 4.07	15	#14
FH32	4.08 — 4.39	15	#14
FH33	4.40 — 4.87	15	#14
FH34	4.88 — 5.3	20	#14
FH35	5.4 — 5.9	20	#14
FH36	6.0 — 6.4	20	#14
FH37	6.5 — 7.1	25	#14
FH38	7.2 — 7.8	25	#14
FH39	7.9 — 8.5	30	#14
FH40	8.6 — 9.4	30	#14
FH41	9.5 — 10.3	35	#14
FH42	10.4 — 11.3	35	#14
FH43	11.4 — 12.4	40	#14
FH44	12.5 — 13.5	45	#14
FH45	13.6 — 14.9	45	#14
FH46	15.0 — 16.3	50	#12
FH47	16.4 — 18.0	60	#12
FH48	18.1 — 19.8	60	#12
FH49	19.9 — 21.7	70	#10
FH50	21.8 — 23.9	80	#10
FH51	24.0 — 26.2	80	#10

Above Heaters for use on Size 1

FH52	26.3 — 28.7	90	#8
FH53	28.8 — 31.4	100	#8
FH54	31.5 — 34.5	125	#8
FH55	34.6 — 37.9	125	#8
FH56	38.0 — 41.5	125	#8
FH57	41.6 — 45.0	150	#6

Above Heaters for use on Size 2

*15 ampere protective device is permitted by NEC. Fuse size shown in table limits fault current.

Attachment No. 5
 Job 21701-523
 Calc No. 21701-523-E-02
 Rev. 0
 SHT. 1 of 2

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

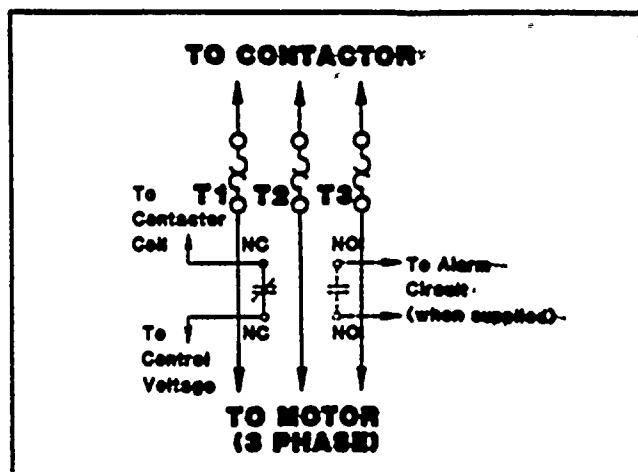
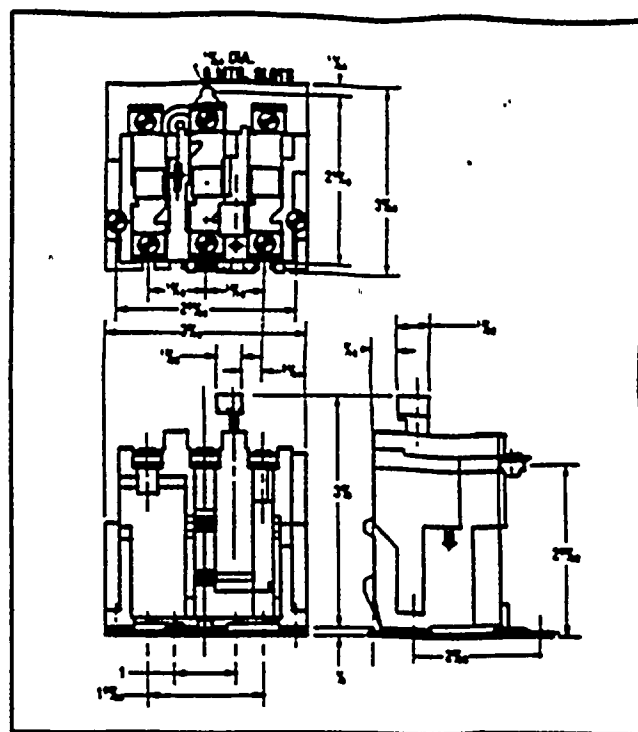
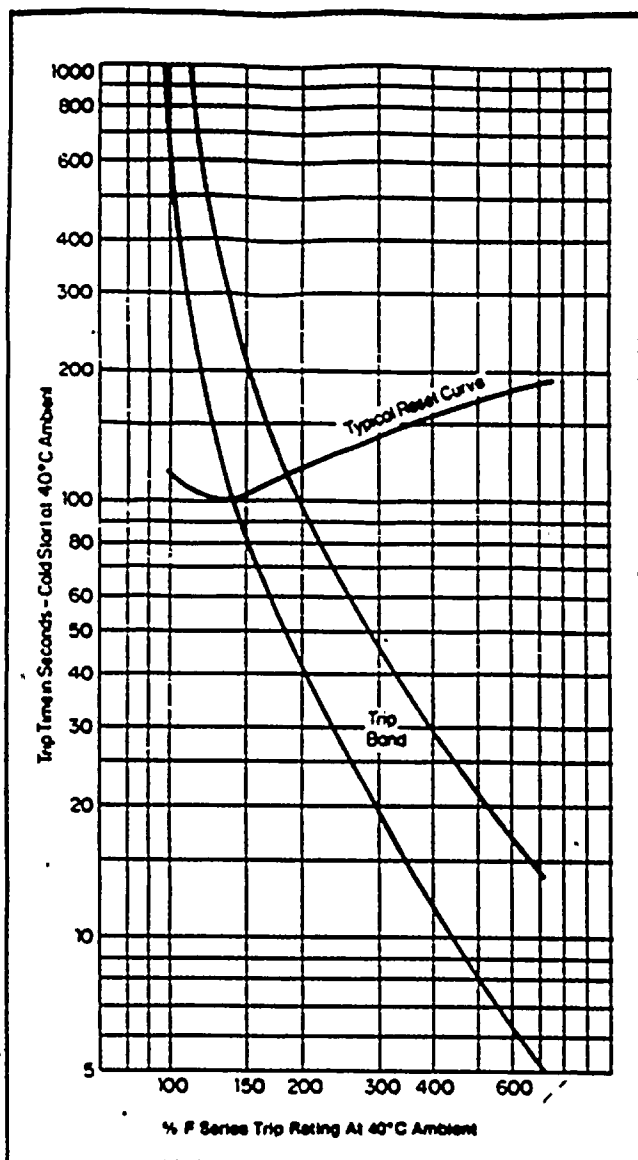
29

30

31

32





Attachment No. 5
Job 21701-523
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 2 of 2



6-1-80
10:30

Tim Sweeney

ABB

ASEA BROWN BOVERI

FAX TRANSMITTAL SHEET

Attachment No.	<u>6</u>
Job	<u>21701-523</u>
Calc No.	<u>21701-523-E-02</u>
Rev. No.	<u>0</u>
Sht.	<u>1</u> of <u>3</u>

913-286-1285

ABB Power Distribution
Circuit Breaker Division
P.O. Box 100524
I-95 & Mechanicsville Highway
Florence, S.C. 29501
Phone (803) 665-4144
Fax (803) 667-5109 - Marketing
(803) 664-0520 - Eng., Purch., Acct, QC

TO: DON HAMROCK

FROM: DEAN SIGMON

OF PAGES(Incl. Cover Page): 2

DATE: 1-24-92

Tim attached

TD-6695 IS THE CURVE
USED FOR OD-20/OD-61
OD-61
LONG TIME PICKUPS - 1.25, 1.55, 1.90, 2.20,
2.50 X

OD-20
LONG TIME PICKUPS .8, 1.0, 1.2, 1.4, 1.6 X

INSTANTANEOUS PICKUP FOR BOTH:
5, 10, 15 X

*3 pages total
Don Hamrock
1-27-91*

*Dean Sigmon
1-24-92*

If there are any problems with this fax transmittal, please call and speak to the Operator.



4

1114 SW 2000

PHASE 5002

OIL URNS D4C	LONG TIME PICKUP POINTS L.V. CENTER PACE (TRIP)					LONG TIME CALIBRATION OFFING	COIL TURNS OD-20	LONG TIME PICKUP POINTS R.V. PALE (ALARM)					LONG TIME CALIBRATION OFFING	NAME PLATE #	INSTANTANEOUS PICKUP POINTS ALL TOLE (IN)		
	1	2	3	4	5			1	2	3	4	5			5X	10X	15X
	125%	150%	175%	200%	250%			80%	100%	120%	140%	160%					
200	6	8	10	11	15	A33	200	4	5	6	7	8	A21	A	25	50	75
68	19	23	29	33	38	A33	68	12	15	18	21	24	A28	B	75	150	225
39	25	31	38	44	50	A31	68	16	20	24	28	32	A32	C	100	250	80
39	38	47	57	66	75	A34	39	24	30	36	42	48	A31	D	150	300	45
18	50	62	76	88	100	A31	39	32	40	48	56	64	A33	E	200	400	60
18	63	78	95	110	125	A32	18	40	50	60	70	80	A28	F	250	500	75
11	88	109	133	154	175	A31	18	56	70	84	98	112	A32	G	350	700	105
11	113	140	171	198	225	A33	11	72	90	108	126	144	A28	H	450	900	135
6	125	155	190	220	250	A28	11	80	100	120	140	160	A29	J	500	1000	150
6	153	194	238	275	318	A31	11	100	125	150	175	200	A32	A1	625	1250	187
6	188	233	285	330	375	A32	6	120	150	180	210	240	A28	A2	750	1500	225
4	219	271	333	385	438	A34	6	140	175	210	245	280	A29	A3	875	1750	262
4	250	310	380	440	500	A31	6	160	200	240	280	320	A31	A4	1000	2000	300
4	281	349	428	495	563	A31	4	180	225	270	315	360	A32	A5	1125	2250	337
4	313	388	475	550	625	A33	4	200	250	300	350	400	A28	A6	1250	2500	375
2	375	465	570	660	750	A28	3	240	300	360	420	480	A28	A7	1500	3000	450
2	438	543	665	770	875	A31	3	280	350	420	490	560	A29	A8	1750	3500	525
2	500	620	760	880	1000	A31	3	320	400	480	560	640	A31	A9	2000	4000	600
2	563	698	855	990	1125	A31	3	360	450	540	630	720	A32	A10	2250	4500	675
2	625	775	950	1100	1250	A33	2	400	500	600	700	800	A28	A11	2500	5000	750
KK-10	750	930	1140	1320	1500	A28	2	480	600	720	840	960	A31	A12	3000	6000	900
1	1000	1240	1520	1760	2000	A31	2	640	800	960	1120	1280	A33	A13	4000	8000	1200
1	1250	1550	1900	2200	2500	A33	1	800	1000	1200	1400	1600	A28	A14	5000	10000	1500
1	1500	1860	2280	2640	3000	A34	1	960	1200	1440	1680	1920	A31	A15	6000	12000	1800
1	2000	2480	3040	3520	4000	A44	1	1280	1600	1920	2240	2560	A33	A16	8000	16000	2400
(K-10)	750	930	1140	1320	1500	A33	2	480	600	720	840	960	A31	A17	3000	6000	900
1	2500	3100	3800	4400	5000	A44	1	1600	2000	2400	2800	3200	A34	A17	4000	8000	1200

RESTRICTED

0061

00-20

LONG TIME AIR GAP .217
INST. AIR GAP .246/256

JAN 27 '92 12:14

VE
35
6

SHIPPING SETTINGS	MARK	R.H. PALE
LONG TIME PICKUP	250%	100%
INSTANT. PICKUP	1000%	1000%
LONG TIME DELAY	MIN:	INTER:

1. CHECK WITH C.B. ENG. BEFORE SPECIFYING
SPEC. CAL. PTS. NOT SHOWN.
2. MARK INTERMEDIATE INSTANTANEOUS
POINT ONLY IF SPECIFIED ON B/M

TIME	CAL. L/T T
BANDS	TIME AT 3C
MIN.	17-22 S
INTER	35-42 S

Attachment No. 6
Job 21701-523
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 2 of 3



RATIO OF ACTUAL CURRENT TO COIL RATING

SPECIALIZED SELECTIVE AND GENERAL-PURPOSE DIRECT-ACTING TRIP DEVICES
 I-T-E Types OD-5, OD-6, OD-500 & OD-600

OD-5 and OD-600 long-time and short-time delay with instantaneous
 OD-6 and OD-500 long-time with instantaneous

Note 1: The upper limit of the band represents the time from the start of the overcurrent until interruption by the circuit breaker. The actual tripping time will be equal to or less than the upper limit of the band. Reset time of device is 5 sec. max. (long-time); 1 sec. max. (short-time)

Note 2: The lower limit of the band represents the time for which the overcurrent may persist at the given value and then drop to 95% of the long-time pickup or 25% of the short-time pickup without tripping the circuit breaker. The actual minimum tripping time will always be in excess of the lower limit of the band. Reset time of device is 4 sec. max. (long-time); 1 sec. max. (short-time)

Note 3: Selected instantaneous pickup point determines time-delay curve cut-off. Allow $\pm 25\%$ variation.

Note 4: Coil ratings - 15, 20, 25, 30, 40, 50, 70, 80, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, 550, 600, 1000, 1200, 1500, 2000, 3000 & 4000 amperes. Apply within the short-circuit current rating of the applicable circuit breaker.

Note 5: Factory settings (unless otherwise specified)
 long-time pickup - 100% of coil rating
 short-time pickup - 400% of coil rating
 instantaneous pickup - 1000% of coil rating
 time band - minimum

Note 6: Curves are applicable for 50/60Hz systems and are based on a normal coil-temperature range of 10-40°C with no previous load being applied to the trip device.

Note 7: Curves are plotted on ratio current basis for general use, with coil rating as unity. When plotting actual coordination curves in amperes, position the long-time, short-time and/or instantaneous pickup setting at the selected ampere rating within the adjustable range. Trace the appropriate bands from the curve, with the center of the band on the selected ampere value.

LONG-TIME PICKUP SETTING
 ADJUSTABLE TO 95%, 100%, 120%,
 140% OR 160% OF COIL RATING
 (SHOWN SET AT 100%)

LONG-TIME BAND
 UPPER LIMIT
 SEE NOTE 1.

LONG-TIME
 DELAY BAND
 MAXIMUM
 INTERMEDIATE
 MINIMUM

SHORT-TIME DELAY PICKUP SETTING ADJUSTABLE
 TO 400%, 700% OR 1000%
 (SHOWN SET AT 400% AND 1000%)

SHORT-TIME BAND
 UPPER LIMIT
 SEE NOTE 1

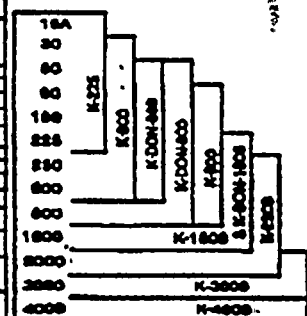
SHORT-TIME BAND
 LOWER LIMIT
 SEE NOTE 2

INSTANTANEOUS
 PICKUP ADJUSTABLE
 FROM 300% TO
 1000% OF COIL
 RATING (SHOWN
 SET AT 500% AND
 1000%)
 SEE NOTE 3

OD-5 AND
 OD-600 ONLY
 SHORT-TIME
 DELAY BANDS
 MAXIMUM
 INTERMEDIATE
 MINIMUM

MAXIMUM
 CIRCUIT BREAKER
 CLEARING TIME
 WITH INSTANTANEOUS
 TRIP

COIL RATING RANGES
 AVAILABLE PER BREAKER



RATIO OF ACTUAL CURRENT TO COIL RATING

CURRENT CHARACTERISTIC CURVES FOR K-LINE & K-DON CIRCUIT BREAKERS
 I-T-E TYPES OD-5 AND OD-600 - LONG-TIME - SHORT-TIME - INSTANTANEOUS -
 DIRECT-ACTING TRIP DEVICES, FOR SPECIAL SELECTIVE TRIPPING APPLICATIONS -
 TYPES OD-6 AND OD-500 - LONG-TIME AND INSTANTANEOUS -
 DIRECT-ACTING TRIP DEVICES FOR 60-100% CALIBRATION REQUIREMENTS

BBC

OWN. BY P.C. TRON DATE 11-1-73

NO. TD-6695

REV: 8

100

101

102

103

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

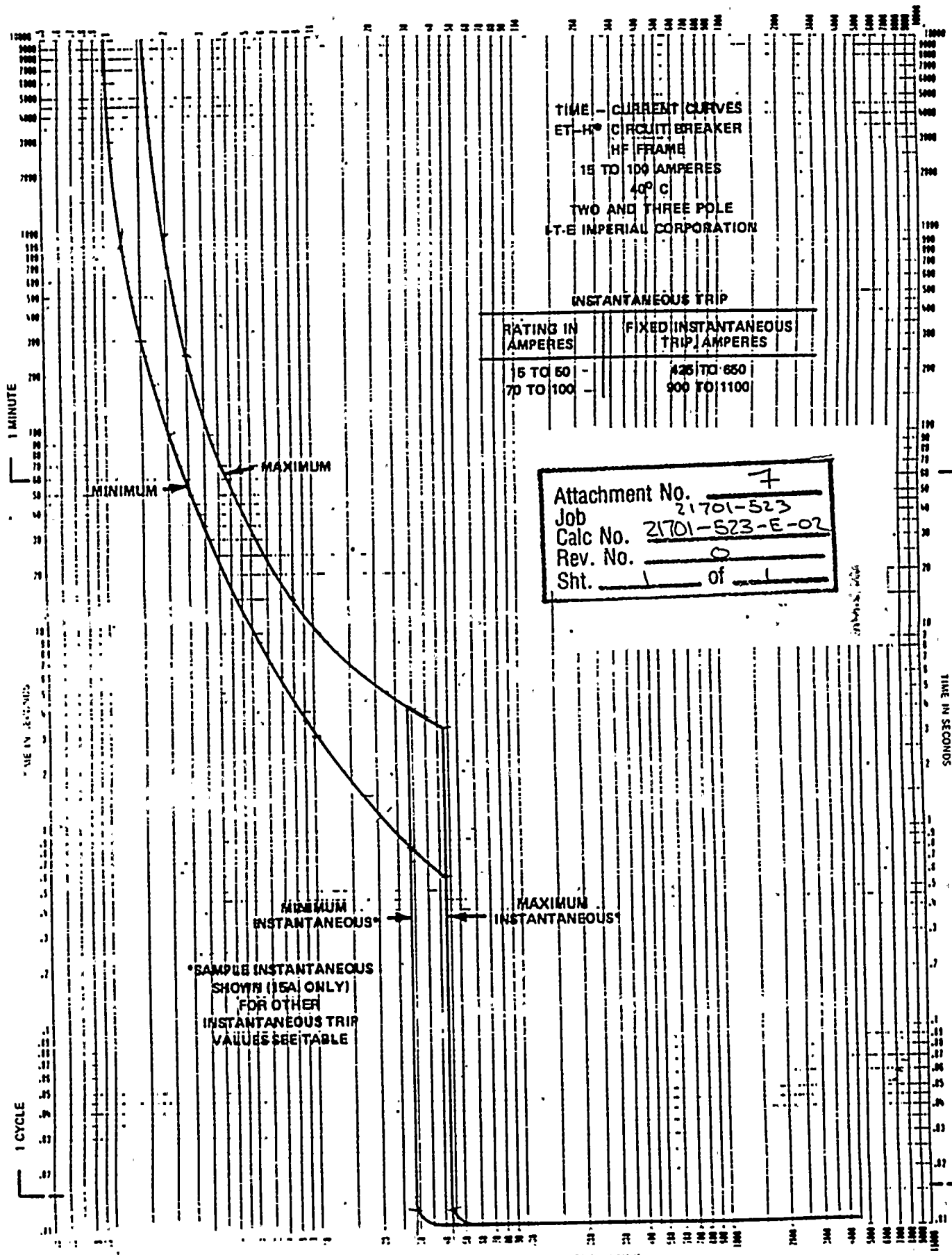
119

120

121

122

123



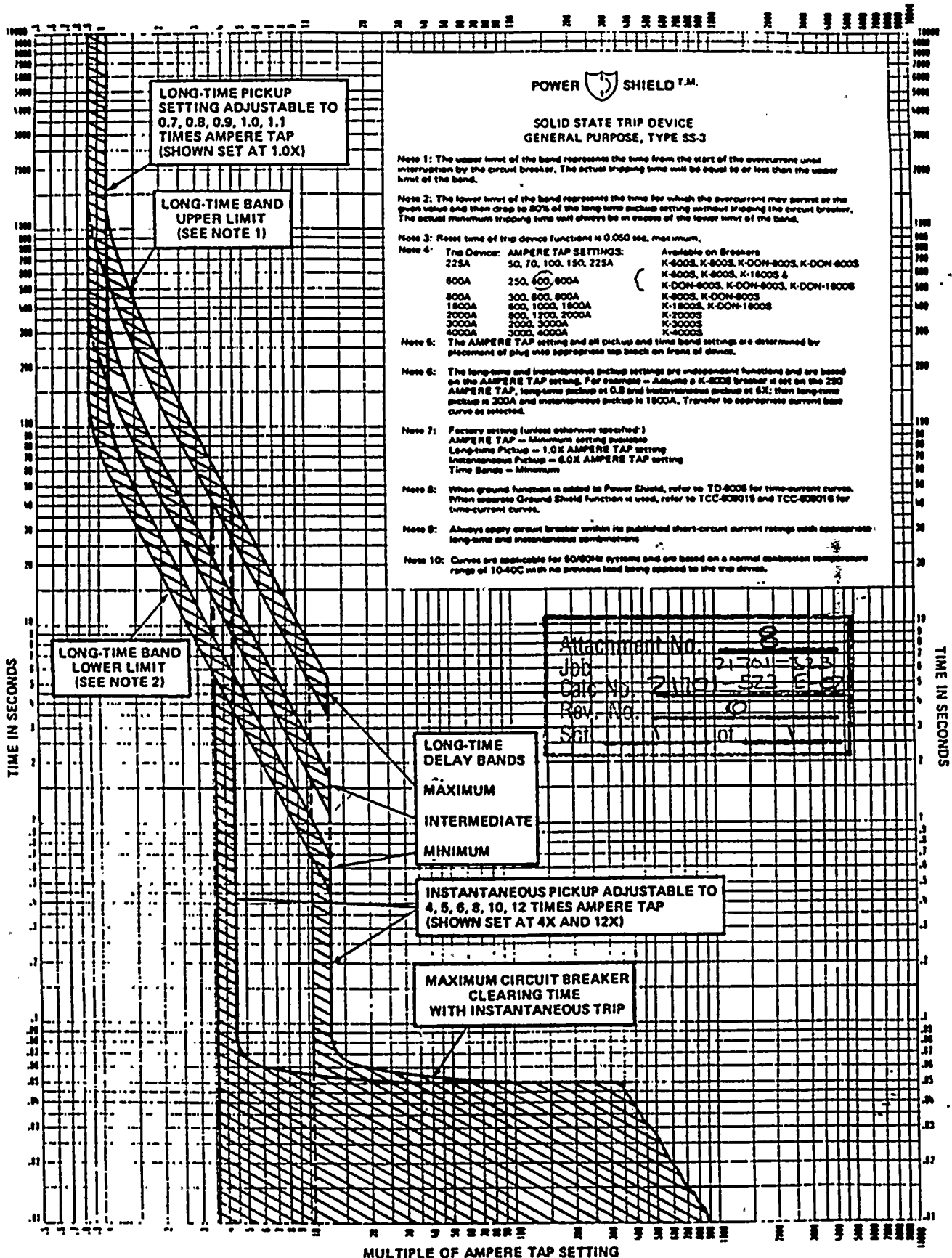
TIME - CURRENT CURVES
 ET-H[®] CIRCUIT BREAKER
 HF FRAME
 15 TO 100 AMPERES
 40° C
 TWO AND THREE POLE
 E-T-E IMPERIAL CORPORATION

INSTANTANEOUS TRIP	
RATING IN AMPERES	FIXED INSTANTANEOUS TRIP AMPERES
15 TO 50 -	125 TO 650
70 TO 100 -	900 TO 1100

Attachment No. 7
 Job 21701-523
 Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 1 of 1

FOR APPLICATION AND COORDINATION PURPOSES ONLY. BASED ON 40°C AMBIENT COLD START. 600 VOLTS 60 HZ, 250 VOLTS DC.

MULTIPLE OF AMPERE TAP SETTING



TIME-CURRENT CHARACTERISTIC CURVES: SOLID-STATE TRIP DEVICE
I-T-E TYPE SS-3; LONG-TIME AND INSTANTANEOUS, GENERAL PURPOSE

FOR K-LINE AND K-DON CIRCUIT BREAKERS

MODEL 1 GRAY

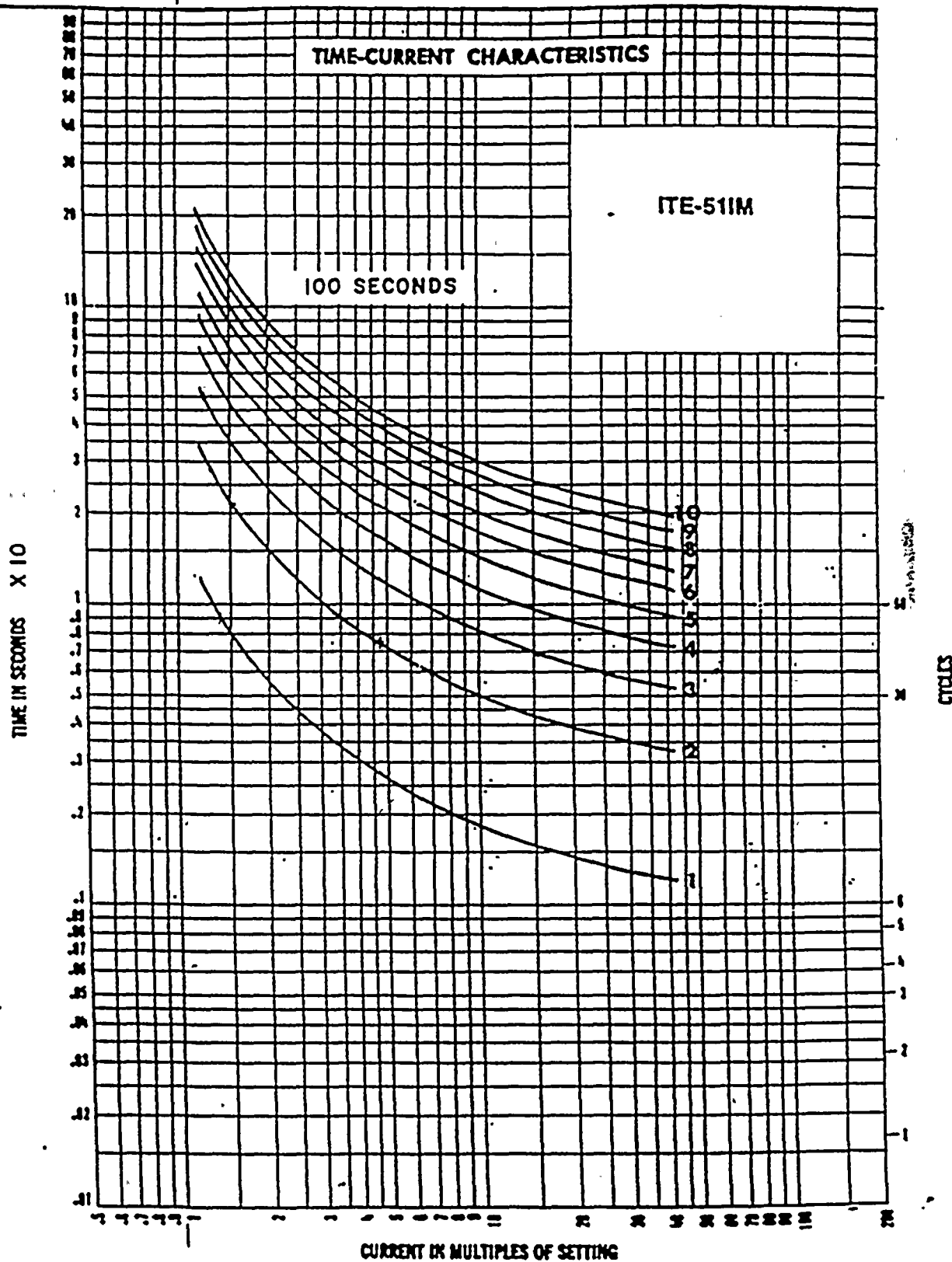
BBC
BOSTON BRIDGE COMPANY

OWN. BY: C. Fowler DATE: 11-17-78

NO. TD-9001

REV. 2





CURRENT IN MULTIPLES OF SETTING
TYPE ITE 51 IM LONG TIME INVERSE

BBC
BROWN BOVERI

Brown Boveri Electric

MAR 12, 1974

TCC-605813

Document No. 7
Calc No. 21701-523
Rev. No. 0
Sht. 1 of 1

MULTIPLE OF PICK-UP SETTING

Attachment No. 10
 Job 21701-523
 Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 1 of 1



GENERAL ELECTRIC

TIME OVERCURRENT RELAY

GES-7004 A

IAC 66 RELAY

Ratings (Amperes)	
Time Unit	Instantaneous Unit
2.5-3	2-8
4.0-8	4-16
	10-40
	20-80
	40-160

Inverse Long Time
Time-Current Curves

(Other relays with duplicate time delay characteristics)
IAC70

Settings	
Time Unit (Taps)	Inst. Unit
2.5, 2.8, 3.1, 3.5, 4.0, 4.5, 5.0	Continuously Adjustable
4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0	



OVERLOAD RELAY
TIME-CURRENT
CHARACTERISTICS

☒ Melting Alloy
RELAY DESIGN: ☐ Bimetallic
☐ Temperature-Compensated

THERMAL UNIT TYPE(S): 80.44-B50

Curves apply only for equipment indicated below:

☒ AC Magnetic Starter
☐ AC Manual Starter
☐ Separate Overload Relay
☐ _____

Size 0E1 Type SB, SC

Form _____ Series A

With (qty.) 3 Thermal Unit(s)

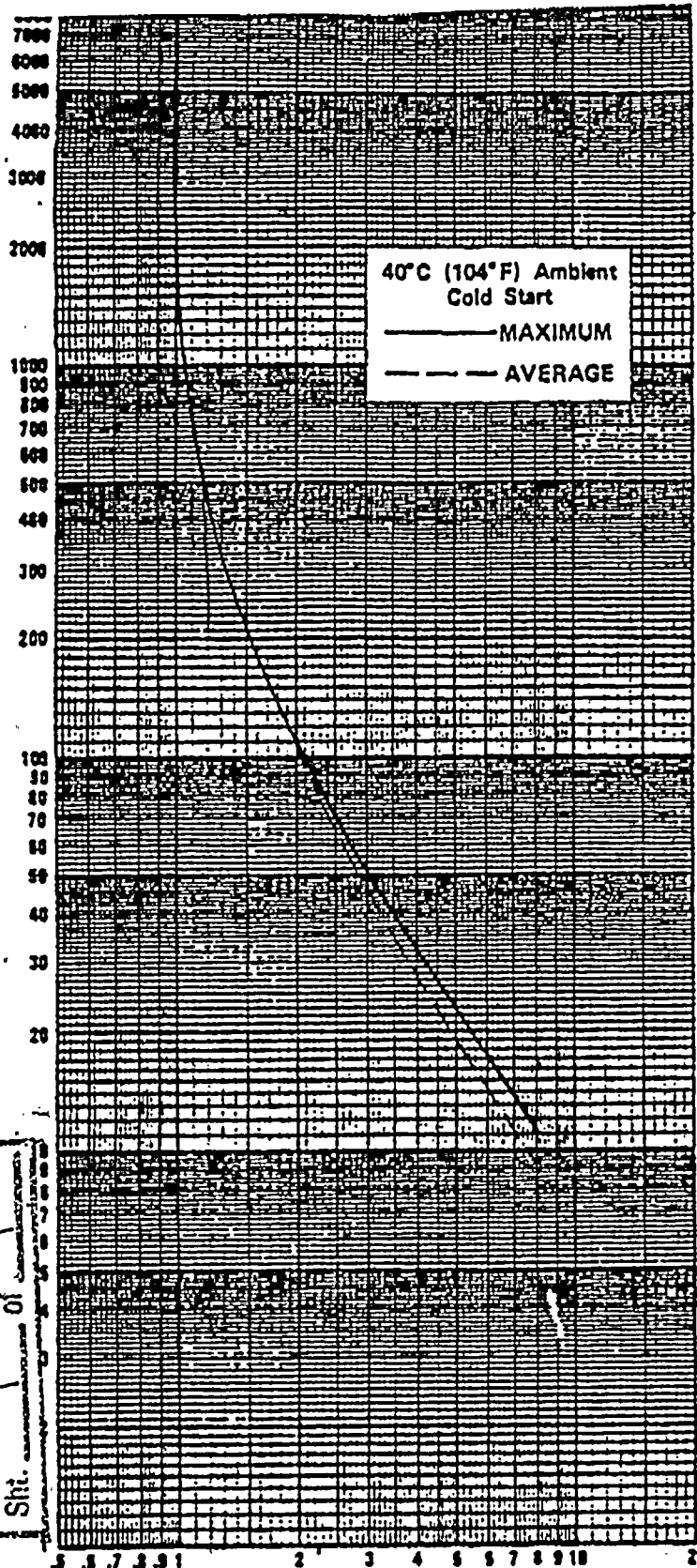
When installed in:

☒ Small Enclosure (Class 8536 Only)
☐ Motor Control Center (Class 8998, 8999, QMB, I-Line)
☐ All Other (Larger) Enclosures
☒ QMB, I-LINE

(Based on table B30068-389

rev. _____, and test R0103.06-L2)

TIME IN SECONDS



MULTIPLES OF TRIP CURRENT RATING

Trip current rating can be determined from instructions given with appropriate thermal unit selection table. Characteristics shown do not necessarily apply to equipment manufactured before date of drawing.

REV.	DATE	DRN. BY	CHKD. BY	APP. BY	DATE
	11-28-73	FMP	FMP	SC	1/31/75
SQUARE D COMPANY MILWAUKEE 12, WISCONSIN, U.S.A.					
A30068-407					

ASH TOR MEX EA-2 EG-2 UK SC ² AUS ITA

MASTER 830068-268

100

100

100

100

100



CR123 OVERLOAD HEATERS

NEMA Rated Motor Starter Heaters

MAGNETIC STARTERS — Full Voltage (Cont'd)

NEMA SIZES 00, 0 AND 1

Max. Motor Full-load Amperes				Heater Cat. No. CR123
A	B	C	D	
0.48	0.46	0.45	0.43	C054A
0.55	0.50	0.49	0.48	C060A
0.57	0.57	0.53	0.53	C066A
0.65	0.62	0.59	0.58	C071A
0.69	0.68	0.65	0.64	C078A
0.83	0.80	0.76	0.74	C087A
0.97	0.91	0.84	0.84	C097A
1.03	0.99	0.93	0.92	C109A
1.12	1.09	1.04	1.02	C118A
1.26	1.22	1.15	1.10	C131A
1.40	1.31	1.27	1.23	C148A
1.46	1.46	1.39	1.38	C163A
1.63	1.59	1.55	1.49	C184A
1.79	1.74	1.73	1.67	C196A
1.97	1.93	1.89	1.79	C220A
2.25	2.13	2.05	1.98	C239A
2.43	2.37	2.28	2.24	C268A
2.60	2.52	2.47	2.43	C301A
2.96	2.87	2.79	2.75	C326A
3.57	3.39	3.31	3.25	C356A
3.86	3.59	3.70	3.43	C379A
4.43	4.31	4.06	4.03	C419A
4.87	4.57	4.47	4.43	C466A
5.37	5.31	4.95	4.94	C526A
5.99	5.86	5.49	5.36	C592A
10.5	10.4	9.67	9.19	C104B
11.7	11.3	10.4	10.0	C113B
12.2	11.9	11.0	10.7	C125B
13.5	13.0	12.4	12.0	C137B
15.1	14.5	13.2	12.9	C151B
17.5	17.4	15.4	15.1	C163B
18.9	18.6	17.1	16.3	C180B
20.8	20.5	18.1	17.9	C198B
22.4	22.3	20.0	19.7	C214B
25.5	24.7	21.5	21.2	C228B
26.2	25.7	22.5	22.3	C250B
27.0	27.0	23.9	23.5	C273B
...	...	26.3	25.5	C303B
...	...	27.0	27.0	C330B

NEMA SIZE 1P

Max. Motor Full-load Amperes		Heater Cat. No. CR123
A	B	
14.2	14.2	C151B
17.3	17.3	C163B
18.7	18.7	C180B
20.6	20.6	C198B
22.5	22.5	C214B
24.7	24.7	C228B
25.5	25.5	C250B
26.7	26.7	C273B
27.9	27.9	C303B
32.1	32.1	C330B
36.0	36.0	C366B

PRICING INFORMATION

Catalog Number	List Price/Pkg. of 3, GO-100
CR123C (All)	\$18.00

All CR123C and 123F heaters are packaged three to a carton. Items of these heaters, being ordered for customer's stock, are to be specified in multiples of three (such as 3, 6, 9, 12, 15, etc.). Minimum order quantity is three.

NEMA SIZE 2

Max. Motor Full-load Amperes				Heater Cat. No. CR123
A	B	C	D	
5.92	5.79	—	—	C592A
6.23	6.12	5.85	5.72	C630A
6.63	6.49	6.47	6.30	C695A
7.72	7.59	7.35	7.04	C778A
8.96	8.71	8.06	7.91	C867A
9.92	9.19	9.03	8.80	C955A
10.4	10.1	9.81	9.27	C104B
11.7	11.2	10.5	9.99	C113B
12.1	11.9	11.6	11.1	C125B
13.5	12.6	12.5	12.1	C137B
14.7	14.5	13.6	13.1	C151B
18.3	17.7	16.7	15.5	C163B
20.1	19.1	17.9	16.8	C180B
22.3	21.4	18.7	18.0	C198B
25.0	22.9	20.4	19.7	C214B
27.7	24.7	22.7	21.6	C228B
29.3	25.9	24.7	23.9	C250B
30.7	27.1	26.3	25.5	C273B
32.7	30.2	29.5	28.2	C303B
35.6	34.8	32.5	31.6	C330B
39.4	38.7	36.7	34.7	C366B
45.0	45.0	41.9	37.8	C400B
—	—	43.2	40.6	C440B
—	—	45.0	45.0	C460B

NEMA SIZE 3

Max. Motor Full-load Amperes		Heater Cat. No. CR123
A	B	
19.3	18.4	F233B
22.1	21.1	F243B
23.4	22.1	F270B
27.0	26.1	F300B
29.1	28.0	F327B
31.8	31.3	F357B
33.9	33.3	F395B
37.6	34.3	F430B
41.9	40.9	F487B
47.7	44.7	F567B
52.1	51.1	F614B
55.8	52.0	F658B
59.7	55.4	F719B
68.1	63.3	F772B
71.5	66.1	F848B
78.2	73.5	F914B
87.5	82.2	F104C
90.0	90.0	F114C

NEMA SIZE 4

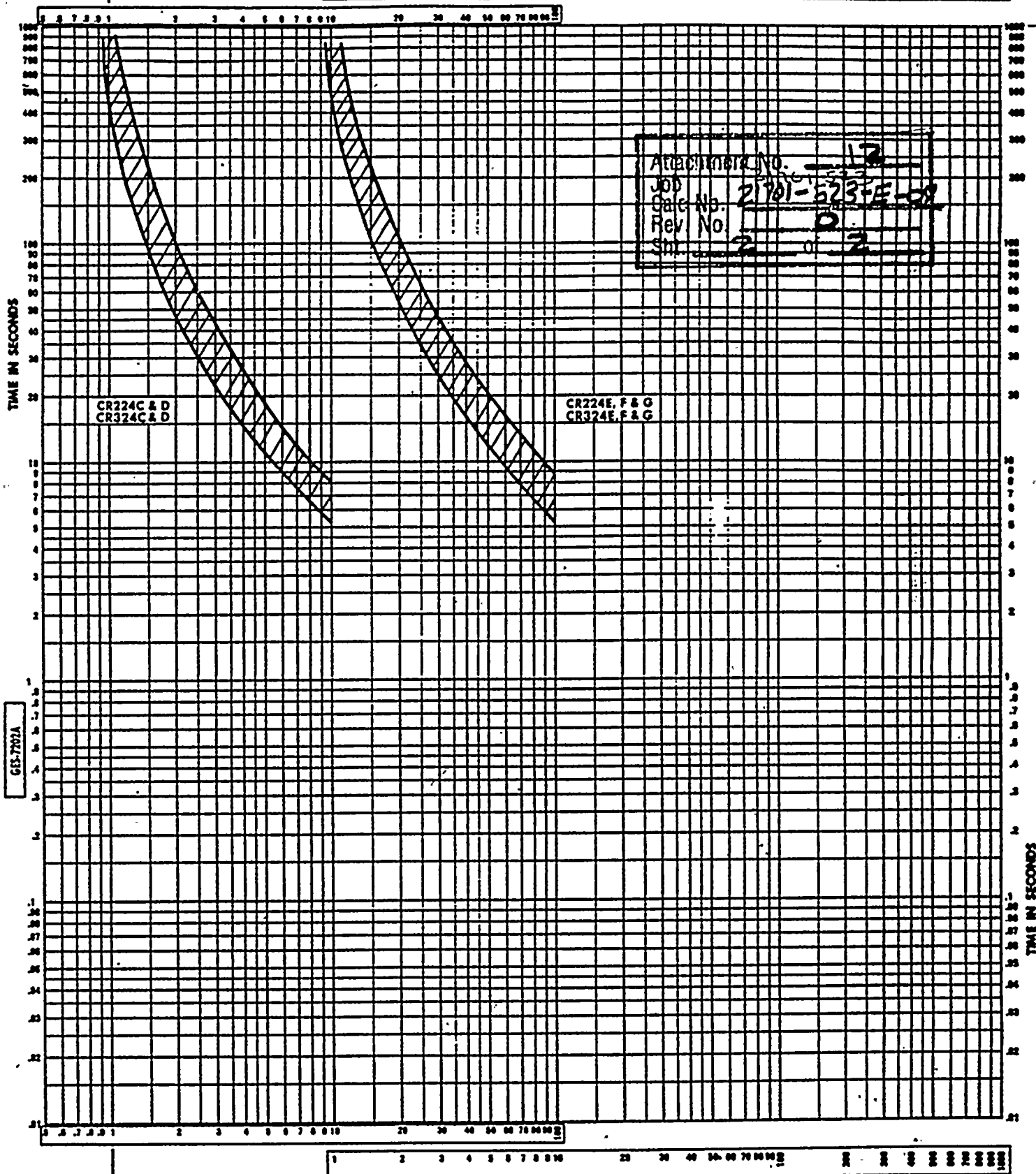
Max. Motor Full-load Amperes				Heater Cat. No. CR123
A	B	C	D	
32.2	32.0	32.0	—	F357B
34.0	34.2	34.0	—	F395B
36.8	36.7	36.7	—	F430B
44.6	43.9	43.9	—	F487B
48.4	46.6	46.6	—	F567B
53.9	52.6	52.6	—	F614B
57.4	55.6	55.6	—	F658B
60.0	58.7	58.7	—	F719B
69.5	67.1	67.1	—	F772B
71.7	70.6	70.6	—	F848B
79.9	76.3	76.3	—	F914B
92.3	88.7	88.7	—	F104C
97.0	93.4	93.4	—	F114C
108.0	102.0	105.0	—	F118C
118.0	110.0	114.0	—	F133C
131.0	122.0	128.0	—	F149C
135.0	131.0	131.0	—	F161C
...	135.0	135.0	—	F174C

NEMA SIZE 5

Max. Motor Full-load Amperes		Heater Cat. No. CR123
A	B	
118	115	C592A
128	125	C630A
138	135	C695A
155	151	C778A
168	164	C867A
184	179	C955A
200	195	C104B
221	215	C113B
237	231	C125B
262	255	C137B
270	270	C151B

Attachment No. 12
 Job 21701-523
 Calc. No. 21701-523-E-02
 Rev. No. 0
 Sht. 1 of 2

MULTIPLES OF CURRENT RATING (TRIP CURRENT)



MULTIPLES OF CURRENT RATING (TRIP CURRENT)

GENERAL ELECTRIC

THERMAL OVERLOAD RELAYS TYPE CR224, CR324

GES-7202A

Current Ratings—
0.41 to 270 amperes

Frequency Rating
25 to 60 Hertz

CR224C, D, E, F and G
CR324C, D, E, F and G
Time-current Curves

(Curves show relay in 40°C ambient)

Adjustments—

Current setting: 90 to 110%
of heater current rating. Curves
shown at 100%.

QUALIFIED AIR CORPORATION
P.O. BOX 44099 CINCINNATI, OHIO 45244

INSTALLATION,
OPERATION, &
MAINTENANCE

DOC. NO. 89M402
REV. 2 DATE 12/12/90
PAGE 76 OF 76

7.0 MANUFACTURER'S DRAWINGS

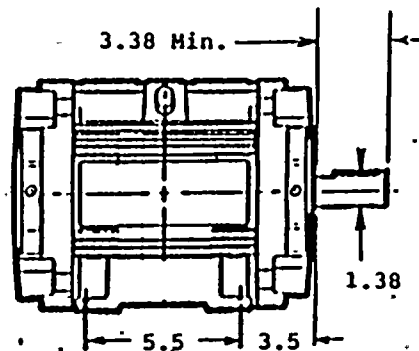
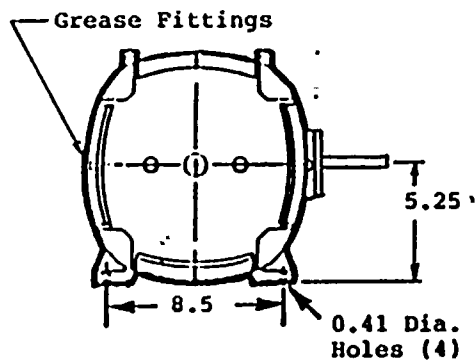
DRAWING DESCRIPTION

DRAWING NUMBER

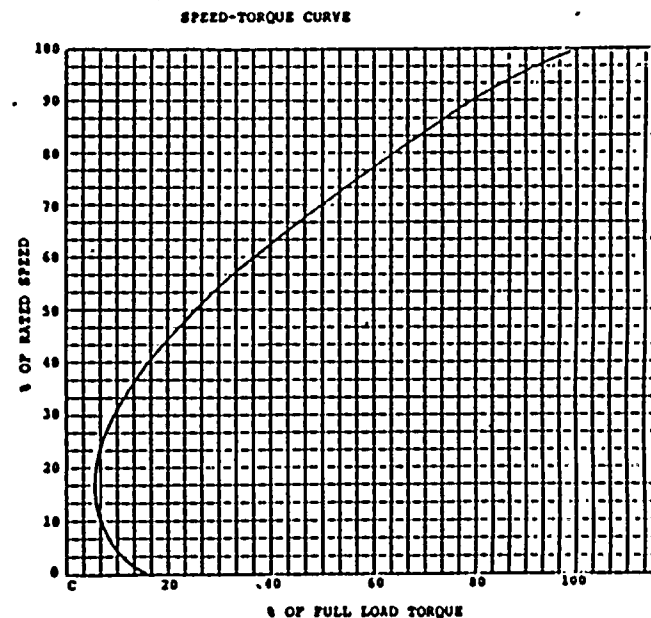
OUTLINE VIEWS: CONDENSING UNIT.....	89C402-001
OUTLINE VIEWS: AIR HANDLING UNIT.....	89C402-002
OUTLINE VIEWS: THERMOSTAT.....	89B402-007
REFRIGERANT PIPING SCHEMATIC.....	89C402-003
REFRIGERANT PIPING INTERFACE DETAIL.....	89B402-006
ELEMENTARY DIAGRAM.....	89C402-004
ELECTRICAL WIRING INTERFACE DIAGRAM.....	89B402-256
CONTROL PANEL DETAIL.....	89C402-008
FINAL ASSEMBLY: CONDENSING UNIT.....	89C402-167
FINAL ASSEMBLY: AIR HANDLING UNIT.....	89C402-168
FINAL ASSEMBLY: THERMOSTAT.....	89C402-115
FINAL ASSEMBLY / WIRING DIAGRAM: CONTROL ENCLOSURE.....	89C402-114
DETAIL: AHU FAN MOTOR.....	89C402-037
DETAIL: CONDENSER FAN MOTOR.....	89C402-036
DETAIL: AIR FILTER.....	89A402-124
DETAIL: SOLENOID VALVE COIL.....	89A402-192
DETAIL: CRANKCASE HEATER.....	89A402-255

Attachment No.	13
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	1 of 4





FOOT MOUNTED



HP: 7-1/2

RPM: 1800 (Nominal)

POWER: 460V/3PH/60HZ

Attachment No. 13
 Job No. 21701-523-E-02
 Calc No. 21701-523-E-02
 Rev. No. 2 of 4
 Sht. 2 of 4

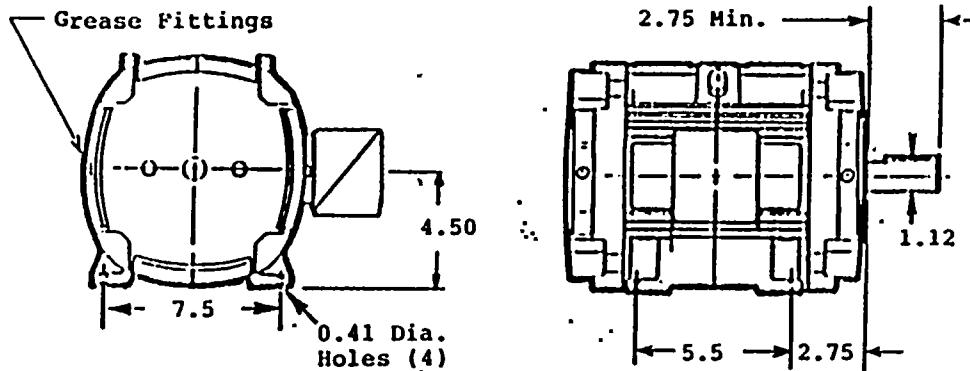
MODIFIED FROM GE PART NO. 5KS213BD05

QUALIFIED AIR CORPORATION
 P.O. BOX 44099 CINCINNATI, OHIO 45244

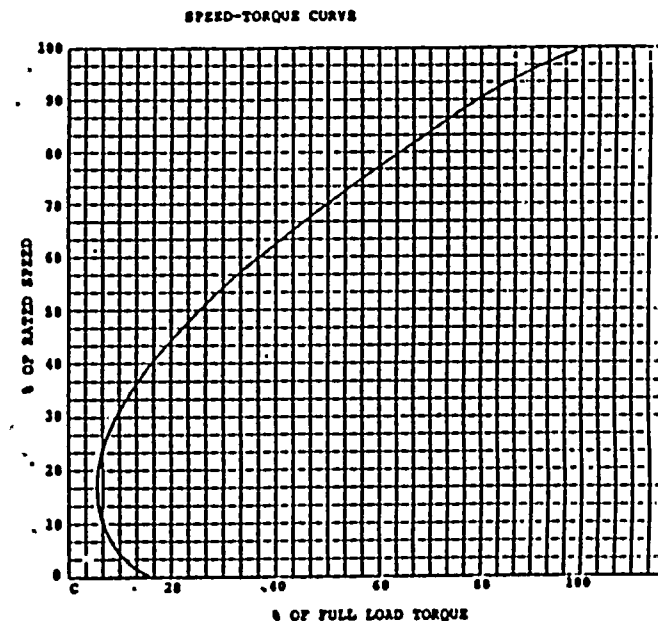
7-1/2 HP MOTOR AND DATA

CUSTOMER FP&L Turkey Point Plant	DRAWN BY A. BELLING	DATE 1-23-91	DRAWING NO. 89A402-037	
	CHECKED BY M. J.	DATE 1-23-91	REVISION 0 1-23-91	
CONTRACT NO. B-89536-80061	QA Leslie Stenke	DATE 1-23-91	SCALE None	SHEET 1 of 1
SPECIFICATION NO. FLO89-069.2002	QAC PROJECT NO 89J402			





FOOT MOUNTED



Attachment No. 13
 Job Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 3 of 4

HP: 5

RPM: 1800 (Nominal)

POWER: 460V/3PH/60HZ

MODIFIED FROM GE PART NO. 5KS184SE208.

QUALIFIED AIR CORPORATION
 P.O. BOX 44099 CINCINNATI, OHIO 45244

5 HP MOTOR AND DATA

CUSTOMER FP&L Turkey Point Plant	DRAWN BY A. BERLING	DATE 1-23-91	DRAWING NO. 89A402-036
	CHECKED BY [Signature]	DATE 1-23-91	
CONTRACT NO. B-89536-80061	QA Leslie Blanks	DATE 1-23-91	REVISION 0 1-23-91
SPECIFICATION NO. FLO89-069.2002	QAC PROJECT NO 89J402		SCALE None
			SHEET 1 of 1

PERFORMANCE DATA

PAUL SNIZEK

3-Phase Production Designs: 182-286 Frames, 230/460V, 1.15 SF

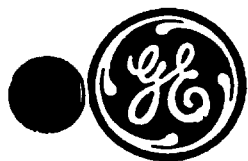
Horse- power	Full- load RPM	Amperes		NEMA Locked Rotor (max.)	NEMA Code Letter	Torque			Efficiency				Power Factor			
		Full- load @ 460v	Full- load @ 200v			Full- load Lb.-ft.	ST %FL (avg.)	BD %FL (avg.)	Full Load		3/4- load	1/2- load	Full load	3/4- load	1/2- load	Max. KVAR
									Guar. Min.							
Type KS, TEFC Extra Severe Duty																
1	885	2.1	4.0	15.0	N	6.1	175	240	75.5	74.0	75.9	71.4	60.5	53.7	41.9	1.2
1.5	1170	2.3	4.8	20.0	M	6.7	248	347	87.5	86.5	88.4	88.4	72.0	66.2	53.5	1.0
	865	3.0	5.9	20.0	M	9.1	193	253	80.0	78.5	80.8	77.4	60.0	53.1	41.1	1.7
2	1165	2.9	6.3	25.0	L	9.0	242	336	87.5	86.5	88.6	87.2	74.0	68.4	55.8	1.3
	875	3.6	7.5	25.0	L	12.0	175	249	82.5	81.5	83.4	80.4	64.0	57.4	45.0	2.0
3	3520	3.7	8.2	32.0	K	4.5	218	335	88.5	87.5	90.4	89.2	87.0	86.6	78.8	0.9
	1765	4.0	8.7	32.0	K	8.9	267	382	89.5	88.5	90.3	88.8	80.0	75.8	64.6	1.5
	1175	4.3	9.1	32.0	K	13.4	243	333	89.5	88.5	91.0	89.3	74.5	69.2	57.1	1.8
	875	5.2	10.9	32.0	K	18.0	188	251	84.0	82.5	85.4	83.0	64.5	58.3	45.8	2.8
5	3515	6.0	13.9	46.0	J	7.5	210	330	89.5	88.5	90.2	88.9	88.0	87.9	81.2	1.4
	1755	6.3	14.3	46.0	J	15.0	247	335	90.2	89.5	91.3	90.7	83.0	70.1	70.7	2.0
	1170	7.0	15.1	46.0	J	22.4	261	352	89.5	88.5	91.6	90.5	75.0	70.8	58.3	2.9
	885	9.9	19.6	46.0	J	29.7	223	234	85.5	84.0	86.5	83.3	55.5	49.1	38.0	5.9
7.5	3530	8.7	20.2	63.5	H	11.2	152	273	91.7	91.0	93.1	92.4	88.0	89.1	83.9	1.7
	1765	9.3	21.9	63.5	H	22.3	212	252	91.7	91.0	92.4	91.6	82.5	81.0	73.4	2.5
	1180	10.7	23.5	63.5	H	33.4	202	244	91.7	91.0	92.3	91.0	72.0	67.6	56.2	4.4
	885	14.2	28.5	63.5	H	44.5	216	225	86.5	85.5	87.8	85.1	57.5	51.8	40.3	7.9
10	3525	11.6	28.8	81.0	H	14.9	161	284	91.7	91.0	93.3	92.9	88.5	89.1	83.7	2.3
	1760	12.7	29.4	81.0	H	29.8	216	252	91.7	91.0	92.6	92.1	81.0	79.6	71.7	3.6
	1175	14.3	31.4	81.0	H	44.6	207	245	91.7	91.0	92.4	91.4	71.5	67.3	56.0	5.9
15	3545	17.3	39.6	116.0	G	22.2	169	298	91.7	91.0	92.8	91.6	88.5	88.8	83.2	3.6
	1770	18.7	43.6	116.0	G	44.5	183	230	92.4	91.7	93.4	92.7	81.5	80.2	72.3	5.3
	1180	20.1	45.8	116.0	G	66.9	169	195	91.7	91.0	92.1	91.3	76.5	74.8	65.7	6.6
20	3540	22.5	52.1	145.0	G	29.7	181	292	92.4	91.7	93.8	92.9	90.0	91.2	87.4	3.7
	1765	24.4	58.5	145.0	G	59.5	178	211	93.0	92.4	93.9	93.6	82.5	82.1	75.7	6.0
	1175	26.7	63.1	145.0	G	89.5	156	186	92.4	91.7	93.4	93.3	76.0	75.2	67.4	8.2
25	3560	27.9	64.8	217.5	G	36.9	197	279	92.4	91.7	93.2	92.1	91.0	91.8	88.2	4.6
	1770	30.0	70.7	182.5	G	74.2	162	205	93.6	93.0	94.4	94.1	83.5	83.6	78.0	6.9
30	3555	33.4	77.8	182.5	G	44.3	194	274	92.4	91.7	93.4	92.6	91.0	91.8	88.0	5.6
	1765	36.0	85.6	217.5	G	89.1	165	206	93.6	93.0	94.4	94.3	83.5	83.6	78.1	8.2

NOTE: Starting and breakdown torques are average expected values.

6/89, rev. 3/90
1/5.01

Attachment No.	13
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	4 of 4





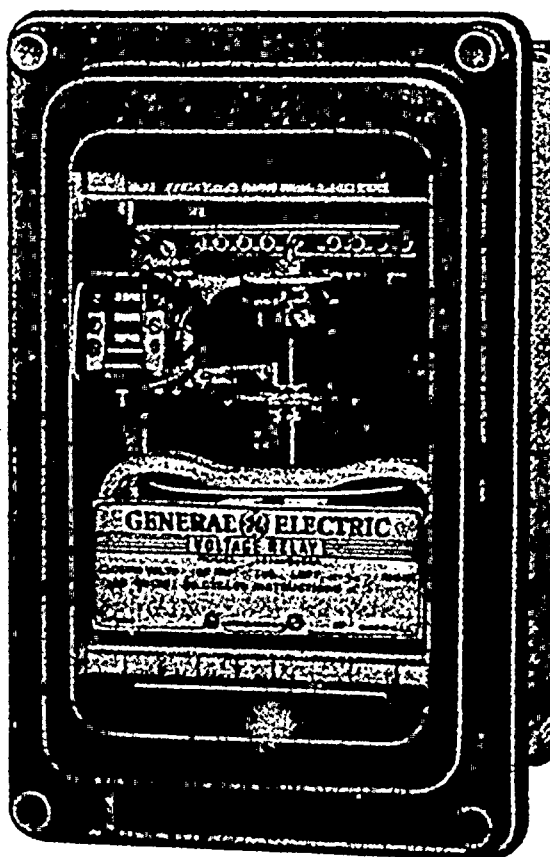
INSTRUCTIONS

UNDervOLTAGE RELAYS

TYPES:

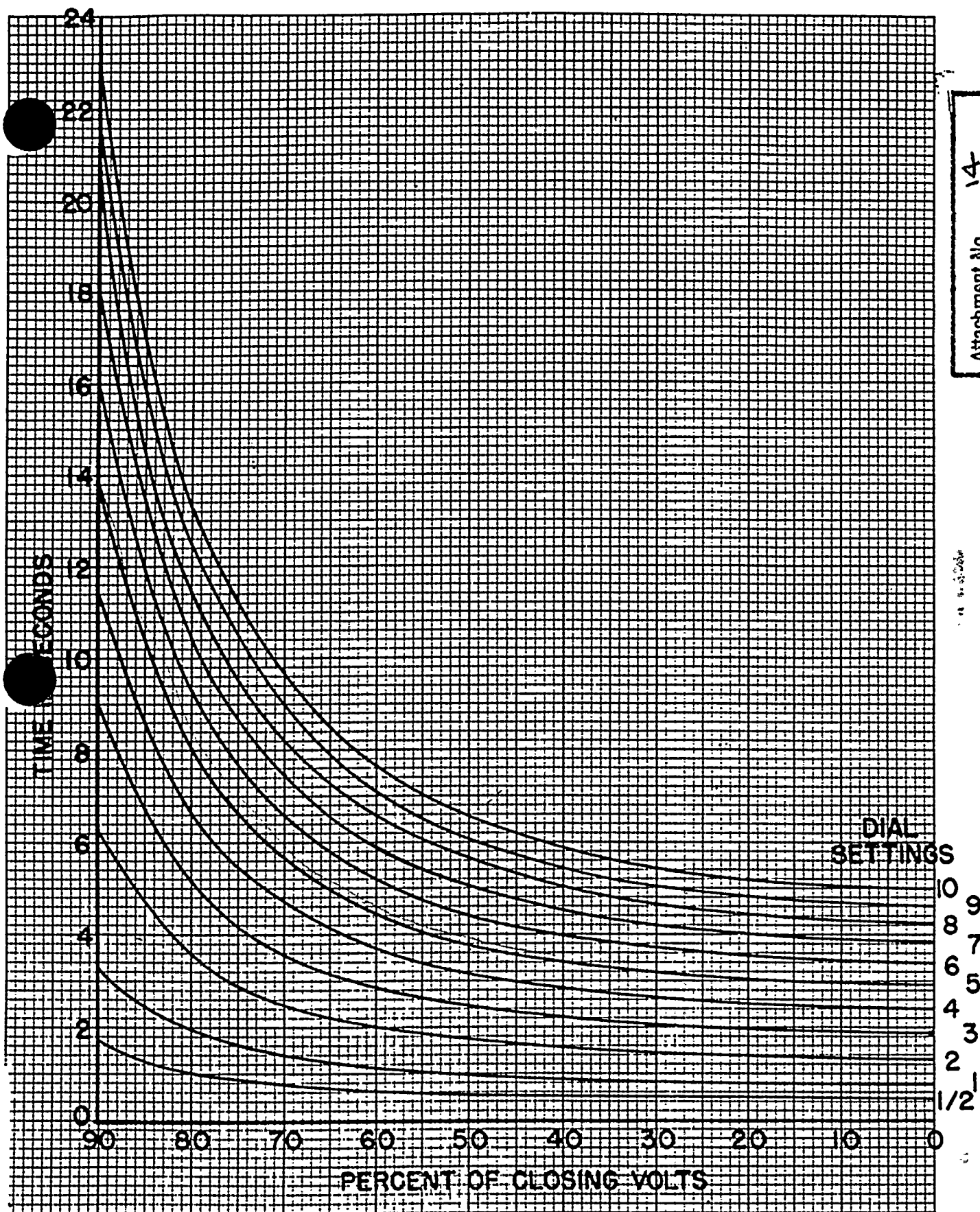
IAV54E IAV55C
 IAV54F IAV55F
 IAV54H IAV55H
 IAV55J

Attachment No.	14
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	1 of 2



GE Meter and Control
 205 Great Valley Parkway
 Malvern, PA 19355-0715





Attachment No.	14
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	2 of 2

Figure 2 (0362A0648-2) Time-Voltage Curves for Type IAV54E and IAV55C Relays

* Revised since last issue

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50





Attachment No.	15
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	1 of 2

March 25, 1992

Mr. T.C. Higgins
Florida Power and Light Co.
P.O. Box 3088
Florida City, FL 33034

Dear Mr. Higgins:

Enclosed is the data on the 3DS3-1000 series compressor. This compressor has the same motor as unloaded version 3DP3-1000.

Sincerely,

Steve Garstang
Manager, Adv.
Application Engineering

SG:dw

cc: fax #407-694-0549



*** COPELAND ELECTRIC CORP ***

HUNTSVILLE, TN 38343

DATE 2/13/86 SIGNED Billy Smith APPROVED *JB* HCE 3675

FRAME 90 STACK 5.25 HF10 POLE 4 PH 3 HZ 60 VOLTS 460

STATOR NO. 131931-03 ROTOR NO. 131934-01 SPEC. 31874

LR AMPS 105 ST TORQ 112 MAX TORQ 114 AT 1502 RPM

LR RT/RISE DEG F/SEC: STAT 7 ROT 11 L-L RESQ25C 1.137 $\pm$ 7%

REFERENCE LAB TEST NO. 4306

DESCRIPTION- 131931-03 XD-543 ROTOR

PERFORMANCE AT 25C AND 460 VOLTS

TORQUE	RPM	AMPS	EFF	P.F.	KWIN	KWOUT
100	1656	42	78.9	89.2	29.83	23.524
95	1667	39.9	80	88.5	28.129	22.507
90	1678	37.7	81.1	88	26.457	21.464
85	1689	35.6	82.2	87.6	24.812	20.398
80	1699	33.3	83.3	87.3	23.194	19.309
75	1708	31.1	84.3	87.2	21.602	18.201
70	1717	28.9	85.2	87.1	20.035	17.074
65	1725	26.7	86.1	87.1	18.492	15.93
60	1733	24.5	87	87	16.974	14.77
55	1740	22.4	87.8	86.9	15.478	13.596
50	1747	20.3	88.6	86.5	14.006	12.409
45	1753	18.3	89.3	85.9	12.535	11.209
40	1759	16.5	89.9	84.8	11.126	9.999
35	1765	14.7	90.3	82.9	9.717 - 5/40	8.778
30	1771	13.1	90.6	79.8	8.328	7.547
25	1776	11.6	90.7	75.1	6.958	6.308
20	1781	10.3	90.3	68.2	5.607	5.061
15	1786	9.2	89.1	58.3	4.273	3.806
10	1790	8.3	86	44.9	2.957	2.544
5	1795	7.5	76.9	27.6	1.658	1.275
0	1800	7.1	0	6.6	.374	0

THESE DATA REPRESENT PERFORMANCE OF ONE MOTOR AND MUST NOT
BE CONSIDERED AS REPRESENTING AVERAGE OR GUARANTEED VALUES
FOR PRODUCTION MOTORS.

Attachment No.	15
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	2 of 2

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

REQUEST FOR ENGINEERING ASSISTANCE

REA No. 91-289
SYS No. 006
US No. _____

1. Project Title: 480 VOLTS LOAD CENTER BREAKER OVERCURRENT TRIP SETTING

PTN Unit No. ☐ 3 ☐ 4 ☒ Common WA No. _____ PWO No. _____

2. Job Category Code: 6 Commitment Source: (Document No.) _____

Licensing Category Code: B 4 Tracking No. FM-91-10-049 (CTRAC, etc.)

3. Expedited work ☒ Yes ☐ No Outage Work ☐ Yes ☒ No Desired Completion Date: 12-31-91

4. Problem Description and Proposed Solution: (Attach documentation for background and necessity.)
- CURRENTLY THERE ARE NO CONTROLLED ENGINEERING DOCUMENTS SPECIFYING THE OVER CURRENT TRIP SETTINGS FOR SAFETY AND ON SAFETY RELATED 480 VOLTS LOAD CENTER BREAKERS. ENCLOSED ATTACHMENT 1 SHOWS DETAILS FOR SOME OF THE BREAKERS BUT NOT FOR ALL BREAKERS. ATTACHMENT 2 SHOWS THE RESULTS OF TESTS DONE BY ABB DURING DUAL UNIT OUTAGE. ENGINEERING IS REQUESTED TO EVALUATE THE DETAILS IN ATTACHMENT 1 AND PROVIDE CORRECT TRIP SETTINGS FOR ALL LOAD CENTER BKRS. ALSO PLEASE EVALUATE THE TEST RESULTS TEST IN ATTACHMENT 2 AND CONFIRM ACCEPTABILITY OF TEST RESULTS. NRC IS REQUESTED TO BE PREPARED FOR EDSFI AUDIT BY NRC
Attachments/sketches attached ☒ Yes ☐ No Dwg No. _____ P.O. No. _____

Department: ELECTRICAL MAINTENANCE

Submitted by: [Signature] R.V. RAJAN 10-24-91
Sponsor's Signature Print Date

Approved by: [Signature] J.B. Sharpe 10-24-91
Sponsor's Supervisor Signature Print Date

7. Work Force Can Support Implementation ☒ Yes ☐ No (If No, provide reason) N/A
DWG & DOCUMENT EVALUATION / CHANGES ONLY

M.O. Pearce M.O. PEARCE 10/25/91
Maintenance Dept Head Signature Print Date

8. Priority Code 3 Approved Modification List ☐ Yes ☒ N/A
DOC ONLY
Approved by: [Signature] M.L. LACAL 10/25/91
Design Control Supervisor Signature Print Date

9. Approval Potential Operability Concerns ☐ Yes ☒ No (Provide basis.)
This REA is a document only engineering analysis. The currently installed Load Center Breakers do not have any known deficiencies that would declare them inoperable, therefore no nuclear safety operability concerns exist.

[Signature] Don Gullen 10/29/91
System Engineer Signature Print Date
[Signature] M. Dowling 10/29/91
Operations Support Supervisor Signature Print Date

10. Approved by: [Signature] A. ZELONKA 10/30/91
Tech Dept. Supervisor Signature Print Date

Attn No. 16
Job No. 71701-523
Calc No. 21701-523-E-02
Rev. No. 0
Shr. 1 of 6

MAINT

TECH DEPT



REQUEST FOR ENGINEERING ASSISTANCE
SUB. LOAD CENTER BREAKER C/L SETTING

REA: 91-289

Attachment No.	16
Job	21701-523
Calc No.	21701-523-E-02
Rev. No.	0
Sht.	2 of 6

ATTACHMENT 2

TEST RESULTS OF LOAD CENTER BREAKERS

BREAKERS TESTED BY ABB AT FACTORY
DURING DUAL UNIT OUTAGE.

UNIT 3

30102
30105
30107
30108
30109
30203
30204
30210
30302
30307
30308, 30312, 30401
30403
30404
30408
30410

UNIT

40102
40105
40107
40108
40109
40204
40203
40408
40302
40307
40308
40312
40401
40403
40408
~~40404~~



BROWN BOVERI

DWA 845514

CIRCUIT BREAKER TEST SHEET

30105
CHP.CUSTOMER Florida Power Light-Turkey PointJOB NO. 34-02417-CBREAKER TYPE K600SERIAL NO. 42503-AB23-5-8CTRIP UNIT TYPE UD 61/20TRIP COIL RATING 225A

TRIP UNIT SETTINGS (AS FOUND)

LONG DELAY 428/225SHORT DELAY NAINSTANTANEOUS 2250GROUND NA

PRIMARY INJECTION TEST

			TEST AMPS	TIME BAND	Reduced Rating		
					A	B	C
LONG DELAY @ 425	% 300		1284A	26-52	40	40	
SHORT DELAY @ NA	%						
INSTANTANEOUS	2250		2250A	0-0.25	.05	.05	.05
GROUND							

SECONDARY CONTROL TESTS

DEVICE	RATING	PART NO.	OPERATION CHECK
CHARGING MOTOR	125VDC		X
CLOSE COIL	125VDC		X
TRIP COIL	125VDC		X
UNDERVOLTAGE COIL	NA		
CONTROL RELAY	125VDC		X

MICROHMS

CONTACT RESISTANCE

A. 110B. 100C. 210

MEGGAR. TEST @1000 VOLTS	BREAKER OPEN			BREAKER CLOSED					
	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
MEG OHMS	2000+	2000+	2000+	2000+	2000+	2000+	2000+	2000+	2000+
HI POT TEST @ KV	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
1 MIN.	NA								

CONTACT OPENING TIME NACONTACT CLOSING TIME NA

REMARKS: Hi pot leakage current recorded in microamps

TESTED BY R. SimonelliDATE 05/28/91

30105

Attachment No. 16
 Job 21701-523
 Calc No. 21701-523-E-02
 Rev. No. 0
 Sht. 3 of 6

1. The first part of the document is a list of names and addresses of the members of the committee.

CIRCUIT BREAKER TEST SHEET

CUSTOMER Florida Power Light - Turkey Point JOB NO. 34-02417-C
 BREAKER TYPE K600 SERIAL NO. 42503-AB26-3-6D
 TRIP UNIT TYPE OD 61/20 TRIP COIL RATING 300A
 TRIP UNIT SETTINGS (AS FOUND)
 LONG DELAY 660 / 270 Int. SHORT DELAY NA
 INSTANTANEOUS 3750 / Int. GROUND NA

PRIMARY INJECTION TEST

	TEST AMPS	TIME BAND	A	B	C
LONG DELAY @ 660 % 300	1380A	27-52 sec	24.93	47.42	28.07
SHORT DELAY @ NA %					
INSTANTANEOUS 3750 x 150%	5625	0-0.25	07	05	05
GROUND NA					

SECONDARY CONTROL TESTS

DEVICE	RATING	PART NO.	OPERATION CHECK
CHARGING MOTOR	125VDC		X
CLOSE COIL	125VDC		X
TRIP COIL	125VDC		X
UNDERVOLTAGE COIL	NA		
CONTROL RELAY	125VDC		

MICROHMS
 CONTACT RESISTANCE A. 29.7 B. 30.5 C. 30.4

MEGGAR TEST @1000 VOLTS	BREAKER OPEN			BREAKER CLOSED					
	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
MEG OHMS	100000	100000	100000	100000	100000	100000	100000	100000	100000
HI POT TEST @ KV	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
1 MIN	NA								

CONTACT OPENING TIME NA CONTACT CLOSING TIME NA

REMARKS: HI pot leakage current recorded in microamps

TESTED BY Shannon Hightower

DATE 05/16/01

Attachment No.	<u>16</u>
Job	<u>21701-513</u>
Calc No.	<u>21701-523-E-02</u>
Rev. No.	<u>0</u>
Sht.	<u>4</u> of <u>6</u>

SEA BROWN BOVERI

CIRCUIT BREAKER TEST SHEET

30203
CHP

CUSTOMER RPL- Turkey Point

JOB NO. 34-02417-C

BREAKER TYPE K600

SERIAL NO. 42503-AB23-1-8C

TRIP UNIT TYPE OD 61/20

TRIP COIL RATING 225 Amps

TRIP UNIT SETTINGS (AS FOUND)

LONG DELAY 349/225

SHORT DELAY NA

INSTANTANEOUS 2250

GROUND NA

PRIMARY INJECTION TEST

	TEST AMPS	TIME BAND	A	B	C
LONG DELAY @ 349 % 300	1047	65-75	72.73	74.24	75.21
SHORT DELAY @ NA %					
INSTANTANEOUS 2250 @ 100%	2250	0.25	.07	.08	.06
GROUND NA					

SECONDARY CONTROL TESTS

DEVICE	RATING	PART NO.	OPERATION CHECK
CHARGING MOTOR	125VDC		
CLOSE COIL	125VDC		X
TRIP COIL	125VDC		X
UNDERVOLTAGE COIL	NA		
CONTROL RELAY	125VDC		X

MICROHMS

CONTACT RESISTANCE A. 117 B. 118 C. 117

MEGGAR TEST @1000 VOLTS	BREAKER OPEN			BREAKER CLOSED					
	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
MEG OHMS	100000	100000	100000	4000	3000	4000	100000	3000	100000
HI POT TEST @ 7KV	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
	1 MIN	NA							

CONTACT OPENING TIME NA

REMARKS: HI pot leakage current recorded in

TESTED BY Shannon Highrower

Attachment No. 16
Job 21701-523
Calc No. 21701-523-E-02
Rev. No. 0
Sht. 5 of 6

30203



2



DWA 690772

30403
CSP

CIRCUIT BREAKER TEST SHEET

CUSTOMER FPI./Turkey Point JOB NO. 34-02417-C
 BREAKER TYPE K600 SERIAL NO. 42503-AB26-1-8C
 TRIP UNIT TYPE OD61/OD20 TRIP COIL RATING 300 Amps
 TRIP UNIT SETTINGS (AS FOUND)
 LONG DELAY 750 Int ^{2.5 x 300} _{INTERLOCK} SHORT DELAY NA
 INSTANTANEOUS 3000 GROUND NA

PRIMARY INJECTION TEST

	TEST AMPS	TIME BAND	A	B	C
LONG DELAY @ 300 % 750	2250	27-47Sec	38.34Sec	41.85 Sec	40.20 Sec
SHORT DELAY @ NA %					
INSTANTANEOUS 3000	3000	0 - 0.25 Sec	2970A	3060A	2980A
GROUND NA					

SECONDARY CONTROL TESTS

DEVICE	RATING	PART NO.	OPERATION CHECK
CHARGING MOTOR	125 VDC		X
CLOSE COIL	125 VDC		X
TRIP COIL	125 VDC		X
UNDERVOLTAGE COIL	NA		NA
CONTROL RELAY	125 VDC		X

MICROHMS

CONTACT RESISTANCE A. 74 B. 68 C. 84

MEGGAR TEST @1000 VOLTS	BREAKER OPEN			BREAKER CLOSED					
	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
MEG OHMS	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
HI POT TEST @ KV	A	B	C	A-GRN	B-GRN	C-GRN	AB	BC	CA
	1 MIN	NA	NA	NA	NA	NA	NA	NA	NA

CONTACT OPENING TIME NA CONTACT CLOSING TIME NA

REMARKS: Hi pot leakage current recorded in microamps

Attachment No.	<u>16</u>
Job	<u>21701-523</u>
Calc No.	<u>21701-523-E-02</u>
Rev. No.	<u>0</u>
Sht.	<u>6</u> of <u>6</u>

