Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

August 1, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Quad Cities Station Units 1 and 2
Response to a Request for Additional
Information 125 Volt Battery System
NRC Docket Nos. 50-254 and 50-265

References (a): D. B. Vassallo letter to D. L. Farrar dated June 26, 1984.

(b): D. L. Farrar letter to J. G. Keppler dated May 11, 1984.

(c): J. G. Keppler letter to D. L. Farrar dated May 7, 1984.

Dear Mr. Denton:

Per Reference (a), your staff requested additional information concerning the 125 Volt DC System at Quad Cities Station. Our response is in the form of an attachment to this letter. Please note that our response to Questions 3 and 4 assumes the use of a 100 ampere battery chargers, the size originally installed. Quad Cities Station has recently completed replacement of its 125 volt battery chargers with 200 ampere rated units.

If you have any questions regarding this matter, please contact this office.

One signed original and forty (40) copies are enclosed for your use.

Very truly yours,

B. Rybak

B. Rybak
Nuclear Licensing Administrator

lm

cc: NRC Resident Inspector - Quad Cities
R. Bevan - NRR

A001 1/1 Add: NRR/DL/ORAB NRR/DSI/ICSB NRR/DSI/PSB Rm/DD AMI/MIB

8930N

ATTACHMENT

Response to Request for Additional

Information on 125 Volt DC Systems

Reference: D. B. Vassallo letter to D. L. Farrar
dated June 26, 1984.

8930N

Question 1

Part 1

The following list includes possible loads which may be manually tripped in order to reduce battery load to 62 amps after the first 30 minutes:

Unit 1

From 125 V DC Turbine Building Bus 1A

Service

345kV Relay House Feed
Escape Lighting Panel #20
Escape Lighting Panel #10
Escape Lighting Panel #30
345kV Control Panel 912-2
Turbine EHC Main Feed
Radwaste Control Panel
Data Acquisition Cabinet
Relay and Metering Panel 901-29
Supervisory Master Station Panel
Protection Relay Panel 901-29
(Main Feed)

From 125V DC Turbine Building Bus 1B

Protection Relay Panel 901-29
(Reserve Feed) and Inverter
For ATWS Cabinet 2201-70B
Protection Relay Panel 901-29 & ATWS
Filter Cabinet 2201-70B
(NOTE: Loads to shed only after SCRAM)

From 125V DC Reactor Building Bus #1

Escape Lighting Panel 29

Unit 2

From 125V DC Turbine Building Bus 2A

Service

345kV Relay House Feed
Escape Lighting Panel 50
Escape Lighting Panel 59
Protection Relay Panel 902-29
(Reserve Feed)

Question 1 (continued)

From 125V DC Turbine Building Bus 2B

Protection Relay Panel 902-29 Back-Up
Reserve Feed & ATWS Inverter

The loads associated with the above services are all non-safety related and are not used to mitigate the consequences of an accident.

Part 2

The Attachment A and associated cell sizing calculation worksheet shows that without any manual load shedding the battery will last approximately two hours.

Question 2

Application of IEEE Standard 485 to Quad Cities batteries is not appropriate since the batteries were never designed in accordance with IEEE Standard 485 (batteries were designed and delivered about 10 years prior to first issuance of IEEE Standard 485). However, in regards to temperature correction factor, compensation for age and design margin the following comments are applicable:

a. Temperature correction factor is not required since the battery rooms are provided with heating and ventilation to maintain the temperature to the original design basis.

b. The battery capacity test acceptance criteria requires that the battery meet the manufacturer's rating. Therefore, the aging factor to account for degregation of battery capacity is not required since the batteries are tested on a routine basis in accordance with manufacturer and technical specifications.

c. The application of design margin in this analysis is not appropriate since the attempt is to show that the battery has sufficient capacity for its application.

The Attachment B and associated cell sizing calculation worksheet shows the loads within the first minute of battery operation. These loads are within the battery capability.

Question 3

The Attachments C, D and associated cell sizing calculation worksheet show the load cycles and battery endurance calculations for the following scenarios:

Attachment C: A LOOP concurrent with a LOCA on Unit 1 and safe shutdown of Unit 2 with turbine building 125Vdc main bus 2A fault. All operating loads to be fed from Unit 1 battery and charger.

Attachment D: Safe shutdown of both units with a LOOP and Unit 2 turbine building 125Vdc main bus 2A fault. All operating loads to be fed from Unit 1 battery and charger.

The battery endurance calculation shows the battery will last for about 8 hours in both scenarios.

Question 4

This scenario is in violation of Quad Cities technical specification and station practice. The battery maintenance and surveillance on any unit battery is performed during two unit outage; however, the Attachment E and its associated cell sizing calculation worksheet shows the battery on Unit 1 (worst case) is capable of supplying the required load for safe shutdown of the operating unit.

In this scenario, with availability of charger, the battery lasts for about 18 hours.

QUESTION 5

The original Gould 100 ampere battery chargers had an automatic load limiting feature which limited the output current to 120% of rated load by reducing the output voltage until the output current is reduced to the setpoint. Excess current is then supplied by the battery, avoiding a charger trip.

The Number 2 125 Volt battery charger tripping on May 10, 1984 has been attributed to a faulty current limit card. Load was transferred to the Number 2A charger which had been earlier replaced with a qualified Class 1E charger with a rated output of 200 amperes. Subsequently, the remaining three (3) 125 Volt battery chargers have been replaced with 200 ampere, qualified Class 1E battery chargers. These chargers also have current limiting circuitry to prevent tripping under normal operations with any of the postulated load scenarios above.

8930N

Quad Cities 125V DC Load Profile

Tabulation of Loading:	1 min.					¼ hr.	½ hr.	1 hr.	2½ hr.
	0-1 sec.	2-9 sec.	10-11 sec.	12-58 sec.	59-60 sec.	next 14 min.	next 15 min.	next ½ hr.	next 1½ hr.
Escape Lighting	100	100	100	100	100	100	100	100	100
Annunciator Relay Cabinet & Visual Annunciator	15	15	15	15	15	15	15	15	15
Indicating Lamps & Auxiliary Relays	42	42	42	42	42	42	42	42	42
RICI Controls	5	5	5	5	5	5	-	-	-
Plant Sirens	-	15	15	15	15	15	-	-	-
Electromatic Relief Valves	-	-	-	-	32	4	4	--	--
Trip OCRS (Sw. Yd.)	108	-	-	-	-	-	-	-	-
Trip Field ACB	10	-	-	-	-	-	-	-	-
Trip ACES	198	-	-	-	-	-	-	-	-
Trip Turb. Mts.	10	-	-	-	-	-	-	-	-
Close ACBS	-	-	20	100	-	-	-	-	-
Standby Diesel Field Flashing	-	140	-	-	-	-	-	-	-
HPCI Turbine Controls	5	5	5	5	5	5	5	5	5
Tip System Shear Valves	-	-	-	-	50	-			-
HPCI Turbine Drain Valves	5	5	5	5	5	5	5	5	5
Total Discharge Currents:	498	327	207	287	269	191	171	167	167

Q-1, Part 2 - Unit 1 (worst case) with no manual load shedding.

ATTACHMENT A, SH. 2

CELL SIZING WORKSHEET

7-24-81

(For Ref. See ESC-291)

Project: Date: Page:

Lowest Expected Electrolyte Temp: °F | Minimum Cell Voltage: | Cell Mfg: | Cell Type: | Sized By:

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) × (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= 498	A1−0=498	M1= 1	T=M1= 1	117	4.3	• • •
					Sec 1 Total	4.3	• • •
Section 2 First Two Periods Only If A3 is greater than A2, go to Section 3.							
1	A1= 498	A1−0=498	M1= 1	T=M1+M2= 15	80	6.2	
2	A2= 191	A2−A1=307	M2= 14	T=M2= 14	88		3.7
					Sec 2 Sub Tot	6.2	3.7
					2 Total	2.5	• • •
Section 3 First Three Periods Only If A4 is greater than A3, go to Section 4.							
1	A1= 498	A1−0=498	M1= 1	T=M1+M2+M3=30	60	8.3	
2	A2= 191	A2−A1=307	M2= 14	T=M2+M3= 29	58		5.1
3	A3= 171	A3−A2=−20	M3= 15	T=M3= 15	50		.3
					Sec Sub Tot	8.3	5.4
					3 Total	2.9	• • •
Section 4 First Four Periods Only If A5 is greater than A4, go to Section 5.							
1	A1= 498	A1−0=498	M1= 1	T=M1+...M4= 120	28	17.5	
2	A2= 191	A2−A1=307	M2= 14	T=M2+M3+M4=119	55		11.0
3	A3= 171	A3−A2=−20	M3= 15	T=M3+M4= 105	50		.7
4	A4= 151	A4−A3=−4	M4= 90	T=M4= 90	45		.1
					Sec Sub Tot	17.5	11.8
					4 Total	6.0	• • •
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+...M5=			

Attachment B
7-24-84

Quad Cities 125V DC Load Profile

Tabulation of Loading:	1 min.					¼ hr.	½ hr.	1 hr.	2½ hr.
	0-1 sec.	2-9 sec.	10-11 sec.	12-58 sec.	59-60 sec.	next 14 min.	next 15 min.	next ½ hr.	next 1½ hr.
Escape Lighting	100	100	100	100	100	100	100	100	100
Annunciator Relay Cabinet & Visual Annunciator	15	15	15	15	15	15	15	15	15
Indicating Lamps & Auxiliary Relays	42	42	42	42	42	42	42	42	42
RICI Controls	5	5	5	5	5	5	-	-	-
Plant Sirens	-	15	15	15	15	15	-	-	-
Electromatic Relief Valves	-	-	-	-	32	4	4	-	-
Trip OCBS (Sw. Yd.)	108	-	-	-	-	-	-	-	-
Trip Field ACB	10	-	-	-	-	-	-	-	-
Trip ACBS	198	-	-	-	-	-	-	-	-
Trip Turb. Mts.	10	-	-	-	-	-	-	-	-
Close ACBS	-	-	20	100	-	-	-	-	-
Standby Diesel Field Flashing	-	140	-	-	-	-	-	-	-
HPCI Turbine Controls	5	5	5	5	5	5	5	5	5
Tip System Shear Valves	-	-	-	-	50	-			-
HPCI Turbine Drain Valves	5	5	5	5	5	5	5	5	5
Total Discharge Currents:	498	327	207	287	269	191	171	167	167

Q-2 - Unit 1 (worst case) first minute load profile.

Attachment C
Sh. 1
7-24-84

Quad Cities 125V DC Load Profile

Tabulation of Loading:	1 min.					¼ hr.	½ hr.	1 hr.	2½ hr.
	0-1 sec.	2-9 sec.	10-11 sec.	12-58 sec.	59-60 sec.	next 14 min.	next 15 min.	next ½ hr.	next 1½ hr.
Escape Lighting	100	100	100	100	100	100	100	100	100
Annunciator Relay Cabinet & Visual Annunciator	15	15	15	15	15	15	15	15	15
Indicating Lamps & Auxiliary Relays	42	42	42	42	42	42	42	42	42
RICI Controls	10	10	10	10	10	10	-	-	-
Plant Sirens	-	15	15	15	15	15	-	-	-
Electromatic Relief Valves	-	-	-	-	64	8	8	-	-
Trip OCBS (Sw. Yd.)	108	-	-	-	-	-	-	-	-
Trip Field ACB	20	-	-	-	-	-	-	-	-
Trip ACBS	204	-	-	-	-	-	-	-	-
Trip Turb. Mts.	20	-	-	-	-	-	-	-	-
Close ACBS	-	-	20	170	-	-	-	-	-
Standby Diesel Field Flashing	-	140	-	-	-	-	-	-	-
HPCI Turbine Controls	10	10	10	10	10	10	10	10	10
Tip System Shear Valves	-	-	-	-	50	-	-	-	-
HPCI Turbine Drain Valves	10	10	10	10	10	10	10	10	10
Total Discharge Currents:	539	342	222	372	316	210	185	177	177
Battery Charger Energized				252	196	90	65	57	57

Q-3, Part 1 - A LOOP concurrent with LOCA in Unit 1 and safe shutdown of Unit 2 with turbine building 125Vdc main bus 2A fault.

ATTACHMENT C, EX 2

7-24-81

CELL SIZING WORKSHEET

(For Ref. See ESC-291)

Project: Date: Page:

Lowest Expected Electrolyte Temp: °F | Minimum Cell Voltage: | Cell Mfg: | Cell Type: | Sized By:

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) × (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= 539	A1−0=539	M1= 1	T=M1= 1	117	4.6	• • •
					Sec 1 Total	4.6	• • •
Section 2 First Two Periods Only If A3 is greater than A2, go to Section 3.							
1	A1= 539	A1−0=539	M1= 1	T=M1+M2= 15	90	6.7	
2	A2= 10	A2−A1=449	M2= 14	T=M2= 14	83		5.5
					Sec 2 Sub Tot	6.7	5.5
					Total	1.2	• • •
Section 3 First Three Periods Only If A4 is greater than A3, go to Section 4.							
1	A1= 539	A1−0=539	M1= 1	T=M1+M2+M3=30	60	9.0	
2	A2= 10	A2−A1=449	M2= 14	T=M2+M3= 29	69		7.5
3	A3= 65	A3−A2=55	M3= 15	T=M3= 15	67		1.3
					Sec 3 Sub Tot	9.0	1.8
					Total	1.4	• • •
Section 4 First Four Periods Only If A5 is greater than A4, go to Section 5.							
1	A1= 539	A1−0=539	M1= 1	T=M1+ M1=7½ HR	11	49.0	
2	A2= 10	A2−A1=449	M2= 14	T=M2+M3+M1=7½ HR	11		40.8
3	A3= 69	A3−A2=59	M3= 15	T=M3+M4= 7¼ HR	12		4.9
4	A4= 97	A4−A3=28	M4= 7¼	T=M4= 7¼ HR	12		2.3
		TIME VALUES IN HOURS ↑			Sec 4 Sub Tot	49.0	47.9
					Total	5.5	• • •
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+M2+M5=			

Quad Cities 125V DC Load Profile

Attachment D
Sh. 1
7-24-84

Tabulation of Loading:	1 min.					¼ hr.	½ hr.	1 hr.	2½ hr.
	0-1 sec.	2-9 sec.	10-11 sec.	12-58 sec.	59-60 sec.	next 14 min.	next 15 min.	next ½ hr.	next 1½ hr.
Escape Lighting	100	100	100	100	100	100	100	100	100
Annunciator Relay Cabinet & Visual Annunciator	15	15	15	15	15	15	15	15	15
Indicating Lamps & Auxiliary Relays	42	42	42	42	42	42	42	42	42
RICI Controls	10	10	10	10	10	10	-	-	-
Plant Sirens	-	15	15	15	15	15	-	-	-
Electromatic Relief Valves	-	-	-	-	64	8	8	-	-
Trip OCBS (Sw. Yd.)	108	-	-	-	-	-	-	-	-
Trip Field ACB	20	-	-	-	-	-	-	-	-
Trip ACBS	204	-	-	-	-	-	-	-	-
Trip Turb. Mts.	20	-	-	-	-	-	-	-	-
Close ACBS	-	-	20	170	-	-	-	-	-
Standby Diesel Field Flashing	-	140	-	-	-	-	-	-	-
HPCI Turbine Controls	10	10	10	10	10	10	10	10	10
Tip System Shear Valves									
HPCI Turbine Drain Valves	10	10	10	10	10	10	10	10	10
Total Discharge Currents:	539	342	222	372	266	210	185	177	177
Battery Charger Energized				252	146	90	65	57	57

Q-3, Part 2 - Safe shutdown of both units with a LOOP and Unit 2 turbine building 125Vdc main bus fault.

ATTACHMENT D, SH. 2

7-24-84

CELL SIZING WORKSHEET

(For Ref. See ESC-291)

Project: Date: Page:

Lowest Expected Electrolyte Temp: °F | Minimum Cell Voltage: | Cell Mfg: | Cell Type: | Sized By:

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) × (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= 539	A1−0=539	M1= 1	T=M1= 1	117	4.6	• • •
					Sec 1 Total	4.6	• • •
Section 2 First Two Periods Only If A3 is greater than A2, go to Section 3.							
1	A1= 539	A1−0=539	M1= 1	T=M1+M2= 15	80	6.7	
2	A2= 90	A2−A1=449	M2= 14	T=M2= 14	92		5.5
					Sec 2 Sub Tot	6.7	5.5
					Total	1.7	• • •
Section 3 First Three Periods Only If A4 is greater than A3, go to Section 4.							
1	A1= 539	A1−0=539	M1= 1	T=M1+M2+M3=30	60	9.0	
2	A2= 90	A2−A1=449	M2= 14	T=M2+M3= 29	60		7.5
3	A3= 65	A3−A2=25	M3= 15	T=M3= 16	20		.3
					Sec 3 Sub Tot	9.0	1.8
					Total	1.2	• • •
Section 4 First Four Periods Only If A5 is greater than A4, go to Section 5							
1	A1= 539	A1−0=539	M1= 1	T=M1+ M4=7½ HR	11	49.0	
2	A2= 90	A2−A1=449	M2= 14	T=M2+M3+M4=7½	HR 11		40.8
3	A3= 65	A3−A2=25	M3= 15	T=M3+M4= 7½ HR	12		2.5
4	A4= 57	A4−A3=−8	M4= 7HR	T=M4= 7HR	12		.3
		TIME VALUES IN HOURS →			Sec 4 Sub Tot	49.0	43.5
					Total	5.5	• • •
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+ M5=			

Quad Cities 125V DC Load Profile

Attachment E
Sh. 1
7-24-84

Tabulation of Loading:	1 min.					¼ hr.	½ hr.	1 hr.	2½ hr.
	0-1 sec.	2-9 sec.	10-11 sec.	12-58 sec.	59-60 sec.	next 14 min.	next 15 min.	next ½ hr.	next 1½ hr.
Escape Lighting	162	162	162	162	162	162	162	162	162
Annunciator Relay Cabinet & Visual Annunciator	30	30	30	30	30	30	30	30	30
Indicating Lamps & Auxiliary Relays	84	84	84	84	84	84	84	84	84
RICI	5	5	5	5	5	5	-	-	-
Plant Sirens	-	30	30	30	30	30	-	-	-
Electromatic Relief Valves	-	-	-	-	32	4	4	-	-
Trip OCBS (Sw. Yd.)	108	-	-	-	-	-	-	-	-
Trip Field ACB	10	-	-	-	-	-	-	-	-
Trip ACBS	288	-	-	-	-	-	-	-	-
Trip Turb. Mts.	10	-	-	-	-	-	-	-	-
Close ACBS	-	-	30	140	-	-	-	-	-
Standby Diesel Field Flashing	-	210	-	-	-	-	-	-	-
HPCI Turbine Controls	5	5	5	5	5	5	5	5	5
Tip System Shear Valves	-	-	-	-	-	-	-	-	-
HPCI Turbine Drain Valves	5	5	5	5	5	5	5	5	5
Total Discharge Currents:	707	327	207	287	219	191	161	157	157
Battery Charger Energized				167	99	71	41	37	37

Q-4 - LOOP, Unit 2 shutdown with maintenance and surveillance on its 125Vdc system, safe shutdown of operating Unit 1.

ATTACHMENT E, SN. 2

7-24-94

CELL SIZING WORKSHEET

(For Ref. See ESC-291)

Project: Date: Page:

Lowest Expected Electrolyte Temp: °F | Minimum Cell Voltage: | Cell Mfg: | Cell Type: | Sized By:

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (6A) Amps/Pos (R_T) or (6B) K Factor (K_T)	(7) Required Section Size (3) ÷ (6A) = Positive Plates or (3) × (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= 707	A1−0= 707	M1= 1	T=M1= 1	117	6.0	• • •
					Sec 1 Total	6.0	• • •
Section 2 First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1= 707	A1−0= 707	M1= 1	T=M1+M2= 15	80	8.8	
2	A2= 71	A2−A1= 636	M2= 14	T=M2= 14	82		7.8
					Sec 2 Sub Tot	8.8	7.8
					Total	1.0	• • •
Section 3 First Three Periods Only — If A4 is greater than A3, go to Section 4.							
1	A1= 707	A1−0= 707	M1= 1	T=M1+M2+M3= 30	60	11.8	
2	A2= 71	A2−A1= 636	M2= 14	T=M2+M3= 29	60		10.6
3	A3= 41	A3−A2= −30	M3= 15	T=M3= 15	60		.4
					Sec 3 Sub Tot	11.8	11.0
					Total	0.8	• • •
Section 4 First Four Periods Only — If A5 is greater than A4, go to Section 5.							
1	A1= 707	A1−0= 707	M1= 1	T=M1+ M4= 18½	HR 6	117.5	
2	A2= 71	A2−A1= 636	M2= 14	T=M2+M3+M4= 18½	HR 6		10.6
3	A3= 41	A3−A2= −30	M3= 15	T=M3+M4= 18¼ HR	6		.4
4	A4= 27	A4−A3= −14	M4= 15 HR	T=M4= 18 HR	6		.7
		TIME VALUES IN HOURS →			Sec 4 Sub Tot	117.5	11.7
					Total	4.1	• • •
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=			