STONE & WEBSTER ENGINEERING CORPORATION [redacted]

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE

NOTED DEC 0 4 1984 E. POTTONEN   NOTED JUL 18 1984 1[redacted]   NOTED SEP 28 1984 E. HARRIS Rev. 4   REV. 5   6   7

A 5010.64 (FRONT)   Rev 6

CLIENT & PROJECT	PAGE 1 OF 61 + 2 INCLUDING ATTACHMENTS
NMPC - NMP2 [redacted] 1985 E. HARRIS Rev. 7	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
NORMAL STATION BATTERY 2BYS-BAT1A (1A1, 1A2, 1A3, 1A4) SIZING NORMAL STATION BATTERY CHARGER 2BYS-CHGR 1A1 SIZING	☐ I - NUCLEAR SAFETY RELATED ☒ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12177	ELECTRICAL 3910	EC-44	NA	NA

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION * REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
J.M. Knudsen 4/6/84	J.J. Pasko 7/18/84		REV. 4	EC-44, REV 3	✓	
J.M. Knudsen 9/26/84	G. O'Neill 9/26/84		REV. 5	REV. 4		✓
J.M. Knudsen 10/12/84	J.J. Pasko 11/27/84		REV. 6	REV. 5		✓
[illegible] C. [illegible]	[illegible] 8/6/85		REV. 7	REV. 6		✓
S. Tsombaris 1/29/88	[illegible] 2/1/88		REV. 8	REV. 7		✓
M. Mellott 7/15/88	S. Tsombaris 7/18/88		REV. 9	REV. 3		✓
Joe C. Kirkpatrick 12/7/88	[illegible] 12/20/88		REV. 10	REV. 9		✓

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DISTRIBUTION *

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	VAOSC		NM-Te Battery Sizing Calc.		
ELEC ENGR'G.	M. SCHILDROTH A. JULKA (NMPC)			9304290059	

9304290059 911031
PDR ADOCK 05000410
S PDR

07-15-91

[illegible]

[illegible]

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CALCULATION IDENTIFICATION NUMBER				PAGE 2
J.O. OR W.O. NO. 12177	DIVISION & GROUP ELECTRICAL	CALCULATION NO. EC-44-8	OPTIONAL TASK CODE N/A	

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12177	ELECTRICAL	EC-44	N/A	

1. Objective

EC-44 checks the Ampere-Hour capacity of Battery 2BYS-BAT1A (1A1, 1A2, 1A3, 1A4) in order to verify the adequacy of the Batteries already purchased, and the adequacy of the purchased Battery charger 2BYS-CHGR1A1.

2. Assumptions

a. The UPS loads used in this calculation are based on calculation EC-12.3 Rev. 2, instead of the rated capacity of the UPS. △5

b. No factors for inaccuracies and growth are used.

c. Battery is sized to support the necessary loads for an orderly shutdown, following simultaneous LOOP and unit trip. △9

d. Battery is sized for a two hour support time.

e. The lowest expected electrolyte temperature is the lowest room temperature in which the battery will be installed ie. 65°F

f. The method employed is the sizing procedure outlined in IEEE-485, 1978.

g. UPS Inverters are not a charger load.

h. The essential lighting load of UPS 2VBB-UPS1C is assumed to occur for 90 minutes to satisfy the requirements of NEC article 700.

i Only 20 Amperes out of 68.90 Amperes of auxiliary relay and indicating light loads on "CEC" panels (pages 43 through 47) are considered in the battery duty cycle since all the loads will not be energized simultaneously. This is considered a random load that may appear at any time during the duty cycle. The load is considered to occur for one full minute, to be conservative.

j The circuit breakers assumed to be tripping are shown on pages 60 & 61. The tripping load is based on the 13.8kV, 4.16kV and 600V undervoltage timers, all set at 3.0 seconds in accordance with applicable ER drawings. 9

Since each switchgear and loadcenter DC bus could be connected to either battery (2BYS-BAT1A or 2BYS-BAT1B), for the purpose of this calculation it is assumed that the entire breaker trip load is supplied by 2BYS-BAT1A.

k. EBOP is assumed to operate for 45 minutes per source W. (page 59) 9

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l. One high voltage disconnect switch is assumed to operate. Only the inrush current is assumed for one full minute which is conservative. This is considered as a random load. (9)

m. The load required to close one 13.8KV and one 4.16KV circuit breakers simultaneously has been assumed as the worst case closing load. This is considered to be a random load that may occur at any time during the duty cycle. The breaker closing load has been assumed for one full minute, to be conservative. (9)

n. The EBOP and the diesel generator fuel oil booster pump are not considered as charger continuous load, because it is assumed they will have performed their intended function before AC power is restored (120 minutes). (9)

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12177	ELECTRICAL	EC-44	NA	

3. Sources

a. Purchase Specification NMP2-E033A, Addendum 2, dated November 2, 1982

b. Technical Data by the Seller, Gould Inc., dated March 17 1977 (Received 5/27/83).

c. IEEE recommended practice for sizing Large Storage Batteries for Generating Stations and Substations. IEEE-485, 1978

d. ETP-110.0.1 (REV. 0), Verification of Lead Storage Battery Size

e. Purchase Specification NMP2-E035A, Uninterruptable Power Supplies dated 6/29/81 (Add. 4); Instruction manuals, EXIDE and ELGAR.

f. Drawings: 12177-EE-1 -5, 12177-EE-M01G-1, 12177-EE-M01D-1

g. IOC, G. Fligg to J. Knudsen dated 2/26/81, attached.

h. Purchase specification NMP2-E034A, Addendum 5. November 3, 1982, Static Battery Chargers.

i. Gould-Brown Boveri Bulletin 10.2-1E

j SWEC ESK-11TML01-9 △9

K. BROWN BOVERI Bulletin 2.3.1.1b

l. SWEC ESK-6WCS01-10 △9

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m. ELGAR Instruction Manual UPS 103-1-176, REV B (SWEC NO 01.560-5002)(SUPERSEDED BY NMPC DOC NO N2E20900IPWSUP002 UPS-253-1-106, REV. 00 (NMPC DOC. NO. N2E20900IPWSUP001) △10

n. EXIDE Instruction Manual 101-710-343-77223 (UPS), REV. 00 (NMPC DOC. NO N2E35600IPWSUP001) △

o. General Electric Bulletin GET-6590, Page B-7, B-10

p. General Electric 4.16kV (GEK 419020) switchgear instruction manual.

q. General Electric Starter drawing 1.080-002-020A

r. General Electric EBOP motor diagram 1.080-002-013A

s. General Electric motor Data Sheet (EBOP) 1.080-002-006E

t. Telecon data from nameplate of EBOP received from the field, page 35 this calculation.

u. Relay charts, pages 43 through 47, this calculation.

v. Letter, G.E. P. Patel to C. Zappile of SWEC dated 8/28/84.

w. IOC, from J. Sternchos to J. Knudsen dated 6/25/85.

x. Calculation EC-123 REV. 2 △9

y. SWEC IOM dated 5/10/82, attached.

z. ESK's:

6AAS01-9	6GMC02-10	6HVR03-10
6ABM03-4	6HVH01-6	6HVR04-10
6ABM04-3	6HVH02-6	6HVR05-10
6ARC01-16	6HVI04-5	6HVR06-8
6ARC02-16	6HVN01-5	6HVR07-9
6CNS04-6	6HVN02-5	6HVR08-9
6CNS05-6	6HVN03-5	6HVR09-10
6GMC01-10	6HVN04-5	6HVT01-8

△9

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12177	ELECTRICAL	EC-44	NA	

6HVT02-8	6HVW08-5	6SWP31-5
6HVT03-9	6IAS01-9	6SWT01-5
6HVT04-8	6IAS02-9	6SWT02-5
6HVT05-8	6IAS03-9	6TMB01-10
6HVT06-9	6LWS06-7	6TMB02-10
6HVW05-5	6LWS07-7	6WCS01-10
6HVW06-5	6LWS13-2	6WCS02-9
6HVW07-5	6LWS14-2	

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4 Conclusions

The battery size, (2) 60, 35 plate cells, as recommended by Gould Inc. in proposal "Technical Data by Seller", Section 3 of Purchase Specification NMP2-E033A, Addendum 1, dated 3/2/78, is acceptable.*

The 500 Ampere Battery Charger as supplied by Power Conversion Products in "Technical Data by Seller", Section 3 of Purchase Specification NMP2-E034A, Addendum 2, dated 1/4/79, is acceptable.

* This is based on (I) 2VBB-UPS1A loading of 65.52 KVA @.8 pf. instead of 75 KVA (II) 2VBB-UPS1C loading of 63 KVA @.9 pf. instead of 75 KVA. per EC-123, Rev. 2

5. Reason for Revision

5a. Revision no. 5

All assumptions and input data are complete. Any future changes will be incorporated by revising this calculation.

5b. Revision no. 6

Final Emergency Bearing Oil Pump data received in source V. ; General Electric letter, page 36 of this calculation is incorporated in EC-100. Also in depth review of logic changed Switchgear D.C. loads.

5c. Revision no. 7

Revision no. 7 was done to correct EBOP and switchgear loads.

5d Revision no. 8

Revision no. 8 was done to improve legibility and to correct inaccuracies and typographical errors throughout the calculation. The inputs and conclusions of this calculation remain unchanged.

5e Revision no. 9

Revision no. 9 was done to revise 2BYS-PNLA101, A102 and A107 loads. Also, the breaker trip load for LOOP with (9)

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CALCULATION IDENTIFICATION NUMBER				
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Unit trip scenario was incorporated. This scenario represents the worst possible case.

Revised pages : 1,3-8, 10, 16-18, 20, 21, 23-31, 33, 34

New pages : 8A, 10A, 60, 61

Replaced pages : 22, 38-40

Redrawn pages : 32

5f. <u>REVISION no. 10</u>

REVISION NO. 10 WAS DONE TO ADD APPLICABLE REV. / DATE TO SOURCES D, M & N.

PAGES REVISED : 7, 8, 10A

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6. Loads Connected to the Battery

Loads Connected to the Battery are shown on Table 1, pages 16 & 17. These loads were determined as follows:

a. Circuit Breaker Operation

15KV, 5KV manufactured by General Electric Co.:

CLOSE OPERATION

1. circuit breaker control Switch to close position.
2. close release coil (6 Amperes) is energized, releasing closing spring. (Opening spring is charged simultaneously).
3. closing spring is then charged (14 Amperes) while close circuit is interlocked open.

TRIP OPERATION

1. circuit breaker control Switch to trip position or protective relay contact closes.
2. trip coil (6 Amperes) is energized, releasing opening Spring.

(See NMP2-E015F instruction manual, GE bulletin GEK-419026)

b. 600V Electrically Operated breakers manufactured by I-T-E:

CLOSE OPERATION

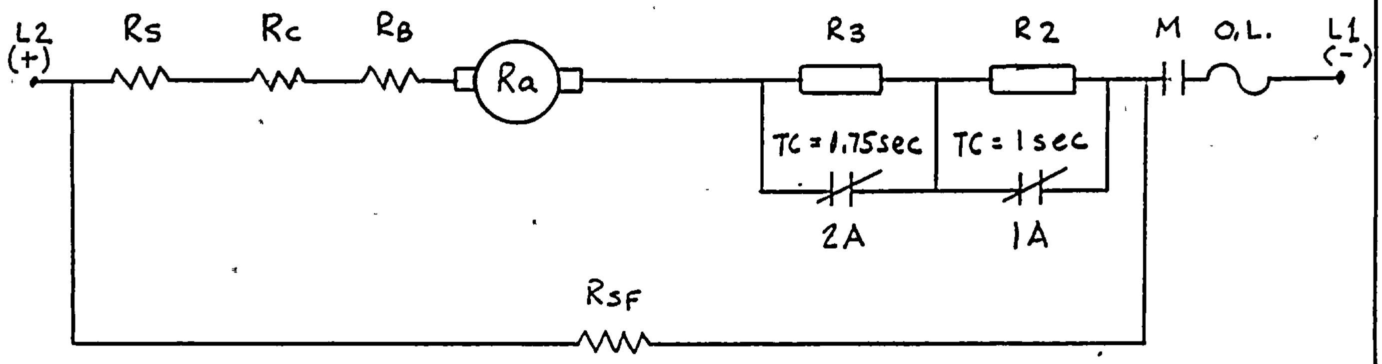
1. circuit breaker control switch to close position

2. close release coil is energized, releasing closing spring. both CLOSE and TRIP springs are charged simultaneously (10 Amperes).

TRIP OPERATION

1. circuit breaker control switch to trip position or protective relay contact closes.
2. trip coil is energized (1.3 Amperes) releasing opening spring.
   See ESK-6WLS07 (typical)

C. Emergency Bearing Lube Oil Pump (EBOP)



Where, R_S = Series field resistance = 0.0007 Ω
R_C = Commutating Pole resistance = 0.0036 Ω (Source v.)
R_B = Brush resistance = 0.0098 Ω
R_{SF} = Shunt field resistance = 40.0 Ω (Source t.)

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$R_3 = 0.05\ \Omega$

$R_2 = 0.105\ \Omega$

R_a = Armature Resistance = 0.0126 Ω (Source v.)

TC = Time to Close; Open at start (source j)

I_{SF} = 2.25 Amperes (source t.)

The value of R_b was calculated based on a brush voltage drop of 2 volts (source v.) and armature current of 205 Amperes (source t.); $2V/205\,A \approx 0.0098\ \Omega$.

EBOP starting current can be found as follows:

$$I_{START} = \frac{VOLTS}{R_S + R_C + R_B + R_a + R_3 + R_2} + I_{SF}$$

$$I_{START} = \frac{123.8\,V}{0.1817\ \Omega} + 2.25 = 683.59 \text{ Amperes}$$

where VOLTS is the battery open circuit voltage.

d. UPS Input KW

2VBB-UPS1A : load is 72,820 VA from source x.

load power factor = 0.8

Diversity Utilization factor = 0.9, from source y.

Efficiency when supplied by the battery = 0.84, from source n.

$$\text{Input KW} = \frac{72{,}800 \times 0.8 \times 0.9}{0.84} = 62.4$$

based on the above KW load, the load current is calculated at various times of the battery duty cycle taking into consideration that the battery voltage is gradually decreasing

$$I_{0\,Time} = \frac{62400\ W}{123.8\ V} = 504 \text{ Amperes}$$; 123.8 V = Battery Open Circuit Volts

$$I_{120\ minutes} = \frac{62{,}400\ W}{101\ V} = 618 \text{ Amperes}$$; 101 V = Minimum Volts at load

$$I_{120\ minutes} - I_{0\,Time} = 618 - 504 = 114 \text{ Amperes}$$

$$I_{90\ minutes} = \frac{90}{120} \times 114 + 504 = 590 \text{ Amperes} *$$

$$I_{45\ minutes} = \frac{504 + 590}{2} = 547 \text{ Amperes} *$$

* Assuming linear discharge characteristics and constant UPS load, for ease of calculation.

2VBB-UPS1C : load is 70,000 VA from source x.

load power factor = 0.9 , from Lighting Specialist

Diversity Utilization factor = 0.9 , from source y.

Efficiency when supplied by the battery = 0.84 , from source n.

$$\text{Input KW} = \frac{70{,}000 \times 0.9 \times 0.9}{0.84} = 67.5 ~~00~~ ~~W~~$$

$$I_{0\,time} = \frac{67\,500\ KW}{123.8\ V} = 545 \text{ Amperes}$$

$$I_{120\ minutes} = \frac{67500\ KW}{101\ V} = 668 \text{ Amperes}$$

$$I_{120\ minutes} - I_{0\,time} = 668 - 545 = 123 \text{ Amperes}$$

$$I_{90\ minutes} = \frac{90}{120} \times 123 + 545 \approx 637 \text{ Amperes}^{*}$$

$$I_{45\ minutes} = \frac{637 + 545}{2} = 591 \text{ Amperes}^{*}$$

$I_{120\ minutes}$ was calculated above only to determine $I_{45\ minutes}$ and $I_{90\ minutes}$.

D. Miscellaneous loads

Miscellaneous loads are depicted in Table 1 along with the loads already discussed in this section.

* Assuming linear discharge characteristics and constant UPS load, for ease of calculation.

TABLE 1 : CONNECTED LOADS

continued on page 17

	DESCRIPTION	LOAD: TRIP COIL QUANT.	LOAD: TRIP COIL AMP/COIL	LOAD: TIMERS QUANT.	LOAD: TIMERS AMP/TIM	LOAD: AUX RELAYS QUANT.	LOAD: AUX RELAYS AMP/REL	LOAD: IND. LIGHTS QUANT	LOAD: IND. LIGHTS AMP/LT	AMPERES: INRUSH	AMPERES: STEADY STATE	RATED HP	RATED KW	RATED KVA	ACTUAL INPUT KW
	2VBB-UPS1A	-	-	-	-	-	-	-	-	-	-	-	-	75	62.4
	2VBB-UPS1C	-	-	-	-	-	-	-	-	-	-	-	-	75	67.5
	2TML-P5	-	-	-	-	-	-	-	-	684	207.25	30	-	-	-
	2EGF-P3	-	-	-	-	-	-	-	-	30	7.50	1	-	-	-
13.8KV SWGR	2NPS-SWG001	8*	6*	-*	-*	-	-	28*	0.06	49.68*	1.68*	-	-	-	-
13.8KV SWGR	2NPS-SWG003	8*	6*	-*	-*	-	-	28*	0.06	49.68*	1.68*	-	-	-	-
13.8KV SWGR	2NPS-SWG002	2*	6*	-	-	-	-	6*	0.06	12.36*	0.36*	-	-	-	-
13.8KV SWGR	2NPS-SWG004, 5	-	-	-	-	-	-	4*	0.06	0.24*	0.24*	-	-	-	-
4.16KV SWGR	2NNS-SWG011, 012, 013, 014, 015	17*	6	-*	-*	-	-	65*	0.06	105.9*	3.9*	-	-	-	-
4.16KV SWGR	2NNS-SWG016, 017 018	-	-	-	-	-	-	6*	0.06	0.36*	0.36*	-	-	-	-
600V SWGR	FEEDER BREAKERS	49*	1.3*	3*	0.06*	13*	0.06*	43*	0.06*	67.24*	2.58*	-	-	-	-

* CHANGED REV. 9 (9)

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CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO. 12177

DIVISION & GROUP: ELECTRICAL

CALCULATION NO. EC-44

OPTIONAL TASK CODE: N/A

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TABLE 1

DESCRIPTION		LOAD: TRIP COIL QUANT	LOAD: TRIP COIL AMP/COIL	LOAD: TIMERS QUANT	LOAD: TIMERS AMP/TM	LOAD: AUX RELAYS QUANT	LOAD: AUX RELAYS AMP/REL	LOAD: IND. LIGHTS QUANT	LOAD: IND. LIGHTS AMP/LT	AMPERES: INRUSH	AMPERES: STEADY STATE	HP	KW	KVA	ACTUAL INPUT KW
125 V DC	2BYS-SWG001A	–	–	–	–	–	–	1	0.06	0.06	–	–	–	–	–
	2CEC-PNL732	–	–	–	–	10	0.03	10	0.06	0.90	6.4*	–	–	–	–
	2CEC-PNL734	–	–	–	–	9	0.03	8	0.06	0.75	17.25*	–	–	–	–
	2CEC-PNL735	–	–	–	–	8	0.03	7	0.06	0.66	17.16*	–	–	–	–
	2CEC-PNL744	–	–	–	–	7	0.03	7	0.06	0.63	28.13*	–	–	–	–
	2YUL-MDS1	1	5.93	–	–	–	–	1	0.06	30.0** △	7.0	0.75	–	–	–
	2YUC-MDS3	1	5.93	–	–	–	–	1	0.06	30.0** △	7.0	0.75	–	–	–
	2YUC-MDS5	1	5.93	–	–	–	–	1	0.06	30.0** △	7.0	0.75	–	–	–
	2YUC-MDS10	1	5.93	–	–	–	–	1	0.06	30.0**	7.0	0.75	–	–	–
	2BYS-PNLA101	–	–	–	–	–	–	–	–	–	10.0*** △	–	–	–	–
	2BYS-PNLA102	–	–	–	–	–	–	–	–	–	30.0*** △	–	–	–	–
	2BYS-PNLA107	–	–	–	–	–	–	–	–	–	27.0*** △	–	–	–	–

* See pages 41-45 for load determination; only 20A out of 68.94 A is considered in the battery duty cycle because all the loads will not be energized simultaneously.

** See Assumption 2, page 6 of this calculation.

*** See panel schedules, pages 38-40 of this calculation.

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NOTES FOR TABLE 1

1. The tripping load occurs within 0.237 seconds. Tripping load is 274.66 Amperes, maximum. (18×6)+(17×6)+(49×1.3)+(16×.03)

2. The immediate motor inrush is 714 (684.0+30.0) Amperes, starting at 0.75 seconds; it is assumed it will last for the entire 1ST minute of the duty cycle, to be conservative.

3. Used total of 180 indicating lights for all switchgear; 180×0.06=10.8 Amperes. This value plus 2.94 Amperes for PGCC indicating lights and relays (74 relay) and 0.24 amperes for HV switch indicating lights equals 13.98 amperes. This load of 13.98 Amperes is used on page 20 of this calculation

4. See sources m. and n. for UPS sources, page 8 of this calculation.

7. Determination of the Battery Duty Cycle

Page 20 depicts the battery loads considered, the time they occur and their duration. Certain loads such as 2YUL-MDS1, etc, have been designated as RANDOM LOADS since they may appear any time during the duty cycle.

Page 21 depicts the sum of battery loads by time period. The 1/2 total load is also shown, because the Duty Cycle Diagram is constructed for a single battery although in reality two identical batteries are used. Page 22 depicts the Battery Duty Cycle Diagram.

The following constitutes the basis for selection of "Start Time" and "duration" for 2EGF-P3. Per FSAR page 9.5-24a the electric motor driven fuel booster pump is a standby pump. However, the pump starts and primes the engine driven pump, when the start signal is given for the engine to start. The pump stops after a speed signal is given from the engine. But the fuel booster pump will also start if fuel pressure in the main header downstream of the engine driven pump falls to 25psi. Based on the above it will be assumed that the pump starts at t=0 and continues to run for 120 minutes.

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J.O./W.O./CALCULATION NO.	REVISION	PAGE
12177 / EC-44		20

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE

SUBJECT/TITLE	QA CATEGORY/CODE CLASS

WORK SHEETS
FOR
STORAGE BATTERIES - LEAD-ACID

A. Length of duty cycle 120 minutes

B. Loads

		Amp	Start (1) Min	Duration Min	
Breaker Tripping	(2)				
ALL SWITCHGEAR AND PGCC PNLS		274.66	0	1 ✓	△9
Continuous Control					
INDIC. LIGHTS FOR 2CEC-PNL732,734,735,744 & SWYD : 138KV, 4.16KV & 125VDC SWGR'S.		13.98	0	120	△9
Emergency Lighting					
2VBB-UPS1C		545-591-637	0	90 ✓	
Inverters					
2VBB-UPS1A		504-547-590 618	0	120 ✓	
Motor Starting Inrush	(3)				
EBOP (2TML-P5)		684	0	1 ✓	
2EGF-P3 (DIESEL GENER. FUEL PUMP)		30	0	1 ✓	
Motor Running					
EBOP (2TML-P5)		207.25	1	44	
2EGF-P3 (DIESEL GENER FUEL PUMP)		7.5	1	119	
Other Loads					
MISCELLANEOUS LOADS ON 2BYS-PNLA101, 102, 107		67	0	120 ✓	△9
RANDOM LOAD : 2CEC-PNL732,734,735,744		20		1	
: 2YUL-MDS1		30		1 ✓	
Breaker Closing, etc.	(4)				
13.8KV & 4.16KV SWGR (1 PER SWGR) (RANDOM LOAD)		28		1 ✓	

(1) "Start" means time from start of cycle to load application.

BATTERY LOAD TABULATION

BY TIME PERIOD

TIME PERIOD	INCREMENTAL LOADS, AMPERES	TOTAL LOAD AMPERES	1/2 TOTAL LOAD (AMPERES)
0 - 1 min.	274.66+13.98+545+504+684+30+67	2118.64	1059.32
JUST AFTER 1 MIN.	13.98+545+504+207.25+7.5+67	1344.73	672.36
45min	13.98+591+547+207.25+7.5+67	1433.73	716.86
JUST AFTER 45min	13.98+591+547+7.5+67	1226.48	613.24 (9)
90 min	13.98+637+590+7.5+67	1315.48	657.74
JUST AFTER 90 min.	13.98+590+7.5+67	678.48	339.24
120 min.	13.98+618+7.5+67	706.48	353.24

RANDOM LOAD = 30 + 20 + 28 = 78 Amperes

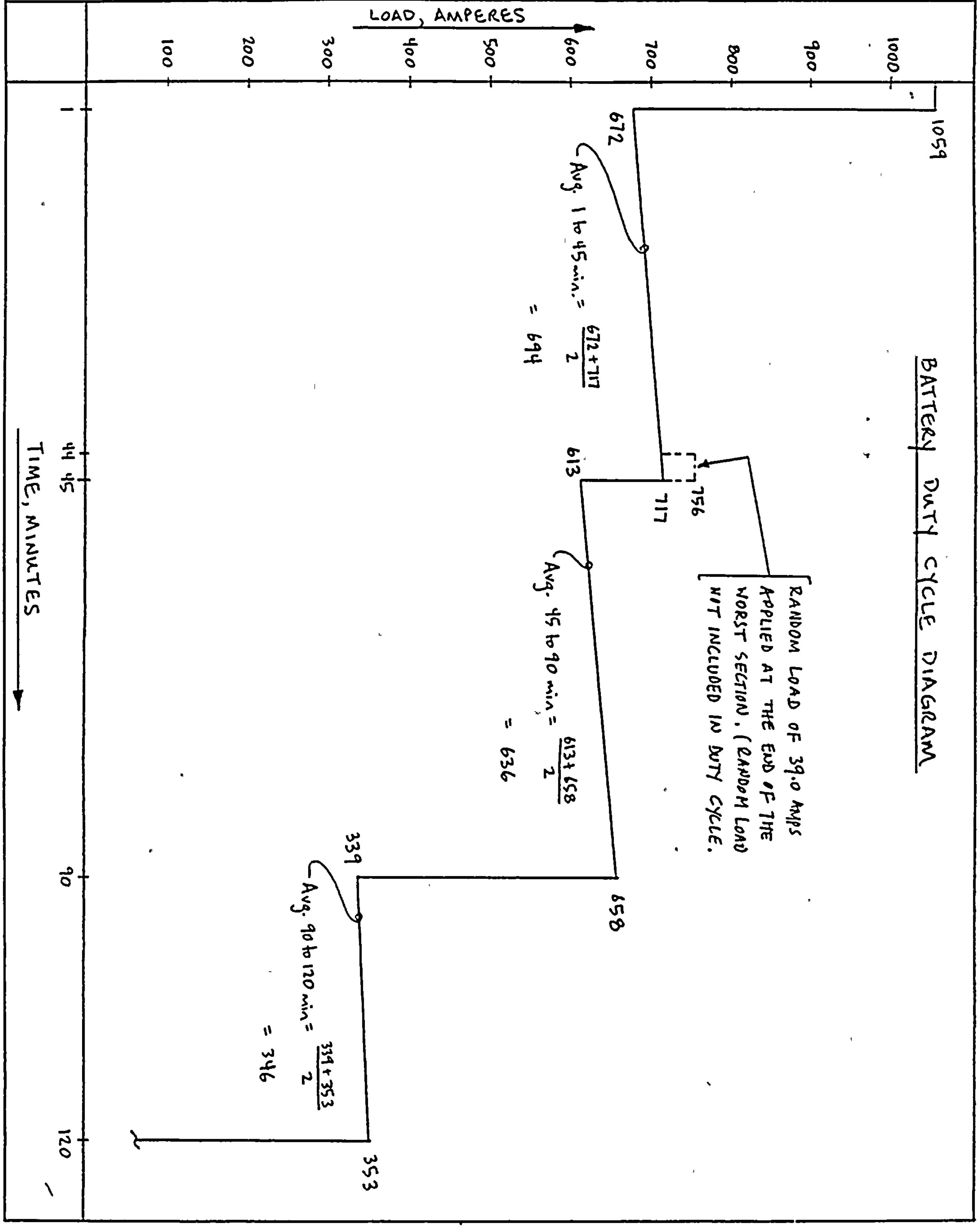
1/2 RANDOM LOAD = $\frac{78}{2}$ = 39 Amperes.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 22
12177	ELECTRICAL	EC-44	N/A	9



8. Explanation of Battery sizing form (page 28, this Calculation) Complying with IEEE-485 and EC-110.0.1.1-0 Page 3

(1) Period is a particular segment of the load profile. For example, 0 to 1 minute is period no. 1, since it is the first period starting from zero (or the left side). The term section is the number of periods under consideration. Section 3 indicates 3 periods are being considered.

(2) Load (amperes), A1 for example, is the load for period 1. (2118.64/2 or 1059 amperes in this case). △9

(3) Change in load (amperes), is the change from one period to the next.

(4) Duration of period (minutes) M1, is the time for a particular period in minutes.

(5) Time to end of section (minutes), T, is the time from T=0 to the time at the end of the section under consideration.

(6A) R_T = Amperes per positive plate

Section 1 R_T is obtained by first referring to Gould Capacity Table, page 41, 1 minute rating to 1.75 volts per cell column and finding the nearest value equal to or greater than A1. (See (2), above).

This value is then divided by $\frac{\text{Plates / cell} - 1}{2}$ for the battery type matching the 1 minute rating used above, the quotient being R_T. For example, type NCX-1050 has a 1 minute rating of 1204 Amperes; this type has 15 plates per cell; $\left(\frac{15-1}{2}\right)$ equals 7; 1204/7 = 172 Amperes/P.P. In our case, A1 = 1059 Amperes; therefore 1059/172 (R_T) = 6.16 P.P. or positive plates for section 1. It should be noted that there is always one more negative plate than positive plates. /9

Section 2 R_T is obtained directly from the battery manufacturer's discharge characteristic for the type of cell whose size this calculation is attempting to verify. In our case the Gould characteristic curve is TC-107011B for NCX-2550, shown on page 42 of this calculation. For example, Section 2, period A1, shows a value of 1059 Amperes. /9 T_1 [see (4) above] = M1 + M2 = 45 minutes. Refer to TC-107011B where the 3/4 hour line intersects the 1.75 final voltage curve. A vertical line dropped from this point will intersect the Base line or Amperes per positive plate line at 86.5 Amperes/P.P. This is the discharge rate for 3/4 hours to 1.75 Volts per cell final voltage.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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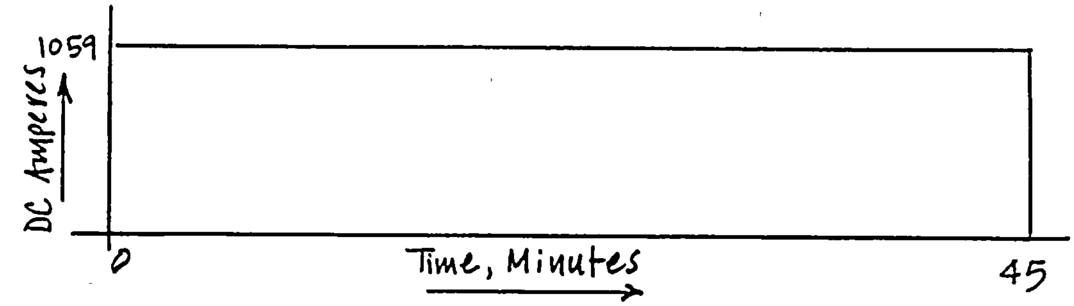
(7) Required Section Size : (3) ÷ (6A) = Number of positive plates ; using the numbers above we have,

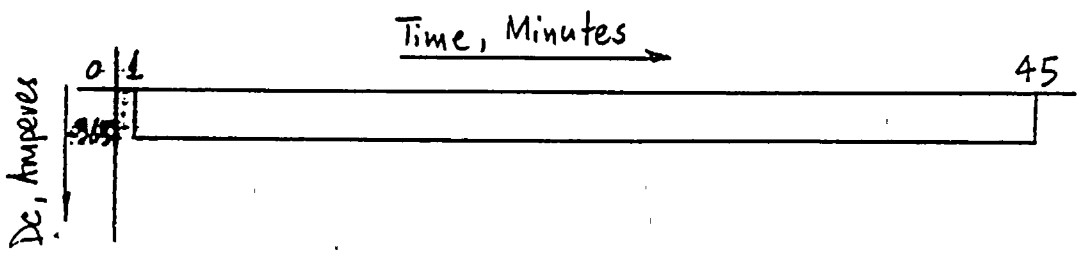
$$1059 \text{ Amperes} \times \frac{1 \text{ P.P.}}{86.5 \text{ Amperes/P.P}} = +12.24 \text{ P.P.}$$ △9

This represents the required number of positive plates for the following period.



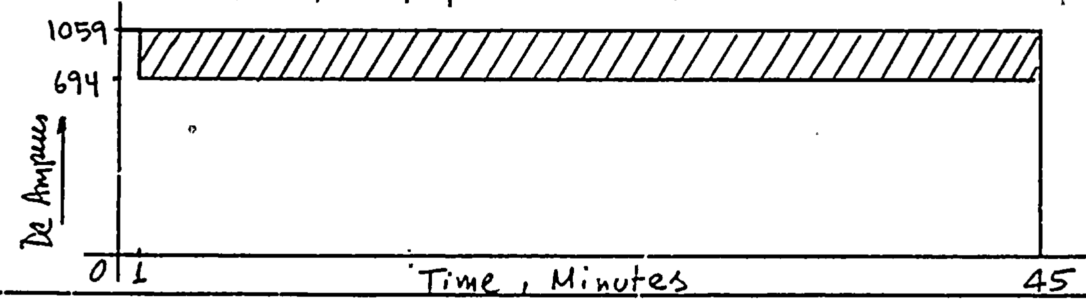
△9

Continuing with Section 2 the second period is 694-1059=-365 Amperes. The time T is 44 minutes. Referring to TC-107011B yields 87.0 Amperes/P.P.; thus $-365 \text{ Amperes} \times \frac{1 \text{ P.P.}}{87.0 \text{ A/P.P.}} =$ -4.20 Amperes for a fictitious period shown below. △9



△9

Superimposed, the profile looks as follows with no random load.



STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 26
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The difference value (4.20) is subtracted from the positive value (12.24), giving the number of positive plates required; this is 8.04 p.p. (9)

Since each subsequent section in the duty cycle is not greater than the previous section, the only additional consideration is the Random Equipment Load, which as mentioned earlier is 39 Amperes and has not been included in the duty cycle.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
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12177	ELECTRICAL	EC-44	N/A	

R = Random period, minutes

AR = Random load, Amperes applied at the end of the section from which the largest number of positive plates was obtained.

MR = Duration of Random period

T = Time to end of Random section

To obtain R_T (6A), do the following:

Take the number of positive plates required from Section 2 above, as previously calculated. For our case 8.04 p.p.. Go to Gould capacity Table on △9 page 41 and in the one minute rating to 1.75 volts per cell column, find the value corresponding to a type with the same or greater number of positive plates. For our case 9.0 is the next greater whole number. Select NCX-1350 with one minute rating of 1494 Amperes.

For NCX-1350 R_T = 1494 Amperes/9 p.p = 166 A/p.p.

Dividing AR by R_T : 39 Amperes $\times \frac{1 \text{ p.p.}}{166 \text{ Amperes}} = 0.23$ p.p. for the random load.

The number of positive plates from Section 2 8.04 pp, and 0.23 p.p. from Random Load are △9 inserted in the appropriate spaces on page 28 for final verification sizing.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

J.O. OR W.O. NO. 12177 | DIVISION & GROUP ELECTRICAL | CALCULATION IDENTIFICATION NUMBER: CALCULATION NO. EC-44 | OPTIONAL TASK CODE N/A | PAGE 28

Lowest Expected Electrolyte Temp: 65° F Minimum Cell Voltage 1.75 VPC Cell Manufacturer GOULD Cell Type NCX-2550 (9)

(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 @ 77 F (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates (3) x (6B) = Rated Amp Hours Pos Values	Neg Values
Section 1 - First Period Only - If A2 is greater than A1, go to Section 2.							
1	A1= 1059	A1-0= 1059	M1= 1	T=M1= 1	172	6.16	***
					Sec 1 Total	6.16	***
Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3.							
1	A1= 1059	A1-0+ 1059	M1+ 1	T=M1+M2= 45	86.5	12.24	
2	A2= 694	A2-A1= -365	M2= 44	T=M2= 44	87.0		-4.20
					Sec Sub Total	12.24	-4.20
					2 Total	8.04	***
Section 3 - First Three Periods - If A4 is greater than A3, go to Section 4							
1	A1=	A1-0=	M1=	T=M1+M2+M3=			
2	A2=	A2-A1=	M2=	T=M2+M3			
3	A3=	A3-A2=	M3=	T=M3=			
					Sec Sub Total		
					3 Total		***
Section 4 - First Four Periods Only - If A5 is greater than A4, go to Section 5							
1	A1=	A1-0=	M1=	T=M1+...M4=			
2	A2=	A2-A1=	M2=	T=M2+M3+M4=			
3	A3=	A3-A2=	M3=	T=M3+M4=			
4	A4=	A4-A3=	M4=	T=M4=			
					Sec Sub Total		
					4 Total		***
Section 5 - First Five Periods Only - If A6 is greater than A5, go to Section 6							
1	A1=	A1-0=	M1=	T=M1+...M5=			
2	A2=	A2-A1=	M2=	T=M2+...M5=			
3	A3=	A3-A2=	M3=	T=M3+M4+M5=			
4	A4=	A4-A3=	M4=	T=M4+M5=			
5	A5=	A5-A4=	M5=	T=M5=			
					Sec Sub Total		
					5 Total		***
Random Equipment Load Only (if needed)							
R	AR= 39	AR-0= 39	MR= 1	T=MR= 1	166	0.23	***

(9)

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

A 5010.65

CALCULATION IDENTIFICATION NUMBER				
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Maximum Section Size 8.04 **Plus Random Section Size** 0.23 **Equals** 8.27 **Uncorrected Size** 8.27. **Uncorrected Size** 8.27 **Times Temperature Correction** 1.08 **Times Design Margin** 1.0 **Times Aging Factor** 1.25 **Equals** 11.16. **When the cell size is greater than a standard cell size, the next larger cell is required.** 9

Required Cell Size: **(A)** 12 **Positive Plates** or 25 total plates per cell; this corresponds to an NCX-1800

or

(B) 1800 **Ampere Hours**

Therefore cell NCX-1800 **is** acceptable for 1/2 the total load.
(acceptable, ~~not acceptable~~)

Since (2) NCX-2550 60-cell batteries have been purchased for NMP2, excess capacity exists, in the order of (2550/1800) or 41.66%.

9. Voltage Profile determination

To determine the voltage at different times during the duty cycle the Work sheet for Lead-Acid batteries Voltage Profile Calculation is filled-out; this appears on page 31 of this calculation. Columns (2) & (3) △9 are based on data from the battery duty cycle. Column (4) or Adjusted Amperes is determined by multiplying the Ampere Rate on column (3) by the temperature correction factor, 1.08 and by the Aging Factor, 1.25. Columns (5) and (6) are defined on the Work Sheet, itself. Columns (3) and (4) use average values when the time span is long (30 minutes or longer); When the time span is short, say 1 minute, maximum values are used. Column (7) assumes that Ampere-Hours at the end of one step is equal to the beginning of the next step.

Data on Column (8) is obtained from Gould graph # TC-107011B, by plotting the appropriate curve at the intersection of the lines defined by data on columns (5) and (7).

Column (9) is defined on the work sheet. Based on Column (9) the Voltage profile is plotted as shown on page 32.

WORK SHEETS FOR STORAGE BATTERIES
LEAD - ACID - VOLTAGE PROFILE CALCULATIONS

Calculated by ____________________
Date ____________________
Checked by ____________________
Date ____________________

J.O. No. 12177
Client NMPC
Station NMP2
Battery No. 2BYS-BAT 1A
Spec No. NMP2-E033A
Spec Dated ____________________

BATTERY TYPE: NCX-2550 (2 UNITS IN PARALLEL)

Length of Duty Cycle ________ minutes
Nominal Battery Voltage ________ v
No. Positive Plates per cell 17
No. of cells 60
Amp Hours per positive plate vs Amps per positive plate data source ____________________

(1) Step	(2) Time in Min.	(3) Ampere Rate	(4) Adjusted Amps	(5) (4) / # Pos. Plates Amps per Positive Plate	(6) (2) x (5) / 60 Amp Hours Per Pos.	(7) Cumulative A.H. Discharge		(8) Volts per Cell (5) at (7)	(9) Battery Voltage (8) x number of cells in Series
1	1	1059 ▲	1430 ▲	84.12 ▲	1.40 ▲	Beginning	0	1.880 ▲	112.80 ▲
						End	1.40 ▲	1.878 ▲	112.68 ▲
2	43	694 ▲	937 ▲	55.11 ▲	39.50 ▲	Beginning	1.40 ▲	1.925 ▲	115.50 ▲
						End	40.90 ▲	1.880 ▲	112.80 ▲
3	1	756 * ▲	1021 ▲	60.06 ▲	1.00 ▲	Beginning	40.90 ▲	1.872 ▲	112.32 ▲
						End	41.90 ▲	1.870	112.20
4	45	636 ▲	859 ▲	50.50 ▲	37.88 ▲	Beginning	41.90 ▲	1.890	113.40
						End	79.78 ▲	1.825 ▲	109.50 ▲
5	30	346 ▲	467 ▲	27.48 ▲	13.74 ▲	Beginning	79.78 ▲	1.900	114.00
						End	93.52 ▲	1.880	112.80
6						Beginning			
						End			
7						Beginning			
						End			
n						Beginning			
						End			

* RANDOM LOAD SUPERIMPOSED ON THE WORST SECTION.

▲ VALUE CHANGED IN REV. 9

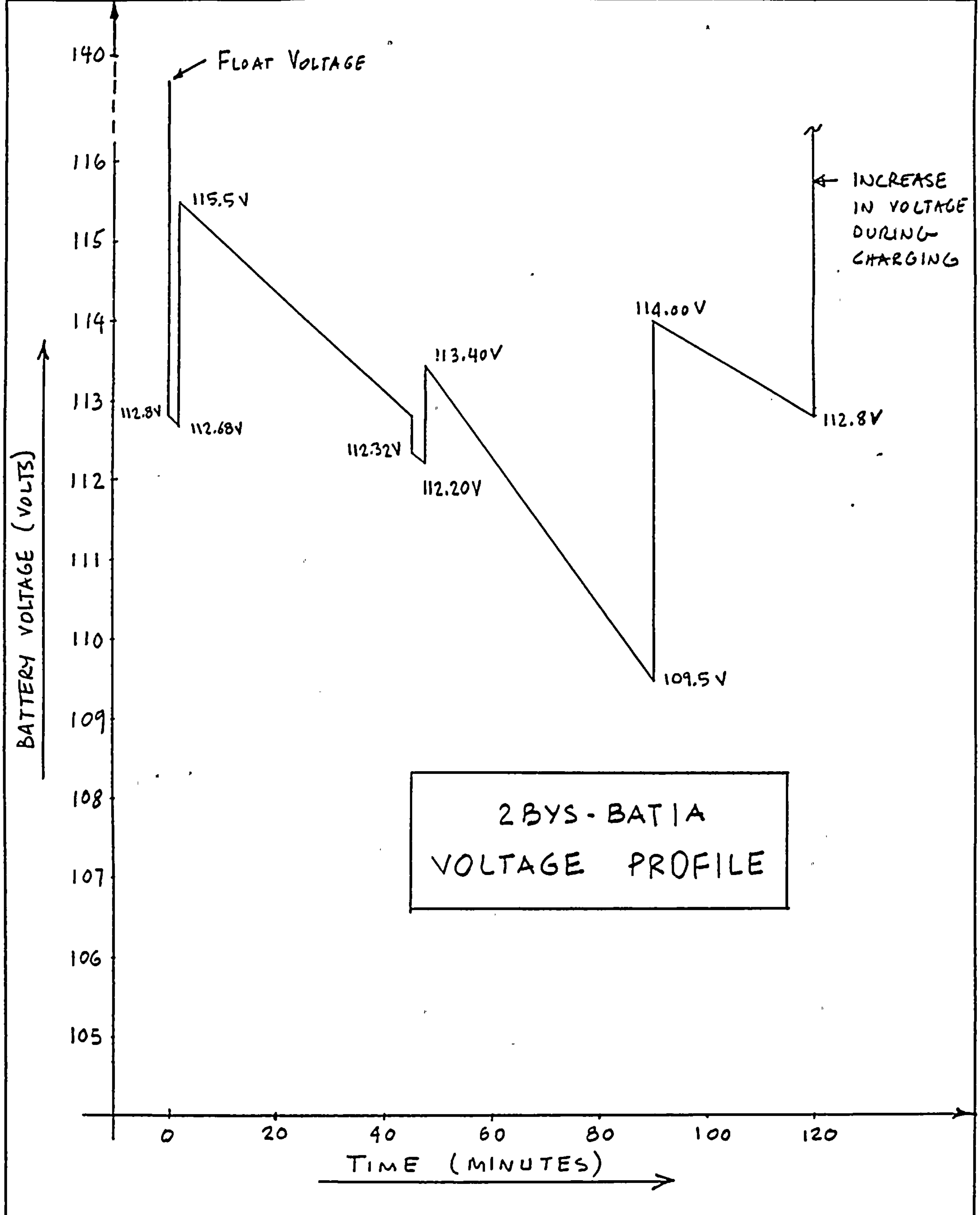
△9

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 32
12177	ELECTRICAL	EC-44	N/A	REDRAWN 9



10. Battery Charger Calculation

Calculate the minimum charger rating:

$$A_r = \frac{AH \times C}{T_1} + A_c$$

where A_r = Required minimum charger rating in amperes
AH = Total ampere hours discharged from the battery during its specified duty cycle
C = Constant to allow for ampere hour efficiency. Use 1.10
A_c = Continuous battery load while charging, amperes
T_1 = Required maximum time for recharging

In this case AH equals (1734 Ampere hours x 2) or 3468 Ampere-hours. 1734 Ampere hours is obtained from Gould curve # TC-107011B, for a 2 hour discharge cycle as follows: for a discharge cycle of 2 hours and 1.75 volts per cell The discharge characteristics of cell NCX-2550 yields 102 Ampere hours per p.p.; since a NCX-2550 has 17 p.p., the discharge current will be 17 x 102 = 1734 Amperes-hours For additional information on the determination of AH, see source g., attached.

T1 is taken as 24 hours, in accordance with source g.

$A_c = 13.98 + 67 = 80.98$ Amperes (9)

$A_r = \frac{1734 \times 2 \times 1.1}{24} + 80.98 \approx 240$ Amperes (9)

Assume a 300 Ampere Charger is provided and check the charging time.

CALCULATION IDENTIFICATION NUMBER				
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$$T_1 = \frac{1734 \times 1.1 \times 2}{300 - 80.98} = 17.42 \text{ hours}$$ △9

Since a 500 Ampere battery charger is actually being supplied by Power Conversion Products, the charging time (T_{500}) will be shorter. This time (T_{500}) can be calculated as follows:

$$T_{500} = \frac{1734 \times 1.1 \times 2}{500 - 80.98} \approx 9.1 \text{ hours}$$ △9

A 500 Ampere Battery Charger is satisfactory since a 9.1 hour recharge time is less than 24 hours. △9

EBOP

{Received from R. York on Tele-con 1/4/84}

$I_a = 205$
$R_F = 40^\omega$ 25°C
30HP =
1750 RPM
Stab Shunt
$I_F = 2.25$
Insul Cl F
Duty Cont
Max Amb 40°C
PSC 0
Part # 254A4103
Type CO365APY
DFFG
Quty. GEH-3967
Mod. 5C0192V0806A801
Ser. # CL-1-1363-CL

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GENERAL ELECTRIC

APPARATUS AND ENGINEERING SERVICES OPERATIONS
GENERAL ELECTRIC COMPANY • MASCHELLMAC OFFICE COMPLEX, 1000 FIRST AVENUE • KING OF PRUSSIA, PENNSYLVANIA 19406

CH 062584 AU30 AD 23

(215) 962-6105

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT NUCLEAR STATION, UNIT #2
STEAM TURBINE GENERATOR EQUIPMENT
TURBINE NO. 170X632
REQUISITION 306-31261

cc: R. A. Plant/S&W
R. M. Bozarth/S&W
W. F. Morrison/Nine Mile
T. E. Lempges/Niagara Mohaw

Subject: DC Motor Parameters

NOTED SEP 04 1984

August 28, 1984

NOTED AUG 31 1984

NOTED SEP 04 1984

Mr. C. Zappile
Stone & Webster Engineering Corp.
P. O. Box 5200
Cherry Hill, New Jersey 08034

Gentlemen:

This is in reply to the request for information for the DC-EBOP (Model #5CD192VD806A801) that you asked for in your letter of April 19, 1984.

1) Max. stall time @ 300% rated current is 10 seconds.

2) Acceleration time of the DC motor at varying voltage is not available. Acceleration of the DC motor is dependent upon many variables (starter operation, voltage, currents, oil temps, etc.)

3) Motor efficiency is:

Full Load	-	88.5%
1/2 Load	-	87.2%
3/4 Load	-	83.7%

4) Armature resistance was previously given - .0126 ohms @ 25°C.

5) The brush voltage drop is 2 volts nominal.

6) The motors rotor has a WK^2 of 15.6 $lbft^2$.

7) The commutating field resistance was also previously supplied - .0036 ohms @ 25°C.

If you have any questions, don't hesitate to give me a call.

Very truly yours,

Pradip V. Patel

PRADIP V. PATEL

SENDER — RETAIN YELLOW COPY. — FORWARD WHITE AND PINK COPIES.

REPLIER — RETURN WHITE — RETAIN PINK

EC-44
PAGE 37

INTEROFFICE CORRESPONDENCE

TO:	LOCATION	SUBJECT / REFERENCE / J.O. NO.
John [illegible] [illegible]	[illegible]	Sizing of Battery Chargers
FROM:	**LOCATION**	
George [illegible]	[illegible]	

MESSAGE:— As per your request, I have attached information as to the sizing of battery chargers. The recharge time to be used is 24 hours for the main station and eight hours for an unattended station. This will yield the smallest battery charger which could be used. However, it is [illegible]'s policy to size the battery charger for the size of the battery and the length of time of the duty cycle. For example, assume that you were using a duty cycle of two hours and a Gould battery NCX 1500 which has a two hour discharge current rating of 510 amperes. In this case you would assume that 1,020 ampere [illegible] hours had been discharged and you would size the battery charger on that basis.

If you need further information, just give me a call on 3-0084.

February 26, 1981 — DATE

G.O. F[illegible] — SIGNATURE

TELEPHONE

REPLY:

DATE

SIGNATURE

TELEPHONE

REPLIER RETURN WHITE COPY — RETAIN THIS COPY

PRINTS	ISSUE ①			ISSUE ②			ISSUE ③			ISSUE ④		
APP. CARD												

STONE & WEBSTER ENGINEERING CORP.
BOSTON, MASS.

ISSUE 1: ORIGINAL ISSUE

CLIENT N.M.P.C. STA NINE MILE - UNIT 2 REF DWGS 0001.420-221-095 JO 12177

PNL NO SERIES 6VB EQPT NO 2BYS-PNLA101 LOC CONTROL BLDG COL 10.5/AG ELEV 306

SVCE 125VDC PH ___ W 2 NEUT ___ MNS: LUGS ONLY, ~~CKT BRKR~~ ~~FUSED SW~~ - CONN: TOP

BR CKTS ___ ~~CKT BRKR,~~ FUSED SW - MTG: ~~FL~~, SURF - NEMA TYPE 12 FDR SIZE 2-1/c #750 BOT

XFMR MK NO ___ EQPT NO ___ KVA ___ ADD'L FEATURES: BUS CAPACITY: 225A

NO	SERVICE	LOAD CONN	LOAD TERM CAB	AMP	CKT	CKT	AMP	LOAD TERM CAB	LOAD CONN	SERVICE	NO
	2WCSN17(828E255TY) 2WCS-IPNL187	10VA		30	1	2	30	-848		EHC01 SH.15	
	2EGFA05(7EGF02)	6VA	*753	↓	3	4	↓	*753	36VA	2HVRN04(11HVR01)	
	2DRSA05(11DRS01)	6VA	*753		5	6			2A	2FPL-PNL176(1)	
	2FPL-PNL177(1)	2A			7	8		-703	75W	2RCSA15(761E79TY)SH5	
	2EGAA03(11EGA01)	10VA*	*745		9	10		-701	2A	2WCSN40 (807E175TY,SH.2)	
	SPARE				11	12		*753	30W	2FPWA06(7FPW06)	
	2WCS-IPNL187 (3)	1.5A*	—	↓	13	14	↓		1A*	2FPLN32 (7FPL16)	
	SPARE			60	15	16	60			SPARE	
	↓			60	17	18	60			↓	
					19	20					
					21	22					
					23	24					
					25	26					
					27	28					
					29	30					
					31	32					
					33	34					
					35	36					
					37	38					
					39	40					
					41	42					

Bus: 1 2

CONN LOAD: EST 10 AMPS

ULT LOAD: ___

TOTAL LOAD: ___

* ESTIMATED LOAD

2BYS-PNLA101

DWG. NO. EE-10C

EC-44
PAGE 38

DESIGNED BY / DRAWN BY AK / DSGN CHK'D BY / CHK'D BY

9

PRINTS	ISSUE 1			ISSUE 2			ISSUE 3			ISSUE 4		
APP. CARD												

ISSUE	DESCRIPTION
1	ORIGINAL ISSUE
2	
3	
4	

STONE & WEBSTER ENGINEERING CORP.
BOSTON, MASS.

DESIGNED BY
DRAWN BY A. KENT
DSGN CHK'D BY
CHK'D BY

CLIENT N.M.P.C. STA NINE MILE - UNIT 2 REF DWGS 0001.420-221-095 JO 12177

PNL NO SERIES 6VB EQPT NO 2BYS-PNLA102 LOC CBCR COL 14/AG ELEV 306

SVCE 125VDC PH ___ W 2 NEUT ___ MNS: LUGS ONLY, ~~CKT BRKR~~ ~~FUSED SW~~ - CONN: TOP

BR CKTS ___ ~~CKT BRKR,~~ FUSED SW - MTG: ~~FL~~, SURF - NEMA TYPE 12 FDR SIZE 2-1/C 750 KCM PER/LEG BOT

XFMR MK NO ___ EQPT NO ___ KVA ___ ADD'L FEATURES BUS CAPACITY : 225A

NO	SERVICE	LOAD CONN	LOAD TERM CAB	AMP	CKT	CKT	AMP	LOAD TERM CAB	LOAD CONN	SERVICE	NO
	2FWSN32(807E160TY) SH 2	5A	*704	30	1	2	30	*704	200W	2WCSN45 (807E175TY,SH.2)	
	2EGFC05(7EGF02)	6VA	*754	↓	3	4	↓	*754	10VA*	2EGAC01(11EGA03)	
	2CES*IPNL406	10A*			5	6			10A*	2CES*IPNL408	
	SPARE				7	8			2A*	2SCIB06 (7SCI14)	
	2ICSN31 (807E173TY SH.3)		*702		9	10		*754	1A*	2SFCB13 (7SFC08)	
	SPARE				11	12		*704		2WCSN50 (WCS01)	
	↓			↓	13	14	↓			SPARE	
				60	15	16	60			↓	
	↓			60	17	18	60			↓	
					19	20					
					21	22					
					23	24					
					25	26					
					27	28					
					29	30					
					31	32					
					33	34					
					35	36					
					37	38					
					39	40					
					41	42					

1 2

CONN LOAD: EST 30Amps

ULT LOAD: ___

TOTAL LOAD ___

*- ESTIMATED LOAD

DWG. NO. EE-10C

2BYS-PNLA102

EC-44
PAGE 39

RESP. ENGR:
DSGN ENGR:

PRINTS	1			ISSUE 2			3			ISSUE 4		
APP. CARD												

ISSUE	DESCRIPTION
1	ORIGINAL ISSUE
2	
3	
4	

STONE & WEBSTER ENGINEERING CORP.
BOSTON, MASS.

CLIENT N.M.P.C. STA NINE MILE - UNIT 2 REF DWGS 0001.420-221-120 JO 12177

PNL NO VB-6 EQPT NO 2BYS-PNLA107 LOC Normal Swgr COL 7.5/AK ELEV 237

SVCE 125VDC PH ___ W 2 NEUT ___ MNS: LUGS ONLY, ~~CKT BRKR~~ ~~FUSED SW~~ - CONN: TOP

BR CKTS ___ ~~CKT BRKR,~~ FUSED SW - MTG: ~~FL~~, SURF - NEMA TYPE ___ FDR SIZE 1-1/c #4/0 PER LEG BOT

XFMR MK NO ___ EQPT NO ___ KVA ___ ADD'L FEATURES BUS: 225A

NO	SERVICE	LOAD CONN	LOAD TERM CAB	AMP	CKT	CKT	AMP	LOAD TERM CAB	LOAD CONN	SERVICE	NO
	2RTX-XSRIA 1.130-203 006	1A *		30	1	2	30		2A	2SPI-0SC001	
	2STX-XNSI 1.120-202 008	20VA		↓	3	4	↓	P856	..	2SFCA13 (7SFC07)	
	2MTX-XMIA (AUX CT)	1A			5	6			6A	2EXC-CUB04(3)(8EXS03)	
	2RCS-PNL1A(3)(2RCSA22 7.1E791TY)	250W			7	8			3A	2CES-IPNL205(GMH02)	
	2MTX-XMIC (AUX CT)	1A			9	10				SPARE	
	2EGF*P3	8.4A			11	12				↓	
	SPARE				13	14					
	2CES-PNL421 (8SPX09)	2A		60	15	16	60				
	SPARE			60	17	18	60				
					19	20					
					21	22					
					23	24					
					25	26					
					27	28					
					29	30					
					31	32					
					33	34					
					35	36					
					37	38					
					39	40					
					41	42					

1 2

CONN LOAD: EST 27AMPS

ULT LOAD: ___

TOTAL LOAD ___

*-EST

EC-44
PAGE 40

2BYS-PNLA107

DWG. NO. EE-10E

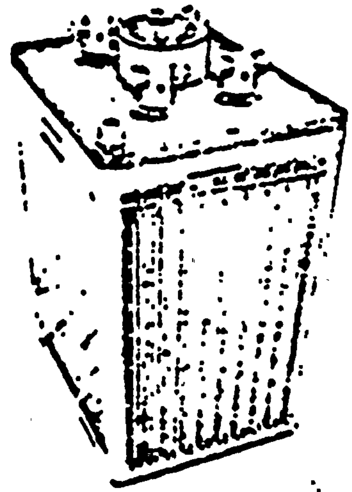
DESIGNED BY
DRAWN BY A KENT
DSGN CHK'D BY
CHK'D BY
RESP. ENGR:
DSGN ENGR:

5215.10

GOULD

Standby Power Cell Chart

TYPE: NCX



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

SPECIFICATIONS

Container—Styrene-Acrylonitrile Plastic.
Cover—Acryl.-Buta.-Styr. Terpolym. Plastic.
Separators—Microporous Material.
Retainers—Fiberglass Mats.
Posts—See Below.①
Post Seals—Floating O-Ring—Seal Nut.
Vents—Screw Type—Spray Proof.②
Level Lines—High and Low—All Jar Faces.
Electrolyte—Height Above Plates—2-3/4".
Electrolyte Withdrawal Tube—Each Cell.
Sediment Space—1-1/16".
Specific Gravity—1.215 @ 77°F. (25°C.).
Inter-Cell Connectors—Lead Plated Copper.

Plate Dimensions	Height	Width	Thickness
Positive Plate	15"	12½"	.230
Negative Plate	15"	12½"	.215

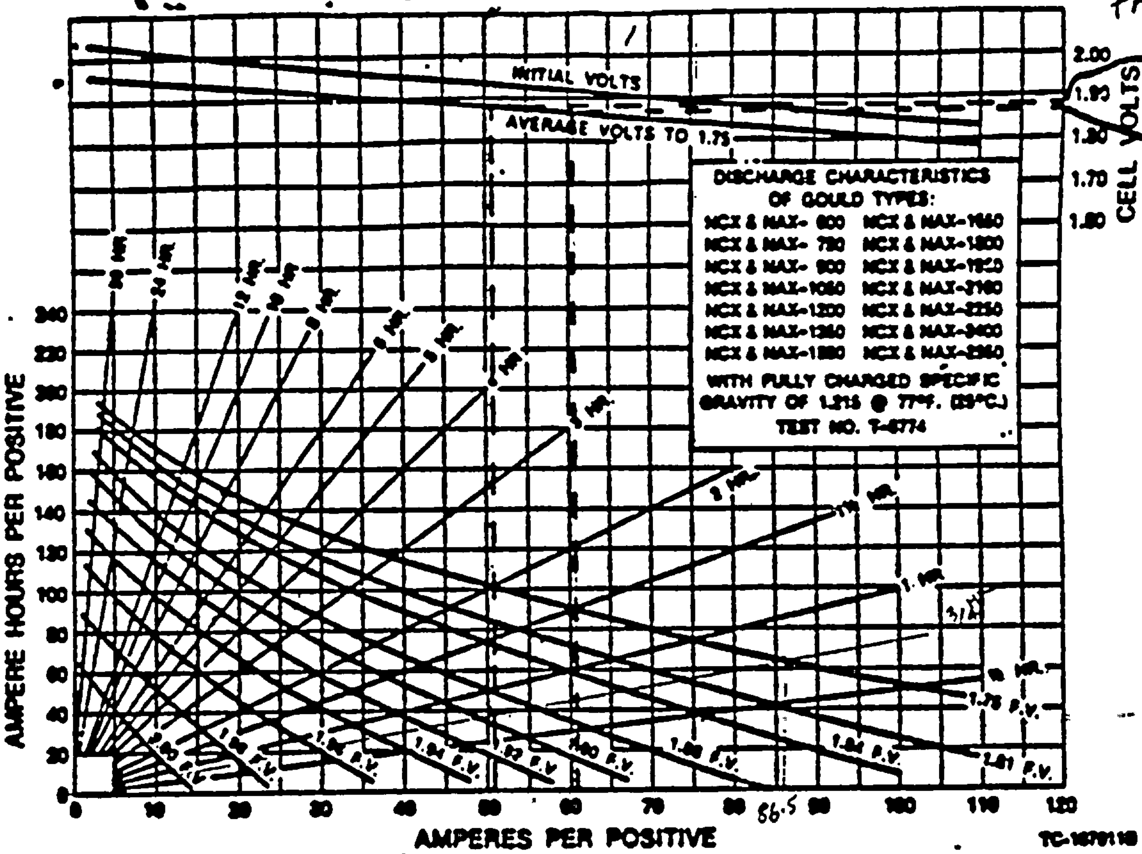
① Posts—600 A.H. to 1350 A.H. Two—1½" square. 1344 A.H. to 1650 A.H. Four—1" square. (Except 1848 A.H.) 1848 A.H. to 2550 A.H. Four—1½" square.

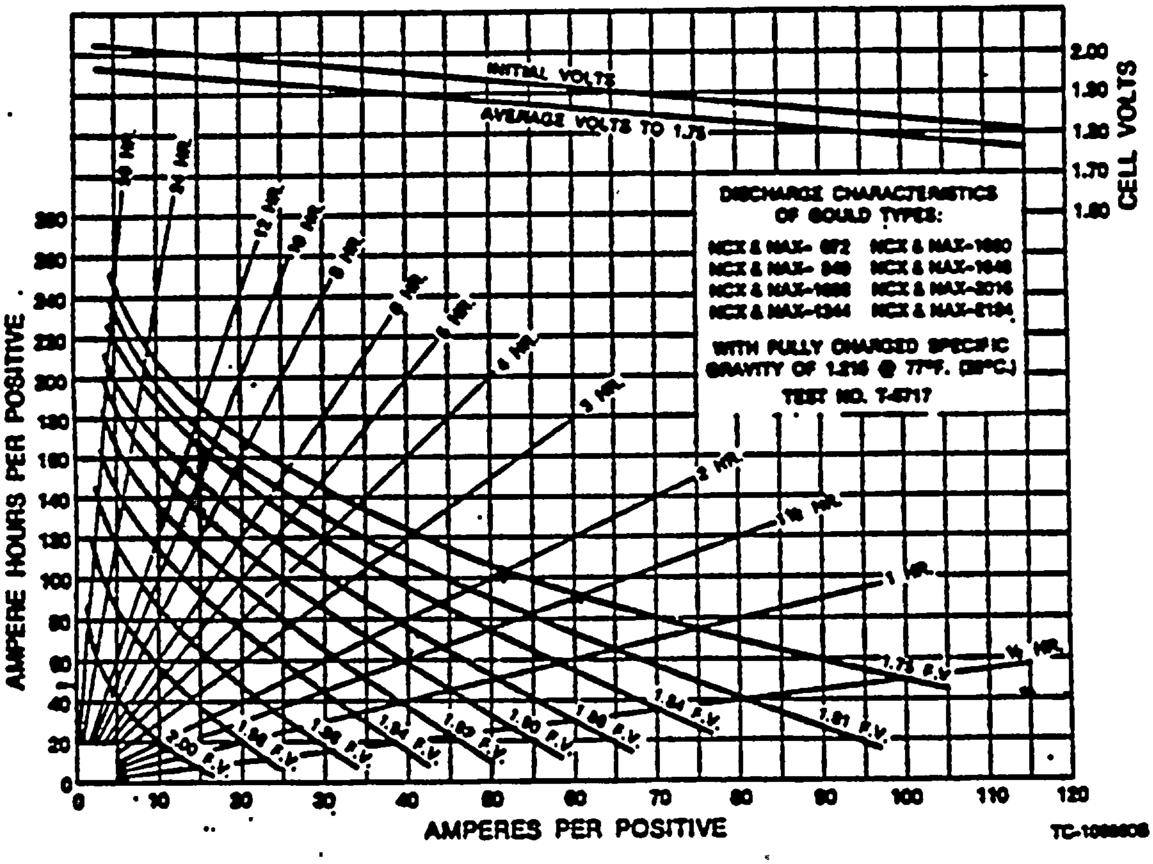
② Combined Filling Funnel—Explosion resistant vent is available at additional cost. Specify Gould "Pro-Vent".**

Type	Plates Per Cell	Ampere Hour Capacities to 1.75 V.P.C. Average*				1 Minute Rate in Amperes*		Overall Dimensions in Inches			Approximate Wgt. in Lbs.		Elect. Gals. Per Cell
		8 Hr.	5 Hr.	3 Hr.	1 Hr.	To 1.75 V.P.C. Avg.	To 1.50 V.P.C. Avg.	L	W	H	Net Wgt.	Packed Wgt.	
NCX-600	9	600	540	468	300	712	1335	7-3/8	14-1/2	22-1/8	177	189	6.0
NCX-672	9	672	588	482	300	636	1210	7-3/8	14-1/2	22-1/8	178	190	6.0
NCX-750	11	750	675	585	375	880	1675	7-3/8	14-1/2	22-1/8	196	207	5.5
NCX-840	11	840	735	615	375	780	1500	7-3/8	14-1/2	22-1/8	196	208	5.6
NCX-900	13	900	810	702	450	1044	1985	7-3/8	14-1/2	22-1/8	213	225	5.1
NCX-1008	13	1008	882	736	450	942	1780	7-3/8	14-1/2	22-1/8	214	226	5.1
NCX-1050	15	1050	945	819	525	1204	2290	7-3/8	14-1/2	22-1/8	231	243	4.3
NCX-1200	17	1200	1080	936	600	1360	2585	7-3/8	14-1/2	22-1/8	249	261	6.0
NCX-1344	17	1344	1176	984	600	1240	2380	9-1/4	14-1/2	22-1/2	268	280	6.8
NCX-1350	19	1350	1215	1053	675	1484	2840	9-1/4	14-1/2	22-1/2	282	294	6.3
NCX-1500	21	1500	1350	1170	750	1620	3080	9-1/4	14-1/2	22-1/2	301	313	6.0
NCX-1650	23	1650	1485	1287	825	1782	3390	11-3/8	14-1/2	22-1/2	348	366	8.0
NCX-1680	21	1680	1470	1230	750	1530	2910	11-3/8	14-1/2	22-1/2	332	350	8.3
NCX-1800	25	1800	1620	1404	900	1932	3675	11-3/8	14-1/2	22-1/2	364	382	7.5
NCX-1848	23	1848	1617	1353	825	1861	3180	14-9/16	14-1/2	22-1/2	397	415	12.8
NCX-1950	27	1950	1755	1521	975	2080	3955	11-3/8	14-1/2	22-1/2	380	398	7.3
NCX-2016	25	2016	1764	1476	900	1788	3400	14-9/16	14-1/2	22-1/2	415	433	12.1
NCX-2100	29	2100	1890	1638	1050	2240	4260	14-9/16	14-1/2	22-1/2	446	464	11.5
NCX-2184	27	2184	1911	1599	975	1924	3660	14-9/16	14-1/2	22-1/2	433	451	11.5
NCX-2250	31	2250	2025	1755	1125	2400	4565	14-9/16	14-1/2	22-1/2	462	480	10.9
NCX-2400	33	2400	2160	1872	1200	2560	4865	14-9/16	14-1/2	22-1/2	479	497	10.3
NCX-2550	35	2550	2295	1989	1275	2720	5170	14-9/16	14-1/2	22-1/2	496	514	9.7

* Includes voltage drop across intercell connections used in standard layouts. ** ®Gould, Inc.

Printed in U.S.A.





Gould Inc., Industrial Battery Division
?0 Cabot Boulevard West, Langhorne, Pa. 19047
Telephone (215) 752-0555

GOULD

2BYS-SWG001B to. 2CEC-PNL732 (P809, P810, P815, P802)				
DWG No.	STEADY STATE LOAD	TRANSIENT LOAD	AMPS	SIZE AMPS
ESK-8SPR07	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25 5.50	0.03 ~~0.25~~ .06 5.50
ESK-8SPR08	(1) 74-HGA (1) Light	(1) 63-HGA (1) 30-HAA	0.03 0.25 0.027 0.022	0.03 ~~0.25~~ .06
ESK-8YUC05	(1) 74-HGA (1) Light	(1) 94-HFA	0.03 0.25 0.486	0.03 ~~0.25~~ .06
ESK-8SPX08	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25 5.50	0.03 ~~0.25~~ .06
ESK-5NNS13	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25 5.50	0.03 ~~0.25~~ .06
ESK-5NNS13	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25 5.50	0.03 ~~0.25~~ .06
ESK-8SPR10	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25 5.50	0.03 ~~0.25~~ .06
ESK-8SPR11	(1) 74-HGA (1) Light	(1) 63-HGA (1) 30-HAA	0.03 0.25 0.027 0.022	0.03 ~~0.25~~ .06
ESK-8YUC05	(2) 74-HGA (2) Light	{(1) 94-HAA (1) 94-HFA} {(1) 94-HAA (1) 94-HFA}	0.06 0.50 0.486 0.486	0.06 ~~0.50~~ 0.12
			TOTAL SIZE AMPS	~~8.30~~

~~8.30 x 1.5 = 12.45~~

0.9 amps in
6.4 random

2BYS-SWG001A to 2CEC-PN734 (P808, P813, P804, P811)

DWG No	Steady State Load	Transient Load	AMP	Size Amps
ESK-8NNS08	(1) 74-HGA (1) Light	(3) 86-HEA	0.03 0.25 16.50	0.03 ~~0.25~~ .06 ~~16.50~~
ESK-8SPR13	(1) 74-HGA (1) Light	(1) 86-HEA (1) 67	0.03 0.25 5.50 —	0.03 ~~0.25~~ .06
ESK-8YUC04	(1) 74-HGA (1) Light	(1) 94-HAA (1) 94-HFA	0.03 0.25 0.48	0.03 ~~0.25~~ .06
ESK-5NPS05	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25	0.03 ~~0.25~~ .06
ESK-5NPS14	(1) 74-HGA	(1) 94 (1) AGA (1) 62-HGA	0.03	0.03
ESK-5NPS10	(1) 62-TU	(3) 27-HFA		
ESK-5NNS24	(1) 74-HGA (1) Light	(2) 62-TU	0.03 0.25	0.03 ~~0.25~~ .06 —
ESK-8NNS07	(1) 74-HGA (1) Light	(3) 86-HEA	0.03 0.25 16.50	0.03 ~~0.25~~ .06 —
ESK-8SPR12	(1) 74-HGA (1) Light	(1) 86-HEA	0.03 0.25 5.50	0.03 ~~0.25~~ .06 —
ESK-8YUC04	(1) 74-HGA (1) Light	(1) 94-HFA (1) 94-HAA	0.03 0.25 0.48	0.03 ~~0.25~~ .06 —
		~~TOTAL SIZE AMPS~~		18.77

0.75A - 1M, ... 17.25 Random

fed from 733

2BYS-SWG001A to 2CEC-PNL735 (P805, P812, P803, P81-)

DWG No.	STEADY STATE LOAD	TRANSIENT LOAD	AMPS	SIZE AMPS
ESK-8NNS06	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 [illegible]
		(3) 86-HEA	16.50	16.50 *
ESK-8SPR05	(1) 74-HGA			0.03
	Light			0.25 .06
		(1) 67		—
		(1) 86-HEA	5.5	—
ESK-8YUC04	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		{(1) 94-HAA, (2) 94-HFA}	0.368	—
ESK-5NNS10	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 86-HEA	5.50	—
ESK-5NPS02	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 86-HEA	5.50	—
ESK-5NPS13	(1) 74-HGA		0.03	0.03
		(1) 94-HFA		Residual transient = [illegible]
		(1) AGA	0.50	Fast transient = [illegible]
		(1) 62-HGA		
ESK-5NNS21	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 86-HEA	5.50	—
ESK-5NNS06	(1) 74-HGA		0.03	0.03
	Light		0.25	0.25 .06
		(1) 86-HEA	5.50	—
		TOTAL SIZE AMPS		~~18.21~~ 17.16

7

0.66 - 1M

17.16 - R

[illegible] = 18.21

~~18.21 x 1.5 = 27 Amps~~

2BYS-SWG001B to 2CEC-PNL744 (P866, P867, P865)				
DWG No	Steady State Load	Transient Load	AMPS	SIZE AMPS
ESK-8SPG04	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 86-HEA	5.50	5.50
		(1) 86-HEA	5.50	5.50
		(1) 86-HEA	5.50	5.50
ESK-8SPU04	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 86-HEA	5.50	
		(1) 86-HEA	5.50	
		(2) 94-HFA	0.368	
		(1) 59-HFA	0.486	
		(1) 50-HGA	0.032	
		(1) 50-HGA	0.032	
ESK-8SPS03	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 63-HGA	0.027	
		(1) 30-HAA	0.022	
ESK-8SPM04	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 30-HAA	0.022	
		(1) 63-HGA	0.027	
ESK-8SPU03	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	0.25 .06
		(1) 86-HEA	5.50	
		(1) 86-HEA	5.50	
		(2) 94-HFA	0.368	
			TOTAL SIZE AMPS	~~17.9~~

SEE P46

~~17.9 x 1.5 = 26.85~~

2BYS-SWG001A to 2CEC-PNL744 (P864)				
DWG. No	STEADY ST		AMPS	SIZE AMPS
ESK-8SPU02	(1) 74-HGA		0.03	0.03
	(1) Light		0.25	~~0.25~~ .06
		S (2) 94-HFA	0.368	—
		P (2) 86-HEA	11.00	11.00 *
ESK-8SPU06	(1) 74-HGA		0.03	0.03
	Light		0.25	~~0.25~~ .06
		(1) AMX-HFA	0.486	—
			TOTAL SIZE AMPS	~~11.56~~

6.40
17.25
17.16
28.13
68.54

11.56 x 1.5 = 17.34 Amp

0.63 1M

28.13 R

Any 20 AMP RANDOM LOAD FOR PGCC

REASON FOR REVISION 5

ALL ASSUMPTIONS AND INPUT DATA ARE COMPLETE. ANY FUTURE CHANGES WILL BE INCORPORATED BY REVISING THIS CALCULATION. 5

REASON FOR REVISION 6

FINAL EMERGENCY BEARING OIL PUMP DATA, RECEIVED IN SOURCE 1-23, G.E. LETTER P.19 THIS CALC., IS INCORPORATED IN EC-100. ALSO IN DEPTH REVIEW OF LOGIC CHANGED SWITCHGEAR d.c. loads.

.5
16.50
16.50

STONE & WEBSTER ENGINEERING CORPORATION · CHERRY HILL OPERAT EC-44, PAGE 48

INTEROFFICE MEMORANDUM

SUBJECT	TOPICAL INFORMATION REPORT FOR TRANSFORMER AND BUS LOADING AND ASSIGNMENTS	J.O. OR W.O. NO	12177-Ec-32-4
		DATE	May 10, 1982
		FROM	TLOtt:JR
TO	All Electrical Engineers and Squad Leaders	CC	JCGabriel KNKhanna DFSabatini

The attached information will be issued as Topical Information Report by our Boston office before long.

In the meantime, I am sending this to you for your information. This document will be used as a guide and not as a rigid standard.

T. L. Ott

T. L. Ott

Attachment

GENERAL

This design criteria is presented as a guide for both allowable bus loadings and assignments of loads to various plant loads. This criteria is meant as a guide to engineers for a standard Stone & Webster design. Finalization of this criteria is dependent on several factors. Among these are: client preferences and approval, economic studies and the complement of equipment to be powered. Whether at a later date assignment or loading criteria should be altered depend on such things as how far the plant design is completed, possible additional loads in the future, costs of adding new equipment, redesign of sills, tray systems, duct lines, and status of purchase orders and equipment production. However, the guidelines set forth in the following design criteria are a useful tool in designing an adequate and flexible distribution system.

Spare and future positions should be provided on all buses if possible. The number of each should be worked out with the client at an early stage. Floor sills should be extended to allow additional equipment to be added if necessary.

For most power plant work, the voltage of the medium voltage and low voltage buses is established early in the design of the plant. The number of medium voltage buses is dependent on several variables including requirements of the large mechanical systems, client preference, philosophy of plant operation and equipment economics, and in the case of nuclear plants - regulatory requirements.

The initial step is to ascertain what the electrical loads are and their power requirements. Then the maximum simultaneously running loads must be calculated for each bus and transformer contemplated. The engineer should use the motor and electric load list as well as logic descriptions, system descriptions, and consultation with the lead power engineer during this stage of design to ascertain the maximum coincident loading of each bus.

TRANSFORMERS

Power transformers should be conservatively sized to allow for future load growth. Station service transformers will generally be about 10 percent of total generator output for nuclear plants.

For fossil plants approximately 7 percent of generator output is used for station service. If a scrubber is required, another 3 percent will be used to power the scrubber auxiliaries.

As loads are defined further, the transformers sizes can be finalized allowing for worst case loading and providing at least 15 percent margin for future growth.

For criteria on sizing smaller transformers, see the information in low voltage load assignments below.

MEDIUM VOLTAGE BUSES

Generally in plants where both 15 kV class and 5 kV class buses are selected, motors above 2500 HP are assigned to the 15 kV class buses. Motors above 250 HP, up to 2500 HP, are assigned to the 5 kV class buses.

In plants where 7.5 kV class buses are utilized as the highest distribution voltage, motors above 4000 HP would be assigned this bus with motors 250 HP to 4000 HP being assigned to the 5 kV class buses.

These HP break points are only guidelines and economic studies should continue to be done for loads which are in question.

METAL CLAD SWITCHGEAR

Metal clad switchgear should not have a coincident loading above 60 to 70 percent of the main bus rating during the early stages of the project to allow for further load growth as the project progresses. If during the latter stage of the project the loads grow, it is best to keep the maximum switchgear bus loading to about 90 percent of the full load rating of the main breaker and bus under the worst operating condition.

To determine maximum running loads on metal clad switchgear early in the project, the electrical engineer should consult with the lead power engineer to determine maximum coincident loading on each bus. Be sure to consider - pumps out for maintenance, transformer failures and bus failures and the subsequent effect on the remaining buses in the analysis.

In the early stages nameplate horsepower should be used for the large motors. This builds in a little extra conservatism for possible increases in brake horsepower (BHP) requirements later. In the latter stages of the project, known BHP at runout conditions should be used.

LOW VOLTAGE BUSES

On low voltage distribution systems, several types of equipment are utilized to feed motor and other type loads. Load center secondary unit substations are used to feed loads directly, as well as providing a power source to MCC's and panelboards (if a separate panelboard system is used). Loads from 60 to 250 HP or 60-250 KVA are generally fed directly from a load center power circuit breaker. If loads in this size range require frequent starting and stopping, reversing control, or two speed control, consider the use of locally mounted starters equipped with nonautomatic breakers.

Loads from 1 HP to 50 HP or 1 to 50 KVA can be assigned to MCC's (some projects have elected to use separate 600 volt class panelboards in lieu of MCC feeder circuit breakers for non-motor loads. S&W's standard design, however, calls for these breakers to be mounted on the MCC). Motor operated valves of any size should be assigned to an MCC. When assigning low voltage loads, care should be taken to assure that auxiliaries to large motors (i.e., lube oil pumps) are on MCC's fed by the same power train as the pump motor itself.

Small loads less than 1 HP or 1 KVA should be assigned to 120 volt panelboards. (If automatic control is required, local starters or contactors should be utilized).

LOAD CENTERS

Since the low voltage loads change dramatically during the life of the project, it is good to have ample capacity in the load centers (LC's) early in the project's life. In the early stage of a project, it is usually a good practice to add connected, continuously running loads and multiplying by .80 for diversity and .90 for utilization (brake HP vs. nameplate HP) to arrive at an estimated load for directly connected loads; for MCC load estimates see the paragraph below. At later stages of the project, maximum running loads should not be greater than 80 percent of the self cooled transformer rating. Also, note that on double ended load centers, the total coincident LC load should not be greater than the highest rating of a single transformer so that one transformer can be out-of-service without forcing load shedding to occur. Transformers are usually not larger than 1000 KVA with a standard 5.75 percent impedance, because above this size ~~either~~ the available short circuit current can become too high for the LC feeder breakers ~~and~~ or MCC's unless a higher impedance transformer is purchased. This inturn can cause voltage profile problems.

Motor control centers are placed for convenience in an area close to motor loads. This keeps cable distances short for voltage considerations and usually means that the total load on a given MCC can be kept fairly well below the standard 600 amp bus. In the early stages of a project, the loads should be held to about 300 amps maximum (400-500 amps on industrial projects). Whenever possible, loads of a common system should be grouped on the same MCC to try to assure system power continuity. Spares and spaces should be grouped to allow for future starters of varying sizes and types. The decision as to whether to allow loads on a MCC above the 300 amp target, or create another MCC, is a matter of judgement and should be discussed with the Lead Electrical Engineer. The standard S&W design calls for panelboards to be fed from the local MCC. Since these loads must also be added to the MCC load, some guidelines are listed below for panel loads.

The following is a list of typical assumptions for bus loading on MCC's, panelboards, and load centers.

1. Motor operated valves (MOV's) and motor operated doors can be ignored when reflecting MCC loads to the load center. For a particular MCC loading, use 20 percent of the total horsepower per MCC that are MOV's or doors.

2. Intermittent loads such as cranes, small compressors, sump pumps, elevators, motor space heaters, switchgear space heaters, etc., can be ignored when reflected to the load center unless the load is on for longer than one hour at a time. (Some judgement is required here and the Lead Electrical Engineer shall provide guidance for each application. On MCC's, add 20 percent of the total of these to the MCC load).

3. Lighting loads should be added on a watts per square foot basis initially until actual loads are known. The lighting specialist can provide estimates based on the type of lighting selected. Add one half amp per duplex receptacle.

4. Since other panelboard loads are unknown until much later, add the distribution transformer KVA until loads are better defined. Keep the number of these transformers reasonable. Consult the equipment specialist for past experience in this area.

5. Work with the building service engineers for an estimate of diversity for various areas of the plant if electric unit heaters are used as well as air conditioning.

6. Ignore welding and vacuum cleaner receptacles.

7. Add continuous loads on the MCC bus and multiply by .80 for diversity and .90 for utilization in the early stages. Later as the motor and load list information is complete, use all of the continuous coincident loads and multiply by .90 for utilization.

These guidelines should be discussed in detail with the Lead Electrical Engineer, and where appropriate, with the client to ensure project agreement before the equipment is purchased if possible.

LOADS CONNECTABLE TO DIESEL GENERATORS

Diesel generators are often used as emergency power sources. In nuclear plants they usually supply the 4160 volt standby buses. In fossil plants, they may feed either 4160 volt or low voltage buses. In nuclear plants, loads other than Class IE safety related loads are often either fed from Class IE buses with an automatic LOCA trip or are assigned to buses which are manually connectable to the diesel bus.

In fossil plants, loads that are important to an orderly shutdown or personnel safety are assigned to buses which can be fed by a diesel generator.

In general, the list below suggests possible candidates for assignment to buses which can be fed from a diesel generator.

1. Emergency lighting
2. Security systems
3. UPS systems/instrumentation buses
4. Battery chargers
5. Instrument air compressors
6. Fire protection systems
7. Scrubber agitators
8. Turning gears
9. Boiler controls
10. Loads which allow for orderly shutdown of the plant or prevent subsequent damage.

LOADS CONNECTABLE TO UPS SYSTEMS

Many factors are involved in assignments of loads to UPS buses vs. standard instrument and control buses. The assignment of many of the loads to UPS buses should be done in conjunction with the Controls engineers. Items such as the acceptability of power interruption, voltage variations, etc., make a joint effort here very important.

The above load assignment guidelines are a good starting point. When followed, they have been found to usually offer an economical and effective design. However, many factors can influence and change these general rules, such as client preference, or late changes in horsepower which would have changed the type equipment feeding the load, but due to transformer size limitations, etc., an exception may have to be made and the load remain on the existing bus. Also, discretion needs to be used with certain type loads, i.e., it might be preferrable to have a 2 KW motor space heater rated at 120 volts and fed from a panelboard if 480 volt heaters are not available as standard.

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REPLIER —

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INTEROFFICE CORRESPONDENCE

TO: J K Hodson	LOCATION 5R	SUBJECT / REFERENCE / J.O. NO. 12177 Time of operation for DC motors for EBOP & ESOP
FROM: J Sternchos	LOCATION 5B	

MESSAGE: —

GE-LSTG Letters dates 1 Sept 1976 and 30 Nov. 1976 for the River Bend Project are applicable to the NMP2 Project.

The Batteries shall be designed for 30 min. for EBOP and 90 min. for ESOP

6/13/85
DATE

SIGNATURE

3317
TELEPHONE

REPLY:

DATE

SIGNATURE

TELEPHONE

A 040.138

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INTEROFFICE CORRESPONDENCE

TO: J. STERNCHOS	LOCATION 5BL	SUBJECT / REFERENCE / J.O. NO. 12177 TIME OF OPERATION OF DC PUMPS EBOP & ESOP
FROM: J. KNUDSEN	LOCATION 5R	

MESSAGE: —

Attached are the G.E. letters concerning the subject pumps for the River Bend Station of Gulf States Utilities. Please write an IOC indicating that the content of these letters would apply to NMP2. Also we require your recommended operating times (duration of operation) for the pumps as well as when, after an accident or otherwise, they could be expected to start. Also, if they operate other than continuous i.e. more than once during the battery 2 hour cycle, then we need this information. The project now requires all sources for ~~for~~ basing decisions used in calcs. Please include whatever sources (other than IOC'S) used to base your decisions.

Thanks,

6/11/85
DATE

John M. Knudsen
SIGNATURE

4496
TELEPHONE

REPLY:

See attached
IOC

6/13/85
DATE

J Sternchos
SIGNATURE

3317
TELEPHONE

040.138

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EC-44

INTEROFFICE CORRESPONDENCE

TO: AK Guul	LOCATION 5R	SUBJECT / REFERENCE / J.O. NO. 12177 ~~ESOP~~ operating time ESOP
FROM: J Sterucki's	LOCATION 5B	

MESSAGE: —

After reviewing GE's letter dated 6/19/88 and the size of the CO_2 system, the information given in the River Bend Project is applicable. The ESOP ~~ESOP~~ will operate for 90 min. The 9712 CO_2 system has 2 13 Ton CO_2 (Liquid) Tank ~~As~~ Thus the purge Time will be Less Than 60 min.

6/25/88
DATE

J Sterucki's
SIGNATURE

3317
TELEPHONE

REPLY:

DATE

SIGNATURE

TELEPHONE

A 040.138

GENERAL ELECTRIC NOTED JUN 24 1985 L SWP

APPARATUS AND ENGINEERING SERVICES OPERATION
GENERAL ELECTRIC COMPANY • ONE UNIVERSITY OFFICE PARK, 29 SAWYER ROAD • WALTHAM, MASSACHUSETTS 02254 • (617) 647-7200

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June 19, 1985

Copy to:
JM Knudsen S&W
J Sternchos S&W

NIAGARA MOHAWK POWER CORPORATION
Nine Mile Point Nuclear Station, Unit #2
J.O. 12177 - Purchase Order No. 2
Steam Turbine Generator Equipment
Turbine No. 170X632
Requisition 306-31261

Mr. A. K. Gwal
Stone & Webster Engineering Corporation
P.O. Box 5200
Cherry Hill, New Jersey 08034

Dear Sir:

As requested by Mr. J. M. Knudsen, I am forewarding our current station battery recommendaions for the emergency bearing oil pump (DCM E11.601B) and the emergency seal oil pump (278A6692).

You will note that time is addressed in the case of the EBOP but not for the ESOP. This is because the time requirements for a successful coast-down are well known, but the events which must precede a safe ESOP shutdown are more difficult to time and are as follows:

1. The machine gas should be vented from operating pressure down to 2-5 PSIG. This can and should be done during coastdown.

2. The purging of hydrogen with carbon dioxide cannot commence until the shaft is at or near standstill because the rotor fans will mix the gases and produce erratic readings on the purge analyzer at the sample connection.

3. It will be necessary to admit approximately 7400 CU. FT. of CO_2 to achieve a safe gas mixture (<5% H_2 in CO_2). It is reasonable to assume that this can be done in 60 minutes with a 6 bottle manifold and 4 bottle changes made expeditiously. We do not know the limitations of a bulk CO_2 supply and CO_2 discharge tends to be self limiting depending on piping configuration because of the formation of solid carbon dioxide (dry ice) at points where rapid expansions take place. There is considerable discussion of the ramifications of handling carbon dioxide in the turbine-generator instruction

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book, volume II, tab 29, GEK-45944.

4. The final and perhaps most difficult variable is operations priorities at the time of the event.

In summary, a 2 hour run time for the ESOP is probably appropriate, but all of the foregoing must be considered.

Yours very truly,

T. J. Grady

T. J. Grady Project Application Engineer
NEW ENGLAND DISTRICT

Attachment

TJG:slb:305.1

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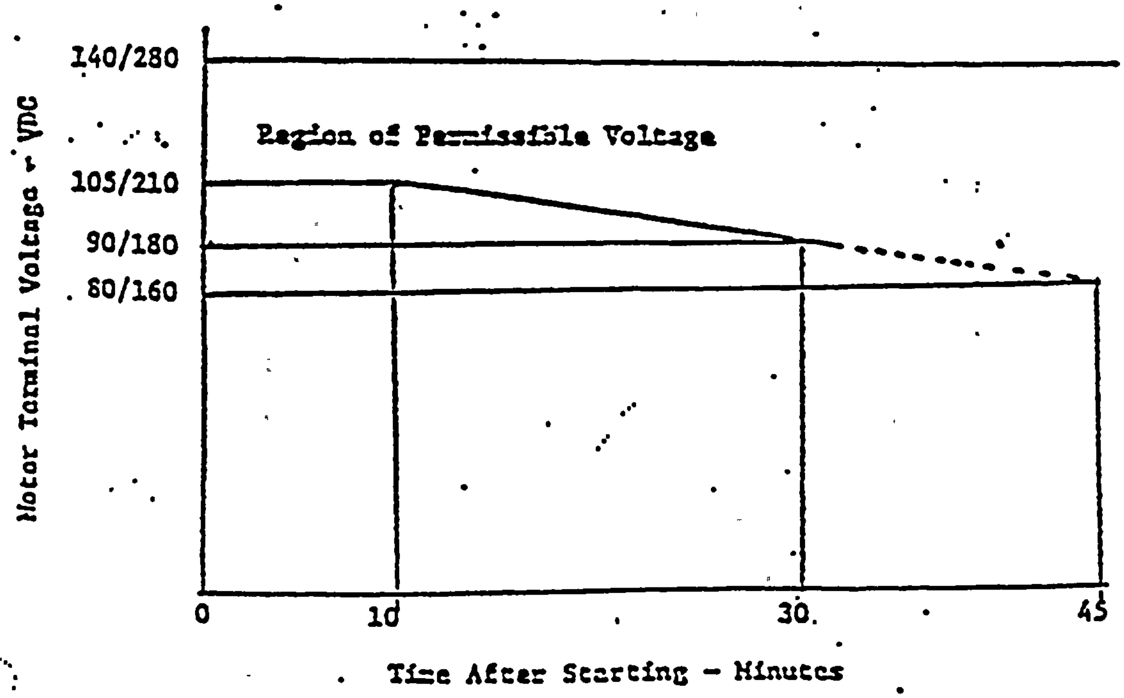
DC Voltage Range of Motor and Starter for the Emergency Bearing Oil Pump (EBOP)

The motor for the emergency bearing oil pump has a nameplate voltage of 120 vdc or 240 vdc depending upon the voltage of the customer's station battery. The motor, motor starter and emergency bearing oil pump are suitable for operation in the voltage range of 105 vdc to 140 vdc (or 210 vdc to 280 vdc). The station battery should have sufficient capacity to start and operate the EBOP, along with all other loads on the battery, for the period of time required to shut the turbine down safely upon a trip concurrent with a loss of power to the a-c driven oil pumps.

For purposes of establishing the required battery capacity, the load due to the EBOP should be based on the assumption that, in starting, the motor will draw 5 times full load current for 10 seconds. During this period and for 10 minutes thereafter, the voltage at the motor terminals must remain above 105 vdc (210 vdc for 240 vdc systems). Between 10 and 30 minutes after starting of the EBOP, the voltage must remain above a linear reduction with time to 90 vdc (180 vdc for 240 vdc systems) at the end of 30 minutes after starting. After 30 minutes, further drop off in voltage is permissible. Should the voltage drop below approximately 80 vdc (160 vdc for 240 vdc systems), the starter will drop out and shut down the EBOP motor. This must not be permitted to occur for at least an additional 15 minutes if there is any possibility that full condenser vacuum might be maintained, prolonging the time required for the turbine to coast to a standstill. This might be the case if power to the condenser cooling water pumps is maintained while power to the a-c driven lube oil pumps is lost.



STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	60
12177	ELECTRICAL	EC-44	N/A	9

CIRCUIT BREAKERS TRIPPING ON BUS UNDERVOLTAGE

SWGR I.D.	CUBICLE	ESK
2NPS-SWG001	1-3	5NPS01-13
	1-6	5RCS01-8
	1-7	5CNM04-10
	1-8	5FWS01-10
	1-9	5CWS01-10
	1-10	5CWS03-9
	1-11	5CWS05-9
	1-12	5CNM06-11
2NPS-SWG002	2-2	5ABM01-8
	2-3	5ABM02-7
2NPS-SWG003	3-4	5RCS02-8
	3-5	5CNM05-10
	3-7	5FWS02-10
	3-8	5CWS06-9
	3-9	5CWS04-9
	3-10	5CWS02-9
	3-12	5FWS04-8
	3-14	5NPS04-13
2NNS-SWG011	11-4	5CCS01-9
	11-6	5HDL01-7
	11-7	5CNM01-6
	11-8	5CNM03-8
2NNS-SWG012	12-2	5HDL03-9
	12-4	5CCS03-9
	12-5	5CCP01-9

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 61
12177	ELECTRICAL	EC-44	N/A	9

2NNS-SWG013	13-2	5CNM07-9
	13-3	5CNM02-7
	13-4	5HDL02-9
	13-8	5CCS02-9
	13-9	5CCP04-4
2NNS-SWG014	14-6	5CCP06-4
	14-7	5RDS01-8
	14-9	5CCP03-8
2NNS-SWG015	15-2	5RDS02-8
	15-4	5CCP02-8
	15-6	5CCP05-4

TOTAL SWITCHGEAR BREAKERS = 36

TOTAL 600V LOAD CENTER BREAKERS = 49