Beaver Valley Power Station
CALCULATION COVER SHEET

RTL# A1.002D

Total Pages: 8	Total Pages (Including Attachments): 45

Calculation ☒ Alternate Calculation ☐			Unit: 2		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	10080-DEC-0246	0	N/A	

Prepared by/Date	Checked by/Date	Verified by/Date
[signature] John F. Ankney 4-7-03	[signature] Paul W. Dearborn 4/8/03	[signature] Paul W. Dearborn 4/8/03
Approved by/Date		Type of Design Verification
[signature] 4/9/03 K. Lynch		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 2 UFSAR Rev. 12, Paragraph 8.1.2,"Transmission System"; Paragraph 8.1.3, "Interconnection to Other Grids"; Paragraph 8.2.1.1, "Transmission Network"; Paragraph 8.2.1.2, "345 kV Switchyard"; Paragraph 8.2.1.3, "138 kV Switchyard"; Paragraph 8.2.2.1, "(Off-site power) Availability Considerations"; Paragraph 8.2.2.2, "Off-site power) Stability Considerations; Figure 8.1-1, "Bulk Power Transmission System Unit 1 and Unit 2; Figure 8.1-2, "Electrical Interconnections"; Figure 8.3-1,"Main One Line Diagram".

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. On Unit 2 2EGS-EG2-2 was tested for 300 starts. The diesel generator successfully passed the 300 start test. A total of 272 valid start and load acceptance runs were made from warm standby temperatures with only one failure to meet the acceptance criteria. A total of 30 valid start and load acceptance runs were made from normal operating equilibrium temperatures with no failures to meet the acceptance criteria. Per the purchase order 2BV-230, no tests were run on the other diesel. Therefore, the diesel reliability was 0.996. 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

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ON STATION BLACKOUT

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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.

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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.

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."

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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).

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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 Determine the Off-site Power Design Characteristic Group

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 Classify the EAC Power Supply System Configuration

The redundancy of the emergency AC power system is evaluated and classified among four available groups labeled A, B, C, and D.

Step 3 Determine the Calculated EDG Reliability

The current EDG reliability is determined consistent with NSAC-108 criteria.

Step 4 Determine the Allowed EDG Target Reliability

Based on current EAC reliability, a method is provided for determining an acceptable EAC target reliability.

Step 5 Determine Coping Duration Requirement

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,

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.

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.

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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	0.006	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 1C: 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).

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Table 3-3

SEVERE WEATHER DATA[b]

SITE	SNOWFALL	TORNADO	STORMS	SALT SPRAY	SITE	SNOWFALL	TORNADO	STORMS	SALT SPRAY
	(h1)	(h2)	(h3)	(h4)		(h1)	(h2)	(h3)	(h4)
ARKANSAS NUCLEAR ONE	6	0.00045	0.067	0	MONTICELLO	46	0.0000728	0.08	0
ARNOLD	33	0.000257	0.25	0	NINE MILE POINT	99	0.0000063	0.05	0
BEAVER VALLEY	45	0.0000692	0.03	0	NORTH ANNA	15	0.0000067	0.08	0
BELLEFONTE	4	0.00025	0.029	0	OCONEE	6	0.00008	0.12	0
BIG ROCK POINT	97	0.000013	0.006	0	OYSTER CREEK	17	0.000058	0.063	0
BRAIDWOOD	40	0.00005	0.05	0	PALISADES	48	0.0000345	0.1	0
BROWNS FERRY	4	0.00045	0.029	0	PALO VERDE	0	0.0000018	0.125	0
BRUNSWICK	2	0.00007	0.12	0	PEACH BOTTOM	22	0.000009	0.026	0
BYRON	35	0.00011	0.04	0	PERRY	38	0.00006	0.08	0
CALLAWAY	24	0.00016	0.05	0	PILGRIM	42	0.00005	0	0.08
CALVERT CLIFFS	9	0.000077	0.062	0	POINT BEACH	42	0.00005	0.1	0
CATAWBA	6	0.00014	0.12	0	PRAIRIE ISLAND	46	0.0001713	0.08	0
CLINTON	24	0.00016	0.1	0	QUAD CITIES	40	0.00009	0.15	0
COMANCHE PEAK	4	0.00009	0.05	0	RANCHO SECO	0	0.0000006	0.1	0
COOK	48	0.00045	0.1	0	RIVER BEND	0	0.00054	0.09	0
COOPER	30	0.00024	0.5	0	ROBINSON	1	0.000097	0.09	0
CRYSTAL RIVER	0	0.00003	0.2	0	SALEM	22	0.000075	0.065	0
DAVIS-BESSE	38	0.00003	0.11	0	SAN ONOFRE	0	0.000053	0.08	0
DIABLO CANYON		[illegible]	0.07	0	SEABROOK	65	0.00091	0.065	0
DRESDEN	40	0.00002	0.05	0	SEQUOYAH	4	0.00049	0.1	0
FARLEY	0	0.00001	0.05	0	SHOREHAM	26	0.000051	0.08	0
FERMI	32	0.00019	0.05	0	SOUTH TEXAS	0	0.00003	0.12	0
FITZPATRICK	89	0.0000057	0.05	0	ST LUCIE	0	0.00003	0.15	0
FORT CALHOUN	25	0.00014	0.5	0	SUMMER	2	0.00006	0.12	0
FORT ST. VRAIN	39	0.00003	0.02	0	SURRY	3	0.00004	0.1	0
GINNA	89	0.000034	0.05	0	SUSQUEHANNA	44	0.000091	0.025	0
GRAND GULF	1	0.00012	0.05	0	THREE MILE ISLAND	35	0.000092	0.027	0
HADDAM NECK	27	0.00009	0.08	0	TROJAN	7	0.000004	0.14	0
HARRIS	1	0.00022	0.13	0	TURKEY POINT	0	0.00002	0.13	0
HATCH	0	0.00009	0.021	0	VERMONT YANKEE	79	0.000071	0.08	0
HOPE CREEK	22	0.000075	0.065	0	VOGTLE	2	0.00016	0.022	0
INDIAN POINT	29	0.00004	[illegible]	0	WATERFORD	0	0.00012	0.09	0
KEWAUNEE	48	0.00006	0.1	0	WATTS BAR	10	0.000422	0.1	0
LASALLE	40	0.00021	0.05	0	WNP-2	53	0.0000007	0.08	0
LIMERICK	32	0.00025	0.027	0	WOLF CREEK	28	0.000085	0.23	0
MAINE YANKEE	74	0.00001	0.054	0	YANKEE ROWE	79	0.00008	0.063	0
MCGUIRE	6	[illegible]	0.05	0	ZION	40	0.00015	0.08	0
MILLSTONE	27	0.00006	0	0.18					

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.

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Table 3-4

SEVERE WEATHER GROUPS (SW)

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

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

OFF-SITE POWER DESIGN CHARACTERISTIC GROUP MATRIX

p1 per errata JFA 4-4-03

I1/2 SITES

SW GROUP \ ESW GROUP	1	2	3	4	5
1	P1	P1	P1	P2	P3
2	P1	P2 (circled)	P2	P2	P3
3	P2	P2	P2	P3	P3
4	P3	P3	P3	P2	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 (circled)	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

P1 per errata JFA 4-4-03

P3* per errata JFA 4-4-03

I1/2 SITES

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 3-5b

I3 SITES

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 3-6b

*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.*

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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

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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.

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:

<u>Evaluation Criteria</u>

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, <u>AND</u> 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).

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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.

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NUCLEAR ENGINEERING MEMORANDUM DUQUESNE LIGHT COMPANY BEAVER VALLEY POWER STATION UNIT 1+2 FORM D37-94153 (1-85)	System No.	DCP/SMR/TER No.	Safety Related	EM No. 30633
	36	NA	Yes ☑ No ☐	MWR No. NA
RECORD TYPE: 640-01-002-001 RECORD DATE (YR. MO. DAY): 88, 2, 29		Account No		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: for [signature] **DATE:** 4/15/88

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						X	X	J.L. Koegtinger	X	X	L.R. Knapp

FOR INFORMATION ONLY

P.1

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

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

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 to Extremely Severe Weather
P.3-4

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

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

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

$b = 12.5$ 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)

$\therefore f = 0.007075$ event/yr

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

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]

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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!

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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. 10080-PEC-0246 Rev. 0 Attach. D Pg. 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. 10080-DEC-0246 Rev. 0 Attach. E Pg. 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. 10080-DEC-0246 Rev. 0 Attach. F Pg. 1 of 2

STONE & WEBSTER ENGINEERING CORPORATION	SUPPLIER'S DOCUMENT DATA FORM
BEAVER VALLEY POWER STATION - UNIT 2 DUQUESNE LIGHT COMPANY J.O. 12241	X RETURN TO SUPPLIER REQUIRED (E1) FOR INFORMATION ONLY NO REVIEW REQUIRED (E1) FILMED
SUPERSEDES S & W FILE NO. (E1) (25-34) (35-38): 2702.190-230-007A	NAME — RESP. ENG. D E CRAFTS, DEPT./DIV. POWER (E1); REVIEWER H T THIEME / L J FUSEGNI, DEPT./DIV. ELEC./POWER (E1)
REMARKS (LIMIT TO 22 CHARACTERS & BLANKS) (53-74) (CODES OR SPECIAL REQUIREMENTS)	
S & W EQUIP. I.D. CODE (E1) (26-36): 2EGS-EG2-1&22C; AREA DESIGNATION CODES (E1) (75-80)	DATE TO REVIEWER (E1): 03/03/80; REQUIRED RETURN DATE (E1): 03/10/80
MFR'S DOC. NO. (E1) (LIMIT TO 24 CHARACTERS & BLANKS) (37-60) (INCLUDE DOC. REV. OR DATE): 11-206147C VOL. 1-5	REVIEW STATUS (R): ✓ APPROVED; APPROVED AS REVISED; UNACCEPTABLE — AS DEFINED IN SPECIFICATION
MFR'S NAME (E1) (LIMIT TO 20 CHARACTERS & BLANKS) (61-80): COLT INDUSTRIES	
DATE RECD (C): MONTH 08, DAY 30, YR (25-30) 78; DOC TYPE (E1) (31): M; MAX DAYS IN REVIEW (E1) (32-33): 07	REVIEWER'S SIGNATURE: H. Thieme / L. Fusegni; DATE 3/10/80
FUNCTIONAL TITLE (E1) (LIMIT TO 44 CHARACTERS & BLANKS) (37-80): 300 START TEST REPORT VOL. 1-5	RESPONSIBLE ENGINEER'S DATE STAMP (E2): NOTED MAR 10 1980 D.E.CRAFTS
S & W FILE NO. (E1) (C) (11-20) (21-24): 2702.190-230-007B	(C) PROJECT CLERK (R) REVIEWER (E1) RESPONSIBLE ENGINEER PRIOR TO REVIEW (E2) RESPONSIBLE ENGINEER AFTER REVIEW
JOB ORDER NO. 12241 00 (4-10)	TYPE CODE (E1): 43226; SEQUENCE NO. (C): DW8003180009

REVIEWER COMMENTS:

Note that this Test Report is the same Document that was entered as S&W File No. 2702.190-230-007A, i.e. this is not a resubmittal. It is now re-entered as S&W File No. 2702.190-230-007B in order to include a new review status. This new status is warrented on the basis of subsequent Colt Industries' submittals as follows:

S&W File No. 2702.190-230-013C
COLT IND. No. 5.63 410.5 206147
Qualification of Fuel System

S&W File No. 2702.190-230-014A
COLT IND. No. (None Given)
Bill of Materials - Fuel System

Both of the above documents were approved S&W on 2/1/80. See transmittal of 2/5/80 to COLT INDUSTRIES.

190-230-007

Calc. 10080-DEC-0246 Rev. 0 Attach. F Pg. 2 of 2

Colt Industries Fairbanks Morse Engine Division	ENGINEERING REPORT	SHEET 1 OF 5	PAGE NO. 1
		FILE NUMBER	11-206147C
SUBJECT	DIESEL GENERATOR SET FOR BEAVER VALLEY POWER STATION UNIT #2	DATE	7-20-78
		PREPARED BY	L. W. Cooper
REPORT TITLE	300 START AND LOAD ACCEPTANCE QUALIFICATION	APPROVED BY	[signature]

INTRODUCTION

A 300 Start and Load Acceptance Qualification Test was run on the second diesel generator unit S/N206147B for Beaver Valley Nuclear Power Station #2 as required by Stone and Webster Purchase Order 2BV-230.

Colt Engineering Instruction 11872825 Rev. 3 which was approved by Stone and Webster details the method of test and acceptance criteria. A total of 300 Start and Load Acceptance runs were required; 270 from warm standby temperatures and 30 from normal equilibrium temperatures, with no more than three failures allowed.

RESULTS

A total of 272 valid Start and Load Acceptance runs were made from warm standby temperatures with only one failure to meet the acceptance criteria.

A total of 30 valid Start and Load Acceptance runs were made from normal operating equilibrium temperatures with no failures to meet the acceptance criteria.

Additional runs were made which are discounted. That is, they are not considered valid runs nor failures, for reasons such as operator errors within the parameters defined in the test procedure.

The results of the Post Trial Inspection (per Paragraph IX of 11872825, Rev. 3) is covered in the material in Appendix P.

CONCLUSION

The diesel generator unit successfully passed the 300 Start and Load Acceptance Qualification Test.

ATTACHMENTS

Appendix A - Approved copy of Colt Engineering Instruction 11872825 Rev. 3 - 300 Start and Load Acceptance Qualification.

Appendix B - Test Logs 43, 44, 45, 46 (with Attachment A), 46A (Sheets 1 & 2), 47, 48, 49, 50 and 54 which record performance data and contain notations, where applicable, to events happening during a run, or maintenance performed.

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RTL# A1.002D

Calculation Affected Document Review Checklist

Calculation: 10080-DEC-0246 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.

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Page 1 of 1

DESIGN VERIFICATION RECORD

NOP-CC-2001-01 Rev. 00

SECTION I: TO BE COMPLETED BY DESIGN ORIGINATOR

DOCUMENT(S)/ACTIVITY TO BE VERIFIED:

Calc. 10080-DEC-0246 Rev. 0, Coping Duration for station Blackout.

☐ SAFETY RELATED ☒ AUGMENTED QUALITY ☐ NONSAFETY RELATED

SUPPORTING/REFERENCE DOCUMENTS

NUMARC 87-00	10CFR50.63
EM 30633	R.G. 1.155
E-mail F. Etzel to J. Ankney 3-31-03	CR 02-07114
E-mail D. McBride to J. Ankney 3-31-03	3BVT: 36.2

DESIGN ORIGINATOR: *(Print and Sign Name)* John F. Ankney [signature] DATE 4-7-03

SECTION II: TO BE COMPLETED BY VERIFIER

VERIFICATION METHOD *(Check one)*

☑ DESIGN REVIEW *(Complete Design Review Checklist or Calculation Review Checklist)* ☐ ALTERNATE CALCULATION ☐ QUALIFICATION TESTING

JUSTIFICATION FOR SUPERVISOR PERFORMING VERIFICATION:

N/A

APPROVAL: *(Print and Sign Name)* N/A DATE N/A

EXTENT OF VERIFICATION:

Design review, complete check for math, compared results to EM 30633.

COMMENTS, ERRORS OR DEFICIENCIES IDENTIFIED? ☐ YES ☑ NO

RESOLUTION: *(For Alternate Calculation or Qualification Testing only)*

N/A

RESOLVED BY: *(Print and Sign Name)* N/A DATE N/A

VERIFIER: *(Print and Sign Name)* Paul W. Dearborn [signature] PAUL DEARBORN DATE 4/8/03

APPROVED BY: *(Print and Sign Name)* K.J. Lynch [signature] DATE 4/9/03

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CALCULATION REVIEW CHECKLIST

NOP-CC-2001-04 Rev. 00

CALCULATION NO. 10080-DEC-0246
REV. 0
UNIT 2

QUESTION	NA	Yes	No	COMMENTS	RESOLUTION
REFERENCES 1 Does the stated objective/purpose clearly describe why the calculation is being performed?		✓			
2. Are applicable codes, standards, design/licensing basis documents, etc., including edition and addenda where appropriate clearly identified?		✓			
3. Do the references reflect the appropriate revision?		✓			
INPUTS 4. Are design inputs clearly identified and their source documents referenced, including revision level as appropriate?		✓			
5. Are the design inputs relevant, current, consistent with design/licensing bases and directly applicable to the purpose of the calculation, including appropriate tolerances and ranges/modes of operation?		✓			
6. Are all design inputs retrievable? If not, have they been added as attachments?		✓			
7. Are preliminary or conceptual inputs clearly identified for later confirmation as open assumptions?	✓				
ASSUMPTIONS 8. Have the assumptions necessary to perform the analysis been adequately documented?	✓				
9. Is suitable justification provided for all assumptions (except those based upon recognized engineering practice, physical constants or elementary scientific principles)?	✓				
10. Are all assumptions for the calculation reasonable and consistent with design/licensing bases?	✓				
11. Have all open assumptions needing later confirmation been clearly identified on the Calculation cover sheet, including when the open assumption needs to be closed?	✓				
12. Has a Condition Report been issued for open assumptions if required?	✓				
13. Have engineering judgments been used?	✓				
14. Are engineering judgments reasonable and adequately documented?	✓				
METHOD OF ANALYSIS 15. Is the method used appropriate considering the purpose and type of calculation?		✓			
16. Is the method in accordance with applicable codes, standards, and design/licensing bases?		✓			
IDENTIFICATION OF COMPUTER CODES (Ref: NOP-SS-1001) 17. Have the versions of the computer codes employed in the design analysis been certified for this application?	✓				
18. Are codes properly identified along with source, inputs and outputs?	✓				
19. Is the code suitable for the analysis being performed?	✓				
20. Does the computer model, that has been created, adequately reflect actual (or to be modified) plant conditions (e.g., dimensional accuracy, type of model/code options used, time steps, etc.)?	✓				
21. Is the computer output reasonable when compared to inputs and what was expected?	✓				
COMPUTATIONS 22. Are the equations used consistent with recognized engineering practice and design/licensing bases?		✓			
23. Is justification provided for any equations not in common use?		✓			
24. Is the justification reasonable?		✓			
25. Have adjustment factors, uncertainties, empirical correlations, etc., used in the analysis been correctly applied?	✓				
26. Is the result presented with proper units and tolerance?	✓				
27. Has proper consideration been given to results that may be overly sensitive to very small changes in input?	✓				

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CALCULATION REVIEW CHECKLIST

NOP-CC-2001-04 Rev. 00

CALCULATION NO. 10080-DEC-0246
REV. 0
UNIT 2

QUESTION	NA	Yes	No	COMMENTS	RESOLUTION
CONCLUSIONS 28. Is the magnitude of the result reasonable when compared to inputs?	✓				
29. Is the direction of trends reasonable?	✓				
30. Are stated conclusions justifiable based on the calculation results?		✓			
31. Are all pages sequentially numbered and marked with a valid calculation number?		✓			
32. Is all information legible and reproducible?		✓			
33. Have all changes in the documentation been initialed (or signed) and dated by the author of the change and all required reviewers?	✓				
34. Have all calculation results stayed within existing design/licensing basis parameters?		✓			
35. If the response to Question 34 is NO, has Licensing been notified as appropriate? (i.e. UFSAR or Tech Spec Change Request has been initiated).	✓				
36. Does the calculation meet its purpose/objective?		✓			
37. Has the calculation vendor used all applicable design information/requirements provided?	✓				
38. Did the calculation vendor determine if the calculation was referenced in design basis documents and/or databases?	✓				
39. Did the Preparer determine if the calculation was used as a reference in the UFSAR?	✓				
40. If the calculation is used as a reference in the UFSAR, is a change to the UFSAR required or an update to the UFSAR Validation Database, if applicable, required?	✓				
41. If the answer to Question 40 is YES, have the appropriate documents been initiated?	✓				
42. Is the calculation acceptable for use?		✓			
43. What checking method was used to review the calculation? Check all that apply.					
• spot check for math					
• complete check for math		✓			
• comparison with tests					
• check by alternate method					
• comparison with previous calculation		✓			

Review Summary: Results agree with EM 30633

☑ **Technical Review**		☐ **Owner's Acceptance Review** *(Required for calculations prepared by a vendor)*	
Reviewer *(Print and Sign Name)* Paul Dearborn Paul W. Dearborn	Date 4/8/03	Reviewer: *(Print and Sign Name)* N/A	Date N/A
		Approver: *(Print and Sign Name)* N/A	Date N/A