



# ENCLOSURE 2      Page 1

## CALCULATION SHEET

PROJECT SONGS 263      JOB NO. 18740-298      CALC. NO. E4C-017  
 SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING      SHEET NO. T109

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
0	<i>[Signature]</i>	<i>8/2/88</i>	<i>[Signature]</i>	<i>8/12/89</i>					

Attachment 9

### PRELIMINARY EVALUATION OF SONGS BLACKOUT SCENARIO

I. Purpose/Scope

- A. Verify that during a Blackout Scenario the duty cycles for the Unit 2 and Unit 3 Class 1E "A", "B", "C" and "D" batteries are at least four (4) hours. Because of similarity between units, only Unit 2 has been evaluated.
- B. Because the Unit 1 Emergency Safe Shutdown Diesel Generator is available within the present Unit 1 Class 1E battery duty cycles, Unit 1 blackout battery evaluations are not required.
- C. Identify the heat due to DC powered electrical equipment losses in each unit by area, except for those loads added by DCP's during the Cycle 5 outage.

II. Blackout Scenario

A review of the one line drawings (30101, 30107, 30108, 30109 and 32109) indicates that Main Control Room HVAC can be maintained by operating a Kirk Key Switch and associated circuit breakers to change the power supply for the Auxiliary Building Emergency Chiller from the blacked out unit to the operating unit.

A review by SCE has established that the following equipment is either not operated or can be de-energized by operator action:

No.	Load Description	Channel	DC Current (Amps)	Blackout Operating Time Period
1	NSSS Protection Cabinet	A	33.1	Operator action prior to 30 minutes will open the associated DC supply breakers
	(4 breakers per channel)	B	40.3	
		C	40.7	
		D	33.8	
2	Shutdown Cooling System Isolation Valves	C	60.00	Valve operation not required
		D	60.00	

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PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017  
 SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T110

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>ASST/...</i>	3/12/84	<i>...</i>	3/12/84					
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No.	Load Description	Channel	D C Current	Blackout Operating Time Period
3A	Reduction in Vital Bus Inverter Current Due to Averaging The Duty Cycle Voltage	A B C D	Note 1B 1.28 Note 1B 2.04 Note 1A 6.96 Note 1A 6.10	Reduction applies to the entire duty cycle
3B	Reduction In Shutdown Cooling System Isolation Valve Inverter Current Due to Averaging The Duty Cycle Voltage	C D	Note 1A .69 Note 1A .70	Reduction applies to the entire duty cycle
4	Diesel Generator Control Panel Fuel Priming Pump	A B	12.60 12.60	Reduction applies to duty cycle after (1) one minute
5	Diesel Generator Starting at End of Blackout	A B	(75.60) (75.60)	Load addition to account per starting of the diesel Generator and closing the diesel generator breaker during blackout recovery (i.e. last minute of the blackout duty cycle).

Notes: 1 The initial battery open circuit voltage was determined from the Average Capacity of Mean-Size Cells curve in calculation E4C-017. This value and the end of duty cycle voltage are then averaged. The resultant average voltage is used to determine an average inverter current.

A. For the "A" battery

$$V_{ave} = (107.8 + 105.4)/2 = 106.6$$

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CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-293 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T111

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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B. For the "B" battery

$$V_{ave} = (109.0 + 105.4)/2 = 107.2$$

C. For the "C" battery

$$V_{ave} = (121.0 + 105.4)/2 = 113.2$$

D. For the "D" battery

$$V_{ave} = (121.3 + 105.4)/2 = 113.4$$

The above load reductions were applied to the present duty cycles contained in calculation E4C-017 Rev 9 (issued for review) to obtain the Load Profile Tables Cell sizing sheets and Load Profile Curves shown in Figures 1 to 4 and Tables 1 to 7.

### III. DC Electrical Equipment Heat Loads During the Blackout

The 125VDC, 250VDC and 120V AC Inverter One Line Diagrams were reviewed against general plant layout drawings and the Circuit and Raceway schedule to establish heat loads by area. Since the DC or inverter loads are purely resistive their load values were directly converted to heat. The load values were obtained from the appropriate battery sizing calculations. Where the battery calculation used a measured current for a distribution panel, the heat for each panel load was distributed in proportion to its circuit breaker rating.

The resultant heat loads were entered into a Lotus table so that total heat loads by room could be determined. These heat loads are shown in Table 8 for Unit 1 and Table 9 for Unit 2.

### IV. Conclusion

By implementing the load reductions discussed in Section II above, blackout duty cycles for Batteries "A", "B", "C", and "D" were extended beyond the minimum 4 hours as calculated in Tables 4 through 7 and summarized below:

Battery	Blackout duty cycle
A	261 min or 4.4 hrs.
B	271 min or 4.5 hrs.
C	751 min or 12.5 hrs.
D	860 min or 14.3 hrs.

OPCV806



CALCULATION SHEET

PROJECT SONGS 2&3 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T112

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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All DC powered electrical equipment heat losses were summarized by area and are shown in Tables 8 and 9 for Unit 1 and Units 2 & 3 respectively.

V. References

1. Calculation E4C-017 Rev 2 (~~issued for review~~) 8/17/89
2. Unit 2 and 3 FSAR Chapter 8
3. Maintenance Work Order 88061296

OPCWP806



# ENCLOSURE 2 Page 5 CALCULATION SHEET

PROJECT SONGS 213

JOB NO. 18742-244

CALC. NO. 011-212

SUBJECT 125 VOLT BATTERY C/I SYSTEM SIZING

SHEET NO. 713

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
0	<i>R. J. ...</i>	8/11/89	<i>R. J. ...</i>	8/11/89	1				
1					2				

ATTACHMENT 9

Table 1

1E 125V DC Load Profile After SISLOP  
Distribution Switchboard 2D1  
Channel A Battery 28007

Time (Seconds)	MSSS Aux.							Random Load*		TOTAL
	4.76 KV ESF SVGR 2A04 DKR OPRS	480V ESF SVGR 2B04 DKR OPRS	Diesel Gen. 20002 Chnl. Panel	Relay Cab. 2L-71 2L-420	Reactor Trip 2L-344 Cab. 2L-32	Vital Bus C&T BCR Invrtr	Y01	Additional Load for Future DCPs	AFW Chnl. Vlvs. HV4705 & HV4730	
0.0-0.1	11.00	7.40	78.40	28.12	3.80	112.69	5.00		246.41	
0.1-0.6	161.00	81.50	78.40	28.12	3.80	112.69	5.00		470.51	
0.6-1.0	161.00	81.50	15.40	28.12	3.80	112.69	5.00		407.51	
1.0-1.1	161.00	81.50	91.00	28.12	3.80	112.69	5.00		483.11	
1.1-1.6	21.00	11.50	91.00	28.12	3.80	112.69	5.00		273.11	
1.6-3.5	21.00	11.50	15.40	28.12	3.80	112.69	5.00		197.51	
3.5-5.0	21.00	11.50	15.40	28.12	3.80	112.69	5.00		197.51	
5.0-5.1	31.00	11.50	15.40	28.12	3.80	112.69	5.00		207.51	
5.1-6.1	161.00	1.50	15.40	28.12	3.80	112.69	5.00		327.51	
6.1-10.0	21.00	1.50	15.40	28.12	3.80	112.69	5.00		127.51	
10.0-10.1	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
10.1-15.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
15.0-15.1	1.00	4.10	15.40	28.12	3.80	112.69	5.00		175.11	
15.1-20.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
20.0-20.1	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
20.1-25.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
25.0-25.1	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
25.1-30.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
30.0-30.1	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
30.1-35.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
35.0-35.1	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
35.1-36.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00		167.51	
36.0-60.0	1.00	1.50	15.40	28.12	3.80	112.69	5.00	30.59	167.51	
1min-30min	1.00	1.50	15.40	28.12	0.00	112.69	5.00	30.59	163.71	
Continuous Load	1.00	1.50	15.40	28.12	0.00	79.59	5.00	30.59	130.61	



# ENCLOSURE 2

## CALCULATION SHEET

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PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017  
 SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T114

REV	ORIGINATOR	DATE	CHECKER	DATE	R. /	ORIGINATOR	DATE	CHECKER	DATE
1	<i>John DeWard</i>	<i>8/17/89</i>	<i>John DeWard</i>	<i>8/17/89</i>					

ATTACHMENT 9

D.C. Restart

0-0.1	1.00	1.50	78.40	28.12	0.00	79.59	5.00	30.59	193.61
0.1-0.6	1.00	1.50	78.40	28.12	0.00	79.59	5.00	30.59	193.61
0.6-1.0	1.00	1.50	15.40	28.12	0.00	79.59	5.00	30.59	130.61
1.0-1.1	1.00	1.50	91.00	28.12	0.00	79.59	5.00	30.59	206.21
1.1-1.5	1.00	1.50	91.00	28.12	0.00	79.59	5.00	30.59	206.21
1.6-2.5	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
3.5-5.0	1.00	1.50	33.00	28.12	0.00	79.59	5.00	30.59	148.21
5.0-5.1	1.00	1.50	33.00	28.12	0.00	79.59	5.00	30.59	148.21
5.1-6.1	1.00	1.50	33.00	28.12	0.00	79.59	5.00	30.59	148.21
6.1-10.0	1.00	1.50	33.00	28.12	0.00	79.59	5.00	30.59	148.21
10.0-10.1	31.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	173.21
10.1-15.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
15.0-15.1	6.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	148.21
15.1-20.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
20.0-20.1	6.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	148.21
20.1-25.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
25.0-25.1	6.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
25.1-30.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	148.21
30.0-30.1	6.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	148.21
30.1-35.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
35.0-35.1	6.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	148.21
35.1-36.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21
36.0-60.0	1.00	1.50	28.00	28.12	0.00	79.59	5.00	30.59	143.21

\* 1-Minute Load in Battery sizing calculation

\*\* The 4.16 kV switchgear and 480V switchgear current has been modified to show that the diesel generator does not start in the first minute. The breaker actions in the first ten seconds of the first minute are the same as Calculation E4C-017. At ten seconds, the diesel generator breaker does not close and the loads on 8007 become the continuous loads. When the diesel generator start does occur after 4 hours, the breaker actions are reinitiated 10 seconds into restart. This has no net effect on the maximum first minute load.



# ENCLOSURE 2 Page 7

## CALCULATION SHEET

PROJECT SONGS 243 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T115

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>[Signature]</i>	8/17/89	<i>[Signature]</i>	8/19/89					
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ATTACHMENT 9

TABLE 2

1E 125V DC Load Profile After SISLOP  
Distribution Switchboard 202  
Channel B Battery 2800S

Time (Seconds)	RSS Aux.						Random Load*		TOTAL Excluding Random Load
	4.16 KV ESF SVGR 2A06 BKR UPRS	480V ESF SVGR 2806 BKR DPRS	Diesel Gen. 20003 Cntl. Panel	Relay Cab. 2L-71 2L-421	Reactor Trip 2L-345 Ckt BKR Cab. 2L-32	Vital Bus Invrtr Y002	Additional Load for Future DCPs	ATW Cntrl. Vls. HV4706 & HV4715	
0-0.1	6.00	7.40	78.40	25.12	3.80	119.50	5.00	248.22	
0.1-0.6	81.00	81.50	78.40	25.12	3.80	119.50	5.00	397.32	
0.6-1.0	81.00	81.50	15.40	28.12	3.80	119.50	5.00	334.32	
1.0-1.1	81.00	81.50	91.00	25.12	3.80	119.50	5.00	409.92	
1.1-1.6	11.00	11.50	91.00	28.12	3.80	119.50	5.00	269.92	
1.6-3.3	11.00	11.50	15.40	28.12	3.80	119.50	5.00	194.32	
3.3-5.0	11.00	11.50	15.40	28.12	3.80	119.50	5.00	194.32	
5.0-5.1	21.00	11.50	15.40	28.12	3.80	119.50	5.00	204.32	
5.1-6.1	161.00	1.50	15.40	28.12	3.80	119.50	5.00	334.32	
6.1-10.0	21.00	1.50	15.40	28.12	3.80	119.50	5.00	194.32	
10-10.1	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
10.1-15.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
15.0-15.1	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
15.1-20.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
20.0-20.1	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
20.1-25.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
25.0-25.1	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
25.1-30.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
30.0-30.1	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
30.1-35.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
35.0-35.1	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
35.1-36.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
36.0-60.0	1.00	1.50	15.40	28.12	3.80	119.50	5.00	174.32	
1min-30min	1.00	1.50	15.40	28.12	0.00	119.50	5.00	170.52	
Continuous Load	1.00	1.50	15.40	28.12	0.00	79.20	5.00	130.22	



# ENCLOSURE 2 Page 8

## CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T1.6

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REV  
INDICATOR

ATTACHMENT 9

D.C. Restart

0-0.1	1.00	1.50	78.40	28.12	0.00	79.20	5.00	34.67	193.22
0.1-0.6	1.00	1.50	78.40	28.12	0.00	79.20	5.00	34.67	193.22
0.6-1.0	1.00	1.50	13.40	28.12	0.00	79.20	5.00	34.67	130.22
1.0-1.1	1.00	1.50	91.00	28.12	0.00	79.20	5.00	34.67	205.82
1.1-1.6	1.00	1.50	91.00	28.12	0.00	79.20	5.00	34.67	205.82
1.6-3.5	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
3.5-5.0	1.00	1.50	33.00	28.12	0.00	79.20	5.00	34.67	147.82
5.0-5.1	1.00	1.50	33.00	28.12	0.00	79.20	5.00	34.67	147.82
5.1-6.1	1.00	1.50	33.00	28.12	0.00	79.20	5.00	34.67	147.82
6.1-10.0	1.00	1.50	33.00	28.12	0.00	79.20	5.00	34.67	147.82
10-10.1	31.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	172.82
10.1-15.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
15.0-15.1	6.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	147.82
15.1-20.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
20.0-20.1	6.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	147.82
20.1-25.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
25.0-25.1	6.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	147.82
25.1-30.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
30.0-30.1	6.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	147.82
30.1-35.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
35.0-35.1	6.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	147.82
35.1-36.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82
36.0-60.0	1.00	1.50	28.00	28.12	0.00	79.20	5.00	34.67	142.82

\* 1-Minute load in Battery sizing calculation

\*\* The 4.16 kV switchgear and 480V switchgear current has been modified to show that the diesel generator does not start in the first minute. The breaker actions in the first ten seconds of the first minute are the same as Calculation E4C-017. At ten seconds, the diesel generator breaker does not close and the loads on 80.8 become the continuous loads. When the diesel generator start does occur after 1 hour, the breaker actions are reinitiated 10 seconds into restart. This has no net effect on the maximum first minute load.





# ENCLOSURE 2 Page 9 CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017  
 SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. 7117

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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ATTACHMENT 9

Table 3

1E 125V DC Load Profile for Blackout

LOAD (AMPS)	Distribution Switchboard 203 Channel D Battery 28009			Distribution Switchboard 204 Channel D Battery 8010		
	Time (minutes)			Time (minutes)		
	0-1	1-30	Constant	0-1	1-30	Constant
Reactor Trip Circuit Breaker Cabinets 2L-33	3.80	0.00	0.00	3.80	0.00	0.00
KSSS Auxiliary Relay Cabinet 2L-71	0.20	0.20	0.20	0.20	0.20	0.20
Controls of Turbine of Turbine Driven AFV	2.00	2.00	2.00			
Additional Loads for future BOPs	5.00		5.00	5.00	5.00	5.00
Turbine Stop Valve for AFV Turbine XV-6716 *		16.97	16.97 *			
Vital Bus Inverter	93.58	93.58	92.85	80.34	80.14	46.34
SOC Isolation Valve Inverter	9.31	9.31	9.31	9.30	9.33	9.31
TOTAL (excluding random load)	114.29	110.09	69.39	98.64	94.67	60.85
Total Random Load		16.97	16.97			0.00

\* 1- Minute Random Load in Battery sizing calculation



# ENCLOSURE 2 CALCULATION SHEET

Page 10

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T122

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>AS</i>	8/17/69	<i>R. Smith</i>	8/17/69	2				
2					3				

ATTACHMENT 9

Table 4

125-VDC BATTERY SIZING CALCULATIONS BATTERY BOOT

Lowest Expected Electrolyte Temp: 60 ° F      Minimum Cell Voltage: 1.85 VPC      Cell Mfg: EXIDE      Cell Type: GM-15      Pos. Plates: 7

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section T Min Rate (minutes)	Required Section Size	
					Capacity at (3)/(6) = Positive Plates Amps/Pos. Pl	Pos. Value Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Section 1 - First Period Only - If A2 is greater than A1, go to section 2						
1	A1 = 483.1	A1 - 0 = 483.1	M1 = 1	T = M1 = 1	105.00	4.60
					Section 1:	Total 4.60
Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3						
1	A1 = 483.1	A1 - 0 = 483.1	M1 = 1	T = M1+M2 = 30.00	84.00	5.75
2	A2 = 163.7	A2 - A1 = -319.4	M2 = 29	T = M2 = 29.00	85.00	-3.76
					Section 2:	Sub-Total 5.75      -3.76
					Total	1.99
Section 3 - First Three Periods Only - If A4 is greater than A3, go to Section 4						
1	A1 = 483.1	A1 - 0 = 483.1	M1 = 1	T = M1+M2+M3 = 260.00	33.00	14.64
2	A2 = 163.7	A2 - A1 = -319.4	M2 = 29	T = M2+M3 = 259.00	33.00	-9.68
3	A3 = 130.6	A3 - A2 = -33.1	M3 = 230	T = M3 = 230.00	35.00	-0.95
					Section 3:	Sub-Total 14.64      -10.62
					Total	4.02
Section 4 - First Four Periods Only - If A5 is greater than A4, go to Section 5						
1	A1 = 483.1	A1 - 0 = 483.1	M1 = 1	T = M1+M2+M3+M4 = 261.00	33.00	14.64
2	A2 = 163.7	A2 - A1 = -319.4	M2 = 29	T = M2+M3+M4 = 260.00	33.00	-9.68
3	A3 = 130.6	A3 - A2 = -33.1	M3 = 230	T = M3+M4 = 231.00	35.00	-0.95
4	A4 = 206.2	A4 - A3 = 75.6	M4 = 1	T = M4 = 1.00	105.00	0.72
					Section 4:	Sub-Total 14.64      -9.90
					Total	4.74



# ENCLOSURE 2 CALCULATION SHEET

Page 11

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T123

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>Handwritten</i>	3/17/89	<i>Handwritten</i>	8/11/89	2				
3					4				

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ATTACHMENT 9

Random Load Only (if needed) (occurring after first 36 sec.)

$R$        $AR \times$        $AR - 0 \times$        $nR \times$        $T \times MR \times$   
 30.6      30.6      1.00      1.00      105.00      0.29

Max. Sect. Size      Random Sect. Size      Uncorrected Size  
 4.74      0.29      5.03 (Pos. Plates)

Uncorrected Size      Age Correction Factor      Temperature Factor      Needed Size  
 5.03      1.25      1.11      6.97 (Pos. Plates)

Available Size      Needed Size      Available Size      X Margin Capacity  
 7      6.97      7      X 100 %      0.37

\* Random section size not added, Not coincident with first minute max.



# ENCLOSURE 2 CALCULATION SHEET

PAGE 12

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T124

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△	<i>[Signature]</i>	8/12/85	<i>[Signature]</i>	8/12/85	△				
△					△				

ATTACHMENT 9

Table 5

125-VDC BATTERY SIZING CALCULATIONS BATTERY BOSS

Lowest Expected Electrolyte Temp: 60 ° F      Minimum Cell Voltage: 1.84 VPC      Cell Mfg: EXIDE      Cell Type: Pos. Plates: GN-15      7

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section T (minutes)	Required Section Size		
					Capacity at (33)(6) + Positive Plates (Amps/Pos. Pl)	Pos. Value	Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Section 1 - First Period Only - If A2 is greater than A1, go to section 2							
1	A1 = 409.9	A1 - 0 = 409.9	M1 = 1	T = M1 = 1	111.00	3.69	
					Section 1: Total	3.69	
Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3							
1	A1 = 409.9	A1 - 0 = 409.9	M1 = 1	T = M1 + M2 = 30.00	87.00	4.71	
2	A2 = 170.5	A2 - A1 = -239.4	M2 = 29	T = M2 = 29.00	33.00	-2.72	
					Section 2: Sub-Total	4.71	-2.72
					Total	1.99	
Section 3 - First Three Periods Only - If A4 is greater than A3, go to Section 4							
1	A1 = 409.9	A1 - 0 = 409.9	M1 = 1	T = M1 + M2 + M3 = 270.00	33.00	12.42	
2	A2 = 170.5	A2 - A1 = -239.4	M2 = 29	T = M2 + M3 = 269.00	33.00	-7.26	
3	A3 = 130.2	A3 - A2 = -40.3	M3 = 240	T = M3 = 240.00	35.00	-1.15	
					Section 3: Sub-Total	12.42	-8.41
					Total	4.02	
Section 4 - First Four Periods Only - If A5 is greater than A4, go to Section 5							
1	A1 = 409.9	A1 - 0 = 409.9	M1 = 1	T = M1 + M2 + M3 + M4 = 271.00	33.00	12.42	
2	A2 = 170.5	A2 - A1 = -239.4	M2 = 29	T = M2 + M3 + M4 = 270.00	33.00	-7.26	
3	A3 = 130.2	A3 - A2 = -40.3	M3 = 240	T = M3 + M4 = 241.00	35.00	-1.15	
4	A4 = 205.8	A4 - A3 = 75.6	M4 = 1	T = M4 = 1.00	111.00	0.68	
					Section 4: Sub-Total	12.42	-7.73
					Total	4.70	



# ENCLOSURE 2 PAGE 13 CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. SYSTEM SIZING SHEET NO. T125

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△	<i>Prost</i>	8/12/84	<i>Prost</i>	8/19/84	△				
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ATTACHMENT 9

Random Load Only (if needed) (occurring after first 36 sec.)

R      AR \*      AR - 0 \*      MR \*      T \* MR \*  
          34.7      34.7      1.00      1.00      111.00      0.31

Max. Sect. Size	Random Sect. * Size	Uncorrected Size
4.70	0.31	5.01 (Pos. Plates)

Uncorrected Size	App. Correction Factor	Temperature Factor	Needed Size
5.01	1.25	1.11	6.95 (Pos. Plates)

Available Size	Needed Size	Available Size	X Margin Capacity
7	6.95	7	0.72

\* Random section size not added, Not coincident with first minute max.



ENCLOSURE 2 PAGE 14  
CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T125

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>[Signature]</i>	8/12/89	<i>[Signature]</i>	8/17/89					
2									

REV. CONTROL CAYTON

ATTACHMENT 9

Table 6

125-VDC BATTERY SIZING CALCULATIONS BATTERY 8009

Lowest Expected Electrolyte Temp: 60 ° F      Minimum Cell Voltage: 1.84 VPC      Cell Mfg: EXIDE      Cell Type: Pos. Plates: GH-17      8

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section 1 Min Rate (minutes)	Capacity at (3)/(6) * Positive Plates Amps/Pcs. Pl	Required Section Size	
						Pos. Value	Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Section 1 - First Period Only - If A2 is greater than A1, go to section 2							
1	A1 = 114.3	A1 - 0 = 114.3	M1 = 1	T = M1 = 1	112.00	1.02	
					Section 1: Total	1.02	
Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3							
1	A1 = 114.3	A1 - 0 = 114.3	M1 = 1.00	T = M1+M2 = 31.00	88.00	1.50	
2	A2 = 110.1	A2 - A1 = -4.2	M2 = 30.00	T = M2 = 30.00	88.00		-0.05
					Section 2: Sub-Total	1.30	-0.05
					Total	1.25	
Section 3 - First Three Periods Only - If A4 is greater than A3, go to Section 4							
1	A1 = 114.3	A1 - 0 = 114.3	M1 = 1	T = M1+M2+M3 = 751.00	13.00	8.79	
2	A2 = 110.1	A2 - A1 = -4.2	M2 = 30	T = M2+M3 = 750.00	13.00		-0.32
3	A3 = 69.4	A3 - A2 = -40.7	M3 = 720	T = M3 = 720.00	14.00		-2.91
					Section 3: Sub-Total	8.79	-3.23
					Total	5.56	



# ENCLOSURE 2 PAGE 15 CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T127

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
0	Russell	8/12/59	Russell	8/12/59					

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ATTACHMENT 9

Random Load Only (if needed) (occurring after first 30 sec.)

R	AR *	AR - 0 *	AR *	T = AR *
17.0	17.0	1.00	1.00	112.00    0.15

---

Max. Sect. Size	+	Random Sect. * Size	=	Uncorrected Size
5.56		0.15		5.71 (Pos. Plates)

  

Uncorrected Size	X	Age Correction Factor	X	Temperature Factor	=	Needed Size
5.71		1.25		1.11		7.93 (Pos. Plates)

  

Available Size	-	Needed Size	] /	Available Size	X 100 %	=	% Margin Capacity
8		7.93		8			0.92

\* Random section size not added, not coincident with first minute max.



ENCLOSURE 2 PAGE 16  
CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T128

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
①	<i>[Signature]</i>	8/12/59	<i>[Signature]</i>	8/17/59	△				
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ATTACHMENT 9

Table 7

125-VDC BATTERY SIZING CALCULATIONS BATTERY 8010

Lowest Expected Electrolyte Temp: 60 ° F Minimum Cell Voltage: 1.84 VPC Cell Mfg: EXIDE Cell Type: GN-17 Pos. Plates: 8

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section T Min Rate (minutes)	Capacity at (3)/(6) * Positive Plates Amps/Pos. Pl	Required Section Size (3)/(6) * Positive Plates Pos. Value	Req. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Section 1 - First Period Only - If A2 is greater than A1, go to section 2							
1	A1 = 98.6	A1 - 0 = 98.6	M1 = 1	T = M1 = 1	112.00	0.63	
						Section 1: Total	0.53
Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3							
1	A1 = 98.6	A1 - 0 = 98.6	M1 = 1	T = M1 = 1	28.00	1.12	
2	A2 = 94.7	A2 - A1 = -4.0	M2 = 29.00	T = M2 = 29.00	90.00	-0.04	
						Section 2: Sub-Total	1.12
						Total	1.08
Section 3 - First Three Periods Only - If A4 is greater than A3, go to Section 4							
1	A1 = 98.6	A1 - 0 = 98.6	M1 = 1	T = M1 = 1	60.00	8.97	
2	A2 = 94.7	A2 - A1 = -4.0	M2 = 29	T = M2 = 29	359.00	11.50	-0.35
3	A3 = 60.9	A3 - A2 = -33.8	M3 = 830	T = M3 = 830	830.00	11.50	-2.94
						Section 3: Sub-Total	8.97
						Total	5.68





CALCULATION SHEET

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO T129

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>[Signature]</i>	8/10/89	<i>[Signature]</i>	8/10/89					

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ATTACHMENT 9

Random Load Only (if needed) (occurring after first 36 sec.)

R	AR *	AR - 0 *	MR *	T * MR *		
	0.0	0.0	1.00	1.00	112.00	0.00

Max. Sect. Size	*	Random Sect. Size	*	Uncorrected Size
5.65		0.00		5.65 (Pos. Plates)

Uncorrected Size	X	Age Correction Factor	X	Temperature factor	*	Needed Size
5.65		1.25		1.11		7.89 (Pos. Plates)

Available Size	**	Needed Size	/	Available Size	X 100 %	* Margin Capacity
8		7.89		8		1.66

\* Random section size not added, not coincident with first minute max.



# ENCLOSURE 2 Page 18

## CALCULATION SHEET

PROJECT SONGS 2&3 JOB NO. 18740-298 CALC. NO. F4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T41

REV.	ORIGINATOR	DATE	CHECKER	DATE	REV.	ORIGINATOR	DATE	CHECKER	DATE
1	<i>[Signature]</i>	8/17/89	<i>[Signature]</i>	8/17/89					
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Table 5.1A

1E 125V DC Load Profile for 90 Minutes After SISLOP  
Distribution Switchboard 2D1  
Channel A Battery 28007

Time (Seconds)	4.16 KV ESF		480V ESF		ESS Aux.		Relay Cab.		Reactor Trip		Vital Bus		Random Load*		TOTAL
	SWGR 2A04	BKR CPRS	SWGR 2B04	BKR CPRS	2C002	2L-71	2L-344	CKT BKR	Y01	Future Loads	APW Cntrl.	WV4705	WV4730	Excluding Random Load	
0.0-0.1		11.00		7.40	78.40	28.12		3.80		113.97			5.00	247.67	
0.1-0.6		161.00		81.50	78.40	28.12		3.80		113.97			5.00	471.79	
0.6-1.0		161.00		81.50	15.40	28.12		3.80		113.97			5.00	408.79	
1.0-1.1		161.00		81.50	91.00	28.12		3.80		113.97			5.00	484.39	
1.1-1.6		21.00		11.50	91.00	28.12		3.80		113.97			5.00	274.39	
1.6-3.5		21.00		11.50	28.00	28.12		3.80		113.97			5.00	211.39	
3.5-5.0		21.00		11.50	33.00	28.12		3.80		113.97			5.00	216.39	
5.0-5.1		31.00		11.50	33.00	28.12		3.80		113.97			5.00	226.39	
5.1-6.1		161.00		1.50	33.00	28.12		3.80		113.97			5.00	346.37	
6.1-10.0		21.00		1.50	33.00	28.12		3.80		113.97			5.00	206.39	
10.0-10.1		31.00		1.50	28.00	28.12		3.80		113.97			5.00	211.39	
10.1-15.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
15.0-15.1		6.00		4.10	28.00	28.12		3.80		113.97			5.00	188.97	
15.1-20.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
20.0-20.1		6.00		1.50	28.00	28.12		3.80		113.97			5.00	186.39	
20.1-25.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
25.0-25.1		6.00		1.50	28.00	28.12		3.80		113.97			5.00	186.39	
25.1-30.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
30.0-30.1		6.00		1.50	28.00	28.12		3.80		113.97			5.00	186.39	
30.1-35.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
35.0-35.1		6.00		1.50	28.00	28.12		3.80		113.97			5.00	186.39	
35.1-36.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
36.0-60.0		1.00		1.50	28.00	28.12		3.80		113.97			5.00	181.39	
1-90 (min)		1.00		1.50	28.00	28.12		0.00		113.97			5.00	177.59	

\* 1- Minute Load in Battery sizing calculation



# ENCLOSURE 2 CALCULATION SHEET

Page 19

PROJECT SONGS 263 JOB NO. 18740-293 CALC. NO. PAC-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T42

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>2000/01/14</i>	<i>3/12/87</i>	<i>AmBul</i>	<i>3/12/87</i>	1				

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Table 5.12

1E 125V DC Load Profile For 90 Minutes After SISLUP  
Distribution Switchboard 202  
Channel B Battery 24008

Time (Seconds)	4.16 KV ESF SVGR 2406 DCB CB25	480V ESF SVGR 2306 BXR CPR5	Diesel Gen. 20003 Cntl. Panel	MSGS Aux. Relay Cab. 2L-71	Reactor Trip 2L-365	Vital Bus CKT BXR Y02 Cab. 2L-33	Invtr Y002	Future Loads	Random Load* AFM Cntrl. Vibs. HV4706 & HV4715	TOTAL Excluding Random Load
0-0.1	6.00	7.40	78.40	28.12	3.80	121.54	5.00		250.26	
0.1-0.6	81.00	81.50	78.40	28.12	3.80	121.54	5.00		379.36	
0.6-1.0	81.00	11.50	15.40	28.12	3.80	121.54	5.00		336.36	
1.0-1.1	81.00	81.50	91.00	28.12	3.80	121.54	5.00		411.96	
1.1-1.6	11.00	11.50	91.00	28.12	3.80	121.54	5.00		271.96	
1.6-3.5	11.00	11.50	28.00	28.12	3.80	121.54	5.00		208.96	
3.5-5.0	11.00	11.50	33.00	28.12	3.80	121.54	5.00		213.96	
5.0-5.1	21.00	11.50	33.00	28.12	3.80	121.54	5.00		223.96	
5.1-6.1	161.00	1.50	33.00	28.12	3.80	121.54	5.00		353.96	
6.1-10.0	21.00	1.50	33.00	28.12	3.80	121.54	5.00		213.96	
10-10.1	31.00	1.50	28.00	28.12	3.80	121.54	5.00		218.96	
10.1-15.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00		188.96	
15.0-15.1	6.00	4.10	28.00	28.12	3.80	121.54	5.00		196.96	
15.1-20.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00		188.96	
20.0-20.1	6.00	1.50	28.00	28.12	3.80	121.54	5.00		193.96	
20.1-25.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00		188.96	
25.0-25.1	6.00	1.50	28.00	28.12	3.80	121.54	5.00		193.96	
25.1-30.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00		188.96	
30.0-30.1	6.00	1.50	28.00	28.12	3.80	121.54	5.00		193.96	
30.1-35.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00		188.96	
35.0-35.1	6.00	1.50	28.00	28.12	3.80	121.54	5.00		193.96	
35.1-36.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00		188.96	
36.0-60.0	1.00	1.50	28.00	28.12	3.80	121.54	5.00	34.67	188.96	
1-90 (min)	1.00	1.50	28.00	28.12	0.70	121.54	5.00	34.67	185.16	

\* 1- Minute Load in Battery sizing calculation



# ENCLOSURE 2

## CALCULATION SHEET

Page 20

PROJECT SONGS 2&3 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T43

REV	ORIGIN	FOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV. INDICATOR
0	25-00001		2/12/79	<i>[Signature]</i>	8/12/79	1					↓

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Table 5.1C

1E 125V DC Load Profile for 480 Minutes After SISLOP

LOAD (AMPS)	Distribution Switchboard 203 Channel C Battery 28009			Distribution Switchboard 204 Channel D Battery 28010		
	Time (minutes) 0-1	1-30	30-480	Time (minutes) 0-1	1-30	30-480
Reactor Trip Circuit Breaker Cabinet 2L-33	3.80	0.00	0.00	3.80	0.00	0.00
WSSS Auxiliary Relay Cabinet 2L-71	0.20	0.20	0.20	0.20	0.20	0.20
Controls of Turbine of Turbine Driven APW	2.00	2.00	2.00			
Additional load for future DCPs	5.00	5.00	5.00	5.00	5.00	5.00
Turbine Stop Valve for APW Turbine HV-4716 *			16.97 *			
Rated Inverter Load Due to the Operation of SOC Isolation Valves HV-9377 & HV-9378 **			60.00 **			60.00 **
Vital Bus Inverter (respectively Y003 & Y004)	100.94	100.94	100.94	86.44	86.44	86.44
(respectively Y006 & Y007)	10.06	10.06	10.06	10.06	10.06	10.06
Load Reduction ***			38.30			32.00
TOTAL (excluding random load)	121.99	118.19	79.09	105.50	101.70	69.70
Total Random Load			76.97			60.00

\* 1- Minute Random Load in Battery sizing calculation

\*\* This 3-Minute Random Load is Conservatively Assumed to be Equal to Rated Inverter Capacity of 70A Minus a Constant 10A Inverter Load

\*\*\* Reduction of Load on Inverters Y003 (38.3) and Y004 (32.0) After Reactor Trip. Based on the Load Measurements Performed Under MO's 87100-486 and 87100-498.



# ENCLOSURE 2 Page 21 CALCULATION SHEET

PROJECT SONGS 2&3 JOB NO. 18740-290 CALC. NO. ELC-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T48

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
0	<i>[Signature]</i>	0/17/64	<i>[Signature]</i>	8/17/84					

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Table 5.3A

125-VDC BATTERY NO. 8007 SIZING CALCULATIONS - 58 CELLS (Channel A) \*\*

Lowest Expected Electrolyte Temp: 60 F Minimum Cell Voltage: 1.85 VPC Cell Mfg: EXIDE Cell Type: GN-15 Pos. Plates: 7

Required Section Size

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section (minutes)	Capacity at (3)/(6) + Positive Plates (Amps/Pos. Pl)	Pos. Value	Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	

Section 1 - first Period Only - If A2 is greater than A1, go to section 2

1	A1 = 484.4	A1 - 0 = 484.4	M1 = 1	T = M1 = 1	105.00	4.61	
					Section 1: Total	4.61	

Section 2 - first Two Periods Only - If A3 is greater than A2, go to Section 3

1	A1 = 484.4	A1 - 0 = 484.4	M1 = 1.00	T = M1 = 90.00	58.00	8.35	
2	A2 = 177.6	A2 - A1 = -306.8	M2 = 89.00	T = M2 = 89.00	58.00		-5.29
					Section 2: Sub-Total	8.35	-5.29
					Total	3.06	

Random Load Only (if needed) (occurring after first 35 sec.)

R	AR = 30.6	AR - 0 = 30.6	MR = 1.00	T = MR = 1.00	105.00	0.29	
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Max. Sect. Size	*	Random Sect. Size	*	Uncorrected Size	
4.61		0.40		4.61 (Pos. Plates)	
Uncorrected Size	X	Age Correction Factor	X	Temperature Factor	=
4.61		1.25		1.11	
Available Size	**	Needed Size	/	Available Size	X 100 %
7		6.40		7	
					% Margin Capacity
					8.56

\* Random section size not added, Mnt coincident with first Minute max.  
 \*\* for load profile see Page 141, for GN-15 S curves see Page 131



# ENCLOSURE 2 CALCULATION SHEET

Page 22

PROJECT SONGS 243 JOB NO. 18740-295 CALC. NO. E/C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T49

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
0	<i>Bushnell</i>	8/17/54	<i>Bushnell</i>	9/17/54					

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Table 5.33

125-VDC BATTERY NO. 8008 SIZING CALCULATION - 58 CELLS (Channel B) \*\*

Lowest Expected Electrolyte Temp: 62 °F    Minimum Cell Voltage: 1.84 VPC    Cell Hrg: EXIDE    Cell Type: GM-15    Pos. Plates: 7

Required Section Size

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section (minutes)	Capacity at (3)/(6) * Positive Plates (Amps/Pos. Pl)	Pos. Value	Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	

Section 1 - First Period Only - if A2 is greater than A1, go to section 2

1	A1 =	A1 - 0 =	H1 =	T = H1 *			
	412.0	412.0	1	1	111.00	3.71	
				Section 1:	Total	3.71	

Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3

1	A1 =	A1 - 0 =	H1 =	T = H1 * H2 =			
	412.0	412.0	1.00	90.00	60.00	6.87	
2	A2 =	A2 - A1 =	H2 =	T = H2 *			
	185.2	-226.8	09.00	09.00	60.00	-3.78	
				Section 2:	Sub-Total	6.87	-3.78
					Total	3.09	

Random Load Only (if needed) (occurring after first 36 sec.)

2	AR =	A2 - 0 =	HR =	T = HR *			
	34.7	34.7	1.00	1.00	111.00	0.31	

Max. Sect. Size \* Random Sect. \* Uncorrected Size

3.71 \* 0.00 = 3.71 (Pos. Plates)

Uncorrected Size \* Age Correction Factor \* Temperature Factor \* Needed Size

3.71 \* 1.25 \* 1.11 = 5.15 (Pos. Plates)

Available Size \* Needed Size / Available Size \* 100 \* % Margin Capacity

7 \* 5.15 / 7 \* 100 = 26.43

\* Rand. section size not added, Not coincident with first Minute max.  
 \*\* For load profile see Page T42, for GM-15 S curves see Page T31



# ENCLOSURE 2 CALCULATION SHEET

Page 23

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T50

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	ESF/ghd	8/17/89	Rob/ltl	8/17/89					

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Table 5.3C

125-VDC BATTERY NO. 8009 SIZING CALCULATIONS - 58 CELLS (Channel C) \*\*

Lowest Expected Electrolyte Temp: 60 F      Minimum Cell Voltage: 1.84 VPC      Cell Hfg: EXIDE      Cell Type: Pos. Plates: 8

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of section (minutes)	Required Section Size	
					Capacity at (3)/(6) * Positive Plates (Amps/Pos. Pl)	Pos. Value Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)

Section 1 - First Period Only - If A2 is greater than A1, go to section 2

1	A1 =	A1 - 0 =	M1 =	T = M1 =		
	122.0	122.0	1	1	112.00	1.09
				Section 1:	Total	1.09

Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3

1	A1 =	A1 - 0 =	M1 =	T = M1 =		
	122.0	122.0	1	30.00	88.00	1.39
2	A2 =	A2 - A1 =	M2 =	T = M2 =		
	118.2	-3.8	29	29.00	90.00	-0.04
				Section 2:	Sub-Total	1.39
					Total	1.34

Section 3 - First Three Periods Only - If A4 is greater than A3, go to Section 4

1	A1 =	A1 - 0 =	M1 =	T = M1 =		
	122.0	122.0	1	480.00	20.00	6.10
2	A2 =	A2 - A1 =	M2 =	T = M2 =		
	118.2	-3.8	29	479.00	21.00	-0.18
3	A3 =	A3 - A2 =	M3 =	T = M3 =		
	79.0	-33.3	45	450.00	21.00	-1.82
				Section 3:	Sub-Total	6.10
					Total	4.09



# ENCLOSURE 2 CALCULATION SHEET

Page 24

PROJECT SONGS 2&3 JOB NO. 18740-298 CALC NO. EAC-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T51

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>W. J. Bell</i>	8/12/99	<i>Paul Baker</i>	8/12/99					
2									

3 Random Load Only (if needed) (occurring after first 30 min.)  
 4  $AR = 0$      $AR = 0$      $IR = 1.00$      $T = IR = 1.00$     112.00    0.69

5 Max. Sect.                  Random Sect. \*                  Uncorrected  
 6 Size                          Size                          Size  
 7 4.09                          0.69                          4.78 (Pos. Plates)

8 Uncorrected                  Age                  Temperature                  Needed  
 9 Size                          Correction                  factor                          Size  
 10 4.78                          1.25                          1.11                          6.64 (Pos. Plates)

11 Available                  Needed                  Available                  X Margin  
 12 Size                          Size                          Size                          Capacity  
 13 8                          6.64                          8                          17.06

14 \* Random section size is added since maximum section size is after 30 minutes.  
 15 \*\* for load profile see Page 1-3, for GH-17 S curves see Page 132

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REV. ORIGINATOR





# ENCLOSURE 2

## CALCULATION SHEET

Page 25

PROJECT SONGS 263 JOB NO. 18740-298 CALC. NO. E4C-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. T52

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
1	<i>John Wood</i>	<i>6/11/89</i>	<i>Edwin Hill</i>	<i>8/11/89</i>	1				

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Table 5.70

125-VDC BATTERY NO. 8010 SIZING CALCULATIONS - 50 CELLS (Channel D) \*\*

Lowest Expected Electrolyte Temp: 60 F Minimum Cell Voltage: 1.81 VPC Cell Mfg: EXIDE Cell Type: GW-17 Pos. Plates: 8

Period	Load (Amperes)	Change in Load (Amperes)	Duration of Period (Minutes)	Time to End of Section (minutes)	Required Section Size		
					Capacity at (3)/(6) * Positive Plates	Pos. Value	Neg. Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Section 1 - First Period Only - If A2 is greater than A1, go to section 2							
1	A1 = 105.5	A1 - 0 = 105.5	H1 = 1	T = H1 = 1	112.00	0.94	
					Section 1: Total	0.94	
Section 2 - First Two Periods Only - If A3 is greater than A2, go to Section 3							
1	A1 = 105.5	A1 - 0 = 105.5	H1 = 1.00	T = H1 = 1.00	88.00	1.20	
2	A2 = 101.7	A2 - A1 = -3.8	H2 = 29.00	T = H2 = 29.00	90.00	-0.04	
					Section 2: Sub-Total	1.20	-0.04
					Total	1.16	
Section 3 - First Three Periods Only - If A4 is greater than A3, go to Section 4							
1	A1 = 105.5	A1 - 0 = 105.5	H1 = 1	T = H1 = 1	480.00	5.27	
2	A2 = 101.7	A2 - A1 = -3.8	H2 = 29	T = H2 = 29	479.00	21.00	-0.10
3	A3 = 69.7	A3 - A2 = -32.0	H3 = 450	T = H3 = 450	450.00	21.00	-1.52
					Section 3: Sub-Total	5.27	-1.70
					Total	3.57	



# ENCLOSURE 2 CALCULATION SHEET

Page 26

PROJECT SONGS 243 JOB NO. 18740-228 CALC. NO. E4G-017

SUBJECT 125 VOLT BATTERY D. C. SYSTEM SIZING SHEET NO. 153

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
①	<i>225-ville</i>	8/12/89	<i>Druffler</i>	8/17/89	△				
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Random Load Only (if needed) (occurring after first 30 min.)						
R	AR * 60.0	AR · D * 60.0	MR * 1.00	T * MR * 1.00	112.00	0.54
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Max. Sect. Size	*	Random Sect. * Size	*	Uncorrected Size		
3.57		0.54		4.11 (Pos. Plates)		
Uncorrected Size	X	Age Correction Factor	X	Temperature factor	*	Needed Size
4.11		1.25		1.11		5.70 (Pos. Plates)
Available Size	-	Needed Size	) /	Available Size	X 100 X	* % Margin Capacity
8		5.70		8		28.79

\* Random section size is added since maximum section size is after 30 minutes.  
 \*\* For load profile see Page 143, for OH-17 S curves see Page 132

Enclosure 3