FORD 1

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SUBJECT: Forwards answers to NRC 910321 station blackout questions.

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April 22, 1991

United States Nuclear Regulatory Commission
Document Control Desk
Attn: Mr. Allen R. Johnson
Project Directorate I-3
Washington, DC 20555

Subject: 10 CFR §50.63, *Loss Of All Alternating Current Power*
R. E. Ginna Nuclear Power Plant
Docket Number 50-244

References: R. C. Mecredy (RG&E) to T. E. Murley (NRC), April 17, 1989
R. C. Mecredy (RG&E) to T. E. Murley (NRC), July 10, 1990

Dear Mr. Johnson,

On March 21, 1991, Rochester Gas & Electric Corporation received a telefax transmitting eight questions pertaining to our above referenced submittals concerning 10 CFR §50.63, *Loss Of All Alternating Current Power*. Answers to these questions are attached.

Very truly yours,

Robert C. Mecredy

Robert C. Mecredy

xc: Mr. Allen R. Johnson (Mail Stop 14D1)
Project Directorate I-3
United States Nuclear Regulatory Commission
Washington, DC 20555

Ginna Senior Resident Inspector

#P249075080

1. Target Emergency Diesel Generator (EDG) Reliability

Provide a verification that the EDG target reliability of 0.975 will be maintained.

Response: As stated in our station blackout responses of April 17, 1989, and July 10, 1990, RG&E has selected a target EDG reliability of 0.975. Established maintenance and testing practices have resulted in a calculated EDG reliability that has consistently exceeded this target value. RG&E is committed to continuing these highly successful practices, and to meeting or exceeding the targeted EDG reliability of 0.975. RG&E plans to implement Nuclear Utility Management and Resources Council (NUMARC) Station Blackout Initiative 5A as soon as NRC Generic Issue B-56 is resolved.

2. Condensate Inventory

a. The submittal states that the reactor will be cooled down. Please indicate the degree of cooldown and depressurization required and the amount of condensate needed to accomplish the cooldown.

   Response: Required condensate was calculated per NUMARC 87-00, Section 7.2.1. This calculation assumed a 50°F per hour cooldown, utilizing both atmospheric relief valves. Calculations have shown that this degree of cooldown would require 4.32×10^4 gallons of water; therefore, the total amount of condensate required, per the NUMARC 87-00 equation, is 76,823 gallons.

b. Verify that the three alternate sources of water for decay heat removal are available for use under SBO conditions. Is a transfer pump necessary to utilize the 110,000 gallon outside storage tank? Do these sources provide adequate NPSH for the turbine driven auxiliary feedwater pump?

   Response: The outside condensate storage tank, the fire water system, and the city water system are available as alternate water sources under station blackout conditions, per procedure ER-AFW.1, *Alternate Water Supply To The AFW Pumps.* Transfer pumps are not necessary to fill the condensate storage tanks from the outside condensate storage tank; this has been confirmed by testing. Tests have shown that all of these sources can be used to fill the condensate storage tank at rates sufficient to remove decay heat from the reactor coolant system. Since the alternate sources of water are all used to refill the normal water supply (i.e., the CST), adequate NPSH is assured.

c. The turbine driven auxiliary feedwater pump has a lube oil cooler cooled by service water. In your submittal of July 10, 1990, you indicated that you intended to study the use of fire water as a backup for the service water. You also indicated that the evaluation would be completed by September 1, 1990. What were the results of the evaluation? Is a test still planned to be completed by June 1, 1991? If fire water was determined not to be viable, what alternative plans have been made for the lube oil cooler water?

Response: The diesel driven fire water pump was evaluated per the criteria of NUMARC 87-00, Appendix B, and was found to be acceptable for use during station blackout scenarios. RG&E is planning to conduct a test by July 1, 1991, to verify the time required to establish a lineup that will allow directing fire water to the turbine driven auxiliary feedwater pump oil cooler and bearings. RG&E has previously shown by testing that the turbine driven auxiliary feedwater pump can run for at least two hours without any service water cooling to its bearings and oil cooler, and that the fire water system can deliver substantial flow to the service water system piping.

3. **Class 1E Battery Capacity**

Provide the battery loads and the battery capacity calculation which was performed to verify that the installed Class 1E batteries have sufficient capacity to provide power for all connected loads during a four hour SBO event.

Response: The requested information and analyses are included in Attachment 1. As noted on the cover memo, several of the larger DC loads on the station batteries are being removed during the refueling outage that is now underway. Therefore, the attached analyses are conservative.

4. **Compressed Air**

a. Is the backup nitrogen supply to the atmospheric steam dump valves (ADVs) sufficient to support ADV operation for four hours during an SBO event?

Response: The backup nitrogen supply consists of six nitrogen bottles for each of the atmospheric relief valves. This backup system was sized to provide eight hours supply of nitrogen to the atmospheric relief valves following a loss of all power.

b. Provide the results of your evaluation of the area of the ADVs during manual operation.

Response: A calculation utilizing NUMARC 87-00 methodology was completed for the atmospheric relief valve area in the Intermediate Building. A copy of this calculation is included in Attachment 2.

5. **Loss Of Ventilation**

a. Describe the analyses that were done to verify that the control room temperature does not reach 120°F during a four hour SBO event. Provide the initial conditions assumed, heat sources and sinks, and assumptions utilized.

Response: A copy of the control room heatup analysis is included in Attachment 3.

b. Was NUMARC 87-00 methodology utilized in calculating the steady state temperature of the steam driven AFW pump room? If not, describe the methodology used.

Response: NUMARC 87-00 methodology was used to calculate the steady state temperature of the turbine driven auxiliary feedwater pump area. A copy of this calculation is included in Attachment 4.

6. **Containment Isolation**

Provide a list of the containment isolation valves of concern. Containment isolation valves of concern are those valves which can not be excluded by the criteria given in RG 1.155 or NUMARC 87-00. An example of such a valve would be a normally closed valve (not locked closed) that fails "as is." Provide the actions to be taken for each valve to effect containment isolation during an SBO and verification that these actions are contained in plant procedures.

Response: A list of all containment isolation valves, along with the NUMARC 87-00 criteria used to exclude them, is included in Attachment 5.

7. **Reactor Coolant Inventory**

a. Describe the method used to assess reactor coolant system inventory for four hours following onset of a SBO.

Response: A simulation using the TREAT code was run for the projected station blackout scenario. A summary of this simulation and a selection of plots from the simulation results is included in Attachment 6. The station blackout transient was also evaluated with MAAP 3.0B Revision 17; similar results were obtained.

b. What primary system RCP leak rate was assumed?

Response: The TREAT simulation assumed a loss of 25 gpm per reactor coolant pump seal, per NUMARC 87-00, and an additional 11 gpm loss, per the maximum losses allowed in the Ginna Technical Specifications. This resulted in a total loss of 61 gpm at time zero.

c. What are the conditions of the reactor coolant system at the end of the SBO event?

Response: Per Question 7a, above, selected plots from the TREAT output are attached.

8. **Quality Assurance**

List SBO response equipment and identify the QA program associated with the equipment.

Response: A list of the equipment required to respond to a station blackout is included in Attachment 7. This list identifies the QA classification of each of these components. Of the items classified as, "Not Nuclear Safety," Bus 15 and Bus 15, Unit 3A are used to power a charging pump from the Technical Support Center diesel generator. The TREAT analysis of station blackout has shown that this pump is not required to maintain natural circulation flow in the reactor coolant system during a four hour station blackout; therefore, this equipment is not required to operate. The outside condensate storage tank and the series of manual valves used to route water from the outside CST to the main condensate storage tanks are also classified as, "Not Nuclear Safety." Since this is one of three possible methods of getting water to the condensate storage tanks during a station blackout, and the other two sets of equipment are already used for Appendix R, RG&E does not believe that reclassifying the outside CST and the manual valves is necessary.

Design Analysis

Ginna Station

Sizing of Vital Batteries

Rochester Gas and Electric Corporation

89 East Avenue

Rochester, New York 14649

EWR 3341

Prepared by:	George W Daniels	3-9-90 DATE
Reviewed by:	Kenneth F. [illegible]	3/9/90 DATE
Approved by:	Charles A. [illegible] Jr.	3·12·90 DATE

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Revision Status Sheet

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1.0 <u>Objective</u>

1.1 The objective of this analysis is to provide a basis for the capacity of Ginna Station vital batteries, designated 1A and 1B. This analysis replaces the previous basis document (analyses), "Class 1E Battery Testing Program", EWR 3341, Rev. 1, dated 9/9/85. It is based on IEEE Standard 485-1983, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations". This standard utilizes the sizing method developed by E.A. Hoxie, Reference 3.4. Due to the treatment of momentary loads, the method is considered very conservative.

1.2 This analyses will provide the basis for ongoing battery load tracking. Electrical Engineering project review practice will assure that this analysis, including the duty cycles and supporting tables, and the sizing worksheets, are revised when accumulated load changes become significant with respect to battery capacity margin.

1.3 This analysis will establish a basis for the Battery Service Test. The battery duty cycle as tabulated below will be the basis for the test load profile. The Service Test load profile should envelope the duty cycle with the exception of momentary loads. Momentary loads are all assumed to continue for one minute in the duty cycle without regard to actual duration, which may be a fraction of a second. This is a conservative assumption appropriate to sizing batteries (Hoxie method), however a more realistic simulation of momentary loads may be used for the Service Test.

1.4 This analysis will establish a basis for battery capacity consistent with the blackout duration (4 hours) determined appropriate for Ginna Station pursuant to 10CFR50.63, "Station Blackout". This requirement is described in Reference 3.7.

2.0 <u>Design Inputs</u>

2.1 IEEE Standard 485-1983, Sizing Large Lead Storage Batteries for Generating Stations and Substations.

2.2 RG&E Dwg. No. 33013-756, Sh. 1.

2.3 RG&E Dwg. No. 33013-756, Sh. 2.

2.4 RG&E Dwg. No. 10905-236

2.5 RG&E Dwg. No. 10905-237

2.6 RG&E Dwg. No. 10905-238

2.7 RG&E Dwg. No. 10905-239

2.8 RG&E Dwg. No. 21945-357

3.0 Referenced Documents

3.1 IEEE Standard 485-1983, Sizing Large Lead Storage Batteries for Generating Stations and Substations.

3.2 Letter from Dennis L. Ziemann, USNRC, to Leon D. White Jr. RG&E, dated 4/18/79, topic VIII-3.A Station Battery Test Requirement.

3.3 Letter from Dennis M. Crutchfield, USNRC, to John E. Maier, RG&E, dated 7/31/81, Safety Evaluation for SEP Topic VIII-3.A, Station Battery Capacity Test Requirements (Ginna).

3.4 E.A. Hoxie, "Some Discharge Characteristics of Lead-Acid Batteries", AIEE Transactions (Applications and Industry), vol. 73, pp 17-22, 1954.

3.5 Handbook of Modern Electronics and Electrical Engineering.

3.6 GNB Battery Specification Sheets, Switchgear and General Industrial Power Cells, Type NAX and NCX, Capacities 600 A. H. to 2550 A. H.

3.7 Letter to T.E. Murley, NRC, from R.C. Mecredy, RG&E, 10CFR50.63, Station Blackout, R.E. Ginna Nuclear Power Plant, dated April 17, 1989.

3.8 Letter form R.L. Steele, Westinghouse, to C.E. Platt, RG&E, dated 4/19/71, Station Battery Test.

4.0 Assumptions

4.1 It is assumed that the inventory of d.c. loads contained in this analysis is complete. This assumption is supported by a review of battery charger currents taken during surveillance inspections, performed over the past year, which indicated currents between 100 and 108 amps. This is in good agreement with the analysis data.

4.2 For the purpose of sizing the battery it is assumed that all a.c. power sources are lost for a period of two hours, after which time the diesel generators become available and those circuit breakers required to energize the a.c. system from the diesels are closed. This assumption (2hrs) is based on requirements stated in Reference 3.3. It will be shown that this time can be extended to four hours without changing the cell sizing requirement.

4.3 It is assumed that five percent (20) of the approximately 400 d.c. solenoid valves are energized from each battery at any time, and that each solenoid draws 0.25 amps. After accounting for all other loads, this assumption provides good agreement with the observed battery charger loads.

4.4 The large d.c. continuous duty motor loads are designed with current limiting resistor networks to limit starting inrush current. The inrush current for the turbine d.c. lube oil pump has been measured at 625 amps, which is 1.72 times the running current. It will be assumed that starting inrush current for the other large d.c. continuous duty motors (for which there is no data) is 2 times running current. This assumption is based on standard design practice for d.c. motors which limits starting inrush current to 2 x running current due to commutation limitations (see p. 3252 of Reference 3.5). It should be noted that motor operated valve motors do not have current limiting resistors to limit inrush current. MOV inrush currents have been measured during the MOVATS testing program and the analysis data was taken from this source.

5.0 <u>Computer Codes</u>

The capacity factors, K, utilized in the Cell Sizing Worksheet are calculated using a least squares polynominal curve routine. This software is documented in Appendix 2.

6.0 <u>Analysis</u>

6.1 Battery Duty Cycle

6.1.1 The loads representing the battery duty cycles are shown in Figures A1 and B1. Individual loads are shown on Tables A1 and B1. The loads are further broken down in Tables A2 and B2, Motor Loads, Tables A3 and B3, D.C. special Loads, and Tables A4 and B4, D.C. Miscellaneous Loads.

6.1.2 Circuit breaker tripping is described in Appendix 1 and an inventory of tripping loads is provided.

6.2 Cell Sizing Calculation

6.2.1 Cell sizing is performed using the cell sizing work sheet from IEEE Std. 485. These work sheets are designated Table A5 and B5 for the A and B battery respectively.

6.2.2 The load data for entry on the work sheet is obtained from the battery duty cycle, Figures A1 and B1.

6.2.3 The battery data is obtain from the GNB Battery Specification Sheets, Reference 3.6.

6.2.4 The capacity rating factor, K_T, is calculated as the ratio of the battery ampere-hour capacity (1200 A.H.) to the discharge rate to 1.75 VPC at 25°C appropriate for the time interval T as given in the sizing worksheet.

6.2.5 The temperature correction factor is 1.02. This is based on Table 1 of IEEE Std. 485-1983 and the design of the temperature control system for the battery rooms which is set to maintain temperature at 75°F (23.9°C) ± 2°F.

6.2.6 The design margin is entered as 1.0, since the battery is already installed. After completing the sizing calculation the existing margin is determined.

6.2.7 For the "A" battery an aging factor of 1.25 is used to allow for the degradation in battery capacity permissible at end of the 20 year design life. It should be noted that battery discharge tests performed in 1987 did not indicate any capacity degradation and since this battery is relatively new, the aging allowance can at this time be considered an additional capacity margin. This analysis should be revised to account for the results of the future discharge tests.

6.2.8 For the "B" battery an aging factor of 1.10 is used since the loading does not permit the standard 1.25. This will reduce the design life of the battery by approximately one half until the duty cycle is adjusted to decrease the load during the first minute of discharge. Since the battery showns no indication of capacity degradation at this time it is fully capable of performing its safety function. However, a plan to reduce the d.c. loads by transfering non-class 1E loads, such as the circulating water valve MOVs, to the TSC battery should be established. This would provide for the full design life and provide margin for uncertainty and additional loads.

7.0 Results

7.1 The cell sizing calculations documented in the worksheets show that battery cell size is sufficient for it to perform its design safety function.

7.2 If the duration of loss of all A.C. power is extended from two to four hours the duration of the appropriate

period is increased by two hours. Review of the sizing work sheet shows that the existing battery cell size is still adequate as shown on cell sizing worksheets, Tables A5A and B5A. The battery, therefore, meets requirements established in 10CFR50.63, "Station Blackout".

7.3 The "B" battery is currently limited in design life due to loading. Modifications to this system should be planned.

7.4 Consideration should be given to removing large non-Class 1E loads from both vital batteries and placing them on the TSC battery.

7.5 Electrical engineering design review practice should specifically address d.c. load tracking to assure that no significant loads are added without revision of this analysis.

7.6 The limiting loads are the turbine d.c. lube oil pump on "A" battery and the circulating water discharge valve operators on "B" battery. These loads have been present since plant start up. The original 1050 A-H batteries would not have had adequate capacity using the current conservative criteria of this analysis.

7.7 The TSC battery was significantly oversized in order to serve as an emergency backup for either vital battery. Loss of all A.C. procedures, ECA-0.0, call for use of the TSC backup in the event of d.c. voltage falling below 105V (1.75 VPC). This feature of the Ginna D.C. system provides additional margin for emergencies exceeding the plant design bases.

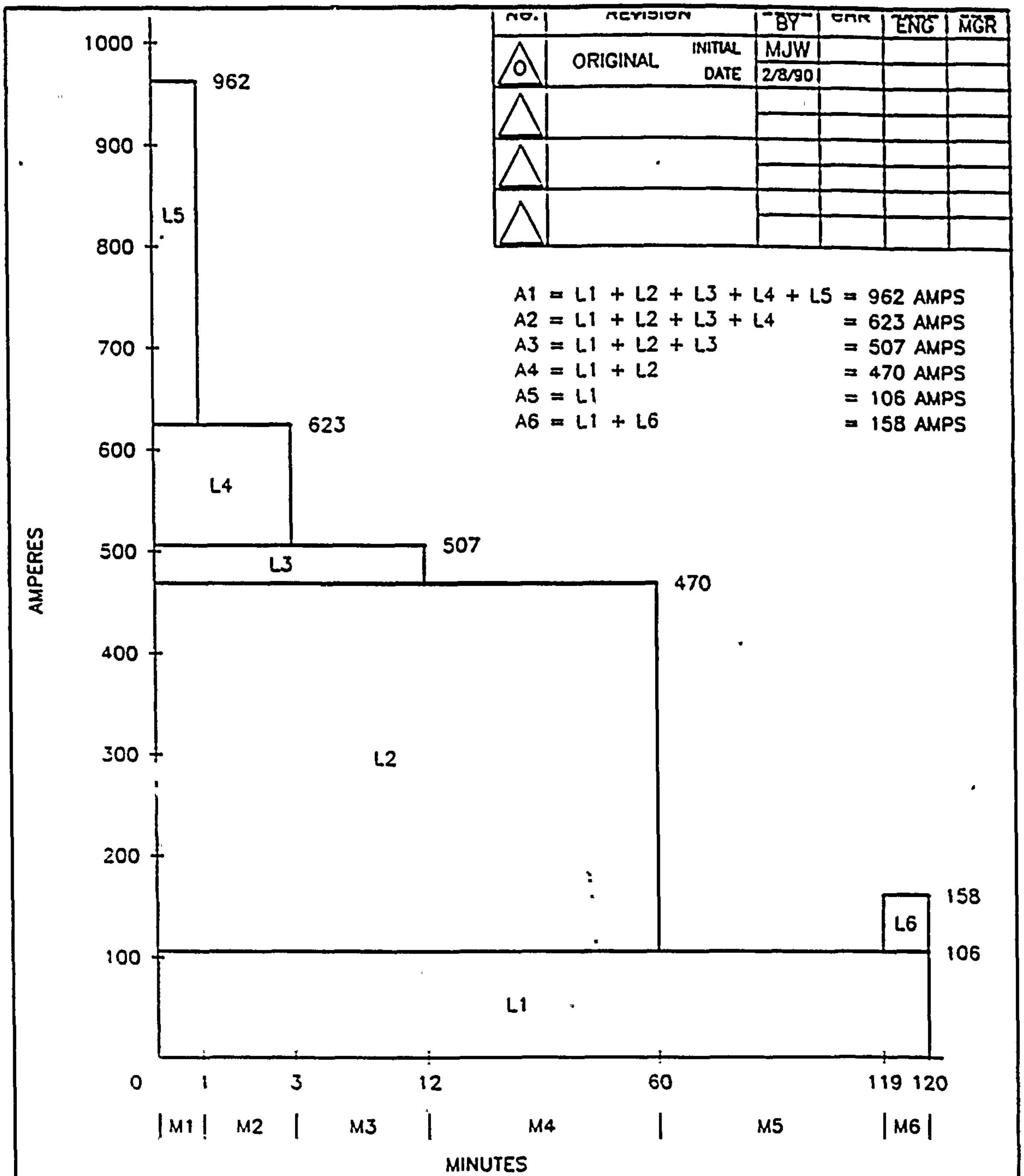

FIGURE A1

"A" BATTERY DUTY CYCLE

Table A1

"A" Battery Duty Cycle for Loss of all A.C.

Battery Train Designation A

Load number	description	Amps @ 120VDC/105VDC	duration
L_1	inverter 1A	50/57	2 hr (4 hr)*
	miscellaneous	55/44	2 hr (4 hr)*
		105/106	
L_2	turbine d.c. lube oil pmp. (running current)	364/na	1 hr
L_3	feedwater pmp. d.c. l.o. pump (running current)	37/na	12 min
L_4	MOV operation (3505A, Table A2)	9/na	3 min
	breaker tripping	107/na	1 min
		116/na	
L_5	motor inrush (above running current)		1 min
	MOVS (3505A)	41/na	
	turbine l.o pump	261/na	
	f.w. pmp. d.c. l.o pmp.	37/na	
		339/na	
L_6	d.g. field flash	17.2/15	1 min (end od 2hr period)
	breaker closing	52/52 "worst case"	

* 4 hr duration for compliance with Station Blackout commitment

Table A2

D.C. Motor Loads on "A" Battery during Loss of All A.C.

motor	running current (Amps)	inrush current (Amps)
Turbine D.C. l.o. pump	364	625 (measured)
Feedwater 1A d.c. l.o. pump	37	74 (est)
MOVs(*) 3505A, Turbine driven aux. feed pmp. stm adm. vlv.	9	50 (measured)
	410	749

* The D.C. motor operated valves are shown on RG&E drawing 10905-254. Of these valves only 3505A, 3504A, and 3996 will be required to operate on loss of all A.C. 3505A is powered from battery "A", the other valves are powered from battery "B". The current data is based on MOVATS test records.

Table A3

D.C. "Special" Loads on "A" Battery During Loss of All A.C.

	Amps	Remarks
Inverter 1A (Main DC Dist. Pnl.)	50	This is the measured load during normal full power operation. All inverter loads remain after loss of A.C.
Field flashing current for the diesel generator	17.2	The field excitation circuit is shown on RG&E drawing 33013-1737 Sh. 2. This is actually the drawing for the "B: diesel but the excitation circuits are identical for both diesels. Since the field flashing current must drop to zero before diesel generator breaker closure can occur, only the "worst case" current for either field flashing or breaker closure is used for the final one minute of the duty cycle. The "worst case" is the closing current for the DB 75 (Bus 14) and the DB 50 (Bus 18) which total 52 amps.

Table A3 (Cont)

	Amps	Remarks
Control Board (Control Bd Panel 1A) Alarm System (Annunciators)	5.0	The annunciator panels can draw 20 amps if all windows in all panels are illuminated. Normally only a few windows are energized, however on loss of all a.c. it will be assumed that 1/4 of the windows are lit.
Diverse C.I. Rack (Control Bd. Panel 1A)	4.0	It will be assumed that containment isolation does not occur concurrent with loss of all A.C. However the relays are normally energized so that the relay load will always be present.
Solenoid Valves (Various Panels)	5.0	There are approximately 400 solenoid valves. It is estimated that at any time 20 (5% of these are energized from "A" battery and each draw 0.25 amp. This estimate is based on reconciling battery charger current with other known loads.

Table A4

C. Miscellaneous Loads on "A" Battery During Loss of All A.C.

	indicator lgts. (amps)	relays (amps)	brkr (trip/close) (amps)	other
-Main Fuse Cabinet	0	0	0	0
Main D.C. Distribution Panel 1A	5.1			
P.A. sys. inverter				10
Battery Rm. vent				7.7
Control Board Panel 1A	2.0			
MQ-483 inverter				5.2
Diverse C.I. rack		4 (See Special Loads)		
Control Bd. Alm. Sys.	5	(See Special Loads)		
Aux. Bldg D.C. Dist. Pnl. 1A	4.4			
Aux. Bldg. D.C. Dist. Pnl. 1A1	1.2			0
Reactor trip switchgear		X		
Aux. Bldg D.C. Dist. Pnl. 1A2	0	0		0
Diesel Gen 1A Dist. Pnl.	1.25	0		0
Screenhouse D.C. Dist. Pnl. 1A	1.8			
Various Panels				
Solenoid Valves. (See Special Loads)				5
Subtotal	20.7	4	2	27.9
			Total	55

Project. [illegible] Station V[illegible] Batt. 1A Date. 2/9/90 Page: 1 of 1

Lowest Expected Electrolyte Temp °F 73 Minimum Cell Voltage 1.75 Cell Mfg: GNB Cell Type. NAX 1200 Sized By. GHD

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) × (6B) = Rated Amp Hrs — Pos Values	Neg Values
Section 1 — First Period Only — If A2 is greater than A1, go to Section 2.							
1	A1= 962	A1−0= 962	M1= 1	T=M1= 1	0.8823529	848.82	• • •
					Sec 1 Total	848.82	• • •
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1= 962	A1−0= 962	M1= 1	T=M1+M2= 3	0.9187741	883.86	
2	A2= [illegible]	A2−A1= [illegible]	M2= 2	T=M2= 2	0.[illegible]005738		−305.29
					Sec 2 Sub Tot		
					Total	578.57	• • •
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4.							
1	A1= 962	A1−0=962	M1= 1	T=M1+M2+M3=12	[illegible]379923	1038.89	
2	A2= 623	A2−A1= [illegible]	M2= 2	T=M2+M3= 11	[illegible]962346		−360.14
3	A3= 507	A3−A2=−116	M3= 9	T=M3= 9	.326912		−[illegible].12
					Sec 3 Sub Tot		
					Total	559.63	• • •
Section 4 — First Four Periods Only — If A5 is greater than A4, go to Section 5.							
1	A1= 962	A1−0= 962	M1= 1	T=M1+ M4= 60	2.0	1924.0	
2	A2= 623	A2−A1=−339	M2= 2	T=M2+M3+M4=[illegible]	[illegible]		−[illegible]
3	A3= 507	A3−A2=−116	M3= 9	T=M3+M4= 57	[illegible]		−222.44
4	A4= 470	A4−A3=−37	M4= 48	T=M4= 48	[illegible]		−[illegible].45
					Sec 4 Sub Tot		
					Total	968.62	• • •
Section 5 — First Five Periods Only — If A6 is greater than A5, go to Section 6.							
1	A1= 962	A1−0= 962	M1= 1	T=M1+ M5= 119	2.971795		
2	A2= 623	A2−A1=−339	M2= 2	T=M2+ M5= 118	2.001115		
3	A3= 507	A3−A2=−116	M3= 9	T=M3+M4+M5=116	2.955272		
4	A4= 470	A4−A3=−37	M4= 48	T=M4+M5= 107	[illegible]200265		
5	A5= 136	A5−A4=−334	M5= 59	T=M5= 59	[illegible]373832		
					Sec 5 Sub Tot		
					Total		• • •
Section 6 — First Six Periods Only — If A7 is greater than A6, go to Section 7.							
1	A1= 962	A1−0= 962	M1= 1	T=M1+...M6=120	2.941177	2829.41	
2	A2= 623	A2−A1=−339	M2= 2	T=M2+...M6=119	2.971795		−1007.44
3	A3= 507	A3−A2=−116	M3= 9	T=M3+ M6=117	[illegible]		−[illegible]
4	A4= 470	A4−A3=−37	M4= 48	T=M4+M5+M6=108	2.193424		−[illegible]
5	A5= 136	A5−A4=−334	M5= 59	T=M5+M6=60	2.0		−[illegible]
6	A6= [illegible]	A6−A5= 52	M6= 1	T=M6= 1	[illegible]	45.88	
					Sec 6 Sub Tot		
					Total	670.331	• • •
Section 7 — First Seven Periods Only — If A8 is greater than A7, go to Section 8.							
1	A1=	A1−0=	M1=	T=M1+ M7=			
2	A2=	A2−A1=	M2=	T=M2+ M7=			
3	A3=	A3−A2=	M3=	T=M3+ M7=			
4	A4=	A4−A3=	M4=	T=M4+ M7=			
5	A5=	A5−A4=	M5=	T=M5+M6+M7=			
6	A6=	A6−A5=	M6=	T=M6+M7=			
7	A7=	A7−A6=	M7=	T=M7=			
					Sec 7 Sub Tot		
					Total		• • •
Random Equipment Load Only (if needed)							
R	AR=	AR−0=	MR=	T=MR=			• • •

Maximum Section Size (8) 469 + Random Section Size (9) 0 = Uncorrected Size (US) (10) 469
US (11) 469 × Temp Corr (12) 1.02 × Design Marg (13) 1.0 × Aging Factor (14) 1.25 = (15) 1196
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 1196 (A) — Positive Plates.
(B) — Ampere Hours. Therefore cell (17) 1200 is required.

Cell Sizing Work Sheet
Table A5

Project. [illegible] Sta. Vital Batt (A) (Station Blackout) Date. 3/9/90 Page: 1 of 1

Lowest Expected Electrolyte Temp F 73 Minimum Cell Voltage 1.75 Cell Mfg: GNB Cell Type. NAX 1200 Sized By. GWD

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) x (6B) = Rated Amp Hrs — Pos Values	Neg Values
Section 1 — First Period Only — If A2 is greater than A1, go to Section 2.							
1	A1=	A1—0=	M1=	T=M1=			***
					Sec 1 Total		***
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1=	A1—0=	M1=	T=M1+M2=			
2	A2=	A2—A1=	M2=	T=M2=			
					Sec 2 Sub Tot		
					Total		***
Section 3 — First Three Periods Only — 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 3 Sub Tot		
					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 4 Sub Tot		
					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 5 Sub Tot		
					Total		***
Section 6 — First Six Periods Only — If A7 is greater than A6, go to Section 7.							
1	A1= 662	A1—0= 662	M1= 1	T=M1+...M6= 240	[illegible]	4544.49	
2	A2= 623	A2—A1= [illegible]	M2= 2	T=M2+...M6= 239	[illegible]		-1535.33
3	A3= [illegible]	A3—A2= -116	M3= 4	T=M3+...M6= 237	[illegible]		-541.54
4	A4= [illegible]	A4—A3= [illegible]	M4= [illegible]	T=M4+M5+M6= [illegible]	[illegible]		[illegible]
5	A5= [illegible]	A5—A4= [illegible]	M5= [illegible]	T=M5+M6= [illegible]	[illegible]		-1399.94
6	A6= [illegible]	A6—A5= [illegible]	M6=	T=M6=	[illegible]	[illegible]	
					Sec 6 Sub Tot	[illegible]	[illegible]
					Total	936.09	***
Section 7 — First Seven Periods Only — If A8 is greater than A7, go to Section 8.							
1	A1=	A1—0=	M1=	T=M1+ M7=			
2	A2=	A2—A1=	M2=	T=M2+ M7=			
3	A3=	A3—A2=	M3=	T=M3+ M7=			
4	A4=	A4—A3=	M4=	T=M4+ M7=			
5	A5=	A5—A4=	M5=	T=M5+M6+M7=			
6	A6=	A6—A5=	M6=	T=M6+M7=			
7	A7=	A7—A6=	M7=	T=M7=			
					Sec 7 Sub Tot		
					Total		***
Random Equipment Load Only (if needed)							
R	AR=	AR—0=	MR=	T=MR=			***

Maximum Section Size (8) ______ + Random Section Size (9) ______ = Uncorrected Size — (US) (10) ______
US (11) ______ × Temp Corr (12) ______ × Design Marg (13) 1.__ × Aging Factor (14) 1.__ = (15) ______
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) ______ (A) — Positive Plates.
(B) — Ampere Hours. Therefore cell (17) ______ is required.

Cell Sizing Worksheet
Table A5A

Figure B1

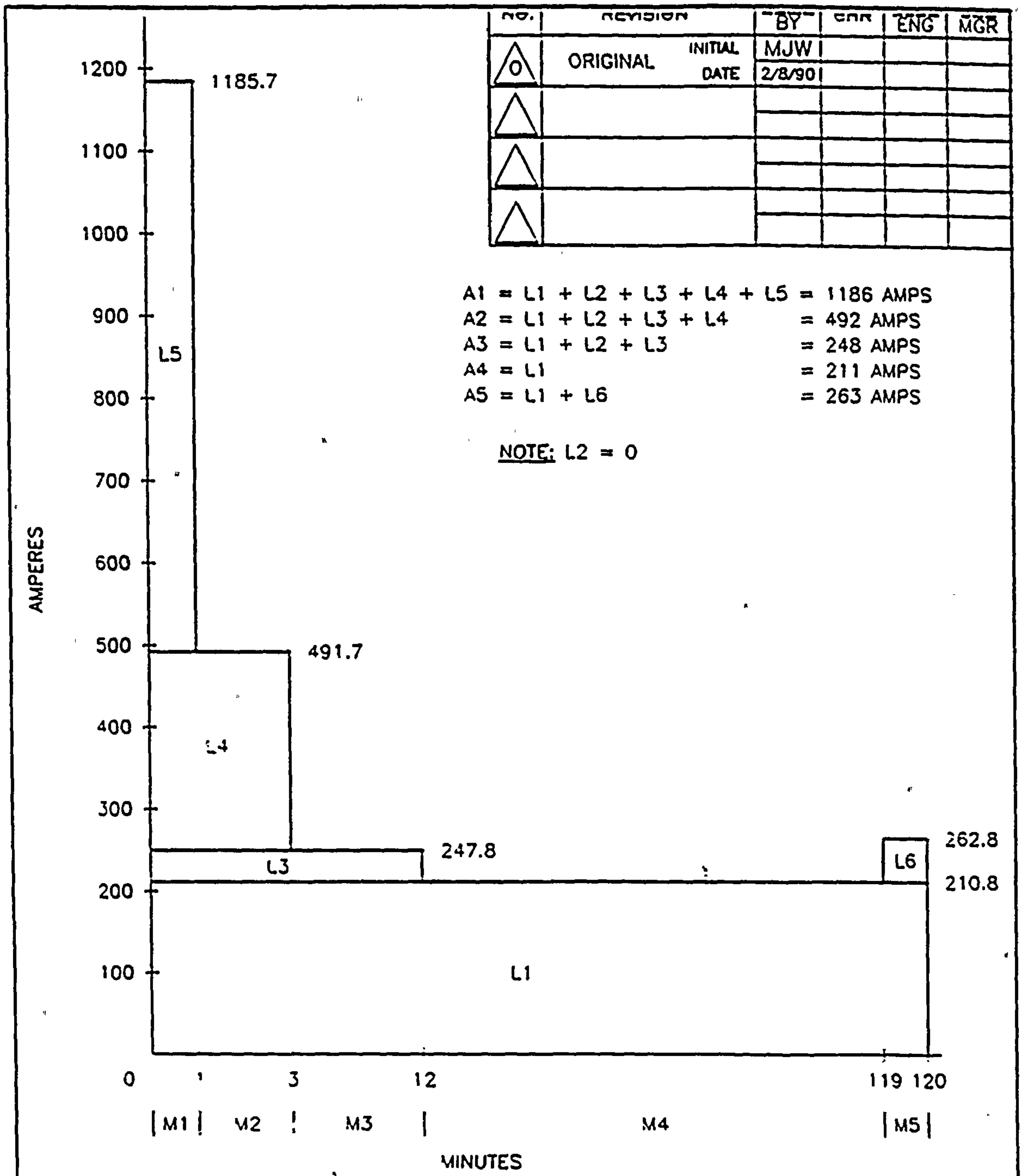

FIGURE B1

"B" BATTERY DUTY CYCLE

Table B1

"B" Battery Duty Cycle for Loss of all A.C.

Battery Train Designation B

Load number	description	Amps @ 120VDC/105VDC	duration
L_1	inverter 1B	50.0/57	2 hr (4 hr)*
	miscellaneous	64.8/56.7	2 hr (4 hr)
	air side seal oil back up pump	73.0/63.9	2 hr (4 hr)
	turb. driven aux feed pmp. d.c. l.o. pmp.	23.0/20.1	2 hr (4 hr)
		210.8/197.7	
L_2	none	0	1 hr.
L_3	feedwater pmp. d.c. l.o. pump	37.0/na	12 min
L_4	MOV operation (3504A, Table B2)	136.9/na	3 min
	breaker tripping	107.0/na	
		~~123.9~~/na 243	
L_5	motor inrush (above running current)		1 min
	MOVS (3504A, 3996)	71/na	
	Air Side Seal Oil B.U. Pump	73/na	
	f.w. pump. d.c. l.o pmp.	37/na	
	T.D. aux f.w. pmp. d.c l.o. pmp.	23/na	
	circ. pmp. disch. vlvs.	490/na	
		694/na	
L_6	d.g. field flash	17.2/15	1 min
	breaker closing	52/52 "worst case"	(end of 2hr period)

* 4 hour duration for compliance with Station Blackout commitment.

Table B2

D.C. Motor Loads on "B" Battery during Loss of All A.C.

motor	running current (Amps)	inrush current (Amps)
Air Side Seal Oil Back Up Pump	73	146 (est)
Feedwater 1A d.c. l.o. pump	37	74 (est)
Turbine Driven Aux Feedwater	23	46 (est)
MOVs(*)		
3504A, Turbine driven aux. feed pmp. stm adm. vlv.	9	50 (measured)
3996, Turbine driven aux. feed pmp. disc. vlv	7.9	37.9 (measured)
3150, 3151, Circulating water pump disch. vlvs. (See Special Loads)	120	610 (est)
	270	964

Table B3

D.C. "Special" Loads on "B" Battery During Loss of All A.C.

	Amps	Remarks
Inverter 1B (Main DC Dist. Pnl.)	50	Same as in 1A
Field flashing current for the diesel generator	17.2	Same as in 1A
Control Board Alarm System (annunciators) (Control Bd Panel 1B)	5.0	Same as in 1A
Diverse C.I. Rack (Control Bd. Panel 1A)	4.0	Same as in 1A
Solenoid Valves (Various Panels)	5.0	Same as in A
Circulating water pump disch. vlv. motor operators	120.0 (running)	Both circulating water pump disch. valve motor operators are supplied from this battery. These are 6.6HP motors. There is currently no data on inrush current. It is therefore estimated as 5x running current.

Table B4

D.C. Miscellaneous Loads on "B" Battery During Loss of All A.C.

	indicator lgts. (amps)	relays (amps)	brkr (trip/close) (amps)	other
-Main Fuse Cabinet	0	0	0	0
Main D.C. Distribution Panel 1B	0.8			
Cont. rm. emerg. lgts.				5.8
Control Board Panel 1B	2.0			
Steam dump vlvs/ TDAFWP gov. ind.	1.31	0.4		
Vent sys. rad. mon.	0.23			
Cont. bd. alarm sys.	5.0 (See Special Loads)			
Diverse C.I. rack	(See Special Loads)	4.0		
Cont. bd annunciator (AVT, SAFW)	1.13			
Aux. Bldg D.C. Dist. Pnl. 1B	4.2			
Aux. Bldg. D.C. Dist. Pnl. 1B1	1.2			0
Reactor trip switchgear			(Trip) 2	
Diesel Gen 1B Dist. Pnl.	1.25	0		0
Screenhouse D.C. Dist. Pnl. 1B	1.0			
Turb. Bldg D.C Dist Pnl	3.5			
Various Panels				
Solenoid Valves. (See Special Loads)				5
Unknown miscellaneous loads				26.4

Battery charger load data from surveillance inspections indicated a total d.c. load of 109 amp. The unknown load added to the known loads (without d.c control room lights).

Subtotal	21.6	4	2	37.2
			Total	64.8

Project. Ginna Station Vital Batt 1B   Date. 2/7/90   Page: 1 of 1

Lowest Expected Electrolyte Temp °F 73   Minimum Cell Voltage 1.75   Cell Mfr: GNB   Cell Type. NAX 1200   Sized By GWD

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) × (6B) = Rated Amp Hrs — Pos Values	Neg Values
Section 1 — First Period Only — If A2 is greater than A1, go to Section 2.							
1	A1= 1196	A1—0= 1196	M1= 1	T=M1= 1	0.8823529	1046.47	• • •
					Sec 1 Total	1046.47	• • •
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1= 1196	A1—0= 1196	M1= 1	T=M1+M2= 3	0.9187741	1099.67	
2	A2= 492	A2—A1= -694	M2= 2	T=M2= 2	0.4005738		-625.00
					Sec 2 Sub Tot		
					Total	464.67	• • •
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4.							
1	A1= 1196	A1—0= 1196	M1= 1	T=M1+M2+M3= 12	[illegible]579923	1290.79	
2	A2= 492	A2—A1= -694	M2= 2	T=M2+M3= 11	[illegible]563346		-747.[illegible]
3	A3= 248	A3—A2= -244	M3= 4	T=M3= 4	[illegible]5269[illegible]2		-250.57
					Sec 3 Sub Tot		
					Total	292.75	• • •
Section 4 — First Four Periods Only — If A5 is greater than A4, go to Section 5.							
1	A1= 1196	A1—0=	M1=	T=M1+ M4=			
2	A2= 492	A2—A1=	M2=	T=M2+M3+M4=			
3	A3= 248	A3—A2=	M3=	T=M3+M4=			
4	A4= [illegible]	A4—A3=	M4=	T=M4=			
					Sec 4 Sub Tot		
					Total		• • •
Section 5 — First Five Periods Only — If A6 is greater than A5, go to Section 6.							
1	A1= 1196	A1—0= 1196	M1=	T=M1+ M5= 120	2.941177	3488.24	
2	A2= 492	A2—A1= -694	M2= 2	T=M2+ M5= 119	2.971795		-2062.43
3	A3= 248	A3—A2= -244	M3= 4	T=M3+M4+M5= 117	3.023939		-739.07
4	A4= 211	A4—A3= -37	M4= 101	T=M4+M5= 105	3.193429		-118.16
5	A5= 263	A5—A4= 52	M5=	T=M5=	0.8823529	232.06	
					Sec 5 Sub Tot	3720.30	-2919.66
					Total	800.64	• • •
Section 6 — First Six Periods Only — If A7 is greater than A6, go to Section 7.							
1	A1=	A1—0=	M1=	T=M1+ M6=			
2	A2=	A2—A1=	M2=	T=M2+ M6=			
3	A3=	A3—A2=	M3=	T=M3+ M6=			
4	A4=	A4—A3=	M4=	T=M4+M5+M6=			
5	A5=	A5—A4=	M5=	T=M5+M6=			
6	A6=	A6—A5=	M6=	T=M6=			
					Sec 6 Sub Tot		
					Total		• • •
Section 7 — First Seven Periods Only — If A8 is greater than A7, go to Section 8.							
1	A1=	A1—0=	M1=	T=M1+ M7=			
2	A2=	A2—A1=	M2=	T=M2+ M7=			
3	A3=	A3—A2=	M3=	T=M3+ M7=			
4	A4=	A4—A3=	M4=	T=M4+ M7=			
5	A5=	A5—A4=	M5=	T=M5+M6+M7=			
6	A6=	A6—A5=	M6=	T=M6+M7=			
7	A7=	A7—A6=	M7=	T=M7=			
					Sec 7 Sub Tot		
					Total		• • •
Random Equipment Load Only (if needed)							
R	AR=	AR—0=	MR=	T=MR=			• • •

Maximum Section Size (8) 1046 + Random Section Size (9) 0 = Uncorrected Size — (US) (10) 1046
US (11) 1046 × Temp Corr (12) 1.02 × Design Marg (13) 1.0 × Aging Factor (14) 1.10 = (15) 1174
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 1174 (A) — Positive Plates.
(B) — Ampere Hours. Therefore cell (17) 1200 is required.

Cell Sizing Work Sheet
Table B5

Project. [illegible] Station [illegible] ([illegible] Blackout) Date: [illegible]/90 Page: 1 of 1

Lowest Expected Electrolyte Temp °F 72 Minimum Cell Voltage 1.75 Cell Mfr: G/IB Cell Type. [illegible] AX 1200 Sized By. G.[illegible]

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) x (6B) = Rated Amp Hrs: Pos Values	Neg Values

Section 1 — First Period Only — If A2 is greater than A1, go to Section 2.

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
1	A1=	A1—0=	M1=	T=M1=			• • •
					Sec 1 Total		• • •

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

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
1	A1=	A1—0=	M1=	T=M1+M2=			
2	A2=	A2—A1=	M2=	T=M2=			
					Sec 2 Sub Tot		
					Total		• • •

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

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
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 3 Sub Tot		
					Total		• • •

Section 4 — First Four Periods Only — If A5 is greater than A4, go to Section 5.

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
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 4 Sub Tot		
					Total		• • •

Section 5 — First Five Periods Only — If A6 is greater than A5, go to Section 6.

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
1	A1=1186	A1—0=1186	M1= 1	T=M1+ M5=240	[illegible].724	5602.66	
2	A2= [illegible]	A2—A1=[illegible]	M2= [illegible]	T=M2+ M5= 239	[illegible].706		−3265.46
3	A3= 238	A3—A2=[illegible]	M3= [illegible]	T=M3+M4+M5=237	[illegible].671		−1129.72
4	A4= 211	A4—A3= [illegible]	M4= 227	T=M4+M5= 228	[illegible].518		−[illegible]
5	A5= [illegible]	A5—A4= 52	M5= [illegible]	T=M5=	[illegible].88235	[illegible]	
					Sec 5 Sub Tot	[illegible]	[illegible]
					Total	1075.69	• • •

Section 6 — First Six Periods Only — If A7 is greater than A6, go to Section 7.

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
1	A1=	A1—0=	M1=	T=M1+ ..M6=			
2	A2=	A2—A1=	M2=	T=M2+ ..M6=			
3	A3=	A3—A2=	M3=	T=M3+ . M6=			
4	A4=	A4—A3=	M4=	T=M4+M5+M6=			
5	A5=	A5—A4=	M5=	T=M5+M6=			
6	A6=	A6—A5=	M6=	T=M6=			
					Sec 6 Sub Tot		
					Total		• • •

Section 7 — First Seven Periods Only — If A8 is greater than A7, go to Section 8.

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
1	A1=	A1—0=	M1=	T=M1+ M7=			
2	A2=	A2—A1=	M2=	T=M2+ M7=			
3	A3=	A3—A2=	M3=	T=M3+ M7=			
4	A4=	A4—A3=	M4=	T=M4+ M7=			
5	A5=	A5—A4=	M5=	T=M5+M6+M7=			
6	A6=	A6—A5=	M6=	T=M6+M7=			
7	A7=	A7—A6=	M7=	T=M7=			
					Sec 7 Sub Tot		
					Total		• • •

Random Equipment Load Only (if needed)

Period	Load	Change in Load	Duration	Time to End	Capacity	Pos Values	Neg Values
R	AR=	AR—0=	MR=	T=MR=			• • •

Maximum Section Size (8) 1075 + Random Section Size (9) 0 = Uncorrected Size — (US) (10) 1075
US (11) 1075 × Temp Corr (12) 1.02 × Design Marg (13) 1.0 × Aging Factor (14) 1.09 = (15) 1125
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 1125 (A) — Positive Plates.
(B) — Ampere Hours. Therefore cell (17) 1200 is required.

Cell Sizing Work Sheet
Table B5A

ROCHESTER GAS AND ELECTRIC CORPORATION

INTEROFFICE CORRESPONDENCE

December 1, 1989

SUBJECT: Station Blackout DC Current Requirements, Breakers

TO: George Daniels

The maximum DC current requirements for breaker operation following a station blackout of Ginna Station's 4160 and 480 volt buses are as follows:

immediately

Bus	Amps	Bus	Amps
11A	0	11B	0
12A	5	12B	0
13	28	15	28
14	24	16	26
18	12	17	16
Total	69		70

after 15 seconds

11A	42	11B	37

These currents represent the trip coil requirements and assumes all breakers existing on the buses are energized prior to the station blackout and no safety injection signal. If safety injection is concurrent with the station blackout an additional 9.5 amps will be required for both 12A and 12B and an additional 2 amps for both 14 and 16.

Once the diesel generators are up to speed and voltage the DC requirement to load the 1E buses onto the generators is 104 amps, 52 for 14 & 18 and 52 for 16 & 17. This represents the closing coil requirements of the diesel generator breakers.

Once the 1E buses are reenergized each additional breaker that is closed will require 20 amps DC.

Theodore H. Miller
Theodore H. Miller
Electrical Engineer

Attachment

xc: Elec. Eng. File w/attach.

Ginna Station
Station Blackout (loss of voltage)
Breaker Condition

Bus 11A

Load	Position	Condition
Sta. Trans 13	1	Trips after 15 seconds
Cond. Booster Pmp 1C	2	"
Circ. Water Pmp 1A	3	"
Heater Drain Pmp 1A	4	"
Cond. Pmp 1C	5	"
Cond. Pmp 1A	6	"
Feed Water Pmp 1A	7	"
Reactor Coolant Pmp 1A	8	"
Aux Bldg. Exh. Fan 1A	9	"
Aux. Trans 11	10	Not tripped
Bus 12A Feed	11	No breaker

Bus 11B

Bus 12 B Feed	21	No breaker
Aux Trans 11	22	Not tripped
Aux. Bldg. Exh. Fan 1B	23	Trips after 15 seconds
Reactor Coolant Pmp 1B	24	"
Feed Water Pmp 1B	25	"
Cond. Pmp 1B	26	"
Heater Drain Pmp 1B	27	"
Circ Water Pmp 1B	28	"
Cond. Booster Pmp 1B	29	"
Sta. Trans 15	30	"
Bus Tie 11A	31	Not tripped

Bus 12A

Bus Tie 11A	12	No trip
Bus Feed	13	No breaker
Sta. Trans 18	14	No trip unless SI
Sta. Trans 14	15	"
Cond. Booster Pmp 1A	16	Trips

Bus 12B

Sta. Trans 16	17	No trip unless SI
Sta. Trans 17	18	"
Bus Feed	19	No breaker
Bus Tie 11B	20	No trip

Bus 13

Ltg Trans 1B5	6A	Trips (DB 25)
Cont. Rod Shroud 1A	6B	"
"	6C	No trip (manual bkr)
Cont. Pnl. MCC AVC-2	6D	Trips (DB 25)
Pwr Dist. Pnl AVC-10	7A	"
Spare	7B	
Spare	7C	
Aux. Pwr Sup. 1A	7D	Trips (DB 25)
Chiller Comp. 1A	8A	"
MCC 1A	8B	"
Aux. Bldg Sup Air Hdlg	8C	"
Ltg. Trans 1A	8D	"
Sta. Serv. Air Comp	9A	"
Instr. Air Comp 1A	9B	"
Pwr Pnl SEP-2B	9C	"
Rod Drive MG 1A	9D	"
PTs	10A	No breaker
Sta. Trans 13	10B	Trips (DB 50)
Bus Tie 14	10C	No breaker

Bus 15

PTs	1A	No breaker
Sta Trans 15	1B	Trips (DB 50)
Bus Tie 16	1C	No breaker
Rod Drive MG 1B	2A	Trips (DB 25)
Instr. Air Comp 1B	2B	"
MCC 1F	2C	"
Turb. Rm. Crane	2D	"
Tech. Support Ctr.	3A	"
Ltg. Trans 1B	3B	"
Chiller Comp 1B	3C	"
Aux. Pwr. Sup 1A	3D	"
MCC 1B	4A	"
Instr. Air Comp. 1C	4B	"
Spare	4C	
Pwr Pnl SEP 4G	4D	"
Future	5A	
MCC 1E	5B	"
Cont. Rod Shroud Fan 1B	5C	"
"	5D	No trip (manual bkr)

Bus 14

PTs	18A	No breaker
Sta. Trans 14	18B	Trips (DB 75)
EDG 1A	18C	No trip
SIP 1C	19A	Trips (DB 50)
Bus Tie 14-13	19B	"
Bus Tie 14-16	19C	No trip (manual)
SIP 1A	20A	Trips (DB 50)
Containment Spray Pmp 1A	20B	No trip
Cont. Fan 1D	20C	Trips (DB 50)
Aux. Bldg. Exh. Fan 1G	21A	"
Spare	21B	
AFWP 1A	21C	"
RHR 1A	22A	"
Heater S/G Control	22B	"
MCC 1C	22C	No trip
Component Cooling Pmp 1A	23A	No trip unless SI
Charging Pmp 1A	23B	Trips (DB 50)
Cont. Fan 1A	23C	"
Spare	24A	
SAFWP 1C	24B	"
Spare	24C	

Bus 16

PTs	11A	No breaker
Sta Trans 16	11B	Trips (DB 75)
EDG 1B	11C	No trip (DB 75)
SIP 1B	12A	Trips (DB 50)
Bus Tie 16-15	12B	"
Bus Tie 14-16	12C	Trips (DB 75)
SIP 1C	13A	Trips (DB 50) Bus 14 preferred source
Containment Spray Pmp 1B	13B	No trip
Cont. Fan 1B	13C	Trips (DB 50)
Cont. Fan 1C	14A	"
Spare	14B	
AFWP 1B	14C	"
RHR 1B	15A	"
Charging Pmp 1B	15B	"
Charging Pmp 1C	15C	"
Heater S/G Backup	16A	"
Component Cooling Pmp 1B	16B	No trip unless SI
MCC 1D	16C	No trip
Spent Fuel Pit Pmp 2	17A	Trips (DB 50)
Spare	17B	
SAFW Pmp 1D	17C	Trips (DB 50)

Bus 18

Intake Heater 1A	29A	Trips (DB 25)
Intake Heater 1C	29B	"
SWP 1A	29C	"
SWP 1C	29D	"
Spare	30A	
Spare	30B	
MCC 1G	30C	Trips (DB 25)
Spare	30D	
PTs	31A	No breaker
Sta Trans 18	31B	Trips (DB 50)
EDG 1A	31C	No trip (DB 50)

Bus 17

PTs	25A	No breaker
Sta Trans 17	25B	Trips (DB 50)
EDG 1B	25C	No trip (DB 50)
Spare	26A	
Spare	26B	
MCC 1G	26C	Trips (DB 25) Bus 18 preferred source
Fire Pmp	26D	Trips (DB 25)
Intake Heater 1B	27A	"
Intake Heater 1D	27B	"
SWP 1B	27C	"
SWP 1D	27D	"
Spare	28A	
Bus Tie 17-18	28B	"

Current Requirements for breaker trips and closures are from Design Analysis #5, DC System Load Survey, EWR 3341, Rev 0, December 21, 1987, page one of Attachment I, attached.

DC LOAD DATA SHEET

DEVICE	MANUF. RATING	SOURCE	AMPS @ 125VDC
4KV 3000A BRKR (DH)			
MOTOR	5A	Conserv. Est	5
RELEASE COIL	27 ohms	W Telecon, 9/17/87	4.63
TRIP COIL	27 ohms	W Telecon, 9/17/87	4.63
X RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
Y RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
4KV 1200A BRKR (DH)			
CLOSING COIL	32A	Conserv. Est.	32
TRIP COIL	27 ohms	W Telecon, 9/17/87	4.63
X RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
Y RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
480V 75A BRKR (DB)			
CLOSE COIL	32A	W AD 33-760	32
TRIP COIL	2A	W AD 33-760	2
X RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
Y RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
480V 50A & 15A BRKR (DB)			
CLOSE COIL	20A	W AD 33-760	20
TRIP COIL	2A	W AD 33-760	2
X RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
Y RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
480V 25A BRKR (DB)			
CLOSE COIL	23A	W AD 33-760	23
TRIP COIL	2A	W AD 33-760	2
X RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
Y RELAY (SZ.00)	18 watts	Cat. Sec. 8221	0.144
MOTOR STARTERS			
SIZE 00-2	18 watts	W Cat. Sec. 8221	0.144
SIZE 3	35 watts	p. 30 3/17/80	0.28
SIZE 4	35 watts	"	0.28
SIZE 5	20 watts	"	0.16
MOTORS	7.46A/HP	$I = \frac{HP \times 746}{.8(125V)}$	7.46A/HP

Appendix 2

Computer Software Documentation

The computer programs utilized in this analysis are classified as Type 4 in accordance with Appendix B of QW 330 (draft).

Type 4: Computer Software Package Documentation Summary

1. Title of Report or Analysis <u>Sizing of Vital Batteries</u>

2. Author <u>G.W. Daniels</u>

3. Verification of Program (s)

(a)

(1) Name of Program: LEAST.PAS

(2) Description (include source code location):

The program performs a least squares fit of a sixth order polynomial to a data set. In this case the data is the set of battery discharge currents to 1.75 VPC for the NAX 1200 cell. The source code is available in the Turbo Pascal Numerical Methods Toolbox, from Borland Software. The input and output of this program are attached to this appendix.

(3) Algorithm Bases

____ Found in text, page <u>N/A</u>

____ Reference <u>N/A</u>

(4) Numerical Methods Used

(i) Description: Least Squares polynomial curve fit.

(ii) Reference <u>Cheney and Kincaid 1985, 362-387</u>

(iii) Other <u>N/A</u>

(b)

(1) Name of Program: BATDSCH:BAS

(2) Description (include source code location):

Appendix 2 (cont.)

Computer Software Documentation

This is a short BASIC program which evaluated a polynomial expression for battery discharge current and calculates the capacity for factor K. The source code is attached to this appendix.

(3) Algorithm Bases: N/A

(4) Numerical Methods Used: None

The Data Points:

X	Y
1.000	1360.0000000
15.000	1060.0000000
30.000	867.0000000
60.000	600.0000000
120.000	408.0000000
180.000	312.0000000

Polynomial Least Squares Fit

Coefficients in least squares approximation:

```
   Coefficient 0:   1.3886879914E+03
   Coefficient 1:  -2.9291408406E+01
   Coefficient 2:   6.1228778315E-01
   Coefficient 3:  -8.9336411502E-03
   Coefficient 4:   6.2985120456E-05
   Coefficient 5:  -1.5697039490E-07
```

X	Least Squares Fit	Residual
1.0000	1.3600000000E+03	-1.8626451492E-09
15.0000	1.0600000000E+03	1.8626451492E-09
30.0000	8.6700000000E+02	1.8626451492E-09
60.0000	6.0000000000E+02	-1.8626451492E-09
120.0000	4.0800000000E+02	-9.3132257462E-10
180.0000	3.1200000000E+02	9.3132257462E-10

Standard Deviation : [illegible]

BATDSCH.BAS

```
10 PRINT "enter disch current time in minutes"
20 INPUT T
30 I=1388.6879914# - 29.291408406# * T + .61228778315# * T^2 - .0089336411502# *
 T^3 + .000062985120456# * T^4 - .0000001569703949# * T^5
35 KT = 1200/I
40 PRINT "disch current=";I;"
   PRINT "KT=";KT
```