Attachment I to JPN - 93 - 025

April 7, 1993

STATION BLACKOUT RULE

Station Battery Four Hour Capacity Calculations

New York Power Authority

James A. FitzPatrick Nuclear Power Plant

Docket Number 50-333

IP3 ☐

JAF ☒

INDEPENDENT DESIGN VERIFICATION
CONTROL SHEET

VERIFICATION OF: JAF-CALC-ELEC-00868 REV.0
Document Title/Number

SUBJECT: STATION BATTERY CAPACITY UNDER STATION BLACKOUT (SBO) CONDITIONS

MOD/TASK NUMBER (If Applicable): N/A

QA CATEGORY: I

DISCIPLINE:	ELEC	MECH	C/S	I&C	FIRE PROTECT	OTHERS (SPECIFY)
Check as required	☒	☐	☐	☐	☐	☐

METHOD USED (1): DR
VERIFIER's NAME: J. PFEFFER
VERIFIER'S INITIALS/DATE: JP 2/23/93
APPROVED BY: Thomas Klein DATE: 2/23/93

REMARKS/SCOPE OF VERIFICATION:

CALCULATION METHOD AND FORMAT WERE VERIFIED.

(1) Methods of Verification: Design Review (DR), Alternate Calculations (AC), Qualification Test (QT)

IP3 ☐

JAF ☒

DESIGN VERIFICATION CHECKLIST
DESIGN REVIEW METHOD

VERIFICATION OF: JAF-CALC-ELEC-00868 REV. 0
Document/Title/Number

SUBJECT: STATION BATTERY CAPACITY UNDER STATION (SBO) BLACKOUT CONDITIONS

MOD/TASK NO.: (If Applicable) N/A

DESIGN VERIFIER: Jerry Pfeffer / Consultant / 2/23/93
Signature/Title/Date

DISCIPLINE:	ELEC	MECH	C/S	I&C	FIRE PROTECT	OTHERS (SPECIFY)
Check as required	☒	☐	☐	☐	☐	☐

		Yes/Not Applicable
1.	Were the inputs correctly selected and incorporated into the design?	(Yes)/NA
2.	Are the physical and functional characteristics of the proposed design within the approved design basis of the system(s) structure(s) or component(s)?	(Yes)/NA
3.	Does the proposed design incorporate license commitments?	(Yes)/NA
4.	Are assumptions necessary to perform the design activity adequately described and reasonable: Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are completed?	(Yes)/NA
5.	Are the appropriate quality and quality assurance requirements specified? e.g., safety classification.	(Yes)/NA
6.	Are the applicable codes, standards and regulatory requirements including issue and addenda properly identified and are their requirements for design met?	(Yes)/NA
7.	Have applicable construction and operating experience been considered?	Yes/(NA)

DESIGN VERIFICATION CHECKLIST
DESIGN REVIEW METHOD

		Yes/Not Applicable
8.	Have the design interface requirements been satisfied?	Yes/(NA)
9.	Was an appropriate design method used?	(Yes)/NA
10.	Is the output reasonable compared to inputs?	(Yes)/NA
11.	Are the specified parts, equipment and processes suitable for the required application?	(Yes)/NA
12.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	Yes/(NA)
13.	Have adequate maintenance features and requirements been satisfied?	Yes/(NA)
14.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	Yes/(NA)
15.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	Yes/(NA)
16.	Has the design properly considered radiation exposure to the public and plant personnel? (ALARA/cobalt reduction)	Yes/(NA)
17.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have satisfactorily accomplished?	(Yes)/N.A
18.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?	Yes/(NA)
19.	Are adequate handling, storage, cleaning and shipping requirements specified?	Yes/(NA)

DESIGN VERIFICATION CHECKLIST
DESIGN REVIEW METHOD

		Yes/Not Applicable
20.	Are adequate identification requirements specified?	Yes/(NA)
21.	Are the conclusions drawn in the Safety Evaluation fully supported by adequate discussion in the test or Safety Evaluation itself?	Yes/(NA)
22.	Are necessary procedural changes specified, and are responsibilities for such changes clearly delineated?	Yes/(NA)
23.	Are requirements for record preparation, review, approval, retention, etc., adequately specified?	Yes/(NA)
24.	Have supplemental reviews by other engineering disciplines (seismic, electrical, etc.) been performed on the integrated design package.	Yes/(NA)
25.	Have the drawings, sketches, calculations, etc., included in the integrated design package been reviewed?	Yes/(NA)
26.	Have reviews been performed to identify any effect on the Check Valve Maintenance Program?	Yes/(NA)
27.	Does the design for check valves meet the intents of INPO SOER 86-03?	Yes/(NA)
28.	Is the plant reference simulator physical and functional fidelity affected and it's design change been factored into the cost?	Yes/(NA)
29.	References used as part of the design review which are not listed as part of the design calculation/analysis.	Yes/(NA)

NONE

CALCULATION CONTROL SHEET

CALC. NO. JAF-CALC-ELEC-00868 REV. 0 IP3 ☐ JAF ☒

MOD/TASK NO. N/A

QA CATEGORY OF CALCULATION: I
CALCULATION TYPE: PRELIMINARY: ____ FINAL: X
PROJECT/TASK: STATION BLACKOUT (SBO)
SYSTEM NO./NAME: 71 / DC POWER
TITLE: STATION BATTERY CAPACITY UNDER SBO CONDITIONS

	NAME	SIGNATURE	DATE
DESIGN ENG.:			
PREPARER:	K.J. VEHSTEDT	K.J. Vehstedt	2/24/93
CHECKER:	K.J. NELSON	K.J. Nelson	2/23/93
VERIFIED: N/A ☐	J. PFEFFER	J. Pfeffer	2/23/93
APPROVED:	T. KLEIN	T. Klein	2/23/93

PROBLEM/OBJECTIVE/METHOD

(1) SUPERCEDE CALC JAF-89-013, REV. 2 FOR 10 CFR 50.63 COMPLIANCE, AND

(2) ANALYZE EXTENDED SBOs FOR IDE CONSIDERATIONS

DESIGN BASIS/ASSUMPTIONS

ANALYSIS PERFORMED IN ACCORDANCE WITH IEEE 485 METHODOLOGY. DATA TAKEN FROM NYPA CALCS JAF-CALC-ELEC-00427 AND 00426, REVISION 1.

SUMMARY/CONCLUSIONS

BOTH 71SB-1 AND 71SB-2 ARE CAPABLE OF POWERING SBO LOADS FOR IN EXCESS OF EIGHT HOURS

REFERENCES

SEE SECTION 6.0

AFFECTED SYSTEMS/COMPONENTS/DOCUMENTS

SYSTEM 71, DC

☐ VOIDED OR
☐ SUPERSEDED BY: N/A (CALC. NO.)

TABLE OF CONTENTS

ATTACHMENTS

(1) PURPOSE

THIS CALCULATION SERVES TO:

(A) SUPERCEDE JAF MISCELLANEOUS CALCULATION 89-013, REV. 2 AS THE "CALCULATION OF RECORD" FOR COMPLIANCE WITH THE STATION BLACKOUT (SBO) RULE, 10 CFR 50.63, AND

(B) ASCERTAIN FOR INDIVIDUAL PLANT EXAMINATION/PROBABILISTIC RISK ASSESSMENT (IPE/PRA) PURPOSES THE MAXIMUM PERIOD OF TIME THE BATTERIES COULD POWER SBO LOADS.

(2) SUCCESS CRITERIA

(A) FOR 10 CFR 50.63 COMPLIANCE PURPOSES, THE BATTERIES WILL BE CONSIDERED CAPABLE OF POWERING SBO MITIGATION EQUIPMENT SO LONG AS THE BATTERY VOLTAGE REMAINS ABOVE 105 V DC (THE SAME CRITERION USED IN THE DESIGN DUTY CYCLE ANALYSES)

(B) FOR IPE/PRA PURPOSES, THE STATION BATTERIES ARE CONSIDERED CAPABLE OF POWERING SBO LOADS SO LONG AS THE BATTERY VOLTAGE REMAINS ABOVE 101.5 V DC. THE 101.5 V CRITERION IS HIGHER THAN THE MINIMUM REQUIRED VOLTAGES GIVEN IN REFERENCE NOS. 2 AND 3.

(3) ASSUMPTIONS

(1) ALL CALCULATIONS REFLECT THE CURRENT FIFTY-EIGHT (58) CELL CONFIGURATION OF 71SB-1 AND 71SB-2. THE 105 V DC SUCCESS CRITERION USED FOR 10 CFR 50.63 COMPLIANCE CALCULATIONS CORRESPONDS TO A FINAL VOLTS PER CELL OF 1.81 V DC. THE 101.5 VDC CRITERION USED FOR THE IPE/PRA ANALYSES CORRESPONDS TO A FINAL V PC OF 1.75 V DC.

(2) EXCEPT AS NOTED HEREIN, (EQUIPMENT) LOAD, CURRENT AND (LOAD) DURATION DATA ARE TAKEN FROM REFERENCE NOS. 2 AND 3.

(3) LOAD SHEDDING IS BASED ON F-AOP-49, REFERENCE NO. 4.

(4) THE STATION BATTERIES ARE SIZED IN ACCORDANCE WITH THE METHODOLOGY GIVEN IN IEEE STANDARD No. 485, REFERENCE NO. 5.

(5) BATTERY DISCHARGE CHARACTERISTICS ARE TAKEN FROM MANUFACTURER'S (GOULD'S) DATA, REFERENCE NOS. 6 AND 10.

(6) THE 10 CFR 50.63 ANALYSES CONSERVATIVELY ASSUME THE FOLLOWING:

- AN INITIAL ELECTROLYTE TEMPERATURE OF 60°F
- BATTERY END-OF-LIFE (EOL) CONDITIONS

THE LOW INITIAL ELECTROLYTE TEMPERATURE ASSUMPTION RESULTS IN APPLICATION OF A 10% CORRECTION FACTOR ON THE CALCULATED REQUIRED CAPACITY. THE EOL ASSUMPTION RESULTS IN APPLICATION OF A 25% CORRECTION FACTOR*.

(7) THE IPE/PRA CALCULATIONS ARE PERFORMED BOTH WITH AND WITHOUT THE ELECTROLYTE TEMPERATURE AND EOL CORRECTION FACTORS.

4.0 ANALYSES

A TOTAL OF SIX CALCULATIONS ARE ANALYZED, THREE FOR EACH BATTERY. ONE 'PAIR' OF CALCULATIONS REPRESENT THE "ANALYSES" OF RECORD FOR COMPLIANCE WITH THE SBO RULE FOR EACH BATTERY. THE REMAINING CALCULATIONS ARE PERFORMED TO ESTIMATE BATTERY CAPACITY (LIFETIME) UNDER SBO CONDITIONS FOR IPE/PRA PURPOSES.

4.1 ANALYSES OF 71SB-1

4.1.1 10 CFR 50.63 COMPLIANCE

AS DETAILED IN REFERENCE NOS. 7 AND 8, JAF IS REQUIRED TO DEMONSTRATE THE CAPABILITY TO COPE WITH A SBO EVENT FOUR HOURS IN DURATION; HENCE THIS ANALYSIS CONSIDERS A FOUR HOUR EXPOSURE TIME.

TABLE 1 OF REFERENCE NO. 3 PROVIDES A LIST OF LOADS, CURRENTS, AND LOAD DURATIONS FOR THE DESIGN DUTY CYCLE CASE. THAT PROFILE (CURRENT DRAW VICE TIME) IS BASED ON AN ASSUMED LARGE BREAK LOCA COINCIDENT WITH A LOSS-OF-OFFSITE POWER AND EFFECTIVE LOSS OF THE 'A' BATTERY CHARGER FOR TWO HOURS. WITH THE EXCEPTIONS NOTED BELOW, THE DESIGN DUTY CYCLE LOAD PROFILE SERVES AS THE BASES FOR ANALYSIS OF SBO BATTERY CAPACITY.

FROM REFERENCE NO. 3, TABLE 2, THE DESIGN DUTY CYCLE LOAD PROFILE IS:

TIME INTERVAL (MIN)	CURRENT (AMPS)
0-1	694 *
1-2	626
3-60	587
61-119	423
119-120	431

* THE 694 A VALUE IS THE HIGHEST CURRENT DEMAND DURING THE FIRST MINUTE.

THE SBO LOAD PROFILE DIFFERS FROM THE DESIGN DUTY CYCLE PROFILE IN THE FOLLOWING AREAS:

(1) THE SBO PROFILE ASSUMES LOAD SHEDDING IN ACCORDANCE WITH AOP-49,

(2) THE SBO PROFILE ASSUMES CONTINUOUS RCIC OPERATION,

(3) THE SBO PROFILE IS BASED ON THE REQUIRED COPING DURATION OF FOUR HOURS.

(4) THE SBO PROFILE CONSIDERS EDG LOADS AND BREAKER RECLOSURE LOADS (FOR RESTORATION OF AC POWER FROM THE 115 KV SYSTEM) AS RANDOM LOADS.

ADJUSTMENTS TO THE DESIGN DUTY CYCLE PROFILE TO REFLECT THE ABOVE SBO-SPECIFIC CONSIDERATIONS ARE DISCUSSED BELOW.

LOAD SHEDDING

THE LOADS SHED FROM 71SB-1 ARE GIVEN IN AOP-49 AND SUMMARIZED IN TABLE 2 OF ATTACHMENT 2 TO REFERENCE NO. 9. DATA FOR THE SHED LOADS IS GIVEN BELOW.

LOAD	CURRENT (A)	TIME SHED (MIN)
94P-13	74	30
31P-7A	58	30
DC LIGHTING	47.12 **	30
71AC-UPS	271 *	60

* THE CURRENT DRAW FROM THE UPS IS TAKEN FROM TABLE II OF REFERENCE NO. 3 AT THE "60TH MINUTE".

** DC LIGHTING PANELS EADC-1, ESWDC-1, E1 AND ERDC2 ARE SHED. THE CURRENT DRAW ASSOCIATED WITH THOSE PANELS IS ESTIMATED AS FOLLOWS:

CONTINUOUS AC CURRENT = $\frac{5900\ W}{120\ V} = 49.17\ A_{AC}$

CONTINUOUS DC CURRENT = $\frac{115\ VDC}{120\ VAC}(49.17) = 47.12\ A$

THE 115 V DC VOLTAGE IS AN ASSUMPTION (BASED ON BATTERY BUS VOLTAGE THIRTY MINUTES INTO THE DESIGN DUTY CYCLE)

SUBTRACTING THE CURRENT DEMANDS ASSOCIATED WITH SHED LOADS FROM THE DESIGN DUTY CYCLE YIELDS THE FOLLOWING PROFILE:

TIME INTERVAL (MIN)	CURRENT (AMPS)
0-1	694
1-2	626
2-30	587
31-60	408
61-120	137

RCIC OPERATION

REFERENCE NO. 3 ALREADY CONSIDERS CONTINUOUS 'RUN' LOADS FOR 13P-3 AND 13P-4 SO THERE IS NO NEED TO ADJUST THE DESIGN DUTY CYCLE PROFILE FOR SBO CONSIDERATIONS.

EDG LOADS

REFERENCE NO. 3 ALREADY CONSIDERS THE LOADS REFLECTIVE OF SUCCESSFULL START/RUN OF A PAIR OF EDGS IN THE FIRST SECONDS OF THE PROFILE. THE DESIGN DUTY

CYCLE PROFILE REFLECTS CONTINUOUS OPERATION OF THE GOVERNOR BOOSTER PUMPS (93GS-5A AND 5C) AS WELL AS THE FUEL OIL PUMPS (93 P-4A AND 4C). THE SBO PROFILE ALSO ASSUMES CONTINUOUS OPERATION OF THOSE PUMPS TO CONSERVATIVELY OVERESTIMATE THE CURRENT DEMAND ON 71SB-1. EDG FIELD FLASHING WILL BE TREATED AS A RANDOM LOAD OF 110 A MAGNITUDE AND 4 S DURATION IN THE SBO ANALYSES.

AC RESTORATION LOADS

RESTORATION OF POWER FROM THE 115 KV SYSTEM TO THE 10500 BUS REQUIRES RECLOSURE OF THE FOLLOWING BREAKERS:

- BRKR # 10012 FROM LINE 4 TO THE NORTH HALF OF THE 115 KV BUS (CONSERVATIVELY ASSUMING THE DISCONNECT WERE OPEN)
- 4KV BRKRS FROM RSS T4, "THROUGH" 10300, TO THE 10500 BUS

REFERENCE NO. 3 CONTAINS A 8.2A LOAD ASSOCIATED WITH 4KV BREAKER RECLOSURE (IN THE 120TH MINUTE). THE CURRENT DEMAND FOR THE 10012 BREAKER IS 11A (FROM REFERENCE NO. 3, ASSUMING THE CURRENT DEMAND FOR RECLOSURE EQUALS THE DEMAND FOR BREAKER TRIP). THE TOTAL RECLOSURE LOAD OF 19.2 A WILL BE TREATED AS A RANDOM LOAD*

THE RESULTING LOAD PROFILE IS:

TIME INTERVAL (MIN)	CURRENT (AMPS)
0-1	694
1-2	626
2-30	587
31-60	408
61-240	137

THE TOTAL RANDOM LOAD IS 129 AMPS.

THE SIZING CALCULATION FOR THE ABOVE PROFILE IS GIVEN IN ATTACHMENT 2. THE REQUIRED POSITIVE PLATES PER CELL IS 12.21 OR 13, THE AVAILABLE PPC IS 16.

4.1.2 IPE/IPRA ANALYSIS WITH PENALTIES

THE LOAD PROFILE USED IN THE 10 CFR 50.63 CALCULATION IS EXTENDED TO EIGHT HOURS BY ASSUMING CONSTANT CURRENT DEMAND AFTER SIXTY (60) MINUTES. A SUCCESS CRITERION OF 101.5 VDC (1.75 VPC) IS USED. AS SHOWN IN ATTACHMENT 3, 71SB-1 IS CAPABLE OF POWERING SBO LOADS FOR IN EXCESS OF EIGHT HOURS ASSUMING LOAD SHEDDING PER AOP-49 AND CONSERVATIVELY ASSUMING INITIAL LOW ELECTROLYTE TEMPERATURE AND BATTERY EOL CONDITIONS.

4.1.3 IPE/PRA ANALYSIS WITHOUT PENALTIES

ATTACHMENT 4 SHOWS 715B-1 IS CAPABLE OF POWERING SBO LOADS FOR IN EXCESS OF 12 HOURS ASSUMING LOAD SHEDDING PER AOP-49 BUT NOT APPLYING EOL AND LOW ELECTROLYTE TEMPERATURE CORRECTION FACTORS

4.2 ANALYSES OF 715B-2

4.2.1 10 CFR 50.63 COMPLIANCE

THE DESIGN DUTY CYCLE LOAD PROFILE FOR 715B-2 IS TAKEN FROM TABLE 1 OF REFERENCE NO. 2:

TIME INTERVAL (MIN)	CURRENT (AMPS)
0-1	588*
1-2	735
2-60	445
61-119	171
120	178

* THE 588A VALUE IS THE HIGHEST CURRENT DEMAND DURING THE FIRST MINUTE

ADJUSTMENTS TO THE ABOVE PROFILE TO REFLECT SBO-SPECIFIC CONSIDERATIONS ARE DISCUSSED BELOW.

LOAD SHEDDING

THE LOADS SHED FROM 115B-2 ARE GIVEN IN AOP-49 AND SUMMARIZED IN TABLE 5 OF ATTACHMENT 1 TO REFERENCE NO. 9. DATA FOR THE SHED LOADS ARE GIVEN BELOW.

LOAD	CURRENT (A)	TIME SHED (MIN)
94P-2	172	30
31P-7B	58	30
DC LIGHTING*	67	30

* DC LIGHTING PANELS EADC-2, EHB1, ERDC3, AND ERW1 ARE SHED. THE CURRENT DRAW ASSOCIATED WITH THOSE PANELS IS ESTIMATED AS FOLLOWS:

$$\text{CONTINUOUS AC CURRENT} = \frac{8400\,W}{120\,V} = 70\,A_{AC}$$

$$\text{CONTINUOUS DC CURRENT} = \frac{115\,V_{DC}}{120\,V_{AC}}(70) = 67\,A_{DC}$$

SUBTRACTING THE CURRENT LOADS ASSOCIATED WITH THE SHED EQUIPMENT FROM THE DESIGN DUTY CYCLE YIELDS THE FOLLOWING PROFILE:

TIME INTERVAL (MIN)	CURRENT (AMPS)
0-1	588
1-2	735
2-30	445
31-60	148
61-119	104
120	111

NOTE THE DESIGN DUTY CYCLE CALCULATION ASSUMES 94P-2 AND 31P-7B WERE SHED AFTER 60 MINUTES.

HPCI OPERATION

REFERENCE NO. 1 ALREADY CONSIDERS CONTINUOUS 'RUN' LOADS FOR 23P-140 AND 23P-141 SO THERE IS NO NEED TO ADJUST THE DESIGN DUTY CYCLE PROFILE FOR SBO CONSIDERATIONS.

EDG LOADS

LOADS ASSOCIATED WITH THE B AND D EDGS ARE TREATED IN THE SAME MANNER AS LOADS ASSOCIATED WITH THE A AND C MACHINES, I.E., THE GOVERNOR BOOSTER AND FUEL OIL PUMPS ARE TREATED AS CONTINUOUS LOADS AND FIELD FLASHING AS A RANDOM LOAD.

AC RESTORATION LOADS

THE LOAD ASSOCIATED WITH RESTORATION OF AC POWER FROM THE 115 KV SYSTEM TO THE 10600 BUS IS THE SAME AS FOR RESTORATION OF THE 10500 BUS; I.E., 19.2 A TREATED AS A RANDOM LOAD

THE RESULTING SBO LOAD PROFILE FOLLOWS:

TIME INTERVAL (MIN)	CURRENT (AMPS)
0-1	588
1-2	735
2-30	445
31-60	148
61-240	104

THE TOTAL RANDOM LOAD IS 129 AMPS.

THE SIZING CALCULATION FOR THE ABOVE LOAD PROFILE IS GIVEN IN ATTACHMENT 5. THE REQUIRED POSITIVE PLATES PER CELL IS 9.58, OR 10, AND THE AVAILABLE PPC IS 16.

4.2.2 IPE/PRA ANALYSIS WITH PENALTIES

THE LOAD PROFILE USED IN THE 10 CFR 50.63 CALCULATION IS EXTENDED TO EIGHT HOURS BY ASSUMING CONSTANT CURRENT DEMAND AFTER SIXTY (60) MINUTES. A SUCCESS CRITERION OF 101.5 VDC (1.75 VPC) IS USED. AS SHOWN IN ATTACHMENT 6, 715B-2 IS CAPABLE OF POWERING SBO LOADS FOR IN EXCESS OF EIGHT HOURS ASSUMING LOAD SHEDDING PER AOP-49 AND CONSERVATIVELY ASSUMING INITIAL LOW ELECTROLYTE TEMPERATURE AND BATTERY EOL CONDITIONS.

4.2.3 IPE/PRA ANALYSIS WITHOUT PENALTIES

ATTACHMENT 7 SHOWS 715B-2 IS CAPABLE OF POWERING SBO LOADS FOR IN EXCESS OF 12 HOURS ASSUMING LOAD SHEDDING PER AOP-49 BUT NOT APPLYING EOL AND LOW ELECTROLYTE TEMPERATURE CORRECTION FACTORS.

5.0 RESULTS AND CONCLUSIONS

AS SHOWN IN ATTACHMENT NOS. 2 THRONGH 7;

(A) BOTH 715B-1 AND 715B-2 ARE CAPABLE OF POWERING THEIR RESPECTIVE SBO LOADS FOR IN EXCESS OF FOUR HOURS WHILE MAINTAINING BATTERY VOLTAGE GREATER THAN OR EQUAL TO 105V DC.

(B) BOTH 715B-1 AND 715B-2 ARE CAPABLE OF POWERING THEIR RESPECTIVE SBO LOADS FOR EIGHT HOURS WHILE MAINTAINING BATTERY VOLTAGE GREATER THAN OR EQUAL TO 101.5 V DC, ASSUMING INITIAL LOW ELECTROLYTE TEMPERATURE AND BATTERY EOL CONDITIONS.

(C) BOTH 715B-1 AND 715B-2 ARE CAPABLE OF POWERING THEIR RESPECTIVE SBO LOADS FOR TWELVE HOURS WHILE MAINTAINING BATTERY VOLTAGE GREATER THAN OR EQUAL TO 101.5 VDC, ASSUMING INITIAL LOW ELECTROLYTE TEMPERATURE AND BATTERY EOL (CONDITION) CORRECTION FACTORS ARE NOT APPLICABLE.

6.0 REFERENCES

(1) JAFNPP UFSAR SECTION 8.7

(2) NYPA CALCULATION JAF-CALC-ELEC-00427, REVISION 0, "125 V DC VOLTAGE DROP: BATTERY B AND ASSOCIATED LOADS", JUNE 1992.

(3) NYPA CALCULATION JAF-CALC-ELEC-00426, REVISION 1, "125 V DC VOLTAGE DROP: BATTERY A AND ASSOCIATED LOADS", OCTOBER 1992.

(4) F-AOP-49, "STATION BLACKOUT", REVISION 2, DATED 21 MARCH 1990

(5) IEEE STANDARD NO. 485-1983, "RECOMMENDED PRACTICE FOR SIZING BATTERIES"

(6) GOULD INC. DRAWING NO. TC-10701, "BATTERY DISCHARGE CURVES", (A COPY IS INCLUDED AS ATTACHMENT NO. 1 TO THIS CALCULATION).

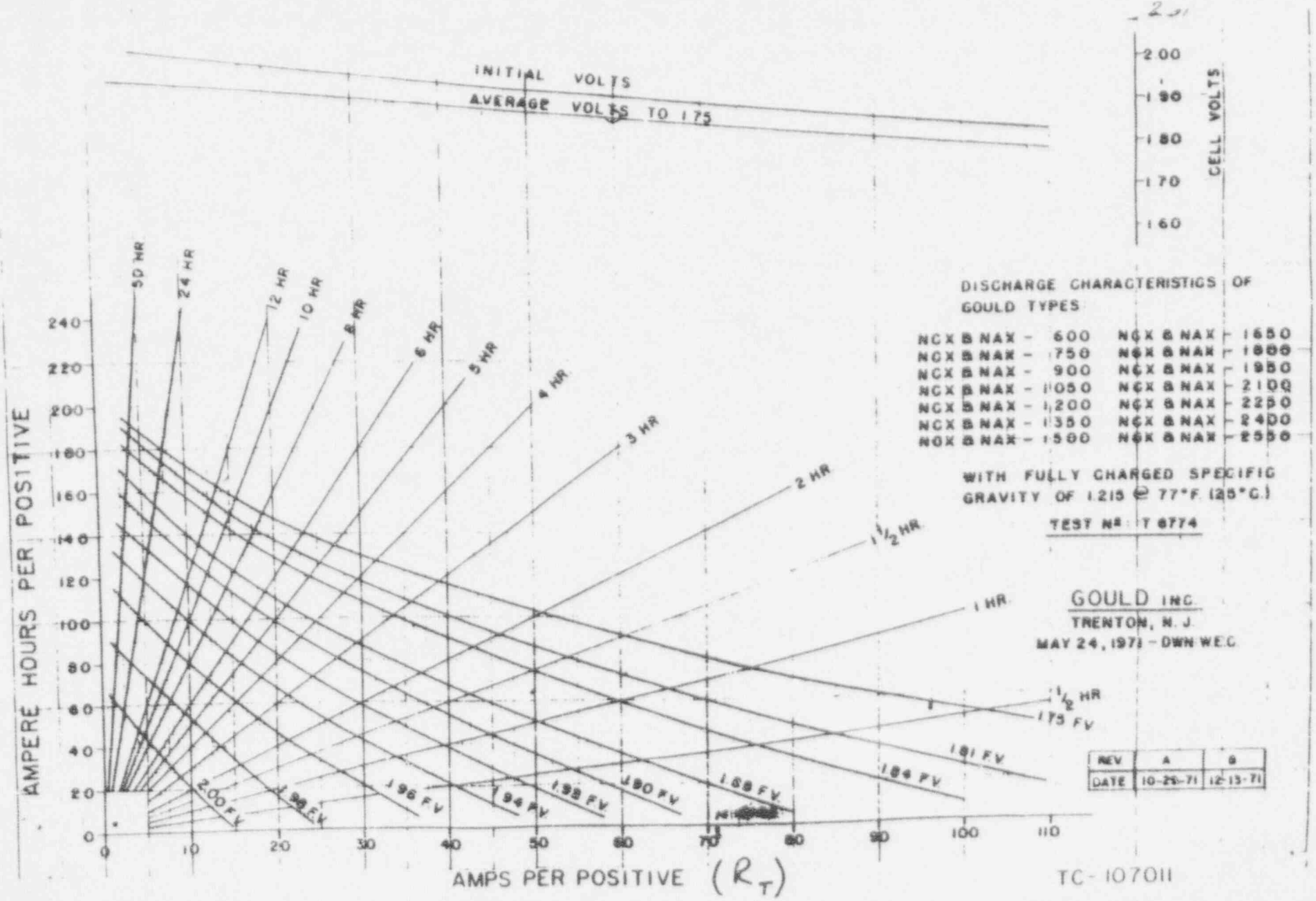
(7) NYPA CALCULATION JAF-89-048, REVISION 0, "PLANT COPING CAPABILITY UNDER SBO CONDITIONS PER NUMARC 87-00", SECTION 7

(8) NYPA CALCULATION JAF-89-012, REVISION 0, "DETERMINATION OF REQUIRED (SBO) COPING DURATION PER NUMARC 87-00"

(9) NYPA LETTER JPN-91-049, 13 SEPTEMBER 1991

(10) GOULD BATTERY DATA (A COPY IS INCLUDED AS ATTACHMENT NO. 9 TO THIS CALCULATION)

ATTACHMENT NO. 1



DISCHARGE CHARACTERISTICS OF GOULD TYPES

NCX & NAX - 600	NCX & NAX - 1650
NCX & NAX - 750	NCX & NAX - 1800
NCX & NAX - 900	NCX & NAX - 1950
NCX & NAX - 1050	NCX & NAX - 2100
NCX & NAX - 1200	NCX & NAX - 2250
NCX & NAX - 1350	NCX & NAX - 2400
NCX & NAX - 1500	NCX & NAX - 2550

WITH FULLY CHARGED SPECIFIC GRAVITY OF 1.215 @ 77°F (25°C.)

TEST NO. T 6774

GOULD INC.
TRENTON, N. J.
MAY 24, 1971 - DWN W.E.C.

REV	A	B
DATE	10-25-71	12-13-71

TC-107011

Project JAF-CALC-ELEC-00868 Date 15JAN93 Page 17 OF 26

Lowest Expected Electrolyte Temp °F 60 Minimum Cell Voltage 1.81 Cell Mfg GOULD Cell Type NCX 2400 Sized By KJV

AT#2 715B-1 '50.63) COMPUTER WORK

(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= 694	A1−0= 694	M1= 1	T=M1= 1	124	5.60	***
					Sec 1 Total	5.60	***
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3							
1	A1= 694	A1−0= 694	M1= 1	T=M1+M2= 2	124	5.60	
2	A2= 626	A2−A1= 68	M2= 1	T=M2= 1	124		0.55
					Sec 2 Sub Tot Total	5.05	***
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4							
1	A1= 694	A1−0= 694	M1= 1	T=M1+M2+M3= 30	85	8.16	
2	A2= 626	A2−A1= 68	M2= 1	T=M2+M3= 29	83		0.80
3	A3= 587	A3−A2= 59	M3= 28	T=M3= 28	83		0.46
					Sec 3 Sub Tot Total	6.91	***
Section 4 — First Four Periods Only — If A5 is greater than A4, go to Section 5.							
1	A1= 694	A1−0= 694	M1= 1	T=M1+ M4= 60	66	10.52	
2	A2= 626	A2−A1= 68	M2= 1	T=M2+M3+M4= 59	66		1.03
3	A3= 587	A3−A2= 59	M3= 28	T=M3+M4= 58	66		0.54
4	A4= 408	A4−A3= 179	M4= 30	T=M4= 30	85		2.10
					Sec 4 Sub Tot Total	6.79	***
Section 5 — First Five Periods Only — If A6 is greater than A5, go to Section 6.							
1	A1= 694	A1−0= 694	M1= 1	T=M1+ M5= 240	28	24.79	
2	A2= 626	A2−A1= 68	M2= 1	T=M2+ M5= 239	28		2.43
3	A3= 587	A3−A2= 59	M3= 28	T=M3+M4+M5= 238	28		1.34
4	A4= 408	A4−A3= 179	M4= 30	T=M4+M5= 210	32		3.34
5	A5= 137	A5−A4= 271	M5= 180	T=M5= 180	76		1.33
					Sec 5 Sub Tot Total	7.84	***
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= 129	AR−0= 129	MR= 1	T=MR= 124	124	1.04	***

Maximum Section Size (8) 7.84 + Random Section Size (9) 1.04 = Uncorrected Size — (US) (10) 5.88
US (11) 5.88 x Temp Corr (12) 1.1 x Design Marg (13) 1.0 x Aging Factor (14) 1.25 = (15) 12.21
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 13 (A) — Positive Plates.

(B) — Ampere Hours. Therefore cell (17) _____ is required.

Fig 3
Cell Sizing Work Sheet

Lowest Expected Electrolyte Temp °F 60 Minimum Cell Voltage 1.75 Cell Mfg GOULD Cell Type NCX-2400 Sized By KJV

ATT # 715B-IPE/PA w/ PENALTI 8 HRS

(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= 694	A1–0= 694	M1= 1	T=M1= 1	160	4.34	...
					Sec 1 Total	4.34	...
Section 2 – First Two Periods Only – If A3 is greater than A2, go to Section 3.							
1	A1= 694	A1–0= 694	M1= 1	T=M1+M2= 2	160	4.34	
2	A2= 626	A2–A1= −68	M2= 1	T=M2= 1	160		0.425
					Sec 2 Sub Tot		
					Total	3.91	...
Section 3 – First Three Periods Only – If A4 is greater than A3, go to Section 4.							
1	A1= 694	A1–0= 694	M1= 1	T=M1+M2+M3= 30	102	6.80	
2	A2= 626	A2–A1= −68	M2= 1	T=M2+M3= 29	102		0.667
3	A3= 587	A3–A2= −39	M3= 28	T=M3= 28	102		0.38
					Sec 3 Sub Tot		
					Total	5.75	...
Section 4 – First Four Periods Only – If A5 is greater than A4, go to Section 5.							
1	A1= 694	A1–0= 694	M1= 1	T=M1+ M4= 60	75	9.25	
2	A2= 626	A2–A1= −68	M2= 1	T=M2+M3+M4= 59	75		0.41
3	A3= 587	A3–A2= −39	M3= 28	T=M3+M4= 58	75		0.52
4	A4= 408	A4–A3= −179	M4= 30	T=M4= 30	102		1.73
					Sec 4 Sub Tot		
					Total	6.07	...
Section 5 – First Five Periods Only – If A6 is greater than A5, go to Section 6.							
1	A1= 694	A1–0= 694	M1= 1	T=M1+ M5= 420	18.75	37.01	
2	A2= 626	A2–A1= −68	M2= 1	T=M2+ M5= 419	18.75		3.63
3	A3= 587	A3–A2= −39	M3= 28	T=M3+M4+M5= 478	18.75		3.08
4	A4= 408	A4–A3= −179	M4= 30	T=M4+M5= 450	19.38		4.03
5	A5= 137	A5–A4= −271	M5= 420	T=M5= 420	20.81		13.92
					Sec 5 Sub Tot		
					Total	9.23	...
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= 129	AR–0= 129	MR= 1	T=MR= 1	160	0.81	...

Maximum Section Size (8) 9.23 + Random Section Size (9) 0.81 = Uncorrected Size – (US) (10) 10.04
US (11) 10.04 × Temp Corr (12) 1.1 × Design Marg (13) 1.0 × Aging Factor (14) 1.25 = (15) 13.81
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 14 (A) – Positive Plates.

(B) – Ampere Hours. Therefore cell (17) _____ is required.

Fig 3
Cell Sizing Work Sheet

Project JAF-CALC-ELEC-00868 Date 15JAN93 Page 19 OF 26

Lowest Expected Electrolyte Temp °F 70 Minimum Cell Voltage 1.75 Cell Mfg GOULD Cell Type NCX2400 Sized By KJV

AT #4 715B-1 IPE/PR W/O PENALTI 12 HR=

(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=694	A1-0=694	M1= 1	T=M1= 1	160	4.34	...
					Sec 1 Total	4.34	...
Section 2 – First Two Periods Only – If A3 is greater than A2, go to Section 3							
1	A1=694	A1-0=694	M1= 1	T=M1+M2= 2	160	4.34	
2	A2=626	A2-A1=-68	M2= 1	T=M2= 1	160		0.425
					Sec 2 Sub Tot Total	3.91	...
Section 3 – First Three Periods Only – If A4 is greater than A3, go to Section 4							
1	A1=694	A1-0=694	M1= 1	T=M1+M2+M3=30	102	6.80	
2	A2=626	A2-A1=-68	M2= 1	T=M2+M3= 29	102		0.67
3	A3=587	A3-A2= -54	M3= 28	T=M3= 28	102		0.55
					Sec 3 Sub Tot Total	5.75	...
Section 4 – First Four Periods Only – If A5 is greater than A4, go to Section 5							
1	A1=694	A1-0=694	M1= 1	T=M1+ M4= 60	75	9.25	
2	A2=626	A2-A1=-68	M2= 1	T=M2+M3+M4=59	75		0.91
3	A3=587	A3-A2=-39	M3= 28	T=M3+M4= 58	75		0.52
4	A4=408	A4-A3= -179	M4= 30	T=M4= 30	102		1.75
					Sec 4 Sub Tot Total	6.07	...
Section 5 – First Five Periods Only – If A6 is greater than A5, go to Section 6.							
1	A1=694	A1-0=694	M1= 1	T=M1+ M5=720	13.5	51.41	
2	A2=626	A2-A1=-68	M2= 1	T=M2+ M5=719			5.04
3	A3=587	A3-A2=-39	M3= 28	T=M3+M4+M5=718			3.59
4	A4=408	A4-A3=-179	M4= 30	T=M4+M5= 690			12.74
5	A5=137	A5-A4= -271	M5= 660	T=M5= 660			18.07
					Sec 5 Sub Tot Total	12.63	...
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=129	AR-0=129	MR= 1	T=MR= 1	160	0.81	...

Maximum Section Size (8) 12.63 + Random Section Size (9) 0.81 = Uncorrected Size – (US) (10) 13.44
US (11) 13.44 x Temp Corr (12) 1.0 x Design Marg (13) 1.0 x Aging Factor (14) 1.0 = (15) 13.44
When the cell size (15) is greater than any standard cell size, the next larger cell is required.

Required cell size (16) 14 (A) – Positive Plates

(B) – Ampere Hours. Therefore cell (17) _____ is required.

Fig 3
Cell Sizing Work Sheet

Lowest Expected Electrolyte Temp °F 60 Minimum Cell Voltage 1.81 Cell Mfg GOULD Cell Type NCX-2400 Sized By KTV

AT #5
7158-2
150.63
COMP.
4 HRS

(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= 555	A1−0= 555	M1= 1	T=M1= 1	124	XXXXXX	***
					Sec 1 Total	XXXXXX	***
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3.							
1	A1= 580	A1−0= 580	M1= 1	T=M1+M2= 2	124	4.74	
2	A2= 735	A2−A1= 155	M2= 1	T=M2= 1	124	1.19	
					Sec 2 Sub Tot Total	5.93	***
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4.							
1	A1= 555	A1−0= 555	M1= 1	T=M1+M2+M3= 30	85	6.92	
2	A2= 735	A2−A1= 180	M2= 1	T=M2+M3= 29	85	1.73	
3	A3= 445	A3−A2= −290	M3= 28	T=M3= 28	85		3.41
					Sec 3 Sub Tot Total	5.24	***
Section 4 — First Four Periods Only — If A5 is greater than A4, go to Section 5.							
1	A1= 555	A1−0= 555	M1= 1	T=M1+M4= 60	66	8.91	
2	A2= 735	A2−A1= 180	M2= 1	T=M2+M3+M4= 59	66	2.23	
3	A3= 445	A3−A2= −290	M3= 28	T=M3+M4= 58	66		4.39
4	A4= 148	A4−A3= −297	M4= 30	T=M4= 30	85		3.49
					Sec 4 Sub Tot Total	3.24	***
Section 5 — First Five Periods Only — If A6 is greater than A5, go to Section 6.							
1	A1= 555	A1−0= 555	M1= 1	T=M1+M5= 240	25	21.00	
2	A2= 735	A2−A1= 180	M2= 1	T=M2+M5= 239	28	5.23	
3	A3= 445	A3−A2= −290	M3= 28	T=M3+M4+M5= 238	25		10.36
4	A4= 148	A4−A3= −297	M4= 30	T=M4+M5= 210	32		4.28
5	A5= 104	A5−A4= −44	M5= 180	T=M5= 180	31a		1.22
					Sec 5 Sub Tot Total	5.39	***
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= 129	AR−0= 129	MR= 1	T=MR= 1	124	1.04	***

Maximum Section Size (8) 5.93 + Random Section Size (9) 1.04 = Uncorrected Size — (US) (10) 6.97
US (11) 6.97 x Temp Corr (12) 1.1 x Design Marg (13) 1.0 x Aging Factor (14) 1.25 = (15) 9.58
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 10 (A) — Positive Plates.

(B) — Ampere Hours. Therefore cell (17) _____ is required.

Fig 3
Cell Sizing Work Sheet

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Lowest Expected Electrolyte Temp °F 60 Minimum Cell Voltage 1.75 Cell Mfg GOULD Cell Type NCX-2400 Sized By KTV

ATT # 715B-2 IPE/EA w/FINAL 8 HR.

(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= 588	A1−0= 588	M1= 1	T=M1= 1			***
					Sec 1 Total		***
Section 2 — First Two Periods Only — If A3 is greater than A2, go to Section 3							
1	A1= 588	A1−0= 588	M1= 1	T=M1+M2= 2	160	3.68	
2	A2= 735	A2−A1= +147	M2= 1	T=M2= 1	160	0.92	
					Sec 2 Sub Tot Total	4.60	***
Section 3 — First Three Periods Only — If A4 is greater than A3, go to Section 4							
1	A1= 588	A1−0= 588	M1= 1	T=M1+M2+M3= 30	102	5.76	
2	A2= 735	A2−A1= 147	M2= 1	T=M2+M3= 29	102	1.44	
3	A3= 445	A3−A2= −290	M3= 28	T=M3= 28	102		2.84
					Sec 3 Sub Tot Total	4.36	***
Section 4 — First Four Periods Only — If A5 is greater than A4, go to Section 5							
1	A1= 588	A1−0= 588	M1= 1	T=M1+M4= 60	75	7.84	
2	A2= 735	A2−A1= 147	M2= 1	T=M2+M3+M4= 59	75	1.96	
3	A3= 445	A3−A2= −290	M3= 28	T=M3+M4= 58	75		3.86
4	A4= 148	A4−A3= −297	M4= 30	T=M4= 30	102		2.91
					Sec 4 Sub Tot Total	3.03	***
Section 5 — First Five Periods Only — If A6 is greater than A5, go to Section 6							
1	A1= 588	A1−0= 588	M1= 1	T=M1+M5= 480	18.75	31.36	
2	A2= 735	A2−A1= 147	M2= 1	T=M2+M5= 479	18.75	7.84	
3	A3= 445	A3−A2= −290	M3= 28	T=M3+M4+M5= 478	18.75		15.47
4	A4= 148	A4−A3= −297	M4= 30	T=M4+M5= 450	19.78		13.02
5	A5= 104	A5−A4= −44	M5= 420	T=M5= 420	20.81		2.11
					Sec 5 Sub Tot Total	6.60	***
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= 129	AR−0= 129	MR= 1	T=MR= 1	160	081	***

Maximum Section Size (8) 6.60 + Random Section Size (9) 0.81 = Uncorrected Size — (US) (10) 7.41
US (11) 7.41 x Temp Corr (12) 1.0 x Design Marg (13) 1.0 x Aging Factor (14) 1.25 = (15) 10.19
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

Required cell size (16) 11 (A) — Positive Plates.

(B) — Ampere Hours. Therefore cell (17) _____ is required.

Fig 3
Cell Sizing Work Sheet

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Lowest Expected Electrolyte Temp °F 70 Minimum Cell Voltage 1.75 Cell Mfr GOULD Cell Type NCX-2400 Sized By KJV

ATT #. 715B: IPE/PRA w/o PEN 12 HRS

(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=	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= 588	A1–0= 588	M1= 1	T=M1+M2= 2	160	3.68	
2	A2= 735	A2–A1= +147	M2= 1	T=M2= 1	160	0.92	
					Sec 2 Sub Tot Total	4.60	***
Section 3 – First Three Periods Only – If A4 is greater than A3, go to Section 4							
1	A1= 588	A1–0= 588	M1= 1	T=M1+M2+M3= 30	102	5.76	
2	A2= 735	A2–A1= 147	M2= 1	T=M2+M3= 29	102	1.44	
3	A3= 445	A3–A2=	M3= 28	T=M3= 28	102		2.84
		-290			Sec 3 Sub Tot Total	4.36	***
Section 4 – First Four Periods Only – If A5 is greater than A4, go to Section 5							
1	A1= 588	A1–0= 588	M1= 1	T=M1+ M4= 60	75	7.84	
2	A2= 735	A2–A1= 147	M2= 1	T=M2+M3+M4= 59	75	1.96	
3	A3= 445	A3–A2= 290	M3= 28	T=M3+M4= 58	75		3.87
4	A4= 148	A4–A3=	M4= 30	T=M4= 30	102		2.91
		-297			Sec 4 Sub Tot Total	3.02	***
Section 5 – First Five Periods Only – If A6 is greater than A5, go to Section 6							
1	A1= 588	A1–0= 588	M1= 1	T=M1+ M5= 720	13.5	43.56	
2	A2= 735	A2–A1= 147	M2= 1	T=M2+ M5= 719	13.5	10.89	
3	A3= 445	A3–A2= 290	M3= 28	T=M3+M4+M5= 718	13.5		21.48
4	A4= 148	A4–A3= 297	M4= 30	T=M4+M5= 690	14		21.21
5	A5= 104	A5–A4= -44	M5= 660	T=M5= 660	13		5.95
					Sec 5 Sub Tot Total	8.82	***
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= 129	AR–0= 129	MR= 1	T=MR= 1	160	0.81	***

Maximum Section Size (8) 8.83 + Random Section Size (9) 0.81 = Uncorrected Size – (US) (10) 9.63
US (11) 9.63 x Temp Corr (12) 1.0 x Design Marg (13) 1.0 x Aging Factor (14) 1.0 = (15) 9.63
When the cell size (15) is greater than a standard cell size, the next larger cell is required.

(A) – Positive Plates.

Required cell size (16) 10

(B) – Ampere Hours. Therefore cell (17) _____ is required.

Fig 3
Cell Sizing Work Sheet

ATTACHMENT 8
SUMMARY OF RESULTS

BATTERY	SUCCESS CRITERION V DC	ECV CORRECTION (YES/NO)	TEMPERATURE CORRECTION (YES/NO)	EXPOSURE (HOURS)	REQUIRED POSITIVE PLATES/CELL
7158-1	105	YES	YES	4	12.21
	101.5	YES	YES	8	13.81
	101.5	NO	NO	12	13.44
7158-2	105	YES	YES	4	9.58
	101.5	YES	YES	8	10.19
	101.5	NO	NO	12	9.63

ATTACHMENT NO. 4
(1 OF 3 PAGES)
CALC PAGE NO. 24 OF 26

General Industrial Stationary Power Cells

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

Type: NAX and NCX Antimony and Calcium

SPECIFICATIONS

Container – Styrene-Acrylonitrile Plastic
Cover – Butadiene Styrene
Separators – Micropourous Material
Retainers – Fiberglass Mats
Posts – See Below [1]
Post Seals – Floating O-Ring–Seal Nut
Vents – Gould (GNB) "Pre-Vent" ™
Level Lines – High and Low - All Jar Faces
Electrolyte – Height Above Plates – 2.75" (70 mm)
Sediment Space – 1.06" (27 mm)
Specific Gravity – 1.215 @ 77°F (25°C)
Inter-Cell Connectors – Lead Plated Copper

NAX/NCX-1650

Plate Dimensions	Height	Width	Thickness
Positive Plate	15 in 381.0 mm	12.5 in 317.5 mm	.320 in 8.13 mm
Negative Plate	15 in 381.0 mm	12.5 in 317.5 mm	.215 in 5.46 mm

[1] Posts–600 A.H. to 1200 A.H. Two–1½" square. 1350 A.H. to 1950 A.H. Four–1" square. 2100 A.H. to 2550 A.H. Four–1½" square.

PHYSICAL CHARACTERISTICS

Cell Type		Plates Per Cell	Overall Dimensions			Antimony		Calcium		Elect. Per Cell	
Antimony	Calcium		L	W	H	Dry Weight	Packed Weight	Dry Weight	Packed Weight	Gals.	Liters
NAX-600	NCX-600	9	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	173 lb 78 kg	185 lb 84 kg	177 lb 80 kg	189 lb 86 kg	6.0	25.1
NAX-750	NCX-750	11	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	191 lb 87 kg	203 lb 92 kg	195 lb 89 kg	207 lb 94 kg	5.6	23.4
NAX-900	NCX-900	13	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	209 lb 95 kg	221 lb 100 kg	213 lb 97 kg	225 lb 102 kg	5.1	21.3
NAX-1050	NCX-1050	15	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	227 lb 103 kg	239 lb 109 kg	231 lb 105 kg	243 lb 110 kg	4.9	20.5
NAX-1200	NCX-1200	17	7.38 in 194.8 mm	14.50 in 382.8 mm	22.13 in 584.2 mm	245 lb 111 kg	257 lb 117 kg	249 lb 113 kg	261 lb 119 kg	5.0	20.9
NAX-1350	NCX-1350	19	9.25 in 244.2 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	277 lb 126 kg	289 lb 131 kg	282 lb 128 kg	294 lb 134 kg	6.3	26.4
NAX-1500	NCX-1500	21	9.25 in 244.2 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	296 lb 135 kg	308 lb 140 kg	301 lb 137 kg	313 lb 142 kg	6.0	25.1
NAX-1650	NCX-1650	23	11.38 in 300.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	342 lb 155 kg	360 lb 164 kg	348 lb 158 kg	366 lb 166 kg	8.0	33.5
NAX-1800	NCX-1800	25	11.38 in 300.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	357 lb 162 kg	375 lb 170 kg	364 lb 165 kg	382 lb 174 kg	7.6	31.8
NAX-1950	NCX-1950	27	11.38 in 300.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	373 lb 170 kg	391 lb 178 kg	380 lb 173 kg	398 lb 181 kg	7.3	30.5
NAX-2100	NCX-2100	29	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	439 lb 200 kg	457 lb 208 kg	446 lb 203 kg	464 lb 211 kg	11.5	48.1
NAX-2250	NCX-2250	31	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	454 lb 206 kg	472 lb 215 kg	462 lb 210 kg	480 lb 218 kg	10.9	45.6
NAX-2400	NCX-2400	33	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	471 lb 214 kg	488 lb 222 kg	479 lb 218 kg	497 lb 226 kg	10.3	43.1
NAX-2550	NCX-2550	35	14.56 in 384.4 mm	14.50 in 382.8 mm	22.50 in 594.0 mm	488 lb 222 kg	506 lb 230 kg	496 lb 225 kg	514 lb 234 kg	9.7	40.6

NOTE – Available per IEEE 323 for Class 1E installations.

AMPERE HOUR CAPACITIES

77°F (25°C)

Cell Type		Ampere Hour Capacities To 1.75 V.P.C.					Ampere Hour Capacities To 1.81 V.P.C.				
Antimony	Calcium	8 hr	5 hr	3 hr	2 hr	1 hr	8 hr	5 hr	3 hr	2 hr	1 hr
NAX-600	NCX-600	600	540	468	408	300	568	504	428	360	264
NAX-750	NCX-750	750	675	585	510	375	710	630	535	450	330
NAX-900	NCX-900	900	810	702	612	450	852	756	642	540	396
NAX-1050	NCX-1050	1050	945	819	714	525	994	882	749	630	462
NAX-1200	NCX-1200	1200	1080	936	816	600	1136	1008	856	720	528
NAX-1350	NCX-1350	1350	1215	1053	918	675	1278	1134	963	810	594
NAX-1500	NCX-1500	1500	1350	1170	1020	750	1420	1260	1070	900	650
NAX-1650	NCX-1650	1650	1485	1287	1122	825	1562	1386	1177	990	726
NAX-1800	NCX-1800	1800	1620	1404	1224	900	1704	1512	1284	1080	792
NAX-1950	NCX-1950	1950	1755	1521	1326	975	1846	1638	1391	1170	858
NAX-2100	NCX-2100	2100	1890	1638	1428	1050	1988	1764	1498	1260	924
NAX-2250	NCX-2250	2250	2025	1755	1530	1125	2130	1890	1605	1350	990
NAX-2400	NCX-2400	2400	2160	1872	1632	1200	2272	2016	1712	1440	1056
NAX-2550	NCX-2550	2550	2295	1989	1734	1275	2414	2142	1819	1530	1122

DISCHARGE CHARACTERISTICS

AMPERES vs HOURS OF DISCHARGE TO 1.75 V.P.C. @ 77°F (25°C)

Cell Type		1 Min Rate	Discharge Time In Hours									
Antimony	Calcium	In Amps	.25	.50	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
NAX-600	NCX-600	712	515	454	300	204	156	127	108	94	83	75
NAX-750	NCX-750	880	686	561	375	255	195	158	135	117	104	93
NAX-900	NCX-900	1044	814	666	450	306	234	190	162	141	125	112
NAX-1050	NCX-1050	1204	939	768	525	357	273	222	189	164	146	131
NAX-1200	NCX-1200	1306	1060	867	600	408	312	254	216	188	166	150
NAX-1350	NCX-1350	1494	1165	953	675	459	351	285	243	211	187	168
NAX-1500	NCX-1500	1620	1263	1033	750	510	390	317	270	235	208	187
NAX-1650	NCX-1650	1782	1389	1136	825	561	429	349	297	258	229	206
NAX-1800	NCX-1800	1932	1506	1232	900	612	468	381	324	282	250	225
NAX-1950	NCX-1950	2080	1622	1327	975	663	507	412	351	305	271	243
NAX-2100	NCX-2100	2240	1747	1429	1050	714	546	444	378	329	292	262
NAX-2250	NCX-2250	2400	1872	1531	1125	765	585	476	405	352	312	281
NAX-2400	NCX-2400	2560	1996	1633	1200	816	624	508	432	376	333	300
NAX-2550	NCX-2550	2720	2121	1735	1275	867	663	539	459	399	354	318

NOTE: All ratings include voltage drop across intercell connections used in standard layouts.

Attachment II to JPN - 93 - 025

April 7, 1993

STATION BLACKOUT RULE

Comparison of SBO Procedure to NUMARC 87-00 Guidance

New York Power Authority

James A. FitzPatrick Nuclear Power Plant

Docket Number 50-333

New York Power Authority
Attachment II to JPN - 93 - 025
James A. FitzPatrick Nuclear Power Plant
Comparison of Procedure AOP-49,"Station Blackout" to NUMARC 87-00

Reference: "Guidelines and Technical Bases for NUMARC Initiatives Addressing Blackout at Light Water Reactors", NUMARC 87-00, revision 1, August 1991,
Chapter 4. "Station Blackout Response Procedures",
Section 4.2 "Operating Procedure Guidelines",
Subsection 4.2.1 "Station Blackout Response Guidelines"
(NUMARC Station Blackout Initiative 2.a)

Review: Abnormal Operating Procedure (AOP) 49 "Station Blackout", Revision 2 dated 3/21/90 was compared to the guidelines of the referenced NUMARC 87-00 criteria. The format for the review documentation below uses the numbering scheme of the NUMARC reference and quotes the criteria for each section. This is followed by identification of the step in AOP-49 which satisfies the criteria, or an explanation of why the criteria is not addressed in AOP-49.

4.2.1 Station Blackout Response Guidelines

(1) *Plant procedures should identify site-specific actions necessary to restore off site or standby (Class 1E) AC power sources. If an AAC power source is available it should be started as soon as possible. Plants relying on AAC power sources should start the AAC power source and commence loading shutdown equipment within the first hour of a station blackout.*

These actions include:

(a) *Early commitment of available staff to restore AC power*

Steps C.4 and C.6.k

(b) *Isolating the shutdown bus to be loaded onto the AAC system from the preferred power supply and blacked out unit's Class 1E power sources*

Not applicable because JAF does not utilize an alternate AC power supply.

(c) *Starting and/or preparing the AAC source for loading*

Not applicable because JAF does not utilize an alternate AC power supply.

(d) *Transferring the designated shutdown bus to the AAC system*

Not applicable because JAF does not utilize an alternate AC power supply.

(2) *Plant procedures should specify actions necessary to assure that shutdown equipment (including support systems) necessary in a station blackout can operate without AC power.*

Steps C.6.a through C.6.k

(3) *Plant procedures should recognize the importance of AFWS/HPCIS/HPCS/RCICS during the early stages of the event and direct the operators to invest appropriate attention to assuring its continued, reliable operation throughout the transient since this ensures decay heat removal.*

Step C.1 directs the operators to enter Emergency Operating Procedure (EOP) 2. EOP-2 "RPV Control" provides guidance to the operator for monitoring and controlling reactor power, reactor pressure vessel pressure, and water level including the use of HPCI and RCIC. Step C.6 addresses alternate means of providing for essential equipment (including HPCI and RCIC) cooling and operation.

(4) *Plant procedures should identify the sources of potential reactor inventory loss, and specify actions to prevent or limit significant loss.*

Step C.1 directs the operators to EOP-2. Step C.5 provides for hydraulic isolation of the reactor water recirculation pumps.

(5) *Plant procedures should ensure that a flow path is promptly established for makeup flow from the CST to the steam generator/nuclear boiler and identify backup water sources to the CST in order of intended use. Additionally, plant procedures should specify clear criteria for transferring to the next preferred source of water.*

Step C.1 directs the operators to EOP-2. Steps C.6.g blocks the automatic transfer of HPCI pump suction to the torus. Step C.6.h. directs operators to use of the CST supply so long as it is available.

(6) *Plant procedures should identify individual loads that need to be stripped from the plant DC buses (both Class 1E and non-Class 1E) for the purpose of conserving DC power.*

Step C.7 provides specific direction for reducing station battery loads to extend battery life.

(7) *Plant procedures should specify actions to permit appropriate containment isolation and safe shutdown valve operations while AC power is unavailable.*

Step B.2 identifies the automatic Group I and Group II isolation following a plant scram, (all applicable valves fail safe or at least one valve in all other lines is normally closed).

(8) *Plant procedures should identify the portable lighting necessary for ingress and egress to plant areas containing shutdown or AAC equipment requiring manual operation.*

A note in Step C.6 identifies the location of portable battery powered lanterns.(9) *Plant procedures should consider the effects of AC power loss on area access, as well as the need to gain entry to other locked areas where remote equipment operation is necessary.*

A note in Step 6.a. reminds the operators that door keys will be required for areas with card reader controlled access. Step C.6.b directs operators to open all fire doors for the RCIC, HPCI and LPCI inverter enclosures.

(10) *Plant procedures should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in a station blackout).*

Steps C.6.a, C.6.b, C.6.c and C.6.d

(11) *Plant procedures should consider habitability requirements at locations where operators will be required to perform manual operations.*

Control room and relay room temperature calculations were performed to demonstrate continued habitability. A warning concerning possible steam leakage in the HPCI and RCIC turbine areas is provided following Step C.6.h

(12) *Non-Class 1E equipment relied upon to cope for the required station blackout duration should be addressed in a maintenance program.*

The only non-class 1E equipment used is RCIC which is a quality assurance category M system. Preventive maintenance for category M equipment is addressed in Work Activity Control Procedure (WACP) 10.1.15 "Control of Preventive Maintenance."

(13) *Plant procedures should consider loss of heat tracing effects for equipment required to cope with a station blackout. Alternate steps, if needed, should be identified to supplement planned action.*

Not applicable because JAF does not rely on heat tracing for station blackout equipment.

4.2.2 AC Power Restoration

(1) *Load dispatchers should give the highest possible priority to restoring power to nuclear units. Procedures and training should consider several potential methods of transmitting power from black start capable units to the nuclear plant.*

This guideline is not addressed by AOP-49. The transmission lines for off site power are controlled by another utility, Niagara Mohawk Power Corporation (NMPC). In cooperation with the New York Power Pool, NMPC established "Major Power Failure Restoration Instructions" CS-101.3 revised 12/1/91. This procedure addresses power restoration from hydroelectric facilities to the Nine Mile Point I Nuclear Power Plant operated by NMPC. The procedure would also assure prompt restoration of off site power to the James A. FitzPatrick Nuclear Power Plant because it derives off site power from the same ring bus as the Nine Mile Point I plant.

(2) *Should incoming transmission lines to a nuclear power plant be damaged, high priority should be assigned to repair and restoration activities to at least one line capable of feeding shutdown equipment.*

(3) *Repair crews engaging in power restoration activities for nuclear units should be given high priority for manpower, equipment and materials.*

These guide lines are not addressed by AOP-49. The transmission lines for off site power are controlled by NMPC. Any condition causing a loss of off site power to the James A. FitzPatrick Nuclear Power plant would also result in degradation of the off site power sources to the NMPC Nine Mile Point I and II nuclear plants. NMPC crews would therefore be expected to respond with appropriate priority. In addition, the Authority has an independent line maintenance facility located in Baldwinsville, New York (approximately 40 miles from the plant site) which would be available to assist NMPC if required to assure prompt restoration.

(4) *Portable AC generators should be designated as backup sources if available and directed to nuclear power plant sites. Procedures should address pre-planned actions and identify required equipment.*

Not applicable because JAF satisfies the 4 hour SBO coping requirements.

(5) *Once preferred and/or standby (Class 1E) AC power becomes available, station procedures should specify the sequence of circuit breaker operations required to restore AC power to shutdown equipment. Any additional actions such as pulling or replacing fuses should also be identified.*

Steps C.9, C.10, and C.11