Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-15-220

October7, 2015

10 CFR 50.36

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
Construction Permit No. CPPR-92
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant Unit 2, Response to Request for Additional Information - Developmental Revision I Technical Specification Section 3.8 - Diesel Generator Batteries**

References:
1. Electronic Mail from J. Poole (NRC) to G. Arent (TVA), "Batteries," dated October 5, 2015
2. TVA Letter to NRC, "Watts Bar Nuclear Plant Unit 2 – Submittal of Developmental Revision I of the Unit 2 Technical Specification & Technical Specification Bases and Developmental Revision D of the Unit 2 Technical Requirements Manual and Technical Requirements Manual Bases," dated June 16, 2014 [ML14169A525]

The purpose of this letter is to respond to a request for additional information (RAI) provided in Reference 1. Tennessee Valley Authority (TVA) was requested to confirm that the Diesel Generator batteries are designed to operate at 50^{o} Fahrenheit (F). This question was identified by the Nuclear Regulatory Commission during their review of Technical Specification (TS) 3.8 provided in Development Revision I of the Watts Bar Nuclear Plant Unit 2 TSs (Reference 2).

The enclosure provides TVA's response to the Reference 1 RAI regarding batteries.

There are no new regulatory commitments associated with this letter. Please direct any questions concerning this matter to Gordon Arent at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 7th day of October 2015.

Respectfully,

J. W. Shea

Digitally signed by J. W. Shea
DN: cn=J. W. Shea, o=Tennessee Valley Authority, ou=Nuclear Licensing, email=jwshea@tva.gov, c=US
Date: 2015.10.07 19:14:15 -04'00'

J. W. Shea
Vice President, Nuclear Licensing

Enclosure:

Response to NRC Request For Additional Information – Diesel Generator Battery Temperature

cc (Enclosure):

U.S. Nuclear Regulatory Commission, Region II
NRC Senior Resident Inspector - Watts Bar Nuclear Plant, Unit 2
NRC Project Manager - Watts Bar Nuclear Plant, Unit 2

Enclosure

Response to NRC Request For Additional Information – Diesel Generator Battery Temperature

Background

By letter dated June 16, 2014, Tennessee Valley Authority (TVA) submitted the Watts Bar Nuclear Plant (WBN) Unit 2 Developmental Revision I of the Technical Specifications (TS) and TS Bases, and Developmental Revision D of the WBN Unit 2 Technical Requirements Manual (TRM) and TRM Bases to the Nuclear Regulatory Commission (NRC) (Reference 1). By electronic mail (email) dated October 5, 2015, the NRC provided a request for additional information (RAI) regarding TS Section 3.8 of Developmental Revision I (Reference 2).

The following response to the Reference 2 RAI addresses the NRC staff concerns related to the design of the Diesel Generator (DG) batteries.

NRC RAI

TS 3.8.6.3 establishes battery operability based on battery cell parameters and average electrolyte temperatures for vital and DG batteries. If the average electrolyte temperature of the representative cells is outside the lower limit (< 60°F for vital batteries and < 50°F for DG batteries), the battery is considered inoperable. The staff requested information about Station battery sizing and testing criteria for 60°F ambient temperature and DG battery at 50°F ambient temperature.

The applicant provided details on correction factors for station batteries for temperature range at and above 60°F and correction factors for DG batteries for temperature range at and above 60°F and NOT 50°F. The staff recommends that the applicant confirm that the DG batteries are designed for operating at 50°F.

TVA Response

Based on TVA's review of 125VDC Diesel Generator Battery sizing analysis calculation WBNEEBMSTI110062; the design temperature used for sizing the DG batteries is 50°F. Attachment 1 provides pages from the calculation confirming the use of 50°F The cell sizing factor for 50°F corresponds to 1.19 and is obtained from Table 1 of IEEE Standard 485, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications" (Attachment 2). Therefore, TVA confirms that the DG batteries are designed for operating at 50°F.

References

1. TVA Letter to NRC, "Watts Bar Nuclear Plant Unit 2 – Submittal of Developmental Revision I of the Unit 2 Technical Specification & Technical Specification Bases and Developmental Revision D of the Unit 2 Technical Requirements Manual and Technical Requirements Manual Bases," dated June 16, 2014 [ML14169A525].

2. Email from J Poole (NRC) to G. Arent (TVA), "Batteries," dated October 5, 2015.

ATTACHMENT 1

TVA Calculation
WBNEEBMSTI110062, "125VDC Diesel Generator (DG) Control Power System Evaluation"

Extracted Pages

NPG CALCULATION COVERSHEET / CTS UPDATE

REV 0 EDMS/RIMS NO.	CTS TYPE:	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
900214B0004/B26 900202 406	Calculation	CALCULATIONS (NUCLEAR)	T9 3121 0150 03

Calc Title:

125VDC DIESEL GENERATOR (DG) CONTROL POWER SYSTEM EVALUATION

	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV
CALC ID	NUC	WBN	EEB	WBNEEBMSTI110062	027	028

CTS UPDATE ONLY ☐ (Verifier and Approval Signatures Not Required)	NO CTS CHANGES ☒ 10/12/12 (For calc revision, CTS has been reviewed and no CTS changes required)

UNIT (check one)	SYSTEMS	UNIDS
0 ☒, 1 ☐, 2 ☐, 3 ☐	082	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
See Rev Log	N/A	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS and/or ISFSI SAR/CoC AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒

CALCULATION NUMBER REQUESTOR	PREPARING DISCIPLINE	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
Name: vupatel PHONE: 301-228-7658	EEB	Design Review	☐ Yes ☒ No

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
Vinu Patel	10/2/12	D S Bhatia	10/2/12
VERIFIER (PRINT NAME AND SIGN)	**DATE**	**APPROVAL (PRINT NAME AND SIGN)**	**DATE**
FAROOQ SOFI	10/10/12	RECox GCP	10/11/12

STATEMENT OF PROBLEM/ABSTRACT

STATEMENT of PROBLEM:

Verify the adequacy of the design and compliance with design criteria and SAR requirements. Review and document and impact.

ABSTRACT:

This calculation evaluate the adequacy of the 125 VDC DG Control Power System battery sizing, charger sizing, protective device sizing, short circuit and coordination, Appendix R, Reg. Guide 1.75 - Associated Circuits, cascade fuses and maximum voltage to the control circuit components. Equipment submerged due to MELB event is identified and the impact of its submergence on the 125 VDC DG Control Power System is evaluated in Appendix I. See Section 8.0 and 9.0 for results and conclusions.

The following revisions are Revision Log Change Only: 17, 21
The revision log changes must be worked in conjunction with the full version that issued the entire calculation.

See revision log for total pages and FSAR and Tech Spec compliance

LEGIBILITY EVALUATED AND ACCEPTED FOR ISSUE All Pages
Initials: [illegible] Date: 10/12/12

MICROFICHE/EFICHE Yes ☐ No ☐ FICHE NUMBER(S)

1.0 Purpose

The purpose of this calculation is to evaluate the adequacy of the 125VDC Diesel Generator Control Power System for compliance with FSAR and design criteria requirements for the following:

-battery sizing
-battery charger sizing
-protective device sizing
-short-circuit protection and coordination
-Appendix R power supply and associated circuits
-Reg Guide 1.75 associated circuits
-cascade fuse analysis
-voltage to components

The purpose of this calculation is also to evaluate the impact of the MELB on 125V DC Diesel Generator Control Power System and demonstrate that in the event of its loss the plant's safe shutdown can be successfully achieved. R14

2.0 Assumptions

Refer to Section 5.0 for documentation and justification of assumptions.

3.0 References and Sources of Design Input Data

3.1 WBN FSAR Sections 8.3.

3.2 Design Criteria WB-DC-30-27, "AC and DC Control Power Systems", DIMS WB-DC-30-27-1 (B26890324040), WB-30-27-2 (B26900510078).

3.3 WBN Preop Test 14D R4.

3.4 TVA drawings and vendor documents listed below:

15N210-4 RF
15W814-5 RJ
1-45W727 R03
1-45W728-1 R02
1-45W760-82-1 R02, -2 R01, -3 R03, -4 R02, -5 R00, -6 R02, -11 R00, -12 R01, -13 R01, -14 R02, -15 R00, -16 R02, -20 R02, -21 R00
45W1761-1 RM
45W1762-1 RH
45W1763-1 RK
45W1780-1 RG, -2 RD, -3 RF, -4 RF, -5 RC, -6 RE

45W1781-1 RN, -2 RD, -3 RG, -4 RF, -5 RC, -6 RE
45W1782-1 RE, -2 RB, -3 RD, -4 RB, -5 RB, -6 RC
45W1787-1 RG
45W2761-1 RJ
45W2763-1 RL
45W2780-1 RK, -2 RE, -3 RH, -4 RG, -5 RC, -6 RF
45W2781-1 RL, -2 RE, -3 RF, -4 RH, -5 RB, -6 RE
47E235-29 R04, -30 R03

Vendor Documents

R11

Contract 83090
DG Manual V01 1 & 2, TVA IDs 979, 980 (DG 1A-A, 1B-B, 2A-A, 2B-B); DG Manual Vol 1 & 2, TVA IDs 1548, 1549 (DG C-S)
650-242, 244; 655-241
6036B11010 RD, SHEETS 1-10
6036C04501 RB
C379C11501 R904
6036C11501 R901
6036C11501 R902
6036F11502 RB

3.5 DS-E8.1.1 R8,"Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)".

3.6 IEEE Standard 485 (1978), IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations".

3.7 SQN Calculation SQN-CPS-007 R0, "Diesel Generator Battery Capacity", B43861210901.

3.8 SQN Calculation SQN-CPS-012 R1, "Diesel Generator Lube Oil Pump Voltage", B87910118002. R11

3.9 Walkdown data for DG distribution panels included as attachment to memo from R.W. Bradford to H.B. Bounds, dated Nov. 28, 1988, "Watts Bar Nuclear Plant-Unit 1 and 2-Walkdown of Electrical Equipment -Walkdown Procedure WP-37", C24881128629.

3.10 National Electric Code, 1987, Chapter 9, Table 8, "Properties of Conductors" (dc resistance at 25^0 C).

This Sheet Added By Rev 11

5.0 Assumptions

5.1 The minimum ambient temperature of the rooms containing the diesel batteries is 50^0 F.
Justification: TVA drawings 47E235-29R2 and 47E235-30R0 list the average DG room temperature at 75^0 F and a normal minimum of 50^0 F. Ref. DCN M11594A.

5.2 The diesel batteries shall support three start attempts; one at the beginning of its 4 hour duty cycle, one at the 29 minute mark and the other at the end of the 4 hours.

Justification: DCN S-34918-A limits the number of starting attempts to three during the 4 hour Station Blackout event. If the diesel fails to reach 200 rpm within 5 seconds of initial start, a fail to start condition exists and the diesel is locked out, requiring a manual reset for a restart attempt. Experience with the diesel has proven that if it does not start at the initial start command, the time required for response and problem correction is significant such that it is reasonable to assume that the first restart attempt will occur in the first 30 minute period. Assuming the third and final starting attempt occurs in the final minute is conservative.

R19

5.3 It is assumed for short-circuit analysis that the DG battery system voltage is determined by the base emf of the battery at 2.06 volts-per-cell such that the battery voltage used in analysis is 119.5V (58 cells x 2.06V).

Justification: Under short-circuit conditions, the charger voltage declines as the output is current-limited. The use of 2.06 volts per cell will provide conservative results.

PREPARED BY [illegible] DATE 6/28/95
CHECKED BY [illegible] DATE 6/29/95

Battery Sizing Calculation
IEEE 485–1983 Work Sheet
DIESEL BATTERIES
SIMULTANEOUS MOTOR STARTS

Period Section	Load (A)	Change In Load (Amps)	Duration of Period (minutes)		Time to End of Section		Capacity At T Min	Required Section Size Pos Pl
Section 1 – First Period Only								
1	A1= ~~108.0~~ ~~108.24~~ 108.41	A1–0 = ~~108.0~~ 108.24	M1=	1	T=M1	1	72.33	1.50 ~~1.49~~
Section 2 – deleted for clarity								
Section 3 – First Three Sections Only								
1	A1= 108.41 ~~108.24~~	A1–0 = ~~108.0~~	M1=	1	T=M1:M3	30	47.33	2.29 ~~2.28~~
2	A2= 17.21 ~~16.81~~ ~~17.04~~	A2–A1 = (91.2)	M2=	28	T=M2:M3	29	47.33	(1.93)
3	A3= ~~81.8~~ ~~82.04~~ 82.21	A3–A2 = 65.0	M3=	1	T=M3	1	72.33	0.90
						Total...		~~1.25~~ 1.26 R25
Section 4 – deleted for clarity								
Section 5 – First Five Periods Only								
1	A1= 108.41 ~~108.24~~	A1–0 = ~~108.0~~	M1=	1	T=M1:M5	240	16.00	6.78 ~~6.77~~ ~~3.75~~
2	A2= 17.21 ~~16.81~~ ~~17.04~~	A2–A1 = (91.2)	M2=	28	T=M2:M5	239	16.00	(5.70)
3	A3= 82.21 ~~81.8~~ ~~82.04~~	A3–A2 = 65.0	M3=	1	T=M3:M5	211	19.00	3.42
4	A4= 15.41 ~~15.01~~ ~~15.24~~	A4–A3 = (66.8)	M4=	209	T=M4:M5	210	19.00	(3.52)
5	A5= 78.81 ~~78.4~~ 78.64	A5–A4 = 63.4	M5=	1	T=M5	1	72.33	0.88
						Total...		~~1.88~~ ~~1.85~~ 1.86

Battery Cell Size (No. Of Pos Plates) = Temp Cor Factor X Aging Factor X Design Margin

= 1.19 X 1.25 X 1.0 X ~~1.83~~ ~~1.85~~ 1.86

= ~~2.75~~ ~~2.72~~ 2.77 Positive Plates

R19

R27

THIS PAGE ADDED BY REVISION 19

ATTACHMENT 2

IEEE Std 485-1997(R2003)

IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

Extracted Pages

IEEE Std 485-1997(R2003)
(Revision of IEEE Std 485-1983)

IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

Sponsor

IEEE Standards Coordinating Committee 29 on Stationary Batteries

Reaffirmed 11 September 2003
Approved 20 March 1997

IEEE Standards Board

Abstract: Methods for defining the dc load and for sizing a lead-acid battery to supply that load for stationary battery applications in full float operations are described. Some factors relating to cell selection are provided for consideration. Installation, maintenance, qualification, testing procedures, and consideration of battery types other than lead-acid are beyond the scope of this recommended practice. Design of the dc system and sizing of the battery charger(s) are also beyond the scope of this recommended practice.
Keywords: battery duty cycle, cell selection, dc load, full float operation, lead-acid batteries, rated capacity, sizing, stationary applications, valve-regulated lead-acid (VRLA) cell, vented battery

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The Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street, New York, NY 10017-2394, USA

ISBN 1-55937-913-8

Note that the "margins" required by 6.3.1.5 and 6.3.3 of IEEE Std 323-1983 are to be applied during "qualification" and are not related to "design margin."

Table 1—Cell size correction factors for temperature

Electrolyte temperature		Cell size correction factor
(° F)	(° C)	
25	–3.9	1.520
30	–1.1	1.430
35	1.7	1.350
40	4.4	1.300
45	7.2	1.250
50	10.0	1.190
55	12.8	1.150
60	15.6	1.110
65	18.3	1.080
66	18.9	1.072
67	19.4	1.064
68	20.0	1.056
69	20.6	1.048
70	21.1	1.040
71	21.7	1.034
72	22.2	1.029
73	22.8	1.023
74	23.4	1.017
75	23.9	1.011
76	24.5	1.006
77	25.0	1.000
78	25.6	0.994
79	26.1	0.987
80	26.7	0.980
81	27.2	0.976
82	27.8	0.972
83	28.3	0.968
84	28.9	0.964
85	29.4	0.960
86	30.0	0.956
87	30.6	0.952
88	31.1	0.948
89	31.6	0.944
90	32.2	0.940
95	35.0	0.930
100	37.8	0.910
105	40.6	0.890
110	43.3	0.880
115	46.1	0.870
120	48.9	0.860
125	51.7	0.850

NOTE—This table is based on vented lead-acid nominal 1.215 specific gravity. However, it may be used for vented cells with up to a 1.300 specific gravity. For cells of other designs, refer to the manufacturer.

6.2.3 Aging factor

As a rule, the performance of a lead-acid battery is relatively stable throughout most of its life, but begins to decline with increasing rapidity in its latter stages, with the "knee" of its life versus performance curve occurring at approximately 80% of its rated performance.

IEEE Std 450-1995 recommends that a battery be replaced when its actual performance drops to 80% of its rated performance because there is little life to be gained by allowing operation beyond this point. Therefore, to ensure that the battery is capable of meeting its design loads throughout its service life, the battery's rated capacity should be at least 125% (1.25 aging factor) of the load expected at the end of its service life.

Exceptions to this rule exist. For example, some manufacturers recommend that vented batteries with Planté, modified Planté, and round plate designs be replaced when their measured capacity drops below 100% of