TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

5N 157B Lookout Place

September 15, 1988

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

Gentlemen:

In the Matter of) Docket No. 50-327
Tennessee Valley Authority)

SEQUOYAH NUCLEAR PLANT (SQN) UNIT 1 - ELECTRICAL CALCULATION PROGRAM FINAL STATUS

References:

1. TVA letter to NRC dated June 12, 1987, "Sequoyah Nuclear Plant (SQN) - Electrical Calculations - Revised Final Status Report"
2. TVA letter to NRC dated February 18, 1988, "Sequoyah Nuclear Plant (SQN) - Electrical Calculations - Revised Final Status for Unit 2 Restart"
3. NRC "Safety Evaluation Report on Tennessee Valley Authority: Sequoyah Nuclear Performance Plan," dated May 1988 (NUREG-1232, Volume 2)
4. TVA letter to NRC dated August 4, 1988, "Sequoyah Nuclear Plant (SQN) Unit 1 - Electrical Calculation Program Status"
5. TVA letter to NRC dated August 11, 1988, "Sequoyah Nuclear Plant (SQN) - Diesel Generator (DG) Load Analysis Results"

This letter provides NRC with the final results of the auxiliary power system (APS) analysis and documents the completion of the SQN unit 1 electrical calculation effort. TVA committed to provide these results to NRC upon their completion (reference 4). Enclosure 1 contains a summary of the APS analysis and a discussion of its results.

In keeping with the commitment made to NRC in reference 1, TVA has identified and revised all essential minimum set electrical calculations required for unit 1 restart for the following items:

1. Verification of all previously unverified assumptions (UVAs)

   SQN's Nuclear Engineering (NE) has addressed this issue by revising all essential minimum sets of calculations required to support unit 1 restart to either delete/document the UVAs or to provide justification for interim operation (JIO).

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2. Deletion of nonconservative or unverified cable lengths

   Calculations were revised to ensure that cable pull card data or field walkdown data was utilized instead of design cable length.

3. Correction of deficiencies identified by the Design Baseline and Verification Program (DBVP)

   Calculations have been revised to address punchlist items and conditions adverse to quality reports/significant condition reports generated by DBVP.

4. Incorporation of configurational control (as-constructed) drawings applicable to DBVP walkdown data

   Calculations were revised to include the DBVP walkdown data and marked-up configurational control drawings.

To complete documentation and to maintain consistency with prior unit 2 calculation submittals, enclosure 2 contains a complete listing of the SQN unit 1 restart calculations cross-referenced to the applicable Procedure Method (PM) 86-02 requirements. With the exceptions of electrical load monitoring system (ELMSAC), SQN-EEB-MS-T106-0002, and technical justification in lieu of calculation for raceway systems (B25 880830 023), all items were complete before submittal of reference 4. The raceway technical justification was issued solely to concisely summarize raceway activities completed before unit 2 restart, which extends also to unit 1.

In addition, in our previous submittal on the DG load analysis results (reference 5), there was a typographical error in table 1. The maximum transient load from 0 to 3 minutes (loss of offsite power with safety injection [SI] Phase A) for DG 1A-A was listed as 4,407 kilowatts (kW) and should have been listed as 4,047 kW.

In conclusion, the results of the ELMSAC, SQN-EEB-MS-T106-002, are acceptable and consistent with previous analyses. Based upon the results of this effort and the efforts provided in reference 5, the SQN electrical calculation program is complete. The results of this program support the restart of SQN unit 1 and corroborate the design basis for two-unit operation.

Please direct questions concerning this issue to B. A. Kimsey at (615) 870-6847.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. Gridley, Manager
Nuclear Licensing and
Regulatory Affairs

Enclosures
cc (Enclosures):

Ms. S. C. Black, Assistant Director
for Projects
TVA Projects Division
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

Mr. F. R. McCoy, Assistant Director
for Inspection Programs
TVA Projects Division
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Sequoyah Resident Inspector
Sequoyah Nuclear Plant
2600 Igou Ferry Road
Soddy Daisy, Tennessee 37379

ENCLOSURE 1

APS Analysis

SQN-EEB-MS-TI06-0002, RO

The electrical load monitoring system alternating current (ac) (ELMSAC) is a quality assurance (QA) load flow computer program that performs APS loading, voltage, and short circuit analyses. The decision to utilize ELMSAC in support of unit 1 restart was based upon TVA's commitment to standardize calculation methods and to use industry-proven QA software (enclosure 4 of reference 4) to produce calculations that may be readily and easily maintained. The following information is a summary of each analytical function of ELMSAC, which was issued August 19, 1988.

A. Loading Analysis

Utilizing the loading data from the data base calculation (TELAS) in conjunction with ELMSAC, TVA conducted APS loading analyses to address the 6.9-kilovolt (kV) unit boards and the 6.9-kV and 480-volt (V) ac class 1E boards. These analyses document the units 1 and 2 power distribution equipment loading profiles for normal operation, full load rejection, and emergency shutdown. The methods utilized for data acquisition, determination/categorization of operational modes, etc., are similar to those previously reviewed by NRC and documented as adequate in reference 3, page 2-[illegible]. Because of greater conservatism in the specification of coincidental loading conditions and to the use of worst-case assumptions for non-class-1E loading (the use of transformer nameplate ratings, etc.), ELMSAC documents slightly higher total loading than calculation OE2-EEBCAL001, "AC APS Voltage and Loading Analysis." However, no overloads were identified on class 1E board buses or connections for either units 1 or 2 other than the previously identified overload condition, which is being corrected by design change notice (DCN) X00195A before restart. Further, the increase in loading does not affect the margins established in the unit 2 DG analysis. The following table compares ELMSAC and the previously calculated OE2-EEBCAL001 results for normal full-load operation fed from the unit station service transformers (worst-case scenario for faults and voltage calculations).

Board Name	ELMSAC (MVA)	CAL001 (MVA)
Unit Bd. 1A	9.46	10.19
Unit Bd. 1B	13.33	14.07
Unit Bd. 1C	13.55	10.29
Unit Bd. 1D	9.90	10.51
Total	[illegible] 24	45.06

megavoltamperes [illegible]

B. Voltage Analyses

The ELMSAC voltage analyses determine and document the following:

1. Steady-state (SS) voltages at 6.9-kV and 480-V buses for:

   a. Full-load (FL) operation at minimum unit generator and offsite power source voltages.

   b. FL rejection loading at minimum unit generator and offsite power source voltages.

   c. Emergency shutdown (SI phases A and B) in one unit concurrent with a FL rejection in the other unit at minimum unit generator/offsite power supply voltages.

2. Transient voltage profiles at all class 1E APS buses and at worst-case, safety-related motor terminals for design basis conditions at time (t)=0 and t=5 seconds (sec).

   Results of the analyses verify the following:

CALCULATED RESULTS FOR 6.9-kV CLASS 1E SHUTDOWN BOARDS

Case	Supply Transf	Time	Shutdown Board (Voltage)			
			1A-A	1B-B	2A-A	2B-B
1. Maximum load	CSST[(1)]	t=0 sec	6707	6730	6206	6192
Unit 2-SI Phase B		t=5 sec	6707	6730	6623	6656
Unit 1-FL Rejection		t=SS	6707	6730*	6650	6681
2. Maximum load	CSST	t=0 sec	6130	6275	6666	6704
Unit 1-SI Phase B		t=5 sec	6648	6694	6666	6704
Unit 2-FL Rejection		t=SS	6681	6714	6666	6704
3. Maximum load	USST[(2)]	SS	6639	6616*	6632	6625
Unit 1-Normal Operation						
Unit 2-Normal Operation						

(1) CSST - Common station service transformer tap at -2.5%, 159 kV
(2) USST - Unit station service transformer, tap at +2.5%, 22.8 kV

All comparable voltages exceed those calculated in OE2-EEBCAL001 with the exception of those indicated by (*). These voltages differ by no more than 0.5 percent. This difference has no impact upon the calculation results.

No changes have been made to the offsite source voltage range, USST, CSST tap settings, or 480-V shutdown board tap settings. Therefore, the previous results of maximum voltage analysis for light load conditions are still applicable and were not redone in this calculation.

The results of the voltage analyses are that:

1. The 6.9-kV shutdown board voltages recover to greater than 6,600 V within 5 seconds to allow resetting of second level under voltage relays.

2. There is adequate voltage at all class 1E motor terminals to accelerate the loads within the times required for all specified operating conditions.

3. There is adequate terminal voltage (90 percent of rated 6,600 V and 460 V) supplied to all class 1E motors, under all SS loading conditions (with minimum source voltages).

C. Short Circuit Study - Medium Voltage System

In reviewing SQN unit 2 restart calculation SQN-APS-008 NRC stated in reference 3, page 2-42, "In normal operation, the non-safety-grade unit board feeder circuit breakers may be required to interrupt a fault greater than designed but less than tested and the unit board load circuit breakers may be required to interrupt a fault significantly above the designed and tested value." TVA has committed to corrective actions, in reference 3, page 2-44, (to be scheduled and submitted to NRC before June 30, 1989) that shall ensure ". . . all circuit breakers will always operate within their service capability as defined by appropriate standards and verified by test or manufacturer's guarantee." Based upon their review of the calculation and upon TVA's commitment, the NRC staff documented in reference 3, page 2-44, ". . . that the fault calculation for the 6.9-kilovolt system provides reasonable assurance that the 6.9-kilovolt system will provide sufficient capacity and capability to meet its safety function as defined in 10 CFR 50, Appendix A, GDC 17." Further, on page 2-45 of reference 3, the NRC staff noted:

> . . . that Revision 1 to calculation APS 008, dated June 1, 1987, and submitted to the staff for review includes analysis of Unit 1 and the effect of two unit operation on fault levels. Also the revised calculation reflects verification of technical data on motors and cable lengths based on walkdown data. Therefore, there are no unverified assumptions remaining in the 6.9-kilovolt fault analysis and the analysis as reviewed is applicable and acceptable, subject to the limitations discussed above, for Unit 1 as well as Unit 2 operation.

SQN-EEB-MS-T106-0002, RO (ELMSAC), also documents the short circuit calculations performed, and this information replaces calculation SQN-APS-008. Similar to SQN-APS-008, ELMSAC addresses two-unit operation and employs walkdown data extensively. The results of the two calculations are similar, i.e., the problem with the unit board circuit breakers is documented in ELMSAC. However, through the use of detailed computer-aided calculations versus more generalized hand calculations, ELMSAC documents slightly lower fault currents. Therefore, system adequacy and performance are still demonstrated. Further, because ELMSAC employs QA software and industry-accepted methodology, the staff conclusion regarding the applicability and acceptability of SQN-APS-008 may be extended to the fault analyses in ELMSAC.

Following is a comparative summary of ELMSAC and SQN-APS-008 unit 1 fault analysis results. Fault values represent interrupting kiloamperes (kA).

BOARD NAME	ELMSAC (kA)	SQN-APS-008 (kA)
Unit Bd. 1A	49.38*	53.66*
Unit Bd. 1B	49.46*	53.66*
Unit Bd. 1C	46.82	53.52*
Unit Bd. 1D	46.81	53.52*
Shutdown Bd. 1A-A	40.73*	42.70*
Shutdown Bd. 1B-B	38.08	42.50*

*Indicates analysis performed with DG contribution included. ELMSAC analysis was performed with and without DG connections to document the DG fault contribution during parallel connection. The 6.9-kV shutdown board determined to have the greatest fault current without DG contribution was selected for final analysis with DG contribution.

D. Branch Technical Position PSB-1

The software previously utilized for PSB-1 verification tests (VNEW and RADIAL) has been replaced by ELMSAC. TVA has performed a confirmatory analysis, using the July 12, 1980 test configuration, to demonstrate that there is no appreciable difference from previously calculated voltages and that ELMSAC results are within 3 percent of measured values. The following results verify the adequacy of ELMSAC with respect to PSB-1.

Board	Configuration 1			Configuration 2		
	ELMS	Radial	Measure	ELMS	Radial	Measure
6.9-kV Start Bus A	7157	7154	7200	7054	7045	7000
6.9-kV Start Bus B	7054	7051	7000	7076	7067	7000
6.9-kV Unit Bd 1B	7053	7051	7100	7075	7067	7090
6.9-kV Shutdown Bd 1A1-A	7046	7044	7000	7068	7060	7100
480-V Shutdown Bd 1A1-A	502	501	495	503	501	500
480-V Reactor Vent Bd 1A-A	494	493	484	496	494	489
Start ERCW PMP Q-A (Term V)	N/A	N/A	N/A	6761	6705	6787
Start AB Gen Sup Fan (Term V)	N/A	N/A	N/A	459	459	466

ENCLOSURE 2

SEQUOYAH UNIT 1 RESTART
ESSENTIAL MINIMUM SET CALCULATIONS (PM 86-02)

AUXILIARY POWER SYSTEM	TVA ELECTRICAL CALCULATIONS
5. EG Sizing	SQN-E3-002
9. Power Cable Sizing a. Safety-related portion	SQN-EEB-MS-TI06-0002 D2SDJ-P213350, D2SDJ-P213350-3, SQN-APS-003 Ampacity issues - L44870227834 (SQN-EPS-007, SQN-EPS-008, EEB-CSTF-0001, SQN-EPS-006, SQN-EPS-009, SQN-CSS-002) SQN-EPS-011
10. Penetration Sizing	0E2-DS196RP SQN-EPS-002 SQN-EPS-004
11. Auxiliary System Load Flow a. Safety-related portion	SQN-EEB-MS-TI06-0002 SQN-APS-004
12. Auxiliary System Voltage Profile a. Safety-related portion	SQN-EEB-MS-TI06-0002, 0E2-EEB CAL001
13. Auxiliary System Short-Circuit Analysis a. Safety-related portion	SQN-APS-008, D2SDJ-P213350-1, SQN-EEB-MS-TI06-0002
14. DG Performance	SQN-E3-002 SQN-E3-011 SQN-E3-015
15. Bus Transfer Tests and Analysis a. Safety-related portion	SQN-APS-005
17. 480-V Class 1E Switchgear Selection, Protection, and Coordination	SQN-APS-003, D2SDJ-P213350-1, SQN-EEB-MS-TI06-0002 D245-DS199RP, D2SDJ-P213350
19. 480-V Class 1E Motor Control Center Selection, Protection, and Coordination	SQN-APS-003, D2SDJ-P213350-1, SQN-EEB-MS-TI06-0002 D245-DS199RP, D2SDJ-P213350, SQN-APS-010 (B25 860127 301)

AUXILIARY POWER SYSTEM	TVA ELECTRICAL CALCULATIONS
20. Submerged Equipment Analysis	D245-D3199RP
22. Appendix R Associated Circuit Analysis	D2SDJ-P213350, D2SDJ-P213350-3

*Note: SQN-EEB-MS-TI05-0001, TVA Electrical Auxiliary System (TELAS) load and cable data base is used in conjunction with SQN-EEB-MS-TI06-0002 (ELMSAC).

CONTROL POWER SYSTEM	
3. Class 1E Battery Sizing	
a. Vital batteries	SQN-CPS-004
b. DG batteries	SQN-CPS-007
5. Vital Battery Charger Sizing	SQN-CPS-004
7. Vital Uninterruptible Power Supply Sizing	SQN-CPS-005
8. Electrical Penetration Sizing and Protection	SQN-EPS-004, SQN-EPS-002, SQN-NV3-PEN-1
9. Distribution Panel and Transformer Sizing	SQN-CPS-003
b. 1E safety-related portion	SQN-CPS-008
c. DG battery system	SQN-CPS-011
11. Low-Voltage AC Power Cable Sizing	
a. Safety-related portion	Ampacity (SQN-EPS-006, SQN-EPS-009, SQN-CSS-002, EEB-CSTF-0001) SQN-VD-VAC-1, -2, -3 SQN-APPR-1, -2
12. DC Power Cable Sizing	
a. Safety-related portion	Ampacity (SQN-EPS-006, SQN-EPS-009, SQN-CSS-002, EEB-CSTF-0001) SQN-VD-VDC-1, -2 SQN-APPR-1, -2

CONTROL POWER SYSTEM	TVA ELECTRICAL CALCULATIONS
13. Control and Instrumentation Cable Sizing	
a. Safety-related portion	Ampacity (SQN-EPS-006, SQN-EPS-009, SQN-CSS-002, EEB-CSTF-0001) SQN-VD-VAC-1, -2, -3 and SQN-VD-VDC-1, -2, SQN-APPR-1, -2 SQN-APS-010
14. Class 1E AC System Load Flow	SQN-CPS-005
16. Class 1E DC System Load Flow	SQN-CPS-004
18. Class 1E AC System Voltage Profile	SQN-VD-VAC-1, -2, -3
20. Class 1E DC System Voltage Profile	
a. Vital battery system	SQN-VC-VDC-1, -2
b. DG battery system	SQN-CPS-012
22. Class 1E AC System Short Circuit Analysis	SQN-APPR-1, -2 SQN-NV3-PEN-1 SQN-CPS-003 SQN-CPS-006
24. Class 1E DC System Short Circuit Analysis	
a. Vital battery system	Same as item 22 above
b. DG battery system	SQN-CPS-011
26. Class 1E AC System Selection, Protection, and Coordination	Same as item 22 above SQN-CPS-013, SQN-E3-003
28. Class 1E DC System Selection, Protection, and Coordination	Same as item 24 above
30. Battery Hydrogen Generation	2-HYDRO6O-1, EEB-DS-E3.1.1 (EEB 841226 926)
31. Submerged Equipment Analysis	SQN-SBMG-1
32. Appendix R Associated Circuit Analysis	SQN-APPR-1, -2

COMMUNICATIONS CALCULATIONS

1. Penetration Protection for Communication Circuits	SQN-NV3-PEN-1, SQN-EPS-002, SQN-EPS-004
2. Associated Circuit Analysis for Appendix R	SQN-APPR-1, -2

LIGHTING SYSTEM CALCULATIONS

1. Lighting Level Selection a. Control room, safe shutdown area, and security portion	Sequoyah Nuclear Plant-Technical Justification-Yard Security Lighting and 125-Volt DC Emergency Lighting Systems (Control Room and Safe Shutdown Areas). (B43 870402 906)
8. Lighting System Penetrations	SQN-NV3-PEN-1, SQN-EPS-002, SQN-EPS-004
10. Appendix R Associated Circuit Analysis	D2SDJ-P213350, D2SDJ-P213350-3

STATION GROUNDING CALCULATIONS

3. Power Plant Lightning Protection	Technical Justification B43 860822 901

INSTRUMENTATION AND CONTROL CALCULATIONS

1. Flow Element Calculations a. Important to safety portion	82586NDH-2 (46-1) 91286BDP-1 (46-4)
2. HVAC Airflow Measuring Station a. Important to safety portion	HVACACC-81486 (46-7)
3. Sample Line Calculations a. Important to safety portion	No safety-related sample lines required for U1 restart
4. Sample Cooler Size Calculations a. Important to safety portion	No safety-related coolers required for U1 restart
5. Isokinetic Nozzle Calculations a. Important to safety portion	82586NDH-1 (46-2)

INSTRUMENTATION AND CONTROL CALCULATIONS

6. Control Valve, Relief Va e, Pressure Regulator Size
   a. Important to safety portion — 82986RAC(CE) (46-8)

7. Heat Trace Calculations
   a. Important to safety portion — 82786NDH (46-3)

8. Control Loop Response Time and Stability Calculations
   a. Important to safety portion — AFW-S&L (46-5)

9. Instrument & Time De'ay Setpoint Accuracy Calculations
   a. Important to safety portion

42586RES1	(002B)
1-PS-30-46A	(003)
1-XE-68-334	(004)
1,2-PT-30-310	(005)
1-LT-3-148	(007)
1-TE-68-1	(008)
1-FS-30-194	(009)
1-TS-30-186	(010)
1-TS-1-17A	(011)
0-TS-12-91A	(012)
1,2-PdT-30-44	(013)

INSTRUMENTATION AND CONTROL CALCULATIONS

9. (Continued)

0-FS-65-25A/B	(025)
1,2-H2E-43-200	(027)
PDT-65-80	(028)
1,2-PDT-65-80	(029)
1-FT-3-147, 155	(032)
RCP-UV-DEVICE27	(034)
1-LT-3-38	(035)
1-PT-1-2B	(036)
1-PT-1-27B	(037)
RWST-LEVEL	(038)
RP-SUMP-1	(039)
2-99-621B	(041)
1-FT-72-13	(042)
61686RDM	(043)
1-PT-1-2A	(044)
0-LDT-67-470	(047)
1-PS-3-139A	(048)
0-LDS-67-470D	[illegible]
1-PS-3-121	(050)

9. (Continued)

1-PS-3-138A	(051)
1-PS-3-148	(052)
0-LS-16-62A1	(053)
1-LT-63-50	(056)
1-LS-87-21	(057)
1-PT-1-5	(058)
1,2-FT-3-142	(059)
0-PS-67-471	(060)
1,2-PDIS-67-490F/E	(061)
1,2-PDIS-67-490B/A	(062)
0-PS-32-62	(063)
1&2-TS-74-43, -44	(064)
0-PS-32-62B	(065)
1-[illegible]S-70-20[illegible]A	(066)
1-FS-74-12A	(067)
1-FS-74-12B	(068)
0-PS-32-62A	(069)
0-RE-90-106A	(070)

INSTRUMENTATION AND CONTROL CALCULATIONS

9. (Continued)

0-PDT-30-148	(071)
27 DAT	(072)
SQN-CSS-005	(074)
LT-63-176	(075)
DS1-2	(076)
DG TIMER RELAYS	(077)
LT-3-4'	(078)
RESON001	(079)
LT-68-320	(080)
LT-3-39	(082)
FT-67-206	(084)
SQN-CSS-018	(086)
SQN-CSS-016	(087)
TSAT	(088)
PT-68-66	(089)
SQN-CSS-020	(090)
SQN-CSS-019	(091)
R5	(092)
2-FT-70-81A/81E	(093)

INSTRUMENTATION AND CONTROL CALCULATIONS		
9. (Continued)	27 S1A	(094)
	SQN-CSS-022	(095)
	2-TS-30-104	(100)
	PS-43-200A	(101)
	62/172	(102)
	ACTD	(103)
	ABGTS-JULY	(109)
10. Control and Essential Air System Calculations a. Important to safety portion	MEB Calculation B43 861014 904	
11. Instrument Sense Line Size Justification a. Important to safety portion	SQNRAJ9886 (46-6)	
12. Electrical Penetrations	SQN-NV3-PEN-1 Design Criteria SQN-DC-V-11-3	

RACEWAY SYSTEMS	
1. Cable Pulling	) Addressed in technical justification in lieu of calculations for raceway systems (B25 880830 023)
2. Cable Tray Fill and Loading	)
3. Conduit System Sizing	)
4. Electrical Separation Analysis and Justifications	)