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STATION BATTERY CAPACITY TESTS 125V DC

1.0 PURPOSE

To provide instructions for testing the capacity of the station 125V DC batteries and their ability to meet the demand requirements of the system to which they are connected satisfying the requirements of Reference 11.6.

2.0 RESPONSIBILITY

The Maintenance Engineer shall be responsible for the proper implementation of this procedure.

3.0 DISCUSSION

Capacity tests performed on the 125V station batteries are divided into the following catagories.

3.1 Acceptance Test - A capacity test performed on a battery upon initial installation to determine that it meets specifications or manufacturers ratings or both. This test consists of a constant current load equal to the manufacturers rating of the battery for a specific length of time.

3.2 Performance Discharge Test - A capacity test performed during shutdown, within the first 2 years of service and at 5 year intervals until the battery shows signs of degradation. Annual performance tests should be given a battery that shows signs of degradation or has reached 85 percent of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10 percent of rated capacity from its average on previous performance tests, or is below 90 percent of the manufacturers rating. This test is performed on the battery, as found, after it has been in service to detect any change in capacity as determined by the acceptance test. Successful completion of this test verifies the battery capacity to be at least 80 percent of the manufacturers rating. Test parameters (i.e. current load and test time) are the same as Acceptance Test parameters for comparison purposes.

3.3 Service Test - A special capacity test performed during refueling operations or at some other outage, with intervals between tests not to exceed 18 months. These tests are performed to verify the capacity of the battery is adequate to maintain in operable status all the actual emergency loads for a period of 2 hours.

3.4 The following topics are contained in this procedure:

4.0 PRECAUTIONS

4.1 There shall be no smoking, sparks or open flames permitted in any of the battery rooms. Hydrogen released by the battery is extremely flammable and may explode.

4.2 Ensure the battery area ventilation is operable. If ventilation system is inoperable, area shall be checked with a portable hydrogen analyzer. No entry should be made into a battery room with hydrogen concentration greater than 2%.

4.3 Use appropriate electrical safety precautions while working on the battery.

4.4 If electrolyte comes in contact with the skin or clothing it should be flushed immediately with water and then neutralized with a solution of baking soda and water (1 lb./gal.). If the electrolyte comes in contact with the eyes, wash or flush with large amounts of clean water. Secure medical treatment immediately.

4.5 Use insulated or sparkproof tools whenever possible during battery maintenance.

4.6 The test leads shall be connected with sufficient length of cable to prevent accidental arcing in the vicinity of the battery.

4.7 All terminals and connections made up during this test shall be torqued to a value of 150 in. lbs. $\pm$ 6 in. lbs.

4.8 Observe the battery for intercell connector heating during the discharge test.

5.0 PREREQUISITES

5.1 Station Equipment Clearance Permits in accordance with Reference 11.4.

5.2 Ensure unobstructed egress from battery room.

5.3 Local eyewash and shower station operable.

5.4 Battery electrolyte at proper level.

5.5 Acceptance Test only - Equalizing Charge of Station Batteries, Reference 11.3, must be performed 3 to 7 days prior to start of test.

5.6 Prior to all capacity tests, Quarterly Station Battery Check - Voltage & Density 125V DC, Reference 11.5, must be performed.

5.7 Insure load on battery is at minimum by use of DC clamp on ammeter on battery output cables. The Maintenance Engineer's permission

shall be required for removal of battery leads with the battery carrying greater than a 10 amp load.

5.8 Visually check to insure all battery connections are clean, tight & free of corrosion.

5.9 Test equipment required by this procedure shall be functional and shall not have exceeded the calibration due date.

5.10 The reactor shall be in CONDITION 3, 4 or 5 prior to the 125V battery being disconnected from its DC bus.

6.0 LIMITATIONS & ACTIONS

6.1 During test as the battery voltage decreases the resistance of the load bank will have to be decreased periodically to maintain desired discharge current.

6.2 If any individual cell is approaching reversal of its polarity (plus 1 V or less) but the battery terminal voltage has not yet reached its lower test limits, the test should be continued with a jumper across the weak cell. Complete the jumper connection away from the cell to avoid arcing near the cell. The new minimum terminal voltage should be determined based on the remaining cells (1.75V x no. of cells).

7.0 MATERIALS OR TEST EQUIPMENT

7.1 Variable resistance bank

7.2 0-300 and 0-3 Volt DC voltmeter

7.3 0-1000 AMP AMMETER

7.4 0 to 300 AMP DC CLAMP-ON AMMETER

7.5 0 to 300 IN. LB. TORQUE WRENCH

8.0 PROCEDURE

8.1 Test Preparation

INITIAL

8.1.1 All applicable prerequisites completed, clamp on ammeter reading_____ _____

8.1.2 Isolate battery by removing the intercell bus connections to which the output cable connections are attached, lifting the six output cables as noted on the following sketch, and then replating the intercell bus connections:

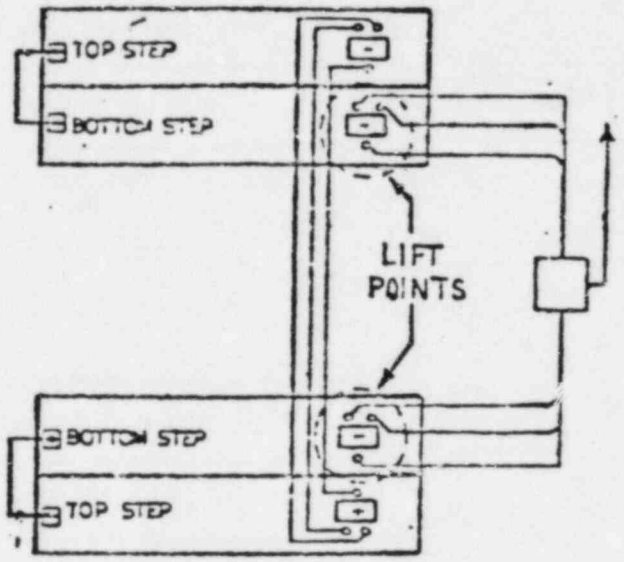


Figure 1: 125V Battery - plan view

8.1.3 According to the following sketch connect test apparatus to the battery at terminals referred to in previous step, (8.1.2). Test apparatus switch shall be left in the open position.

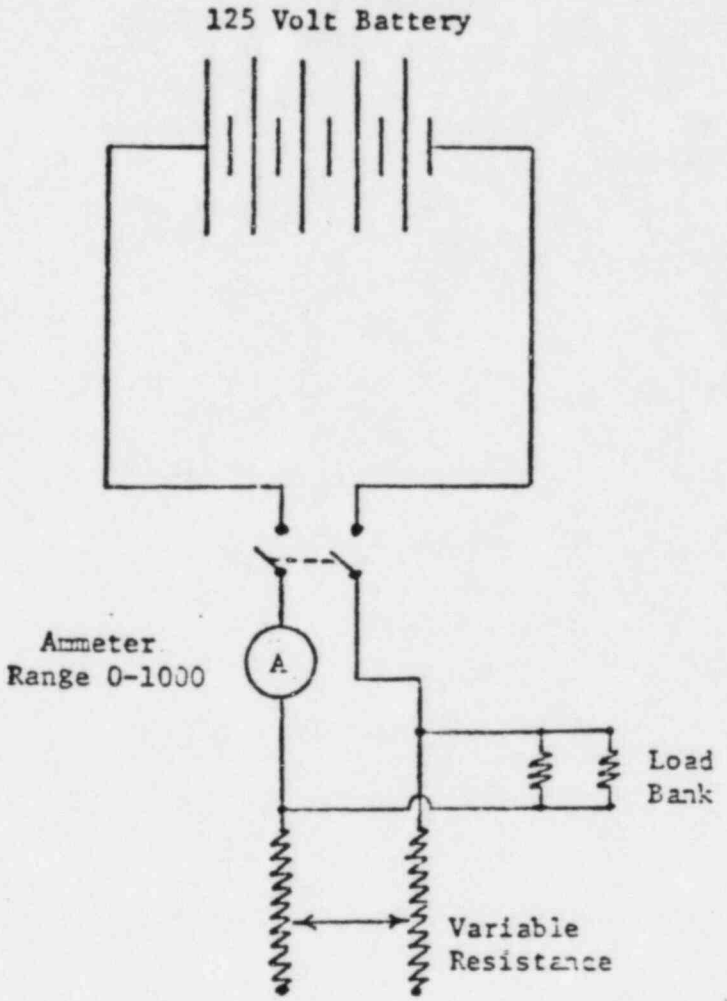


Figure 2

125 Volt Battery - Capacity Test Apparatus Sketch

8.1.4 Read and record temperature of battery electrolyte on every sixth cell.

cell no.	temperature	thermometer no.
_____	_____	_____
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	

8.2 Acceptance and Performance Discharge Test

8.2.1 Correct battery capacity for temperature according to capacity correction curve, Appendix 12.1 to correspond to a 2 hour discharge rate of 859 amps at 77°F (25°C). Temperature corrected discharge rate _____ amp.

8.2.2 Start the test by closing the test apparatus switch, placing the load bank in the battery circuit, and maintain the constant current discharge rate calculated in step 8.2.1 for the entire test period while performing and recording measurements designated on Appendices 12.2 & 12.3 at the following time intervals:

8.2.2.1 Appendix 12.2 - Reading at start of test and at ten minute intervals or whenever load resistance is changed.

8.2.2.2 Appendix 12.3 - Readings at start of test and at test times of 45, 90, 105 and 120 minutes.

8.2.3 Proceed to step 8.4 for test limits.

8.3 Service Test

8.3.1 Start the test by closing the test apparatus switch, placing the load bank in the battery circuit, and maintain the constant current discharge rates and times specified in the applicable 125 Volt Battery Load & Voltage Profile (Appendices 12.4, 12.5 & 12.6) while performing and recording measurements designated on Appendices 12.2 & 12.3 at the following time intervals:

8.3.1.1 Appendix 12.2 Readings at start of test and every ten minutes or whenever the load resistance is changed.

8.3.1.2 Appendix 12.3 Readings at start of test and at test times of 45, 90, 105 and 120 minutes.

8.4 Test Limits

8.4.1 Maintain required discharge current until one of the following limits is reached:

8.4.1.1 Battery terminal voltage decreases to 105 volts (ICV average 1.75 volts).

8.4.1.2 Inability to maintain required current discharge rate.

8.4.1.3 Test time of 2 hours elapsed (Service Test only). _____

8.5 Test Completion

8.5.1 When one of the limits of paragraph 8.4 is reached record:

Test Duration _____
Battery Voltage _____ Instr. No._____
Ending Discharge Rate _____ Instr. No._____ _____

8.5.2 Open test circuit switch and disconnect test apparatus. _____

8.5.3 Set system voltage equal to battery voltage and reconnect battery output cables lifted in step 8.1.2 Intercell battery connections to which the battery output cables are attached should be lifted prior to and replaced following output cable reconnections. Bolts shall be Torqued to the values in paragraph 4.7.

_____

8.5.4 Watch Engineer notified that battery system is back to normal that the charger and bus should be returned to service, and Reference 11.3 should be performed. _____

8.5.5 For an acceptance or performance test determine the battery capacity using the following equation:

$$\text{\% capacity @ } 25^{\circ}C = \frac{Ta}{2 \text{ hrs}} \times 100$$

were the test discharge current is at rating and where

T_a = Actual duration of test to minimum specified terminal voltage

Calculated percent capacity at 25°C _____

8.5.6 If the battery does not deliver its expected capacity the test shall be repeated once after:

8.5.6.1 An equalizing charge has been performed on the battery at least 3 to 7 days prior to the retest.

8.5.6.2 All connections have been checked to be clean, tight and free of corrosion.

9.0 ACCEPTANCE CRITERIA

9.1 Battery discharge tests shall be considered acceptable if the following criteria are met:

9.1.1 Acceptance Test: capacity 100% or greater

9.1.2 Performance Test: capacity 80% or greater

9.1.3 Service Test: two hour test complete with battery voltage greater than 105 VDC

9.2 Upon failure to meet the above Acceptance Criteria, the Watch Engineer shall be notified and a MWR shall be initiated in accordance with Reference 11.8 to find and correct the cause of the problem.

10.0 FINAL CONDITIONS

10.1 Battery reconnected to its respective bus and on float

10.2 Procedure and data sheets submitted for review, approval and retention in accordance with Reference 11.7.

11.0 REFERENCES

11.1 Gould Battery Tech. Manual File R42.18Ø

11.2 IEEE Standard 450-1975, IEEE Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations

11.3 SNPS SP23.315.Ø2 Equalizing Charge of Station Batteries

11.4 SNPS SP12.Ø11.Ø1 Station Equipment Clearance Permits

11.5 SNPS SP34.315.Ø1 Quarterly Station Battery Check - Voltage & Density 125 VDC

11.6 Technical Specifications, 5/19/76, Section 4.8.2.3.2.d and e

11.7 SP 12.Ø16.Ø1 Surveillance Program

11.8 SP 12.Ø13.Ø1 Maintenance Work Requests

12.0 APPENDICES

12.1 Capacity Correction Curve for Temperatures at variances to standard 77°F (25°F) at 2 hour rate discharges, Specific Gravity - 1.215

12.2 125 Volt Battery Capacity Test Data Sheet

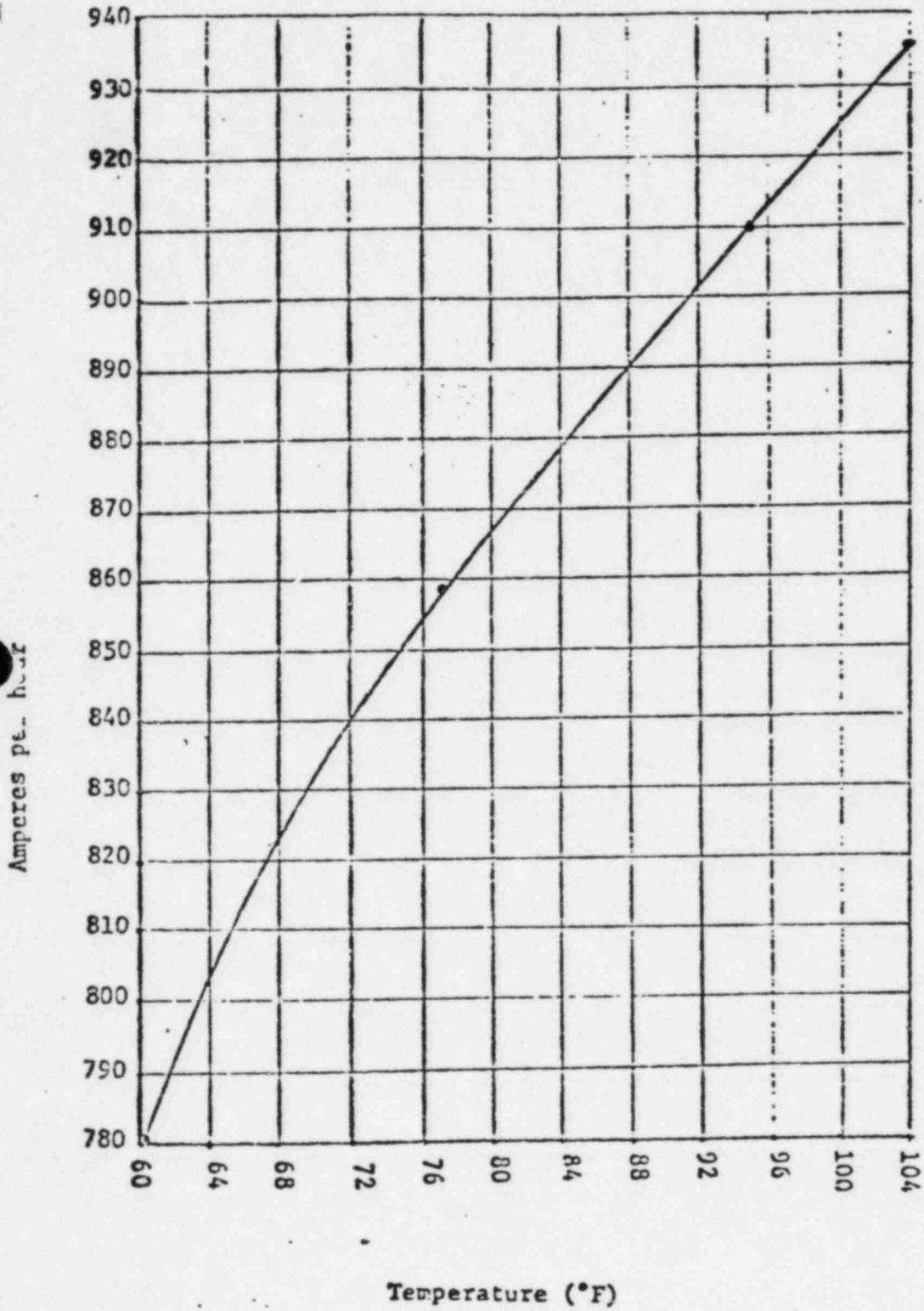
12.3 Individual Cell Voltage Data Sheet

12.4 125V Battery A Load and Voltage Profile

12.5 125V Battery B Load and Voltage Profile

12.6 125V Battery C Load and Voltage Profile

Capacity Correction Curve for Temperatures at variances to standard 77°F (25°C) at 2 hour rate discharges
Specific Gravity - 1.215



125 Volt Battery Capacity Test

System _____ Data Sheet

Voltmeter No._____
Ammeter No. _____

Reading No.	1	2	3	4	5	6	7
Time							
Battery Voltage							
Battery Current							

Reading No.	8	9	10	11	12	13	14
Time							
Battery Voltage							
Battery Current							

Reading No.	15	16	17	18	19	20	21
Time							
Battery Voltage							
Battery Current							

Conducted By:_____ Date:_____

Cnt. Engr. Review:_____ Date:_____

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APPENDIX 12.3

INDIVIDUAL CELL VOLTAGE DATA SHEET
125 VDC SYSTEM _____
VOLTMETER NO. _____

Cell No.	Start	45 min	90 min	105 min	120 min	Cell No.	Start	45 min	90 min	105 min	120 min
1						31					
2						32					
3						33					
4						34					
5						35					
6						36					
7						37					
8						38					
9						39					
10						40					
11						41					
12						42					
13						43					
14						44					
15						45					
16						46					
17						47					
18						48					
19						49					
20						50					
21						51					
22						52					
23						53					
24						54					
25						55					
26						56					
27						57					
28						58					
29						59					
30						60					

Conducted By: _____ Date: _____

Maint. Eng. Review: _____ Date: _____

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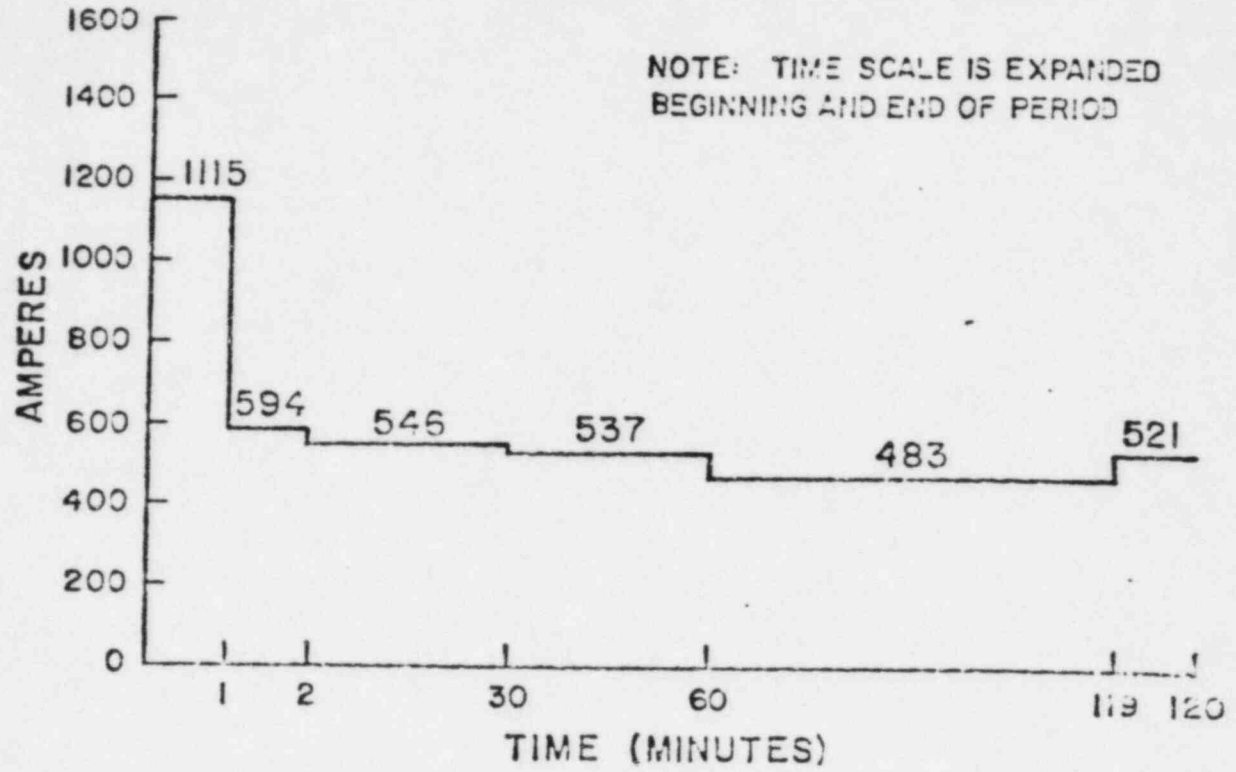
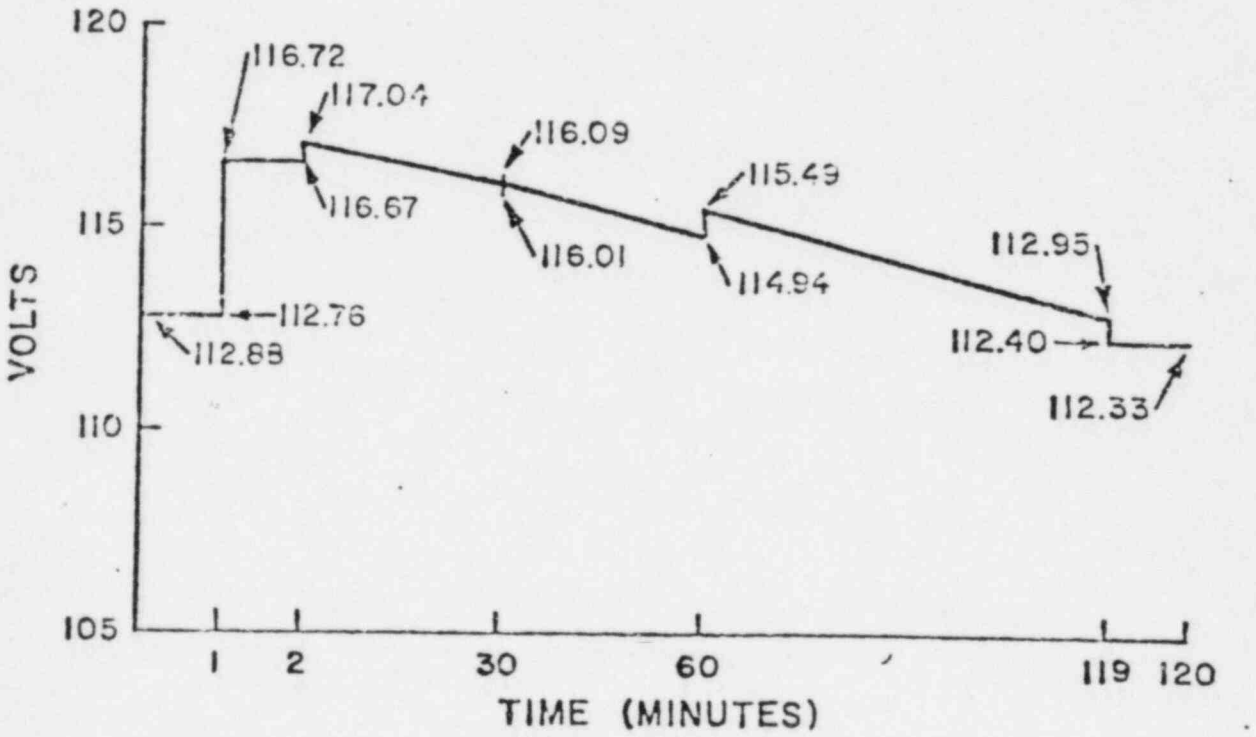
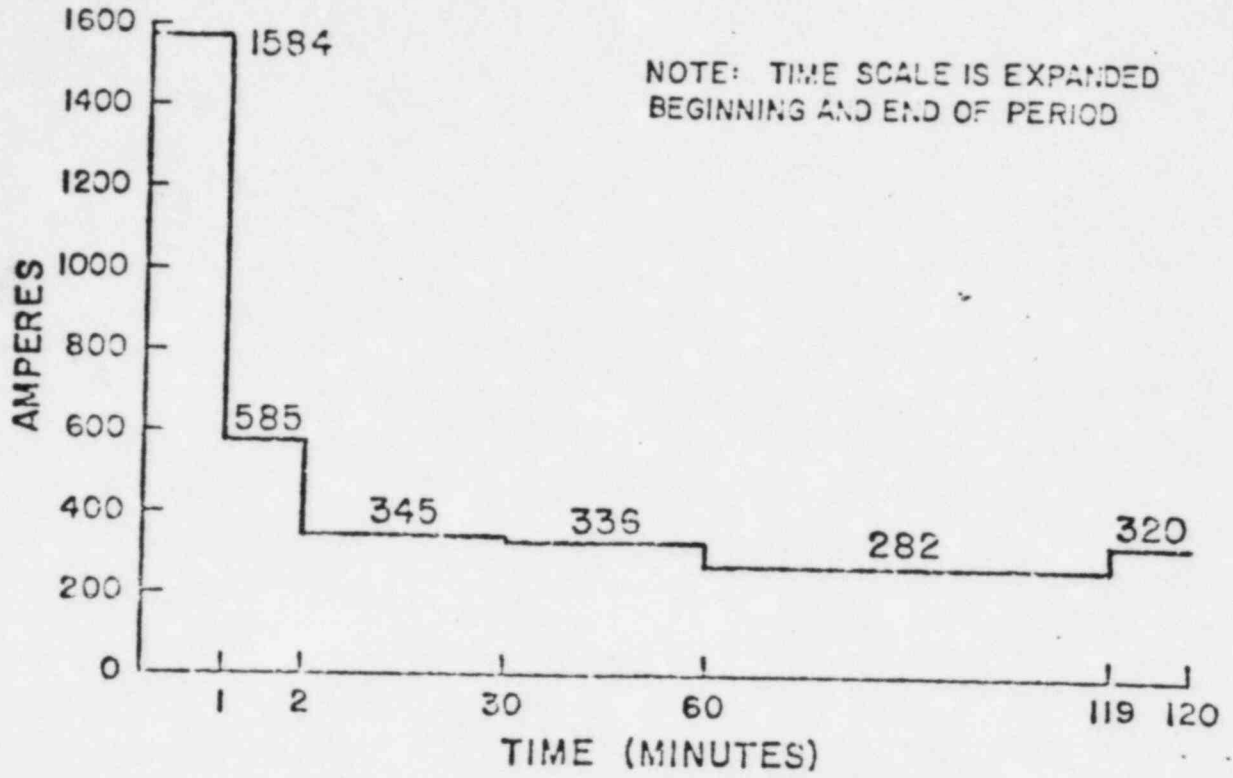
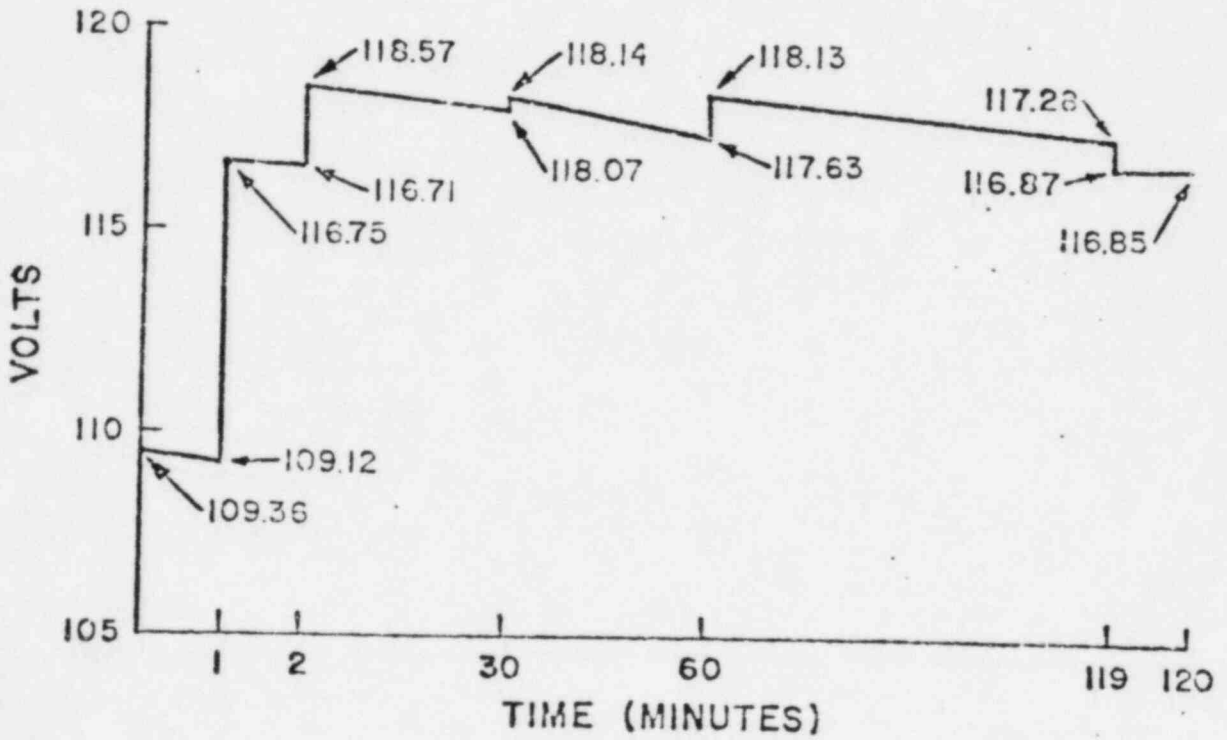




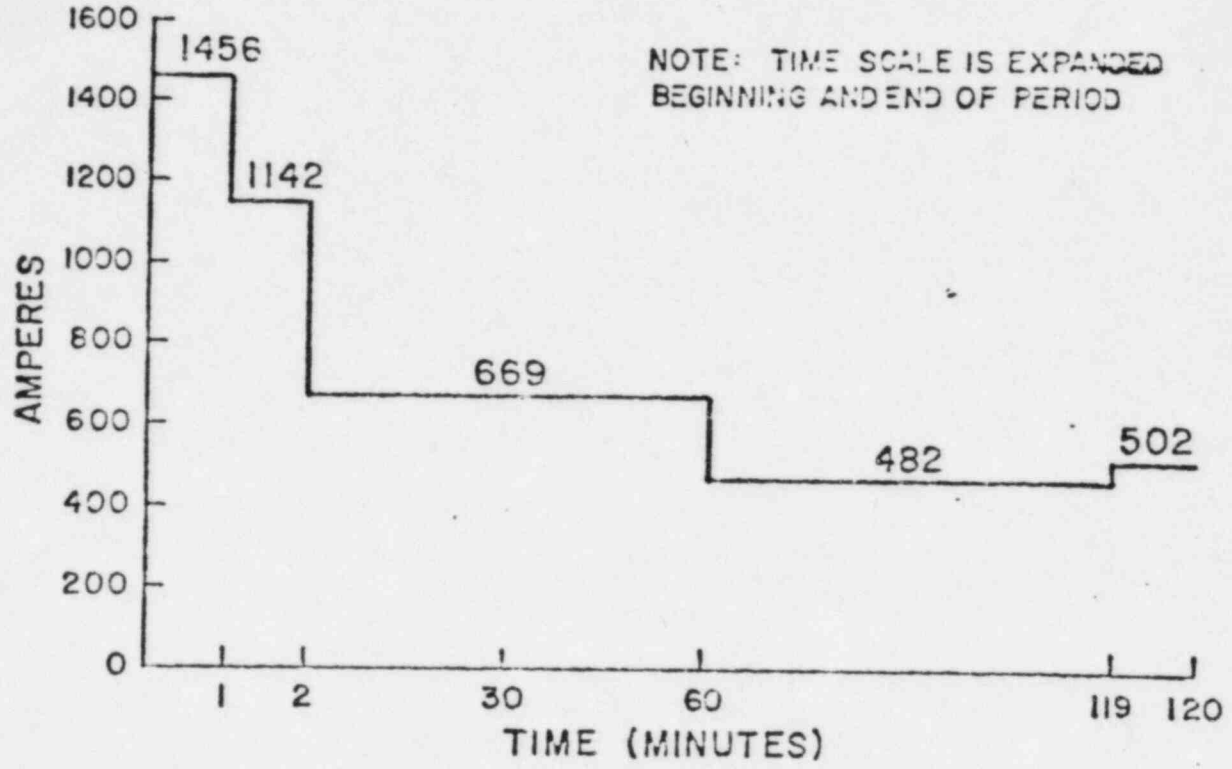
APPENDIX 12.4
125V BATTERY A
LOAD AND VOLTAGE PROFILE

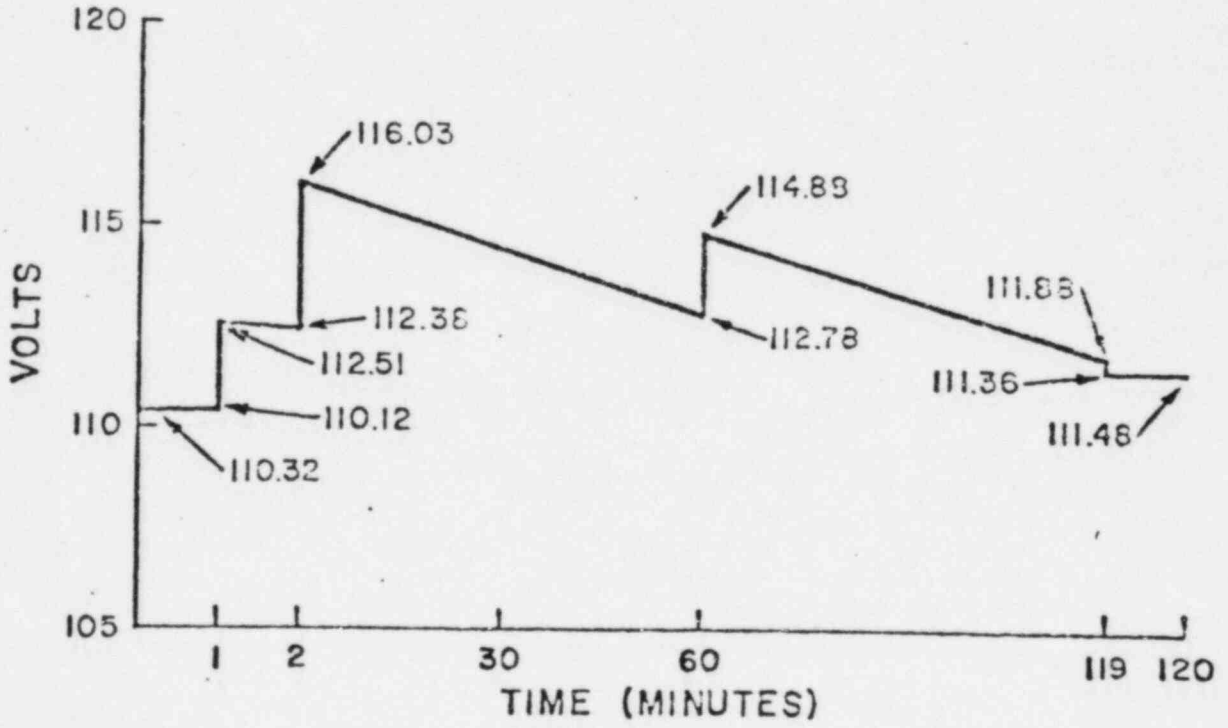




APPENDIX 12.5

125V DC BATTERY B
LOAD AND VOLTAGE PROFILE





APPENDIX 12.6

125 V BATTERY C
LOAD AND VOLTAGE PROFILE

NOTES FOR APPENDICES 12.4, 12.5 & 12.6

1. Voltage profiles are based on the design minimum temperature of 77°F.

2. Voltage profiles are based on end-of-life capacity of the batteries (80 percent of rated capacity).

3. Voltage profiles are based on assumed loss of current supplied by the battery charges for the entire 2 hr. period.

4. The load profiles are based on the limiting DBA with respect to battery capacity, which is the LOCA.

5. Load profiles are based on manual/remote stopping from the main control room of certain non-safety related loads after they are no longer required. These loads are oil pumps for reactor recirculation pump M.G. set - turned off after 60 min. Main turbine bearing oil pump - turned off after 60 min.

6. Design minimum charge state is 105 V.