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SUBJECT: Provides reponses to action items identified during 881020-21 electrical issues meeting. S66 RA

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CP&L
Carolina Power & Light Company

SERIAL: NLS-88-280

DEC 0 5 1988

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
RESPONSE TO ACTION ITEMS FROM OCTOBER 20-21, 1988
ELECTRICAL ISSUES MEETING

Gentlemen:

This letter provides responses to certain action items, identified in Dr. R. Lo's October 31, 1988 meeting minutes, which evolved during the October 20-21, 1988 electrical issues meeting.

Item 1: Modification of the 480 Volt DB-50 Circuit Breakers - "CP&L is completing an engineering study on the modification, and the most likely method for upgrade would either be the installation of current limiting fuses or load banks. CP&L stated that, depending on the decision on the modification method, completion is expected during the 13th refueling outage scheduled for 1990. In any case, CP&L is committed to make good faith efforts to expedite the completion of the modification in 1990 and in no case, later than 1991. CP&L will inform the staff of its decisions which is expected within 30 days."

Response

At the meeting in Raleigh, NC, CP&L stated to the NRC that depending on the decision on the modification method (i.e., current limiters vs. load bank), it could be feasible to complete the project in the 13th refueling outage scheduled for 1990. CP&L has since decided to proceed with the current limiter option. This option consists of modifying the bus work on the load side of the breaker (Westinghouse DB breakers) to allow for installation of a current limiter. This installation will make the gear similar to Westinghouse gear designed specifically for applications on systems whose available fault currents exceed the interrupting rating of the breakers alone (Westinghouse DSL breakers), with the following exceptions:

- For DSL breakers, the current limiters are integrally mounted on the breaker elements or in compartments along side the breaker compartment. Due to space limitations in the existing switchgear, it will be necessary to modify the DB switchgear bus work to allow for installation of the limiter.

A001

- For DSL breakers, the current limiter is on the line side of the breaker. Due to space limitations in the existing switchgear, the limiter will be installed on the load side of the DB breaker.

CP&L will make good faith efforts to expedite the completion of the modification in 1990 and in no case later than 1991 as previously committed.

Item 2: Adequacy of Station Battery Duty Cycle - "CP&L will provide the staff with revised calculations using the methodology of IEEE-485 to demonstrate the adequacy of the B-battery for one-hour duty cycle."

Response

The following calculations are attached:

Calc No.	Subject	Rev.	Date
7988-E1	125V DC Battery Load Profile B	4	3-21-88
7988-E2	Calc. for DC Short Circuit	1	7-6-87
7988-E3	125V DC Battery Load Profile A	3	5-16-88
7988-E4	DC Voltage Profile	3	6-7-88
7988-E5	Minimum Inverter Voltage Verification	3	6-7-88

Item 3: Current Interrupting Capability of 480 Volt MCCBs - "During the outage, CP&L will complete the upgrade of the current 14,000 amps interrupting capability of the MCCBs for the motor control centers 5, 6, 9 and 10 to 22,000 amps. CP&L will forward the staff a letter describing the modification within 30 days."

Response

Modification M-939 replaces the existing Westinghouse type FA, FB and EHB Series breakers on MCC 5 and 6 which are not used in a breaker-starter combination. These breakers, which have a UL-489 AIC rating of 14,000 amps, will be replaced with Westinghouse FD 3000 series breakers, which have a UL-489 AIC rating of 25,000 amps. The breaker-starter combinations have a UL-489 AIC rating of 22,000 amps, and thus will not be replaced.

Implementation of Modification M-939 has commenced. It is CP&L's intention to replace these breakers during Refueling Outage No. 12.

The fault currents on MCC 9 and 10 do not exceed the interrupting capability of the breakers currently used on these MCCs; therefore, these breakers will not be replaced.

Questions regarding this matter may be referred to Mr. R. W. Prunty at (919) 836-7318.

Yours very truly,

L. I. Loflin
Manager
Nuclear Licensing Section

JSK/crs (131CRS)

cc: Mr. M. L. Ernst
Mr. R. Lo
Mr. L. Garner (NRC - HBR)

CAROLINA POWER & LIGHT COMPANY
P. O. BOX 1551
RALEIGH, NORTH CAROLINA 27602

ANALYSIS

FOR

125 V. DC BATTERY LOAD PROFILE B

FOR

RNP UNIT 2

ANALYSIS I.D. 7988-E1

SAFETY CLASSIFICATION: (Q)

SEISMIC CLASSIFICATION: (N/A)

APPROVAL

REV. NO.	PREPARED BY/ DATE	VERIFIED BY/ DATE	PRIN. OR RES. ENG./ DATE	PROJECT ENG./ DATE
~~0~~				
4	3-3-88	CDB 3-18-88	WWPine II 3-21-88	[illegible] 03-18-88
REASON FOR CHANGE	M-927 M-947	M-896 PCN84-008 (ENG EVAL. 86-149)	PM-807C	
2				
REASON FOR CHANGE				
3				
REASON FOR CHANGE				

FORM NO. 78055 REV. 10/85

Computed by: [signature] Date: 3-3-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988 - E1
Checked by: CDBernardo Date: 3-18-88	CALCULATION SHEET	Pg. 1 of 1 Rev. 4
Tar / PID No.: 87-039/01		File: R87-039/01-DE-A031
Project Title:		
Calculation Title: 125 V DC BATTERY LOAD PROFILE B		
Status: Prelim. ☐ Final ☒ Void ☐		

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REFERENCES:

1. HBR SYSTEM DESCRIPTION SD-016 REV 22 "ELECTRICAL"
2. S&L PROPRIETARY COMPUTER PROGRAM ELMS-DC VERSION- 1.20
3. DC LOAD DATA FORMS- PREPARED AND REVIEWED
4. HBR DRAWINGS NOTED FOR EACH INDIVIDUAL LOAD
5. ZION STATION ROD DRIVE MG SET (W) INSTRUCTION MANUAL (DWG 671C243 SHT 8)
6) CP&L LETTER # ESL-264- FIELD MEASURED VALUES & ELECTROLYTE TEMPERATURE PROFILE.
7) WESTINGHOUSE CATALOG AD 33-760 "TYPE DB AIR CIRCUIT BREAKERS" FOR 600 VAC APPLICATION
8) S&L SPECIFICATION F-2737-01 "WESTINGHOUSE 4KV & 6.9KV SWITCHGEAR" TECHNICAL DATA FOR BYRON STATIONS 1 & 2. HBR 4KV SWGR IS SAME MODEL AND TYPE AS THAT CONTAINED IN THIS SPECIFICATION.
9) CP&L LETTER # ESL-259 RETAINING TO DIESEL GENERATOR FIELD FLASHING DATA VALUES.
10) HBR UPDATED FSAR TABLE 8.3.2.-1, ADMENDMENT #3
11) HBR PLANT OPERATING MANUAL VOLUME 3 PART 4- VARIOUS PROCEDURES.
12) WESTINGHOUSE DIRECTIONAL OVERCURRENT RELAYS: TYPES IRC, IRP, IRD, IRQ, IRV BULLENTIN 41-130B WE A

NOTE: SPECIFIC REFERENCES: 5, 7, 8, & 12 ARE INCLUDED IN THIS CALCULATION AT THE END

LIST OF ABBREVIATIONS:

HBR- H.B. ROBINSON STATION
C- CONTINUOUS
M- MOMENTARY
A- AMPERES
RLY- RELAY
LT- INDICATING LIGHT
DUR- DURATION
QTY- QUANTITY
TOT- TOTAL
LOP- LOSS OF OFFSITE POWER
LOCA- LOSS OF COOLANT ACCIDENT
INT- INTERMITTANT
(W) WESTINGHOUSE
FSAR- FINAL SAFETY ANALYSIS REPORT

NOTES AND ASSUMPTIONS:

1. ALL CALCULATIONS WILL BE BASED ON SLIDERULE ACCURACY (3 SIGNIFICANT DIGITS MAXIMUM)

2. ALL RELAYS WILL BE ASSUMED TO BE ENERGIZED UNLESS IT IS READILY OBVIOUS THAT THEY WILL BE DE-ENERGIZED DURING THE LOAD CYCLE SCENARIO. (ie TEST RELAYS OR RELAYS THAT ARE ENERGIZED DURING REACTOR POWER OPERATION)

3. IN THE CASE OF RED-GREEN POSITION INDICATING LIGHTS, ONLY ONE OF THE PAIR WILL BE INCLUDED IN THE LOAD TALLY.

4. 4160V SWGR BREAKER SPRING CHARGING MOTOR RUN AFTER A BREAKER CLOSE OPERATION.

5) THIS CALCULATION WILL SHOW THAT DIESEL GENERATOR "B" WILL START, IT'S FIELD WILL FLASH AND FAIL TO LOAD ONTO 480V SWGR E2 AT THE INITIATION OF LOCA & LOPI. THEN DG "B" WILL THEN BE RE-STARTED AND THE FIELD FLASHED AGAIN AT TIME EQUAL TO 59 MINUTES AND THE DG "B" BREAKER TO 480V SWGR E2 WILL THEN CLOSE AT TIME DURING THE 59TH MINUTE.

THE COMPUTER WILL CALCULATE THE HIGHEST PEAK LOAD DURING THE 59TH MINUTE, WHICH WILL BE THE CLOSING OF THE DG BRR. THIS ACTUATION DRAWS 32.0 AMPS COMPARED TO FIELD FLASHING which REQUIRES 15.18 AMPS.

ASSUMPTIONS & NOTES

6) 480 V SWGR TRIPPING SCENARIO WILL INCLUDE TRIPPING THE BUS TIE BKR BETWEEN 480V SWGR E1 & E2, ALONG WITH SEVEN ADDITIONAL 480V SWGR BKR'S TRIPPING. THIS ASSUMPTION SHOWS THAT THE BATTERY LOAD PROFILE TO BE CALCULATED WILL SUPPLY THE NECESSARY DC CURRENT TO TRIP THIS TIE BKR. NORMAL OPERATING BKR LINE-UP MAY DIFFER, BUT THIS IS THE MOST CONSERVATIVE APPROACH FOR CALCULATING THIS BATTERY'S LOAD PROFILE.

7) LOAD DURATION ARE TO BE CONSIDERED AS 60 MINUTES, UNLESS OTHERWISE NOTED.

8) 480V SWGR BKR (Cubicle) NUMBERS IDENTIFIED FROM HBR Dwg 5379-5374 REV 5

9) BATTERY ELECTROLYTE TEMPERATURE VERIFIED TO BE 67°F (PER REFERENCE # 6)

10) FOR ROD DRIVE M-G SETS, ONLY DC LOAD CONSISTS OF 1 LIGHT & RELAY (TYPE IRV). DURING LOCA & LOP REACTOR TRIP BREAKERS OPERATE & NOT THE MG SET OUTPUT BREAKER; THEREFORE A VALUE OF .18A CONTINOUS CURRENT IS CONSERVATIVE.

LOAD VALUES FOR VARIOUS DEVICES:

a) INDICATING LTS

THE VAST MAJORITY OF INDICATING LIGHTS ON THE MAIN CONTROL BOARD ARE 28V BULBS IN SERIES WITH A 2500Ω RESISTOR ACROSS THE 125VDC SUPPLY VOLTAGE. THEREFORE, THE BULB Ω =:

$$\frac{28V}{125V} = \frac{x}{x+2500\Omega}$$

WHERE x = BULB RESISTANCE

SOLVING FOR x:

$$x = 721.6\Omega$$

∴ THE TOTAL CKT Ω = 721.6Ω + 2500Ω = 3221.6Ω

THE TOTAL CKT POWER CONSUMPTION = $\frac{V^2}{R}$

∴ POWER CONSUMED BY LT CKT = $\frac{125V^2}{3221.6\Omega} = 4.85W$

∴ FOR CONSERVATISM ALL MAIN CONTROL BOARD (RTGB) INDICATING LTS WILL BE ASSUMED TO DRAW 5W. OR $\frac{5W}{125V}$ .04A

a) CONT'D

THERE ARE ALSO MANY INDICATING LTS THAT ARE WIRED DIRECTLY ACROSS THE 125VDC SUPPLY. IN CONVERSATIONS WITH PLANT STAFF IN MOST CASES 250V BULBS WITH DRAW APPROX 10W @ 250V ARE USED ON THE 125V CKT TO INCREASE BULB LIFE. THEREFORE 5W (1/2 OF 10W @ 250V) WILL BE USED FOR THESE CKTS AS WELL

b) RELAYS

THE VAST MAJORITY OF INDUSTRIAL TYPE CTL RELAYS USED ARE (W) TYPE BFD PER (W) CATALOG 16-321 THESE RELAYS HAVE A COIL POWER OF 12W.

(W) MG-G RELAYS ARE ALSO USED EXTENSIVELY FOR SWITCHGEAR AND GENERATOR PROTECTIVE RELAYING CKTS. PER (W) CATALOG 41-750B MG-G RELAYS WITH A 125VDC OPERATING COIL HAVE A 2000Ω COIL RESISTANCE

$\therefore$ POWER CONSUMED $= \frac{V^2}{R} = \frac{125^2}{2000\Omega} = 7.8\,W$

FOR CONSERVATISM AND EASE IN ESTIMATING LOAD 12W WILL BE USED FOR ALL RELAYS. $\frac{12W}{125V} = .1\,A$

c) SOLENOID VALVES

THE VAST MAJORITY OF SOLENOID VALVES ARE ASCO WITH 125VDC OPERATING COILS. SINCE MOST OF THE VALVES ARE LOCATED IN RADIATION OR OTHER INACCESSABLE AREAS ACCORDING TO ASCO CAT. NP-1, THEIR NUCLEAR GRADE SOLENOID VALVES WITH 125VDC OPERATING COILS CONSUME 17.4W.

∴ ALL SOLENOID VALVES IN THIS CALC. WILL BE ASSUMED TO DRAW 17.4W.

$$\frac{17.4W}{125V} = .14A$$

NOTE: FOR TROTS SOV'S ONLY - NAMEPLATE DATA IS 50WATTS/SOV.

$$\frac{50WATTS}{125V} = .4A/EACH$$

LOAD CYCLE SCENARIO:

LOP CONCURRENT WITH LOCA FOR ONE HOUR AND BATTERY DUTY CYCLE. LOP AND LOCA OCCURS WHEN REACTOR IS AT FULL POWER.

SARGENT & LUNDY ENGINEERS

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BY [illegible] DATE 3-3-88
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MCC "B" BKR 2

INVERTER B

50.0 A CONTINOUS CURRENT

MEASURED VALUE OF INVERTER WAS 36.4 AMPS, TO BE CONSERVATIVE USE 50.0 A CURRENT VALUE THE MEASURED VALUE OF 35.0 AMPS WAS THE OUTPUT CURRENT OF THE INVERTER. FOR CONSERVATISM AND EFFICIENCY OF THE INVERTER, THIS VALUE WILL BE 50.0 AMPS. (PER REFERENCE #6) (* 3.7A. LOAD ADDED BY PM-807C (ERFIS MUX ADD.) LOAD DOES NOT EXCEED 50A. CONTINUOUS USED.

MCC "B" BKR #4

DC POWER PANEL 25 (SWITCH-YARD)

2.6A CONTINOUS CURRENT MEASURED IN THE FIELD (PER REFERENCE #6)

CIRCUITS 1, 2, 3, 4, 7, 8, 9 DELETED BY MOD 927. HOWEVER, FOR CONSERVATISM, THE LOAD WILL NOT BE REDUCED.

SARGENT & LUNDY ENGINEERS

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LOAD TABULATION - DISTRIBUTION PANEL "B"

a) CKT #1 - 480V SWGR E2

CWD 956, 163A, 163B, 239, 833, 514, 655, 513, 834A, 834B, 290, 216, 209, 276, 277, 895, 897, 896, 238

CONTINUOUS LOAD

23 IND LTS @ .04A EACH - .92A
21 RELAYS @ .1A EACH - 2.1 A
8 SOV's @ .14A EACH (INT) 0.0 A

3.02A TOTAL CONT. LOAD
M-947

INTERMITTANT LOAD

8 480V BKR TRIPS @ 2A EA - 16A
(OCCURS @ T=0), WITH DURATION OF 1 SECOND. THESE BKR(cubicle) NUMBERS ARE: 23A, 24A, 24B, 25A, 25B, 26C, 28B, & 29B.
480 V SWGR, BREAKERS ARE DB50, DB75 & DB100

TRIPPING CURRENT FOR DB50, 75 & 100 IS 2.0A/EACH
CLOSING CURRENT FOR DB50 IS 24.0 A
CLOSING CURRENT FOR DB75 IS 32.0 A
CLOSING CURRENT FOR DB100 IS 32.0 A

(ALL INFORMATION OBTAINED FROM WESTINGHOUSE CATALOG)

b) CKT #2 4160V SWGR BUSES 3+4
CWD 956, 934, 929A, 929B, 262, 931, 930, 263, 606
813, 815, 626, 620, 101

CONTINUOUS LOAD

23 IND LTS @ .04A EACH - .92 A
18 RELAYS @ .1 A EACH - 1.8 A

2.72A TOTAL CONT. LOAD

INTERMITTANT LOAD

1- 4160V BKR TRIPS @ 4.2A/EACH

1- 4160V BKR TRIPS @ T=0
5- 4160V BKR'S TRIP @ T= 15 seconds.
ASSUME ALL 6 4160V BKR'S TRIP @ T=0
6X 4.2A/EACH = 25.2A TOTAL
THESE BKR (cubicle) NUMBERS ARE: 20, 22, 23, 25, 26, 27

ANOTHER LOAD SHEET WILL BE FILLED OUT FOR THE 1- 4160V BKR CLOSING @ 30.0A/EACH @ T=0 AND A LOAD DURATION OF 5 SECONDS. THIS BKR (cubicle) NUMBER IS 19.

DIST. PNL "B"

c) CKT #3 4160 V BKR TEST PNL

LOAD = 0A (ONLY USED FOR BREAKER TESTING)

d) CKT #4 480 V SWGR Busses 2B & 3

CWD 956, 272, 937, 71, 130, 589, 938, 227, 73, 585, 759, 898A, 898B, 273, 899

CONTINUOUS LOAD

13 IND LTS @ .04A EACH = .52
7 RLYS @ .1A EACH = .7
2 SOVS @ .14A EACH (INT) 0.0
1.22A TOTAL

10-460 V BKR will TRIP @ 2.0/EACH = 20.0 A
@ T=0, and will last for 1 second.
THESE BKR (cubicle) NUMBERS ARE: 9B, 10B, 10C, 11B, 13C, 14A, 14K, 15A, 15B & 16B

DIST. PANEL "B"

e) CKT #5 125V DC "B-A" MCC

(SEE INDIVIDUAL LOAD ITEMS FOR "B-A" MCC)

3.08A TOTAL MEASURED IN FIELD (REFERENCE #6)

f) CKT #6 SAMPLE PNL

CWD 88 THRU 99

5 RELAYS (SEE EXPLANATION below) 0.0
16 IND LITES @ .04A/EA = .64
17 SOV'S @ .14A/EA (INT) = 0
.64 A TOTAL

RELAY COILS ARE IN SERIES WITH SOV. SOV ARE INT LOADS, & SO ARE THE RELAYS.

G) CKT #7 TROTS

NO DWG'S AVAILABLE - ALL DATA OBTAINED FROM WALKDOWN

9 RELAYS @ .1A/EA = .9A
17 IND LITES @ .04A/EA .68A
14 SOV @ .4A/EA (INT) 0
1.58A TOTAL

DIST. PANEL "B"

H) CKT#8 DG EXCITER "B"
DWG 5379-1716
15.18A PER CP&L LETTER # ESL-259

CONSTANT CURRENT VALUE OF 15.18A, LOADS STARTS @ T=2 SECONDS WITH CONTINUOUS LOAD DURATION OF 7 SECONDS.
THIS LOAD WILL ALSO BE SEQUENCED ON @ 59 MINUTES, WITH THE SAME PARAMETERS REFERENCED ABOVE

2) CKT#9 REACTOR TRIP BKR'S
CWD 46
3 IND LITES @ .04A/E = .12A CONTINUOUS LOAD
2 (W) 480V BKR
BOTH-BKRS TRIP @ 2A EACH = 4A INT LOAD
(OCCURS @ T=0), WITH DURATION OF 1 SECOND
THESE BKR'S ARE TYPE DB50.

DIST. PNL "B"

k) CKT #10 ANNUNCIATOR (RTGB)
LUNDELL - 5 POWER SUPPLIES

6.5A NORMAL CONTINUOUS PER FIELD MEASURMENT WITH 50% OF LITES ENERGIZED
INRUSH CURRENT OF 11.74 AMPS, WITH INRUSH DURATION OF 59 SECONDS.
INRUSH CURRENT VALUE WAS MEASURED IN THE FIELD BY PRESSING TEST BUTTON @ MAIN CONTROL BOARD. ALL ANNUNCIATOR WINDOWS LIT.
(PER REFERENCE #6)

l) CKT #11 WASTE DISPOSAL PNL

CWD 340, 341, 342, 344 → 350 ⟶ 366, 372

26 IND LITES @ .04A/EA =	= 1.04
17 RELAYS @ .1A/EA =	= 1.7
23 SOV'S @ .14A/EA (INT)	= 0.0
2 ANNUNCIATOR (24 WINDOWS) @ 1.0A/EACH ANNUNCIATOR	= 2.0
	4.74 TOTAL

SARGENT & LUNDY ENGINEERS

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DIST. PANEL "B"

m) CKT #12 DG "B" CONTROL

CWD 950, 5379-1153, SHT. 1

12 IND LITES @ .04A/EA	= .48A
13 RELAY @ .1A/EA	1.3 A
4 SOV'S @ .14A/EA	.56A
	2.34A TOTAL

n) CKT #13 TURB EMER. TRIP

CWD 711, 716

3 SOV'S @ .14A/EA (INT)	0.0
1 RELAYS @ .1A/EA =	0.1
	0.1A TOTAL

o) CKT #14 GAS STRIPPER PNL "B"

CWD 174, 5379-1548

14 IND LITES @ .04A EACH	= 0.56
6 RELAYS @ .1A EACH	0.6
9 SOV'S @ .14A EACH (INT)	0.0
	1.16A TOTAL

SARGENT & LUNDY ENGINEERS

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DIST. PANEL "B"

P) CKT #15 GAS ANALYZER PNL
CWD 125, 126, 319, 342, 343, 373

29 SOV'S @ .14A EACH (INT) = 0.0 A
0.0 A TOTAL

ENG. EVAL. 86-149
PCN 84-008

Q) CKT #16 AUX PNL "G-C"

11.8 A TOTAL
SEE ATTACHED SHEETS FOR INDIVIDUAL LOADS PER CKT NUMBER & DWG REFERENCES

SARGENT & LUNDY ENGINEERS

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DIST. PANEL "B"

r) CKT # 17 GENERATOR LOCKOUT

CWD 913

1 IND. LITE @ .04A/EA = 0.04

2 RELAYS @ .1A/EA = 0.2

.24A TOTAL

s) CKT #18 RPS "B"

DWG CP-380-5379-3239 → 3252

22 RELAYS @ .1A/EA = 2.2A TOTAL

T) CKT #19 REVERSE CURRENT VALVES

CWD 740

6 SOV'S @ .14A/EACH = .84A TOTAL

Form GQ-3.08.1 Rev. 2 8L-F647 10-85 KPS

SARGENT & LUNDY ENGINEERS

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DIST. PANEL "B"

U) CKT #20 SAFEGUARDS "B" DWG CP-380-5379-3227 → 3238

46 RELAYS @ .1A/EA = 4.6A

13 IND. LITES @ .04A/EA = .52A

5.12A TOTAL

M-947

V) CKT #21 DRUMMING CONTROL PNL

CWD 374 THRU 389

12 RELAYS @ .1A/EA = 1.2 A

16 IND. LITES @ .04A/EA = 0.64 A

16 SOV'S @ .14A/EA (INT) = 0.0 A

1.84 TOTAL

CALC 7988-E1R 4
SHT 19 OF 53
BY AD DATE 3-3-88
CHK CDB DATE 3-8-88

W) CKT #22 DIST. PNL B1

(SEE INDIVIDUAL LOAD SHEETS FOR DIST. PNL B1)

7.4A CONTINUOUS LOAD - DETERMINED BY ACTUAL FIELD MEASUREMENT. (PER REFERENCE #6)

X) CKT #23 STEAM DRIVEN AFW PMP CONTROL

CWD 628, 630A, 630B, 630C

18 RELAYS @ .1A/EA = 1.8A

7 IND. LITES @ .04A EACH = .28 A

7 SOV'S @ .14A EACH (CONT) = 0.98 A

9 SOV'S @ .14A EACH (INT) = 0.0 A

3.06A TOTAL

SARGENT & LUNDY ENGINEERS

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DIST. PANEL "B"

1) CKT # 24 ROD DRIVE MG SET "B"

CWD 73

.18 A CONTINUOUS LOAD FROM ZION ROD DRIVE MG SET INSTRUCTION MANUAL.

BOTH ZION & H.B. ROBINSON HAVE SIMILAR MG SETS

NOTE: FOR RECORD # 27, & 28 WHICH ARE PAGES 45 & 46 OF THIS CALCULATION, WHICH REPRESENT THE STARTING OF THE DIESEL GENERATOR "B"; FLASHING THE FIELD AND 480 V SWGR E-2 DG "B" BKR CLOSING DURING THE 59TH MINUTE OF THE ONE HOUR LOAD PROFILE.

RECORD NUMBER # 29 ON PAGE 46 OF THIS CALCULATION IS FOR THE AUTO TRANSFER FOR 4KV SWGR BUSSES 3 & 4. WHEN AUTO TRANSFER OCCURS, A SINGLE 4KV BKR CLOSES, THUS CONNECTING BOTH BUSSES TOGETHER.

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125V DC. "B-A" MCC (FED FROM DIST. PNL "B" CKT #5)

a) CKT #1 602 PNL - RADWASTE EVAP.

12 IND LITES @ .04A/EA	=	0.48
9 RELAYS @ .1A/EA	=	.9
1 ANNUNCIATOR 18 WINDOW & 2 LITES PER WINDOW	=	1.5
		2.88 A

NO DWG REFERENCE - DATA OBTAINED FROM FIELD WALKDOWN

b) CKT #2 480V SWGR 12m

0.2 AMP MEASURED IN THE FIELD. (PER REFERENCE #6)

NO DWG REFERENCE

c) CKT #3 - SPARE

d) CKT #4 SPARE

e) CKT #5 603 & 601 RADWASTE EVAP - NOT USED - NO LOAD

f) CKT #6 SPARE

3.08 A TOTAL

SARGENT & LUNDY ENGINEERS

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DIST. PNL B-1 (- FED FROM DIST. PNL "B" CKT # 22)

a) CKT #1 230KV PRIMARY RELAYS & CARRIER EQUIP.
CWD 975

b) CKT #2 230KV BKR FAILURE RELAYS
NO DWG REFERENCE FOUND

c) CKT #3 230KV SUPERVISORY CONTROL & ALARMS
CWD 977B

d) CKT #4 230KV OSCILLOGRAPH POWER SUPPLY
CWD 975

7.4 A CONTINUOUS LOAD WAS MEASURED IN THE FIELD. ALL CKT BKR'S REFERENCED ABOVE WERE IN THE CLOSED (ENERGIZED) POSITION. (PER REFERENCE #6)

SARGENT & LUNDY ENGINEERS

Calcs. For 125VDC BATTERY LOAD PROFILE

[X] Safety-Related [ ] Non-Safety-Related

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LOAD (PNL B, CKT #6) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 1 CWD 144						
SV	3	.14	.42	C		
RLY	2	.1	.2	C		
LT	1	.04	.04	C		
					.66	
CKT# 2 CWD 147						
SV	3	.14	.42	C		
RLY	2	.1	.2	C		
LT	1	.04	.04	C		
					.66	
CKT# 3 CWD 155						
SV	1	.14	.14	C		
RLY	1	.1	.1	C		
LT	3	.04	.12	C		
					.36	
CKT# 4 CWD 304						
SV	1	.14	.14	INT		.14 (INT)
RLY	—	—	—	—		
LT	1	.04	.04	C		
					.04	
CKT# 5 CWD 306						
SV	1	.14	.14	INT		.14 (INT)
RLY	—	—	—	—		
LT	1	.04	.04	C		
					.04	

SARGENT & LUNDY ENGINEERS

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LOAD (PNL B, CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 6 CWD 308						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT# 7 CWD 309						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT# 8 CWD 311						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT# 9 CWD 312						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT# 10 CWD 314						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	

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SARGENT & LUNDY ENGINEERS

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Project H.B. ROBINSON

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Approved by	Date

LOAD (PNL B, CKT #'s) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 11 CWD 315						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT # 12 CWD 303						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	1	.04	.04	C	.04	
CKT # 13 CWD 152A +152B						
SV	1	.14	.14	INT		.14 (INT)
RLY	1	.1	.1	C		
LT	2	.04	.08	C	.18	
CKT # 14 CWD 103						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	2	.04	.08	C	.08	
CKT # 15 CWD 157						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	

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LOAD (PNL B, CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 16 CWD 118						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT # 17 CWD 164						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT # 18 CWD 123						
SV	1	.14	.14	C		
RLY	1	.1	.1	C		
LT	2	.04	.08	C		
					.32	
CKT # 19 CWD 167						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	2	.04	.08	C	.22	
CKT # 20 CWD 129						
SV	1	.14	.14	INT		.14 (INT)
RLY	—	—	—			
LT	2	.04	.08	C	.08	

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LOAD (PNL B, CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 21 CWD 169						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	2	.04	.08	C		
					.22	
CKT # 22 CWD 317						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	1	.04	.04	C		
					.04	
CKT # 23 CWD 120A						
SV	2	.14	.28	INT		.28 (INT)
RLY	1	.1	.1	C		
LT	2	.04	.08	C	.18	
CKT # 24 CWD 127						
SV	3	.14	.42	C		
RLY	1	.1	.1	C		
LT	4	.04	.16	C	.68	
CKT # 25 CWD 125						
SV	1	.14	.14	INT		.14 (INT)
RLY	1	.1	.1	C		
LT	3	.04	.12	C	.22	

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Calcs. For 125VDC BATTERY LOAD PROFILE

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LOAD (PNL B, CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 26 CWD 140						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT # 27 CWD 190						
SV	1	.14	.14	INT		.14 (INT)
RLY	—	—	—			
LT	1	.04	.04	C	.04	
CKT # 28 CWD 194						
SV	2	.14	.28	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.32	
CKT # 29 CWD 229						
SV	1	.14	.14	C		
RLY	1	.1	.1	C		
LT	3	.04	.12	C		
					.36	
CKT # 30 CWD 250						
SV	2	.14	.28	C		
RLY	—	—	—			
LT	5	.04	.2	C		
					.48	

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LOAD (PNL B, CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 31 CWD						
SV						
SPARE RLY					0	
LT						
CKT# 32 CWD 590						
SV	1	.14	.14	C		
RLY	1	.1	.1	C		
LT	2	.04	.08	C		
					.32	
CKT# 33 CWD 510						
SV	—	—	—			
BLANK RLY	—	—	—		0	
LT	—	—	—			
CKT# 34 CWD 134						
SV	—	—	—			
RLY	—	—	—			
LT	4	.04	.16	C	.16	
CKT# 35 CWD 100						
SV	—	—	—			
RLY	—	—	—			
LT	2	.04	.08	C	.08	

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LOAD (PNL & CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 36 CWD 702						
SV	–	–	–			
RLY	5	.1	.5	C	.5	
LT	–	–	–		–	
CKT# 37 CWD						
SPARE SV	–	–	–			
RLY	–	–	–		0	
LT	–	–	–			
CKT# 38 CWD704						
SV	9	.14	1.26	C		
RLY	–	–	–			
LT	2	.04	.08	C		
					1.34	
CKT# 39 CWD705						
SV	–	–	–			
RLY	–	–	–			
LT	–	–	–			
VALUE MEASURED IN FIELD				C	.2	
CKT# 40 CWD 141						
SV	2	.14	.28	INT		.28 (INT)
RLY	1	.1	.1	C	.1	
LT	–	–	–			

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LOAD (PNL B, CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT #41 CWD 594						
SV	1	.14	.14	C		
RLY	—	—	—			
LT	1	.04	.04	C		
					.18	
CKT # 42 CWD 642						
SV	3	.14	.42	C		
RLY	—	—	—			
LT	—	—	—			
					.42	
CKT # 43 CWD 642						
SV	3	.14	.42	C		
RLY	—	—	—			
LT	—	—	—			
					.42	
CKT # 44 CWD 152A						
CWD 152B SV	—	—	—			
NO LOAD RLY	—	—	—			
(BACK-UP LT	—	—	—			
FEED)					0	
CKT # 45 CWD 716						
SV	—	—	—			
RLY	1	.1	.1	C		
LT	—	—	—			
					.1	

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LOAD (PNL B, CKT #16 AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 46 CWD 342						
343 SV						
RLY	2	.1	.2	C		
LT	2	.04	.08	C	.28	
CKT # 47 CWD 136						
SV	1	.14	.14	C		
RLY	1	.1	.1	C		
LT	3	.04	.12	C	.36	
CKT # 48 CWD						
SPARE SV						
RLY					0	
LT						
CKT # 49 CWD						
SPARE SV						
RLY						
LT					0	
CKT # 50 CWD 926						
SV	—	—	—			
RLY	2	.1	.2	C	.2	
LT	—	—	—			

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LOAD (PNL & CKT #) AUX PNL GC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 51 CWD						
SPARE SV						
RLY	0					
LT						

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CKT # 52 CWD 137						
SV	3	.14	.42	INT		.42 (INT)
RLY	—	—	—			
LT	3	.04	.12	C	.12	
CKT # 53 CWD 513						
SV	0	—	—	—	—	—
M-896 RLY	4	0.1	0.4	0	0	0
LT	2	0.04	0.08	0	0	0
CKT # 54 CWD 514						
SV	0	—	—	—	—	—
RLY	4	0.1	0.4	0	0	0
M-896 LT	2	0.04	0.08	0	0	0
CKT # CWD						
SV						
RLY						
LT						

Project: H. B. ROBINSON UNIT 2 Date: Page:

Lowest Expected Electrolyte Temp: °F 67 Minimum Cell Voltage: 1.75 Cell Mfg: GNB Cell Type: MCX Sized By:

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CHK COB DATE 3-16-88

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) x (6B) = Rated Amp Hrs	
						Pos Values	Neg Values
Section 1 — First Period Only — If A2 is greater than A1, go to Section 2.							
1	A1 = 212.94	A1 − 0 = 212.94	M1 = 1	T = M1 = 1	112	1.90	• • •
					Sec 1 Total	1.90	• • •
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1 = 212.94	A1 − 0 = 212.94	M1 = 1	T = M1 + M2 = 59	42.5	5.01	—
2	A2 = 112.5	A2 − A1 = 100.44	M2 = 58	T = M2 = 58	42.5	—	-2.36
					Sec 2 Sub Tot	5.01	-2.36
					Total	2.65	• • •
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4.							
1	A1 = 212.94	A1 − 0 = 212.94	M1 = 1	T = M1 + M2 + M3 = 60	42.5	5.01	—
2	A2 = 112.5	A2 − A1 = 100.44	M2 = 58	T = M2 + M3 = 59	42.5	—	-2.36
3	A3 = 144.5	A3 − A2 = 32	M3 = 1	T = M3 = 1	112	0.29	—
					Sec 3 Sub Tot	5.30	-2.36
					Total	2.94	• • •

Maximum Section Size (8) 2.94 + Random Section Size (9) 0 = Uncorrected Size — (US) (10) 2.94
US (11) 2.94 x Temp Corr (12) 1.06 x Design Marg (13) 1.00 x Aging Factor (14) 1.00 = (15) 3.12
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 4 (A) — (Positive Plates.)

(B) — Ampere Hours. Therefore cell (17) _____ is required.

3849

Fig 3
Cell Sizing Work Sheet

******** LOAD PROFILE ********

PERIOD #	AMPS	DURATION(MIN)
1	212.94	1
2	112.5	38
3	144.5	1

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BY [signature] DATE 3-3-88
CHK CDB DATE 3-18-88

==========

MAXIMUM SECTION SIZE = UNCORRECTED SIZE
2.94 = 2.94

US	X TEMP. CORR.	X DESIGN MARGIN	X AGING FACTOR	= MINIMUM REQUIRED SIZE
2.94	1.06	1.00	1.00	3.12

MINIMUM REQUIRED BATTERY SIZE	ACTUAL BATTERY SIZE	REMAINING MARGIN
4 POSITIVE PLATES	4 POSITIVE PLATES	28.2 %

press enter to cont.

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ILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
ATION : H.B. ROBINSON UNIT NO. 2

BATTERY DATA

Location of battery	1E Battery Room
Battery name	Battery B 340AH
Min electrolyte temp, F	67.
Cell manufacturer	GOULD
Cell type	MCX/MAX (MODELS 170,255,...)
Battery nominal volts	125.0
Battery minimum volts	105.0
Number of cells	60
Number of positive plates ...	4
Design margin	1.00
Aging factor	1.00

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ILITY : CAROLINA POWER & LIGHT
TION : H.B. ROBINSON

PROJECT NO. 7988-00
UNIT NO. 2 ..

LOAD DATA

*** Record number = 1 ***

Load name	MCC B BKR 2
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	50.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

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*** Record number = 2 ***

Load name	MCC B BKR 4
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	2.600
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

*** Record number = 3 ***

Load name	DIST PNL B CKT 1
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	16.000
Inrush duration - sec	
Cont load current - amps	
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
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Modification	
Cable number	

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TILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
ATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 4 ***

Load name	DIST PNL B CKT 2 PT1
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	25.200
Inrush duration - sec	1
Cont load current - amps	2.720
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 5 ***

Load name	DIST PNL B CKT 3
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 6 ***

Load name	DIST PNL B CKT 4
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	20.000
Inrush duration - sec	1
Cont load current - amps	1.220
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

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UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 7 ***

Load name	DIST PNL B CKT 5
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	3.080
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 8 ***

Load name	DIST PNL B CKT 6
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.640
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 9 ***

Load name	DIST PNL B CKT 7
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	1.580
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

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TILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0(
ATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 10 ***

Load name	DIST PNL B CKT 8
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	15.180
Time load starts - MM.ss	.02
Load duration - MM.ss	.07
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 11 ***

Load name	DIST PNL B CKT 9
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	4.000
Inrush duration - sec	1
Cont load current - amps	.120
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 12 ***

Load name	DIST PNL B CKT 10
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	11.740
Inrush duration - sec	59
Cont load current - amps	6.500
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

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TILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
ATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 13 ***

Load name	DIST PNL B CKT 11
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	4.740
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 14 ***

Load name	DIST PNL B CKT 12
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	2.340
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 15 ***

Load name	DIST PNL B CKT 13
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.100
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0C
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 16 ***

Load name	DIST PNL B CKT 14
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	1.160
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 17 ***

Load name	DIST PNL B CKT 15
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 18 ***

Load name	DIST PNL B CKT 16
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	11.800
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
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Cable number	

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TILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
ATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 19 ***

Load name	DIST PNL B CKT 17
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.240
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 20 ***

Load name	DIST PNL B CKT 18
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	2.200
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 21 ***

Load name	DIST PNL B CKT 19
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.840
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

UTILITY : CAROLINA POWER & LIGHT
STATION : H.B. ROBINSON

PROJECT NO. 7988-00
UNIT NO. 2..

LOAD DATA

*** Record number = 22 ***

Load name	DIST PNL B CKT 20
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	5.12 M-947
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

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BY [illegible] DATE 3-3-88
CHK CDB DATE 3-18-88

*** Record number = 23 ***

Load name	DIST PNL B CKT 21
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	1.840
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

*** Record number = 24 ***

Load name	DIST PNL B CKT 22
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	7.400
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
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Cable number	

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TILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
ATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 25 ***

Load name	DIST PNL B CKT 23
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	3.060
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 26 ***

Load name	DIST PNL B CKT 24
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.180
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 27 ***

Load name	DG START
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.000
Time load starts - MM.ss	.00
Load duration - MM.ss	.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
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Modification	
Cable number	

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UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-OC
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 28 ***

Load name	DG BRKR CLOSING
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	32.000
Time load starts - MM.ss	59.10
Load duration - MM.ss	.01
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 29 ***

Load name	4KV BUS TRANS CLOSE
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	30.000
Time load starts - MM.ss	.00
Load duration - MM.ss	.05
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
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SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For 125 V DC BATTERY LOAD PROFILE		Calc. No. 7988-E1
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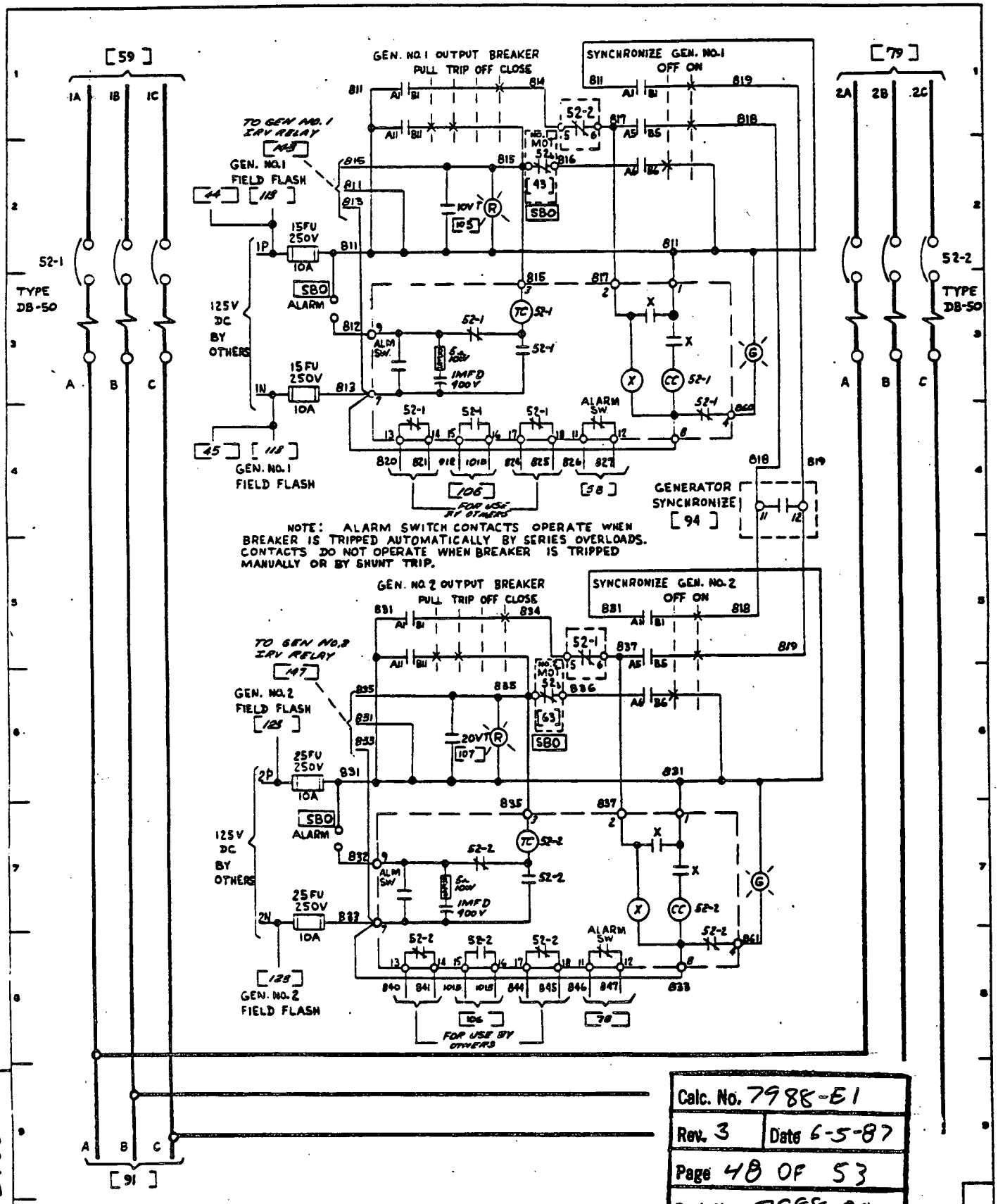
Client CP&L	Prepared by		Date
Project H.B. ROBINSON	Reviewed by		Date
Proj. No. 7988-00 Equip. No.	Approved by		Date

CONCLUSION

THE EXISTING STATION 125 V DC BATTERY B IS OF SUFFICIENT SIZE TO MEET ITS LOAD PROFILE FOR A ONE HOUR TIME DURATION. REFER TO PAGES 34 & 35 OF THIS CALCULATION. STATION 125 V DC BATTERY B HAS A REMAINING MARGIN OF 26.5% FOR THIS ONE HOUR LOAD PROFILE.



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WESTINGHOUSE ELECTRIC CORPORATION
INDUSTRY SYSTEMS BUFFALO, NEW YORK

GENERATOR OUTPUT CIRCUIT BREAKER

SUB 12	DWG 671C243	SHEET 8
CONT'D ON 9		

Westinghouse

Control Voltages and Operating Currents

Electrically operated air circuit breakers should be operated from reliable sources of control power. Standard control voltages and ranges for electrically operated low voltage breakers are measured at the mechanism terminals for solenoid mechanisms given below:

Control Voltages

Direct Current			Alternating Current		
Standard Control Voltages	To Close	To Trip	Standard Control Voltages	To Close	To Trip
24	.....	14 to 30①	115	95 to 125	95 to 125
48	.....	28 to 60	230	190 to 250	190 to 250
125	90 to 130	70 to 140	460	380 to 500	380 to 500
250	180 to 260	140 to 280			

① 24-volt tripping is not recommended

Operating Currents

Type of Breaker	No. of Poles	Closing Current – Volts				Tripping Current – Volts					
		125 Dc	250 Dc	230 Ac	460 Ac	48 Dc	125 Dc	250 Dc	115 Ac	230 Ac	460 Ac
DB-15	2, 3	20	10	30	15	5	2	1	1	.5	.2
DB-25	2, 3	23	10	35	20	5	2	1	1	.5	.2
DB-50	2, 3	20	10	20	10	5	2	1	1	.5	.2
DB-75	2, 3	32	18	32	18	5	2	1	1	.5	.2
DB-100	2, 3	32	18	32	18	5	2	1	1	.5	.2

Control power for ac closing of low voltage breakers in metal-enclosed switchgear is usually taken from the bus or line-side of the breaker through current limiting fuses, or through standard fuses and current limiting resistors. When it is necessary to supply closing power through a control power transformer, a 3 Kva transformer is used for all breaker types and regardless of the number of breakers. For tripping power only, a 250 va control power transformer is adequate for all breaker ratings and regardless of the number of breakers.

Other Attachments

Control Relays

A control relay is normally supplied on each electrically operated type DB breaker. The function of the control relay is to close and open the closing solenoid circuit of the breaker during a closing operation, so that the heavy closing current does not pass through the control switch or other initiating device.

When the control switch of the breaker is closed, it energizes the control relay. A contact from the relay completes the closing solenoid circuit. When the breaker is closed, the breaker closing mechanism mechanically opens the relay contact which interrupts the closing current.

Alarm Switches

It may be desirable when a breaker trips on a fault or overload to ring an alarm of some type. Alarm switches are available on the type DB breaker that will close their contact when the breaker is tripped by the series overcurrent device but which is mechanically blocked from closing when the breaker is manually tripped or opened by the shunt trip device. Undervoltage tripping attachment, when supplied, can also operate an alarm.

Auxiliary Switches

Auxiliary switch circuits are available on the type DB breakers in groups of 4 or 8②. These switches are used to control indicating lamps, shunt trip coil circuits or other duties in automatic or manual control schemes.

The switches are contained in molded cases. A rotary design moving contact is used with a wiping action between contact surfaces. The contact faces are silverplated and are held against each other by auxiliary spring tension when they are engaged in the closed position.

Normally, the auxiliary switches have alternate make and break contact when the breaker is in the open or closed position. These can be changed, however, to give any combination of make and break contacts desired.

The auxiliary switch contacts have the following characteristics:

Contacts can carry 15 amperes continuously or 250 amperes for 3 seconds.

Interrupting Capacity:

Volts	Circuit	
	Non-Inductive	Inductive
125 Dc	11 Amperes	6.25 Amperes
250 Dc	2 Amperes	1.75 Amperes
115 Ac	75 Amperes	15 Amperes
450 Ac	25 Amperes	5 Amperes

Interlocks

Interlocks can also be supplied to prevent the operation of breakers under certain conditions. For example, two breakers may be interlocked so that only one may be closed at any one time but both may be open at any one time. Electric lockout attachments or key interlocks are recommended to perform these special functions. Key interlocks on drawout switchgear are so designed and mounted that the interlocking function will not be defeated by substitution of a different breaker in the cell. Mechanical interlocks are also available for non-drawout breakers.

Electric lockout attachments are available on the type DB breakers. The lockout prevents closing of the breaker by holding the breaker linkage in the trip-free position. Energizing the lockout coil frees the linkage and permits closing the breaker. After the breaker is closed, de-energizing the lockout coil does not cause tripping. Standard coil voltages are 48, 125 or 250 dc and 115 230 or 460 ac.

Mountings and Enclosures

Mountings

The type DB circuit breakers are available for dead front fixed mounting or for drawout mounting in individual enclosures or in metal enclosed switchgear assemblies.

Enclosures

Breakers applied in hazardous locations with explosive atmospheres or otherwise contaminated atmospheres, should be provided with proper enclosures to prevent explosions and to maintain proper breaker performance. Individual circuit breakers of the type DB can be supplied with enclosures as shown by the following table:

② Twelve auxiliary switch circuits are available on the types DB-50, 75 and 100 breakers.

Name of Bidder: Westinghouse Electric Corporation

7. CIRCUIT BREAKER DATA (On a symmetrical basis):	(Insert all data in these columns)				
	1200A 250 MVA	1200A 350 MVA	3000 A 350 MVA	1200 A 500 MVA	2000 A 500 MVA
	4.16 kV	4.16 kV	4.16 kV	6.9 kV	6.9 kV
7.1 Manufacturer.....	Westinghouse		Westinghouse		West.
7.2 Type.....	50DHP250	50DHP350	50DHP350	75DHP500	75DHP500
7.3 Horizontal or vertical drawout.	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
7.4 Indicate the ANSI standard covering the circuit breaker rating.....	C37.06	C37.06	C37.06	C37.06	C37.06
7.5 Nominal voltage class.....(V)	4,160	4,160	4,160	7,200	7,200
7.6 Nominal 3-phase MVA class.(MVA)	250	350	350	500	500
7.7 Rated maximum voltage.....(V)	4,760	4,760	4,760	8,250	8,250
7.8 Rated voltage range factor.....	1.24	1.19	1.19	1.25	1.25
7.9 Low frequency withstand....(kV)	19	19	19	36	36
7.10 Impulse withstand (BIL)....(kV)	60	60	60	95	95
7.11 Rated continuous current....(A)	1200	1200	3000	1200	2000
7.12 Rated short circuit current:					
a. At 4.16 kV.....(A)	33,200	46,900	46,900	N.A.	N.A.
b. At 4.76 kV.....(A)	29,000	41,000	41,000	N.A.	N.A.

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Name of Bidder: Westinghouse Electric Corporation

CIRCUIT BREAKER DATA, Cont.	(Insert all data in these columns)				
	1200 A 250 MVA 4.16 kV	1200 A 350 MVA 4.16 kV	3000 A 350 MVA 4.16 kV	1200 A 500 MVA 6.9 kV	2000 A 500 MVA 6.9 kV
c. At 6.9 kV.....(A)	N.A.	N.A.	N.A.	39,500	39,500
d. At 8.25 kV.....(A)	N.A.	N.A.	N.A.	33,000	33,000
7.13 Rated permissible tripping delay.....(seconds)	2	2	2	2	2
7.14 Maximum symmetrical interrupting capability.....(A)	36,000	49,000	49,000	41,000	41,000
7.15 Close and latch capability..(A)	58,000	78,000	78,000	66,000	66,000
7.16 Stored energy device (spring charging motor):					
a. Voltage range required.....:.(V)	40-50	90-130	90-130	90-130	90-130
b. Inrush current at nominal operating volts dc.....(A)	35	28	30	30	30
c. Is spring recharged after trip or close?.....	close	close	close	close	close
d. Time required to recharge spring.....(cycles)	5	5	5	5	5

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Name of Bidder: Westinghouse Electric Corporation

CIRCUIT BREAKER DATA, Cont.	(Insert all data in these columns)				
	1200 A 250 MVA 4.16 kV	1200 A 350 MVA 4.16 kV	3000 A 350 MVA 4.16 kV	1200 A 500 MVA 6.9 kV	2000 A 500 MVA 6.9 kV
7.17 Control circuit nominal operating volts dc:					
a. Closing control voltage range.....(V)	40-50	90-130	90-130	90-130	90-130
b. Closing control current at normal voltage.....(A)	7.8	4.2	4.2	4.2	4.2
c. Tripping voltage range....(V)	28-60	70-140	70-140	70-140	70-140
d. Tripping current at normal voltage.....(A)	7.8	4.2	4.2	4.2	4.2
7.18 Trip coil requirements:					
a. Voltage range required....(V)	28-60	70-140	70-140	70-140	70-140
b. Trip coil current at nominal operating volts dc.....(A)	7.8	4.2	4.2	4.2	4.2
7.19 Time from energizing trip coil until:					
a. Main contacts part...(cycles)	2.5	2.5	2.5	2.5	2.5
b. Circuit is interrupted at 100% interrupting rating .....(cycles)	5.0	5.0	5.0	5.0	5.0
c. Auxiliary switch "a" contacts open.....(cycles)	2.6 ± .2	2.6 ± .2	2.7 ± .4	2.5 ± .4	2.5 ± .4

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IRQ-2, IRQ-5, IRQ-6, IRQ-7, IRQ-8, IRQ-9, IRQ-11 for Ground Fault Detection (FT-42 Case)

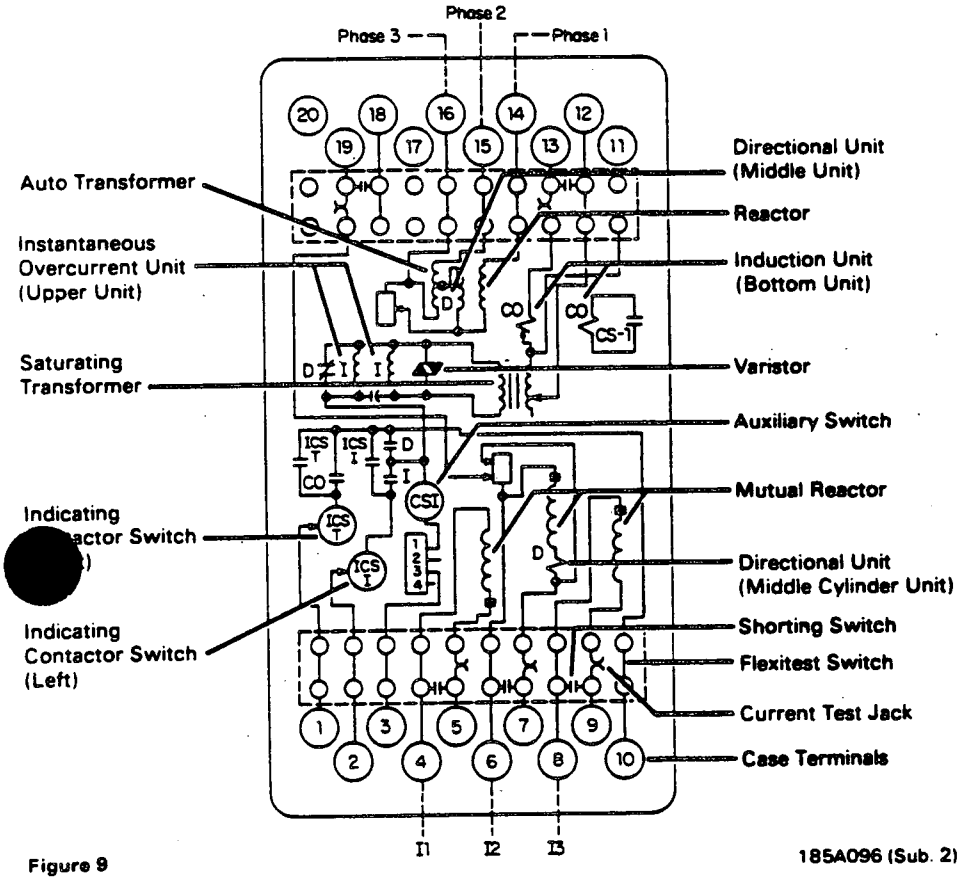

Figure 9

185A096 (Sub. 2)

Relay Settings

The instantaneous and time-overcurrent units require setting, whereas the directional unit does not.

On both overcurrent units, the tap selected determines the minimum pickup or contact-closing current of the unit. Selective time dial settings on the time-overcurrent unit can be determined by referring to the time current curves in the appropriate Instruction Leaflet.

CS-1 Coil Operating Time

Operating time of the CS-1 auxiliary switch is approximately 5 milliseconds.

CS-1 Coil Resistance (Ohms)

1165 ohms for 24/48/125/250 volt relays except the 24 volt IRV which has a 110 ohm coil.

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DESIGN VERIFICATION RECORD

I. Instructions to Verification Personnel

Plant: BNP U2 TAR No.: _____ Project: _____ File No.: _____

Design Documents: 7988-E1 (Document No.) 4 (Rev.) 125 V DC BATTERY LOAD PROFILE B (Document Title)

_____ (Document No.) _____ (Rev.) _____ (Document Title)

Design in verification should be done in accordance with ANSI N45.2.11, Section 6, as amended by Reg. Guide 1.64, Rev. 2.

Verification Methods to be used:

- ✓ Design Review
- ____ Alternate or Simplified Calculations
- ____ Qualification Testing

Documents(s) "Q" Level:

- ✓ Q
- ____ RW-Q
- ____ FP-Q
- ____ Non-Q

Special Instructions:

ASSIGNED TO C. BURNSIDE FOR VERIFICATION

S M Hyde DPE 03-04-88 Date

II. Verification Documentation:

Method Used:

- ✓ Design Review (Attach any documentation)
- ____ Alternate or Simplified Calculations (Attach calculations)
- ____ Qualification Testing

Design Document Acceptable: Yes ____ No ✓

If Not Acceptable, Give Reasons or Provide Comments on Reverse Side of This Form: See back

Verification Check Completed By (Signature): C D Burnside 3-9-88 Date

Acknowledgement of Verification: S M Hyde (DPE) 03-09-88 Date

---

III. Resolution of Comments

Comments Resolved (See Reverse Side):

_____ Responsible Engineer 3-17-88 Date

Action taken makes Design Document Acceptable

S M Hyde Discipline Project Engineer 03-18-88 Date C D Burnside Verifier 3-18-88 Date

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For D.C. SHORT CIRCUIT		Calc. No. 7988-E2
		Rev. 1 Date 7-6-87
X Safety-Related	Non-Safety-Related	Page 1 of ..

Client CP&L	Prepared by M.M. Power	Date 7-6-87
Project H.B. ROBINSON	Reviewed by D.M. Kupperian	Date 7-7-87
Proj. No. 7988-02 Equip. No.	Approved by T.M. McCarley	Date 7/7/87

PURPOSE:

TO VERIFY THAT THE CALCULATED SHORT CIRCUIT CURRENTS ARE WITHIN THE RATINGS OF THE CIRCUIT BREAKERS

REV. 0 - ALL PAGES.

REV. 1 - ADDED SECTION ON TIME CONSTANTS REVISED PAGES 2, 3, 4 ADDED PAGES 5 THRU 9 FOR CALCULATION 10-> 32 FOR REFERENCES

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For DC SHORT CIRCUIT	Calc. No. 7988-E2
	Rev. — Date —
X Safety-Related	Non-Safety-Related	Page 2 of

Client CP&L	Prepared by	Date
Project H.B. ROBINSON	Reviewed by	Date
Proj. No. 7988-00 Equip. No.	Approved by	Date

1 | REF. 14 LETTER FROM GNB TO CP&L DATED 3-23-87 ON SHORT CIRCUIT CAPACITY OF BATTERIES

REFERENCES.

1. LETTER FROM A.B. CUTTER CP&L TO T.M. McCAULEY ON D.C. EQUIPMENT FILE: R87-039100 ESL-257 -XX-A528
2. ITE TEST REPORT ON GOULD BATTERIES TEST #20032

1 | 3. LETTER FROM WESCO TO CP&L 5-1-87 ON PANEL BRACING

4. CP&L ELECTROLYTE TEMPERATURE RECORDS

5. GOULD CURVE RELATING TO TEMPERATURE MC-101470

6. S&L STD. ESC-291 (1986)

7. PCP LETTER TO S&L 4-24-87 ON BATTERY CHARGERS

8. WEST. LETTER TO CP&L 5-12-1987 ON EHB CIR BKRS.

9. IEEE STD 946-1985

1 | 10. GOULD CATALOG. INFO ON NCX AND MCX CELLS

11. Telecons BETWEEN W & S&L 4-20-87 TO 4-29-87

ASSUMPTIONS

IMPEDANCE OF CABLES HAVE BEEN IGNORED FOR SHORT CIRCUIT CALCULATIONS WHICH RESULTS IN CONSERVATIVE VALUES. 1

1 | 12. TELECON BETWEEN R. BEAVERS S&L AND LARRY LUTZ PCP 6-19-87 ON BATTERY CHARGER CHARACTERISTICS.

13 S&L CALCULATION 7988-E5 R. 0

Form GO-3.08.1 Rev. 2 SL-F647 04/84

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For DC SHORT CIRCUIT	Calc. No. 7988-E2
	Rev. 1 Date
X Safety-Related / Non-Safety-Related	Page 3 of

Client CP&L	Prepared by	Date
Project H.B. ROBINSON	Reviewed by	Date
Proj. No. 7988-00 Equip. No.	Approved by	Date

BATTERY A

FROM REF. 1 GOULD NCN-1050-60 CELL BATTERY
PCP CHGR. 300A @ 125VDC

FROM REF. 2. BATT CELL SHORT CIRCUIT
= 9210A @ 77°F

FROM REF 4 MAX TEMP HISTORY = 87°F - USE 104°F CONSERVATIVE

FROM REF 5 MULTIPLIER EQUAL 1.15

SHORT CIRCUIT = 9210 x 1.15 = 10,591.5 A.

FROM REF 7 BATT CHRGR SHORT CIRCUIT IS 30000

TOTAL MAX SHORT CIRCUIT = 10,591.5 + 30000 = 13,591.5 A

FROM REF. 8 CIR. BKRS ARE GOOD FOR
30,000 AMPS FOR TIME CONSTANTS LESS THAN 10 MS.

PER REF. 9 BATTERY SHORT CIRCUIT CAN
BE 10 TIMES THE 1 MIN. RATE to 1.75 VPC

PER REF. 10 THE 1 MIN RATE IS 1204 AMPS
THEREFORE BATTERY SHORT CIRCUIT IS 12,040 AMPS
TOTAL SHORT CIRCUIT CURRENT = 12040 + 3000 = 15,040

CONCLUSION

THE SHORT CIRCUIT CURRENT USING EITHER TEST VALUES OR THE IEEE METHOD (12,670 or 1504 IS LESS THAN THE 30,000 A CIRCUIT BREAKER RATING.

Form GO-3.08.1 Rev. 2 SL-F647 04/84

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For DC SHORT CIRCUIT		Calc. No. 7988-E2
		Rev. Date 4 [illegible]
X Safety-Related	Non-Safety-Related	Page 4 of

Client CP&L	Prepared by	Date
Project H.B. ROBINSON	Reviewed by	Date
Proj. No. 7988-00 Equip. No.	Approved by	Date

BATTERY B

FROM REF 1 GOULD MCX-3410 60 CELL BATTERY
PCP CHGR 300 A @ 125 VDC

FROM REF 11 BATT SHORT CIRCUIT = 3987 @ 77°F
FROM REF 4 & 5 - MAX TEMP = 89°F USE 104°F 40°C TO BE CONSERVATIVE
SHORT CIRCUIT = 3987 × 1.15 = 4585 A

FROM REF 7 BATT CHGR MAX SHORT CIRCUIT = 3000 A

TOTAL MAX SHORT CIRCUIT = 4585 + 3000 = 7585

PER REF. 9. BATTERY SHORT CIRCUIT CAN BE
10 TIMES THE 1 MIN. RATING TO 1.75 VPC

FROM REF 10 THE 1MIN RATE IS 4418 AMPS.
THEREFORE THE BATTERY SHORT CIRCUIT IS 4480 A

TOTAL SHORT CIRCUIT = 4480 + 3000 = 7480 AMPS

FROM REF. 8 THE CIR. BKRS ARE GOOD
FOR AT LEAST 10,000 AMPS. UL RATING
CIRCUIT TIME CONSTANT NOT A FACTOR

CONCLUSION

THE SHORT CIRCUIT CURRENT USING ETHER TEST VALUES OR THE IEEE METHOD FIND 7480 IS LESS THAN THE 30,000 A CIR. BKR RATING.

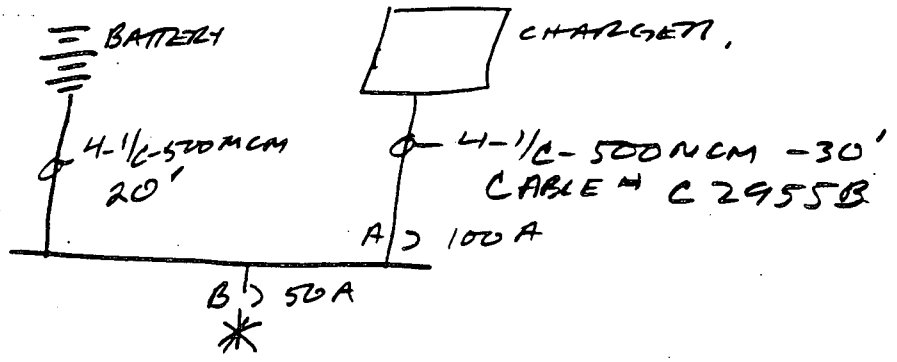
Form GQ-3.08.1 Rev. 2 SL-F647 04/84

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For	Calc. No. 7984-E2
	Rev. 1 Date
X Safety-Related	Non-Safety-Related	Page 5 of

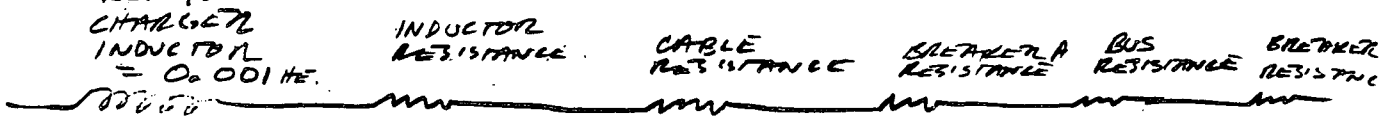
Client	Prepared by	Date
Project	Reviewed by	Date
Proj. No. Equip. No.	Approved by	Date

CIRCUT TIME CONSTANT BATTERY A



A TIME CONSTANT FOR EACH CONTRIBUTION WILL BE CALCULATED. THE RESULTS WILL BE COMBINED TO PROVIDE AN OVERALL TIME CONSTANT.

BATTERY CHARGER.



INDUCTOR RESISTANCE

ASSUME AN EFFICIENT INDUCTOR WITH $X/R = 100$

$$100 = \frac{WL}{R} = \frac{2\pi 60 (0.001)}{R} \qquad R = \frac{2\pi 60 (0.001)}{100} = 0.003770\ \Omega$$

CABLE RESISTANCE. cable RESISTANCE NEGLIGIBLE.

SSL-ESA 102

$$R = \frac{0.00270}{100'} \times 60' \times \frac{1}{2} = 0.000810$$

BREAKER RESISTANCE - A

FROM REF 11 -

50 A - 0.0014 Ω/POLE

100 A - 0.0009 Ω/POLE x2 → 0.0018 Ω

Form GQ-3.08.1 Rev. 2 SL-F647 04/84

BUS RESISTANCE,

ASSUME RESISTANCE TO BE THE SAME AS THE INTERNAL RESISTANCE OF A CELL PER POLE

$0.0001954 \times 2 = 0.0003908 \approx 0.000391$

BREAKER RESISTANCE B

$2 \times 0.0019\ \Omega/\text{POLE} = 0.0038$

TOTAL R =

0.003770	INDUCTOR
0.000810	CABLE
0.0018	BREAKER A
0.000391	BUS
0.0038	BREAKER B
0.010571 Ω	

TIME CONSTANT BAT CHGR $= L/R = \frac{0.001}{0.010571} = 0.0946$ SECONDS.

BATTERY

THE BATTERY ITSELF IS A CAPACITIVE DEVICE THEREFORE ONLY CONSIDER THE CABLING.

$R = \frac{0.00270\ \Omega}{100'} \times 40' \times \frac{1}{2} = 0.000540\ \Omega$

$WL = X_{L@60} = 0.00259 = \quad L = \frac{0.00259}{377} = 6.872 \times 10^{-6}\ H/100'$

$L = \frac{6.872 \times 10^{-6}}{100} \times 40' \times 1/2 = 1.37 \times 10^{-6}\ H.$

$$\text{TIME CONSTANT}_{BATT} = L/R = \frac{1.37 \times 10^{-6}}{5.40 \times 10^{-4}} = 0.0025 \text{ SECONDS.}$$

THE BATTERY CONTRIBUTION IS 10,591.5

AT 1 m s THE CURRENT WOULD DECAY (ASSUMING THE THE SOURCE SHORT CIRCUITS) EXPONENTIALLY DUE TO THE TIME CONSTANT AS FOLLOWS.

$$I = I_f e^{-T/\tau} \quad (\tau \leftarrow \text{TIME CONSTANT}) = 10,591.5 e^{-\frac{0.001}{0.0025}} = 7100 \text{ AMPS}$$

BATTERY CHARGER.

$$I = 3000 e^{-\frac{0.001}{0.0946}} = 2968 \text{ AMPS}$$

$$\frac{\Delta I}{\Delta t}_{INRUSH} = \frac{13,591.5 - (7100 + 2968)}{0.0015 \text{ SECONDS}} = 3529 \text{ AMPS}/10^{-3} \text{ SECONDS} \approx \frac{di}{dt}$$

$$\frac{di}{dt} = \frac{d(13591.5(1 - e^{-T/\tau_{eq}}))}{dT}$$

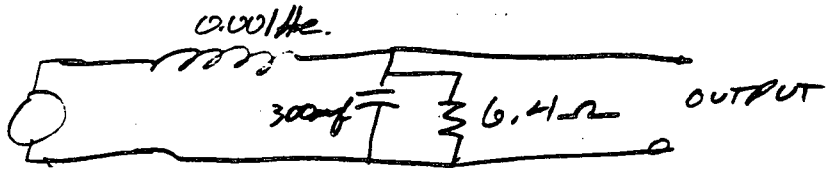
$$\frac{di}{dt} = 0 - 13591.5 e^{-T/\tau_{eq}} \left(\frac{-1}{\tau_{eq}}\right) \quad dt$$

at $T = 0$

$$\frac{3523.1 \text{ amps}}{10^{-3} \text{ SEC}} = \frac{13591.5 \text{ AMPS}}{\tau_{eq}}$$

$$\tau_{eq} = \frac{13591.5 \times 10^{-3}}{3523} = 0.00386 \text{ SECONDS}$$

THE APPROXIMATE OVERALL TIME CONSTANT IS 3.9 MILLISECONDS WHICH IS LESS THAN THE 10 MILLISECOND MAXIMUM. ALSO THE BATTERY CHARGER HAS THE FOLLOWING CIRCUIT.



THIS CIRCUIT ALLOWS THE INDUCTOR CURRENT TO FLOW THROUGH THE CHARGER RESISTOR WHEN THE CIRCUIT BREAKER STARTS TO OPEN. THIS REDUCES THE L/R RATIO FURTHER BUT WAS NOT TAKEN INTO ACCOUNT AND IS THEREFORE CONSERVATIVE

CONCLUSIONS.

BATTERY A

THE SHORT CIRCUIT CURRENTS CALCULATED (13,591.5A, TEST VALUES; 15,040A, IEEE METHOD) ARE ABOVE THE UL RATING OF THE BREAKERS. TESTED VALUES OF 30 KA at 125 Vdc HAVE BEEN PERFORMED SUCCESSFULLY FOR CIRCUITS WITH A TIME CONSTANT OF 10 MILLISECONDS OR LESS. THE OVERALL TIME CONSTANT IS 3.9 MILLISECONDS WHICH IS SIGNIFICANTLY LESS THAN 10. THEREFORE THE APPLICATION OF W EHB BREAKERS IS ACCEPTABLE.

BATTERY B

THE SHORT CIRCUIT CURRENTS CALCULATED ARE LESS THAN THE U.L. RATING AND THEREFORE AN ACCEPTABLE APPLICATION.

PARALLEL OPERATION

THE SHORT CIRCUIT AVAILABLE FOR THE TWO BATTERIES IN PARALLEL PLUS ONE CHARGER IS CONSERVATIVELY AS FOLLOWS:

	CALCULATION	IEEE
BATT A	10,591.5	12040
BATT B	4585	4480
CHGR	3000	3000
	18,176.5 AMPS	19,520 AMPS

FROM PREVIOUS CALCULATION ABOVE IT CAN BE EXPECTED THAT THE ADDITION OF THE SECOND BATTERY INTO THE L/R CALCULATION WILL SLIGHTLY REDUCE THE TIME CONSTANT, THEREFORE THE CIRCUIT BREAKERS ARE ACCEPTABLE.

PER REF [4] THE BUS IS BRACED FOR 20 KA. THEREFORE THE BUS IS ADEQUATELY BRACED FOR PARALLEL OPERATION.

CP&L

Carolina Power & Light Company

Calc. No. 7988-E2	
Rev. 1	Date 7-1-87
Page 10	
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File: R87-039/00-XX-A528

ESL-257

Mr. Tom McCauley
Sargent & Lundy Engineers
55 East Monroe Street
Chicago, Illinois 60603

H. B. ROBINSON STEAM ELECTRIC PLANT - UNIT 2
STATION BATTERY CHARGER INFORMATION

Dear Mr. McCauley:

Station battery and charger information for the "A" and "B" DC systems at the H. B. Robinson Steam Electric Generating Plant is as follows:

Station Battery A:	Gould Type NCX-1050, 60 cells, 1050 AH (8-hour rating)
Battery Charger A:	Power Conversion Products Model #4157, Form A
Input:	440V, 3Ø, 60 HZ, 92A
Output:	125VDC, 300A
Station Battery B:	Gould Type MCX-340, 60 cells, 340 AH (8-hour rating)
Battery Charger B:	Power Conversion Products Model #4157, Form A
Input:	440V, 3Ø, 60 HZ, 92A
Output:	125VDC, 300A

Yours very truly,

A B Cutter by RLS

A. B. Cutter - Vice President
Nuclear Engineering & Licensing

JJD/lah

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

20032

ITE Imperial Corporation

DISTRIBUTION	
Gould Inc.	2
H. R. C. File	1

Calc. No.	7948-E2
Rev.	1
Date	7-1-87
Page	11
Proj. No.	

TEST REPORT

TITLE

TYPE OF TEST

Short Circuit

TYPE DEVICE

Gould Stationary Power Cells
Types FPS, MCX, and NCX.

OBJECT

To investigate the performance of these designs when subjected to dead short circuits of two (2) second and thirty (30) second duration.

PREPARED BY W. E. Liebert DATE April 13, 1973

TESTED BY C. M. Jackson DATE March 21, 28, 1973

LABORATORY Heberlein Research Center

OSC. NO. 47711 to 47716, 47825 T.O. NOS. -----

FILE No. 375 D.O./S.O. 39-00074

DEVELOPMENT NUMBER + SHOP ORDER

TEST NO. 20032

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Page	12
Proj. No.	

TEST REQUEST

Test Engineer .

Please use this page to describe the test device, using Dwg. Nos., Layout Nos., E.P.L. Nos., and description, to describe the complete assembly, major components, adjustments, and conditions pertinent to the type of tests to be performed. This page will be incorporated into the test report.

DEVICE TESTED:

Gould stationery power cells (calcium) of the following types and ratings:

FPX-225
MCX-595
NCX-1800
NCX-2100
NCX-2550

I-T-E Imperial Corporation

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TEST REPORT

PROCEDURE:

For all tests three (3) of the same type of cells as listed on the tabulation of data were connected in series with links supplied by Gould. The short circuit was applied by an I-T-E type K-1600 circuit breaker (all 3 poles in parallel) which was connected to the battery with a short loop of copper bus bar. A shunt was in series in this circuit to measure the current. See sketch No. 1.

The current and volts across the battery were monitored with a Siemens magnetic oscillograph.

The resistance of each sample battery was measured prior to test, and the open circuit voltage was measured after each test with a DC voltmeter.

All pertinent data and values of fault current and voltages measured from the oscillograms is tabulated on Table No. I.

RESULTS:

There was no visual damage caused at any time. Refer to the Tabulation of Data, Table No. I.

TESTS WITNESSED BY:

Representatives of Gould Industrial Battery Division

Messers: R. W. Hopewell - March 21 and 28, 1973
W. F. Hurley - March 21, 1973
W. C. King - March 21, 1973
J. W. Swanekamp - March 21 and 28, 1973

CERTIFICATION:

This is to certify that the enclosed data are the results of tests performed at the I-T-E Imperial Corporation's Heberlein Research Center, Cahlfont, Pennsylvania on March 21 and 28, 1973 and are true and correct.

DATE APRIL 17, 1973

W. A. Carter
Laboratory Director
Heberlein Research Center

jh

ITE Imperial CORPORATION

TEST NO. 20032
SO / WO 39-00034
3-21-73

TABULATION OF DATA – TABLE NO. 1

SHORT CIRCUIT TESTS
GOULD STATIONERY POWER CELLS

Calc. No. 7986-EC | Rev. 7-1-87 | Page 14 | Proj. No.

TRIAL NO.	OSC. NO.	BATTERY TYPE	EXT. RES. Ω	O.C.V. D.C.	C.C.V. START OF FAULT	C.C.V. END OF FAULT .2Ω	O.C.V. @ 50 m s AFTER	O.C.V. AFTER TEST (METER)	DC FAULT CURR. START kA	DC FAULT CURR. END kA	DURATION CURR. FLOW SEC.	REMARKS
1.	47711	MCK575	89.5	N.M.	0.725	0.650	5.750	N.M.	6.57	6.34	1.94	OSCILLOGRAPH DID NOT RECORD INITIATION OF FAULT CURRENT. NO VISUAL DAMAGE
		754								[redacted]		
2.	47712	MCK596	89.5	6.087	0.763	0.650	5.800	6.192	6.78	6.30	1.95	NO VISUAL DAMAGE
		754			.254	.216			6.97	[redacted]		
3.	47713	MCK2100	93.5	6.086	1.575	1.438	5.813	6.189	14.98	14.57	1.96	NO VISUAL DAMAGE
		2254			.525	.479			6.68	[redacted]		
4.	47714	MCK1800	93.5	6.088	1.338	1.213	5.738	6.174	12.73	12.32	1.95	NO VISUAL DAMAGE
		1932			.446	.404			6.28	[redacted]		
5.	47715	FPS-25	93.5	6.063	1.100	1.000	5.715	6.166	10.05	9.62	1.95	NO VISUAL DAMAGE
												"
6.	47716	MCK2550	93.5	6.025	1.650	1.613	5.788	6.169	16.61	16.10	1.95	NO VISUAL DAMAGE.
		5720			.55	.537			6.12	[redacted]		
7.	47825	MCK2850	93.5	N.M.	1.525	1.400	5.725	N.M.	16.81	14.87	28.27	NO VISUAL DAMAGE
		3720			.508	.466			6.19	[redacted]		THE OSCILLOGRAPH DID NOT RECORD THE INITIATION OF FAULT CURRENT

.508 + .466 = .974 Avg. 6.39 Avg

4 OF 6

Calc. No. 7988-E2	Date 7-1-87
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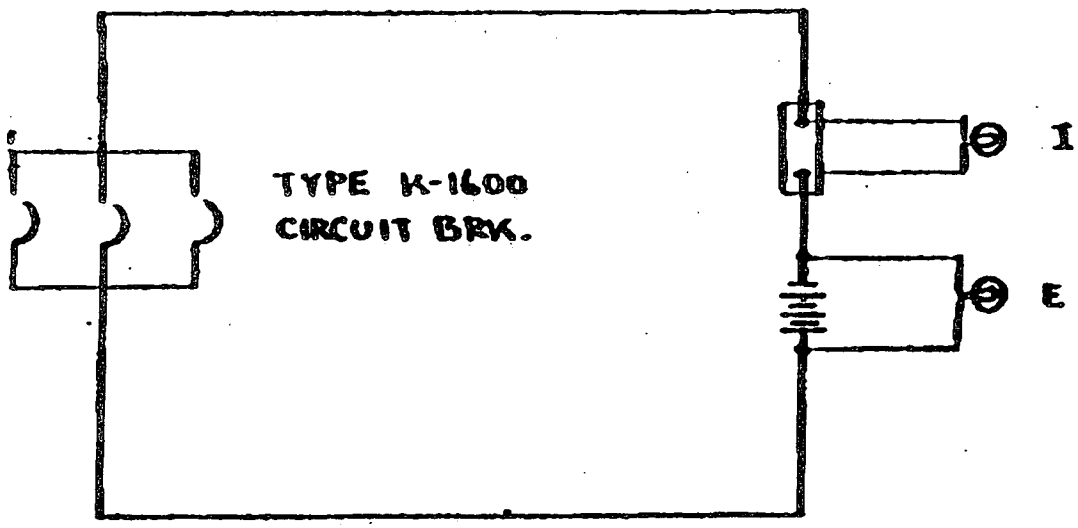

SK. N= 1

DATE	FOR TEST ARRANGEMENT	I-T-E IMPERIAL CORPORATION
REQ. NO.	GOULD BATTERY TESTS.	TEST NO. 20032
S.O.		1 OF 6

INTERCELL CONNECTOR IR DROP
POWER BATTERIES @ 1 MINUTE RATE

NAX - NCX			MAX - MCX		
A. H.	OHMS	Voltage Drop	A. H.	OHMS	Voltage Drop
600	.00002406	.01713	170	.00002947	.00689
672	.00002406	.0153	190	.00002947	.00625
750	.00002406	.02117	255	.00002947	.00999
840	.00002406	.0190	285	.00003439	.01042
900	.0000116	.01211	340	.00003439	.01540
1008	.0000116	.010927	380	.00004057	.01533
1050	.0000116	.013966	425	.00002166	.01191
1200	.0000116	.015776	475	.00002614	.01189
1344	.00001069	.013255	510	.00002614	.01709
1350	.00001069	.01597	595	.00002614	.01976
1500	.00001069	.01753	MPP		
1650	.00000871	.01552	160	.00002947	.0076
1680	.00000871	.013326	240	.00002947	.01131
1800	.00000871	.01682	320	.00003439	.01712
1848	.000008	.013376	400	.00003439	.01325
1950	.00000871	.0181168	480	.000017012	.0123
2016	.000008	.014496	560	.000017012	.0142
2100	.000008	.01792			
2184	.000008	.0156			
2250	.000006	.0144			
2400	.000006	.01536			
2550	.000006	.01632			

Calc. No.	7988-E2
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NAX-NCX CELL DATA

	INTERNAL RESISTANCE	SHORT CIRCUIT CURRENT	V
NAX-NCX- 600	0.0003303	5446	
NAX-NCX- 672	0.0003699	4865	
NAX-NCX- 750	0.0002573	6732	
NAX-NCX- 840	0.0002978	6043	
NAX-NCX- 900	0.0002253	7986	2.02
NAX-NCX-1008	0.0002497	7206	
NAX-NCX-1050	0.0001954	9210	1.7996 V
NAX-NCX-1200	0.0001730	10404	
NAX-NCX-1344	0.0001897	9486	
NAX-NCX-1350	0.0001574	11429	
NAX-NCX-1500	0.0001452	12393	1.7995
NAX-NCX-1650	0.0001320	13632	
NAX-NCX-1680	0.0001537	11704	
NAX-NCX-1800	0.0001217	14779	
NAX-NCX-1848	0.0001416	12706	
NAX-NCX-1950	0.0001131	15912	1.7996
NAX-NCX-2016	0.0001315	13678	
NAX-NCX-2100	0.0001050	17136	
NAX-NCX-2184	0.0001222	14718	
NAX-NCX-2250	0.0000980	18360	
NAX-NCX-2400	0.0000919	19584	
NAX-NCX-2550	0.0000865	20808	

PLATES

NAX -	POSITIVE PLATE	0.320" x 12 1/2" w. x 15" H. - 11.53 Lbs.
	NEGATIVE PLATE	0.215" x 12 1/2" w. x 15" H. - 8.37 Lbs.
NCX -	POSITIVE PLATE	0.320" x 12 1/2" w. x 15" H. - 12.0 Lbs.
	NEGATIVE PLATE	0.215" x 12 1/2" w. x 15" H. - 8.5 Lbs.

JARS AND COVER

600-1200	Jar - 6.00 lbs., cover - 0.90 lbs.
1344-1800	Jar - 8.00 lbs., cover - 1.00 lbs.
1650-1950	Jar - 11.12 lbs., cover - 1.38 lbs.
1848-2550	Jar - 13.00 lbs., cover - 1.80 lbs.

Jar height - overall - 20"
sealing lip - 1/2"
wall thickness - 0.250"
bottom thickness - 0.250"

SEPARATORS AND MATS

0.795" Centers -	Separator	.089" x 12 7/8" x 16 1/8" L.
	Mat	.030" x 12 7/8" x 16 1/8" L.
1.040" Centers -	Separator	.190" x 12 7/8" x 16 1/8" L.
	Mat	.050" x 12 7/8" x 16 1/8" L.

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Westinghouse
Electric Supply Company

2013 Raleigh Boulevard
Box 41189
Raleigh, NC 27629
919 • 834 • 8211

W E S C O

May 1, 1987

Carolina Power & Light Company
Post Office Box 1551
Raleigh, N.C. 27602

Attn: Mr. Kent Russel

Dear Mr. Russel,

Our people at Westinghouse said that on a WEB - Panel the bus and support are suited for use of 20,000 IC breakers. The structure of our panels are built to withstand the highest possible IC breaker that will fit in the panel.

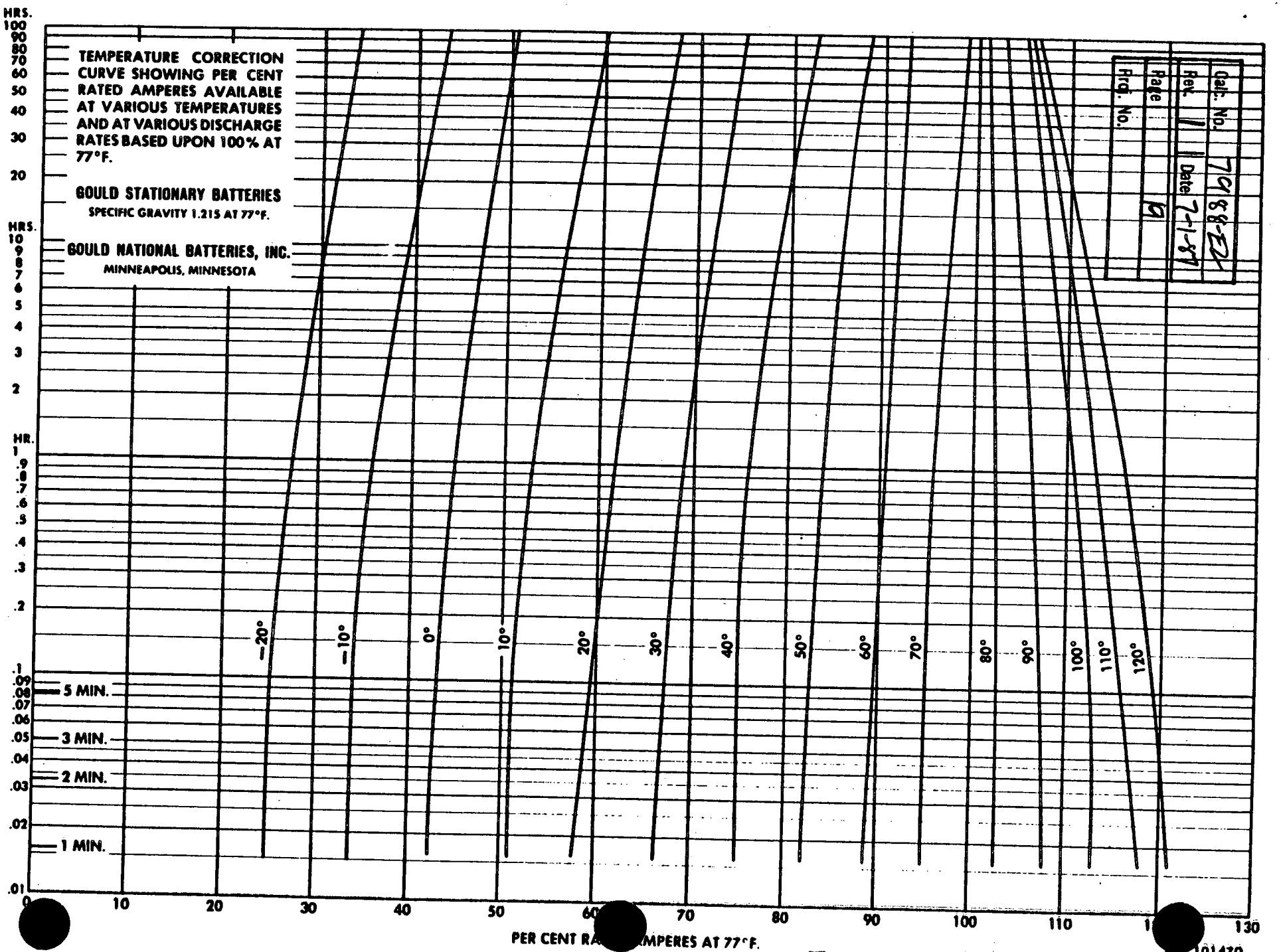
If you have any further questions, please feel free to give us a call.

Thank You,

Doug Roberts

Doug Roberts

WDR/lah


TEMPERATURE CORRECTION CURVE SHOWING PER CENT RATED AMPERES AVAILABLE AT VARIOUS TEMPERATURES AND AT VARIOUS DISCHARGE RATES BASED UPON 100% AT 77°F.
GOULD STATIONARY BATTERIES
SPECIFIC GRAVITY 1.215 AT 77°F.
GOULD NATIONAL BATTERIES, INC.
MINNEAPOLIS, MINNESOTA
Dwg. No. 76888-24
Rev. 1
Date 7-1-57
Page 19
TIME RATE TO 1.75 VOLTS PER CELL
HRS.
HR.
5 MIN.
3 MIN.
2 MIN.
1 MIN.
-20°
-10°
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
PER CENT RATED AMPERES AT 77°F.
ME-101470

forty two east street, p.o. box 380, crystal lake, illinois 60014, telephone: 815/459-9100, twx 910/634-3356, fax 815/459-9118

power conversion products inc

I mailed to Larry Lutz

Calc. No.	7988-E2
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April 24, 1987

Sargent & Lundy
55 E. Monroe Street
Chicago, IL 60603

Attn: Mr. Bob Treece

Subject: Short-Circuit Output of Cat. 4157

Dear Mr. Treece:

The short-circuit current of equipment like the subject magnetic amplifier controlled battery charger has two components: a brief high-current spike from the discharge of the output short-circuit current and a sustained short-circuit current determined by the characteristics of the transformers.

In the case of the subject magnetic amplifier controlled battery charger, the output capacitor is so small that its contribution can be neglected. The steady-state output, on the other hand, is fairly substantial since the charger is not current-limited into a short.

Without measuring the commutating reactance of the transformer and the saturated reactance of the magnetic amplifiers, I cannot calculate the short-circuit output current. However, my estimate is that the current is unlikely to exceed 10 times the output, or 3000 Amperes. As a result of this high output current, the output circuit breaker of the battery charger will trip after a few cycles; thus, taking the charger out of service. On the basis of this information, we can conclude, that an output short-circuit is not likely to cause a problem with circuit breaker interrupting ratings.

Sincerely,

POWER CONVERSION PRODUCTS INC.

Jefferson T. Mitchell
Vice President Engineering

JTM/cb

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Westinghouse
Electric Corporation

3701 National Drive
Box 10388
Raleigh North Carolina 27606-0388

May 12, 1987

Mr. R. L. Sanders, Manager
Nuclear Engineering
Carolina Power & Light
P. O. Box 1551
Raleigh, NC 27602

Subject: (W) EHB Breakers

Gentlemen:

This letter is in response to your inquiry regarding Type EHB Breakers installed in your DC system at the H. B. Robinson Steam Electric Plant.

Westinghouse Electric Corporation states that its two-pole designs of EHB molded-case circuit breakers with nominal ratings from 15 to 100 amperes can safely interrupt these DC circuits:

- 21 kA at 250 volts with a time constant of 10 millisecond or less.
- 30 kA at 125 volts with a time constant of 10 millisecond or less.

These assigned interrupting ratings are based upon:

1. UL tests at 250 volts with 10 kA available.
2. Engineering tests at 250 volts with 20.9 kA available.
3. Both sets of tests were in accordance with UL 489 procedures and met all requirements of that standard.

Hopefully, these comments will satisfy your immediate needs.

Very truly yours,

R. Scott Pollock
Electric Utility Sales

RSP/mma

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Switchgear and General Industrial Stationary Power Cells

CAPACITIES—600 A.H. to 2550 A.H. @ 8 HOUR RATE TO 1.75 V.P.C. AVERAGE

Type: NAX and NCX Antimony and Calcium

SPECIFICATIONS

Container — Styrene-Acrylonitrile Plastic
Cover — Butadiene Styrene
Separators — Micropourous Material
Retainers — Fiberglass Mats
Posts — See Below [1]
Post Seals — Floating O-Ring–Seal Nut
Vents — Gould (GNB) "Pre-Vent" ™
Level Lines — High and Low - All Jar Faces
Electrolyte — Height Above Plates — 2.75" (70 mm)
Sediment Space — 1.06" (27 mm)
Specific Gravity — 1.215 @ 77°F (25°C)
Inter-Cell Connectors — Lead Plated Copper

NAX/NCX-1650

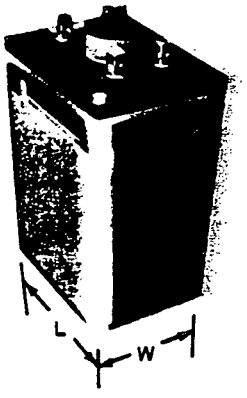


Plate Dimensions	Height	Width	Thickness
Positive Plate	15 in 381.0 mm	12.5 in 317.5 mm	.320 in 8.13 mm
Negative Plate	15 in 381.0 mm	12.5 in 317.5 mm	.215 in 5.46 mm

[1] Posts—600 A.H. to 1200 A.H. Two—1½" square. 1350 A.H. to 1950 A.H. Four—1" square. 2100 A.H. to 2550 A.H. Four—1½" square.

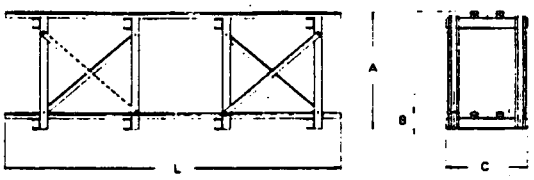
PHYSICAL CHARACTERISTICS

Cell Type		Plates Per Cell	Overall Dimensions			Antimony		Calcium		Elect. Per Cell	
Antimony	Calcium		L	W	H	Net Weight	Packed Weight	Net Weight	Packed Weight	Gals.	Liters
NAX-600	NCX-600	9	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	173 lb 79 kg	185 lb 84 kg	177 lb 80 kg	189 lb 86 kg	6.0	25.1
NAX-750	NCX-750	11	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	191 lb 87 kg	203 lb 92 kg	195 lb 89 kg	207 lb 94 kg	5.6	23.4
NAX-900	NCX-900	13	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	209 lb 95 kg	221 lb 100 kg	213 lb 97 kg	225 lb 102 kg	5.1	21.3
NAX-1050	NCX-1050	15	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	227 lb 103 kg	239 lb 109 kg	231 lb 105 kg	243 lb 110 kg	4.9	20.5
NAX-1200	NCX-1200	17	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	245 lb 111 kg	257 lb 117 kg	249 lb 113 kg	261 lb 119 kg	5.0	20.9
NAX-1350	NCX-1350	19	9.25 in 244.2 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	277 lb 126 kg	289 lb 131 kg	282 lb 128 kg	294 lb 134 kg	6.3	26.4
NAX-1500	NCX-1500	21	9.25 in 244.2 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	296 lb 135 kg	308 lb 140 kg	301 lb 137 kg	313 lb 142 kg	6.0	25.1
NAX-1650	NCX-1650	23	11.38 in 300.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	342 lb 155 kg	360 lb 164 kg	348 lb 158 kg	366 lb 166 kg	8.0	33.5
NAX-1800	NCX-1800	25	11.38 in 300.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	357 lb 162 kg	375 lb 170 kg	364 lb 165 kg	382 lb 174 kg	7.6	31.8
NAX-1950	NCX-1950	27	11.38 in 300.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	373 lb 170 kg	391 lb 178 kg	380 lb 173 kg	398 lb 181 kg	7.3	30.5
NAX-2100	NCX-2100	29	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	439 lb 200 kg	457 lb 208 kg	446 lb 203 kg	464 lb 211 kg	11.5	48.1
NAX-2250	NCX-2250	31	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	454 lb 206 kg	472 lb 215 kg	462 lb 210 kg	480 lb 218 kg	10.9	45.6
NAX-2400	NCX-2400	33	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	471 lb 214 kg	489 lb 222 kg	479 lb 218 kg	497 lb 226 kg	10.3	43.1
NAX-2550	NCX-2550	35	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	488 lb 222 kg	506 lb 230 kg	496 lb 225 kg	514 lb 234 kg	9.7	40.6

NOTE: Available per IEEE 323 for Class 1E installations

STATIONARY BATTERY RACKS FOR NAX/NCX CELLS

	In	cm
A	37.25	94.62
B	4.00	10.16
C	21.00	53.34



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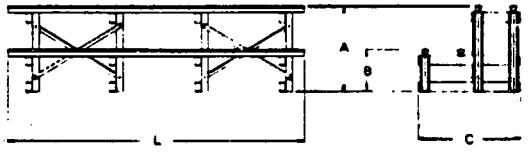
2 TIER RACKS

CELL TYPES	NO. OF CELLS	RACK PART NUMBER	LENGTH		WEIGHT	
			Ft-in	cm	lbs	kg
NAX/NCX-600 TO NAX/NCX-1200	12	S09-074470	4'-0"	122	115	52
	24	S09-074478	8'-0"	244	201	91
	58	S09-074500	19'-0"	579	469	213
	60	S09-074502	20'-0"	610	481	219
	120*	S09-074502	20'-0"ea	610 ea	481 ea	219 ea
NAX/NCX-1350 TO NAX/NCX-1500	12	S09-074472	5'-0"	152	128	58
	24	S09-074482	10'-0"	304	256	116
	58*	S09-074488	13'-0" ea	396 ea	329 ea	150 ea
	60*	S09-074488	13'-0" ea	396 ea	329 ea	150 ea
	120†	S09-074488	13'-0" ea	396 ea	329 ea	150 ea
NAX/NCX-1650 TO NAX/NCX-1950	12	S09-074474	6'-0"	183	175	80
	24	S09-074486	12'-0"	366	314	143
	58*	S09-074492	15'-0" ea	457 ea	389 ea	177 ea
	60*	S09-074492	15'-0" ea	457 ea	389 ea	177 ea
	120†	S09-074492	15'-0" ea	457 ea	389 ea	177 ea
NAX/NCX-2100 TO NAX/NCX-2550	12	S09-074478	8'0"	244	201	71
	24	S09-074494	16'-0"	488	398	181
	58*	S09-074500	19'-0"	579 ea	469 ea	213 ea
	60*	S09-074500	19'-0" ea	579 ea	469 ea	213 ea
	120†	S09-074500	19'-0" ea	579 ea	469 ea	213 ea

* = 2 Racks required. † = 4 Racks required.

	In	cm
A	23.50	59.69
B	11.50	29.21
C	28.50	72.39



2 STEP RACKS

CELL TYPES	NO. OF CELLS	RACK PART NUMBER	LENGTH		WEIGHT	
			Ft-in	cm	lbs	kg
NAX/NCX-600 TO NAX/NCX-1200	12	S09-074508	4'-0"	122	111	50
	24	S09-074516	8'-0"	244	195	87
	58	S09-074538	19'-0"	579	455	207
	60	S09-074540	20'-0"	610	468	213
	120†	S09-074540	20'-0" ea	610 ea	468 ea	213 ea
NAX/NCX-1350 TO NAX/NCX-1500	12	S09-074510	5'-0"	152	124	56
	24	S09-074520	10'-0"	304	248	113
	58*	S09-074526	13'-0" ea	396 ea	319 ea	145 ea
	60*	S09-074526	13'-0" ea	396 ea	319 ea	145 ea
	120†	S09-074526	13'-0" ea	396 ea	319 ea	145 ea
NAX/NCX-1650 TO NAX/NCX-1950	12	S09-074512	6'-0"	183	168	76
	24	S09-074524	12'-0"	366	304	138
	58*	S09-074530	15'-0" ea	457 ea	374 ea	170 ea
	60*	S09-074530	15'-0" ea	457 ea	374 ea	170 ea
	120†	S09-074530	15'-0" ea	457 ea	374 ea	170 ea
NAX/NCX-2100 TO NAX/NCX-2550	12	S09-074516	8'-0"	244	195	89
	24	S09-074532	16'-0"	488	388	176
	58*	S09-074538	19'-0"	579 ea	455 ea	207 ea
	60*	S09-074538	19'-0" ea	579 ea	455 ea	207 ea
	120†	S09-074538	19'-0" ea	579 ea	455 ea	207 ea

* = 2 Racks required. †=4 Racks required. NOTES: For Zone 1 seismic protection, add suffix - 333 to rack part number.
For Zone 2 thru 4 seismic protection, add suffix - 666 to rack part number.
Overall length and width for seismic racks may vary. Contact your local GNB representative.

GNB Incorporated, Industrial Battery Division
2010 Cabot Boulevard West, Langhorne, Pa. 19047
Telephone (215) 750-2600

TWX: GOULD LAHN: 510-667-2056

GB-3541A 5M 4/85

AMPERE HOUR CAPACITIES
77°F (25°C)

Cell Type		Ampere Hour Capacities To 1.75 V.P.C.					Ampere Hour Capacities To 1.81 V.P.C.				
Antimony	Calcium	8 hr	5 hr	3 hr	2 hr	1 hr	8 hr	5 hr	3 hr	2 hr	1 hr
NAX-600	NCX-600	600	540	468	408	300	568	504	428	360	264
NAX-750	NCX-750	750	675	585	510	375	710	630	535	450	330
NAX-900	NCX-900	900	810	702	612	450	852	756	642	540	396
NAX-1050	NCX-1050	1050	945	819	714	525	994	882	749	630	462
NAX-1200	NCX-1200	1200	1080	936	816	600	1136	1008	856	720	528
NAX-1350	NCX-1350	1350	1215	1053	918	675	1278	1134	963	810	594
NAX-1500	NCX-1500	1500	1350	1170	1020	750	1420	1260	1070	900	650
NAX-1650	NCX-1650	1650	1485	1287	1122	825	1562	1386	1177	990	726
NAX-1800	NCX-1800	1800	1620	1404	1224	900	1704	1512	1284	1080	792
NAX-1950	NCX-1950	1950	1755	1521	1326	975	1846	1638	1391	1170	858
NAX-2100	NCX-2100	2100	1890	1638	1428	1050	1988	1764	1498	1260	924
NAX-2250	NCX-2250	2250	2025	1755	1530	1125	2130	1890	1605	1350	990
NAX-2400	NCX-2400	2400	2160	1872	1632	1200	2272	2016	1712	1440	1056
NAX-2550	NCX-2550	2550	2295	1989	1734	1275	2414	2142	1819	1530	1122

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DISCHARGE CHARACTERISTICS
AMPERES vs HOURS OF DISCHARGE TO 1.75 V.P.C. @ 77°F (25°C)

Cell Type		1 Min Rate	Discharge Time In Hours									
Antimony	Calcium	In Amps	.25	.50	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
NAX-600	NCX-600	712	515	454	300	204	156	127	108	94	83	75
NAX-750	NCX-750	880	686	561	375	255	195	158	135	117	104	93
NAX-900	NCX-900	1044	814	666	450	306	234	190	162	141	125	112
NAX-1050	NCX-1050	1204	939	768	525	357	273	222	189	164	146	131
NAX-1200	NCX-1200	1306	1060	867	600	408	312	254	216	188	166	150
NAX-1350	NCX-1350	1494	1165	953	675	459	351	285	243	211	187	168
NAX-1500	NCX-1500	1620	1263	1033	750	510	390	317	270	235	208	187
NAX-1650	NCX-1650	1782	1389	1136	825	561	429	349	297	258	229	206
NAX-1800	NCX-1800	1932	1506	1232	900	612	468	381	324	282	250	225
NAX-1950	NCX-1950	2080	1622	1327	975	663	507	412	351	305	271	243
NAX-2100	NCX-2100	2240	1747	1429	1050	714	546	444	378	329	292	262
NAX-2250	NCX-2250	2400	1872	1531	1125	765	585	476	405	352	312	281
NAX-2400	NCX-2400	2560	1996	1633	1200	816	624	508	432	376	333	300
NAX-2550	NCX-2550	2720	2121	1735	1275	867	663	539	459	399	354	318

NOTE: All ratings include voltage drop across intercell connections used in standard layouts.

DISCHARGE CHARACTERISTICS

AMPERES vs HOURS OF DISCHARGE TO 1.81 V.P.C. @ 77°F (25°C)

Cell Type		1 Min Rate	Discharge Time In Hours									
.ntimony	Calcium	In Amps	.25	.50	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
NAX-600	NCX-600	555	380	340	264	184	144	112	104	88	80	68
NAX-750	NCX-750	686	475	425	330	230	180	140	130	110	100	85
NAX-900	NCX-900	814	570	510	396	276	216	168	156	132	120	102
NAX-1050	NCX-1050	939	665	595	462	322	252	196	182	154	140	119
NAX-1200	NCX-1200	1061	760	680	528	368	288	224	208	176	160	136
NAX-1350	NCX-1350	1165	855	765	594	414	324	252	234	198	180	153
NAX-1500	NCX-1500	1264	950	850	660	460	360	280	260	220	200	170
NAX-1650	NCX-1650	1390	1045	935	726	506	396	308	286	242	220	187
NAX-1800	NCX-1800	1507	1140	1020	792	552	432	336	312	264	240	204
NAX-1950	NCX-1950	1622	1235	1105	858	598	468	364	338	286	260	221
NAX-2100	NCX-2100	1747	1330	1190	924	644	504	392	364	308	280	238
NAX-2250	NCX-2250	1872	1425	1275	990	690	540	420	390	330	300	255
NAX-2400	NCX-2400	1997	1520	1360	1056	736	576	448	416	352	320	272
NAX-2550	NCX-2550	2122	1615	1445	~~1122~~	~~782~~	~~612~~	~~476~~	442	374	340	289

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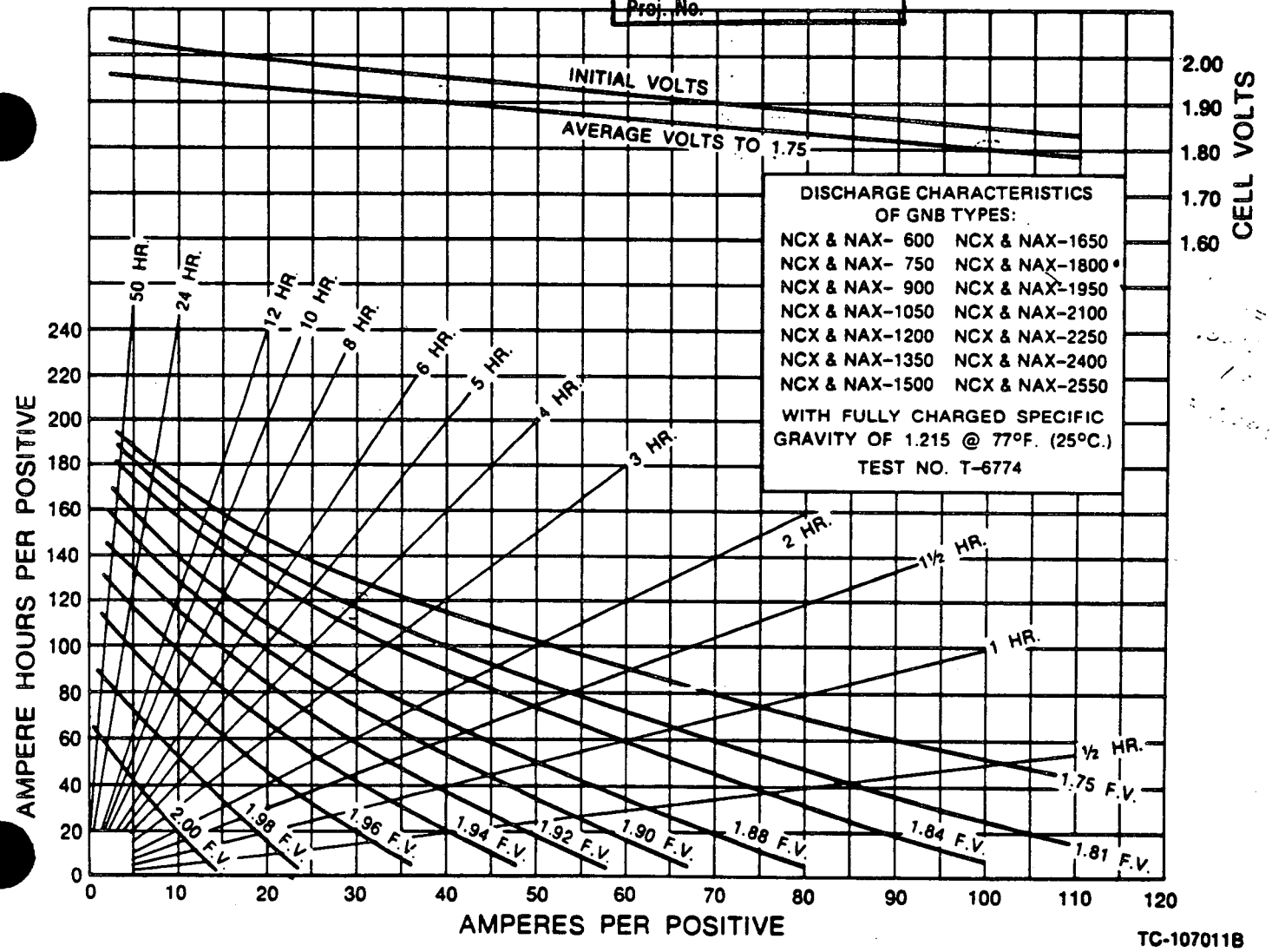

TC-107011B

GNB

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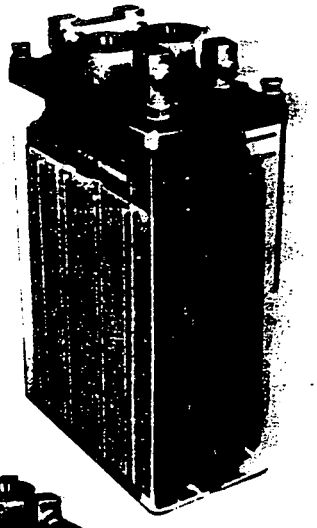
Switchgear and General Industrial Stationary Power Cells

Type: MAX and MCX Antimony and Calcium

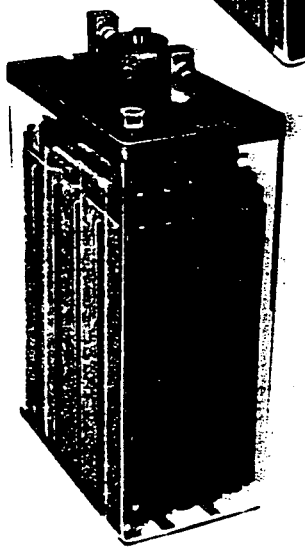
CAPACITIES—170 A.H. to 595 A.H. @ 8 HOUR RATE TO 1.75 V.P.C. AVERAGE

SPECIFICATIONS

Container — Syrene - Acrylonitrile Plastic
Cover — Butadiene Styrene
Separators — Micropourous Material
Retainers — Fiberglass Mats
Posts — Two - 1" (25.4 mm) Square
Post Seals — Floating O - Ring—Seal Nut
Vents — Gould (GNB) "Pre-Vent" ™
Level Lines — High and Low - All Jar Faces
Electrolyte — Height above plates - 2.50" (63.5 mm)
Sediment Space — .95" (23.8 mm)
Specific Gravity — 1.215 @ 77°F (25°C)
Inter-Cell Connectors — Lead Plated Copper



2-MAX/MCX-170



MAX/MCX-425

Plate Dimensions	Height	Width	Thickness
Positive Plate	11.56 in 293.7 mm	9.19 in 233.4 mm	.320 in 8.13 mm
Negative Plate	11.56 in 293.7 mm	9.19 in 233.4 mm	.215 in 5.46 mm

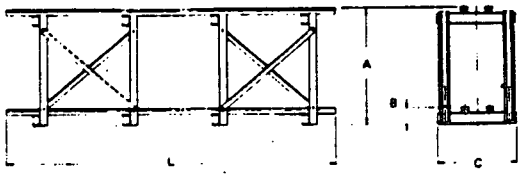
PHYSICAL CHARACTERISTICS

Cell Type		Plates	Overall Dimensions			Antimony		Calcium		Elect. Per Cell	
Antimony	Calcium	Per Cell	L	W	H	Net Weight	Packed Weight	Net Weight	Packed Weight	Gals	Liters
2-MAX-170	2-MCX-170	5	6.25 in 158.7 mm	11.13 in 282.7 mm	18.25 in 463.5 mm	103 lbs 47 kg	109 lbs 49 kg	106 lbs 48 kg	112 lbs 51 kg	1.3	5.4
2-MAX-255	2-MCX-255	7	6.25 in 158.7 mm	11.13 in 282.7 mm	18.25 in 463.5 mm	124 lbs 56 kg	130 lbs 59 kg	126 lbs 57 kg	132 lbs 60 kg	1.2	5.0
MAX-340	MCX-340	9	4.13 in 104.9 mm	11.13 in 282.7 mm	18.25 in 463.5 mm	79 lbs 36 kg	83 lbs 38 kg	80 lbs 36 kg	84 lbs 38 kg	1.6	6.7
MAX-425	MCX-425	11	5.13 in 130.3 mm	11.13 in 282.7 mm	18.25 in 463.5 mm	96 lbs 44 kg	101 lbs 46 kg	98 lbs 44 kg	103 lbs 47 kg	1.9	8.0
MAX-510	MCX-510	13	6.5 in 165.1 mm	11.13 in 282.7 mm	18.25 in 463.5 mm	117 lbs 53 kg	123 lbs 56 kg	119 lbs 54 kg	125 lbs 57 kg	2.7	11.3
MAX-595	MCX-595	15	6.5 in 165.1 mm	11.13 in 282.7 mm	18.25 in 463.5 mm	128 lbs 58 kg	134 lbs 61 kg	130 lbs 59 kg	136 lbs 62 kg	2.7	11.3

NOTE: Available per IEEE 323 for Class 1E installation.

STATIONARY BATTERY RACKS FOR MAX/MCX CELLS

	In	cm
A	31.75	80.65
B	4.00	10.16
C	18.00	45.72



2 TIER RACKS

CELL TYPES	NO. OF CELLS	RACK PART NUMBER	LENGTH		WEIGHT	
			Ft-In	cm	lbs	Kg
2-MAX/MCX-170	12	S09-078144	3'-0"	91	59	27
	24	S09-078146	4'-0"	122	69	31
2-MAX/MCX-255	58	S09-078156	9'-0"	274	135	61
	60	S09-078156	9'-0"	274	135	61
	120	S09-078172	17'-0"	518	248	113
MAX/MCX-340	12	S09-078144	3'-0"	91	59	27
	24	S09-078148	5'-0"	152	77	35
	58	S09-078162	12'-0"	366	174	79
	60	S09-078162	12'-0"	366	174	79
	120*	S09-078162	12'-0" ea	366 ea	174 ea	79 ea
MAX/MCX-425	12	S09-078144	3'-0"	91	59	27
	24	S09-078150	6'-0"	183	87	39
	58	S09-078166	14'-0"	427	208	96
	60	S09-078166	14'-0"	427	208	96
	120*	S09-078166	14'-0" ea	427 ea	208 ea	96 ea
MAX/MCX-510	12	S09-078146	4'-0"	122	69	31
	24	S09-078152	7'-0"	213	115	52
	58	S09-078172	17'-0"	518	248	113
MAX/MCX-595	60	S09-078174	18'-0"	548	263	120
	120*	S09-078174	18'-0" ea	548 ea	263 ea	120 ea

*2 Racks Required

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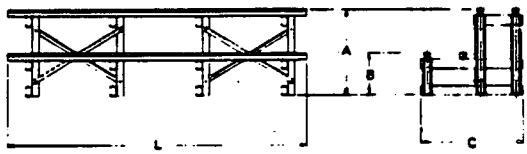
2 STEP RACKS

	In	cm
A	21.50	54.61
B	11.50	29.21
C	22.50	57.15



CELL TYPES	NO. OF CELLS	RACK PART NUMBER	LENGTH		WEIGHT	
			Ft-In	cm	lbs	Kg
2-MAX/MCX-170	12	S09-078184	3'-0"	91	56	25
	24	S09-078186	4'-0"	122	67	30
2-MAX/MCX-255	58	S09-078196	9'-0"	274	131	60
	60	S09-078196	9'-0"	274	131	60
	120	S09-078212	17'-0"	518	241	110
MAX/MCX-340	12	S09-078184	3'-0"	91	56	25
	24	S09-078188	5'-0"	152	75	34
	58	S09-078202	12'-0"	366	169	77
	60	S09-078202	12'-0"	366	169	77
	120*	S09-078202	12'-0" ea	366 ea	169 ea	77 ea
MAX/MCX-425	12	S09-078184	3'-0"	91	56	25
	24	S09-078190	6'-0"	183	85	39
	58	S09-078206	14'-0"	427	203	92
	60	S09-078206	14'-0"	427	203	92
	120*	S09-078206	14'-0" ea	427 ea	203 ea	92 ea
MAX/MCX-510	12	S09-078186	4'-0"	122	67	30
	24	S09-078192	7'-0"	213	111	50
	58	S09-078212	17'-0"	518	241	110
MAX/MCX-595	60	S09-078214	18'-0"	549	253	115
	120*	S09-078214	18'-0" ea	549 ea	253 ea	115 ea

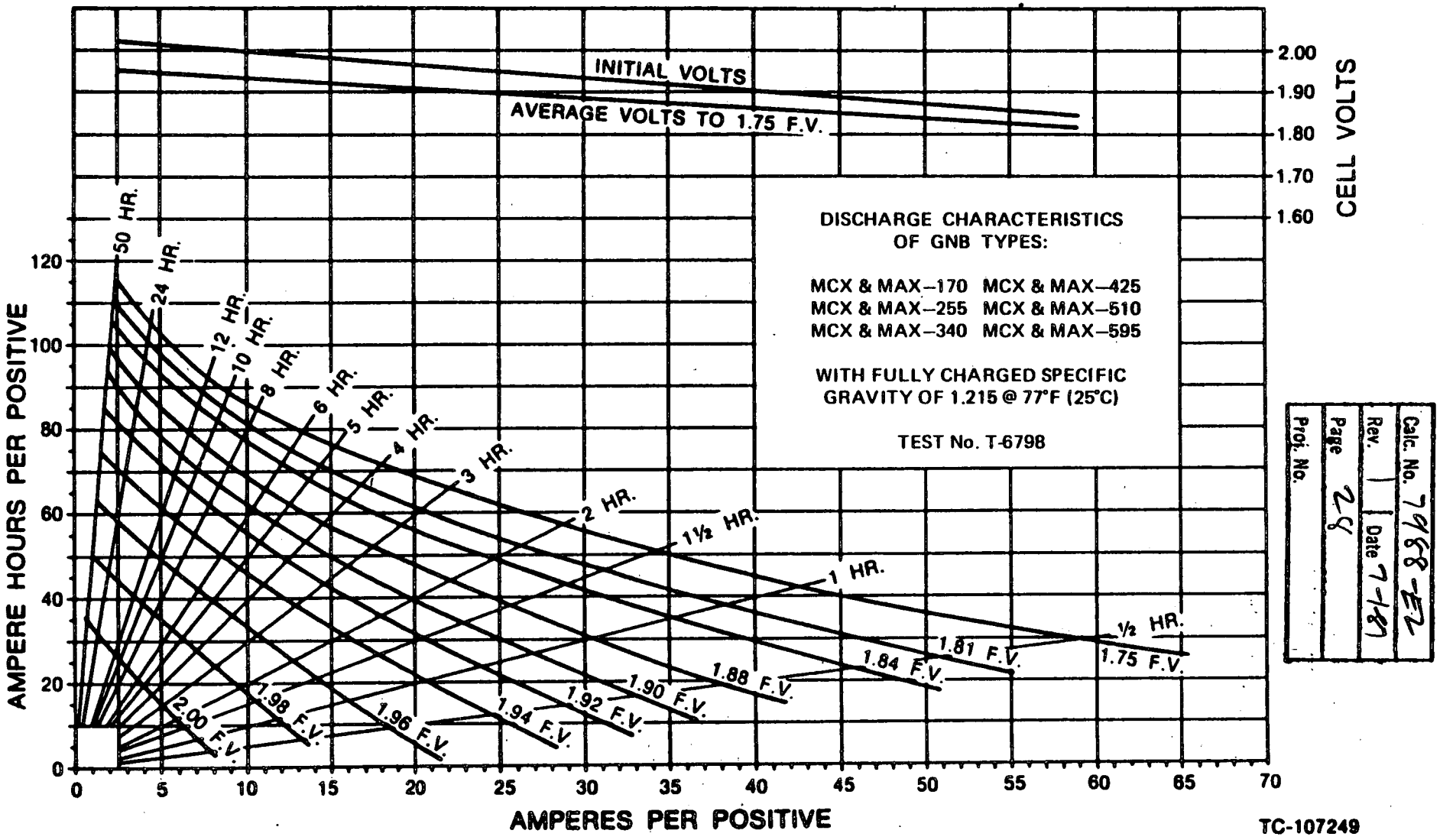
*2 Racks Required

NOTES: For Zone 1 seismic protection, add suffix - 333 to rack part number.
For Zone 2 thru 4 seismic protection, add suffix - 666 to rack part number.
Overall length and width for seismic racks may vary. Contact your local GNB representative.

GNB Batteries Inc., Industrial Battery Division
2050 Cabot Boulevard West, Langhorne, Pa. 19047
Telephone (215) 752-0555
CABLE: GOULNATBAT, LANGHORNE, PA - TWX: GOULD LAHN. 510-667-2056

GNB

GB-3538 5M 6/83



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TC-107249

AMPERE HOUR CAPACITIES
77°F (25°C)

Cell Type		Ampere Hour Capacities To 1.75 V.P.C.					Ampere Hour Capacities To 1.81 V.P.C.				
Antimony	Calcium	8 hr	5 hr	3 hr	2 hr	1 hr	8 hr	5 hr	3 hr	2 hr	1 hr
2-MAX-170	2-MCX-170	170	153	133	120	85	160	140	120	106	76
2-MAX-255	2-MCX-255	255	230	199	180	127	240	210	180	158	114
MAX-340	MCX-340	340	306	265	240	170	320	280	240	212	152
MAX-425	MCX-425	425	383	332	300	213	400	350	300	264	190
MAX-510	MCX-510	510	459	398	360	255	480	420	360	318	228
MAX-595	MCX-595	595	536	464	420	298	560	490	420	372	266

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DISCHARGE CHARACTERISTICS
AMPERES vs HOURS OF DISCHARGE TO 1.75 V.P.C. @ 77°F (25°C)

Cell Type		1 Min Rate In Amps	Discharge Time In Hours						
Antimony	Calcium		.25	.50	1.0	2.0	3.0	5.0	8.0
2-MAX-170	2-MCX-170	234	168	133	85	57	44	30	21
2-MAX-255	2-MCX-255	339	244	193	127	86	66	46	32
MAX-340	MCX-340	448	322	255	170	115	88	61	42
MAX-425	MCX-425	550	396	313	213	143	110	76	53
MAX-510	MCX-510	654	470	372	255	172	132	92	63
MAX-595	MCX-595	756	544	430	298	201	154	107	74

DISCHARGE CHARACTERISTICS
AMPERES vs HOURS OF DISCHARGE TO 1.81 V.P.C. @ 77°F (25°C)

Cell Type		1 Min Rate In Amps	Discharge Time In Hours						
Antimony	Calcium		.25	.50	1.0	2.0	3.0	5.0	8.0
2-MAX-170	2-MCX-170	173	126	102	76	53	40	28	20
2-MAX-255	2-MCX-255	250	189	153	114	79	60	42	30
MAX-340	MCX-340	331	252	204	152	106	80	56	40
MAX-425	MCX-425	407	315	255	190	132	100	70	50
MAX-510	MCX-510	483	378	306	228	159	120	84	60
MAX-595	MCX-595	559	441	357	266	186	140	98	70

NOTE: All ratings include voltage drop across intercell connections used in standard layouts.

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Memorandum of Telephone Conversation

SARGENT & LUNDY

Various calls
Date 4/20-4/29 Time

Person Called	Company
Ted Merklin/Frank Carpenter	Westinghouse
Person Calling	**Company**
G.A. Olson / T.M. McCauley	S&L
Project	**Project No.**
H.R. Robinson CP&L	7988-00

Subject Discussed
Ratings of EHB 250V DC Breakers at Robinson and breaker resistances

Summary of Discussion, Decisions and Commitments

1. Breaker Resistance 50A Breaker 0.0019-Ω / pole
100A Breaker 0.0009-Ω / pole

2. Breaker Rating: Westinghouse has tested these breakers at currents in excess of 10,000 A. DC. These tests were successful but Westinghouse believes that a sufficient number of tests were not performed to allow them to support these test values in writing.

3. A new breaker Series C HFD is now available. It is electrically and physically designed to replace the EHB and Westinghouse rates it at 22000 A at 250 V DC

cc

File

T.M. McCauley
Signature

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Memorandum of Telephone Conversation

SARGENT & LUNDY

Date 6-19-87 Time 11 AM

Person Called	Company
JEFF MITCHELL LARRY LUTZ	PCP
Person Calling	**Company**
R. BEAUERS	SEL
Project	**Project No.**
ROBINSON	7988-00

Subject Discussed

BATTERY CHARGER OUTPUT FILTER COMPONENTS.

Summary of Discussion, Decisions and Commitments

I CALLED MR. MITCHELL REGARDING THE BATTERY CHARGERS SUPPLIED BY PCP MODEL 4157 FOR THE CP&L ROBINSON NUCLEAR PLANT. I WAS REFERRED TO LARRY LUTZ. MR. LUTZ PROVIDED THE FOLLOWING INFORMATION

L1 - 1 MILLIHENRY

C1 - 300 - MICROFARADS

R1 - 4-1.6 OHM IN SERIES - 6.4 OHMS

REF. PCP DWG IDF-141 DATED 12-16-69

cc

File

R R Beauers

Signature

NB Incorporated Industrial Battery Division

2010 Cabot Blvd. West, Suite 1
Langhorne, PA 19047
Telephone (215) 750-2600

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Date	7-6-87
Page	32 FINAL
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March 23, 1987

Carolina Power & Light Company
P.O. Box 1551
Mail Code OHS5B1
Raleigh, N.C. 27602

Attn: John Disosway

Dear Mr. Disosway:

This letter is in reference to our telephone conversation on March 23, 1987.

The NCX-1050 battery has a rated short circuit current of 9210A at 77°F. The MCX-340 has a rated short circuit current of 3987A at 77°F. At 105°F the short circuit value is 116% of the rated value at 77°F.

If you have any other questions, please feel free to contact me.

Sincerely,

Steve Vechy
Applications Engineering

SV:dh

CAROLINA POWER & LIGHT COMPANY
P. O. BOX 1551
RALEIGH, NORTH CAROLINA 27602

ANALYSIS

FOR

125 V. DC BATTERY LOAD PROFILE A

FOR

RNP UNIT 2

ANALYSIS I.D. 7988-E3

SAFETY CLASSIFICATION: (Q)

SEISMIC CLASSIFICATION: (N/A)

APPROVAL

REV. NO.	PREPARED BY/ DATE	VERIFIED BY/ DATE	PRIN. OR RES. ENG./ DATE	PROJECT ENG./ DATE
~~0~~				
~~1~~				
REASON FOR CHANGE				
2	[signature] 3-3-88	C D Burnside 3-8-88	W W Price Jr 3-21-88	[signature] 3-29-88
REASON FOR CHANGE	M-896 M-807C M-947			
3	[signature] 5-13-88	C D Burnside 5/16/88	W W Price Jr 5/16/88	[signature] 05-16-88
REASON FOR CHANGE	DELETE UNNECESSARY FSAR REFERENCE ON SH. 2 CORRECT CLERICAL ERRORS ON SH. 23			

FORM NO. 78055 REV. 10/85

Computed by: [signature] Date: 3-3-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E3
Checked by: C D Brunnert Date: 3-18-88	CALCULATION SHEET	Pg. L of L / Rev. 2
Tar / PID No.: 87-039/01		File: L87-039/01-DE-A-631
Project Title:		
Calculation Title: 125 V. DC BATTERY LOAD PROFILE A		
Status: Prelim. ☐ Final ☒ Void ☐		

LIST OF EFFECTIVE PAGES

PAGE	REV	PAGE	REV	PAGE	REV	
L	3	21	2	42	1	3
1	1	22	1	43	1	
2	3	23	3	44	2	3
3	1	24	1	45	1	
4	1	25	1	46	1	
5	1	26	1	47	1	
6	1	27	1	48	1	
7	1	28	1	49	1	
8	1	29	1	50	1	
9	2	30	1	51	1	
10	1	31	1	52	1	
11	1	32	1	53	1	
12	1	33	1			
13	1	34	2			
14	1	35	2			
15	2	36	2			
16	1	37	1			
17	1	38	2			
18	1	39	1			
19	1	40	1			
20	1	41	1			

CALC. 7988-E3 R 3
SHT L OF L
BY [signature] DATE 5-13-88
CHK C D Brunnert DATE 5-16-88

1 F 13

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For 125 V DC BATTERY LOAD PROFILE A	Calc. No. 7988-E3
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Client CP&L	Prepared by S.V. Tuttle Date 6-5-87
Project H.B ROBINSON	Reviewed by G.A. Olson Date 6-5-87
Proj. No. 7988-00 Equip. No.	Approved by T.M. McCauley Date 6/5/87

REVIEW SUMMARY:

REV	AFFECTED PAGES	REVIEWER	REVIEW METHOD
0	ALL PAGES	G.A. Olson	REVIEW OF ORIGINAL CALC.
1	ALL PAGES	G.A. Olson	REVIEW OF DATA & ELMS PRINTOUT

Form GQ-3.08.1 Rev. 2

PURPOSE:

TO VERIFY THAT EXISTING STATION 125 V DC BATTERY "A" IS SIZED SUFFICIENTLY TO MEET THE DESIGN PARAMETERS AND LOAD PROFILE CONDITIONS FOR A SPECIFIC TIME DURATION OF ONE HOUR

SARGENT & LUNDY ENGINEERS CHICAGO

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CALC 7988.E3 R 1
SHT 2 OF 54
BY [illegible] DATE 5-13-88
CHK [illegible] DATE 5-16-88

REFERENCES:

1) HBR SYSTEM DESCRIPTION SD-016, REV 22
2) S&L PROPRIETARY COMPUTER PROGRAM ELMS-DC VERSION-1.20
3) DC LOAD DATA FORMS - PREPARED & REVIEWED
4) HBR DRAWINGS NOTED FOR EACH INDIVIDUAL LOAD
5) ZION STATION ROD DRIVE MG SET (W) INSTRUCTION MANUAL (DWG 671C243 SHT 8)
6) CP&L LETTER # ESL-263 PERTAINING TO ELECTROLYTE TEMPERATURE PROFILE
7) WESTINGHOUSE (W) CATALOG AD33-760 "TYPE DB AIR CIRCUIT BREAKER" FOR 600V AC APPLICATIONS
8) S&L SPECIFICATION F-2737-01 "WESTINGHOUSE 4KV & 6.9KV SWITCHGEAR" - TECHNICAL DATA FOR BYRON STATIONS 1&2
9) BETA ANNUNCIATOR CATALOG FOR MODEL 1211-C (UNIT 1&2 NET GENERATION RECORDER PANEL)
10) CP&L LETTER # ESL-259 PETAINING TO THE DIESEL GENERATOR FIELD FLASHING DATA VALUES
11) DELETED
12) HBR PLANT OPERATING MANUAL VOLUME 3 PART 4 - VARIOUS PROCEDURES
13) WESTINGHOUSE - DIRECTIONAL OVERCURRENT RELAYS: TYPES IRC, IRP, IRD, IRQ, IRV BULLETIN 41-130B D WE A

NOTE: SPECIFIC REFERENCES 5, 7, 8, 9, & 13 ARE INCLUDED IN THIS CALCULATION AT THE END.

Form GO-3.08.1 Rev. 2

SARGENT & LUNDY ENGINEERS CHICAGO

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LIST OF ABBREVIATIONS:

HBR - H.B. ROBINSON STATION
C - CONTINOUS
M - MOMENTARY
A - AMPERES
RLY - RELAY
LT - INDICATING LIGHT
DUR - DURATION
QTY - QUANTITY
TOT - TOTAL
LOP - LOSS OF OFFSITE POWER
LOCA - LOSS OF COOLANT ACCIDENT
INT - INTERMITTANT
(W) - WESTINGHOUSE
FSAR - FINAL SAFETY ANALYSIS REPORT

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For 125 V DC BATTERY LOAD PROFILE A	Calc. No. 7988-F3
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NOTES & ASSUMPTIONS:

1. ALL CALCULATIONS WILL BE BASED ON SLIDE RULE ACCURACY (3 SIGNIFICANT DIGITS MAXIMUM)

2. ALL RELAYS WILL BE ASSUMED TO BE ENERGIZED UNLESS IT IS READILY OBVIOUS THAT THE RELAY WILL BE DE-ENERGIZED DURING THE LOAD CYCLE SCENARIO. (ie. TEST RELAYS OR RELAYS THAT ARE ENERGIZED DURING REACTOR POWER OPERATION).

3) IN THE CASE OF RED-GREEN POSITION INDICATING LIGHTS, ONLY ONE OF THE PAIR WILL BE INCLUDED.

4) 4160 V SWGR. BREAKER SPRING CHARGING MOTORS RUN AFTER A BREAKER CLOSE OPERATION.

5) THIS CALCULATION WILL SHOW THAT DIESEL GENERATOR "A" WILL START, FIELD FLASH WILL OCCUR AND FAIL TO LOAD ONTO THE 480V SWGR E1 AT THE INITIATION OF LOCA AND OR LOP. THEN DG "A" WILL THEN BE RE-STARTED, FIELD FLASH WILL OCCUR AT TIME EQUAL TO 59 MINUTES AND THE DG "A" BKR TO 480V SWGR E1 WILL THEN CLOSE ALSO DURING THE 59TH MINUTE OF THIS ONE HOUR LOAD PROFILE.

THE COMPUTER WILL CALCULATE THE HIGHEST PEAK LOAD DURING THE 59TH MINUTE, WHICH WILL BE THE CLOSING OF THE DG "A" BKR. THIS BKR ACTUATION DRAWS 320 AMPS COMPARED TO FIELD FLASHING WHICH REQUIRES 15.18 AMPS.

6) 4KV SWGR @ HBR IS SAME MODEL AND TYPE AS THAT CONTAINED IN S&L SPECIFICATION F-2737-01

SARGENT & LUNDY ENGINEERS CHICAGO

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7) 480V SWGR TRIPPING SCENARIO WILL INCLUDE TRIPPING THE BUS TIE BKR BETWEEN 480V SWGR E1 & E2, ALONG WITH SEVEN ADDITIONAL 480V SWGR BKRS. TRIPPING. THIS ASSUMPTIONS SHOWS THAT THE BATTERY LOAD PROFILE TO BE CALCULATED WILL SUPPLY THE NECESSARY DC CURRENT TO TRIP THIS TIE BKR. NORMAL OPERATING BKR LINE-UP MAY DIFFER, BUT THIS IS THE MOST CONSERVATIVE APPROACH FOR CALCULATING THIS BATTERY'S LOAD PROFILE.

8) LOAD DURATION ARE TO BE CONSIDERED AS 60 MINUTES, UNLESS OTHERWISE NOTED.

9) 480V SWGR BKR (Cubicle) NUMBERS IDENTIFIED FROM HBR DWG 5379-5374 REV 5

10) BATTERY ELECTROLYTE TEMPERATURE VERIFIED TO BE 67°F, SUMMER MONTHS. (REFER TO REFERENCE #6)

11) FOR UNIT 1 & 2 NET GENERATION ANNUNCIATOR PANEL, THREE WINDOWS ARE BEING USED. ASSUME A LOAD OF 3.0 AMPS. WHICH IS CONSERVATIVE BECAUSE FULL LOAD FOR THIS ANNUNCIATOR IS 5.0 A. PER REFERENCE #9

12) FOR ROD DRIVE MG SETS, ONLY DC LOAD CONSISTS OF 1 LIGHT & RELAY (TYPE IRV). DURING A LOCA & LOP REACTOR TRIP BREAKERS OPERATE & NOT THE MG SET OUTPUT BREAKER; THEREFORE A VALUE OF .18 A CONTINOUS CURRENT IS CONSERVATIVE

LOAD VALUES FOR VARIOUS DEVICES:

a) INDICATING LTS

THE VAST MAJORITY OF INDICATING LIGHTS ON THE MAIN CONTROL BOARD ARE 28V BULBS IN SERIES WITH A 2500Ω RESISTOR ACROSS THE 125VDC SUPPLY VOLTAGE. THEREFORE, THE BULB Ω =:

$$\frac{28V}{125V} = \frac{x}{x+2500\Omega}$$

WHERE x = BULB RESISTANCE

SOLVING FOR x:

$x = 721.6\Omega$

∴ THE TOTAL CKT Ω = 721.6Ω + 2500Ω = 3221.6Ω

THE TOTAL CKT POWER CONSUMPTION = $\frac{V^2}{R}$

∴ POWER CONSUMED BY LT CKT = $\frac{125V^2}{3221.6\Omega} = 4.85W$

∴ FOR CONSERVATISM ALL MAIN CONTROL BOARD (RTGB) INDICATING LTS WILL BE ASSUMED TO DRAW 5W, OR $\frac{5W}{125V} = .04A$

SARGENT & LUNDY ENGINEERS

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a) CONT'D

THERE ARE ALSO MANY INDICATING LTS THAT ARE WIRED DIRECTLY ACROSS THE 125VDC SUPPLY. IN CONVERSATIONS WITH PLANT STAFF IN MOST CASES 250V BULBS WITH DRAW APPROX 10W @ 250V ARE USED ON THE 125V CKT TO INCREASE BULB LIFE. THEREFORE 5W (½ OF 10W @ 250V) WILL BE USED FOR THESE CKTS AS WELL.

b) RELAYS

THE VAST MAJORITY OF INDUSTRIAL TYPE CTL RELAYS USED ARE (W) TYPE BFD PER (W) CATALOG 16-321 THESE RELAYS HAVE A COIL POWER OF 12W.

(W) MG-6 RELAYS ARE ALSO USED EXTENSIVELY FOR SWITCHGEAR AND GENERATOR PROTECTIVE RELAYING CKTS. PER (W) CATALOG 41-750B MG-6 RELAYS WITH A 125VDC OPERATING COIL HAVE A 2000Ω COIL RESISTANCE

$\therefore$ POWER CONSUMED $= \frac{V^2}{R} = \frac{125^2}{2000\Omega} = 7.8\,W$

FOR CONSERVATISM AND EASE IN ESTIMATING LOAD 12W WILL BE USED FOR ALL RELAYS. $\frac{12W}{} = .1A$

C) SOLENOID VALVES

THE VAST MAJORITY OF SOLENOID VALVES ARE ASCO WITH 125VDC OPERATING COILS. SINCE MOST OF THE VALVES ARE LOCATED IN RADIATION OR OTHER INACCESSABLE AREAS ACCORDING TO ASCO CAT. NP-1, THEIR NUCLEAR GRADE SOLENOID VALVES WITH 125VDC OPERATING COILS CONSUME 17.4W.

∴ ALL SOLENOID VALVES IN THIS CALC., WILL BE ASSUMED TO DRAW 17.4W.

$\frac{17.4W}{125V} = .14A$

NOTE: FOR TROTS SOV'S ONLY - NAMEPLATE DATA IS 50WATTS/SOV.

$\frac{50WATTS}{125V} = .4A/EACH$

LOAD CYCLE SCENARIO:

LOP CONCURRENT WITH LOCA FOR ONE HOUR AND BATTERY DUTY CYCLE. LOP AND LOCA OCCURS WHEN REACTOR IS AT FULL POWER.

SARGENT & LUNDY ENGINEERS

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LOAD TABULATION - DISTRIBUTION PANEL "A"

a) CKT # 1 - 480V SWGR E1

CWD 955, 274, 275, 890, 892, 287, 511, 832, 651, 831, 512, 162A, 162B, 237, 214, 891, 205,

CALC 7988-E3 R 2
SHT 9 OF 54
BY [illegible] DATE 3-3-88
CHK CDB DATE 3-14-88

CONTINUOUS LOAD -

22 IND LTS @ .04A EACH - .88A TOTAL
21 RELAYS @ .1A EACH - 2.1A TOTAL
8 SOV'S @ .14A EACH (INT) 0.0A TOTAL

2.98A TOTAL
M-947

INTERMITTANT LOAD

8 480V BKR TRIPS @ 2A/EACH = 16.0A
(OCCURS @ T=0) FOR 1 SECOND
THESE BKR(cubicle) NUMBERS ARE: 18B, 19B, 20C, 20B, 19C, 21B, 22B, 22C

TRIPPING CURRENTS FOR DB50, 75 & 100 ARE 2.0A/EACH
CLOSING CURRENTS FOR DB50 IS 24.0A/EACH
CLOSING CURRENTS FOR DB75 & DB100 ARE 32.0A/EACH

(ALL INFORMATION OBTAINED FROM WESTINGHOUSE CATALOG)

b) CKT #2 4160V SWGR BUSES 1+2
CWD 955, 109, 811, 615, 933, 625, 605, 926, 260, 928, 261, 927, 932, 105

CONTINUOUS LOAD

24 IND LTS @ .04A EACH = .96A
24 RELAYS @ .1A EACH 2.4A

3.36A TOTAL CONT LOAD

INTERMITTANT LOAD

1-4160V BKR TRIP @ 4.2 A/EACH
1 4160V BKR TRIPS @ T=0 SECONDS
6-4160V BKR'S TRIP @ T=15 SECONDS
ASSUME ALL 7 4160V BKR TRIP @ T=0
7 X 4.2A/EACH = 29.4 A. TOTAL
THESE BKR(cubicle) NUMBERS ARE: 7, 1, 2, 3, 5, 6, 14

4kV BUS TRANSFER WILL NOT OCCUR DURING LOP BECAUSE OF LOSS OF VOLTAGE RELAY which MONITOR VOLTAGE OF START-UP TRANSFORMER

SARGENT & LUNDY ENGINEERS

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c) CKT #3 HYDROGEN CONTROL PANEL
CWD 875, DWG 5379-176

CONTINOUS LOAD

1 IND LITE @ .04A/EACH = .04A
1 RELAY @ .1A/EACH = .1A

.14A CONT. LOAD

SARGENT & LUNDY ENGINEERS

Calcs. For	125 V DC BATTERY LOAD PROFILE A
X Safety-Related	Non-Safety-Related
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Client	CP&L
Project	H.B. ROBINSON
Proj. No.	7988-00 Equip. No.

Prepared by	Date
Reviewed by	Date
Approved by	Date

d) CKT #4 480V SWGR BUSES 1+2A
CWD 955, 270, 894, 893, 131, 225, 935, 757, 132, 271, 936

CONTINUOUS LOAD

12 IND LTS @ .04A EACH .48A
6 RELAYS @ .1A EACH - .6

1.08 A TOTAL CONT. LOAD

INTERMITTANT LOAD

10- 480V BKR TRIPS @ 20A/EACH @ T=0 = 20.0A
FOR 1 SECOND
THESE BKR (Cubicles) NUMBERS ARE: 1B, 2B, 2C, 4C, 5C, 6B, 7C, 8B, 4B & 6C

NOTE: NO CWD'S OR DWG'S CAN BE FOUND FOR CUBICLES 4B & 6C. FOR CONSERVATISM, INCLUDE THESE BREAKERS AS TRIPPING @ T=0

e) CKT #5 LIGHTING PANEL LP-33

FULL LOAD PER HBR FSAR = 115.0A CONT. LOAD

f) CKT #6 SPARE 0.0 CONT. LOAD

g) CKT #7 START TRANSFORMER MOTOR OPERATED DISC. CWD 925

CONTINUOUS LOAD

1- IND LT @ .04A EACH = .04A

1- RELAY @ .1A EACH = .1

.14A TOTAL CONT LOAD

INTERMITTANT LOAD

1/4HP MOTOR · 2.5A, PEERLESS ELEC FRAME DE56B

DO NOT INCLUDE, BECAUSE THIS WILL BE CLOSED AND MANUAL ACTION IS REQUIRED TO OPEN IT.

h) CKT #8 D-G "A" EXCITER
CWD 880

15.18 A PER CP&L LETTER # ESL-259 CONT. LOAD STARTING @ T=2 SECONDS WITH A DURATION OF 7 SECONDS. THIS LOAD WILL ALSO BE SEQUENCED @ 59 MINUTES, WITH THE SAME PARAMETERS REFERENCED ABOVE.

i) CKT #9 INVERTER C

DC INPUT - 50A MAX PER EQUIPMENT NAMEPLATE

j) CKT #10 RX TRIP BREAKER "A" + RX TRIP BYPASS BREAKER B

CWD 45

CONT. LOAD - 3 - LTS @ .04A EACH = .12A TOTAL

MOM. LOAD - 2 BKR TRIPS @ T=0 2A ea. = 4A TOT
AND LAST FOR 1 SECOND

THESE BKR'S ARE TYPE DB50

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k) CKT #11 INVERTER A

DC INPUT - 81 A MAX PER EQUIPMENT NAMEPLATE.

* 3.7 A. LOAD ADDED BY PM-B07C (ERFIS MUX ADDITION). LOAD ADDED DOES NOT EXCEED EQUIPMENT MAX.

SARGENT & LUNDY ENGINEERS

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l) CKT #12 ROD DRIVE MG SET "A"
CWD 71

.180A - ESTIMATED FROM ZION ROD DRIVE MG SET INSTRUCTION MANUAL

m) CKT # 13 EXCITER FIELD BKR
CWD 862, 863, 864 & 865

CONT

4 IND LTS @ .04A EACH .16A
8 RELAYS @ .1A EACH .8

.96 A TOTAL CONT LOAD

1-480V SWGR BKR TRIPPING @ 2.0A/EACH = 2.0A MOMENTARY LOAD
LASTING FOR 1 SECOND

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m) CKT #14 GAS STRIPPER CTL CAB "A"
CWD 173

CONTINUOUS LOAD
9 SOLS @ .14A/EACH (INT) = 0.0
6 RELAYS @ .1A EACH = .6A
14 IND LTS @ .04A EACH = .56A

1.16 A TOTAL CONT LOAD

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d) CKT #15 GENERATOR PROTECTIVE RLY PNL
CWD 912

CONTINUOUS LOAD

1 - IND LTS @ .04A EACH = .04A
2 - RELAYS @ .1A EACH = .2A

.24A TOTAL CONT LOAD

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p) CKT #16 AUX PNL "DC" FUSE PNL.
CWD 955

TOTAL CONT. LOAD = 18.12 A (SEE ATTACHED SHEETS)

q) CKT #17 AUX TRANSFORMER ANNUN.
CWD 940, 942

CONTINOUS LOAD

4-RELAYS @ .1A/EA = .4 A
4-LITES @ .04A/EA = .16A

.56A TOTAL CONT. LOAD

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f) CKT #18 RPS TRAIN "A"
5379-3243, 3245, 3246, 3249, 3250

CONTINOUS LOAD

21 RELAY @ .1A/EA = 2.1A TOTAL CONT LOAD

5) CKT #19 TURB OVERSPEED TRIP SYS
CWD 712, 713

9 RELAYS @ .1A EA = .9A
16 IND LITES @ .04A/E = .64A
14 SOV'S @ .4A/EACH (INT) = 0.0

1.54A TOTAL CONT LOAD

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t) CKT 20 SAFEGUARDS TRAIN "A"
5379-3232, 3233, 3234, 3235, 3238

CONTINOUS LOAD

46 RELAY @ .1A/E = 4.6 A
13 LITES @ .04A/E = .52 A

5.12 A TOTAL CONT LOAD
M-947

u) CKT #21 SPARE

NO LOAD 0.0 TOTAL CONT. LOAD

v) CKT #22 TURBINE AUTO TRIP
CWD 710

2 RELAYS @ .1/EA =	.2A
1 IND LITE @ .04A/E	.04A
1 SOV @ .14A/E (INT)	0.0
	.28A TOTAL CONT. LOAD

w) CKT #23 STARTUP TRANSFORMER ANNUN.
CWD 942, 5379-148

CONTINOUS LOAD

1 RELAYS @ .1A/EA	= .1
1 LITES @ .04A/EA	= .04
	.14A TOTAL CONT LOAD

x) CKT #24 D-G "A" CTL POWER
CWD 945, 5379-1153 SHT 1

13 RELAYS @ .1A/EA	= 1.3A
12 IND LITES @ .04A/EA	= .48A
4 SOV'S @ .14A/EA	.56A
	2.34A TOTAL CONT LOAD

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LISTED BELOW ARE TWO ENTRIES TO THE ELMS DC PROGRAM.

Y) DG BRKR CLOSING:

480V SWGR BKR CLOSING @ 32.0 A/EACH @ T= 59.10 MINUTES WITH A DURATION OF 1 SECOND.

THIS REPRESENTS THE DG "A" STARTING, FLASHING ITS FIELD, & DG "A" BKR CLOSING ON 480V SWGR E-1.

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BY [illegible] DATE 5-13-88
CHK [illegible] DATE 5-16-88

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LOAD ~~DESCRIPTION~~ AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 1 CWD 141						
SV	3	.14	.42	C		
RLY	2	.1	.2	C		
LT	2	.04	.08	C		
					.70	
CKT# 2 CWD 153A +153B						
SV	1	.14	.14	INT		.14 (INT)
RLY	1	.1	.1	C		
LT	3	.04	.12	C		
					.22	
CKT# 3 CWD 154						
SV	1	.14	.14	C		
RLY	1	.1	.1	CT		
LT	3	.04	.12	C		
					.36	
CKT# 4 CWD 204						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	1	.04	.04	C		
					.04	
CKT# 5 CWD 302						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	1	.04	.04	C		
					.04	
PG TOTAL					1.36	.42

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LOAD (PNL & CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 6 CWD 305						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT # 7 CWD 307						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT # 8 CWD 310						
SV	1	.14	.14	C		
RLY						
LT	1	.09	.04	C		
					.18	
CKT # 9 CWD 313						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT # 10 CWD 301						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
PG TOTAL					.9	

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LOAD (PNL & CKT #'S) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 11 CWD 604						
SV						
RLY	7	.1	.7	C		
LT						
					.7	
CKT# 12 CWD 156						
SV	2	.14	.28	C		
RLY						
LT	1	.04	.04	C		
					.32	
CKT# 13 CWD 150						
SV	2	.14	.28	C		
RLY						
LT	1	.09	.09	C		
					.32	
CKT# 14 CWD 196						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT# 15 CWD 197						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
PG TOTAL					1.7	

Form QQ-3.08.1 Rev. 2 SL-F647 10-85 KPS

SARGENT & LUNDY ENGINEERS

Calcs. For 125VDC BATTERY LOAD PROFILE

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LOAD (PNL & CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 16 CWD 230						
SV						
SPARE RLY					0.0	
LT						
CKT # 17 CWD 316						
SV	1	.14	.14	C		
RLY	1	.1	.1	C		
LT	4	.04	.16	C		
					.4	
CKT # 18 CWD 151A						
+151B SV	1	.14	.14	INT		.14 (INT)
RLY	1	.1	.1	C		
LT	3	.04	.12	C		
					.22	
CKT # 19 CWD 107						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	2	.04	.08	C		
					.08	
CKT # 20 CWD 111						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	2	.04	.08	C		
					.08	
PG TOTAL					.78	.42

Form GQ-3.06.1 Rev. 2 8L-F047 10-86 KP8

SARGENT & LUNDY ENGINEERS

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LOAD (PNL & CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 21 CWD 124						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	2	.04	.08	C		
					.08	
CKT# 22 CWD 158						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT# 23 CWD 159						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	2	.04	.08	C		
					.08	
CKT# 24 CWD 166						
SV	1	.14	.14	C		
RLY						
LT	2	.04	.08	C		
					.22	
CKT# 25 CWD 168						
SV	1	.14	.14	C		
RLY						
LT	2	.04	.08	C		
					.22	
PG TOTAL					.78	.28

Form GQ-3.08.1 Rev. 2 SL-F847 10-85 KPS

SARGENT & LUNDY ENGINEERS

Calcs. For 125VDC BATTERY LOAD PROFILE

[X] Safety-Related [ ] Non-Safety-Related

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LOAD (PNL & CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 26 CWD 318						
SV	1	.14	.14	INT		.14 (INT)
RLY						
LT	1	.04	.04	C		
					.04	
CKT# 27 CWD 119						
SV	2	.14	.28	INT		.28 (INT)
RLY	2	.1	.2	C		
LT	2	.04	.08	C		
					.28	
CKT# 28 CWD193						
SV	1	.14	.14	C		
RLY						
LT	2	.04	.08	C		
					.22	
CKT# 29 CWD183						
SV	1	.14	.14	C		
RLY						
LT	2	.04	.08	C		
					.22	
CKT# 30 CWD184						
SV	1	.14	.14	C		
RLY						
LT	2	.04	.08	C		
					.22	
PG TOTAL					.98	.42

Form GQ-3.08.1 Rev. 2 SL-F647 10-85 KP8

SARGENT & LUNDY ENGINEERS

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LOAD (PNL & CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 31 CWD 198						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
CKT# 32 CWD 278						
SV						
RLY	2	.1	.2	C		
LT						
					.2	
CKT# 33 CWD 762						
SV	1	.14	.14	C		
RLY						
LT	2	.04	.08	C		
					.22	
CKT# 34 CWD 133						
SV						
RLY						
LT	4	.04	.16	C		
					.16	
CKT# 35 CWD 627						
SV						
RLY	7	.1	.7	C		
LT	4	.04	.16	C		
					.86	
PC TOTAL					1.62	

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CKT# 36 CWD 702						
SV						
RLY	5	.1	.5	C	.5	
LT						
CKT# 37 CWD 701						
SV						
RLY	4	.1	.4	C	.4	
LT						
CKT# 38 CWD 704						
SV	14	.14	1.96	C		
RLY						
LT	3	.04	.12	C	2.08	
CKT# 39 CWD 705						
SV						
SPARE RLY					0	
LT						
CKT# 40 CWD 706A						
SV	4	.14	.56	C		
RLY						
LT	1	.04	.04	C	.60	
PC TOTAL					2.58	

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LOAD (ALL A CKT #'s) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 41 CWD 706A						
SV	4	.14	.56	C		
RLY						
LT	1	.04	.04	C		
					.60	
CKT # 42 CWD 706A						
SV	4	.14	.56	C		
RLY						
LT	1	.04	.04	C		
					.60	
CKT # 43 CWD 144						
SV	2	.14	.28	C		
RLY	1	.1	.1	C		
LT						
					.38	
CKT # 44 CWD 147						
SV	2	.14	.28	C		
RLY	1	.1	.1	C		
LT						
					.38	
CKT # 45 CWD 594						
SV	1	.14	.14	C		
RLY						
LT	1	.04	.04	C		
					.18	
					2.14	

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LOAD (PNL A, CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT# 46 CWD 642						
SV	3	.14	.42	C		
RLY						
LT						
					.42	
CKT# 47 CWD 642						
SV	3	.14	.42	C		
RLY						
LT						
					.42	
CKT# 48 CWD 151A						
SV						
NO LOAD RLY						
(BACK-UP LT	1					
FEED)					0	
CKT# 49 CWD 153A						
SV						
RLY						
LT	1	.04	.04	C		
					.04	
CKT# 50 CWD 583						
SV	2	.14	.28	C	.28	
RLY						
LT						
PG TOTAL						

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LOAD (PNL & CKT #) AUX PNL DC	QTY	A EACH	A TOT	LOAD DUR	TOTAL C. LOAD	TOTAL M. LOAD
CKT # 51 CWD SPARE SV						
RLY						
LT						
CKT # 52 CWD 137						
SV	3	.14	.42	INT		.42 (INT)
RLY						
LT	3	.04	.12	C		
					.12	
CKT # 53 CWD 803						
SV						
(ANNUNCIATOR) RLY						
LT						
EPED EST					3.0	
CKT # 55 CWD 511						
SV	0	—	—	—	—	—
RLY	4	0.1	0.4	0	0	0
M-896 LT	2	0.02	0.08	0	0	0
CKT # 56 CWD 512						
SV	0	—	—	—	—	—
RLY	4	0.1	0.4	0	0	0
M-896 LT	2	0.02	0.08	0	0	0
PG TOTAL					3.12	

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CHK CDB DATE 3-18-88

Project: H.B ROBINSON UNIT 2 Date: Page:

Lowest Expected Electrolyte Temp: °F 67 Minimum Cell Voltage: 1.75 Cell Mfg: GNB Cell Type: NCX Sized By:

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) x (6B) = Rated Amp Hrs: Pos Values	Neg Values
Section 1 — First Period Only — If A2 is greater than A1, go to Section 2.							
1	A1 = 357.96	A1 − 0 = 357.96	M1 = 1	T = M1 = 1	172	2.08	• • •
					Sec 1 Total	2.08	• • •
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1 = 357.96	A1 − 0 = 357.96	M1 = 1	T = M1 + M2 = 59	75	4.77	—
2	A2 = 286.56	A2 − A1 = −71.4	M2 = 58	T = M2 = 58	75	—	-0.95
					Sec 2 Sub Tot	4.77	-0.95
					Sec 2 Total	3.82	• • •
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4.							
1	A1 = 357.96	A1 − 0 = 357.96	M1 = 1	T = M1 + M2 + M3 = 60	75	4.77	—
2	A2 = 286.56	A2 − A1 = −71.4	M2 = 58	T = M2 + M3 = 59	75	—	-0.95
3	A3 = 318.56	A3 − A2 = 32	M3 = 1	T = M3 = 1	172	0.19	—
					Sec 3 Sub Tot	4.96	-0.95
					Sec 3 Total	4.01	• • •

Maximum Section Size (8) 4.01 + Random Section Size (9) 0 = Uncorrected Size — (US) (10) 4.01
US (11) 4.01 x Temp Corr (12) 1.06 x Design Marg (13) 1.00 x Aging Factor (14) 1.00 = (15) 4.25
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 5 (A) — Positive Plates

(B) — Ampere Hours. Therefore cell (17) _____ is required.

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Fig 3
Cell Sizing Work Sheet

UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
STATION : H.B. ROBINSON UNIT NO. 2

BATTERY DATA

Location of battery	Aux Bldg Battery Room
Battery name	Battery A
Min electrolyte temp, F	67.
Cell manufacturer	GOULD
Cell type	NCX/NAX (MODELS 600,750,...)
Battery nominal volts	125.0
Battery minimum volts	105.0
Number of cells	60
Number of positive plates ...	7
Design margin	1.00
Aging factor	1.00

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UTILITY : CAROLINA POWER & LIGHT
STATION : H.B. ROBINSON

PROJECT NO. 7988-00
UNIT NO. 2

LOAD DATA

*** Record number = 1 ***

Load name	DIST PNL A CKT 1
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	16.000
Inrush duration - sec	1
Cont load current - amps	2.98 M-947
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

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*** Record number = 2 ***

Load name	DIST PNL A CKT 2
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	29.400
Inrush duration - sec	1
Cont load current - amps	3.360
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

*** Record number = 3 ***

Load name	DIST PNL A CKT 3
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.140
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference ..	
Revision	
Modification	
Cable number	

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UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 4 ***

Load name	DIST PNL A CKT 4
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	20.000
Inrush duration - sec	1
Cont load current - amps	1.080
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 5 ***

Load name	DIST PNL A CKT 5
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	115.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 6 ***

Load name	DIST PNL A CKT 6
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

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UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 7 ***

Load name	DIST PNL A CKT 7
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.140
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 8 ***

Load name	DIST PNL A CKT 8
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	15.180
Time load starts - MM.ss	.02
Load duration - MM.ss	.07
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 9 ***

Load name	DIST PNL A CKT 9
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	50.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

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UTILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-C
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 10 ***

Load name	DIST PNL A CKT 10
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	4.000
Inrush duration - sec	1
Cont load current - amps	.120
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 11 ***

Load name	DIST PNL A CKT 11
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	81.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 12 ***

Load name	DIST PNL A CKT 12
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.180
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
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Cable number	

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LOAD DATA

*** Record number = 13 ***

Load name	DIST PNL A CKT 13
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	2.000
Inrush duration - sec	1
Cont load current - amps	.960
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 14 ***

Load name	DIST PNL A CKT 14
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	1.160
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 15 ***

Load name	DIST PNL A CKT 15
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.240
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
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LOAD DATA

*** Record number = 16 ***

Load name	DIST PNL A CKT 16
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	18.120
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 17 ***

Load name	DIST PNL A CKT 17
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.560
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 18 ***

Load name	DIST PNL A CKT 18
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	2.100
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

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ILITY : CAROLINA POWER & LIGHT
TATION : H.B. ROBINSON

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UNIT NO. 2 :

LOAD DATA

*** Record number = 19 ***

Load name	DIST PNL A CKT 19
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	1.540
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
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*** Record number = 20 ***

Load name	DIST PNL A CKT 20
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	5.12 M-947
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 21 ***

Load name	DIST PNL A CKT 21
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.000
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
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ILITY : CAROLINA POWER & LIGHT PROJECT NO. 7988-0
STATION : H.B. ROBINSON UNIT NO. 2

LOAD DATA

*** Record number = 22 ***

Load name	DIST PNL A CKT 22
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.280
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 23 ***

Load name	DIST PNL A CKT 23
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.140
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 24 ***

Load name	DIST PNL A CKT 24
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	2.340
Time load starts - MM.ss	.00
Load duration - MM.ss	60.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
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LOAD DATA

*** Record number = 25 ***

Load name	DG START
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	.000
Time load starts - MM.ss	.00
Load duration - MM.ss	.00
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

*** Record number = 26 ***

Load name	DG BRKR CLOSING
Status (E,N, or M)	E (Existing, New, or Modified)
Inrush current - amps	.000
Inrush duration - sec	0
Cont load current - amps	32.000
Time load starts - MM.ss	59.10
Load duration - MM.ss	.01
Source bus or panel	
System code	
Source of equipment data	
Drawing or other reference	
Revision	
Modification	
Cable number	

SARGENT & LUNDY ENGINEERS CHICAGO

Calcs. For 125 V DC BATTERY LOAD PROFILE A	Calc. No. 7988-E3
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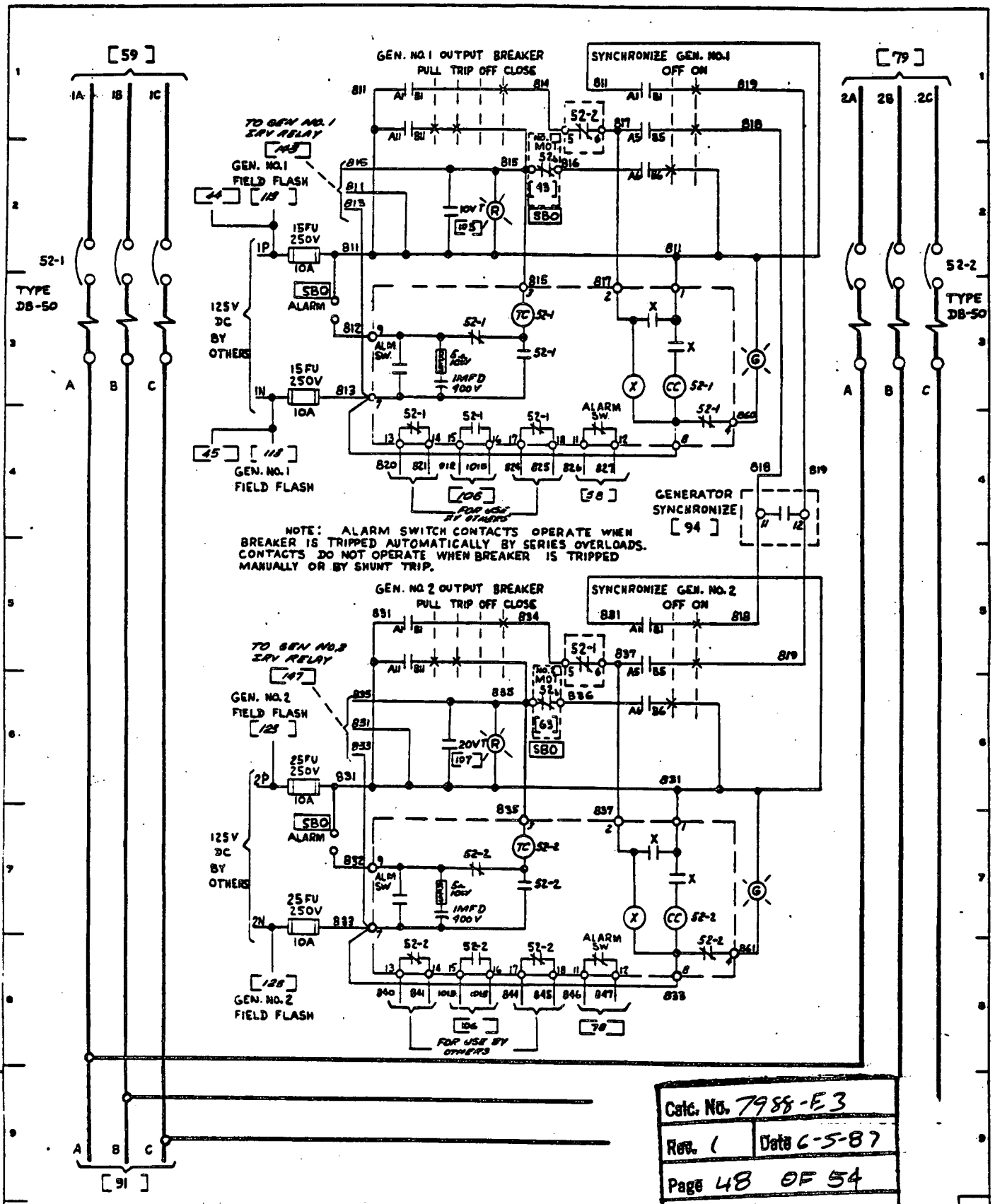
Client CP&L	Prepared by / Date
Project H. B. ROBINSON	Reviewed by / Date
Proj. No. 7988-00 Equip. No.	Approved by / Date

CONCLUSION:

THE EXISTING STATION 125V DC BATTERY A IS OF SUFFICIENT SIZE TO MEET ITS LOAD PROFILE FOR A ONE HOUR TIME DURATION. REFER TO PAGES 35 & 36 OF THIS CALCULATION. STATION 125V DC BATTERY A HAS A REMAINING MARGIN OF 63.6% FOR THIS ONE HOUR LOAD PROFILE.



671C243

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WESTINGHOUSE ELECTRIC CORPORATION
GENERATOR OUTPUT CIRCUIT BREAKER
SUB 12
CONT'D ON 9
671C243
TO YORK SHEET 8
SHEET 8

Westinghouse

Control Voltages and Operating Currents

Electrically operated air circuit breakers should be operated from reliable sources of control power. Standard control voltages and ranges for electrically operated low voltage breakers are measured at the mechanism terminals for solenoid mechanisms given below:

Control Voltages

Direct Current			Alternating Current		
Standard Control Voltages	To Close	To Trip	Standard Control Voltages	To Close	To Trip
24	.....	14 to 30①	115	95 to 125	95 to 125
48	.....	28 to 60	230	190 to 250	190 to 250
125	90 to 130	70 to 140	460	380 to 500	380 to 500
250	180 to 260	140 to 280			

① 24-volt tripping is not recommended

Operating Currents

Type of Breaker	No. of Poles	Closing Current – Volts				Tripping Current – Volts					
		125 Dc	250 Dc	230 Ac	460 Ac	48 Dc	125 Dc	250 Dc	115 Ac	230 Ac	460 Ac
DB-15	2, 3	20	10	30	15	5	2	1	1	.5	.2
DB-25	2, 3	23	10	35	20	5	2	1	1	.5	.2
DB-50	2, 3	20	10	20	10	5	2	1	1	.5	.2
DB-75	2, 3	32	18	32	18	5	2	1	1	.5	.2
DB-100	2, 3	32	18	32	18	5	2	1	1	.5	.2

Control power for ac closing of low voltage breakers in metal-enclosed switchgear is usually taken from the bus or line-side of the breaker through current limiting fuses, or through standard fuses and current limiting resistors. When it is necessary to supply closing power through a control power transformer, a 3 Kva transformer is used for all breaker types and regardless of the number of breakers. For tripping power only, a 250 va control power transformer is adequate for all breaker ratings and regardless of the number of breakers.

Other Attachments

Control Relays

A control relay is normally supplied on each electrically operated type DB breaker. The function of the control relay is to close and open the closing solenoid circuit of the breaker during a closing operation, so that the heavy closing current does not pass through the control switch or other initiating device.

When the control switch of the breaker is closed, it energizes the control relay. A contact from the relay completes the closing solenoid circuit. When the breaker is closed, the breaker closing mechanism mechanically opens the relay contact which interrupts the closing current.

Alarm Switches

It may be desirable when a breaker trips on a fault or overload to ring an alarm of some type. Alarm switches are available on the type DB breaker that will close their contact when the breaker is tripped by the series overcurrent device but which is mechanically blocked from closing when the breaker is manually tripped or opened by the shunt trip device. Undervoltage tripping attachment, when supplied, can also operate an alarm.

Auxiliary Switches

Auxiliary switch circuits are available on the type DB breakers in groups of 4 or 8②.

These switches are used to control indicating lamps, shunt trip coil circuits or other duties in automatic or manual control schemes.

The switches are contained in molded cases. A rotary design moving contact is used with a wiping action between contact surfaces. The contact faces are silverplated and are held against each other by auxiliary spring tension when they are engaged in the closed position.

Normally, the auxiliary switches have alternate make and break contact when the breaker is in the open or closed position. These can be changed, however, to give any combination of make and break contacts desired.

The auxiliary switch contacts have the following characteristics:

Contacts can carry 15 amperes continuously or 250 amperes for 3 seconds.

Interrupting Capacity:

Volts	Circuit	
	Non-Inductive	Inductive
125 Dc	11 Amperes	6.25 Amperes
250 Dc	2 Amperes	1.75 Amperes
115 Ac	75 Amperes	15 Amperes
460 Ac	25 Amperes	5 Amperes

Interlocks

Interlocks can also be supplied to prevent the operation of breakers under certain conditions. For example, two breakers may be interlocked so that only one may be closed at any one time but both may be open at any one time. Electric lockout attachments or key interlocks are recommended to perform these special functions. Key interlocks on drawout switchgear are so designed and mounted that the interlocking function will not be defeated by substitution of a different breaker in the cell. Mechanical interlocks are also available for non-drawout breakers.

Electric lockout attachments are available on the type DB breakers. The lockout prevents closing of the breaker by holding the breaker linkage in the trip-free position. Energizing the lockout coil frees the linkage and permits closing the breaker. After the breaker is closed, de-energizing the lockout coil does not cause tripping. Standard coil voltages are 48, 125 or 250 dc and 115 230 or 460 ac.

Mountings and Enclosures

Mountings

The type DB circuit breakers are available for dead front fixed mounting or for drawout mounting in individual enclosures or in metal enclosed switchgear assemblies.

Enclosures

Breakers applied in hazardous locations with explosive atmospheres or otherwise contaminated atmospheres, should be provided with proper enclosures to prevent explosions and to maintain proper breaker performance. Individual circuit breakers of the type DB can be supplied with enclosures as shown by the following table:

② Twelve auxiliary switch circuits are available on the types DB-50, 75 and 100 breakers.

Name of Bidder: Westinghouse Electric Corporation

7. CIRCUIT BREAKER DATA (On a symmetrical basis):	(Insert all data in these columns)				
	1200A 250 MVA	1200A 350 MVA	3000 A 350 MVA	1200 A 500 MVA	2000 A 500 MVA
	4.16 kV	4.16 kV	4.16 kV	6.9 kV	6.9 kV
7.1 Manufacturer.....	Westinghouse		Westinghouse		West.
7.2 Type.....	50DHP250	50DHP350	50DHP350	75DHP500	75DHP500
7.3 Horizontal or vertical drawout.	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
7.4 Indicate the ANSI standard covering the circuit breaker rating.....	C37.06	C37.06	C37.06	C37.06	C37.06
7.5 Nominal voltage class.....(V)	4,160	4,160	4,160	7,200	7,200
7.6 Nominal 3-phase MVA class.(MVA)	250	350	350	500	500
7.7 Rated maximum voltage.....(V)	4,760	4,760	4,760	8,250	8,250
7.8 Rated voltage range factor.....	1.24	1.19	1.19	1.25	1.25
7.9 Low frequency withstand....(kV)	19	19	19	36	36
7.10 Impulse withstand (BIL)....(kV)	60	60	60	95	95
7.11 Rated continuous current....(A)	1200	1200	3000	1200	2000
7.12 Rated short circuit current:					
a. At 4.16 kV.....(A)	33,200	46,900	46,900	N.A.	N.A.
b. At 4.76 kV.....(A)	29,000	41,000	41,000	N.A.	N.A.

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Name of Bidder: Westinghouse Electric Corporation

CIRCUIT BREAKER DATA, Cont.	(Insert all data in these columns)				
	1200 A 250 MVA 4.16 kV	1200 A 350 MVA 4.16 kV	3000 A 350 MVA 4.16 kV	1200 A 500 MVA 6.9 kV	2000 A 500 MVA 6.9 kV
c. At 6.9 kV.....(A)	N.A.	N.A.	N.A.	39,500	39,500
d. At 8.25 kV.....(A)	N.A.	N.A.	N.A.	33,000	33,000
7.13 Rated permissible tripping delay.....(seconds)	2	2	2	2	2
7.14 Maximum symmetrical interrupting capability.....(A)	36,000	49,000	49,000	41,000	41,000
7.15 Close and latch capability..(A)	58,000	78,000	78,000	66,000	66,000
7.16 Stored energy device (spring charging motor):					
a. Voltage range required.....(V)	40-50	90-130	90-130	90-130	90-130
b. Inrush current at nominal operating volts dc.....(A)	35	28	30	30	30
c. Is spring recharged after trip or close?.....	close	close	close	close	close
d. Time required to recharge spring.....(cycles)	5	5	5	5	5

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Name of Bidder: Westinghouse Electric Corporation

CIRCUIT BREAKER DATA, Cont.	(Insert all data in these columns)				
	1200 A 250 MVA 4.16 kV	1200 A 350 MVA 4.16 kV	3000 A 350 MVA 4.16 kV	1200 A 500 MVA 6.9 kV	2000 A 500 MVA 6.9 kV
7.17 Control circuit nominal operating volts dc:					
a. Closing control voltage range.....(V)	40-50	90-130	90-130	90-130	90-130
b. Closing control current at normal voltage.....(A)	7.8	4.2	4.2	4.2	4.2
c. Tripping voltage range....(V)	28-60	70-140	70-140	70-140	70-140
d. Tripping current at normal voltage.....(A)	7.8	4.2	4.2	4.2	4.2
7.18 Trip coil requirements:					
a. Voltage range required....(V)	28-60	70-140	70-140	70-140	70-140
b. Trip coil current at nominal operating volts dc.....(A)	7.8	4.2	4.2	4.2	4.2
7.19 Time from energizing trip coil until:					
a. Main contacts part...(cycles)	2.5	2.5	2.5	2.5	2.5
b. Circuit is interrupted at 100% interrupting rating .....(cycles)	5.0	5.0	5.0	5.0	5.0
c. Auxiliary switch "a" contacts open.....(cycles)	2.6 ± .2	2.6 ± .2	2.7 ± .4	2.5 ± .4	2.5 ± .4

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Page 52 of 54
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F-2737-01
L-2737-01
- Revised CA, 05-18-77

Memorandum of Telephone Conversation

SARGENT & LUNDY

Date 6-5-87 Time 4:00 P.M.

Person Called	Company
Les Porter	Beta (214) 241-2200
Person Calling	**Company**
S. V. Tutich	S&L
Project	**Project No.**
DC ELMS at H. B. Robinson	7988-00

Subject Discussed

Current Draw for Beta Model #1211-C Annunciator, 144 Points at 125VDC

Summary of Discussion, Decisions and Commitments

I asked Mr. Porter what the current draw would be for this annunciator, with all lights on and its logic (relays) energized. His reply was 5.0A maximum or 625 watts. He stated that this value will be available when the "test" button is pushed, which energizes all lights and relays. This condition is abnormal.

In the case at H. B. Robinson, only three windows are being used. S&L estimates a 3.0A continuous current is very conservative.

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cc T. McCauley - 24
J. S. Mowbray - 24
G. Olson - 24

File 30P/

S. V. Tutich D. Mowbray
Signature Electrical Project Engineer

SL-F713 10/84—F3

IRQ-2, IRQ-5, IRQ-6, IRQ-7, IRQ-8, IRQ-9, IRQ-11 for Ground Fault Detection (FT-42 Case)

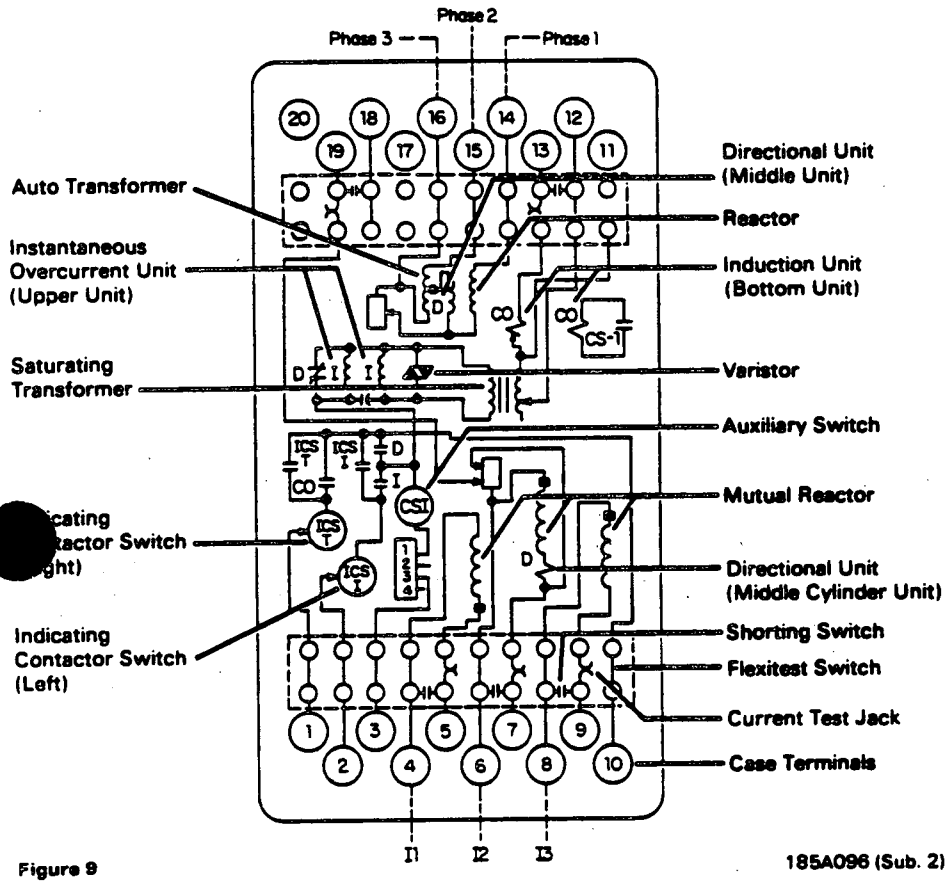

Figure 9

185A096 (Sub. 2)

Relay Settings

The instantaneous and time-overcurrent units require setting, whereas the directional unit does not.

On both overcurrent units, the tap selected determines the minimum pickup or contact-closing current of the unit. Selective time dial settings on the time-overcurrent unit can be determined by referring to the time current curves in the appropriate Instruction Leaflet.

CS-1 Coil Operating Time

Operating time of the CS-1 auxiliary switch is approximately 5 milliseconds.

CS-1 Coil Resistance (Ohms)

1165 ohms for 24/48/125/250 volt relays except the 24 volt IRV which has a 110 ohm coil.

Calc. No. 7988-E3	
Rev. 1	Date 6-5-87
Page 54 (FINAL)	
Proj. No. 7988-00	

DESIGN VERIFICATION RECORD

I. Instructions to Verification Personnel

Plant: RNP #2 TAR No.: _____ Project: _____ File No.: R87-039/01-DE-4631

Design Documents: 7986-63 (Document No.) 3 (Rev.) 125V. DC BATTERY LOAD PROFILE A (Document Title)

_____ (Document No.) _____ (Rev.) _____ (Document Title)

Design in verification should be done in accordance with ANSI N45.2.11, Section 6, as amended by Reg. Guide 1.64, Rev. 2.

Verification Methods to be used:

✓ Design Review
___ Alternate or Simplified Calculations
___ Qualification Testing

Documents(s) "Q" Level:

✓ Q
___ RW-Q
___ FP-Q
___ Non-Q

Special Instructions:

ASSIGNED TO C. D. BURNSIDE FOR VERIFICATION

S M Hyde DPE 05-16-88 Date

II. Verification Documentation:

Method Used:

X Design Review (Attach any documentation)
___ Alternate or Simplified Calculations (Attach calculations)
___ Qualification Testing

Design Document Acceptable: Yes ✓ No ___

If Not Acceptable, Give Reasons or Provide Comments on Reverse Side of This Form: _____

Verification Check Completed By (Signature): Charles D Burnside 5-16-88 Date

Acknowledgement of Verification: S M Hyde (DPE) 05-16-88 Date

III. Resolution of Comments

Comments Resolved (See Reverse Side):

_____ Responsible Engineer _____ Date

Action taken makes Design Document Acceptable

_____ Discipline Project Engineer _____ Date _____ Verifier _____ Date

Com. No.	Acpt. Y/N	Comment	Resolution	Resolved Initial/Date

CAROLINA POWER & LIGHT COMPANY
P. O. BOX 1551
RALEIGH, NORTH CAROLINA 27602

ANALYSIS

FOR

DC VOLTAGE PROFILE

FOR

RNP Unit 2

ANALYSIS I.D. 7988-E4

SAFETY CLASSIFICATION: (Q)

SEISMIC CLASSIFICATION: (N/A)

APPROVAL

REV. NO.	PREPARED BY/ DATE	VERIFIED BY/ DATE	PRIN. OR RES. ENG./ DATE	PROJECT ENG./ DATE
0				
1				
REASON FOR CHANGE				
2	3/4/88	CD Burmaster 3/21/88	WW Price 3/21/88	SM Hyde 03-11-88
REASON FOR CHANGE	M-947			
3	5-18-88	E. Anastassiades 5/26/88	WW Price 6/7/88	SM Hyde 06-07-88
REASON FOR CHANGE	GENERAL REVISION			

FORM NO. 78055 REV. 10/85

Computed by: [illegible] Date: 5-18-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E4
Checked by: E. Anastos Date: 5/20/88	CALCULATION SHEET	Pg. i of i / Rev. 3
Tar / PID No.:		File:
Project Title:		
Calculation Title: DC VOLTAGE PROFILE		
Status: Prelim. ☐ Final ☐ Void ☐		

LIST OF EFFECTIVE PAGES

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Attach. 2 Sh. 1 of 1	3

FORM NO. 78055 REV. 10/85

Computed by:	Date: 5-18-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E4	
Checked by:	Date:	CALCULATION SHEET	Pg. 1 of 6	Rev. 3
Tar / PID No.:			File:	

Project Title:

Calculation Title: DC VOLTAGE PROFILE

Status: Prelim. ☐ Final ☐ Void ☐

I. PURPOSE

To determine the voltage profile for battery A and B for the one hour duty cycle.

II. SUMMARY OF RESULTS

Minimum battery voltage during the one hour duty cycle is as follows:

Battery A - 109.2 Volts at t = 60 Min.

Battery B - 106.8 Volts at t = 60 Min.

III. REFERENCES

A. Gould battery characteristic curves -

1. TC - 107011B (battery A, NCX-1050) (Attachment 1)
2. TC - 107249 (battery B, MCX-340) (Attachment 2)

B. Calculation 7988-E1, "125V dc Battery Load Profile B," revision 4

C. Calculation 7988-E3, "125V dc Battery Load Profile A," revision 3

D. IEEE Standard 485-1983, "IEEE Recommended Practice for Sizing Large Lead Acid Storage Batteries for Generating Stations and Substations

IV. BASES AND ASSUMPTIONS

A. Minimum battery temperature will be 67°F. Therefore, a temperature correction factor of 1.06 will be applied per Reference D.

B. Battery duty cycle currents were obtained from References B and C.

C. To provide for aging and design margin, a factor of 1.375 (battery A) and 1.155 (battery B) has been applied to the calculated duty cycles of References C (battery A) and B (battery B). For battery A, the margin was distributed as 1.10 for design margin and 1.25, per recommendation of Reference D, for aging. For battery B, the margin was arbitrarily distributed as 1.10 for aging and 1.05 for design margin. Battery B does not have sufficient capacity to meet the recommended 1.25 margin for aging of Reference D.

FORM NO. 78055 REV. 10/85

Computed by: [signature] Date: 5-18-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E4	
Checked by: Anastasia Date: 5/20/88	CALCULATION SHEET	Pg. 3 of 6	Rev. 3
Tar / PID No.:		File:	
Project Title:			
Calculation Title: DC VOLTAGE PROFILE			
Status: Prelim. ☐ Final ☐ Void ☐			

V. ANALYSIS

A. Battery A — Gould NCX-1050
7 positive plates
60 cells

1. Corrected Duty Cycle

TIME (MIN.)	AMPS	X TEMPERATURE CORRECTION FACTOR	X AGING MARGIN	X DESIGN MARGIN	= CORRECTED AMPS
1	357.96	1.06	1.25	1.10	521.73
58	286.6	1.06	1.25	1.10	417.72
1	318.6	1.06	1.25	1.10	464.36

2. Battery Terminal Voltage

Voltages determined from Reference A.1.

TIME (MIN.)	CORR. AMPS	AMP HOURS	CUMM. AH	AMPS/ POS PL	AH/ POS PL	VOLTS PER CELL	BATT. VOLTS
0	521.73	0.	0.	74.53	0.	1.89	113.4
1	521.73	8.7	8.7	74.53	1.24	1.887	113.4
1	417.72	0.	8.7	59.67	1.24	1.91	114.6
59	417.72	403.80	412.5	59.67	58.93	1.84	110.4
59	464.36	0.	412.5	66.34	58.93	1.825	109.5
60	464.36	7.74	420.24	66.34	60.03	1.82	109.2

V. ANALYSIS

A. Battery B

Gould MCX-340
4 positive plates
60 cells

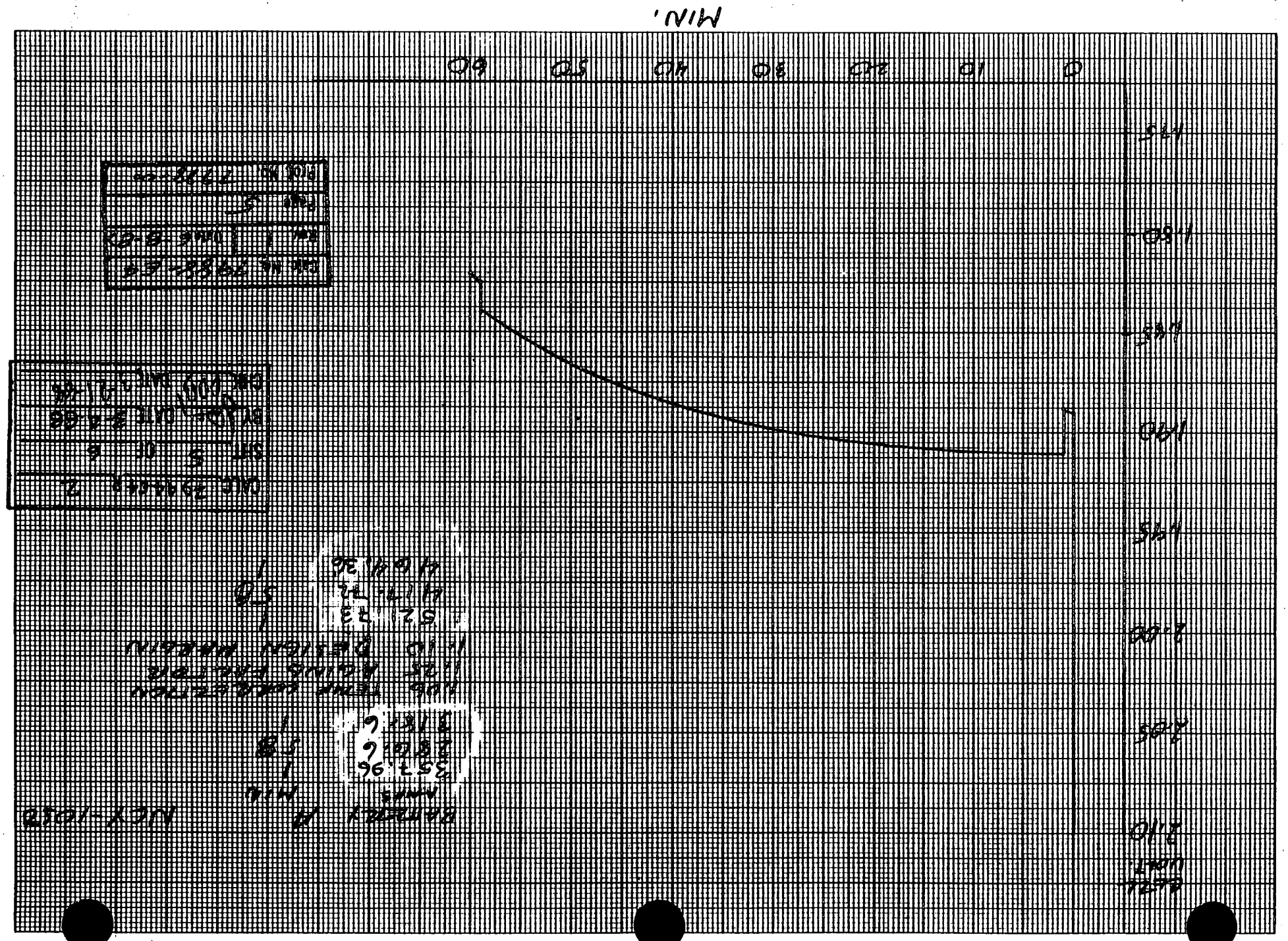
1. Corrected Duty Cycle

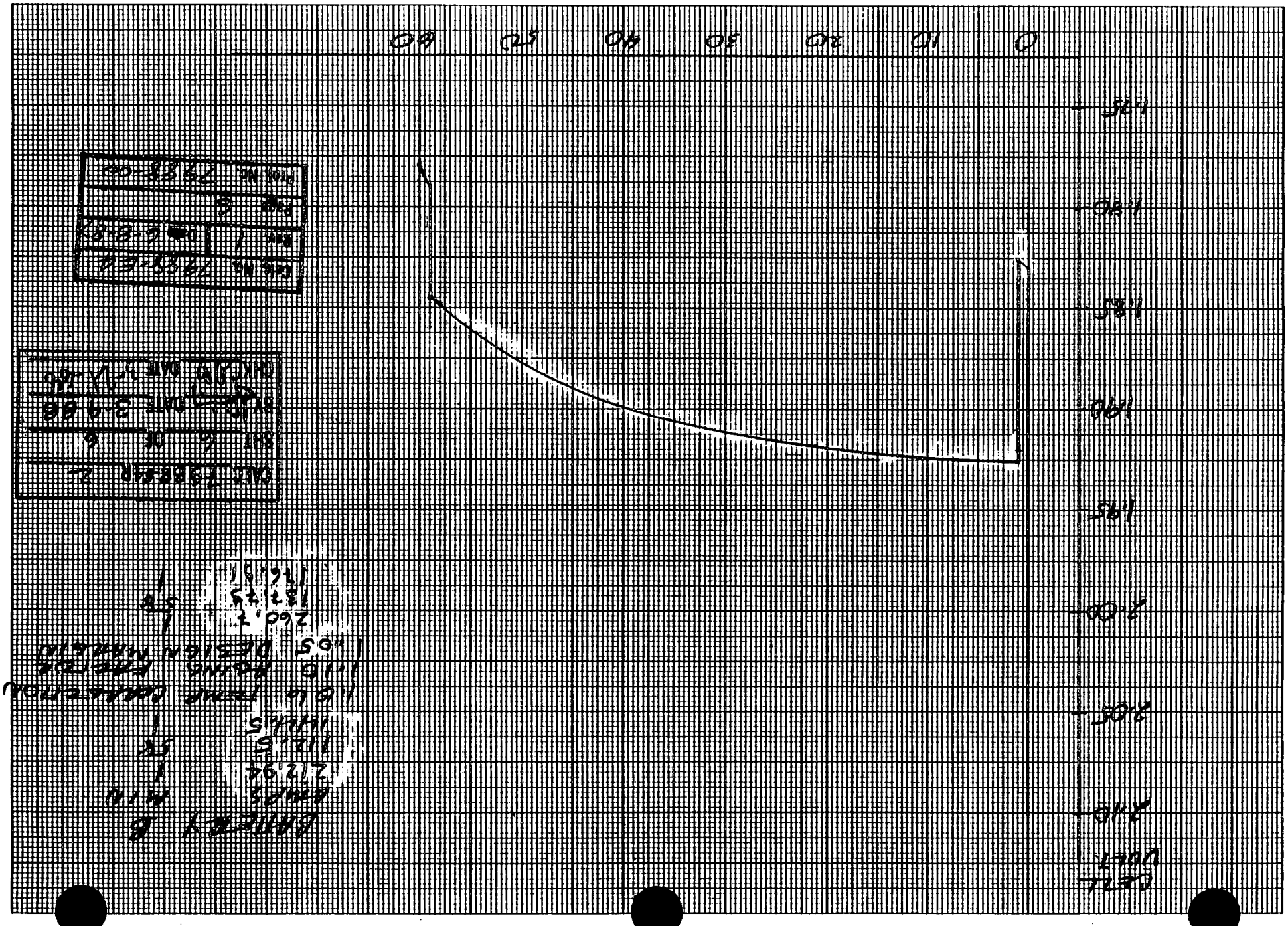
TIME (MIN.)	AMPS	X TEMPERATURE CORRECTION FACTOR	X AGING MARGIN	X DESIGN MARGIN	= CORRECTED AMPS
1	212.94	1.06	1.10	1.05	260.7
58	112.5	1.06	1.10	1.05	137.73
1	144.5	1.06	1.10	1.05	176.91

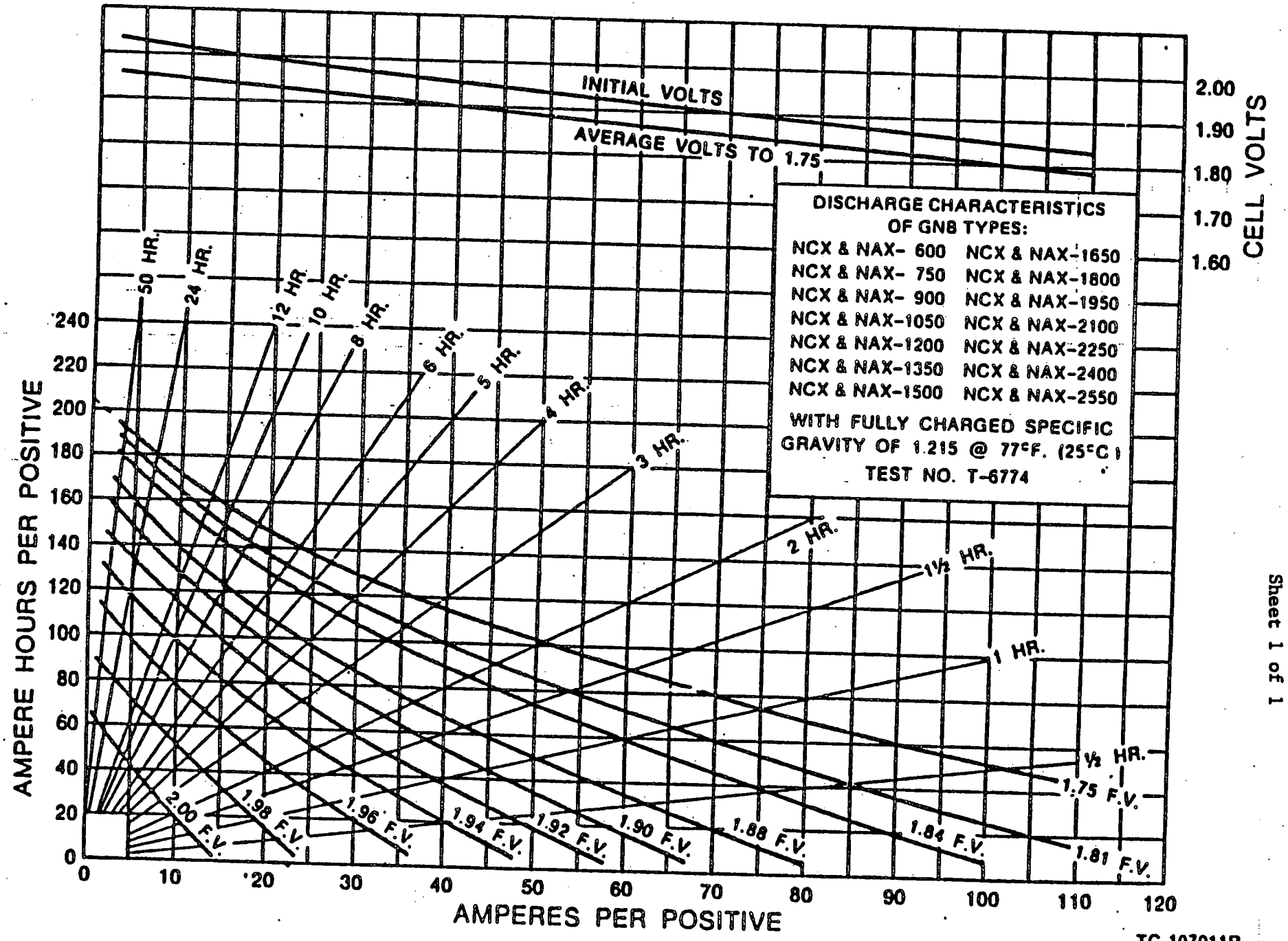
2. Battery Terminal Voltage

Voltages determined from Reference A.2.

TIME (MIN.)	CORR. AMPS	AMP HOURS	CUMM. AH	AMPS/ POS PL	AH/ POS PL	VOLTS PER CELL	BATT. VOLTS
0	260.7	0.	0.	65.18	0.	1.83	109.8
1	260.7	4.35	4.35	65.18	1.09	1.825	109.5
1	137.73	0.	4.35	34.43	1.09	1.925	115.5
59	137.73	133.14	137.49	34.43	34.37	1.846	110.76
59	176.91	0.	137.49	44.23	34.37	1.79	107.4
60	176.91	2.95	140.44	44.23	35.11	1.78	106.8



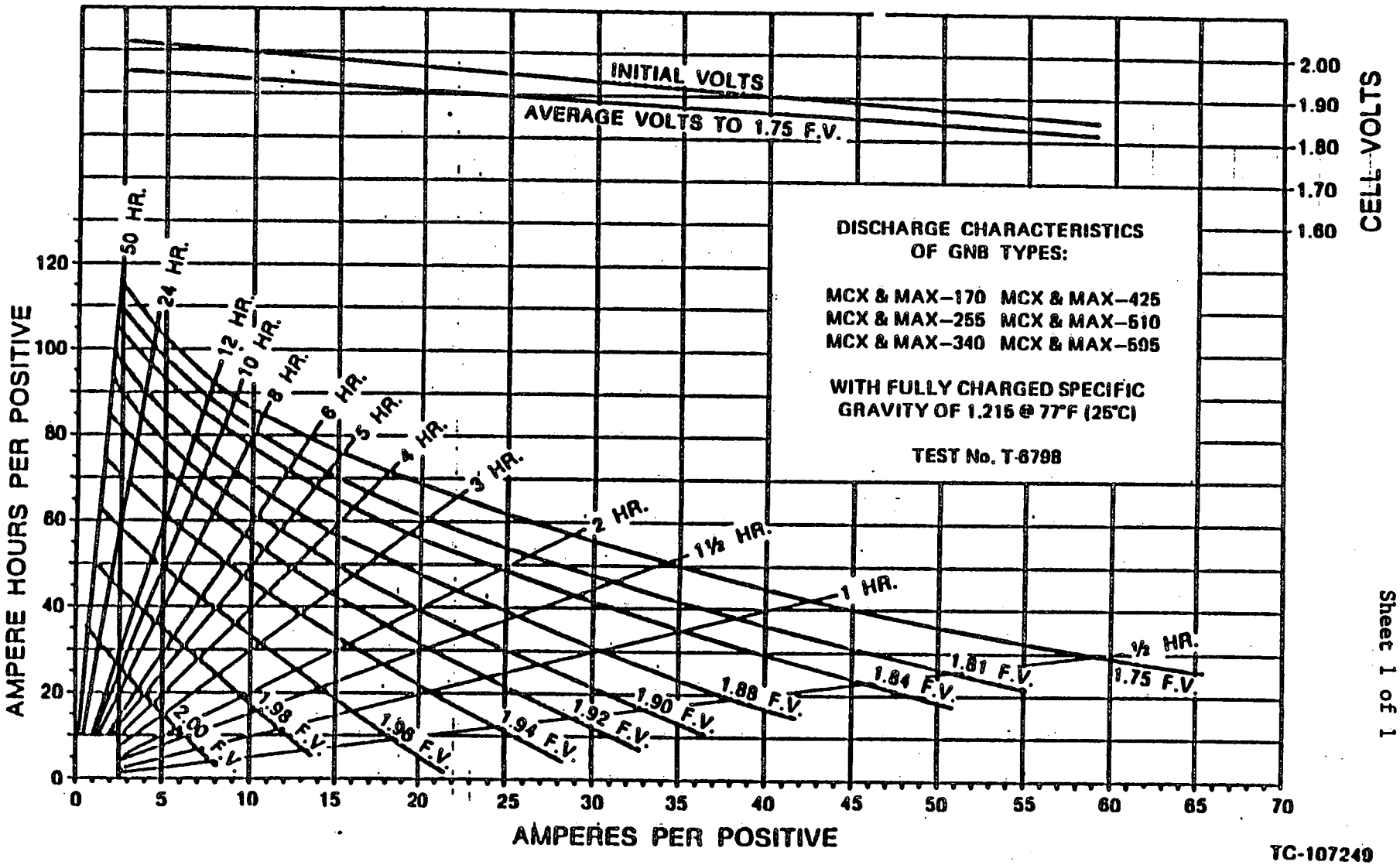




TC-107011B

Calculation 7988-E4
Attachment 1
Sheet 1 of 1

Page added rev. 3



TC-107249

Calculation 7988-E4
Attachment 2
Sheet 1 of 1

Page added rev. 3

DESIGN VERIFICATION RECORD

I. Instructions to Verification Personnel

Plant: RNP U2 TAR No.: _____ Project: _____ File No.: R87-0396-DE-A681

Design Documents: 7988-C 4 3 _____
(Document No.) (Rev.) (Document Title)

_____ _____ _____
(Document No.) (Rev.) (Document Title)

Design in verification should be done in accordance with ANSI N45.2.11, Section 6, as amended by Reg. Guide 1.64, Rev. 2.

Verification Methods to be used:

✓ Design Review
___ Alternate or Simplified Calculations
___ Qualification Testing

Documents(s) "Q" Level:

✓ Q
___ RW-Q
___ FP-Q
___ Non-Q

Special Instructions:

ASSIGNED TO E. ANASTASSIADES FOR VERIFICATION

B M Hyde 05-19-00
DPE Date

II. Verification Documentation:

Method Used:

✓ Design Review (Attach any documentation)
___ Alternate or Simplified Calculations (Attach calculations)
___ Qualification Testing

Design Document Acceptable: Yes ✓ No ___

If Not Acceptable, Give Reasons or Provide Comments on Reverse Side of This Form: _____

Verification Check Completed By (Signature): E. Anastassiades 5 holes
Date

Acknowledgement of Verification: B M Hyde 06-07-00
(DPE) Date

III. Resolution of Comments

Comments Resolved (See Reverse Side):

_____ _____
Responsible Engineer Date

Action taken makes Design Document Acceptable

_____ _____ _____ _____
Discipline Project Engineer Date Verifier Date

CAROLINA POWER & LIGHT COMPANY
P. O. BOX 1551
RALEIGH, NORTH CAROLINA 27602

ANALYSIS

FOR

MINIMUM INVERTER VOLTAGE VERIFICATION

FOR

RNP - 2

ANALYSIS I.D. 7988-E5

SAFETY CLASSIFICATION: (Q)

SEISMIC CLASSIFICATION: (N/A)

APPROVAL

REV. NO.	PREPARED BY/ DATE	VERIFIED BY/ DATE	PRIN. OR RES. ENG./ DATE	PROJECT ENG./ DATE
0				
1				
REASON FOR CHANGE				
2	J.D. 3-4-88	C D Burnside 3-16-88	W W Price 3-21-88	J M Hyatt 03-10-88
REASON FOR CHANGE	M-947			
3	J.D. 5-18-88	E. Anastassiades 5/23/88	W W Price 6/7/88	J M Hyatt 06-07-88
REASON FOR CHANGE	General Revision			

FORM NO. 78055 REV. 10/88

Computed by: [illegible] Date: 5-18-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E5
Checked by: E. Anastasiades Date: 5/23/88	CALCULATION SHEET	Pg. i of i / Rev. 3
Tar / PID No.:		File:
Project Title:		
Calculation Title: Minimum Inverter Voltage Verification		
Status: Prelim. ☐ Final ☒ Void ☐		

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FORM NO. 78055 REV. 10/85

Computed by: [illegible]	Date: 5-18-92	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E5	
Checked by: Anastasiadis	Date: 5/23/92	CALCULATION SHEET	Pg. 1 of 6	Rev. 3
Tar / PID No.:			File:	
Project Title:				
Calculation Title: Minimum Inverter Voltage Verification				
Status: Prelim. ☐ Final ☒ Void ☐				

I. PURPOSE

To verify that the minimum voltage at the battery terminals during its discharge cycle will be at or above the voltage required to assure operation of the instrument inverters. The minimum voltage required at the inverter terminals is 105 volts.

II. SUMMARY OF RESULTS

During the battery duty cycle, the minimum voltages required at battery A and B terminals exceed the voltage necessary to support the minimum voltage requirement of 105 volts at the inverter input terminals.

INVERTER	MINIMUM ALLOWABLE VOLTAGE	MINIMUM BATTERY VOLTAGE
A	106.415	109.2
B	105.969	106.8
C	106.380	109.2

III. REFERENCES

A. Okonite Bulletin EHB-81, "Engineering Data - Copper and Aluminum Conductor Electrical Cables." Tables 1-3 and 1-4.

B. Calculation 7988-E1, 125V dc Battery Load Profile B, Rev. 4

C. Calculation 7988-E3, 125V dc Battery Load Profile A, Rev. 3

D. Calculation 7988-E4, 125V dc Voltage Profile, Rev. 3

E. Instruction Manual for Model 125CT Single Phase Fixed-frequency Inverter, Westinghouse Instruction Book 19-600-37, March 26, 1968

IV. BASES AND ASSUMPTIONS

A. Original plant cables for RNP were rated for a maximum temperature of 75 C. For conservatism in this calculation, resistances will be based on conductors at 90 C. From Reference A, the applicable resistances for class B stranded annealed coated copper are:

500 MCM	0.0278	per 1000 feet
#2 AWG	0.211	per 1000 feet

B. Cable lengths shown on sketches are based on field inspection of installed cable lengths.

C. Minimum inverter voltage is 105V per Reference E.

D. Current used in determining the voltage drop between the battery and the dc MCC is the maximum current occurring during the battery duty cycle, References B and C, times the design margin applied in Reference D.

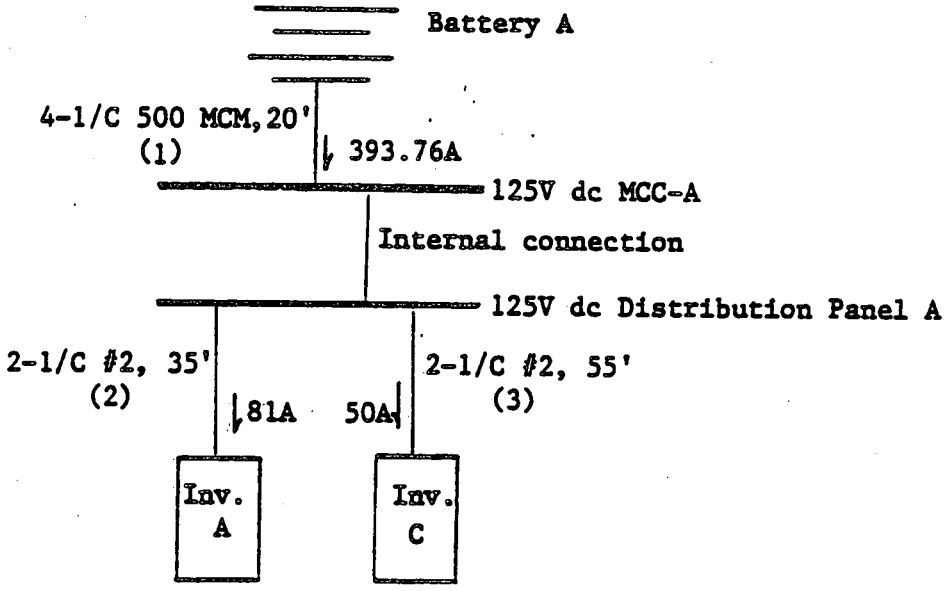
E. Inverter currents are taken from References B and C.

F. Minimum voltages at battery terminals were obtained from Reference D.

Computed by:	Date: 5-18-98	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E5	
Checked by: Anastasia Ivdas	Date:		Pg. 3 of 6	Rev. 3
Tsr / PID No.:		CALCULATION SHEET	File:	
Project Title:				
Calculation Title: Minimum Inverter Voltage Verification				
Status: Prelim. ☐ Final ☒ Void ☐				

V. ANALYSIS

A. Battery A



INVERTER A

A CABLE	B CABLE RES. ($\Omega/10^3$ ft)	C CABLE LENGTH ONE-WAY (ft.)	D TOTAL RES. (Ω) [2 X B X C]	E CURRENT (A)	F VOLTAGE DROP (V) [D X E]
(1)	0.0278/2*	20	5.56×10^{-4}	393.76	0.219
(2)	0.211	35	0.01477	81.	1.196
				TOTAL DROP	1.415

* parallel 500 MCM's

FORM NO. 78055 REV. 10/85

Computed by:	Date:	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E5	
Checked by: Anas Tassiodes	Date: 5/23/88	CALCULATION SHEET	Pg. 4 of 6	Rev. 3
Tar / PID No.:			File:	

Project Title:

Calculation Title: Minimum Inverter Voltage Verification

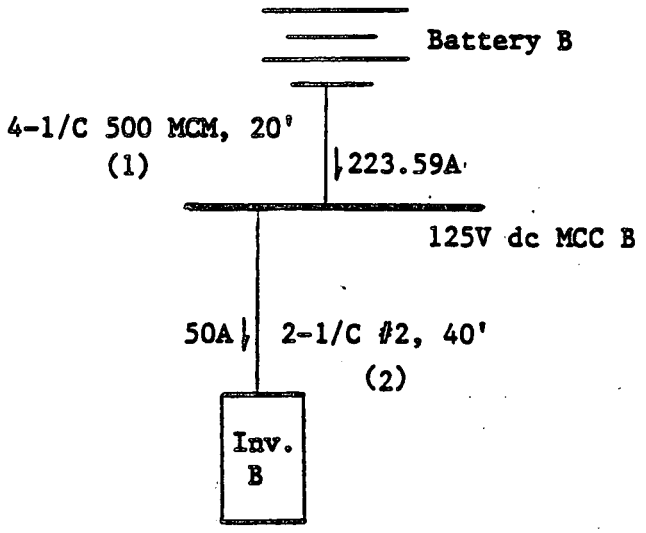
Status: Prelim. ☐ Final ☒ Void ☐

INVERTER C

A CABLE	B CABLE RES. ($\Omega/10^3$ ft)	C CABLE LENGTH ONE-WAY (ft.)	D TOTAL RES. (Ω) [2 X B X C]	E CURRENT (A)	F VOLTAGE DROP (V) [D X E]
(1)	0.0278/2*	20	5.56×10^{-4}	393.76	0.219
(3)	0.211	55	0.0232	50.	1.161
				TOTAL DROP	1.380

* parallel 500 MCM's

B. Battery B



INVERTER B

A	B	C	D	E	F
CABLE	CABLE RES. ($\Omega/10^3$ ft)	CABLE LENGTH ONE-WAY (ft.)	TOTAL RES. (Ω) [2 X B X C]	CURRENT (A)	VOLTAGE DROP (V) [D X E]
(1)	0.0278/2*	20	5.56×10^{-4}	223.59	0.125
(2)	0.211	40	0.0169	50.	0.844
				TOTAL DROP	0.969

* parallel 500 MCM's

Computed by:	Date: 5-16-88	CAROLINA POWER & LIGHT COMPANY	Calculation ID: 7988-E5	
Checked by: Anastasiadis	Date: 5/23/88	CALCULATION SHEET	Pg. 6 of 6	Rev. 3
Tar / PID No.:			File:	
Project Title:				
Calculation Title: Minimum Inverter Voltage Verification				
Status: Prelim. ☐ Final ☒ Void ☐				

C. Minimum required battery voltages

A INVERTER	B MIN. REQ'D. VOLTAGE (V)	C VOLTAGE DROP (V)	D MIN. REQ'D. BATT. VOLT. (V) [B + C]	E MINIMUM BATTERY VOLTAGE (V)*
A	105	1.415	106.415	109.2
B	105	0.969	105.969	106.8
C	105	1.380	106.380	109.2

* From Reference D.

DESIGN VERIFICATION RECORD

I. Instructions to Verification Personnel

Plant: RNP U2 TAR No.: _____ Project: _____ File No.: R87-039/01-DE-A681

Design Documents: 7988-E5 (Document No.) 3 (Rev.) _____ (Document Title)

_____ (Document No.) _____ (Rev.) _____ (Document Title)

Design in verification should be done in accordance with ANSI N45.2.11, Section 6, as amended by Reg. Guide 1.64, Rev. 2.

Verification Methods to be used:

✓ Design Review
___ Alternate or Simplified Calculations
___ Qualification Testing

Documents(s) "Q" Level:

✓ Q
___ RW-Q
___ FP-Q
___ Non-Q

Special Instructions:

ASSIGNED TO E. ANASTASSIADES FOR VERIFICATION

[signature] DPE 05-19-98 Date

II. Verification Documentation:

Method Used:

✓ Design Review (Attach any documentation)
___ Alternate or Simplified Calculations (Attach calculations)
___ Qualification Testing

Design Document Acceptable: Yes ✓ No ___

If Not Acceptable, Give Reasons or Provide Comments on Reverse Side of This Form: _____

Verification Check Completed By (Signature): E. Anastassiades 5/23/98 Date

Acknowledgement of Verification: [signature] (DPE) 06-07-98 Date

III. Resolution of Comments

Comments Resolved (See Reverse Side):

_____ Responsible Engineer _____ Date

Action taken makes Design Document Acceptable

_____ Discipline Project Engineer _____ Date _____ Verifier _____ Date