Beaver Valley Power Station
CALCULATION COVER SHEET

RTL# A1.002D

Total Pages: 8	Total Pages (Including Attachments): 49

Calculation ☒ Alternate Calculation ☐	Unit: 1	ORGANIZATION:
TITLE: Coping Duration for Station Blackout (SBO).		QA Category ☒ I-SR ☐ II ☐ III ☐ F

System	Bldg	Calculation No.	Rev	Add	Seismic: Yes ☐ No ☒
36	N/A	8700-DEC-0248	0	N/A	

Prepared by/Date	Checked by/Date	Verified by/Date
John F. Ankney 4-7-03	Paul W. Dearborn 4/8/03	Paul W. Dearborn 4/8/03
Approved by/Date		Type of Design Verification
K. Lynch 4/9/03		Design Review ☒ Other ☐ Alternate Calc. ☐ None ☐

CROSS REFERENCE DATA

TER	Not Applicable
DCP	Not Applicable
Condition Report	CR 02-07114 and CA-01
Engineering Memorandum	EM-30633
Work Order	Not Applicable
Temporary Mod.	Not Applicable
Supersedes Calc, Rev, Add	Not Applicable
Supplement Calc, Rev, Add	Not Applicable
Purchase Order No.	Not Applicable
Pipe Line No.	Not Applicable
Cable/Raceway No.	Not Applicable
Computer Program, Rev	Not Applicable
Keywords	Not Applicable
Referenced Drawings:	Not Applicable
Equipment Asset Nos-EIN	Not Applicable

DOCUMENTS AFFECTED:

UFSAR	Not Applicable
Tech Specs	Not Applicable
Operating Manual	Not Applicable
BVPS Calcs	Not Applicable
BVPS Dwgs	Not Applicable
DBD	Not Applicable
Vendor Documents	Not Applicable

REVISION STATUS SHEET			
Revision Number		Affected Sections	Description of Revision
Rev.0		N/A	Original issue of the calculation

INDEX

ATTACHMENTS

Attachments (continued)

1.0 Background/Objective:

1.1 This calculation determines the Station Blackout (SBO) coping duration using NUMARC 87-00 methodology (Attachment B). Condition Report 02-07114 identified that a previous SBO coping duration calculation was attached to Engineering Memorandum EM-30633. As stated in the Condition Report, an EM is not appropriate for documenting an engineering calculation. This calculation is being performed to officially document the SBO coping duration in a formal calculation.

2.0 Design Inputs and References:

2.1 Nuclear Management and Resources Council (NUMARC 87-00, November 1987), Section 3, Required Coping duration Category (for SBO). Guidelines and Technical Basis for NUMARC Initiatives. The following inputs were obtained from this document: ESW Group(1), Variables (b,c,h1,h2,h3,and h4) for the estimated frequency of loss of off-site power due to severe weather (SW Group), SW Group(2), off-site power design characteristic Group P2, EAC Group(C), target EDG reliability of 0.975.

2.2 10CFR50.63, "Loss of all Alternating Current Power" (Station Blackout), June 21, 1988.

2.3 Regulatory Guide 1.155, "Station Blackout", June 1988.

2.4 EM-30633, "Station Blackout Issue – NUMARC Initiatives" response dated 4-18-1988.

2.5 Condition Report CR 02-07114, "BVPS Coping Analysis Should be Calculation (Not Engineering Memorandum)" dated 8-27-2002.

2.6 E-mail Francis W Etzel to John Ankney 3-31-2003, Grid Related Loss of Off-site Power Frequency.

2.7 E-mail Douglas McBride to John Ankney 3-31-2003, Diesel Generator Reliability.

2.8 NRC letter dated November 23, 1990 to Duquesne Light Company, "Safety Evaluation Related to Station Blackout"

2.9 3BVT.36.2 Issue 1 Rev. 1 dated 12-20-2002, "Emergency Diesel Generator Reliability"

2.10 Unit 1 UFSAR Rev. 19. Paragraph 2.2.2.5, "Severe weather Phenomena"; Paragraph 8.3,"System Interconnections"; Paragraph 8.3.1 "Grid Stability Study"; Paragraph 8.5.2.2, "Diesel Generator Starting Reliability"; Figure 8.1 Sh 2 of 2, "Electrical one line diagram"; Figure 8.3-1, "Electrical Interconnections Switchyard – Power Station.

3.0 Method Of Analysis

3.1 The method of determining the SBO coping duration is shown in Section 3 of NUMARC 87-00 (Attachment B).

4.0 DESCRIPTION OF COMPUTER PROGRAM

4.1 Not Applicable

5.0 Assumptions:

5.1 Not Applicable.

6.0 Acceptance Criteria:

6.1 Not Applicable.

7.0 Body Of Analysis: The page numbers below are referenced to NUMARC 87-00

7.1 Step one (Refer to NUMARC 87-00 Page 3-2): Determine the Off-site Power Design Characteristic Group. **Note that per Attachment A memorandum from the Nuclear Utility Group on Station Blackout the generic response formats have been determined by the Staff to be an acceptable means of complying with the response requirements of the Rule, 10CFR50.63.**

7.2 Part 1.A Page 3-3: Determine **Site Susceptibility to Grid-Related Loss of Off-site** Power Events. The average occurrences per NUREG-1032 for the majority of systems is about **once per 100 site-years. Per E-mail (Attachment D) from Francis Etzel to John Ankney the grid loss of off-site power is 1 in 31.6 years for Unit 1 and 1 in 43.3 years for Unit 2. Since BV grid related loss of off-site power frequency does not exceed once per 20 years, BV is not classified P3.**

7.3 Part 1.B Page 3-4: Estimate Frequency of Loss of Off-site Power Due to Extremely Severe Weather (ESW). Use method B based upon data obtained from the National Oceanic and Atmospheric Administration (NOAA) data summarized in Table 3-2 Page 3-6. The NRC provided this data for use by the utilities and is not required to be verified by the utility. From the table for Beaver Valley, the **ESW Group is 1**.

7.4 Part 1.C Page 3-7: Determine the Estimated Frequency of Loss of Off-site Power Due to Severe Weather (SW Group). Use the following equation on Page 3-7 to determine the frequency.
f=(1.3*E–04)*h1+b*h2+(1.2*E–02)h3+c*h4
Where: b=12.5 for sites with multiple rights of way i.e. Beaver Valley
c=0 since Beaver Valley (BV) is not vulnerable to affects of salt spray
h1=45 for BV per Table 3-3 Page 3-9
h2=0.0000692 for BV per Table 3-3 Page 3-9
h3=0.03 for BV per Table 3-3 Page 3-9
h4=0 for BV per Table 3-3 Page 3-9

f=0.00585+0.000865+0.00036+0=0.007075 events per year

Based upon the above frequency of loss of off-site the **SW Group = 2** per Table 3-4 Page 3-10

7.5 Part 1D Page 3-10: Evaluate Independence of Off-site Power System. Refer to Page 3-11. **The Off-site Power System can be assigned Group I3** since "All Off-site power sources are connected to the unit's safe shutdown buses through (1) one switchyard, or(2) two or more electrically connected switchyard." and "The normal source of AC power is from the unit main generator and there is one automatic transfer and no manual transfers of all safe shutdown buses to one preferred or one alternate Off-site power source."

7.6 Part 1E Page 3-11: Determine Off-site AC Power Design Characteristic Group (P Group). Refer to Page 3-12 Table 3-6a for I3 sites. **Using the matrix for ESW=1 and SW=2 the Off-site power design Characteristic Group is P2.**

7.7 Step two:
Part 2A Page 3-15: Determine the Number of EAC Power Supplies Normally Available. Since BV is a single or multi-unit site with normally dedicated power supplies, we need to count the total number of standby power supplies normally available to the blacked-out unit's safe shutdown equipment that are not being used as an Alternate AC power source. **The total number of standby power supplies normally available is 2.**

7.8 Part 2B Page 3-15: Determine the Number of Necessary EAC Power Supplies. Since BV is a single or multi-unit site with normally dedicated power supplies, we need to count the total number of EAC standby power supplies on a per unit basis necessary to operate safe shutdown equipment following a loss of off-site power. **The total number of standby power supplies necessary is 1.**
Part 2C Page 3-16: Using Table 3-7 on Page 3-16 the EAC Group is determined to be C.

7.9 Step Three Page 3-16: **Determine the calculated EDG Reliability.** Refer to Attachment F for the original reliability tests. During the 100 start factory test, only one failure to start occurred on the first attempt for the first diesel generator set due to a pinion abutment, and no failures occurred on the first attempt for the second diesel generator. Therefore, one diesel had a 0.99 reliability and the other diesel had a 1.00 reliability. Per E-mail (Attachment E) dated 3-31-03 from the system engineer to design engineering the reliability for last diesel generator 100 starts (each diesel) has been above 97.5% for the diesels at both units. The continuing program is included in procedure 3BVT.11.36.2 and is based upon NUMARC 87-00.

7.10 Step Four, Page 3-17, Paragraph 3.2.4: Determine Allowed EDG Target Reliability. **Beaver Valley has selected a target EDG reliability of 0.975** and use this target level in their reliability program. Per E-mail (Attachment E) dated 3-31-03 from the system engineer to design engineering the reliability for last diesel generator 100 starts (each diesel) has been above 97.5% for the diesels at both units. The program is included in procedure 3BVT.11.36.2.

7.11 Step Five Page 3-19: Determine Coping Duration Category. Using Table 3-8 on Page 3-19 **for off-site power group of P2, an EAC group of C, and an allowed EDG target reliability of 0.975 the coping duration is 4 Hours.**

8.0 Benchmark Calculation

8.1 Not Applicable

9.0 Results

9.1 As shown in the Body of Analysis, the coping duration for SBO is 4 hours.

10. RECOMMENDATION

10.1 None

Calc. 8700-DEC-0248 Attach. A Page 1 of 4
Rev. 0

NUCLEAR UTILITY GROUP
ON STATION BLACKOUT

SUITE 800
1400 L STREET, N. W.
WASHINGTON, D. C. 20005-3502
TELEPHONE (202) 371-5700

M E M O R A N D U M

October 24, 1988

TO: NUMARC 87-00 Seminar Attendees

FROM: Michael Childers, NUGSBO Chairman

SUBJ: Transmittal of NUMARC 87-00 Supplemental Documents

As you were informed at the NUMARC 87-00 seminars held earlier this year,[1] NUMARC/NUGSBO has continued to work on several documents which support resolution of the station blackout issue and supplement NUMARC 87-00. These documents, copies of which are attached, include: (1) Appendix F; (2) Appendix F Topical Report; (3) generic response format for plants using alternate AC power; (4) generic response format for plants using AC independent power; (5) Questions and Answers from the NUMARC 87-00 seminars; and (6) NUMARC 87-00 Errata Sheet.

These documents have been sent to your executives along with a letter from the NRC which states that these documents provide interpretations, clarifications and methods for meeting the requirements of the station blackout rule consistent with the existing NRC station blackout Regulatory Guide (Reg. Guide 1.155) and NUMARC 87-00. The two Appendix F documents replace the existing Appendix F currently found in NUMARC 87-00, while the Questions and Answers document serves to further define and interpret how the station blackout rule may be satisfied through use of the NUMARC 87-00 document. Items found in the errata sheet are to be incorporated into NUMARC 87-00 and the generic response formats have been determined by the Staff to be an acceptable means of complying with the response requirements of the rule, 10 C.F.R. §50.63.

Please feel free to call with any questions you may have.

1/ The seminars were held on May 25 and 26 in Washington, D.C., on June 1 and 2 in Dallas, and on June 15 and 16 in San Francisco.

Calc. 8700-DEC-0248 Attach. A Pg. 2 of 4
Rev. 0

OCTOBER 1988

Errata to NUMARC 87-00

1. P. 2-7 - Section 2.5.1, should read:

   "Sources of expected PWR and BWR reactor coolant inventory loss include (1) normal system leakage, (2) losses from letdown, (3) losses due to reactor coolant pump seal leakage and (4) BWR inventory loss due to SRV cycling and ADS actuation. Expected rates of reactor coolant inventory loss under station blackout conditions are not expected to result in core uncovering for a PWR or more than a momentary core uncovering for a BWR in the four-hour time period. Therefore, makeup systems in addition to those currently available under blackout conditions are not expected to be required. As a result, it is expected that sufficient head exists to maintain core cooling under natural circulation (including reflux boiling).

2. PP. 2-12, 2-13 - delete the last four lines on page 2-12 and the first line on page 2-13 in entirety.

3. P. 2-13 - Section (3) "Control Room Habitability", second paragraph - delete the first two sentences in entirety.

Calc. 8700-DEC-0248 Rev. 0 Attach. A Pg. 3 of 4

Errata to NUMARC 87-00
Page 2

4. P. 2-14 - Section 2.7.2(3) - insert the following sentence before the last sentence:
"Additionally, it is expected that operators would act within the first hour to establish a stable independent decay heat removal mode which is a significant factor in the plant's ability to cope with a station blackout."

5. P. 2-17 - Section 2.11.2 - add to the end of the last sentence of the paragraph that begins "With EDG testing . . . ."
"following reactor shutdown."

6. P. 3-12 - Table 3-5a - matrix location (SW2, ESW2) should read "P1".

7. P. 3-13 - Table 3-5b - matrix location (SW2, ESW2) should read "P1"; matrix location (SW2, ESW3) should read "P2*".

8. P. 3-13 - Table 3-6b - matrix location (SW3, ESW3) should read "P3*".

9. P. 3-15 - Part 2.B.A. -

   insert: between "supplies" and "necessary" the following: "on a per unit basis"

   delete: "during a station blackout on a per unit basis."

Calc. 8700-DEC-0248 Attach. A Pg 4 of 4 Rev. 0

insert: "following a loss of offsite power."

10. P. 3-15 - Part 2.B.B. -

    delete: "during a station blackout for all units at the site."

    insert: "following a loss of offsite power."

11. P. 3-16 - Table 3-7 - add an asterisk after the heading "Supplies Available".

12. P. 3-16 - Table 3-7 - Note beginning with "Shared" -

    delete: "concurrently".

13. P. 3-17 - Section 3.2.3 - clarify item (1):

    "(1) CALCULATE THE MOST RECENT EDG RELIABILITY FOR EACH EDG BASED ON THE LAST 20, 50, AND 100 DEMANDS (USING DEFINITIONS AND METHODOLOGY CONTAINED IN SECTION 2 OF NSAC-108 OR EQUIVALENT)."

14. P. 3-19 - Table 3-8 - The "Required Coping Duration Category" on the last line should be "8".

15. P. 4-3 - Section 4.2.1(10)(d) - delete ", as required."

16. P. 4-10 - Section 4.3.1 - strike the last sentence of item (13).

Calc. 8700-DEC-0248 Rev. 0 Attach. B Pg. 1 of 20

3. REQUIRED COPING DURATION CATEGORY

3.1 PROCEDURE OVERVIEW

This section provides a methodology for determining the required station blackout coping duration.

3.2 PROCEDURE

Five steps are provided for determining the required coping duration category:

Step 1 <u>Determine the Off-site Power Design Characteristic Group</u>
Plant weather, grid, and switchyard features are grouped into three categories of susceptibility to losing off-site power labeled P1, P2, and P3.

Step 2 <u>Classify the EAC Power Supply System Configuration</u>
The redundancy of the emergency AC power system is evaluated and classified among four available groups labeled A, B, C, and D.

Step 3 <u>Determine the Calculated EDG Reliability</u>
The current EDG reliability is determined consistent with NSAC-108 criteria.

Step 4 <u>Determine the Allowed EDG Target Reliability</u>
Based on current EAC reliability, a method is provided for determining an acceptable EAC target reliability.

Step 5 <u>Determine Coping Duration Requirement</u>
Based on the allowed EDG target reliability determined in Step 4, a coping duration category is calculated.

3.2.1 Step One: Determine The Off-site Power Design Characteristic Group

The objective of this first step is to distinguish between sites having particular susceptibilities to losing off-site power due to plant-centered, grid-related, and weather-related events. Three off-site power design groups are provided:

P1 - Sites characterized by redundant and independent power sources that are considered less susceptible to loss as a result of plant-centered and weather-initiated events;

P2 - Sites whose off-site power sources are less redundant or independent, or that are more susceptible to extended off-site power losses due to weather-initiated events or more frequent losses due to plant-centered events; and,

P3 - Sites whose off-site power sources are (1) least redundant or independent combined with moderate severe weather potential, (2) most susceptible to extended off-site power losses due to weather-initiated or grid-related events, or (3) susceptible to grid-related events.

These categories are provided by the Staff in the draft station blackout regulatory guide and are designed to be mutually exclusive. Further discussion concerning independence of offsite sources is provided in Section 3.3.4.

THERE ARE FIVE PARTS IN STEP ONE TO DETERMINING THE OFF-SITE POWER DESIGN CHARACTERISTIC GROUP:

PART 1.A DETERMINE THE SITE SUSCEPTIBILITY TO GRID-RELATED LOSS OF OFFSITE-POWER EVENTS;

PART 1.B ESTIMATED FREQUENCY OF LOSS OF OFF-SITE POWER DUE TO EXTREMELY SEVERE WEATHER (ESW GROUP);

PART 1.C DETERMINE THE ESTIMATED FREQUENCY OF LOSS OF OFF-SITE POWER DUE TO SEVERE WEATHER (SW GROUP);

PART 1.D EVALUATE INDEPENDENCE OF OFF-SITE POWER SYSTEM (I GROUP); AND,

Calc. 8700-PEG-0248 Rev. 0 Attach. B Pg. 3 of 20

PART 1.E DETERMINE OFF-SITE AC POWER DESIGN CHARACTERISTIC GROUP (P GROUP).

Part 1.A: Determine Site Susceptibility to Grid-Related Loss of Off-site Power Events

Grid-related loss of off-site power events are defined as LOOPs that are strictly associated with the loss of the transmission and distribution system due to insufficient generating capacity, excessive loads, or dynamic instability. Although grid failure may also be caused by other factors, such as severe weather conditions or brush fires, these events are not considered grid-related since they were caused by external events.

The industry average frequency of grid-related events is approximately 0.020 per site-year, with most events isolated to a few systems. According to NUREG-1032, the average occurrence for the majority of systems is about once per 100 site-years. NUREG-1032 notes sites having a frequency of grid-related events at the once per 20 site-year frequency are limited to St. Lucie, Turkey Point, and Indian Point. Accordingly, no other sites are expected to exceed the Once per 20 site-year frequency of grid-related loss of off-site power events.

PLANTS SHOULD BE CLASSIFIED AS P3 SITES IF THE EXPECTED FREQUENCY BASED ON PRIOR EXPERIENCE OF GRID-RELATED EVENTS EXCEEDS ONCE PER 20 YEARS. THIS DOES NOT INCLUDE EVENTS OF LESS THAN 5 MINUTES DURATION. EVENTS OF LONGER DURATION MAY BE EXCLUDED IF THE RESULTS OF ANALYSIS CONCLUDES THE EVENT IS NOT SYMPTOMATIC OF UNDERLYING OR GROWING GRID INSTABILITY.

PLANTS CLASSIFIED AS P3 SITES ON THE BASIS OF GRID EXPERIENCE NEED NOT COMPLETE THE REMAINING PARTS OF THIS STEP IN ORDER TO DETERMINE COPING DURATION REQUIREMENTS.

calc. 8700-DEC-0248 Rev. 0 Attach. B   Pg. 4 of 20

Part 1.B: Estimated Frequency of Loss of Off-site Power Due to Extremely Severe Weather (ESW Group)

The estimated frequency of loss of off-site power due to extremely severe weather is determined by the annual expectation of storms at the site with wind velocities greater than or equal to 125 mph. These events are normally associated with the occurrence of great hurricanes where high windspeeds may cause widespread transmission system unavailability for extended periods. Since electrical distribution systems are not designed for these conditions, it is assumed that the occurrence of such windspeeds will directly result in the loss of off-site power.

USE METHOD "A" OR "B" BELOW TO DETERMINE THE ESTIMATED FREQUENCY OF LOSS OF OFF-SITE POWER DUE TO EXTREMELY SEVERE WEATHER AT THE SITE AND SELECT AN ESW GROUP:

A. **Site-specific data provides the most accurate source for calculating the annual frequency of storms with wind velocities greater than or equal to 125 mph, and can be used in calculating the estimated frequency of loss of off-site power due to extremely severe weather.**

Once the frequency (e) is calculated, use Table 3-1 to assign the site to an ESW Group.

Table 3-1

EXTREMELY SEVERE WEATHER GROUPS (ESW)

ESW GROUP	ANNUAL WINDSPEED EXPECTATION $\geq$ 125 MPH
1	$e < 3.3 \times 10^{-4}$
2	$3.3 \times 10^{-4} \leq e < 1 \times 10^{-3}$
3	$1 \times 10^{-3} \leq e < 3.3 \times 10^{-3}$
4	$3.3 \times 10^{-3} \leq e < 1 \times 10^{-2}$
5	$1 \times 10^{-2} \leq e$

B. If site data is not readily available to perform this calculation, the annual estimated frequency of loss of off-site power due to extremely severe weather may be derived from data recorded at local weather stations. Alternatively, a loss of off-site power frequency estimate for extremely severe weather may be based on data obtained from the National Oceanic and Atmospheric Administration (NOAA). Site-specific NOAA data is summarized in Table 3-2 along with the appropriate ESW Group.

Calc. 8700 - DEC-0248 Rev. 0 Attach. B Pg. 6 of 20

Table 3-2

EXTREMELY SEVERE WEATHER DATA[a]

SITE	STORMS 125 MPH+	ESW GROUP	SITE	STORMS 125 MPH+	ESW GROUP
ARKANSAS NUCLEAR ONE	0.0002	1	MONTICELLO	0.0003	1
ARNOLD	0.0008	2	NINE MILE POINT	0.0001	1
BEAVER VALLEY	0.0001	1	NORTH ANNA	0.0034	4
BELLEFONTE	0.0001	1	OCONEE	0.0011	3
BIG ROCK POINT	0.0001	1	OYSTER CREEK	0.005	4
BRAIDWOOD	0.001	3	PALISADES	0.0006	2
BROWNS FERRY	0.0001	1	PALO VERDE	0.0004	2
BRUNSWICK	0.013	5	PEACH BOTTOM	0.0026	3
BYRON	0.0002	1	PERRY	0.0001	1
CALLAWAY	0.0001	1	PILGRIM	0.0068	4
CALVERT CLIFFS	0.0038	4	POINT BEACH	0.0036	4
CATAWBA	0.0011	3	PRAIRIE ISLAND	0.002	3
CLINTON	0.0002	1	QUAD CITIES	0.0002	1
COMANCHE PEAK	0.0001	1	RANCHO SECO	0.0005	2
COOK	0.0006	2	RIVER BEND	0.0068	4
COOPER	0.0014	3	ROBINSON	0.0036	4
CRYSTAL RIVER	0.006	4	SALEM	0.0038	4
DAVIS-BESSE	0.0004	2	SAN ONOFRE	0.0001	1
DIABLO CANYON	0.0001	1	SEABROOK	0.0038	4
DRESDEN	0.0001	1	SEQUOYAH	0.0007	2
FARLEY	0.002	3	SHOREHAM	0.01	5
FERMI	0.0001	1	SOUTH TEXAS	0.012	5
FITZPATRICK	0.0001	1	ST LUCIE	0.017	5
FORT CALHOUN	0.0014	3	SUMMER	0.0011	3
FORT ST. VRAIN	0.0001	1	SURRY	0.006	4
GINNA	0.0001	1	SUSQUEHANNA	0.0018	3
GRAND GULF	0.004	4	THREE MILE ISLAND	0.002	3
HADDAM NECK	0.01	5	TROJAN	0.0011	3
HARRIS	0.01	5	TURKEY POINT	0.023	5
HATCH	0.0009	2	VERMONT YANKEE	0.0034	4
HOPE CREEK	0.0038	4	VOGTLE	0.0006	2
INDIAN POINT	0.0079	4	WATERFORD	0.0068	4
KEWAUNEE	0.0036	4	WATTS BAR	0.0001	1
LASALLE	0.0002	1	WNP-2	0.0001	1
LIMERICK	0.002	3	WOLF CREEK	0.0003	1
MAINE YANKEE	0.0028	3	YANKEE ROWE	0.0056	4
MCGUIRE	0.0001	1	ZION	0.0001	1
MILLSTONE	0.012	5			

Note (a): NRC STAFF PROVIDED THE DATA IN TABLE 3-2 USING CLIMATOLOGICAL SOURCES CITED IN THE REFERENCES TO THIS PROCEDURE. NUMARC HAS NOT VERIFIED THE ACCURACY OF THIS DATA.

Part IC: Determine the Estimated Frequency of Loss of Off-site Power Due to Severe Weather (SW Group)

Four factors are used to calculate the estimated frequency of loss of off-site power due to severe weather:

(1) *Annual expectation of snowfall for the site, in inches [h_1];*

(2) *Annual expectation of tornadoes of severity f2 or greater at the site (i.e., windspeeds greater than or equal to 113 miles per hour), in events per square mile [h_2];*

(3) *Annual expectation of storms for the site with wind velocities between 75 and 124 mph [h_3]; and,*

(4) *Annual expectation of storms with significant salt spray for the site [h_4].*

These factors are combined in the following relationship to yield the estimated frequency of loss of off-site power due to severe weather:

$$f = (1.3 \times 10^{-4}) * h_1 + b * h_2 + (1.2 \times 10^{-2})\, h_3 + c * h_4$$

where:

b	=	*12.5 for sites with multiple rights of way*
b	=	*72.3 for sites with a single right of way*
c	=	*0.78 if site is vulnerable to effects of salt spray*
c	=	*0 for other sites*

Sites which are determined to be susceptible to the effects of salt spray may remedy this situation through design or procedures to minimize the loss of off-site power.

DETERMINE THE ESTIMATED FREQUENCY OF LOSS OF OFF-SITE POWER DUE TO SEVERE WEATHER AS FOLLOWS:

A. Determine the total amount of snowfall in inches which falls on the site in any year. NOAA data for snowfall are provided in Table 3-3. Label the data used as h_1.

B. Determine the expected frequency of "f2+" tornadoes per square mile for the site using plant-specific data. NSSFC data are also provided in Table 3-3. Label the data used as h_2.

C. Determine the expected frequency of storms with winds between 75 and 124 mph at the site. NOAA data are also provided in Table 3-3. Label the data used as h_3.

D. Determine the expected frequency of hurricanes and tropical storms with significant salt spray for the site. NOAA data for sites vulnerable to the effects of salt spray are also provided in Table 3-3. Label the data used as h_4.

E. Calculate the estimated frequency of loss of off-site due to severe weather, f, in events per year.

F. Use Table 3-4 to determine the Severe Weather Group (SW Group).

Calc. 8700-DEC-0248 Rev. 0 Attach. B Pg. 9 of 20

Table 3-3

SEVERE WEATHER DATA[b]

SITE	SNOWFALL (h1)	TORNADO (h2)	STORMS (h3)	SALT SPRAY (h4)
ARKANSAS NUCLEAR ONE	6	[illegible]	[illegible]	0
ARNOLD	30	0.0000257	0.25	0
BEAVER VALLEY	45	0.0000692	0.03	0
BELLEFONTE	4	0.0000251	[illegible]	0
BIG ROCK POINT	97	[illegible]	0.006	0
BRAIDWOOD	40	[illegible]	0.08	0
BROWNS FERRY	4	0.000405	0.09	0
BRUNSWICK	2	[illegible]	0.12	0
BYRON	35	0.000118	0.01	0
CALLAWAY	24	[illegible]	0.05	0
CALVERT CLIFFS	9	0.0000077	0.082	0
CATAWBA	6	[illegible]	0.12	0
CLINTON	28	[illegible]	0.1	0
COMANCHE PEAK	4	[illegible]	0.05	0
COOK	40	[illegible]	0.1	0
COOPER	30	[illegible]	0.5	0
CRYSTAL RIVER	0	[illegible]	0.1	0
DAVIS-BESSE	30	[illegible]	0.11	0
DIABLO CANYON		[illegible]	0.02	0
DRESDEN	40	[illegible]	0.08	0
FARLEY	0	[illegible]	0.05	0
FERMI	32	[illegible]	0.05	0
FITZPATRICK	[illegible]	0.0000057	0.06	0
FORT CALHOUN	29	0.00094	0.5	0
FORT ST. VRAIN	59	[illegible]	0.02	0
GINNA	[illegible]	0.0000054	0.06	0
GRAND GULF	1	[illegible]	0.05	0
HADDAM NECK	27	[illegible]	0.08	0
HARRIS	[illegible]	[illegible]	0.15	0
HATCH	0	[illegible]	0.072	0
HOPE CREEK	22	[illegible]	0.046	0
INDIAN POINT	29	[illegible]	[illegible]	0
KEWAUNEE	40	[illegible]	0.1	0
LASALLE	40	[illegible]	0.08	0
LIMERICK	28	[illegible]	0.027	0
MAINE YANKEE	78	[illegible]	0.034	0
MCGUIRE	6	[illegible]	0.08	0
MILLSTONE	27	[illegible]	0	0.10
MONTICELLO	46	0.0001218	0.08	0
NINE MILE POINT	89	[illegible]	0.06	0
NORTH ANNA	15	0.0000067	0.08	0
OCONEE	6	[illegible]	0.12	0
OYSTER CREEK	17	[illegible]	0.063	0
PALISADES	48	0.0001845	0.1	0
PALO VERDE	0	[illegible]	0.125	0
PEACH BOTTOM	22	[illegible]	0.026	0
PERRY	31	[illegible]	0.08	0
PILGRIM	42	[illegible]	0	0.08
POINT BEACH	42	[illegible]	0.1	0
PRAIRIE ISLAND	46	0.0001713	0.08	0
QUAD CITIES	40	[illegible]	0.15	0
RANCHO SECO	0	[illegible]	0.1	0
RIVER BEND	0	0.000054	0.09	0
ROBINSON	1	0.000197	0.09	0
SALEM	22	0.0000275	0.045	0
SAN ONOFRE	0	0.0000153	0.08	0
SEABROOK	63	0.0000091	0.045	0
SEQUOYAH	4	0.0001499	0.1	0
SHOREHAM	26	0.0000251	0.08	0
SOUTH TEXAS	0	0.000081	0.12	0
ST LUCIE	0	0.000013	0.15	0
SUMMER	2	[illegible]	0.12	0
SURRY	8	[illegible]	0.1	0
SUSQUEHANNA	44	[illegible]	0.028	0
THREE MILE ISLAND	35	[illegible]	0.027	0
TROJAN	7	[illegible]	0.14	0
TURKEY POINT	0	[illegible]	0.18	0
VERMONT YANKEE	79	[illegible]	0.04	0
VOGTLE	2	[illegible]	0.022	0
WATERFORD	0	[illegible]	0.09	0
WATTS BAR	10	0.0001422	0.1	0
WNP-2	53	[illegible]	0.05	0
WOLF CREEK	20	0.0001115	0.21	0
YANKEE ROWE	79	[illegible]	0.053	0
ZION	40	[illegible]	0.08	0

NOTE (b): NRC STAFF PROVIDED THE DATA IN TABLE 3-3 USING CLIMATOLOGICAL SOURCES CITED IN THE REFERENCES TO THIS PROCEDURE. NUMARC HAS NOT VERIFIED THE ACCURACY OF THIS DATA.

Calc. 8700-DEC-0248 Rev. 0 Attach. B Pg. 10 of 20

Table 3-4

SEVERE WEATHER GROUPS (SW)

SW GROUP	ESTIMATED FREQUENCY OF LOSS OF OFFSITE POWER
1	$f < 0.0033$
2	$0.0033 \leq f < 0.0100$
3	$0.0100 \leq f < 0.0330$
4	$0.0330 \leq f < 0.100$
5	$0.10 \leq f$

Part 1D: Evaluate Independence of Off-site Power System (I Group)

The potential for long duration loss of off-site power events can have a significant impact on station blackout risk and required coping durations. Long duration LOOP events are associated with grid failures due to severe weather conditions or unique transmission system features. Shorter duration LOOP events tend to be associated with specific switchyard features. Two features, in particular, are of special importance: (1) the independence of the off-site power sources constituting the preferred power supply to the shutdown buses on-site, and (2) the power transfer schemes when the normal source of AC power is lost.

Two plant groupings are specified in this part for classifying the interface of the preferred power supply to the safe shutdown bus: I1/2 and I3. The I1/2 group is characterized by features associated with greater independence and redundancy of sources, and a more desirable transfer scheme. I3 sites have simpler, less desirable off-site power systems and switchyard capabilities. The importance of the site groupings becomes evident when combined with the potential for losing off-site power due to severe and extremely severe weather.

THE OFF-SITE POWER SYSTEM IS IN THE I3 GROUP IF:

(1) A "YES" ANSWER CAN BE ASSIGNED TO CONDITION "A" BELOW,

AND

(2) A "YES" CAN BE ASSIGNED TO EITHER CONDITIONS "B(1)" OR "B(2)", BELOW.

A. All off-site power sources are connected to the unit's safe shutdown buses through (1) one switchyard, or (2) two or more electrically connected switchyards.

B(1) The normal source of AC power is from the unit main generator and there are no automatic transfers and one or more manual transfers of all safe shutdown buses to preferred or alternate off-site sources.

B(2) The normal source of AC power is from the unit main generator and there is one automatic transfer and no manual transfers of all safe shutdown buses to one preferred or one alternate off-site power source.

OTHERWISE THE SITE IS ASSIGNED TO THE I1/2 GROUP.

Part 1E: Determine Off-site AC Power Design Characteristic Group (P Group)

Site susceptibility to loss of off-site power is separated into three basic groups, based on combinations of features. The determining features are: (1) independence of off-site power, (2) severe weather potential, measured either by experience or recurrence intervals, and (3) extremely severe weather potential. The following tables establish the off-site power design characteristic group.

A. REVIEW THE INDEPENDENCE OF OFF-SITE POWER GROUP, SW GROUP AND ESW GROUP, AND

Calc. 8700-DEC-0248 Rev.0 Attach.B Pg. 12 of 20

USE THE FOLLOWING TABLES TO DETERMINE THE OFF-SITE POWER DESIGN CHARACTERISTIC GROUP.

OFF-SITE POWER DESIGN CHARACTERISTIC GROUP MATRIX

I1/2 SITES

P1 per errata JFA 4-4-03

SW GROUP	ESW GROUP 1	2	3	4	5
1	P1	P1	P1	P2	P3
2	P1	P2	P2	P2	P3
3	P2	P2	P2	P3	P3
4	P3	P3	P3	P3	P3
5	P3	P3	P3	P3	P3

Table 3-5a

I3 SITES

Beaver valley

SW GROUP	ESW GROUP 1	2	3	4	5
1	P2	P2	P2	P2	P3
2	P2	P2	P2	P2	P3
3	P2	P2	P3	P3	P3
4	P3	P3	P3	P3	P3
5	P3	P3	P3	P3	P3

Table 3-6a

NOTE: Coastal plants are susceptible to long duration LOOPS as a result of extremely severe weather associated with hurricanes. As a result, plants with otherwise sufficient EDG reliability and configuration and lower susceptibility to severe weather events may be in a higher coping duration category solely due to the probability of a hurricane induced LOOP.

B. IF A PLANT IS SUSCEPTIBLE TO A HURRICANE INDUCED LOOP AND HAS HURRICANE RESPONSE PROCEDURES WHICH MEET THE GUIDELINES OF SECTION 4.2.3 OF THIS DOCUMENT, USE THE FOLLOWING TABLES TO DETERMINE THE OFF-SITE POWER DESIGN CHARACTERISTIC GROUP.

OFF-SITE POWER DESIGN CHARACTERISTIC GROUP MATRIX

For Hurricane Exposed Plants

11/2 SITES

ESW GROUP (columns); SW GROUP (rows)

SW GROUP	ESW 1	ESW 2	ESW 3	ESW 4	ESW 5
1	P1	P1	P1	P2*	P3*
2	P1	P2*	P2 P1 per errata JFA 4-4-03	P2	P3*
3	P2	P2	P2	P3*	P3
4	P3	P3	P3	P3	P3
5	P3	P3	P3	P3	P3

Table 3-5b

13 SITES

ESW GROUP (columns); SW GROUP (rows)

SW GROUP	ESW 1	ESW 2	ESW 3	ESW 4	ESW 5
1	P2	P2	P2	P2	P3*
2	P2	P2	P2	P2	P3*
3	P2	P2	P3 P3* per errata JFA 4-4-03	P3	P3
4	P3	P3	P3	P3	P3
5	P3	P3	P3	P3	P3

Table 3-6b

*DENOTES SITE UPGRADE ATTRIBUTED TO IMPLEMENTATION OF PLANT SPECIFIC PRE-HURRICANE SHUTDOWN REQUIREMENTS AND PROCEDURES WHICH PROVIDE AN ENHANCED 8-HOUR COPING CAPABILITY UNDER ANTICIPATED HURRICANE CONDITIONS.

3.2.2 Step Two: Classify The Emergency AC Power Configuration

After the likelihood of losing off-site power, the redundancy of the emergency AC power system is the next most important contributor to station blackout risk. With greater EAC system redundancy, the potential for station blackout diminishes, as does the likelihood of core damage. The importance of EAC redundancy is reflected in this procedure through the use of four distinct EAC configuration groups:

- *A - Characterized by highly redundant and independent EAC sources to safe shutdown equipment;*
- *B - Having better than typical redundant and independent EAC sources to safe shutdown equipment;*
- *C - Having typical redundant and independent EAC sources to safe shutdown equipment; and.*
- *D - Having the lowest level of independency and redundancy in EAC sources powering safe shutdown equipment.*

Placement in one of the groups listed depends on the number of EAC standby power supplies available and the number required to operate AC-powered decay heat removal equipment necessary to achieve and maintain safe shutdown in a station blackout. Overall, the greater the level of EAC redundancy, the less restrictive are the station blackout coping durations and maximum EDG failure rates before longer coping durations are required, or corrective actions become necessary.

The potential for excess EAC power sources to be used as Alternate AC is directly related to the existing level of EAC redundancy. Since EAC redundancy is an important parameter for determining station blackout coping duration categories, EAC power sources relied upon as Alternate AC power sources must not also be considered when assessing the required coping duration.

Accordingly, the following process precludes the use of an EAC power source as both an input to determine the EAC group and an Alternate AC source. This process eliminates the potential for "double counting" the value of an individual EAC power source, both as preventing the station blackout, and in responding to its occurrence.

To illustrate this point, consider a single unit site that has three EAC power sources, and needs only one for safe shutdown. This site can be classified as either a one-out-of-three site (EAC Group A); or a one-out-of-two site (EAC Group C) with the third EAC power source available as a potential Alternate AC power source, if it meets the criteria for Alternate AC specified in Appendix B.

THIS STEP CONSISTS OF THREE PARTS:

PART 2.A	*DETERMINE THE NUMBER OF EAC POWER SUPPLIES NORMALLY AVAILABLE;*
PART 2.B	*DETERMINE THE NUMBER OF NECESSARY EAC STANDBY POWER SUPPLIES; AND,*
PART 2.C	*SELECT THE EAC POWER CONFIGURATION GROUP.*

Calc. 8700-DEC-0248 Rev. 0 Attach. B Pg. 15 of 20

Part 2.A Determine the Number of EAC Power Supplies Normally Available

A. SINGLE UNIT OR MULTI-UNIT SITES WITH NORMALLY DEDICATED POWER SUPPLIES

Count the total number of standby power supplies (see Appendix A) normally available to the blacked-out unit's safe shutdown equipment that are not being used as an Alternate AC power source.

B. MULTI-UNIT SITES WITH NORMALLY SHARED POWER SUPPLIES

Count the total number of dedicated and shared standby power supplies normally available to safe shutdown equipment at each site that are not being used as an Alternate AC power source.

Part 2.B Determine the Number of Necessary EAC Standby Power Supplies

The number of EAC standby power supplies required for station blackout is based on the AC loads needed at each unit to remove decay heat (including the heat generated by AC-powered decay heat removal systems) in order to achieve and maintain safe shutdown with off-site power unavailable.

The number of EAC standby power sources necessary to operate safe shutdown equipment may be less than that required for LOCA loads.

The number of necessary EAC standby power sources should be determined by accounting for the individual safe shutdown loads, or inferred from the site's design basis for operating Class 1E AC equipment without off-site AC power.

A. SINGLE UNIT OR MULTI-UNIT SITES WITH NORMALLY DEDICATED POWER SUPPLIES

Count the total number of EAC standby power supplies necessary to operate safe shutdown equipment ~~during a station blackout on a per unit basis.~~ following a loss of offsite power. → on a per unit basis per errata JFA 4-4-03

B. MULTI-UNIT SITES WITH NORMALLY SHARED POWER SUPPLIES

Count the total number of EAC standby power supplies necessary to operate safe shutdown equipment ~~during a station blackout for all units at the site.~~ following a loss of offsite power per errata JFA 4-4-03

calc. 8700-DEC-0248 Rev. 0 Attach. B Pg. 16 of 20

Part 2.C Select the EAC Power Configuration Group

USE THE TABLE PROVIDED BELOW TO SELECT THE EAC GROUP: per Errata JFA 4-4-03

Table 3-7

EAC GROUP	SHARED AND DEDICATED SUPPLIES NECESSARY FOR SAFE SHUTDOWN	SUPPLIES AVAILABLE*
A	1	3 DEDICATED
A	1	4
B	2	5
B	2	4
C	1	2 DEDICATED
C	1	3 SHARED
D	3	4
D	3	5
D	2	3
D	1	2 SHARED

Dedicated -- for EAC standby power supplies not normally shared with other units at a site

Shared -- for EAC standby power supplies in which some number are normally capable of providing AC power to safe shutdown equipment at more than one unit at a site ~~concurrently.~~ per Errata JFA 4-4-03

* If any of the EAC power sources are normally shared among units at a multi-unit site, this is the total number of shared and dedicated sources for those units at the site.

3.2.3 Step Three: Determine The Calculated EDG Reliability

The unit EDG reliability is used in conjunction with the site's off-site power design characteristics (i.e., P1, P2, or P3), and the EAC configuration (A, B, C, or D) to determine the unit's required station blackout coping duration. The unit EDG reliability is calculated by averaging the individual EDG reliability for the last 20, 50, and 100 demands for each machine. However, if the total number of valid demands is less than 100 (e.g., newly licensed plant, EDGs which have undergone intensive maintenance or a reliability requalification program), the EDG reliability over the last 20, and the last 50 if available, can be averaged and compared to the evaluation criteria in Section 3.2.4. If the unit's EDG reliability over the last 20 demands is > 0.90, or > 0.94 over the last 50 demands, then the unit may select an EDG target reliability of either 0.95 or 0.975 as detailed in Section 3.2.4.

calc. 8700-DEC-0248 Rev.0 Attach.B Pg.17 of 20

The objective of the three-tier approach to reliability measurement is to provide greater depth of understanding regarding reliability trends. The 20-demand sample set is the most volatile, and offers a very sensitive indication of EDG performance. Since this indicator moves with each incremental failure or success, it is not considered a reliable measure of long-term performance. Similarly, the 100-demand sample set offers a long-term trend indication, while providing limited insight to recent trends due to data smoothing effects. The 50-demand sample set bridges the two indicators while also providing an intermediate level. Taken together, the set of indicators provides a fairly complete picture of EDG reliability.

per Errata JFA 4-4-03

DETERMINE THE CURRENT UNIT EDG RELIABILITY:

(1) CALCULATE THE MOST RECENT EDG RELIABILITY FOR EACH EDG BASED ON THE LAST 20, 50, AND 100 DEMANDS (USING NSAC-108 DEFINITIONS AND METHODOLOGY CONTAINED IN SECTION 2 OF THAT DOCUMENT OR EQUIVALENT).

(2) CALCULATE THE NUCLEAR UNIT AVERAGE EDG RELIABILITY FOR THE LAST 20 DEMANDS BY AVERAGING THE RESULTS FROM (1), ABOVE.

CALCULATE THE NUCLEAR UNIT AVERAGE EDG RELIABILITY FOR THE LAST 50 DEMANDS BY AVERAGING THE RESULTS FROM (1), ABOVE.

CALCULATE THE NUCLEAR UNIT AVERAGE EDG RELIABILITY FOR THE LAST 100 DEMANDS BY AVERAGING THE RESULTS FROM (1), ABOVE.

3.2.4 Step Four: Determine Allowed EDG Target Reliability

The minimum EDG reliability should be targeted at 0.95 per demand per EDG for plants in EAC Groups A, B, C, and 0.975 per demand per EDG for plants in EAC Group D. These reliability levels should be considered minimum target reliabilities. Each plant should establish an EDG Reliability Program as outlined in Appendix D to this document. Plants which select a target EDG reliability of 0.975 should utilize this target level in their reliability program. If the diesel generator performance falls below the target reliability level specified, action should be taken through an EDG reliability program such as set forth in Appendix D to restore the target reliability level.

The unit EDG reliability for the last 20, 50, and 100 demands calculated in the previous step provides the allowed target reliability used in determining minimum required station blackout coping durations in the next step.

ALLOWED TARGET RELIABILITIES ARE DETERMINED AS FOLLOWS:

(1) COMPARE THE CALCULATED AVERAGE NUCLEAR UNIT EDG RELIABILITY DETERMINED IN SECTION 3.2.3 TO THE CRITERIA BELOW:

Evaluation Criteria

LAST 20 DEMANDS > 0.90 RELIABILITY
LAST 50 DEMANDS > 0.94 RELIABILITY
LAST 100 DEMANDS > 0.95 RELIABILITY

(2) IF THE EAC GROUP IS A, B, OR C, AND ANY OF THE THREE EVALUATION CRITERIA IN SECTION 3.2.4, STEP FOUR, PART (1) ARE MET, THEN THE NUCLEAR UNIT MAY SELECT AN EDG RELIABILITY TARGET OF EITHER 0.95 OR 0.975 FOR DETERMINING THE REQUIRED STATION BLACKOUT COPING DURATION. IF THE EAC GROUP IS D, AND ANY OF THE THREE EVALUATION CRITERIA IN SECTION 3.2.4, STEP FOUR, PART (1) ARE MET, THEN THE ALLOWED EDG RELIABILITY TARGET IS 0.975.

(3) IF THE EAC GROUP IS A, B, OR C, AND NONE OF THE THREE EVALUATION CRITERIA IN SECTION 3.2.4, STEP FOUR, PART (1) ARE MET, THEN 0.95 SHOULD BE USED AS THE RELIABILITY TARGET FOR DETERMINING THE REQUIRED STATION BLACKOUT COPING DURATION.

ADDITIONALLY, IF THE RELIABILITY IS LESS THAN 0.90 BASED ON THE LAST 20 DEMANDS, THEN ACCEPTABILITY OF THE COPING DURATION RESULTING FROM USING 0.95 MAY REQUIRE FURTHER JUSTIFICATION.

IF THE EAC GROUP IS D AND NONE OF THE THREE EVALUATION CRITERIA IN PART (1) ARE MET, THE REQUIRED COPING DURATION CATEGORY CALCULATED IN STEP FIVE, SECTION 3.2.5 SHOULD BE INCREASED TO THE NEXT HIGHEST LEVEL (I.E., FOUR HOURS BECOMES EIGHT HOURS; EIGHT HOURS BECOMES 16 HOURS).

calc. 8700-DEC-0248 Rev.0 Attach. B pg. 19 of 20

3.2.5 Step Five: Determine Coping Duration Category

USE THE TABLE PROVIDED BELOW TO DETERMINE THE COPING DURATION REQUIREMENT IN HOURS:

Table 3-8

OFFSITE POWER GROUP (From Section 3.2.1)	EAC GROUP (From Section 3.2.2)	ALLOWED EDG TARGET RELIABILITY (Per Demand) (From Section 3.2.4)	REQUIRED COPING DURATION CATEGORY
P1	A	0.950	2
P1	B	0.950	4
P1	C	0.950	4
P1	D	0.975	4
P2	A	0.950	4
P2	B	0.950	4
BV → P2	C	0.975	4
P2	C	0.950	8
P2*	C	0.950	4
P2	D	0.975	8
P2*	D	0.975	4
P3	A	0.975	4
P3	A	0.950	8
P3*	A	0.950	4
P3	B	0.975	4
P3	B	0.950	8
P3*	B	0.950	4
P3	C	0.975	8
P3*	C	0.975	4
P3	C	0.950	16
P3*	C	0.950	8
P3	D	0.975	8
P3*	D	0.975	4

*** Denotes site upgrade attributable to implementation of plant specific pre-hurricane shutdown requirements and procedures which provide an enhanced coping capability under anticipated hurricane conditions.**

3.2.6 Required Action

Step Five (Section 3.2.5) yields one of the four coping duration categories discussed in the NRC Station Blackout Regulatory Guide 1.155: two hours, four hours, eight hours, or 16-hours. Plants in the eight and 16-hour categories should undertake actions to reduce risk consistent with NUMARC Station Blackout Initiative 1.

THE FOLLOWING COURSES OF ACTION ARE AVAILABLE TO REDUCE THE ASSESSED RISK OF

STATION BLACKOUT:

(1) IMPLEMENT ACTION TO REDUCE THE REQUIRED COPING DURATION TO AT LEAST THE FOUR HOUR CATEGORY BY:

- (a) REVIEWING PLANT-SPECIFIC WEATHER DATA;
- (b) MODIFYING THE SWITCHYARD TO CHANGE THE I-GROUP; AND/OR,
- (c) MODIFYING THE PLANT TO CHANGE THE EDG CONFIGURATION; AND/OR,
- (d) IMPROVING EDG RELIABILITY.

(2) INSTALL OR UTILIZE AN EXISTING ALTERNATE AC POWER SOURCE THAT MEETS THE CRITERIA PROVIDED IN APPENDIX B.

calc. 8700-DEC-0248 Rev.0 Attach. C Pg. 1 of 5

NUCLEAR ENGINEERING MEMORANDUM
DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION UNIT 1 + 2
FORM D37—98153 (1-85)

Record Type	Record Date (YR. MO. DAY)	System No.	DCP/SMR/TER No.	Safety Related	EM No.
640-01-002-001	88, 2, 29	36	NA	Yes ☑ No ☐	30633

Account No ________

MWR No. NA

PAGE No. 1 OF 1

TO: N. R. TONET

RESPONSE DUE DATE: MARCH 18, 1988

PRIORITY NO. 5

E.M. TITLE: STATION BLACKOUT ISSUE – NUMARC INITIATIVES

SUBJECT:

Based on enclosed NUMARC 87-00 "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at LWR's", Engineering is requested to perform analysis for determining coping duration using methodology provided in Sec. 3 and FSAR values for severe weather conditions. A meeting will be scheduled in the near future after personnel have reviewed the attached information for addressing:

- AC Power Availability
- Station Blackout Response Procedures (coping + restoration)
- EDG Reliability and reducing Cold Starts

REFERENCES:
NDI NSM: 2404 + 2430
NDI NSM: 1210
ECA-0.0, "Loss of All AC Power"
USI A-44 Station Blackout

Mark No. NA
Orig. Dept. Code L
RFI No.

PREPARED BY: J.J. Maracek EXTENSION: 5232

APPROVED BY: [signature] DATE: 3-1-88

COMPUTER ON LINE

TO:

ASSIGNED TO: Mike Y. Lee

ASSIGNED SECTION:

RESPONSE:

Attached is the calculation and methodology of the determination of coping duration for station blackout. The coping duration has been determined as 4 hours

FOR INFORMATION ONLY

REFERENCES:

ENGINEERING CHANGE NOTICE
Required? ☐ YES ☐ NO
E.C.N. Number:

PREPARED BY: Mike Y. Lee EXTENSION: X5-733

APPROVED BY: [signature] DATE: 4/15/88

*NECU Engr. Records Ctr. Not To Receive R.F.I.

DISTRIBUTION

S	R		S	R	w/o Att.	S	R	w/Att.	S	R	
X	X	NECU Engr. Records Ctr.	X	X	Technical Services Mgr.			Petrun			T. Johnson
X	X	Planning & Outage Mgt.	X	X	Plant Manager	X	X	R.E. Martin	X	X	J.G. Treese
		Nuclear Construction Mgr.	X	X	Nuclear Safety Mgr.	X	X	S. Nass	X	X	T.O. Dorhy
						X	X	J.L. Koepfinger	X	X	L.R. Kna

FOR INFORMATION ONLY

10-88

calc. 8700-DEC-0248 Rev. 0 Attach. C Pg. 2 of 5

P. 1

Refer to NUMARC 87-00 Section 3 : {Ref. 4 attached]

Step One : Determine The Off-site Power Design Characteristic
P. 3-2 Group

Part 1.A : Grid-Related Loss of Off-site power
P. 3-3 = Once per 100 site-years

Part 1.B : Estimated Frequency of Loss of Off-site Power Due
P. 3-4 to Extremely Severe Weather

ESW Group = 1 e = 0.0001 P. 3-6

Part 1.C : Determine the Estimated Frequency of Loss of Off-site
P. 3-7 Power Due to Severe Weather (SW Group)

$$f = (1.3 \times 10^{-4}) * h_1 + b * h_2 + (1.2 \times 10^{-2}) h_3 + c * h_4$$

b = 12.5 for sites with multiple rights of way

c = 0

h_1 = 45 Table 3-3 P. 3-9 Ref. (4)

h_2 = 0.0000692 Table 3-3 P. 3-9 Ref. (4)

h_3 = 0.03 Table 3-3 P. 3-9 Ref. (4)

∴ f = 0.007075 event/yr

Table 3-4 P. 3-10 Ref. (4) SW Group = 2

Calc. 8700-DEC-0248 Rev. 0 Attach. C Pg. 3 of 5

P.2

Part 1D: Evaluate Independence of Off-site Power System
P. 3-10 (I Group)

P.3-11 . It is I3 Group

Part 1E: Determine Off-site AC power design characteristic
P. 3-11 Group (P Group)

P. 3-12 It is P2 Group

Step two:

Part 2A: P. 3-15 Ref. (4) Determine the Number of EAC Power Supplies Normally Available

A. Single unit or multi-unit sites with normally dedicated power supplies: [2]

Part 2B: Determine the number of necessary EAC standby power supplies: [1]

P.3

Part 2C: Select the EAC Power Configuration Group:

[C] P. 3-16 Ref. (4)

Step Four: Determine Allowed EDG Target Reliability:

0.975

Step Five: Determine Coping Duration Category:

Ref. (4) P. 3-19 Table 3-8

4 Hrs ANSWER!

Calc. 8700-DEC-0248 Rev. 0 Attach. C Pg. 5 of 5

P.4

References :

(1) UFSAR Section 8.3 , Fig 8.1-1 & 8.3-1 , Section 8.4

(2) UFSAR Table 2.2-3 Section 2.2.2.5

(3) Assesment of Coping Duration Requirements , Revision 2.1 , Oct. 24, 1986 Nuclear Utility Group on Station Blackout Suite 700 , 1200 Seventeenth St. , N.W. , Washington D.C. 20036

(4) NUMARC 87-00 Guidelines and Technical Bases for NUMARC Initatives Addressing Station Blackout at Light Water Reactors , Nov. 87 Nuclear Management and Resources Council , Inc. 1776 Eye St. N.W. Washington D.C. 20006-2496

Calc. 8700-DEC-0248 Rev. 0 Attach. D Page 1 of 1

Francis W Etzel
03/31/2003 09:09 AM

To: John F Ankney/FirstEnergy@FirstEnergy
cc: Kevin J Lynch/FirstEnergy@FirstEnergy, Sum T Leung/FirstEnergy@FirstEnergy
Subject: Re: Loss of offsite power frequency

John,

The grid related loss of offsite power frequency is 3.16E-02/ yr (or 1 in 31.6 yrs) at Unit 1 and 2.31E-02/ yr (or 1 in 43.3 yrs) at Unit 2. These are the plant specific values based on operating years and actual occurrences (1 in 15.8 yrs for Unit 1, 0 in 9.93 yrs at Unit 2). If you want an overall industry value it is 2.71E-02/yr (or 1 in 36.9 yrs), which is based on EPRI Technical Report 1000158, "Losses of Off-Site Power at U.S. Nuclear Power Plants - Through 1999", July 2000.

Bill

John F Ankney

John F Ankney
03/30/2003 09:32 PM

To: Francis W Etzel/FirstEnergy@FirstEnergy, Sum T Leung/FirstEnergy@FirstEnergy
cc: Kevin J Lynch/FirstEnergy@FirstEnergy
Subject: Loss of offsite power frequency

Gentleman,

I am responding to CA-02-07114-01. I need to know the grid related loss of offsite power frequency. An analysis in EM 30633 stated this to be once per 100 site years. Is this correct? It would be appreciated if I could have the response by Wednesday 4-2-03 so that I can meet my Corrective Action due date. I am presently on the back shift for 1R15.

Thank you,

John

Calc. 8700-DEC-0248 Rev.0 Attach.E Page 1 of 1

Douglas L McBride
03/31/2003 07:28 AM

To: John F Ankney/FirstEnergy@FirstEnergy
cc:
Subject: Re: Diesel Generator Reliability

As per the Station Blackout program, I keep a database of EDG start demands, load demands, start failures and load failures. Per the SBO program we are required to keep above 97.5%. Obviously, we respond to any failure and make "prevent recurrence" corrective actions if they occur.

As of today, for Unit 1, over the last 100 unit start and load demands I am counting two failures. One was the seized river water pumps. This is not really an EDG failure, but the EDG could not have ran with no river water. The second is when the 4 kv bus undervoltage relay locked up and prevented the EDG from loading during the LOOP/SI test. Again, not an EDG failure, but it could not have loaded.

As of today, for Unit 2, over the last 100 unit start and load demands I have no failures.

The BVT number is 3BVT 11.36.2 if you want to review it and it is on my shelf above my desk.

DLM

John F Ankney

John F Ankney
03/31/2003 01:37 AM

To: Douglas L McBride/FirstEnergy@FirstEnergy
cc: Kevin J Lynch/FirstEnergy@FirstEnergy
Subject: Diesel Generator Reliability

Doug,

I am presently performing a calculation where I need to know the reliability of the safety Diesel generators. Unit 1 UFSAR gives a reliability of 0.99 along with the basis. I cannot seem to find the reliability of the Unit 2 DGs. Do you maintain a data base of the times the DGs do not start when tested? Is there special maintenance done to assure reliability?
Could you please respond to the above questions by Wednesday 4-2-03 so that I can answer a CA?

Thanks,
John

Calc. 8700-DEC-0248 Rev. 0 Attach. F Page 1 of 6

A review of diesel generator power and control circuits' separation by fire area has been conducted in accordance with IOCFR50 Appendix R to ensure that a single fire will not disable both Emergency Diesel Generators. As a result of this review modifications have been made to the original diesel generator control circuits; and cables and equipment core have been relocated to bring the diesel generator circuits into compliance with Appendix R. The modifications included relocation of Emergency Diesel Generator-2 differential protection relays and fuel transfer pump relays, rerouting of Emergency Diesel Generator-1 and -2 field flash cables, and installation of isolation relays and circuit breakers to disconnect non-essential engine controls in the event of fire-induced cable faults in the affected circuits.

With these modifications at least one diesel generator will remain unaffected or recoverable by operating procedure, in the event of an Appendix R design basis fire.

8.5.2.2 Diesel Generator Starting Reliability

The diesel generator set is capable of starting and accepting loads with a 0.99 reliability at the 95 percent confidence level. A diesel generator target reliability of 97.5 percent has been designated in accordance with the NUMARC 87-00 document entitled "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors".[8,9] NUMARC 87-00 has been endorsed by the NRC as an acceptable means of satisfying the Station Blackout Rule - 10 CFR 50.63. If diesel generator performance falls below the target reliability level specified, actions will be taken to restore the target reliability level in accordance with guidance contained in Appendix D of the NUMARC 87-00 document. Furthermore, the diesel generator is designed for nuclear power plant service and has included in its system certain redundant subsystems and highly reliable components.

The diesel generator sets were given a 100 start test at the factory. If any two failures had occurred, the test would have to begin again. However, only one failure to start occurred on the first attempt for the first diesel generator set due to a pinion abutment, and no failures occurred on the first attempt for the second diesel generator set.

Preoperational tests involved fast start and accepting loads per the diesel loading sequence described above. Also, at least once a month, one set will be started manually, synchronized with the system, and run for a period of time furnishing rated power to the system.

It is concluded that the diesel generators will start and accept loads based on design for nuclear service and load data given to the vendor. The diesel generator sets have been tested at the factory to demonstrate the 99 percent reliability as described above and further to start and accept continuous load and 1/2 hr load rating.

To ensure electrical starting system integrity, the diesel generators are periodically started and exercised in accordance with IEEE Std. 308-1971.[2] (Refer to Table 8.6-1).

Calc. 8700-DEC-0248 Rev. 0 Attach F Page 2 of 6

INSPECTION REPORT CONTINUATION
5010 25 (QCD-101)

☐ FINAL REPORT
☒ TRIP REPORT NO. 3

STONE & WEBSTER ENGINEERING CORPORATION
SHOP QUALITY CONTROL

SHEET 2 OF 2

CLIENT: Duquesne Light Company — J.O. NO. 11700.50

VENDOR/SUBVENDOR: Electromotive Division of General Motors Corporation — ORDER NO. BV-116

FOR FULL HEADING, SEE QCD-101

WHEN REFERRING TO RECORDS CHECKED OR TESTS WITNESSED, LIST BY LINE NUMBERS SHOWN ON QCD-101

On May 25, 1972 Client personnel headed by Mr. Don DeVos met with the vendor personnel and Mr. C. N. Watson, District Chief Procurement Quality Control Division of Stone and Webster Engineering Corporation for the purpose of witnessing test procedure on unit #2 of this order.

Tests were conducted in accordance with the vendor's engineering test instructions #416 Revision D dated 12-1-71. We understand these instructions had previously been submitted and approved by Stone and Webster.

①* Test results were satisfactory both to the client and Stone and Webster personnel. All test data to be documented and presented to the assigned inspector prior to release for shipment. The portion of the test procedure witnessed included load testing (1/3 load run for 1/2 hour - 2/3 load run for 1/2 hour and full load run for 1 hour minimum), and reliability proof tests of 100 consecutive starts.

Note: Prior to composition of this report, we understand that the vendor has shipped both units to the jobsite without notification to this department of their intentions. Consequently no final inspection of the units can be made by this department of Stone and Webster and no supporting documentation was made available to the P.Q.C. inspector assigned.

*2 We have no assurance that the seismic requirements have been met nor can we provide any assurance that documentary requirements have been met. The vendor's Mr. Klatt was well aware of our intent.

With this report, we therefore close our file unless otherwise advised.

The testing on unit 2 was witnessed by Mr. C. N. Watson, District Chief P.Q.C. Division and this report was written by Pete Schroeter.

*1. Test ~~Results received~~ 2/27/73 + attached. NLH

2. Seismic approval received by field on 10-2-72 NLH.

	SYS. CODE	EQ. ID. NO.	MAJOR	MINOR	UNIT	P.O.
F	EEG	EE-EG-1,2	P	P	1	116

Unit #1 EDG Tests JFA 4-7-03

P 5.03

0 1 2 1 0

Attn - Tran. Since - Revisions with has been made - tests indicated - Rev D dated 12-22-71

ISSUED BY		NUMBER
G. V. Lund L. F. Enence	**ENGINEERING TEST INSTRUCTION** ELECTRO-MOTIVE DIVISION GENERAL MOTORS CORPORATION LA GRANGE ILLINOIS BV-116	416
APPROVED		FIRST ISSUED
D. ... De Braal		May 22, 1968
		SUPERSEDES

SUBJECT: TESTING MODEL 999 GENERATING PLANT UNITS

AFFECTS MODELS: 999-16, 999-20

PART NOS AFFECTED:

REF. DRAWINGS: AI-1018, AI-1097, AI-1518, AI-1863, AI-1953, AI-2061
ETI-388
EMS-1004, EMS-1011, EMS-1014, EMS-1018
FORM 1774

01336

Calc. 8700-DEC-0248 Rev. 0 Attach. F Pg. 3 of 6

Unit #1 EDG Tests JFA 4-7-03

BV-17 microfilm Roll BV-116

GENERAL

The subject units are designed for nuclear power plant emergency standby service which requires a high degree of reliability. To meet this requirement, these units are designed with certain redundant sub-systems and highly reliable components and require a degree of testing not common to other units. The purpose of this instruction is to define this special testing and does not cancel any less stringent test requirements that may be applicable to components used in these models or does this instruction take the place of good manufacturing and quality control practice required to produce quality products.

The sequence or order of carrying out tests, the detail methods used and the place or location of conducting the tests are left to the discretion of the Quality Control Department.

Engineering Specification Releases must be consulted for actual equipment supplied on each order and any special testing that may be required.

The instructions are set forth in ten parts as follows:

Part I - Prestart Inspection

Part II - Static Check of Alarms

Part III - First Start

P 10.02

3-19-75

	SYS. CODE	EQ. ID. NO.	MAJOR	MINOR	UNIT	P. O.
E AA	CE	EF-EG-1,2	8	~~2.700~~ 2.702	1	BV-116

REV	DATE	W.F.C.	PAGES AFFECTED	CHANGED BY	APPROVED
D	12-22-71	44160	7, 9, 10	J. Ryker	H.A.Williams

Calc. 8700-DEC-0248 Rev. 0 Attach. F Pg 4 of 6

PART VI - LOAD RUN (Continued) unit #1 EDG Tests JFA 4-7-03

5. Check power C.T connections with KVAR loading.

6. Check and record full speed no load and full speed full load.

7. Verify with all systems and circuits functioning that engine will start and accept load.

8. Check and record time start signal to when full speed and voltage first reach rated values. With a normal emergency start sequence, this time MUST NOT exceed 6 seconds. If more than 6 seconds are required, check all time delay relays and reset as necessary to meet the 6 second specification. (D)

9. Run Item 8. simulating a pinion abutment, requiring a second start. Time to rated speed and voltage MUST NOT exceed 10 seconds. Excessive time requires that the timing relays associated with the second start be checked and re-timed as necessary to meet the 10 second requirement. (D)

0 1 3 4 4

PART VII - RELIABILITY PROOF TESTS

1. With controls set in Automatic mode, unit must start and accept load 100 consecutive times. No control adjustment are to be made during these tests.

   a. Start signals approximately every 5 minutes.

   b. Loaded portion of each cycle 1 minute duration minimum.

   c. Check and record time from start signal (see Part VI, 8) for starts 1 through 5, 25th, 50th, 75th and 96 through 100.

   In addition, record time required to reach rated speed and voltage whenever an abutment occurs (D)

   d. Make starts 1 - 50 with preferred start switch SCS in the No. 1 position. The 51 - 100th starts in the No. 2 position.

   Only 2 abutments on a single motor set are permitted during 100 successive starting attempts. If this limit is exceeded, stop the test and start over after effecting necessary corrections to eliminate the abutment problem (D)

   e. At least once during this series of tests engine must not be started for a period of not less than 12 hours during which the immersion heater must function and maintain oil temperature above LOTS setting.

2. A "failure" during the Reliability Proof Tests is any failure of the unit to reach rated speed and voltage within 10 seconds after the start signal. The normal functioning of back up systems and the resulting alarms do not constitute a failure if the 10 second speed/voltage requirement is met. If a unit exceeds the 10-second limit during any start, record time to rated speed and voltage for that start and reason for failure. (D)

E	SYS. CODE	EQ. ID. NO.	MAJOR	MINOR	UNIT	P. O.
	EEG	EE-EG-1,2	P	~~2.700~~ 2.707	1	116

P 10.02

2-9-75

Calc. 8700 - DEC-0248 Rev. 0 Attach. F Pg 5 of 6

PART VII - RELIABILITY PROOF TESTS

Unit #1 EDG Tests VFA 4-7-03

2: (Continued) (D)

The Reliability Proof Tests may be interrupted for the replacement of a failed or suspect part and the tests continued from that point IF the part being replaced has not caused a "failure" as defined above.

Any replacement part must be properly pre-qualified to the satisfaction of the Quality Control Department

3. Should unit fail to complete Test 1 above, necessary repairs and modifications are to be made and the test repeated as follows:

a. Failure occurs during starts 1-50. Start over with start 1 again.

b. Failure occurs during starts 51-100.

(1) Failed device is in start 2 control circuit and has no connection with start 1 circuit or is in connection with no two bank of starters. Start over at start 51.

(2) Failed device is a part common to both start systems or is not redundant. Start over with start 1.

01345

PART VIII - PRE-SHIPMENT LOAD RUN

1. Run unit at rated load for 1/2 hour minimum

2 Load unit until rack is against stop and record output of this condition.

PART IX - AFTER LOADING INSPECTION

1. Bar engine over and inspect each power assembly for, broken rings, wet piston crown, scored liners, etc.

2 Check generator slip rings.

	SYS. CODE	EQ. ID. NO.	MAJOR	MINOR	UNIT	P. O.
E	EGS	EE-EG-1,2	23	~~2700~~ 2702	1	116

2702 - S.O./[illegible] 2/19/75

3 Check for water, lube oil, fuel oil or exhaust leaks.

4. Check ring gear and starter motor pinions for chipped or broken teeth.

PART X - PREPARATION FOR SHIPMENT

P 10.02

1. Remove all test jumpers and external power connections

2. Check all electrical connections to insure that all connection are tight

3. Doors of cabinets should be closed tightly and all panels and cover plates must be in place

4. Drain engine cooling system, immersion heater and heat exchangers. Drain lube oil cooler core. Do not reinstall drain plugs and DO NOT seal drain openings. Drain plugs are to be "shipped loose" aboard their respective units.

5 Drain fuel from suction strainers. Remove and clean the strainer element and reinstall.

BV-116

Calc. 8700-DEC-0248 Rev. 0 Attach. F Pg. 6 of 6

Unit #1 EDG Tests JFA 4-7-03

APPENDIX "B"

Report of IEEE/PES/NPEC/SC4.2C Meeting
September 20, 1973
Reliability Testing of Diesel-Generator Units

JB-20

Task Force SC4.2C is responsible for developing the qualification testing requirements that will be included as a revision to IEEE 387, "Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations". This meeting on September 20, 1973 was called specifically to initiate the development of an IEEE position on reliability testing for diesel-generator standby power supplies. In particular is the desire to develop a testing procedure, other than 300 successive starts, that will be acceptable to the AEC.

At the beginning Mr. Faust Rosa of the AEC explained their present position and requirements for reliability testing. They have relaxed on their requirement for 99% reliability with a 95% confidence factor and apparently are no longer looking for statistical numbers as a means of verifying reliability. They have accepted the Zion qualification tests and have a Regulatory Guide under preparation which will be similar. These tests are as follows.

1. Margin Tests

   This test must demonstrate the capability of the unit to carry 115% of the plant design emergency load and also the capability to start a motor 1/3 larger than required by the plant design, while the unit is carrying 50% of its rated load. This test must be performed twice for each unit and may be done at the factory or in the field.

2. Reliability Tests Before Criticality

   100 start and load tests with no more than one failure are required. The starts must be cold starts, and the loading must be to 50% in 30 seconds and held at 50% until temperature equilibrium.

cc - SL Chapin
H.T. Thieme
A.P. Stakulis
BV-116 (Circ thru J.F)

NOTED JAN 15 1974

Calc. 8700-DEC-0248 Rev. 0 Attach. G
Pg. 1 of 1

RTL# A1.002D

Calculation Affected Document Review Checklist

Calculation: 8700-DEC-0248 Revision: 0 Addendum: N/A

		YES	NO	DOCUMENT/SECTION
	Do the Calculation Assumptions and/or Conclusions affect:			
1.	The UFSAR?	☐	☒	
2.	Technical Specifications?	☐	☒	
3.	Design Basis Documents?	☐	☒	
4.	The Operating Manual?*	☐	☒	
5.	The Abnormal Operating Procedures?*	☐	☒	
6.	Emergency Procedures?*	☐	☒	
7.	OST/BVT Procedures?*	☐	☒	
8.	The ISI/IST Program?*	☐	☒	
9.	Other Plant Procedures?*	☐	☒	
10.	Equipment Setpoints?*	☐	☒	
11.	Other BVPS Calculations?	☐	☒	
12.	Vendor Calculations?	☐	☒	
13	Other VTIs?*	☐	☒	
14.	Equipment Specifications?	☐	☒	
15.	Procurement Specifications?	☐	☒	
16.	The Fire Protection Safe Shutdown Report?	☐	☒	
17.	The EQ Program?	☐	☒	
18.	Any other Design Basis documents?	☐	☒	
19.	Any radiological inputs and/or consequences?	☐	☒	

* When these items are checked YES, list the Engineering Change Package number that will update or track the update of the affected document(s). Attach this Checklist to the Calculation to document this review.