ENCLOSURE 1

SEQUOYAH NUCLEAR PLANT

PROPOSED TECHNICAL SPECIFICATIONS

TVA-SQN-TS-36

CHANGE NO. 1

DIESEL GENERATOR BATTERY FLOAT VOLTAGE

SURVEILLANCE REQUIREMENTS (Continued)

4.8.1.1.3 The 125-volt D.C. distribution panel, 125-volt D.C. battery bank and associated charger for each diesel generator shall be demonstrated OPERABLE:

a. At least once per 7 days by verifying:

   1. That the parameters in Table 4.8-1a meet the Category A limits.

   2. That the total battery terminal voltage is greater than or equal to 124-volts on float charge.

b. At least once per 92 days by:

   1. Verifying that the parameters in Table 4.8-1a meet the Category B limits,

   2. Verifying there is no visible corrosion at either terminals or connectors, or the cell to terminal connection resistance of these items is less than 150×10^{-6} ohms, and

   3. Verifying that the average electrolyte temperature of 6 connected cells is above 60 F.

c. At least once per 18 months by verifying that:

   1. The cells, cell plates and battery racks show no visual indication of physical damage or abnormal deterioration.

   2. The battery to battery and terminal connections are clean, tight and coated with anti-corrosion material.

   3. The resistance of each cell to terminal connection is less than or equal to 150×10^{-6} ohms.

4.8.1.1.4 Reports - All diesel generator failures, valid or non-valid, shall be reported to the Commission pursuant to Specification 6.9.1. Reports of diesel generator failures shall include the information recommended in Regulatory Position C.3.b of Regulatory Guide 1.108, Revision 1, August 1977. If the number of failures in the last 100 valid tests (on a per nuclear unit basis) is greater than or equal to 7, the report shall be supplemented to include the additional information recommended in Regulatory Position C.3.b of Regulatory Guide 1.108, Revision 1, August 1977.

SURVEILLANCE REQUIREMENTS (Continued)

f. At least once per 10 years* by:

1. Draining each fuel oil storage tank, removing the accumulated sediment and cleaning the tank using a sodium hypoclorite solution, and

2. Performing a pressure test of those portions of the diesel fuel oil system designed to Section III, subsection ND of the ASME Code at a test pressure equal to 110 percent of the system design pressure.

4.8.1.1.3 The 125-volt D.C. distribution panel, 125-volt D.C. battery bank and associated charger for each diesel generator shall be demonstrated OPERABLE:

a. At least once per 7 days by verifying:

1. That the parameters in Table 4.8-1a meet the Category A limits.

2. That the total battery terminal voltage is greater than or equal to 124-volts on float charge.

b. At least once per 92 days by:

1. Verifying that the parameters in Table 4.8-1a meet the Category B limits,

2. Verifying there is no visible corrosion at either terminals or connectors, or the cell to terminal connection resistance of these items is less than 150×10^{-6} ohms, and

3. Verifying that the average electrolyte temperature of 6 connected cells is above 60 F.

c. At least once per 18 months by verifying that:

1. The cells, cell plates and battery racks show no visual indication of physical damage or abnormal deterioration.

2. The battery to battery and terminal connections are clean, tight and coated with anti-corrosion material.

3. The resistance of each cell to terminal connection is less than or equal to 150×10^{-6} ohms.

*These requirements are waived for the initial surveillance.

TVA-SQN-TS-36
Change No. 1
Sequoyah Nuclear Plant
Justification for Proposed Technical Specification Change

DIESEL GENERATOR BATTERY FLOAT VOLTAGE

The diesel generator batteries at Sequoyah have been replaced with lead calcium cells. The manufacturer (C&D Batteries) recommends a minimum float voltage of 2.17 volts for each cell. The Sequoyah batteries consist of 19 three cell units. The minimum total float voltage requirement is:

2.17 volts/cell x 57 cells = 123.69 volts

The minimum float voltage specified in surveillance requirement 4.8.1.1.3.a.2 should be 124 volts (rounded up).

The present technical specification test value of 129 volts exceeds the manufacturer's maximum of 128.25 volts. The larger voltage can shorten battery life.

A copy of the manufacturer's specification sheets and part of the instruction manual are included are attachments.

STATIONARY BATTERIES

25 to 200 Amp. Hours
DCU - Lead Calcium
DU - Lead Antimony

SPECIFICATIONS

CELLS PER UNIT	One, two or three		
PLATES	Height	Width	Thickness
Positive	5.88"	5.63"	0.266"
Negative	5.88"	5.63"	0.170"
Outside Negative	5.88"	5.63"	0.110"

SPECIFIC GRAVITY ..... 1.210 nominal at 77°F

CONTAINER .... Transparent thermoplastic

CELL COVER .... Thermoplastic

SEPARATORS .... Microporous

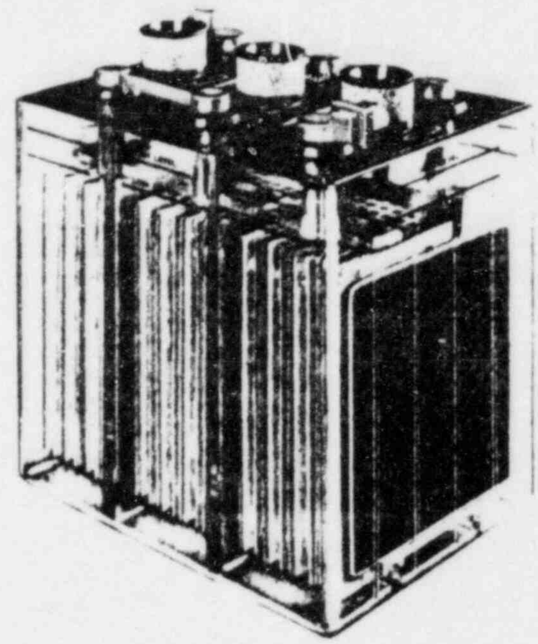
RETAINERS .... Fibrous glass mat

ELECTROLYTE HEIGHT ABOVE PLATES .... 1.75" except 11 plate — 1.63"

SEDIMENT SPACE ...... 0.5" except 11 plate — 0.56"

TERMINALS .... DCU/DU - 3 thru 11: Two flag terminals with 1/4" - 20 bolts
DCU/DU - 13 thru 17: Two 0.75" posts with 5/16" - 18 stud and cap nuts

VENT CAPS .... Flame arrestor type



3DCU-7

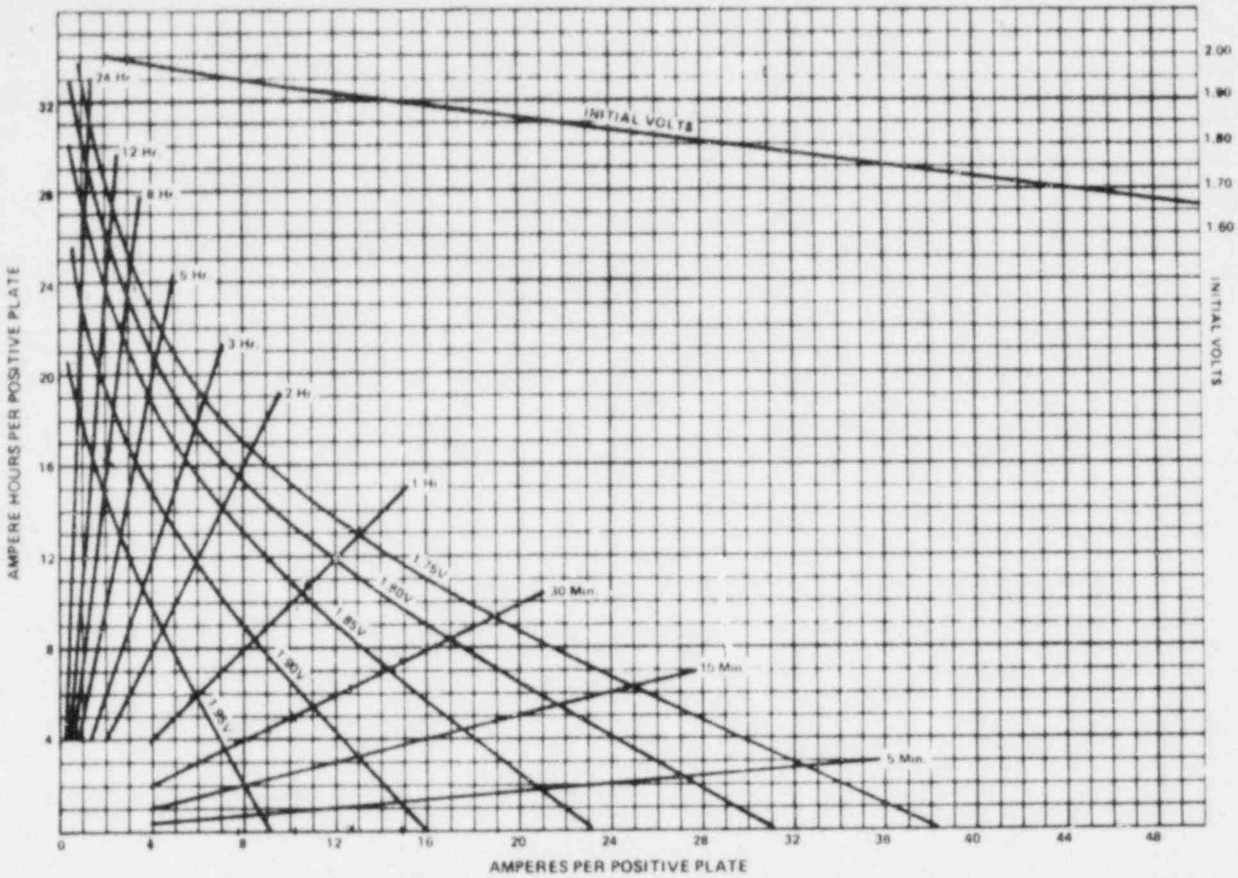
Type of Cell: Calcium	Type of Cell: Antimony	Cells per Unit	*Nominal Cap. 1.75 VPC @ 77°F (Includes Connector Voltage Drop) — Ampere Hours: 8 Hrs.	5 Hrs.	3 Hrs.	1.5 Hrs.	1 Hr.	Amperes: 30 Min.	15 Min.	1 Min.	Overall Dimensions: L (in.)	W (in.)	H (in.)	Approx. Weight (lbs.): Net Filled	Dom. Packed	Elect. per Cell (lbs.)
2DCU-3	2DU-3	2	25	22	19	15.3	12.5	19	24.9	37.5	3.59			18	22	3
3DCU-3	3DU-3	3	25	22	19	15.3	12.5	19	24.9	37.5	5.28			27	32	3
2DCU-5	2DU-5	2	50	44	38	30.6	25	38	49.8	75	3.59			22	26	2.8
3DCU-5	3DU-5	3	50	44	38	30.6	25	38	49.8	75	5.28			33	38	2.8
2DCU-7	2DU-7	2	75	66	57	45.9	38	57	74.7	111	6.38	7.38	10.31	36	40	5.8
3DCU-7	3DU-7	3	75	66	57	45.9	38	57	74.7	111	9.47			53	58	5.8
2DCU-9	2DU-9	2	100	88	76	61.2	50	76	99.6	148	6.38			40	44	5.3
3DCU-9	3DU-9	3	100	88	76	61.2	50	76	99.6	148	9.47			60	65	5.3
2DCU-11	2DU-11	2	120	105	90	75	60	96	126	184	7.50	7.19	10.25	48	55	5.8
3DCU-11	3DU-11	3	120	105	90	75	60	96	126	184	11.13			71	79	5.8
DCU-13	DU-13	1	150	132	114	91.8	75	114	149.4	220	6.38			38	44	12.5
DCU-15	DU-15	1	175	154	132	107.1	88	133	174.3	253	6.38	7.38	10.75	40	46	11.5
DCU-17	DU-17	1	200	176	150	122.4	100	152	199.2	288	6.38			42	48	10.5

Note: Electrolyte weighs approximately 10 lbs. per gallon

* Data based on discharge from float at 77°F for a minimum of 72 hours in accordance with Federal Specification W-B-134.

SWIFT INDUSTRIAL POWER

TYPICAL DISCHARGE CHARACTERISTICS OF DCU, DU
(EXCEPT DCU-11)



Data based on discharge from float at 77°F for a minimum of 72 hours in accordance with Federal Specification W-B-134.

RACK SPECIFICATIONS

Battery	No. of Cells	TWO TIER Model RD 701 (L), Width: 13 in., Height: 31.38 in. — Length (L) ft.	Weight lbs.	No. Req'd.	TWO STEP Model RD 703 (L), Width: 17.5 in., Height: 24.38 in. — Length (L) ft.	Weight lbs.	No. Req'd.	THREE TIER Model RD 702 (L), Width: 16 in., Height: 56.38 in. — Length (L) ft.	Weight lbs.	No. Req'd.
2DCU/DU-3	12	3	46	1	3	47	1	–	–	–
thru	23/24	3	46	1	3	47	1	–	–	–
	26	3	48	1	3	47	1	–	–	–
3DCU/DU-5	60	5	61	1	5	62	1	5	102	1
2DCU/DU-7	12	3	46	1	3	47	1	–	–	–
thru	23/24	4	54	1	4	55	1	3	79	1
	26	4	54	1	4	55	1	3	79	1
3DCU/DU-9	60	9	106	1	9	108	1	4	91	1
2DCU/DU-11	12	3	46	1	3	47	1	–	–	–
and	23/24	4	54	1	4	55	1	3	79	1
	26	5	61	1	5	62	1	4	91	1
3DCU/DU-11	60	10	114	1	10	116	1	10	201	1
DCU/DU-13	12	4	54	1	4	55	1	–	–	–
thru	23/24	7	90	1	7	92	1	5	102	1
	26	8	98	1	8	100	1	6	114	1
DCU/DU-17	60	9	106	2	9	108	2	4	–	1

Notes: 1. Above data is for C&D standard racks only. For seismic zones, C&D type EP racks are available. See Section 12-550.

2. Rack lengths for other than 60-cell batteries can be calculated by the formula.
Number of cells per tier or step × (L + 0.5) – 0.5 = Total Rack Length
(Where "L" is length of cell.)
Where dimensions are critical, check with C&D engineering.

3. Rack width does not include thickness of crossbracing. Increase width by 0.5" for crossbracing when this dimension is critical.

BATTERIES
3043 WALTON ROAD, PLYMOUTH MEETING, PA. 19462
an Eltra company

BATTERIES OF CANADA
150 CONNIE CRESCENT, UNIT 15, CONCORD, ONTARIO L4K 1B6
an Eltra company

Printed in U.S.A.

10M/180

3.11 SUITABLE WATER FOR FILLING

If in doubt about the suitability of the local water supply for use in lead-acid batteries, consult your nearest C & D Representative. If he does not have a recent analysis report available, send a one-quart sample in a chemically clean non-metallic container and stopper, prepaid to Technical Services Dept., C & D Batteries Division, Eltra Corporation, 3043 Walton Road, Plymouth Meeting, PA 19462. The sample will be analyzed and a report as to its safety for use in lead-acid batteries will be forwarded. Indicate the source of the water and the sender's name and location on the sample.

The quantity of water consumed by a battery is proportional to the amount of charge is receives. Lead-antimony batteries begin their life with low water consumption, which increases as much as five or more times toward the end of their life. Lead-calcium batteries, because of the greater purity of their components, require only about one-tenth the water needed by equivalent-sized new lead-antimony batteries. This low requirement remains constant during their entire life. Fig. 10 gives the approximate water consumption for various size cells at the normal operating temperature of 77°F.

3.12 CONNECTING BATTERY TO CHARGER

Only direct current (dc) is used for charging. With the charging source de-energized, connect the **positive** terminal of the battery **to** the **positive** of the charger or system and the **negative** terminal of the battery **to** the **negative** of the charger or system. Re-energize the system following procedures that are provided in charger manual.

4.0 INITIAL CHARGE

All batteries shipped wet and fully charged lose some charge in transit or while standing idle before installation. At the first opportunity, they should be given their first or initial charge using the following method.

4.1 CONSTANT VOLTAGE METHOD

This method of giving the initial charge is the most common and is used when circuit voltage limitations make it impractical to use the constant current method. First, determine the maximum allowable voltage that may be applied to the connected equipment. Divide this voltage by the number of cells in the battery, thus obtaining the maximum voltage per cell. Determine if the battery is a lead-antimony or lead-calcium type by the nomenclature on the cell. If **lead-antimony**, refer to the following table and charge for the time indicated at the maximum voltage permitted by the associated equipment.

TABLE I - LEAD-ANTIMONY CELLS

CHARGE VOLTAGE PER CELL (VPC) (1.210 SPECIFIC GRAVITY)			
INITIAL		FLOAT	EQUALIZE
VPC	HOURS	VPC	VPC
2.39	40	2.15 to 2.17	2.33 for 8 to 24 hrs.
2.36	60		
2.33	110		
2.30	168		
2.24	210		

If **lead-calcium** the following applies:

TABLE II - LEAD-CALCIUM CELLS

CHARGE VOLTAGE PER CELL (VPC)				
SP. GR. OF CELLS	FLOAT VPC		INITIAL/EQUALIZE (VPC)	
	MIN.	NOMINAL	CRITICAL CELL VOLT	NOM. VPC
→ 1.210	2.17	2.20-2.25	2.13	2.33-2.38
1.225	2.18	2.22-2.27	2.15	2.36-2.40
1.250	2.20	2.25-2.30	2.18	2.38-2.43
1.275	2.23	2.29-2.34	2.20	2.40-2.46
1.300	2.27	2.33-2.38	2.23	2.45-2.50

TABLE III - BRUSHING & TORQUE SPECIFICATIONS FOR CELL CONNECTIONS

CELL TYPE	RECOM. TORQUE	TYPE BRUSH
Cells with posts that do not have copper inserts:		
Communications Batteries KT, KCT, LT, LCT UPS & Switchgear Batteries DU & DCU 13, 15, 17 KA & KC 5, 7, 11, 13 KY & KCY-7 KCX 7, 9, 11, 13, 15, 17 LA & LC - 13, 15, 17 LY & LCY - 5, 7 Photovoltaic Batteries DCPSA - 11, 13, 15, 17 DCPSD - 9, 11, 13 KCPSA - 5, 7, 9, 11, 13, 15, 17 KCPSD - 5, 7, 9, 11, 13 LCPSA - 5, 7, 11, 13, 15, 17, 19, 21, 23, 25 LCPSD - 5, 11, 13, 15, 17, 19	110 inch-lbs. -0 inch-lbs. +10 inch-lbs.	wire brush
Mini-Tank Cells MT & MCT	160 inch-lbs. -0 inch-lbs. +10 inch-lbs.	wire brush
Cells with posts that have copper inserts:		
Tank Cells RHA & RHC UPS & Switchgear Batteries KA & KC-15, 17, 19, 21 KY & KCY-23, 25 KCX-19, 21, 23, 25, 27, 29, 31, 33 LA & LC - 19, 21, 23, 25, 27, 29, 31, 33 LCX - All sizes LY & LCY - 9, 11, 35, 37, 39	160 inch-lbs. -0 inch-lbs. +5 inch-lbs.	plastic bristle brush
Cells with large flag terminals (no inserts):		
DU & DCU - 3, 5, 7, 9, 11 DCPSA - 3, 5, 7, 9 DCPSD - 3, 5, 7	70 inch-lbs. -0 inch-lbs. +5 inch-lbs.	wire brush
Cells with small flag terminals (no inserts):		
A, AC, B, BC and small specialty batteries	15 inch-lbs. -3 inch-lbs. +0 inch-lbs.	wire brush

ENCLOSURE 2

SEQUOYAH NUCLEAR PLANT

PROPOSED TECHNICAL SPECIFICATIONS

TVA-SQN-TS-36

CHANGE NO. 2

ISOLATION TIMES FOR CONTAINMENT ISOLATION VALVES

TABLE 3.3-5 (Continued)

TABLE NOTATION

(1) Diesel generator starting and sequence loading delays included. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps, SI and RHR pumps.

(2) Using air operated valve

(3) The following valves are exceptions to the response times shown in the table and will have the values listed in seconds for the initiating signals and function indicated:

Valves: FCV-26-240, -243

Response times:	
2.d.	$21^{(8)}$/ $31^{(9)}$
3.d.	$22^{(8)}$
4.d.	$21^{(8)}$/ $31^{(9)}$
5.d.	$24^{(8)}$/ $34^{(9)}$
6.d.	$21^{(8)}$/ $31^{(9)}$

Valves: FCV-61-96, -97, -110, -122, -191, -192, -193, -194

Response times:	
2.d.	$31^{(8)}$
3.d.	$32^{(8)}$
4.d.	$31^{(8)}$
5.d.	$34^{(8)}$
6.d.	$31^{(8)}$

Valve: FCV-70-143

Response times:	
2.d.	$61^{(8)}$/ $71^{(9)}$
3.d.	$62^{(8)}$
4.d.	$61^{(8)}$/ $71^{(9)}$
5.d.	$64^{(8)}$/ $74^{(9)}$
6.d.	$61^{(8)}$/ $71^{(9)}$

(4) On 2/3 any Steam Generator

(5) On 2/3 in 2/4 Steam Generator

(6) Radiation detectors for Containment Ventilation Isolation may be excluded from Response Time Testing.

(7) Diesel generator starting and sequence loading delays not included. Offsite power available. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps.

(8) Diesel generator starting and sequence loading delays not included. Response time limit includes operating time of valves.

(9) Diesel generator starting and sequence loading delays included. Response time limit includes operating time of valves.

TABLE 3.3-5 (Continued)

TABLE NOTATION

(1) Diesel generator starting and sequence loading delays included. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps, SI and RHR pumps.

(2) Using air operated valve

(3) The following valves are exceptions to the response times shown in the table and will have the values listed in seconds for the initiating signals and function indicated:

Valves: FCV-26-240, -243

Response times:	
2.d.	21(8)/ 31(9)
3.d.	22(8)
4.d.	21(8)/ 31(9)
5.d.	24(8)/ 34(9)
6.d.	21(8)/ 31(9)

Valves: FCV-61-96, -97, -110, -122, -191, -192, -193, -194

Response times:	
2.d.	31(8)
3.d.	32(8)
4.d.	31(8)
5.d.	34(8)
6.d.	31(8)

Valve: FCV-70-143

Response times:	
2.d.	61(8)/ 71(9)
3.d.	62(8)
4.d.	61(8)/ 71(9)
5.d.	64(8)/ 74(9)
6.d.	61(8)/ 71(9)

(4) On 2/3 any Steam Generator

(5) On 2/3 in 2/4 Steam Generator

(6) Radiation detectors for Containment Ventilation Isolation may be excluded from Response Time Testing.

(7) Diesel generator starting and sequence loading delays not included. Offsite power available. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps.

(8) Diesel generator starting and sequence loading delays not included. Response time limit includes operating time of valves.

(9) Diesel generator starting and sequence loading delays included. Response time limit includes operating time of valves.

TVA-SQN-TS-36
Change No. 2
Sequoyah Nuclear Plant
Justification for Proposed Technical Specifications

ISOLATION TIMES FOR CONTAINMENT ISOLATION VALVES

The isolation times for the containment isolation valves on the ice condenser glycol lines were increased from 10 seconds to 30 seconds. These changes were approved by the NRC on May 4, 1982 for units 1 and 2 (Amendment 13 for the unit 1 operating license; Amendment 4 to the unit 2 operating license). During the process of revising our procedures, an error of omission was discovered in our original change request. Although the valve stroke time was changed, the overall phase A response time, which includes the valve stroke time, was overlooked. Also, a similar error was discovered in the fire protection system containment isolation valves. The fire protection valves list a 20-second valve stroke time. However, the phase A response time is not consistent with the valve stroke time.

NRC has reviewed and approved the response times for both sets of valves. This change only corrects errors in the implementation of the response time.

ENCLOSURE 3

SEQUOYAH NUCLEAR PLANT

PROPOSED TECHNICAL SPECIFICATIONS

TVA-SQN-TS-36

CHANGE NO. 3

INSTRUMENTATION SURVEILLANCE REQUIREMENT TEST FREQUENCY

OF TABLES 4.3-1 AND 4.3-2

TABLE 4.3-1

REACTOR TRIP SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
1. Manual Reactor Trip	N.A.	N.A.	S/U(1)	1, 2, and *
2. Power Range, Neutron Flux	S	D(2), M(3) and Q(6)	Q	1, 2
3. Power Range, Neutron Flux, High Positive Rate	N.A.	R(6)	Q	1, 2
4. Power Range, Neutron Flux, High Negative Rate	N.A.	R(6)	Q	1, 2
5. Intermediate Range, Neutron Flux	S	R(6)	S/U(1)	1, 2, and *
6. Source Range, Neutron Flux	S(7)	R(6)	Q and S/U(1)	2, 3, 4, 5, and *
7. Overtemperature Delta T	S	R	M	1, 2
8. Overpower Delta T	S	R	M	1, 2
9. Pressurizer Pressure--Low	S	R	Q	1, 2
10. Pressurizer Pressure--High	S	R	Q	1, 2
11. Pressurizer Water Level--High	S	R	Q	1, 2
12. Loss of Flow - Single Loop	S	R		1
13. Loss of Flow - Two Loops	S	R	N.A.	1

TABLE 4.3-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
14. Main Steam Generator Water Level--Low-Low	S	R	Q	1, 2
15. Steam/Feedwater Flow Mismatch and Low Steam Generator Water Level	S	R	Q	1, 2
16. Undervoltage - Reactor Coolant Pumps	N.A.	R	M	1
17. Underfrequency - Reactor Coolant Pumps	N.A.	R	M	1
18. Turbine Trip				
A. Low Fluid Oil Pressure	N.A.	N.A.	S/U(1)	1
B. Turbine Stop Valve Closure	N.A.	N.A.	S/U(1)	1
19. Safety Injection Input from ESF	N.A.	N.A.	M(4)	1, 2
20. Reactor Trip Breaker	N.A.	N.A.	M(5) and S/U(1)	1, 2, and *
21. Automatic Trip Logic	N.A.	N.A.	M(5)	1, 2, and *
22. Reactor Trip System Interlocks				
A. Intermediate Range Neutron Flux, P-6	N.A.	R	S/U(8)	2, and *
B. Power Range Neutron Flux, P-7	N.A.	R	S/U(8)	1
C. Power Range Neutron Flux, P-8	N.A.	R	S/U(8)	1
D. Power Range Neutron Flux, P-10	N.A.	R	S/U(8)	1, 2
E. Turbine Impulse Chamber Pressure, P-13	N.A.	R	S/U(8)	1
F. Power Range Neutron Flux, P-9	N.A.	R	S/U(8)	1
G. Reactor Trip, P-4	N.A.	R	S/U(8)	1, 2, and *

MAR 25 1982

TABLE 4.3-2

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
1. SAFETY INJECTION AND FEEDWATER ISOLATION				
a. Manual Initiation	N.A.	N.A.	M(1)	1, 2, 3, 4
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
c. Containment Pressure-High	S	R	Q	1, 2, 3
d. Pressurizer Pressure--Low	S	R	Q	1, 2, 3
e. Differential Pressure Between Steam Lines--High	S	R	Q	1, 2, 3
f. Steam Flow in Two Steam Lines--High Coincident with T_{avg}--Low-Low or Steam Line Pressure--Low	S	R		1, 2, 3
2. CONTAINMENT SPRAY				
a. Manual Initiation	N.A.	N.A.	M(1)	1, 2, 3, 4
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
c. Containment Pressure--High-High	S	R	Q	1, 2, 3

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
3. CONTAINMENT ISOLATION				
a. Phase "A" Isolation				
1) Manual	N.A.	N.A.	M(1)	1, 2, 3, 4
2) From Safety Injection Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
b. Phase "B" Isolation				
1) Manual	N.A.	N.A.	M(1)	1, 2; 3, 4
2) Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
3) Containment Pressure--High-High	S	R	Q	1, 2, 3
c. Containment Ventilation Isolation				
1) Manual	N.A.	N.A.	M(1)	1, 2, 3, 4
2) Automatic Isolation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
3) Containment Gas Monitor Radioactivity-High	S	R	M	1, 2, 3, 4

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
4) Containment Purge Air Exhaust Monitor Radioactivity-High	S	R	M	1, 2, 3, 4
5) Containment Particulate Activity-High	S	R	M	1, 2, 3, 4
4. STEAM LINE ISOLATION				
a. Manual	N.A.	N.A.	M(1)	1, 2, 3
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3
c. Containment Pressure--High-High	S	R	Q	1, 2, 3
d. Steam Flow in Two Steam Lines--High Coincident with T_{avg} -- Low-Low or Steam Line Pressure--Low	S	R	Q	1, 2, 3
5. TURBINE TRIP AND FEEDWATER ISOLATION				
a. Steam Generator Water Level--High-High	S	R	Q	1, 2, 3
6. AUXILIARY FEEDWATER				
a. Manual	N.A.	N.A.	M(1)	1, 2, 3
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
c. Main Steam Generator Water Level-Low-Low	S	R	Q	1, 2, 3
d. S.I.	See 1 above (all SI surveillance requirements)			
e. Station Blackout	N.A.	R	N.A.	1, 2, 3
f. Trip of Main Feedwater Pumps	N.A.	N.A.	R	1, 2
g. Auxiliary Feedwater Suction Pressure - Low	N.A.	R	M	1, 2, 3
7. LOSS OF POWER				
a. 6.9 kv Shutdown Board Undervoltage				
1. Loss of Voltage	S	R	M	1, 2, 3, 4
2. Load Shedding	S	R	N.A.	1, 2, 3, 4
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS				
a. Pressurizer Pressure, P-11	N.A.	R (4)	N.A.	1, 2, 3
b. T_{avg}, P-12	N.A.	R (4)	N.A.	1, 2, 3
c. Steam Generator Level, P-14	N.A.	R (4)	N.A.	1, 2

TABLE 4.3-1

REACTOR TRIP SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
1. Manual Reactor Trip	N.A.	N.A.	S/U(1)	1, 2, and *
2. Power Range, Neutron Flux	S	D(2), M(3) and Q(6)	Q	1, 2
3. Power Range, Neutron Flux, High Positive Rate	N.A.	R(6)	Q	1, 2
4. Power Range, Neutron Flux, High Negative Rate	N.A.	R(6)	Q	1, 2
5. Intermediate Range, Neutron Flux	S	R(6)	S/U(1)	1, 2, and *
6. Source Range, Neutron Flux	S(7)	R(6)	M and S/U(1)	2, 3, 4, 5, and *
7. Overtemperature ΔT	S	R	M	1, 2
8. Overpower ΔT	S	R	M	1, 2
9. Pressurizer Pressure--Low	S	R	Q	1, 2
10. Pressurizer Pressure--High	S	R	Q	1, 2
11. Pressurizer Water Level--High	S	R	Q	1, 2
12. Loss of Flow - Single Loop	S	R	Q	1
13. Loss of Flow - Two Loops	S	R	N.A.	1
14. Steam Generator Water Level--Low-Low	S	R	Q	1, 2

TABLE 4.3-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
15. Steam/Feedwater Flow Mismatch and Low Steam Generator Water Level	S	R	Q	1, 2
16. Undervoltage - Reactor Coolant Pumps	N.A.	R	M	1
17. Underfrequency - Reactor Coolant Pumps	N.A.	R	M	1
18. Turbine Trip				
A. Low Fluid Oil Pressure	N.A.	N.A.	S/U(1)	1
B. Turbine Stop Valve Closure	N.A.	N.A.	S/U(1)	1
19. Safety Injection Input from ESF	N.A.	N.A.	M(4)	1, 2
20. Reactor Trip Breaker	N.A.	N.A.	M(5) and S/U(1)	1, 2, and *
21. Automatic Trip Logic	N.A.	N.A.	M(5)	1, 2, and *
22. Reactor Trip System Interlocks				
A. Intermediate Range Neutron Flux, P-6	N.A	R	S/U (8)	2, and *
B. Power Range Neutron Flux, P-7	N.A.	R	S/U (8)	1
C. Power Range Neutron Flux, P-8	N.A.	R	S/U (8)	1
D. Power Range Neutron Flux, P-10	N.A.	R	S/U (8)	1, 2
E. Turbine Impulse Chamber Pressure, P-13	N.A.	R	S/U (8)	1
F. Power Range Neutron Flux, P-9	N.A.	R	S/U (8)	1
G. Reactor Trip, P-4	N.A.	R	S/U (8)	1, 2, and *

TABLE 4.3-2

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
1. SAFETY INJECTION AND FEEDWATER ISOLATION				
a. Manual Initiation	N.A.	N.A.	M(1)	1, 2, 3, 4
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
c. Containment Pressure-High	S	R	Q	1, 2, 3
d. Pressurizer Pressure--Low	S	R	Q	1, 2, 3
e. Differential Pressure Between Steam Lines--High	S	R	Q	1, 2, 3
f. Steam Flow in Two Steam Lines--High Coincident with T_{avg}--Low-Low or Steam Line Pressure--Low	S	R	Q	1, 2, 3
2. CONTAINMENT SPRAY				
a. Manual Initiation	N.A.	N.A.	M(1)	1, 2, 3, 4
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
c. Containment Pressure--High-High	S	R	Q	1, 2, 3

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
3. CONTAINMENT ISOLATION				
a. Phase "A" Isolation				
1) Manual	N.A.	N.A.	M(1)	1, 2, 3, 4
2) From Safety Injection Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
b. Phase "B" Isolation				
1) Manual	N.A.	N.A.	M(1)	1, 2, 3, 4
2) Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
3) Containment Pressure--High-High	S	R	Q	1, 2, 3
c. Containment Ventilation Isolation				
1) Manual	N.A.	N.A.	M(1)	1, 2, 3, 4
2) Automatic Isolation Logic	N.A.	N.A.	M(2)	1, 2, 3, 4
3) Containment Gas Monitor Radioactivity-High	S	R	M	1, 2, 3, 4

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
4) Containment Purge Air Exhaust Monitor Radio-activity-High	S	R	M	1, 2, 3, 4
5) Containment Particulate Activity-High	S	R	M	1, 2, 3, 4
4. STEAM LINE ISOLATION				
a. Manual	N.A.	N.A.	M(1)	1, 2, 3
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3
c. Containment Pressure--High-High	S	R	Q	1, 2, 3
d. Steam Flow in Two Steam Lines--High Coincident with T_{avg} -- Low-Low or Steam Line Pressure--Low	S	R	Q	1, 2, 3
5. TURBINE TRIP AND FEEDWATER ISOLATION				
a. Steam Generator Water Level--High-High	S	R	Q	1, 2, 3
6. AUXILIARY FEEDWATER				
a. Manual	N.A.	N.A.	M(1)	1, 2, 3
b. Automatic Actuation Logic	N.A.	N.A.	M(2)	1, 2, 3

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
c. Main Steam Generator Water Level-Low-Low	S	R	Q	1, 2, 3
d. S.I.	See 1 above (all SI surveillance requirements)			
e. Station Blackout	N.A.	R	N.A.	1, 2, 3
f. Trip of Main Feedwater Pumps	N.A.	N.A.	R	1, 2
g. Auxiliary Feedwater Suction Pressure-Low	N.A.	R	M	1, 2, 3
7. LOSS OF POWER				
a. 6.9 kv Shutdown Board Undervoltage				
1. Loss of Voltage	S	R	M	1, 2, 3, 4
2. Load Shedding	S	R	N.A.	1, 2, 3, 4
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS				
a. Pressurizer Pressure, P-11	N.A.	R (4)	N.A.	1, 2, 3
b. T_{avg}, P-12	N.A.	R (4)	N.A.	1, 2, 3
c. Steam Generator Level, P-14	N.A.	R (4)	N.A.	1, 2

An instruction can be adequately reviewed in approximately 10 minutes. This is an accumulated time of .667 hours per instruction or 392 manhours or 49 (8 hour) man days per year. The average salary is approximately $30 per hour for a cost of $11,760 per year.

CONCLUSION

The total time saved on both units 1 & 2 where the plants would be in a condition where a single failure would cause a safeguard actuation is 784 hours or 98 (8 hour) days. The operator distraction time saved would be 196 hours or 24.5 (8 hour) days.

The total manhour savings for both units would be 3920 man hours or 490 (8 hour) days at a cost of $98,000 in instrument mechanic time. The review time savings would be 523 manhours or 65.33 (8 hour) man days for a savings of $15,690.

The data collected and reviewed (attachment 1) shows these selected loops to be highly reliable. Extending the frequency to quarterly would have the previously covered positive benefits and would not jeopardize the overall reliability of the plant safety systems.

The plant will maintain a periodic assessment program to guarantee that the systems specified maintain their high reliability. This will include review of SI packages, and repair or replacement of components when problems occur.

TVA-SQN-TS-36
Change No. 3
Sequoyah Nuclear Plant
Justification for Proposed Technical Specifications

This request encompasses 49 instructions in total. There are a number of considerations to be addressed.

1. Each instruction requires an average of 1.0 hour with the loop actually removed from service. This totals 588 hours per year, per unit, that the plant is in a ½ trip condition. In other words this is 73.5 (8 hour) days with the plant in a compromised state.

   The proposed change would delete 392 hours or 49 (8 hour) days from the number now required. This would remove 2/3 of the time when a single plant failure could cause a safeguard actuation, thereby, improving plant reliability.

   The removal of instrument loops from service for the purpose of testing challenges the safeguards actuation system. We have had several occurrences of safety injection and reactor trip actuations directly related with the performance of surveillance instructions. We believe that by reducing the number of challenges to the safeguards systems, in our test program, we can reduce the possibility of inadvertently challenging our safeguard systems.

2. Each instruction performed requires interface with the unit operator. There is also the problem with status lights and indications that are associated with the loop being tested.

   A. The operator must spend approximately 15 minutes reviewing and approving each instruction. This averages out to 147 hours or 18.375 (8 hour) days a year when he is distracted from his vital duties. The proposed change would return 98 hours or 12.25 (8 hour) days of the operators valuable time per year.

   B. While the loop being tested is removed from service the associated trip status lights and indicators are in an abnormal condition. The times on this are as described in item #1. Although the operators are trained to work with this type of situation it is feasible to consider it contributing to an improper decision at a critical moment.

3. We are expending large quantities of the available instrument mechanic and engineering time to perform and review the monthly functional tests.

   A. The average instruction requires approximately 2.0 hours to perform. The minimum number of people assigned is 2 and normally it is 3. It will take 2.5 persons assigned as average. This yields 2940 manhours or 367.5 (8 hour) man days per unit per year to perform these 49 instructions. At an average salary of $25 per hour, this is a cost of $73,500 per year. The proposed change would reduce the cost for performing these instructions to $24,500. More importantly it would free 1960 manhours or 245 (8 hour) man days for a much needed plant secondary preventive maintenance program.

   One additional factor is that the work load associated with the monthly testing is so great that many times they are performed on overtime. This creates budgetary problems and manpower problems.

   B. All instructions performed must be reviewed by the senior instrument mechanic foreman, the instrument engineer, the instrument assistant supervisor, and plant QA.

DATA COLLECTED ON SELECTED SQN FUNCTIONAL TEST

Note: The word tolerance used in these papers refers to manufacturer tolerance which is more restricting than technical specification tolerance.

I. Pressurizer Pressure Loops: IMI-99-FT 4.1, 4.2, 4.3, 4.4 for channels I, II, III, & IV.

A. FT 4.1: 13 instructions reviewed (13 consecutive monthly performances)
   1. 1-20-81 PB-455A (high pressure reactor trip) was not out of tolerance but adjusted closer to desired value.

B. FT 4.2: 12 instructions reviewed (12 consecutive monthly performances)
   1. There were no changes required.

C. FT 4.3: 13 instructions reviewed (13 consecutive monthly performances)
   1. 10-11-81 PB-457C (low pressure reactor trip) was not outside of tolerance but adjusted closer to desired value.

D. FT 4.4: 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

Conclusion: In total, 51 consecutive performances of pressurizer pressure monthly FTs were reviewed. There were two minor calibrations made to bring bistable setpoints closer to the desired value.

II. Pressurizer Level Loops: IMI-99-FT 5.1, 5.2, 5.3 for channels I, II, & III.

A. FT 5.1: 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

B. FT 5.2: 12 instructions reviewed (12 consecutive monthly performances)
   1. There were no changes required.

C. FT 5.3: 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

Conclusion: In total, 38 consecutive performances of pressurizer level monthly FTs were reviewed. There were no calibrations required.

III. Reactor Coolant System Flow Loops: IMI-99-FT-6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12 for four loop plant channels I, II, & III in each loop.

A. FT 6.1, 6.4, 6.7, & 6.10 (loops 1, 2, 3, & 4 protection set I): 13 instructions reviewed (13 consecutive monthly performances).
   1. There were no changes required.

B. FT 6.2, 6.5, 6.8, & 6.11 (loops 1, 2, 3, & 4 protection set II): 12 instructions reviewed (12 consecutive monthly performances).
   1. 2-25-81 FB-415 (flow loop 1 protection set II low flow reactor trip) was not outside tolerance but adjusted closer to desired value.

C. FT 6.3, 6.6, 6.9, & 6.12 (loops 1, 2, 3, & 4 protection set III): 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

Conclusion: In total, 152 consecutive performances of reactor coolant flow monthly FTs were reviewed. There was one minor calibration made to bring bistable setpoints closer to the desired value.

IV. Steam Generator Level Loops: IMI-99-FT 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.12 for four loop plant channels I, II, III, IV in each loop.

A. FT 7.6 & 7.9 (protection set I): 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

B. FT 7.3 & 7.12 (protection set II): 12 instructions reviewed (12 consecutive monthly performances)
   1. There were no changes required.

C. FT 7.2, 7.5, 7.8, 7.11 (protection set III): 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

D. FT 7.1, 7.4, 7.7, 7.10 (protection set IV): 13 instructions reviewed
   1. There were no changes required.

Conclusion: In total, 154 consecutive performances of steam generator level monthly FTs were reviewed. There was no necessity for any recalibration.

V. Steam Generator Mismatch: IMI-99-FT 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8 for four loop plant channels I & II in each loop.

A. FT 8.1, 8.2, 8.3, 8.4 (protection set I) 14 instructions reviewed (14 consecutive monthly performances)
   1. 3-18-81 FB-522B: Bistable not outside tolerance but calibrated to bring it closer to the desired value.
   2. 10-7-81 FB-542B: Bistable no. outside tolerance but calibrated to bring it closer to the desired value.

B. FT 8.5, 8.6, 8.7, 8.8 (protection set II) 12 instructions reviewed (12 consecutive monthly performances)
   1. 6-18-81 FB-513B: Bistable at tolerance, recalibrated to desired value.
   2. 10-16-81 FB-533B: Bistable not out of tolerance but calibrated to bring closer to desired value.
   3. 12-30-81 FB-513B: Bistable at tolerance recalibrated to desired value.

Conclusion: In total, 104 consecutive performances of steam generator flow mismatch monthly FTs were reviewed. There were no components outside tolerance but 5 bistables were recalibrated to bring them closer to the desired value.

VI. Steam Pressure Deviation: IMI-99-FT 9.1, 9.2 (protection sets III & IV)

A. FT 9.1 (protection set III): 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

B. FT 9.2 (protection set IV): 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

Conclusion: In total, 26 consecutive performances of steam generator pressure deviation monthly FTs were reviewed. There were no components requiring recalibration.

VII. Containment Pressure: IMI-99-FT 16.1, 16.2, 16.3, 16.4 four channels, protection sets I, II, III, IV

A. FT 16.1 (protection set I): 14 instructions reviewed (14 consecutive monthly performances)
   1. 1-27-81 PB-937A (high-high containment pressure) was not outside tolerance, but was adjusted closer to the desired value.

B. FT 16.2 (protection set II): 12 instructions reviewed (12 consecutive monthly performances)
   1. There were no changes required.

C. FT 16.3 (protection set III): 13 instructions reviewed (13 consecutive monthly performances)
   1. There were no changes required.

D. FT 16.4 (protection set IV): 13 instructions reviewed (13 consecutive monthly performances)
   1. 10-23-81 PB-934A (high-high containment pressure) was not outside tolerance, but was adjusted closer to desired value.

Conclusion: In total, 52 consecutive performances of containment pressure monthly FTs were reviewed. There were two minor calibrations made to bring bistable setpoints closer to the desired value.

VIII. NIS Power Range: IMI-99-PRM-FT 41, 42, 43, 44 four channels, protection sets I, II, III, IV

A. FT 41 (protection set I): 11 consecutive performances reviewed
   1. No changes required.

B. FT 42 (protection set II): 11 consecutive performances reviewed
   1. No changes required.

C. FT 43 (protection set III): 11 consecutive performances reviewed
   1. No changes required.

D. FT 44 (protection set IV): 11 consecutive performances reviewed
   1. No changes required.

Conclusion: In total, 44 consecutive performances of NIS power range monthly FTs were reviewed. There were no recalibrations required.

ENCLOSURE 4

SEQUOYAH NUCLEAR PLANT

PROPOSED TECHNICAL SPECIFICATIONS

TVA-SQN-TS-36

CHANGE NO. 4

CHANGES TO REFLECT INSTALLATION OF PERMANENT HYDROGEN

MITIGATION SYSTEM

HYDROGEN MITIGATION SYSTEM

LIMITING CONDITION FOR OPERATION

3.6.4.3 The primary containment hydrogen mitigation system shall be operable.

APPLICABILITY: MODES 1 and 2.

ACTION

With one train of hydrogen mitigation system inoperable, restore the inoperable train to OPERABLE status within 7 days or increase the surveillance interval of S.R. 4.6.4.3 from 92 days to 7 days on the operable train until the inoperable train is returned to OPERABLE status.

SURVEILLANCE REQUIREMENTS

4.6.4.3 The hydrogen mitigation system shall be demonstrated OPERABLE:

a. At least once per 92 days by energizing the supply breakers and verifying that at least 62 of 64 igniters are energized.*

b. At least once per 18 months by verifying the cleanliness of each igniter by a visual inspection.

* Inoperable igniters must not be on corresponding redundant circuits which provide coverage for the same region.

TVA-SQN-TS-36
Change No. 4
Sequoyah Nuclear Plant

JUSTIFICATION FOR PROPOSED TECHNICAL SPECIFICATIONS

As required by Sequoyah Nuclear Plant unit 1 operating license condition 2.C(22).D, TVA is required to install a permanent hydrogen mitigation system. These changes reflect the installation of the permanent system. The permanent system hydrogen mitigation system is a two train system with 32 igniters in each train.

The permanent hydrogen mitigation system employs controlled ignition to mitigate the effects of hydrogen during potential degraded core accidents or class 9 accidents. The containment structures and key equipment have been shown by analysis or testing to survive the pressure and temperature loads from selected degraded core accidents and to continue to function. The extensive research program has confirmed our analytical assumptions, demonstrated equipment survivability and shown that controlled ignition can indeed mitigate the effects of hydrogen releases in closed vessels. The permanent hydrogen mitigation system is an adequate hydrogen control system that would perform its intended function in a manner that provides adequate safety margins.

ENCLOSURE 5

SEQUOYAH NUCLEAR PLANT

PROPOSED TECHNICAL SPECIFICATIONS

TVA-SQN-TS-36

CHANGE NO. 5

ADDITION OF SECOND LEVEL OF UNDERVOLTAGE PROTECTION

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION

FUNCTIONAL UNIT	TOTAL NO. OF CHANNELS	CHANNELS TO TRIP	MINIMUM CHANNELS OPERABLE	APPLICABLE MODES	ACTION
7. LOSS OF POWER					
a. 6.9 kv Shutdown Board — Loss of Voltage					
1. Start Diesel Generators	2/shutdown board	1 loss of voltage on any shutdown board	2/shutdown board	1, 2, 3, 4	20*
2. Load Shedding	2/shutdown board	1/shutdown board	2/shutdown board	1, 2, 3, 4	20*
b. 6.9 kv Shutdown Board . Degraded Voltage					
1. Voltage Sensors	3/shutdown board	2/shutdown board	2/shutdown board	1, 2, 3, 4	20*
2. Diesel Generator Start and Load Shedding Timer	2/shutdown board	1/shutdown board	1/shutdown board	1, 2, 3, 4	20*
3. SI/Degraded Voltage Enable Timer	2/shutdown board	1/shutdown board	1/shutdown board	1, 2, 3, 4	20*
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS					
a. Pressurizer Pressure - Not P-11	3	2	2	1, 2, 3	22a
b. T_{avg} - P-12	4	2	3	1, 2, 3	22b
c. Steam Generator Level P-14	3/loop	2/loop any loop	3/loop	1, 2	22c

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION

FUNCTIONAL UNIT	TOTAL NO. OF CHANNELS	CHANNELS TO TRIP	MINIMUM CHANNELS OPERABLE	APPLICABLE MODES	ACTION
9. AUTOMATIC SWITCHOVER TO CONTAINMENT SUMP					
A. RWST Level - Low COINCIDENT WITH	4	2	3	1, 2, 3, 4	18
Containment Sump Level - High	4	2	3	1, 2, 3, 4	18
AND Safety Injection	(See 1 above for Safety Injection Requirements)				

Note: Manual switchover of RHR pump suction from the RWST to containment sump will be employed until containment sump level indicators are returned OPERABLE. Automatic switchover is not required OPERABLE during the interim. This note will remain in effect for a period not to exceed 30 days (July 18, 1982).

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
6. AUXILIARY FEEDWATER		
a. Manual	Not Applicable	Not Applicable
b. Automatic Actuation Logic	Not Applicable	Not Applicable
c. Main Steam Generator Water Level-low-low	≥ 21% of narrow range instrument span each steam generator	≥ 20% of narrow range instrument span each steam generator
d. S.I.	See 1 above (all SI Setpoints)	
e. Station Blackout	0 volts with a 5.0 second time delay	0 volts with a 5.0 ± 1.0 second time delay
f. Trip of Main Feedwater Pumps	N.A.	N.A.
g. Auxiliary Feedwater Suction Pressure-Low	≥ 2 psig (motor driven pump) ≥ 6.5 psig (turbine driven pump)	≥ 1 psig (motor driven pump) ≥ 5.5 psig (turbine driven pump)
7. LOSS OF POWER		
a. 6.9 kv Shutdown Board Undervoltage-Loss of Voltage		
1. Start of Diesel Generators	0 volts with a 1.5 second time delay	0 volts with a 1.5 ± 0.5 second time delay
2. Load Shedding	0 volts with a 5.0 second time delay	0 volts with a 5.0 ± 1.0 second time delay

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
b. 6.9 kv Shutdown Board- Degraded Voltage		
1. Voltage Sensors	6560 volts	6560 volts ± 33 volts
2. Diesel Generator Start and Load Shed Timer	300 seconds	300 seconds ± 15 seconds
3. SI/Degraded Voltage Logic Enable Timer	11 seconds	11 seconds ± 0.6 seconds
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS		
a. Pressurizer Pressure Manual Block of Safety Injection P-11	≤ 1970 psig	≤ 1980 psig

TABLE 3.3-5 (Continued)

ENGINEERED SAFETY FEATURES RESPONSE TIMES

INITIATING SIGNAL AND FUNCTION	RESPONSE TIME IN SECONDS
10. Station Blackout	
a. Auxiliary Feedwater Pumps	≤ 60
11. Trip of Main Feedwater Pumps	
a Auxiliary Feedwater Pumps	≤ 60
12. Loss of Power	
a. 6.9 kv Shutdown Board - Degraded Voltage or Loss of Voltage	≤ 10(10)
13. RWST Level-Low Coincident with Containment Sump Level-High and Safety Injection	
a. Automatic Switchover to Containment Sump	≤ 250
14. Containment Purge Air Exhaust Radioactivity - High	
a. Containment Ventilation Isolation	≤ 10(6)
15. Containment Gas Monitor Radioactivity High	
a. Containment Ventilation Isolation	≤ 10(6)
16. Containment Particulate Activity High	
a. Containment Ventilation Isolation	≤ 10(6)

TABLE 3.3-5 (Continued)

TABLE NOTATION

(1) Diesel generator starting and sequence loading delays included. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps, SI and RHR pumps.

(2) Using air operated valve

(3) Valve FCV-70-143 is an exception to the response time shown in the table and will have the following values in seconds for the initiating signal and function indicated.

2.d. $61^{(8)}/71^{(9)}$
3.d. $62^{(8)}$
4.d. $61^{(8)}/71^{(9)}$
5.d. $64^{(8)}/74^{(9)}$
6.d. $61^{(8)}/71^{(9)}$

(4) On 2/3 any Steam Generator

(5) On 2/3 in 2/4 Steam Generator

(6) Radiation detectors for Containment Ventilation Isolation may be excluded from Response Time Testing.

(7) Diesel generator starting and sequence loading delays not included. Offsite power available. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps.

(8) Diesel generator starting and sequence loading delays not included. Response time limit includes operating time of valves.

(9) Diesel generator starting and sequence loading delays included. Response time limit includes operating time of valves.

(10) The response time for loss of voltage is measured from the time voltage is lost until the time full voltage is restored by the diesel. The response time for degraded voltage is measured from the time the load shedding signal is generated, either from the degraded voltage or the SI enable timer, to the time full voltage is restored by the diesel. The response time of the timers are covered by the requirements on their setpoints.

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
c. Main Steam Generator Water Level-Low-Low	S	R	M	1, 2, 3
d. S.I.	See 1 above (all SI surveillance requirements)			
e. Station Blackout	N.A.	R	N.A.	1, 2, 3
f. Trip of Main Feedwater Pumps	N.A.	N.A.	R	1, 2
g. Auxiliary Feedwater Suction Pressure - Low	N.A.	R	M	1, 2, 3
7. LOSS OF POWER				
a. 6.9 kv Shutdown Board - Loss of Voltage				
1. Start Diesel Generators	S	R	M	1, 2, 3, 4
2. Load Shedding	S	R	N.A.	1, 2, 3, 4
b. 6.9 kv Shutdown Board - Degraded Voltage				
1. Voltage sensors	S	R	M	1, 2, 3, 4
2. Diesel Generators Start and Load Shedding Timer	N.A.	R	N.A.	1, 2, 3, 4
3. SI/Degraded Voltage Logic Timer	N.A.	R	N.A.	1, 2, 3, 4

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS				
a. Pressurizer Pressure, P-11	N.A.	R (4)	N.A.	1, 2, 3
b. T_{avg}, P-12	N.A.	R (4)	N.A.	1, 2, 3
c. Steam Generator Level, P-14	N.A.	R (4)	N.A.	1, 2
9. AUTOMATIC SWITCHOVER TO CONTAINMENT SUMP				
a. RSWT Level - Low	S	R	M	1, 2, 3, 4
COINCIDENT WITH Containment Sump Level - High	S	R	M	1, 2, 3, 4
AND Safety Injection	(See 1 above for all Safety Injection Surveillance Requirements)			

Note: Manual switchover of RHR pump suction from the RWST to containment sump will be employed until containment sump level indicators are returned OPERABLE. Automatic switchover is not required OPERABLE during the interim. This note will remain in effect for a period not to exceed 30 days (July 18, 1982).

SURVEILLANCE REQUIREMENTS (Continued)

d. At least once per 18 months by verifying that the battery capacity is adequate to supply and maintain in OPERABLE status all of the actual or simulated emergency loads for 2 hours when the battery is subjected to a battery service test.

e. At least once per 60 months by verifying that the battery capacity is at least 82% of the manufacturer's rating when subjected to a performance discharge test. Once per 60 month interval, this performance discharge test may be performed in lieu of the battery service test.

f. Annual performance discharge tests of battery capacity shall be given to any battery that shows signs of degradation or has reached 85% of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10% of rated capacity from its average on previous performance tests, or is below 90% of the manufacturer's rating.

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION

FUNCTIONAL UNIT	TOTAL NO. OF CHANNELS	CHANNELS TO TRIP	MINIMUM CHANNELS OPERABLE	APPLICABLE MODES	ACTION
7. LOSS OF POWER					
a. 6.9 kv Shutdown Board — Loss of Voltage					
1. Start Diesel Generators	2/shutdown board	1 loss of voltage on any shutdown board	2/shutdown board	1, 2, 3, 4	20*
2. Load Shedding	2/shutdown board	1/shutdown board	2/shutdown board	1, 2, 3, 4	20*
b. 6.9 kv Shutdown Board Degraded Voltage					
1. Voltage Sensors	3/shutdown board	2/shutdown board	2/shutdown board	1, 2, 3, 4	20*
2. Diesel Generator Start and Load Shedding Timer	2/shutdown board	1/shutdown board	1/shutdown board	1, 2, 3, 4	20*
3. SI/Degraded Voltage Enable Timer	2/shutdown board	1/shutdown board	1/shutdown board	1, 2, 3, 4	20*
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS					
a. Pressurizer Pressure - Not P-11	3	2	2	1, 2, 3	22a
b. T_{avg} - P-12	4	2	3	1, 2, 3	22b
c. Steam Generator Level P-14	3/loop	2/loop any loop	3/loop	1, 2	22c

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION

FUNCTIONAL UNIT	TOTAL NO. OF CHANNELS	CHANNELS TO TRIP	MINIMUM CHANNELS OPERABLE	APPLICABLE MODES	ACTION
9. AUTOMATIC SWITCHOVER TO CONTAINMENT SUMP					
A. RWST Level - Low	4	2	3	1, 2, 3, 4	18
COINCIDENT WITH Containment Sump Level - High	4	2	3	1, 2, 3, 4	18
AND Safety Injection	(See 1 above for Safety Injection Requirements)				

Note: Manual switchover of RHR pump suction from the RWST to containment sump will be employed until containment sump level indicators are returned OPERABLE. Automatic switchover is not required OPERABLE during the interim. This note will remain in effect for a period not to exceed 30 days (July 18, 1982).

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
6. AUXILIARY FEEDWATER		
a. Manual	Not Applicable	Not Applicable
b. Automatic Actuation Logic	Not Applicable	Not Applicable
c. Main Steam Generator Water Level-low-low	$\geq$ 21% of narrow range instrument span each steam generator	$\geq$ 20% of narrow range instrument span each steam generator
d. S.I.	See 1 above (all SI Setpoints)	
e. Station Blackout	0 volts with a 5.0 second time delay	0 volts with a 5.0 ± 1.0 second time delay
f. Trip of Main Feedwater Pumps	N.A.	N.A.
g. Auxiliary Feedwater Suction Pressure-Low	$\geq$ 2 psig (motor driven pump) $\geq$ 6.5 psig (turbine driven pump)	$\geq$ 1 psig (motor driven pump) $\geq$ 5.5 psig (turbine driven pump)
7. LOSS OF POWER		
a. 6.9 kv Shutdown Board Undervoltage-Loss of Voltage		
1. Start of Diesel Generators	0 volts with a 1.5 second time delay	0 volts with a 1.5 ± 0.5 second time delay
2. Load Shedding	0 volts with a 5.0 second time delay	0 volts with a 5.0 ± 1.0 second time delay

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
b. 6.9 kv Shutdown Board- Degraded Voltage		
1. Voltage Sensors	6560 volts	6560 volts ± 33 volts
2. Diesel Generator Start and Load Shed Timer	300 seconds	300 seconds ± 15 seconds
3. SI/Degraded Voltage Logic Enable Timer	11 seconds	11 seconds ± 0.6 seconds
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS		
a. Pressurizer Pressure Manual Block of Safety Injection P-11	≤ 1970 psig	≤ 1980 psig

TABLE 3.3-5 (Continued)

ENGINEERED SAFETY FEATURES RESPONSE TIMES

INITIATING SIGNAL AND FUNCTION	RESPONSE TIME IN SECONDS
10. Station Blackout	
a. Auxiliary Feedwater Pumps	≤ 60
11. Trip of Main Feedwater Pumps	
a Auxiliary Feedwater Pumps	≤ 60
12. Loss of Power	
a. 6.9 kv Shutdown Board - Degraded Voltage or Loss of Voltage	$\leq 10^{(10)}$
13. RWST Level-Low Coincident with Containment Sump Level-High and Safety Injection	
a. Automatic Switchover to Containment Sump	≤ 250
14. Containment Purge Air Exhaust Radioactivity - High	
a. Containment Ventilation Isolation	$\leq 10^{(6)}$
15. Containment Gas Monitor Radioactivity High	
a. Containment Ventilation Isolation	$\leq 10^{(6)}$
16. Containment Particulate Activity High	
a. Containment Ventilation Isolation	$\leq 10^{(6)}$

TABLE 3.3-5 (Continued)

TABLE NOTATION

(1) Diesel generator starting and sequence loading delays included. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps, SI and RHR pumps.

(2) Using air operated valve

(3) Valve FCV-70-143 is an exception to the response time shown in the table and will have the following values in seconds for the initiating signal and function indicated.

2.d. 61(8)/71(9)
3.d. 62(8)
4.d. 61(8)/71(9)
5.d. 64(8)/74(9)
6.d. 61(8)/71(9)

(4) On 2/3 any Steam Generator

(5) On 2/3 in 2/4 Steam Generator

(6) Radiation detectors for Containment Ventilation Isolation may be excluded from Response Time Testing.

(7) Diesel generator starting and sequence loading delays not included. Offsite power available. Response time limit includes opening of valves to establish SI path and attainment of discharge pressure for centrifugal charging pumps.

(8) Diesel generator starting and sequence loading delays not included. Response time limit includes operating time of valves.

(9) Diesel generator starting and sequence loading delays included. Response time limit includes operating time of valves.

(10) The response time for loss of voltage is measured from the time voltage is lost until the time full voltage is restored by the diesel. The response time for degraded voltage is measured from the time the load shedding signal is generated, either from the degraded voltage or the SI enable timer, to the time full voltage is restored by the diesel. The response time of the timers are covered by the requirements on their setpoints.

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
c. Main Steam Generator Water Level-Low-Low	S	R	M	1, 2, 3
d. S.I.	See 1 above (all SI surveillance requirements)			
e. Station Blackout	N.A.	R	N.A.	1, 2, 3
f. Trip of Main Feedwater Pumps	N.A.	N.A.	R	1, 2
g. Auxiliary Feedwater Suction Pressure - Low	N.A.	R	M	1, 2, 3
7. LOSS OF POWER				
a. 6.9 kv Shutdown Board - Loss of Voltage				
1. Start Diesel Generators	S	R	M	1, 2, 3, 4
2. Load Shedding	S	R	N.A.	1, 2, 3, 4
b. 6.9 kv Shutdown Board - Degraded Voltage				
1. Voltage sensors	S	R	M	1, 2, 3, 4
2. Diesel Generators Start and Load Shedding Timer	N.A.	R	N.A.	1, 2, 3, 4
3. SI/Degraded Voltage Logic Timer	N.A.	R	N.A.	1, 2, 3, 4

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
8. ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INTERLOCKS				
a. Pressurizer Pressure, P-11	N.A.	R (4)	N.A.	1, 2, 3
b. T_{avg}, P-12	N.A.	R (4)	N.A.	1, 2, 3
c. Steam Generator Level, P-14	N.A.	R (4)	N.A.	1, 2
9. AUTOMATIC SWITCHOVER TO CONTAINMENT SUMP				
a. RSWT Level - Low COINCIDENT WITH	S	R	M	1, 2, 3, 4
Containment Sump Level - High AND	S	R	M	1, 2, 3, 4
Safety Injection	(See 1 above for all Safety Injection Surveillance Requirements)			

Note: Manual switchover of RHR pump suction from the RWST to containment sump will be employed until containment sump level indicators are returned OPERABLE. Automatic switchover is not required OPERABLE during the interim. This note will remain in effect for a period not to exceed 30 days (July 18, 1982).

SURVEILLANCE REQUIREMENTS (Continued)

d. At least once per 18 months by verifying that the battery capacity is adequate to supply and maintain in OPERABLE status all of the actual or simulated emergency loads for 2 hours when the battery is subjected to a battery service test.

e. At least once per 60 months by verifying that the battery capacity is at least 82% of the manufacturer's rating when subjected to a performance discharge test. Once per 60 month interval, this performance discharge test may be performed in lieu of the battery service test.

f. Annual performance discharge tests of battery capacity shall be given to any battery that shows signs of degradation or has reached 85% of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10% of rated capacity from its average on previous performance tests, or is below 90% of the manufacturer's rating.

TVA-SQN-TS-36
Change No. 5
Sequoyah Nuclear Plant
Justification for Proposed Technical Specifications

These technical specifications are being revised to reflect the addition of a second level of over and undervoltage protection required by operating license conditions 2.C(18).c (unit 1) and 2.C(11).b (unit 2).

The second level of undervoltage relays operate if a 6900-volt shutdown board bus voltage drops below the level required to successfully start all the safety-related equipment that would be required for the design basis accident. The relays will initiate 3 different time delay sequences. The first sequence of 30 seconds will ride through normal system transients before annunciating in the main control room. The second sequence of 10 seconds is short enough to allow safety-related equipment to be powered within the time required by the safety analysis. At the end of 10 seconds, if a safety injection has been initiated or is subsequently initiated, the shutdown board will transfer to its diesel generator.

The third time delay of five minutes is long enough to allow operator action to correct the undervoltage condition but not allow damage to connected safety-related equipment. At the end of the 5-minute delay, the shutdown board will transfer to its diesel if voltage has not been corrected. Since the loss of voltage relays on normal feeder only are set at 80 percent of nominal for four seconds, the band of voltages that a nonaccident degraded voltage condition can exist is from 80-95 percent of nominal for five minutes. At 80 percent of nominal, the voltage at the terminals of running motors will not drop below 71 percent of motor-rated voltage. NEMA class B motors will not stall out or be damaged above this point for the time delay of five minutes. Also, during the five minute time delay, the 125V dc vital battery boards could be powered by the batteries instead of the battery chargers. However, the vital batteries have sufficient capacity to meet this requirement as well as meet the original design requirements as identified in section 8.3.2 of the Sequoyah FSAR.

Attached is supplementary technical information that provides the basis for our justification.

ATTACHMENT

Tennessee Valley Authority
Sequoyah Nuclear Plant Units 1 and 2
Degraded Voltage Relaying
Supplementary Technical Information

061273.01

CONTENTS

SUPPLEMENTARY TECHNICAL INFORMATION
DEGRADED GRID PROTECTION FOR CLASS 1E POWER SYSTEMS
SEQUOYAH NUCLEAR PLANT

1.0 INTRODUCTION

On July 28, 1978, the NRC requested TVA to assess the susceptibility of the safety-related electrical equipment at Sequoyah Nuclear Plant to a sustained voltage degradation of the offsite source and interaction of the offsite and onsite emergency power systems. FSAR question 8.33 contained four positions with which the current design of the plant was to be compared. After comparing the current design to the staff positions, TVA was required to either propose modifications to satisfy the positions and criteria or furnish an analysis to substantiate that the existing facility has equivalent capabalities.

By this submittal, TVA is proposing certain design modifications to satisfy the criteria and staff positions. The modifications include installation of a second-level undervoltage protection system for the Class 1E equipment. The NRC required that the setpoint, surveillance requirements, test requirements, and allowable limits were to be included by TVA in the plant technical specifications.

2.0 DESIGN BASE CRITERIA

The design base criteria that were applied in determining the acceptability of the system modifications to protect the safety-related equipment from a sustained degradation of offsite grid are:

1. General Design Criterion 17 (GDC 17), "Electrical Power Systems," of appendix A, "General Design Criteria for Nuclear Power Plants," of 10 CFR 50.
2. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
3. IEEE Standard 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations."
4. Staff positions as detailed in FSAR question 8.33 dated July 28, 1978.
5. ANSI Standard C84.1-1977, "Voltage Ratings for Electrical Power Systems and Equipment (60 HZ)."

3.0 EVALUATION

This section provides, in subsection 3.2, a description of the proposed modifications for the second-level undervoltage protection; and, in subsection 3.3, a discussion of how the proposed modifications meet the design base criteria.

3.1 Existing Undervoltage Protection. The present design uses three single induction disks, inverse time undervoltage relays with a setpoint of 70 percent of nominal for each 6900V shutdown board to detect loss of voltage.

1. A Westinghouse-type CV-7 relay monitors the voltage on the normal feed to the board and will initiate transfer in 2.5 seconds (at zero volts) to the alternate breaker if the alternate supply voltage is greater than 90 percent of nominal (detected by Westinghouse-type SG relays). The closure of the alternate breaker is delayed until the residual bus voltage is less than 30 percent of nominal (detected by GE-type RAV relays).

2. A GE-type IAV relay on the 6.9-kV bus initiates the automatic start sequence of the diesel generator for a sustained loss of voltage for 1.5 seconds (at zero volts).

3. A second GE-type IAV relay on the 6.9-kV bus for a sustained loss of voltage for a total of five seconds (at zero volts) will initiate load shedding (the normal and alternate feeder breakers are tripped and locked out; all the 6.9-kV motor loads and the major 480V loads are tripped). When the diesel generator set has attained rated speed and voltage (maximum of 10 seconds from initiation of automatic start signal), it is automatically connected to the 6.9-kV shutdown board bus. The return of voltage to the 6.9-kV shutdown board bus initiates logic which connects the required loads in the proper sequence and time.

3.2 Modification. TVA will (1) replace the existing loss of voltage relays, on normal feeder breaker only, with three instantaneous solid-state relays (ITE-type 27H) arranged in a two-out-of-three coincidence logic (see Figure A-II). The logic will energize two timers, either of which will initiate transfer to the alternate, if the alternate supply voltage is greater than 95 percent of nominal by tripping the bus normal supply breaker. The relays will have a nominal setpoint of 5520 volts ± 1 percent (80% of nominal) with a relay/timer combined time delay of 4 seconds + 5 percent. The diesel generator starting and load shedding circuitry described in 3.1 -2,-3 will not be modified. (2) To protect the Class 1E buses from a sustained degraded undervoltage, each of the two 6.9kV Class 1E buses per unit will be provided with a set of three instaneous solid-state undervoltage relays (ITE-type 27/59H). These relays will have a nominal setpoint of 6560V ± 1/2 percent (95% of nominal). The relays will be arranged in a two-out-of-three coincidence logic to initiate three time delay sequences (see Figure A-I). The first sequence of 30 seconds will ride through normal system voltage transients (motor starts - both safety and nonsafety related) before annunciating the undervoltage in the main control room. The second sequence is short enough to allow safety-related equipment to be powered within the time required by the safety analysis. At the end of 10 seconds if an SIS has been initiated, or is subsequently initiated, the shutdown board degraded voltage relays will initiated load shedding and subsequently transfer the shutdown board to its diesel generator. The return of bus voltage initiates load sequencing of safety-related equipment. The third time delay is long enough to allow operator action but not result in damage to connected safety-related equipment. At the end of five minutes, the shutdown board will initiate load shedding and subsequently transfer the shutdown board to its diesel generator if degraded voltage has not been corrected. The error associated with these relay/timers is $\pm$0.5 percent.

To protect the Class 1E buses from a sustained over-voltage, each of the two 6.9-kV Class 1E buses per unit will be provided with a set of three instantaneous solid-state overvoltage relays (ITE-type 59H). These relays will be arranged in a one-out-of-three coindence logic which will annunciate in the control room. The relays will have a nominal voltage setpoint of 7260 volts $\pm$ 1 percent (105 percent of nominal). The operator will take the action necessary to reduce the voltage.

Load shedding for a loss of bus voltage ($\leq$70 percent) is being being maintained once the diesel generators are supplying their respective buses. Degraded voltage relaying will not open the standby supply breaker and will not initiate load shedding and resequencing if a 6900-volt shutdown board is supplied by its diesel generator. The output of these relays is blocked when the standby breaker is closed. TVA's bases for this is discussed in section 3.3.2.

Proposed changes to the plant's technical specifications, adding the surveillance requirements, allowable limits for the setpoint and time delay, and limiting conditions for operation for the second level undervoltage monitors are furnished in appendix B. An analysis to substantiate the limiting conditions and minimum and maximum setpoint limits is furnished in appendix A.

3.3 Discussion

3.3.1 NRC staff position 1 requires that a second level of undervoltage protection for the onsite power system be provided. The position stipulates other criteria that the undervoltage protection must meet. Each criterion is restated below followed by a discussion regarding TVA's compliance with that criterion.

1. "The selection of voltage and time setpoints shall be determined from an analysis of the voltage requirements of the safety-related loads at all onsite system distribution levels."

   TVA's proposed setpoint of 6560 volts at the 6.9-kV bus is 99 percent of the motor-rated voltage of 6.6 kV. This setpoint reflected down to the 480V buses will be at least 90 percent of the motor-rated voltage during their operation. As the 460-volt motors are the most limiting equipment in the system, this setpoint is adequate. See analysis in appendix A for details.

2. "The voltage protection shall include coincidence logic to preclude spurious trips of the offsite power sources."

   The proposed modification incorporates a two-out-of-three logic scheme which satisfies this criterion.

3. "The time delay selected shall be based on the following conditions:

   a. The allowable time delay, including margin, shall not exceed the maximum time delay that is assumed in the FSAR accident analysis."

      For a degraded voltage condition simultaneous with a SI actuation, the proposed time delay of 10 seconds, to load shed and connect the diesel generator to the bus does not exceed the maximum time delay in the accident analysis.

      Without the presence of a SI signal, the time delay of 5 minutes will not be the cause of any damage to the safety-related equipment. The setpoint is within voltage ranges recommended by ANSI C84.1-1977.

   b. "The time delay shall minimize the effect of short-duration disturbances from reducing the availability of the offsite power source(s)."

      The time delays selected will prevent spurious trips from the offsite source on starting the largest driven motor loads.

   c. "The allowable time duration of a degraded voltage condition at all distribution system levels shall not result in failure of safety systems or components."

      The time delays chosen will not cause any failures of the safety-related equipment since the voltage setpoint is within the allowable tolerance of the equipment-rated voltage.

4. "The voltage monitors shall automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and tim.-delay limits have been exceeded."

This criterion is met due to multiple logic sensing of the voltage monitors and redundant timing relays (for the undervoltage scheme).

5. "The voltage monitors shall be designed to satisfy the requirements of IEEE Standard 279-1971."

The proposed modifications are designed to meet the applicable requirements IEEE Standard 279.

6. "The technical specifications shall include limiting conditions for operation, surveillance requirements, trip setpoints with minimum and maximum limits, and allowable values for the second-level voltage protection monitors."

TVA's proposal for technical specification changes are furnished in appendix B.

3.3.2 The second NRC staff position requires "that the system design automatically prevents load shedding of the emergency buses once the onsite sources are supplying power to all sequenced loads. The load shedding must also be reinstated if the onsite breakers are tripped. In the event an adequate basis can be provided for retaining the load-shed feature when loads are energized by the onsite power system, the licensee's bases for the setpoint and limits must be documented."

TVA has elected to retain the loss-of-voltage ($\leq$70 percent) load-shed feature once the diesel generators are supplying their respective buses. TVA's bases for retention of the this feature is that it provides for automatic resequencing of the loads following any temporary loss of bus voltage. Since the loss-of-voltage load shedding relay setpoint is fixed at 4860 volts (70 percent of nominal), the starting of the largest driven load will not cause actuation of the load shedding feature. Therefore, the operation of the load shedding relay system is:

1. To shed loads to relieve overloading the diesel generator.

2. Allow the diesel generator to recover to rated speed and voltage.

3. Reconnect required loads in the proper sequence.

It is TVA's position that only mechanical or electrical component failures of the diesel generator could cause the voltage to reach a this level (70 percent) for the time delay required to initiate the loss-of-voltage load shed relays. Should this occur, the second redundant safety train would safely shut down the unit. The minimum and maximum value of the undervoltage setpoints will be included in the Technical Specifications.

3.3.3 The third NRC staff position requires that certain test requirements be added to the technical specifications. These tests were to demonstrate the full-functional operability and independence of the onsite power sources and are to be performed at least once per 18 months during shutdown. The tests are to simulate loss of offsite power in conjunction with a safety injection actuation signal and to simulate interruption and subsequenct reconnection of onsite power sources.

These requirements are already met by Sequoyah surveillance requirements 4.8.1.1.2.d.6 and 4.8.1.1.2.d.7.

3.3.4 The fourth NRC staff position requires that the voltage levels at the safety-related buses be optimized for the full load and minimum load conditions that are expected throughout the anticipated range of voltage variations of the power source by appropriate adjustment of the voltage tap settings of the intervening transformers. It is required that the adequacy of the design in this regard be verified by actual measurement, and by correlation of measured values with analytical results.

An analysis of Sequoyah unit 1 has been completed and the results submitted to A. Schwencer, Chief, Licensing Branch No. 2, from our L. M. Mills, Manager, Nuclear Regulation and Safety, on October 3, 1980. These results verified the adequacy of our design calculations for the ac auxiliary power system used in optimizing the transformer taps for varying conditions of operation. On April 2, 1981, another letter was sent to your A. Schwencer concerning NRC's agreement to not repeat the test for our Sequoyah Unit 2. Therefore, TVA satisfies the requirements of this position.

4.0 CONCLUSIONS

TVA has determined that the modifications comply with the three staff positions. All the staff's requirements and design base criteria have been met. The modifications will protect the Class 1E equipment from a sustained degraded voltage condition of the offsite power source.

The proposed changes to the technical specification adequately test the system modifications. The surveilance requirements, limiting conditions for operation, minimum and maximum limits for the trip setpoint, and allowable values meet the intent of the staff positions.

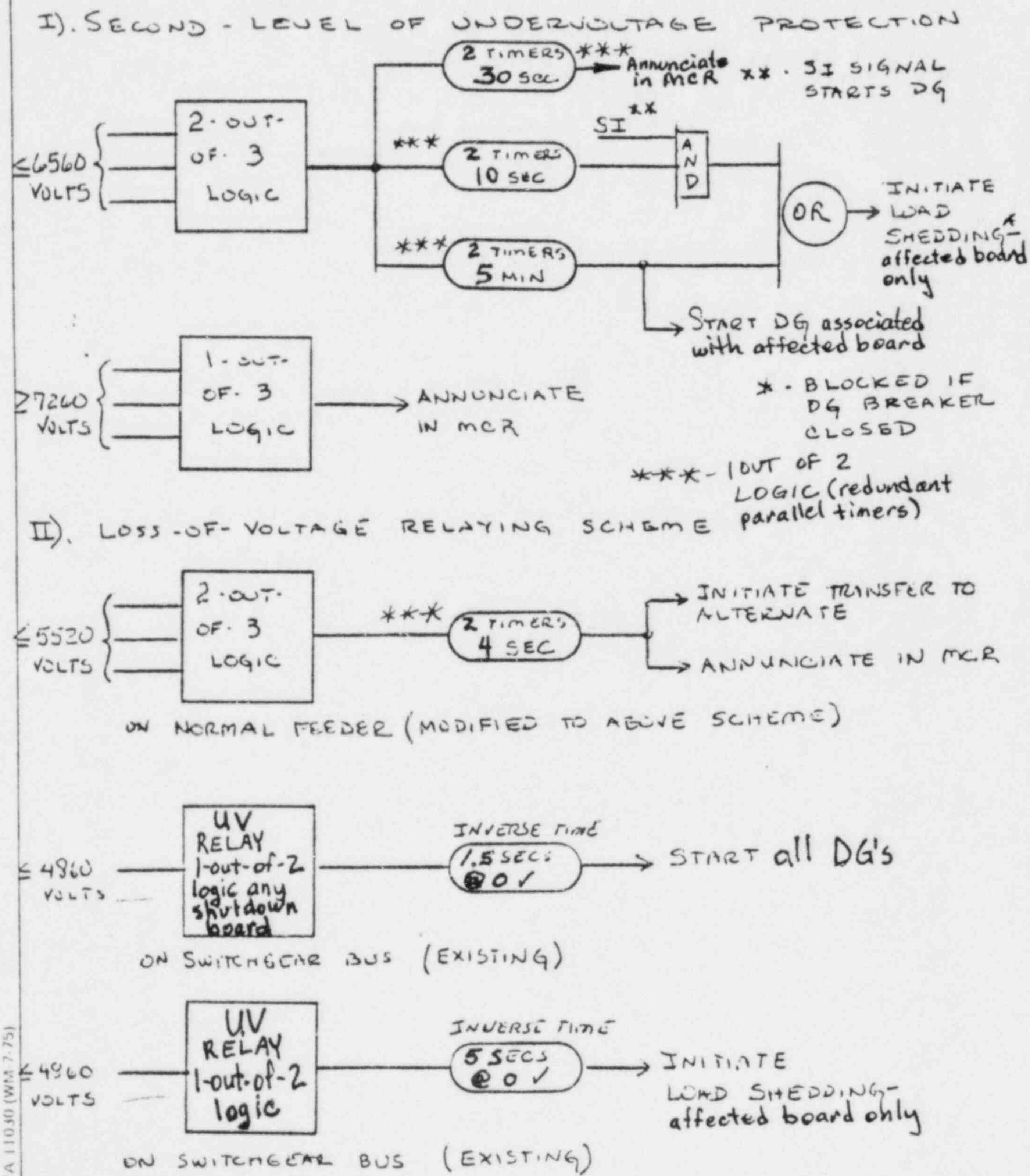
It is therefore concluded that TVA's proposed modifications and technical specification changes are adequate. TVA intends to incorporate these modifications in the plant design on both units by the end of the first refueling outage of unit 1 and the technical specification changes will be implemented at that time. This is in accordance with the requirements stated in our unit operating license.

SHEET ______ OF ______

SEQUOYAH NUCLEAR PLANT
DEGRADED AND LOSS OF VOLTAGE
RELAYING SCHEME

COMPUTED GLN DATE 10-15-81
CHECKED ______ DATE ______

FIGURE A



TVA 11030 (WM-7-75)

Tennessee Valley Authority
Sequoyah Nuclear Plant Units 1 and 2
Degraded Voltage Relaying
Supplementary Technical Information

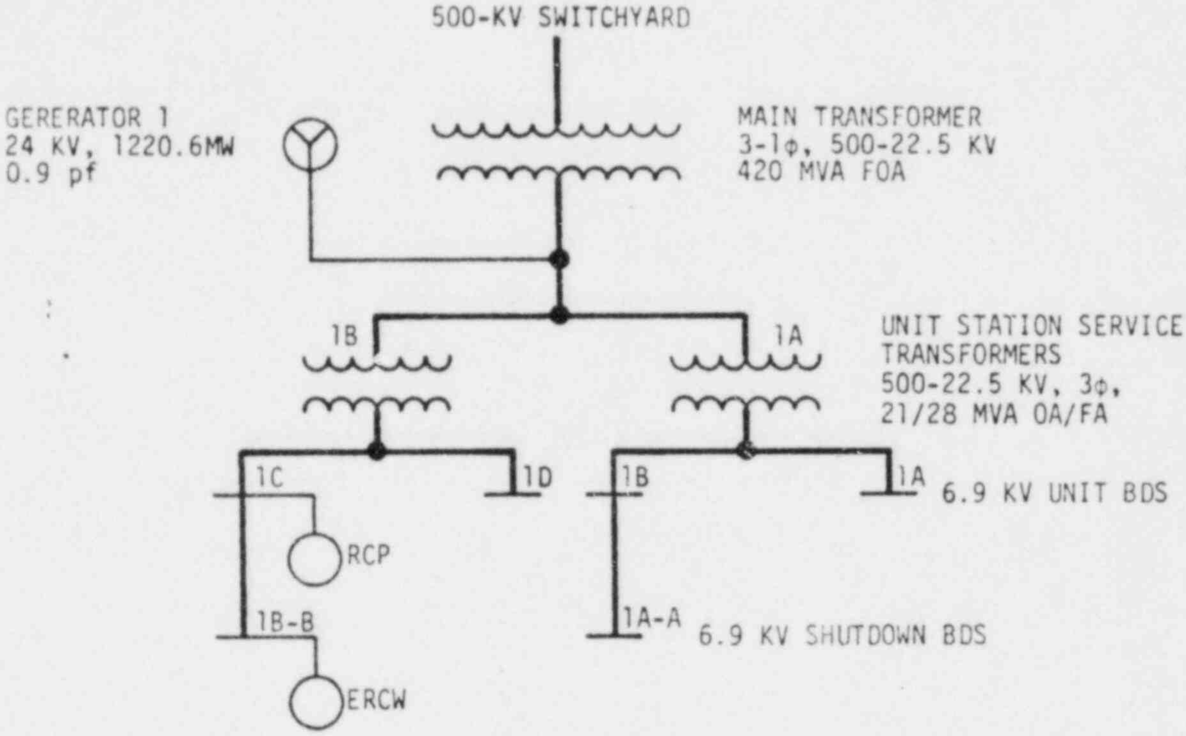
Appendix A
Voltage and Time Delay Analysis

061273.02

FIGURE B

PROGRAM N2DVUN

THE PURPOSE OF THIS PROGRAM IS TO EVALUATE THE VOLTAGES ASSOCIATED WITH NORMAL OPERATION.



MOTOR AND BOARD VOLTAGES

MOTOR	HP	BOARD	STARTUP KV		MAX. RECOVERY TIME (SEC)	STEADY STATE KV	
			MOTOR	BD		MOTOR	BD
RCP	6000	UNIT	5956	6120	28	6600	6624
ERCW pp	700	SHUTDOWN	6285	6498	2	6528	6580

CONDITIONS:

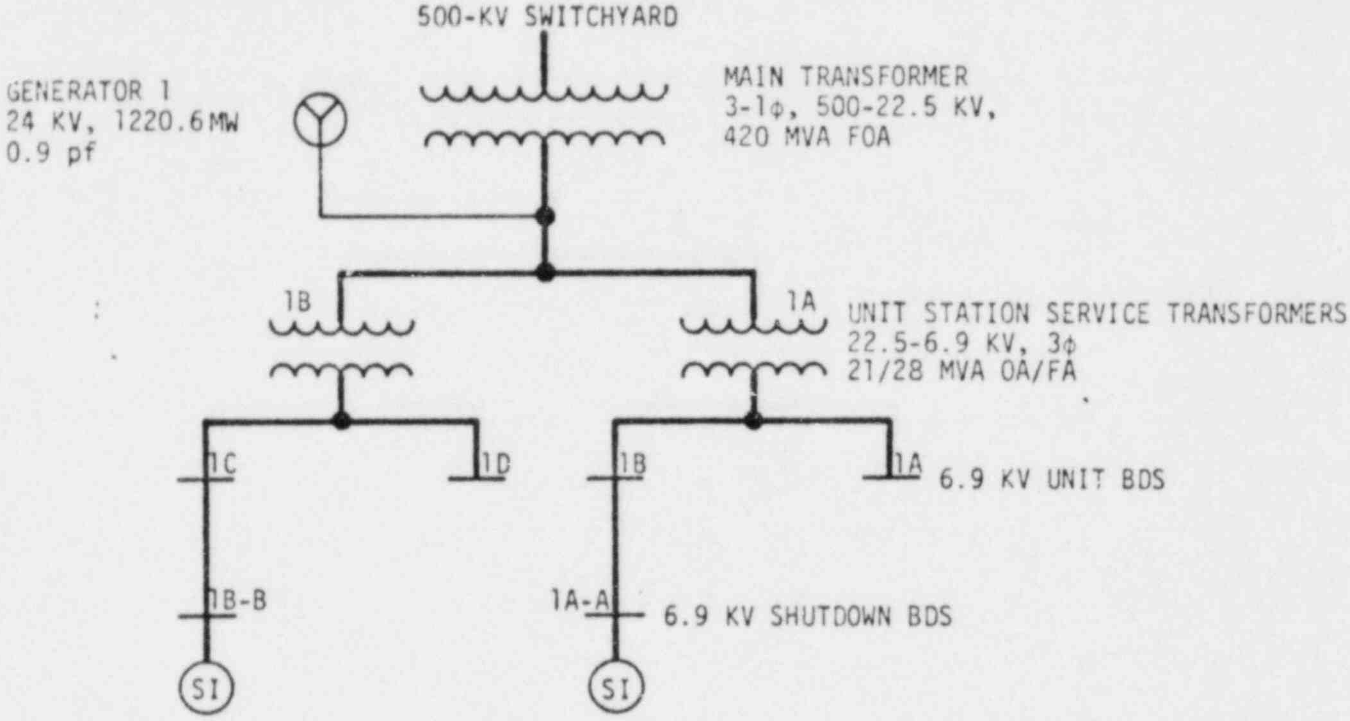
1. Generator Voltage at its Minimum of 22.8 kV.

2. USST Voltage Taps at the +2-1/2 Percent Buck Position.

FIGURE C

PROGRAM N2DVUL

THE PURPOSE OF THIS PROGRAM IS TO EVALUATE VOLTAGES ASSOCIATED WITH THE DESIGN-BASIS ACCIDENT WHILE UNIT CONNECTED.



MOTOR AND BOARD VOLTAGES

MOTOR	HP	BOARD	BOARD START-UP KV	RECOVERY TIME (SEC)	BOARD STEADY-STATE KV
ALL SI ACTUATED LOADS	-	UNIT	- 6387	~4	6685
	~4000	SHUTDOWN	6197	~4	6639

CONDITIONS:

1. Generator Voltage at its Minimum of 22.8 kV.

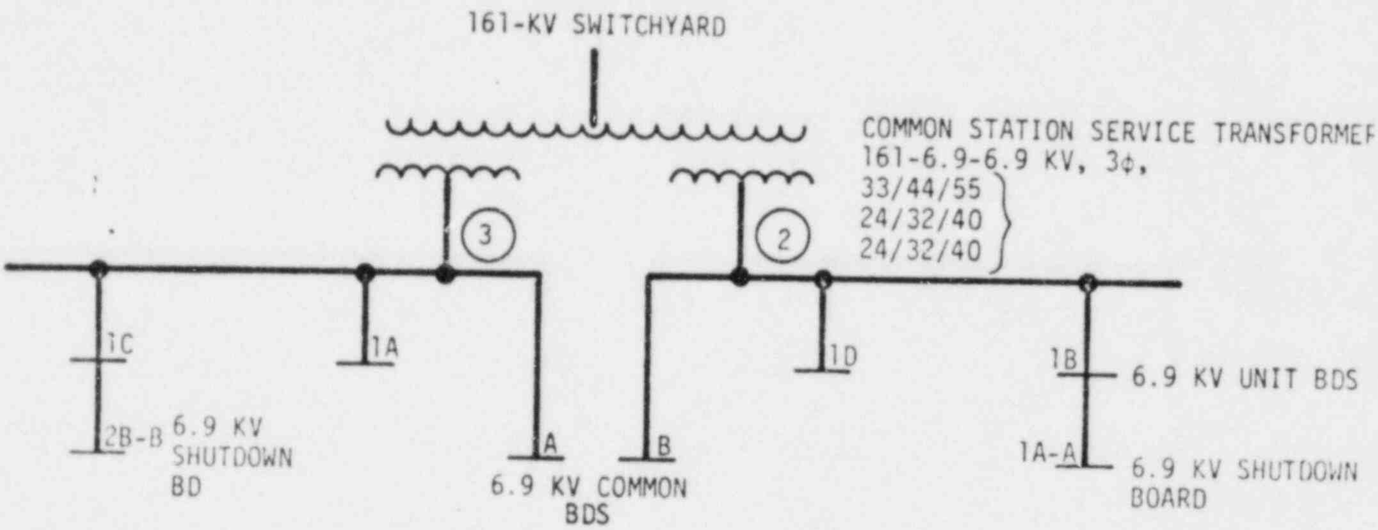
2. USST Voltage Taps at the +2-1/2 Percent Buck Position.

FIGURE D

PROGRAM N2DVCL

THE PURPOSE OF THIS PROGRAM IS TO EVALUATE VOLTAGES ASSOCIATED WITH THE DESIGN-BASIS ACCIDENT UNDER THE FOLLOWING CONDITIONS:

1) UNIT 1 LOCA WITH SWITCHYARD ELECTRICAL FAULT.
2) UNIT 2 FULL-LOAD REJECTION STILL UNIT CONNECTED.
3) ONE CSST OUT-OF-SERVICE.
4) 161-KV GRID VOLTAGE AT 162 KV.
5) CSST VOLTAGE TAPS AT THE -5% BOOST POSITION.



MOTOR AND BOARD VOLTAGES

COMPUTER NODE: (2)

MOTOR	HP	BOARD	BOARD START-UP KV	RECOVERY TIME (SEC)	BOARD STEADY-STATE KV
ALL SI ACTUATED LOADS	4000	UNIT (2)	6577	~4	7045
		SHUTDOWN	6370	~4	6995
	4000	UNIT (3)	6578	~4	7059
		SHUTDOWN	6375	~4	7007

FIGURE E

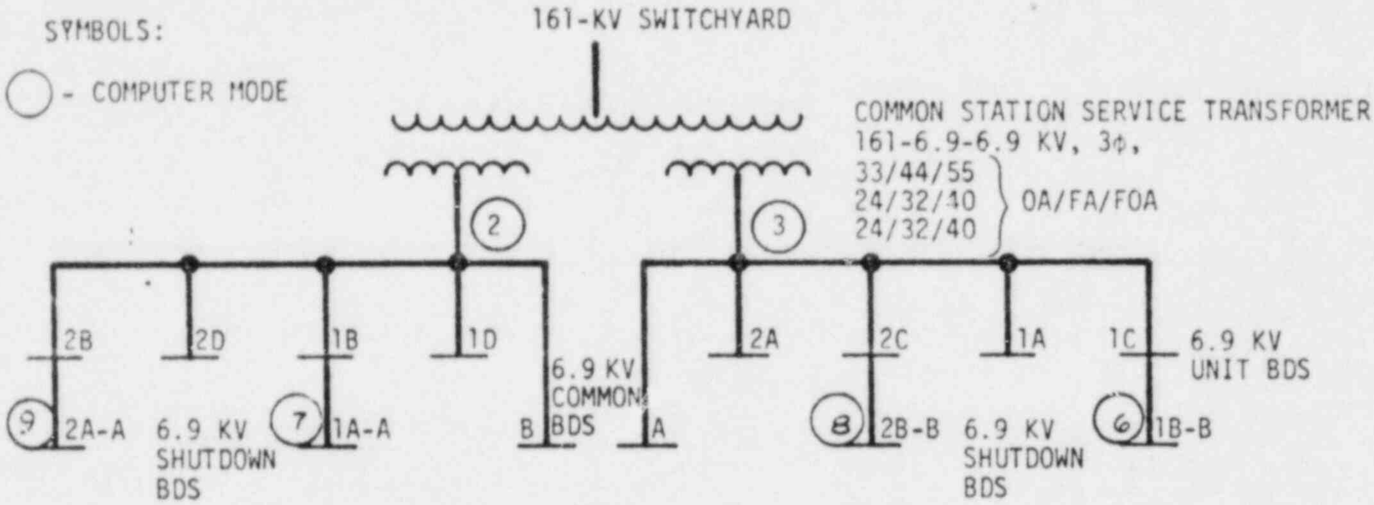
PROGRAM N2FLR2U

THE PURPOSE OF THIS PROGRAM IS TO EVALUATE VOLTAGES ASSOCIATED WITH THE WORST-CASE COMMON STATION SERVICE TRANSFORMER (CSST) LOADING UNDER THE FOLLOWING CONDITIONS:

1) ONE CSST OUT-OF-SERVICE
2) BOTH UNITS IN FULL-LOAD REJECTION
3) 161-KV GRID AT 162 KV
4) CSST VOLTAGE TAPS AT THE -5% BOOST POSITION

SYMBOLS:

◯ - COMPUTER MODE



BOARD	NODE	STEADY-STATE KV
UNIT	2	6629
SHUTDOWN	9	6589
SHUTDOWN	7	6585
UNIT	3	6662
SHUTDOWN	8	6618
SHUTDOWN	6	6617

Tennessee Valley Authority
Sequoyah Nuclear Plant Units 1 and 2
Degraded Voltage Relaying
Supplementary Technical Information

Appendix B
Technical Specification Changes

061273.03

The justifications for the proposed technical specification changes required for the degraded voltage protection modification are provided below. Marked up copies of the affected page follow.

Page 3/4 3-21

The engineered safety feature actuation system instrumentation for loss of electric power has been modified to include the degraded voltage instrumentation.

Page 3/4 3-27

The setpoints are determined to be adequate for protection based on the study presented in appendix A, "Voltage and Time Delay Analysis," to the degraded voltage report.

Page 3/4 3-32

The footnote was added to the loss of power response time to identify exactly what is measured for the degraded voltage channels. The timers are excluded because the response time is dependent on both the timers selected and the presence of a safety injection (SI) signal. The response will be measured from the time of a signal out of the timers to the time full voltage is restored. This eliminates the need to consider the SI signal and the different timer setpoints. The response time of the timers is covered by the setpoints specified in table 3.3-4.

Page 3/4 3-37

The surveillance requirements are modified to include testing of the degraded voltage channels. The channel check for the voltage sensors will consist of a verification that the annunicator panel is not lit if the voltage is in specification. Channel checks cannot be performed on the timers and are, therefore, listed as not applicable. The channel functional test will consist of a test of the annunciator circuits only. The timers cannot be tested without actuating the diesels and shedding loads, therefore, these circuits are listed as not applicable.

Page 3/4 8-13

The minimum battery capacity has been increased to 82 percent to account for possible discharge during the five minute delay on the degraded voltage protection channel actuation. The new limit will ensure that the batteries can meet the two hour accident load requirement for all cases.

MJB:COH
5/28/82

Tennessee Valley Authority
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Licensing Submittal

Appendix C
FSAR Changes

O61273.04

Replace pages 8.3-8 and 8.3-9 of "Standby Diesel Generator Operation" with the following:

061274.04

Standby Diesel Generator Operation

The diesel generator system is shown on single line diagram, Figure 8.3-20. The schematic of the engine start and stop circuits is shown in Figure 8.3-21. Remote control of the engine from the main control room is accomplished through interposing relays located in the diesel building. The schematic for this control is shown in figure 8.3-22.

The 6.9-kV shutdown boards in each power train derive power from either of two circuits from the 6.9-kV unit boards, or from their respective standby power source. During conditions where neither the nuclear unit nor preferred (offsite) power are available, each 6.9-kV shutdown board is energized from a separate, independent dedicated standby diesel generator unit. See table 8.2-2 for complete description of board transfer schemes.

The connection of the diesel generators to the 6.9-kV shutdown boards is initiated by either the loss-of-voltage relays on the 6.9-kV bus or the degraded voltage relays. The loss-of-voltage relays are set to pickup at 70 percent of nominal whereas the degraded voltage relays are set to pickup at 95 percent of nominal. A sustained voltage below these setpoints will initiate starting the diesel generators, tripping the normal or alternate feeder breaker, all 6.9-kV loads except the 480V shutdown board transformers, and the major 480V loads. Table 8.3-2 lists the loads that are automatically tripped. For a complete description of the voltage relay logic, see the system description of section (page 8.3-4). When the diesel generator set has reached rated speed and voltage (maximum of 10 seconds from initiation of automatic start signal), it is automatically connected to the 6.9-kV shutdown board bus. The return of voltage to the 6.9-kV shutdown board bus initiates logic which connects the required loads in the proper sequence. Table 8.3-3 shows the order in which the loads are applied.

The loss of voltage load shedding relays remain in the circuit at all times. If the load shedding relays ($\leq$70 percent) and time delay (5 seconds at 0 volts) setpoint is reached, the proper operation is:

1. To shed loads to prevent overloading the diesel generator.

2. Allow the diesel generator to recover to rated speed and voltage.

3. Reconnect the loads in the proper sequence.

Since the load shedding relays recognize loss of voltage, the starting of the largest driven load will not cause actuation of the load shedding feature.

As shown in Table 8.3-3, there are two loading sequences. One, which is applied in the absence of a "safety injection signal (SIS)," the non-accident condition," and the other, the "accident condition," applied when a safety injection signal is received prior to, or coincident with a sustained loss of voltage on the 6.9-kV shutdown board. A safety injection signal received during the course of a nonaccident shutdown loading sequence will cause the actions described below:

1. Loads already sequentially connected which are not required for an accident will be disconnected.

2. Loads already sequentially connected which are required for an accident will remain connected.

3. Loads awaiting sequential loading that are not required for an accident will not be connected.

4. Loads awaiting sequential loading that are required for an accident will have their sequential timers reset to time zero from which they will then be sequentially loaded.

Replace the bus transfer scheme description for the 6.9-kV shutdown boards in Table 8.2.2 with the following:

061274.04

Item	Board/Bus	Power Supplies Normal	Power Supplies Alternate	Standby	Remarks
15	6.9-kV Shutdown Board 1A-A	6.9-kV Unit Board 1B	6.9-kV Unit Board 1A	Diesel Gen 1A-A	Automatic transfer to the alternate is initiated by undervoltage on the normal feeder at 80% nominal voltage for four seconds. Transfer between normal and alternate is accomplished by closing alternate breaker at 30% nominal voltage if alternate supply voltage 95% nominal. Loss-of-bus voltage (≤70 percent) for 1.5 seconds starts the diesel generators and continued failure for an additional 3.5 seconds will trip incoming feeder breakers and most motor breakers. When diesel generator is up to rated speed and voltage, the emergency breaker will close automatically to connect the diesel to the board, and loads will be applied as required by a sequential timer. Return to normal supply is manual only and is a fast transfer (≤6 cycles). MCR is annunciated on under voltage condition at 80% nominal. Transfer to the diesel generator for a sustained degraded undervoltage (UV) is initiated in 10 seconds (if a SI has been initiated, or is subsequently initiated) and 5 minutes for non-SI if below setpoint of 95% nominal. MCR annunciation occurs for UV of 95% nominal and overvoltage of 105% nominal. The shutdown utility bus allows any 6.9-kV shutdown board to be connected to any other or all other 6.9-kV shutdown boards. All circuit breakers connected to this bus are normally open and disconnected. Use of the bus requires manual insertion and closing of two of the breakers.
16	6.9-kV Shutdown Board 1B-B	6.9-kV Unit Board 1C	6.9-kV Unit Board 1D	Diesel Gen 1B-B	

Replace "System Operation" in section 8.3.1.1 with the following:

To protect the Class 1E buses from a sustained degraded undervoltage, each of the two 6.9-kV Class 1E buses per unit will be provided with a set of three instaneous solid-state undervoltage relays (ITE-type 27/59H). These relays will have a nominal setpoint of 6560V ± 1/2 percent (95 percent of nominal). The relays will be arranged in a two-out-of-three coincidence logic to initiate three time delay sequences. The first sequence of 30 seconds will ride through normal system voltage transients before annunciating the undervoltage in the main control room. The second sequence of 10 seconds is short enough to allow safety-related equipment to be powered within the time required by the safety analysis. At the end of 10 seconds if a SIS has been initiated, or is subsequently initiated, the shutdown board will transfer to its diesel generator. The third time delay of five minutes is long enough to allow operator action but not allow damage to connected safety-related equipment. At the end of five minutes, the shutdown board will transfer to its diesel generator if the voltage has not returned to normal.

To protect the Class 1E buses from a sustained overvoltage, each of the two 6.9-kV Class 1E buses per unit will be provided with a set of three instantaneous solid-state overvoltage relays (ITE-type 59H). These relays will be arranged in a one-out-of-three coindence logic which will annunciate in the control room. The relays will have a nominal voltage setpoint of 7260 volts ± 1 percent (105 percent of nominal). The operator will take the action necessary to reduce the voltage.

There are no automatic transfers of board supplies between redundant power sources. All 480V shutdown boards and all motor control centers have alternate feeders to their respective board buses. Transfers between the normal and alternate feeder are manual. Some manual transfers of loads between power trains are used. These transfers are at the 480V level and involve nine loads which are tabulated in Table 8.3-10.

A means of manually interconnecting power sources at the 6.9-kV level is provided. This is provided by the shutdown utility bus, which on figure 8.1-2, allows any 6.9-kV shutdown board to be connected to any other or all other 6.9-kV shutdown boards. All circuit breakers connected to this bus are normally open and disconnected (racked out). Use of the bus requires manual insertion and closing of two of the breakers. The purpose of this utility bus is to increase the flexibility of the Standby Power System.

A manual means of supplying power to the 480V auxiliary building common board (which is not normally supplied power from the diesel generators during a condition where offsite power is lost) is provided. Provisions have been made to mammually connect this board to the 480V shutdown boards 1B2 and 2B2. This is shown in figure 8.3-9. The purpose is to provide power to operate the ice condenser refrigeration units and glycol pumps during the unlikely condition of a loss of offsite power that exceeds 2-3 days. The two normal bus feeder breakers must be moved from their normal compartments to the compartments which are connected to the 480V shutdown boards 1B2 and 2B2.

System Operation

The 6.9-kV shutdown boards in each power train derive power from either of two circuits from the 6.9-kV unit boards, or from their respective standby power source (diesel generator). The feeders connecting each shutdown board with these three sources are termed the normal, alternate, and standby feeders. The normal and alternate feeders can derive power from the nuclear unit, via separate unit station service transformers and separate 6.9-kV unit boards. The normal and alternate feeders can also derive power from the separate preferred source circuits, via separate windings (on either of two separate common station service transformers) and separate 6.9-kV unit boards. During conditions where neither nuclear unit nor preferred (offsite) power is available, each 6.9-kV shutdown board is energized from a separate standby diesel generator, via the standby feeder.

The alignment of each unit's standby distribution system is determined by plant conditions, the sources selected to energize it, and the status of components within the distribution system.

A loss of voltage (≤ 80%) on a normal feeder to a 6.9-kV shutdown board is detected by a two-out-of-three logic followed by a definite time delay of four seconds to initiate automatic transfer to the alternate feeder, if the alternate feeder voltage is at least 95 percent of nominal. The transfer is delayed until the bus voltage has decreased to 30 percent of nominal. The return transfer to the normal feeder is initiated manually and is a high-speed transfer, completed in approximately six cycles or less.

A sustained (1.5 seconds at zero volts) loss of voltage (≤ 70 percent) on the 6.9-kV shutdown board starts the diesel generator and initiates (after an additional 3.5 seconds) logic that trips the normal or alternate feeder breaker, all 6900V loads (except the 480V shutdown board transformers), and the major 480V loads. Table 8.3-2 shows the loads that are automatically stripped. Figures 8.318 and 8.3-19 show the load stripping schematically. When the diesel generator has reached rated speed and voltage, the generator will be automatically connected to the 6.9-kV shutdown board bus. (Refer to figure 8.3-20a.) This return of voltage to the 6.9-kV shutdown bus initiates logic which connects the required loads in sequence. Table 8.3-3 shows the sequence of applied loads. The standby (onsite) power system's automatic sequencing logic is designed to automatically connect the required loads in proper sequence should the logic receive an accident signal prior to, concurrent with, or following a loss of all nuclear unit and preferred (offsite) power.

The following analyses evaluates voltages associated with different conditions of unit operation and shutdown.

For normal operation of units 1 and 2, the main generator is used to supply power to the plant auxiliary power system through the unit station service transformers. With the main generator at its minimum voltage of 22.8 kV, starting the largest motor on the 6.9-kV unit and shutdown board will not cause spurious tripping of the normal (see Figure B).

If a safety injection (SI) should occur during normal operation of the unit, the reactor would be tripped and the turbine stop valves closed. If an electrical fault in the generator or switchyard is not present, the generator is not tripped, via the main transformer high-side breaker, for 30 seconds. During this time, approximately 4000 horsepower of SI motors are simultaneously started. The 6.9-kV shutdown board voltage will dip to approximately 6200 volts but will recover to 6640 volts after approximately four seconds, with the main generator voltage at its minimum of 22.8 kV (see Figure C).

For the same condition, but with an electrical fault of the switchyard or main generator, the 6.9-kV unit boards are transferred (approximately six cycles) to the preferred offsite supply. With one of the two CSST's out of service, the starting of the SI actuated loads will cause the 6.9-kV shutdown boards to dip to approximately 6370 volts for approximately four seconds recovering to approximately 7000 volts, with the 161-kV grid at 162 kV (see Figure D).

For the case of a two-unit full-load rejection, with one CSST out of service and the 161-kV grid at 162 kV, the steady-state 6.9-kV shutdown board voltages range from 6585 to 6618 volts, which is adequate for starting the required medium- and low-voltage motors (see Figure E).

For all the cases listed above, the recovery voltages and times are within the time and voltage settings of the degraded undervoltage detection system and would not cause spurious trips of the normal or preferred supplies.

Analysis of Time Delay Selected

The second level of undervoltage relays operate if a 6900-volt shutdown board bus voltage drops below the level required to successfully start all the safety-related equipment that would be required for the design basis accident. The relays will initiate three time delay sequences. The first sequence of 30 seconds will ride through normal system transients before annunciating in the main control room. The second sequence of 10 seconds is short enough to allow safety-related equipment to be powered within the time required by the safety analysis. At the end of 10 seconds, if a safety injection has been initiated, or is subsequantly initiated, the shutdown board will transfer to its diesel generator.

The third time delay of five minutes is long enough to allow operator action to correct the undervoltage condition, but not allow damage to connected safety-related equipment. At the end of the 5-minute delay, the shutdown board will transfer to its diesel if voltage has not been corrected. Since the loss of voltage relays on normal feeder only are set at 80 percent of nominal for four seconds, the band of voltages that a non-accident degraded voltage condition can exist is from 80 to 95 percent of nominal for five minutes. At 80 percent of nominal the voltage at the terminals of running motors will not drop below 71 percent of motor rated voltage. NEMA Class B motors will not stall out or be damaged above this point for the time delay of five minutes. Also, during the five-minute time delay the 125V dc vital battery boards could be powered by the batteries instead of the battery chargers. However, the vital batteries have sufficient capacity to meet this requirement, as well as meet the original design requirements as identified in section 8.3.2 of the Sequoyah FSAR.

For a loss of voltage, both the selected time delays allow for the loss-of-voltage relays to initiate transfer to the alternate supply, if it is greater than 95 percent of nominal, before tripping and transferring to the diesels.

An error of $\pm$ 0.5 percent for the timer/relays in the degraded voltage protection circuits has been considered in the design.