TEST RECORD -- GENERAL

REPORT NO.: CA-1723
SHEET NO. 1 OF 1 SHEETS
DATE OF TEST 8-83 & 3-84
DATE OF REPORT 4-5-84

LOCATION: SEQUOYAH NUCLEAR PLANT
SUBJECT: CALIBRATION OF 6.9 KV S.D. BD DEGRADED V. RELAYS
GENERAL DATA: BROWN BOVERI - ITE 27N, CAT. 211T0175

COPIES SENT TO: EBA, ELF, HECTOR DESOUZA (1330 CST2-C) JMB, WBM, AAB, C(

TESTED BY: JEN & MNC
CHECKED BY:
APPROVED BY: [illegible]

6.9 KV SHUT DOWN BOARD	DEVICE	S/N	INITIAL TEST DATE	INITIAL TEST D.O.	INITIAL TEST P.U.	S.I. 235 PERFORMANCE 3-14,15,20-84 AS FOUND D.O.	AS FOUND P.U.	AS LEFT D.O.	AS LEFT P.U.
1AA	27DAT	1029	8-23-83	109.3	110.0	108.79	109.51	109.32	110.03
	27DBT	1034	" " "	109.3	110.0	108.88	109.58	109.30	109.96
	27DCT	1036	" " "	109.3	110.0	108.87	109.56	109.32	110.06
1BB	27DAT	1031	8-22-83	109.3	110.0	108.90	109.5	109.3	110.0
	27DBT	1023	" " "	109.3	110.0	108.76	109.4	109.3	110.0
	27DCT	1028	" " "	109.3	110.0	108.76	109.4	109.3	110.0
2AA	27DAT	1024	8-23-83	109.3	110.0	108.44	109.59	109.3	110.0
	27DBT	1025	" " "	109.3	110.0	108.86	109.56	109.27	110.0
	27DCT	1027	" " "	109.3	110.0	108.89	109.59	109.32	110.04
2BB	27DAT	1032	8-22-83	109.3	110.0	108.50	109.6	109.3	110.0
	27DBT	1026	" " "	109.3	110.0	108.50	109.2	109.3	110.0
	27DCT	1030	" " "	109.3	110.0	108.50	109.2	109.3	110.0

Attachment 6 ... 12 of 52
27DAT

1A-A

TVA 6472 (PO-4-68)

8/4/73

SHEET No.:	...-126211
D1 OF D1 SHEETS	
DATE OF TEST:	8-15-86
DATE OF REPORT:	

LOCATION: SNP

SUBJECT: 6.9KV SDBD 1B-B Overvoltage Relay

GENERAL DATA:

Setting Sheet # 3018

COPIES SENT TO:

TESTED BY: Mary Harper & Bobbye D Malone

CHECKED BY:

APPROVED BY:

DPSO-SMI-3E

	BΦ						
Device	59DBT						
Serial No	3182						
Target	OK						
			PERCENT OFF SET POINT				
As found P.U.	117.6				2.8%		
As found D.O	112.3						
As left P.U	121.3						
As left D.O	117.6						
Equipment	TVA #	Calib Due Date					
EPOCH I	531815	6-26-87					
Fluke 8600A	486446	9-23-86					

TVA 6472 (PO-4-68)

6 13 57

22DAI

1B-B

SHEET NO.

_____ OF _____ SHEETS

LOCATION: SNP

DATE OF TEST 4/3/86

SUBJECT: 6.9 KV SD BD 2B-B UNDERVOLTAGE RELAYS

DATE OF REPORT

GENERAL DATA:

SETTING SHEET # 3020 DATE OF SETTING SHEET 8-25-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: COX + NICHOLS

CHECKED BY:

APPROVED BY:

	AΦ	BΦ	CΦ
DEVICE	27DAT	27DBT	27DCT
SERIAL #	1032	1026	1030
TARGET	OK	OK	OK
AS FOUND P.U.	110.1V	110.2V	110.1
AS FOUND D.O.	109.3V	109.3V	109.2
AS LEFT P.U.	110.1	110.2V	110.1
AS LEFT D.O.	109.3V	109.3V	109.2
TAP	99%	99%	99%

* PERCENT OFF SET POINT (AS FOUND)

	P.U.	D.O.
AΦ	.09%	0%
BΦ	.18%	0%
CΦ	.09%	.09%

EQUIPMENT	TVA #	CALIBRATION DUE DATE
FPOCH-1	531818	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{SET POINT VALUE})} \times 100 = \%\ \text{OFF SET POINT}$$

TVA 6472 (PO-4-68)

6 14 52

27DAT

1B-B

SHEET NO.: [illegible]

LOCATION: SNP

SUBJECT: 6.9 KV SD BD 2B-B OVERVOLTAGE RELAYS

GENERAL DATA:

DATE OF TEST: 4/3/86

DATE OF REPORT:

SETTING SHEET # 3018 DATE OF SETTING SHEET 8-25-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: COX & NICHOLS

CHECKED BY:

APPROVED BY:

	AΦ	BΦ	CΦ	*PERCENT OFF SET POINT (AS FOUND)	
DEVICE	59DAT	59DBT	59DCT		
SERIAL #	NA	NA	NA		
TARGET	OK	OK	OK	AΦ	.41%
AS FOUND P.U.	121.5	124.9	122	BΦ	4.0%
AS FOUND D.O.	113.4	121.5	119.6	CΦ	.83%
AS LEFT P.U.	121.5	120.8	120.9		
AS LEFT D.O.	113.4	117.2	118.5		
TAP	120V	120V	120V		

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-1	831318	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{SET POINT VALUE})} \times 100 = \%\ \text{OFF SET POINT}$$

TVA 6472 (PO-4-68)

15 52

27DAT

1B-B

LOCATION: SNP	____ OF ____ SHEETS
SUBJECT: 6.9 KV SD BD 1B-B VOLTAGE RELAYS	DATE OF TEST: 4/3/86
GENERAL DATA:	DATE OF REPORT.

SETTING SHEET # 3085 DATE OF SETTING SHEET 9-7-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY:	CHECKED BY:	APPROVED BY:
COX + NICHOLS		

	AΦ	BΦ	CΦ
DEVICE	27TS1A	27TS1B	27TS1C
SERIAL #	3871	3882	3417
TARGET	OK		
AS FOUND P.U.	94.7	94.7	95.1
AS FOUND D.O.	92.3	92.3	92.6
AS LEFT P.U.	94.4	94.5	94.7
AS LEFT D.O.	92.1	92.2	92.1
TAP	90V	90V	90V

* PERCENT OFF SET POINT (AS FOUND)

AΦ = .33%
BΦ = .33%
CΦ = .65

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-1	531818	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{SET POINT VALUE})} \times 100 = \%\ \text{OFF SET POINT}$$

TVA 6472 (PO-4-68)

6 16 52

?? DAT

B-B

LOCATION: SNP	___ OF ___ SHEETS
SUBJECT: 6.9 KV SD BD 1B-B VOLTAGE RELAYS	DATE OF TEST: 4/3/86
GENERAL DATA:	DATE OF REPORT:

SETTING SHEET # 3088 DATE OF SETTING SHEET 9-7-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY:	CHECKED BY:	APPROVED BY:
COX + NICHOLS		

		AΦ	CΦ		* PERCENT OFF SET POINT (AS FOUND)
DEVICE		AX716	CX716		
SERIAL #		3368	4050		AΦ = .09%
TARGET		OK	OK		CΦ = .18%
AS FOUND P.U.		112.5	112.5		
AS FOUND D.O.		109.4	109.5		
AS LEFT P.U.		112.5	112.5		
AS LEFT D.O.		109.4	109.5		
TAP		110 V	110 V		

DEVICE - 27RSIA APPLY 115V & REDUCE VOLTAGE TO CLOSE CONTACTS AT 35V
AS FOUND 35.1 AS LEFT 35.1

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-1	531818	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{AS FOUND VALUE})} \times 100 = \%\ \text{OFF SET POINT}$$

TVA 6472 (PO-4-68)

1B-B

27 DAT

Electrical Laboratory and Test Branch

LOCATION Sequoyah Nuclear Plant
CIRCUIT 69KV SDBD 1BB Voltage Relays VOLTAGE 6.9 KV
SETTING SHEET NO. 3018 DATED 8-25-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage	Voltage	Voltage		
PHASE	A	B	C		
TAP	120V	120V	120V		

ROUTINE TEST BY LAC & MNC DATE 3-20-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST. SETTING~~ Device	59DAT		59DBT		59DCT					
~~CURRENT IN SEC.~~ Target	OK		OK		OK					
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " As Found	121.9	119.3	125.8	122.8	121.4	119.2				
300% " " " " As Left	121.9	119.3	121.0	119.3	121.4	119.2				
400% " " " "										
500% " " " "			SI-235							
1000% " " " " *	0.7%		LAC ~~[illegible]~~	3.9%	03%					

* Percent out of tolerance (As Found)

ROUTINE TEST BY JFN MWP DATE 9/19/84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	59DAT		59DBT		59DCT			SI-235		
CURRENT IN SEC. TARGET	OK		OK		OK					
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " AS FOUND	121.7	118.95	117.5	114.1	121	119.21				
300% " " " " AS LEFT	121.0	118.3	120.96	117.75	121	119.21				
400% " " " "										
500% " " " "	.58%		2.9%		0%					
1000% " " " "	* PERCENT	OUT	OF TOLERANCE		(AS FOUND)					

ROUTINE TEST BY TNL & MHH DATE 3-20-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER	59DAT		59DBT		59DCT					
INST. SETTING DEVICE										
CURRENT IN SEC. TARGET		OK		OK		OK				
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.			P.U.	D.O.				
200% " " " " AS FOUND	123.0	121.0	126.6	123.4	123.33	121.14				
300% " " " " AS LEFT	121.45	118.04	121.15	117.65	121.14	118.74	SI-235			
400% " " " "										
500% " " " "										
1000% " " " " *	1.6%		4.6%		1.9%					

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY Cox / Lewis DATE 9/12/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME ~~LEVER~~ DEVICE	59DAT		59DBT		59DCT					
INST ~~SETTING~~ TARGET	OK	"	OK		OK					
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " As Found	120.2	117.1	117.1	114.7	120.1	117.8				
300% " " " " As Left	120.9	117.8	121.1	117.5	121.0	118.5				
400% " " " "										
500% " " " "										
1000% " " " " *	0.66%		3.22%		0.7%					

TVA 6471A (PO-2-58) * Percent off set pt. (as Found) 18-B

[illegible] No. 6 [illegible] 18 [illegible] 52
[illegible] Identifier 27DAT

Electrical Laboratory and Test Branch

LOCATION Sequoyah Nuclear Plant
CIRCUIT 69KV BD BD.1BB Voltage Relays VOLTAGE 69 KV
SETTING SHEET NO. 3C88 DATED 9-7-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage	Voltage			
PHASE	A	B			
TAP	LAC 3-20-84 ~~120V~~ 110V	LAC 3-20-84 ~~120V~~ 110V			

ROUTINE TEST BY LAC MNC DATE 3-20-84 DATE TRIP TEST .

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER	AX 728		CX 728							
~~INST. SETTING~~ Device	~~AX 7...~~		~~CX 7...~~							
~~CURRENT IN SEC.~~ Target	OK									
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U	D.O	P.U	D.O.						
200% " " " " As Found	112.5	109.6	111.4	108.6						
300% " " " " As Left	112.5	109.6	111.4	108.6						
400% " " " "										
500% " " " "		SI-235								
1000% " " " " *		0.3%		0.6%						

* Percent out of tolerance (As found)

ROUTINE TEST BY VFN MWP DATE 9/20/84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	AX72B		CX72B							
CURRENT IN SEC. TARGET	OK									
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O						
200% " " " " AS FOUND	113.2	110.45	112.05	109.31						
300% " " " " AS LEFT	112.1	109.29	112.05	109.31						
400% " " " "										
500% " " " " *		1.65%								
1000% " " " " *	PERCENT OUT OF TOLERANCE (AS FOUND)									

ROUTINE TEST BY TNL & MHH DATE 3-19-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	AX728		CX 728							
CURRENT IN SEC. TARGET		OK		OK						
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.						
200% " " " " AS FOUND	112.32	109.32	112.9	110.1						
300% " " " " AS LEFT	112.3	109.3	112.1	109.2						
400% " " " "										
500% " " " "										
1000% " " " " *		.47%		.73%						

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY COX/LEWIS DATE 9/12/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ DEVICE	AX728		CX728							
~~INST. SETTING~~ TARGET		OK		OK						
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU	DO	PU	D.O.						
200% " " " " As Found	112.3	109.1	112.0	109.1		SI 235				
300% " " " " As Left	112.4	109.2	112.4	109.3						
400% " " " "										
500% " " " "										
1000% " " " " *		0.18%		0.18%						

TVA 6471A (PO-2-58) * PERCENT OFF SET PT. (AS FOUND) B-B

Attachment No. 6 ... 19 52
Location Identifier 27DAT

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

LOCATION Sequoyah Nuclear Plant
CIRCUIT 6.9 KV SD BD 1BB Voltage Relay VOLTAGE 6.9 KV
SETTING SHEET NO. 3088 DATED 9-7-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage		Voltage		Voltage				Voltage	
PHASE	A		B		C				A, B & C	
TAP	90V		90V		90V					

ROUTINE TEST BY LAC & MNC DATE 3-20-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST. SETTING~~ Device	27TSIA		27TSIB		27TSIC				27RSIA	
~~CURRENT IN SEC.~~ Target	OK		OK		ok				ok	
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			Apply	115V
200% " " " "									Reduce	Voltage
300% " " " " As Found	94.1	92.0	94.3	92.3	95.0	92.7			3 contacts	
400% " " " " As Left	94.1	92.0	94.3	92.3	95.0	92.7			close @	
500% " " " "			SI 235						35V	
1000% " " " " *		0.0%		0.3%		0.8%				

* Percent out of tolerance (As found)

ROUTINE TEST BY JFN MWP DATE 9/20/84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	27TS1A		27TS1B		27TS1C		SI-235		27RS1A	
CURRENT IN SEC. TARGET	OK		OK		OK					
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY	115V
200% " " " " AS FOUND	94.41	92.1	94.79	92.6	95.25	92.87			Reduce	Volt-
300% " " " " AS LEFT	94.26	91.97	94.22	92.0	94.41	92.0			AGE	Contact
400% " " " "									close @	
500% " " " " *		.11%		.65%		.95%			35	V
1000% " " " " *	PERCENT OUT OF TOLERANCE (AS FOUND)									

ROUTINE TEST BY TNL & MHH DATE 3-19-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING Device	27TS1A		27TS1B		27TS1C		SI-235		27RS1A	
CURRENT IN SEC. TARGET		OK		OK		OK				
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY	115V
200% " " " " As Found	93.45	93.34	93.4	93.3	93.5	93.2			REDUCE	VOLT-
300% " " " " As Left	94.25	91.85	94.1	91.7	94.6	92.2			AGE	CONTACT
400% " " " "									CLOSE @	
500% " " " "									35V	V
1000% " " " " *		1.5%		1.4%		1.3%				

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY Cox / Lewis DATE 9/12/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ DEVICE	27TSIA		27TSIB		27TSIC				27RSIA	
~~INST. SETTING~~ TARGET		OK		OK		OK				
CURRENT IN SEC.							SI-235			
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU.	DO	PU.	DO	P.U.	DO.			APPLY	115V
200% " " " " As Found	93.6	91.2	93.7	91.3	93.8	91.2			REDUCE	VOLTAGE
300% " " " " As Left	94.1	91.8	94.4	92.1	94.6	92.0			CONTACT	CLOSE
400% " " " "								As Found	33.8	
500% " " " "								As Left	35.2	
1000% " " " " *		0.8%		0.76%		0.82				

TVA 6471A (PO-2-58) * PERCENT off SET PT. (as Found)

Identifier 27 DAT

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

LOCATION Sequoyah Nuclear Plant
CIRCUIT 69 KV SRED 2BB Voltage Relay VOLTAGE 69 KV
SETTING SHEET NO. 3020 DATED 5-25-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage	Voltage	Voltage		
PHASE	A	B	C		
TAP D.O.	99%	99%	99%		
P.U.	110V	110V	110V		

ROUTINE TEST BY LAC & MNC DATE 3-20-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ S/N	1032		1026		1030					
~~INST. SETTING~~ Device	27DAT		27DBT		27DCT					
~~CURRENT IN SEC.~~ Target	ok		ok		ok					
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " As Found	109.6	108.5	109.2	108.5	109.2	108.5				
300% " " " " As Left	110.0	109.3	110.0	109.3	110.0	109.3				
400% " " " "										
500% " " " "			SI-235							
1000% " " " " *	0.36	0.73	0.72	0.73	0.72	0.73				

* Percent out of Tolerance (As Found)

ROUTINE TEST BY JEN MWP DATE 9/19/84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	27DAT		27DBT		27DCT					
CURRENT IN SEC. TARGET	ok		ok		ok					
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " AS FOUND	110.4	109.75	110.4	109.74	110.4	109.77				
300% " " " " AS LEFT	110.0	109.3	110.0	109.3	110.0	109.3	SI-235			
400% " " " "										
500% " " " " *	.36%	.41%	.36%	.40%	.36%	.43%				
1000% " " " "										

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY MHH & TNL DATE 3-20-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER		C MH 3-20-85				A MH	3-20-85			
INST. SETTING DEVICE	27DAT		27DBT		27DCT					
CURRENT IN SEC. TARGET		ok		ok		ok				
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
300% " " " " AS FOUND	111.11	110.29	111.27	110.39	111.17	110.36				
400% " " " " AS LEFT	110.7	109.33	110.09	109.29	110.09	109.29				
500% " " " "										
1000% " " " " *	1.0%	.9%	1.2%	1.0%	1.1%	1.0%				

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY Cox / Lewis DATE 9/12/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ DEVICE	27DAT		27DBT		27DCT					
~~INST. SETTING~~ TARGET		ok		ok						
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	DO	P.U.	D.O				
200% " " " " As Found	110	109.3	110.1	109.3	110.1	109.3				
300% " " " " As Left	110	109.3	110.1	109.3	110.1	109.3	SI-235			
400% " " " "										
500% " " " "										
1000% " " " " *	0%	0%	0.09%	0%	0.09%	0%				

* PERCENT OUT OF TOLERANCE (AS FOUND)

TVA 6471A (PO-2-58) 1B-B

27 DAT

TEST RECORD -- GENERAL

SHEET No.: CA-1649

D11 OF D12 SHEETS

LOCATION: [illegible] EAR PLANT

DATE OF TEST: 8-25-83

SUBJECT: 6.9 [illegible] DEGRADED VOLTAGE TIMERS

DATE OF REPORT: 8-30-83

GENERAL DATA: [illegible] E7012FC002 1.5-15 SEC.
DV1-2 " 7012 PK 1-300 "
LV1-2 " 7012 PB .5-5 "
DA1-2 " 7012 PD 5-50 "

COPIES SENT TO: ERP, FLE, WRM, WAD, CCM

TESTED BY: M. CALLAHAM

CHECKED BY: RRK

APPROVED BY: RRK

S.S. 2991 & 3018
8-17-83 8-25-83

SHUT DOWN BOARD 1B-B

TIMER	TIME IN SEC.
DS1	10
DS2	10
DV1	296
DV2	291
DA1	30
DA2	30
LV1	3
LV2	3

		TVA #	DUE DATE
TEST EQUIP.	RELAY TEST SET	266151	3-25-84
	FLUKE	486433	2-16-84

1B-B

TVA 6472 (PO-4-68)

[illegible] 6 [illegible] 22-352
27DAT

REASON FOR TEST: INITIAL [X] SPECIAL [ ] ROUTINE [ ]

LOCATION SEQUOYAH NUCLEAR PLANT DATE 9-23-83 TIME [illegible]

CIRCUIT & VOLTAGE 6.9 KV S.D. BD. 1B-B VOLTAGE RELAYS TRIPS OCB. OR DEVICE [illegible]

DATA BY M. CALLAHAM CHECKED BY [illegible] APPROVED BY [illegible]

COPIES SENT TO ERH, ELE, WBM, WAD, CCM

TYPE RELAYS 27N/59H DEVICE No. (SEE BELOW) SETTING SHEET No. 3018 DATED 7-25-83

CIRCUIT	PRIMARY LOAD DATA					CT RATIO		
	AMP.	MW IN	MW OUT	MVAR IN	MVAR OUT	RELAY CT	AUX. CT	OVERALL RATIO
6.9 KV								
KV								
KV								

RELAY PHASING DATA

RELAY ~~Ø OR Z~~ DEVICE #	POTENTIAL (SEE NOTE 1) PHASE	WIRE DESIG.	STUDS	VOLTS	~~CURRENT~~ E REF. PHASE	WIRE DESIG.	STUD	~~AMPS~~ VOLTS	PHASE ANGLE E Z LAGS E REF.
27DAT	A-B		3-4	114.2	A-B	1B-B BUS	2-1	113.9	0.2°
27DBT	B-C		3-4	113.8	↓	VOLTMETER	↓	↓	120.4°
27DCT	C-A		4-3	113.6		LOCATED			240.1°
						ON PAN. 12			
59DAT	A-B		3-4	114.2					0.2°
59DBT	B-C		3-4	113.7					120.4°
59DCT	C-A		4-3	113.6					240.1°

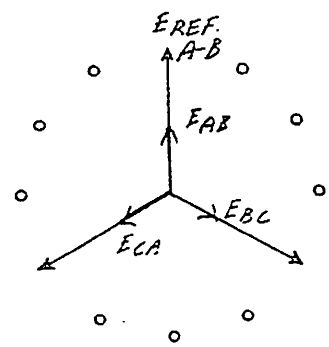
CURRENT POLARITY ON THE PHASE ANGLE METER WAS

[ ] TOWARD

[ ] AWAY FROM THE LAST CURRENT TRANSFORMER POLARITY MARK.

CURRENT WAS READ [ ] ENTERING

[ ] LEAVING THE RELAY.



DIFFERENTIAL RELAY TAP SETTINGS:

TRANSF. WDG.	RELAY TAP	STUD No.
HI		
LO		
TER		

NOTE 1: LIST FIRST THE POTENTIAL STUD NO. WHICH IS CONNECTED TO POLARITY ON THE PHASE ANGLE METER. FOR EXAMPLE: 7-8; 7 IS POLARITY.

NOTE 2: PHASING SHOULD BE TAKEN AT THE SAME PLACE IN THE CIRCUIT THAT CALIBRATION WAS MADE ON THE RELAYS, IF POSSIBLE.

REMARKS:		TVA #	DUE DATE
TEST EQUIP:	FLUKE	486433	2-16-84
	FLUKE	462251	2-16-84
	ØL METER	489411	12-9-83

TVA 6646 (PO-1-69)

1B-B

Attachment 6 Sheet 23 of 52
Loop No. 27DAT

TEST RECORD -- GENERAL

SHEET No.: D3 of D12 SHEETS

LOCATION: SEQUOYAH NUCLEAR PLANT

DATE OF TEST: 8-22-83

SUBJECT: 6900 V SD. BD. 1B-B - VOLTAGE RELAYS

DATE OF REPORT: 8-30-83

GENERAL DATA: 27DAT DBT DCT - BROWN BOVERI, ITE 27N, CAT. 211T0175
59DAT, DBT, DCT - BROWN BOVERI, ITE 59H, CAT. 211C0175
27TS1A, S1B, S1C AND AX, CX - BROWN BOVERI, ITE 27H, CAT. 211B0175

COPIES SENT TO: EBA, ELE, WBM, WAD, CCM

TESTED BY: M. CALLAHAM

CHECKED BY: ARK

APPROVED BY: ARK

S.S. 2991 & 3018
8-17-83 8-25-83

DEVICE NO.		S/N		P.U.	D.O.		TARGET		
DEGRADED VOLTAGE (BUS)									
27DAT		1031		110.0	109.3		OK		
27DBT		1023		110.0	109.3		OK		
27DCT		1024		110.0	109.3		OK		
LOSS OF VOLTAGE (ALT. FDR)									
AX728		3868		112.4	109.3		OK		
CX728		4050		111.9	109.3		OK		
LOSS OF VOLTAGE (NOR. FDR)									
27TS1A		3871		94.2	92.0		OK		
27TS1B		3882		94.5	92.0		OK		
27TS1C		3417		94.8	92.0		OK		
OVERVOLTAGE (BUS)									
59DAT		NO #		121.0	118.3		OK		
59DBT		3182		121.0	118.0		OK		
59DCT		3180		121.0	119.9		OK		

TEST EQUIP.		TVA #	DUE DATE
FLUKE	8600 A	486433	2-16-84
DOBLE F-3C TEST SET		512761	7-18-84

1B-B

Attachment 6 Sheet 29 of 52
Loop # 27 DAT

TEST RECORD -- GENERAL

SHEET NO.: SI-235

___ OF ___ SHEETS

LOCATION: SNP

SUBJECT: 6.9 KV SOBDZA-A UNDERVOLTAGE RELAYS

DATE OF TEST: 3/13/86

DATE OF REPORT: 3/19/86

GENERAL DATA:

SETTING SHEET # 3019 DATE OF SETTING SHEET 8-25-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: HOOPER & LEWIS

CHECKED BY:

APPROVED BY:

	A φ	B φ	C φ	* PERCENT OFF SET POINT (AS FOUND)		
DEVICE	27DAT	27DBT	27DCT		P.U.	D.O.
SERIAL #	1024	1025	1033			
TARGET	OK	OK	OK	A φ	0%	0%
AS FOUND P.U.	110.0	110.1	110.0	B φ	.1%	.1%
AS FOUND D.O.	109.3	109.4	109.3	C φ	0%	0%
AS LEFT P.U.	110.0	110.0	110.0			
AS LEFT D.O.	109.3	109.3	109.3			
TAP	99%	99%	99%			

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-I TEST SET	531815	6-25-86
KEITHLEY	537774	6-2-86

* FORMULA FOR PERCENT OFF SET POINT

(AS FOUND VALUE) - SET POINT VALUE) / SET POINT VALUE X 100 = % OFF SET POINT

TVA 6472 (PO-4-68)

[illegible] No. 2 Sheet 25 of 52

[illegible] Identifier 27DAT

2A-0

TEST RECORD -- GENERAL

SHEET No.: SI-235

____ OF ____ SHEETS

LOCATION: SNP

SUBJECT: 6.9 KV SDBD 2A-A OVERVOLTAGE RELAYS

DATE OF TEST: 3-19-86

DATE OF REPORT: 3-19-86

GENERAL DATA:

SETTING SHEET # 3019 DATE OF SETTING SHEET 8-25-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: HOOPER & LEWIS

CHECKED BY:

APPROVED BY:

	AΦ		BΦ		CΦ		* PERCENT OFF SET POINT (AS FOUND)	
DEVICE	59DAT		59DBT		59DCT			
SERIAL #	3173		3156		3176			
TARGET	OK		OK				AΦ	.25%
AS FOUND P.U.	121.3 V		121.6 V		121.5 V		BΦ	.5%
AS FOUND D.O.	~~[illegible]~~	119.7 V	118.5 V		118.2 V		CΦ	.41%
AS LEFT P.U.	121 V		120.9 V		120.9 V			
AS LEFT D.O.	118 V		117.8 V		117.6			
TAP	120 V		120 V		120 V			

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-II TEST SET	531815	6-25-86
KEITHLEY	537774	6-2-86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{\text{(AS FOUND VALUE)} - \text{(SET POINT VALUE)}}{\text{(SET POINT VALUE)}} \times 100 = \%\ \text{OFF SET POINT}$$

TVA 6472 (PO-4-68)

[illegible] 6 [illegible] 26 [illegible] 52

[illegible] 27DAT

2A-A

TEST RECORD -- GENERAL

SHEET No. SI-235

____ OF ____ SHEETS

LOCATION: SNP

DATE OF TEST: 3/19/86

SUBJECT: 6.9 KV SD BD 2A-A VOLTAGE RELAYS

DATE OF REPORT: 3/19/86

GENERAL DATA:

SETTING SHEET # 3059 DATE OF SETTING SHEET 9-7-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: Hooper & Lewis

CHECKED BY:

APPROVED BY:

	AΦ	CΦ	* PERCENT OFF SET POINT (AS FOUND)	
DEVICE	AX816	CX816		
SERIAL #	3416	3883		
TARGET	OK	OK	AΦ	.36%
AS FOUND P.U.	113.5	112.5	CΦ	.27%
AS FOUND D.O.	109.7	109.6		
AS LEFT P.U.	113.1	112.3		
AS LEFT D.O.	109.3	109.4		
TAP	110 V	110 V		

DEVICE - 27RSIA APPLY 115V & REDUCE VOLTAGE TO CLOSE CONTACTS AT 35V
AS FOUND 34.25 AS LEFT 35

EQUIPMENT	TVA #	CALIBRATION DUE DATE
KD Test Box	239411	6-26-86
EPOCH-II TEST SET	531815	6-25-86
KEITHLEY	537774	6-2-86

* FORMULA FOR PERCENT OFF SET POINT

$\frac{\text{AS FOUND VALUE} - \text{(SET POINT VALUE)}}{\text{AS FOUND VALUE}} \times 100 = \%$ OFF SET POINT

[illegible]
(Set Point Value)

TVA 6472 (PO-4-68)

6 [illegible] 27DAT

TEST RECORD -- GENERAL

SHEET No. SI-235

____ OF ____ SHEETS

LOCATION: SNP

SUBJECT: 6.9 KV SD. BD. 2A-A VOLTAGE RELAYS

DATE OF TEST: 3/19/86

DATE OF REPORT: 3/19/86

GENERAL DATA:

SETTING SHEET # 3089   DATE OF SETTING SHEET 9-7-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: HOOPER & LEWIS

CHECKED BY:

APPROVED BY:

	A Φ	B Φ	C Φ	* PERCENT OFF SET POINT (AS FOUND)	
DEVICE	27TS1A	27TS1B	27TS1C		
SERIAL #	3881	3867	387[illegible]		
TARGET	OK	OK	OK	A Φ	.5%
AS FOUND P.U.	95.0	94.6	95.1	B Φ	.2%
AS FOUND D.O.	92.5	92.2	92.3	C Φ	.3%
AS LEFT P.U.	94.5	94.6	94.7		
AS LEFT D.O.	92.1	92.2	92.0		
TAP	90V	90V	90V		

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-I TEST SET	531815	6-25-86
KEITHLEY	537774	6-2-86

* FORMULA FOR PERCENT OFF SET POINT

(AS FOUND VALUE − SET POINT VALUE) / (SET POINT VALUE) × 100 = % OFF SET POINT

6 26 82

[illegible] 27DAT

TVA 6472 (PO-4-68)

2A-A

ROUTINE RELAY TEST RECORD

Electrical Laboratory and Test branch

Attachment No. C Sheet 29 of 52
Loop cycle 27DAT

LOCATION SEQUOYAH NUCLEAR PLANT
CIRCUIT 6.9 KV SD BD 2AA VOLTAGE RELAY VOLTAGE 6.9 KV
SETTING SHEET NO. 3019 DATED 8-25-83 NORMAL TRIP SUPPLY 125 V DC

TYPE OF RELAYING	VOLTAGE		VOLTAGE		VOLTAGE					
PHASE	A		B		C					
TAP	120 V		120 V		120 V					

ROUTINE TEST BY JEN-MHH DATE 3-14-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST.~~ SETTING DEVICE	59DAT		59DBT		59DCT					
CURRENT IN SEC. TARGET		OK		OK		OK				
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " AS FOUND	121.14	118.8	121.27	118.59	121.3	118.6				
300% " " " " AS LEFT	120.98	118.74	121.06	118.39	120.99	118.28				
400% " " " "										
500% " " " "		SI-235								
1000% " " " " *	.115%		.24%		.25%					

* AS FOUND PERCENT OUT OF TOLERANCE

ROUTINE TEST BY MHH & BGM DATE 9-24-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER	59DAT		59DBT		59DCT					
~~INST. SETTING~~ DEVICE										
CURRENT IN SEC. TARGET		OK		OK		OK				
TEST RECORD	PU	DO	PU	DO	PU	DO	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME AS FOUND	119.98	117.67	119.75	117.01	119.78	116.89				
200% " " " " AS LEFT	121.08	119.06	121.02	118.57	121.13	118.46				
300% " " " "										
400% " " " "	SI-235									
500% " " " "										
1000% " " " " *	.91%		1.03%		1.01%					

*As found percent out of tolerance

ROUTINE TEST BY JFN DATE 3/14/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER DEVICE	59DAT		59DBT		59DCT		SI-235			
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.	EQUIP		TVA#	DUE DATE
200% " " " " AS FOUND	123.2	120.92	123.37	120.49	123.47	120.39	EPOCH-I		531816	1/17/86
300% " " " " AS LEFT	121.11	118.71	121.09	118.20	120.9	117.70	FLUKE		521962	5/9/85
400% " " " "										
500% " " " " * PERCENT OUT OF TOLERANCE AS FOUND										
1000% " " " " *		1.2%		1.96%		2.04%				

ROUTINE TEST BY JFN MHH DATE 9/27/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER				SI-235			EQUIP		TVA#	DUE DATE
INST. SETTING DEVICE	59DAT		59DBT		59DCT		EPOCH-I		531815	6-25-86
CURRENT IN SEC.							KEITHLEY		537774	11-18-85
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " AS FOUND	120.5	117.4	120.3	117.2	119.8	116.9				
300% " " AS LEFT	120.96	117.86	121.2	118.1	121.0	117.7				
400% " " " "	*.4%		.57%		.99%					
500% " " " "										
1000% " " " "	* PERCENT OFF SET POINT									

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

Attachment No. 6 Sheet 30 of 52
Loop Folder for 27DAT

LOCATION SEQUOYAH NUCLEAR PLANT
CIRCUIT 6.9 KV SDSD 2AA VOLTAGE RELAY VOLTAGE 6.9 KV
SETTING SHEET NO. 3089 DATED 9-7-83 NORMAL TRIP SUPPLY 125 V DC

TYPE OF RELAYING	VOLTAGE		VOLTAGE		VOLTAGE				VOLTAGE	
PHASE	A		B		C				A, B, & C	
TAP	90V		90V		90V					

ROUTINE TEST BY JFN-MHH DATE 3-14-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~										
~~INST. SETTING~~ DEVICE	27TS1A		27TS1B		27TS1C				27RS2A	
~~CURRENT IN SEC.~~ TARGET		OK		OK		OK				
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY 115V	
200% " " " " AS FOUND	95.20	92.95	94.95	92.3	95.52	93			REDUCE VOLTAGE	
300% " " " " AS LEFT	94.36	92.02	94.14	92.04	94.45	91.76			4 CONTACTS	
400% " " " "									CLOSE @	
500% " " " "		SI-235							35 V	
1000% " " " " *	1.03%		.326%		1.09%					.28%

* PERCENT OUT OF TOLARANCE (AS FOUND)

ROUTINE TEST BY MHH & BGM DATE 9-24-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER DEVICE	27TS1A		27TS1B		27TS1C				27RS2A	
~~INST. SETTING~~ ~~DEVICE~~		~~OK~~	MH 9-29-84							
~~CURRENT IN SEC.~~ TARGET		OK		OK		OK				
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY 115V	
200% " " " " AS FOUND	93.6	91.25	93.75	91.56	94.02	91.45			REDUCE VOLTAGE	
300% " " " " AS LEFT	94.26	91.96	94.28	92.10	94.5	91.16			4 CONTACTS	
400% " " " "									CLOSE @	
500% " " " "		SI-235							35 V	
1000% " " " " *	.81%		.48%		.60%					

*PERCENT OUT OF TOLLARANCE (AS FOUND)

ROUTINE TEST BY UFN DATE 3/14/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER								SI-235		
INST. SETTING DEVICE	27TS1A		27TS1B		27TS1C				27RS2A	
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY 115V	
200% " " " AS FOUND	96.0	93.5	95.61	93.31	96.00	93.4			REDUCE	
300% " " " AS LEFT	94.5	92.0	94.40	92.01	94.8	92.00			VOLTAGE +	
400% " " " "									CONTACT CLOSE	
500% " " " " *		1.6%		1.4%		1.52%			@ 35V	
1000% " " " " *	PerCent out of Tolerance as found									

EQUIP TVA# DUE DATE
EQUIP I 531816 11/7/86
FLUKE 521962 5-9-85

ROUTINE TEST BY MHH & BGM DATE 7-13-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	27TS1A		27TS1B		27TS1C					
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.C.	EQUIP TVA#		DUE DATE	
200% " " " "				91.4	94.0	~~93~~				
300% " " " " AS FOUND	93.7	91.3	93.7	~~93.1~~	~~11.4~~	91.3	EICO# I 531815		6-25-85	
400% " " " " AS LEFT	94.5	92.0	94.3	92.0	~~92.0~~ 94.7	92.0	KEITHLEY 537715		11-15-85	
500% " " " "										
1000% " " " "				MHH						

TVA 6471A (PO-2-58)

2A-A

TYPE OF RELAYING	VOLTAGE	VOLTAGE	VOLTAGE	VOLTAGE
PHASE	A	B	C	A, B, C

ROUTINE TEST BY JFN, MAH DATE 9/27/85 DATE TRIP TEST

SETTING RECORD SI-235

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER									27R52A	
INST. SETTING DEVICE	27TS1A		27TS1B		27TS1C					
CURRENT IN SEC.	* 10%		[illegible]		[illegible]					

TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY 115V	
200% " " AS FOUND	93.5	92.1	94.4	92.0	94.8	92.0			REDUCE CLOSE	
300% " " AS LEFT	93.5	92.1	94.4	92.0	94.8	92.0			CONTACT AT	
400% " "									35 VOLTS	
500% " "										
1000% " "										

EQUIP	TVA #	DUE DATE	
EPOCH I	531815	6-25-86	9/27/85
KEITHLEY	537774	~~[illegible]~~ 11-18-85	
KD BOX	259411	6-26-86	

* PERCENT OFF SET POINT

ROUTINE TEST BY DATE DATE TRIP TEST

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
SETTING RECORD										
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										

TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY DATE DATE TRIP TEST

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
SETTING RECORD										
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										

TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY DATE DATE TRIP TEST

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
SETTING RECORD										
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										

TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

REMARKS

6 21 52

27DAT

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

Attachment No. 6 Sheet 32 of 52
Loop S/N 27DAT

LOCATION SEQUOYAH NUCLEAR PLANT
CIRCUIT 6.9 KV SD BD 2AA VOLTAGE RELAY VOLTAGE 6.9 KV
SETTING SHEET NO. 3019 DATED 8-25-83 NORMAL TRIP SUPPLY 125 V DC

TYPE OF RELAYING		VOLTAGE		VOLTAGE		VOLTAGE					
PHASE		A		B		C					
TAP	D.O. / P.U.	99% / 110V		99% / 110V		99% / 110V					

ROUTINE TEST BY JFN-MHH DATE 3-14-84 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~	S/N	1024		1025		1027					
~~INST. SETTING~~	DEVICE	27DAT		27DBT		27DCT					
CURRENT IN SEC.	TARGET		OK		OK		OK				
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " "	AS FOUND	~~109.58~~	~~109.54~~	109.56	109.56	109.59	109.59				
300% " " " "	AS LEFT	110	109.3	110	109.27	110.09	109.32				
400% " " " "	109.591	109.889									
500% " " " "				SI-235							
1000% " " " "	*	.265%		.375%		.375%					

* AS FOUND PERCENT OUT OF TOLERANCE

ROUTINE TEST BY MHH & BGM DATE 9-24-84 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~	S/N	1024		1025		1027 REPLACED BY 1035					
~~INST. SETTING~~	DEVICE	27DAT		27DBT		27DCT			MR# A082430		
CURRENT IN SEC.	TARGET		OK		OK		OK	575#5884 130'75			
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			P.U.	D.O.
200% " " " "	AS FOUND	109.57	109.94	109.67	109.75	109.57	109.92			NEW	
300% " " MHH 9-24-84	~~AS LEFT~~		~~109.71~~								
400% " " " "	AS LEFT	110.03	109.35	110.04	109.29	~~110.04~~	~~109.33~~ MHH 9-24-84			110.04	109.33
500% " " " "	SI-235										
1000% " " " "	*	.39%	.33%	.3%	.32%	.37%	.35%				

* AS FOUND PERCENT OUT OF TOLERANCE

ROUTINE TEST BY JFN DATE 3/14/85 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER								SI-235			
INST. SETTING	DEVICE	27DAT		27DBT		27DCT					
CURRENT IN SEC.											
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O.	P.U.	D.O.	P.U.	D.O.	EQUIP	TVA #		DUE DATE
200% " " " "	AS FOUND	110.5	109.6	110.45	109.54	110.3	109.4	EPOCH-I	531816		1/17/86
300% " " " "	AS LEFT	110.0	109.3	109.99	109.3	110.0	109.3	FLUKE	521962		5/9/85
400% " " " "											
500% " " " "	*	.45%	.27%	.41%	.22%	.27%	.04%				
1000% " " " "											

* Per Cent out of Tolerance as Found

ROUTINE TEST BY MHH DATE 9-15-85 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER	Device	~~27S~~ 27DAT		27DBT		27DCT					
INST. SETTING											
CURRENT IN SEC.											
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		PU	D.O.	PU	DO	PU	DO	Equip	TVA No		Due Date
200% " " " "	As found	110.0	109.3	110.0	109.3	110.0	109.3	EPOCH I	531815		6-25-86
300% " " " "	As left	110.0	109.3	110.0	109.3	110.0	109.3	Keithley	532275		11-15-85
400% " " " "											
500% " " " "											
1000% " " " "											

TYPE OF RELAYING VOLTAGE VOLTAGE VOLTAGE

PHASE A B C

ROUTINE TEST BY JFN MHH DATE 9/27/85 DATE TRIP TEST

SETTING RECORD FOUND LEFT FOUND LEFT FOUND LEFT FOUND LEFT

TIME LEVER SI-235

INST. SETTING DEVICE 27DAT 27DBT 27DCT

CURRENT IN SEC.

TEST RECORD AMPS CYCLES AMPS CYCLES AMPS CYCLES AMPS CYCLES

	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.	EQUIP	TUAR	DUE DATE
150% SET TAP SET TIME									
200% " " AS FOUND	110.1	109.35	110.0	109.35	110.0	109.35	EPOCH-I	631815	6/25/86
300% " " AS LEFT	110.1	109.35	110.0	109.35	110.0	109.35	KEITHLEY	537774	11/18/85
400% " " " " *	.047	.047	.07	.047	.07	.047			
500% " " " "									
1000% " " " "	* PERCENT OFF SET POINT								

ROUTINE TEST BY ______ DATE ______ DATE TRIP TEST ______

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
SETTING RECORD										
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY ______ DATE ______ DATE TRIP TEST ______

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
SETTING RECORD										
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY ______ DATE ______ DATE TRIP TEST ______

	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
SETTING RECORD										
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

REMARKS

C 33 52

27DAT

Attachment No. 6 Sheet 34 of 52
Loop #/Identifier 27DAT

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

LOCATION SEQUOYAH NUCLEAR PLANT
CIRCUIT 6.9 KV SD BD 2AA Voltage Relay VOLTAGE 6.9 KV
SETTING SHEET NO. 3089 DATED 9-7-83 NORMAL TRIP SUPPLY 125 V DC

TYPE OF RELAYING	VOLTAGE	VOLTAGE			
PHASE	A	C			
TAP	110V	110V			

ROUTINE TEST BY JFN - MHH DATE 3-14-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST. SETTING~~ DEVICE	AX 816		CX 816							
~~CURRENT IN SEC.~~ TARGET		OK		OK						
TEST RECORD	~~AMPS~~	CYCLES	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.						
200% " " " " AS FOUND	112.45	108.31	112.39	110.07						
300% " " " " AS LEFT	113.08	109.34	111.76	109.37						
400% " " " "										
500% " " " "		SI-235								
1000% " " " " *	.448%		.704%							

* AS FOUND PERCENT OUT OF TOLARANCE

ROUTINE TEST BY MHH - BGM DATE DATE TRIP TEST

SETTING RECORD	~~FOUND~~	~~LEFT~~	~~FOUND~~	~~LEFT~~	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER	~~PU~~	~~D.O~~	~~PU~~	~~DO~~						
INST. SETTING Device	AX 816		CX 816							
CURRENT IN SEC. Target		OK		OK						
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME ~~As found~~	P.U	D.O	P.U	D.O						
200% " " " " As found	112.29	108.6	111.54	108.9						
300% " " " " As left	112.94	109.3	111.87	109.25						
400% " " " "										
500% " " " "		SI-235								
1000% " " " " *		.64%		.37%						

* As found Percent out of Tolerance

ROUTINE TEST BY JFN DATE 3/14/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER						SI-235				
INST. SETTING DEVICE	AX 816		CX 816							
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	EQUIPMENT			number		due date
200% " " " " AS FOUND	114.6	110.9	113.56	110.9	FLUKE			521962		5-9-85
300% " " " " AS LEFT	112.9	109.2	112.16	109.28	EPOCH-I			531816		1-17-86
400% " " " "										
500% " " " "		1.46%		1.46%						
1000% " " " " *	Per Cent		OUT OF		TOLERANCE AS FOUND					

ROUTINE TEST BY JFN MHH DATE 9/27/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER		SI-235								
INST. SETTING DEVICE	AX 816		CX 816							
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	EQUIP			TVA #		DUE DATE
200% " " AS FOUND	112.3	108.3	111.7	108.8	EPOCH I			531815		6-25-86
300% " " AS LEFT	112.7	109.4	112.3	109.4	KEITHLEY			537774		11-18-85
400% " " " " *		.97%		.98%						
500% " " " "										
1000% " " " " *	PERCENT		OFF SET		POINT					

TEST RECORD -- GENERAL

REPORT No.:

SHEET No.: ______ OF ______ SHEETS

DATE OF TEST: 5/18/82

DATE OF REPORT:

LOCATION: SEQUOYAH NUCLEAR PLANT

SUBJECT: 6.9KV SDBD 2AA VOLTAGE RELAYS

GENERAL DATA: (27TS2A) W CV-7 STYLE 187554A 120V 60~, 2-2A TARGET.
(27RS1A) GE RAV 12RAV11B2A MAX 95V D.O. 25-50V.

COPIES SENT TO:

TESTED BY: COX + NICHOLS

CHECKED BY:

APPROVED BY:

SS#7595 DAted 9-19-79

SI 235

Dev. 27TS2A

P.U. = 81 V. Target = .3

CONTACT Closes in 2.6 secs on Complete Loss of Voltage

Dev 27RS2A

Reducing Voltage From 115V contacts 2-3 Close At 35 V.

EQUIPMENT	TVA #	DATE DUE
RELAY TEST SET	239666	2-24-83
VARIAC	489536	11-17-82
VOLT METER	189600	5-6-83

6 35 52

27'DAT

24-A

TVA 6472 (PO-4-68)

TEST RECORD -- GENERAL

REPORT NO.:
SHEET NO.: OF SHEETS
DATE OF TEST
DATE OF REPORT

LOCATION: SEQUOYAH NUCLEAR PLANT
SUBJECT: 6.9 KV SD BD 2AA VOLTAGE RELAYS
GENERAL DATA: W CV-7 STYLE 187554A 120V 60HZ TARGET .2-2
GE RAV 12RAV11B2A MAX 95V D.C. 25-50V

COPIES SENT TO:

TESTED BY: | CHECKED BY: | APPROVED BY:

SS# 7595 DATED 9-19-79
SI-235

DEVICE	PICKUP	TARGET
27TS2A	81V	.2A

LOSS OF POT CONTACT CLOSE IN 2.6 SEC

DEVICE
27RS2A
REDUCING VOLTAGE FROM 115V CONTACT 2-3 CLOSE 35 V

EQUIPMENT	TVA #	DATE DUE
RELAY TEST SET	266151	2-25-84
VOLTMETER	486433	2-16-84
VARIAC	489536	3-7-84

Attachment 6 Sheet 31 of 52
Loop #/Identifier 27 DAT

TEST R[illegible]ORD -- GENERAL

REPORT NO. CA-1149

SHEET NO. [illegible] of [illegible] SHEETS

LOCATION: SEQUOYAH NUCLEAR PLANT

SUBJECT: 6900V S.D. BD. 2A-A - VOLTAGE RELAYS

DATE OF TEST: 8-23-83

DATE OF REPORT: 8-30-83

GENERAL DATA: 27DAT, DBT, DCT - BROWN BOVERI, ITE 27N, CAT. [illegible]
59DAT, DBT, DCT - BROWN BOVERI, ITE 59H, CAT. 211C0175
27TSIA, SIB, SIC AND AX, CX - BROWN BOVERI, ITE 27H, CAT. 211B0175

COPIES SENT TO: EBA, ELE, WBM, WAD, CCM

TESTED BY: M. CALLAHAM

CHECKED BY: ARK

APPROVED BY: ARK

S.S. 2992 & 3019
8-17-83 & 8-25-83

DEVICE NO.		S/N		P.U.	D.O.		TARGET		
DEGRADED VOLTAGE (BUS)									
27DAT		1024		110.0	109.3		OK		
27DBT		1025		110.0	109.3		OK		
27DCT		1027		110.0	109.3		OK		
LOSS OF VOLTAGE (ALT. FDR)									
AX 816		3416		112.8	109.3		OK		
CX 816		3893		112.3	109.3		OK		
LOSS OF VOLTAGE (NOR. FDR)									
27TSIA		3891		94.1	92.0		OK		
27TSIB		3867		94.1	92.0		OK		
27TSIC		3875		94.8	92.0		OK		
OVERVOLTAGE (BUS)									
59DAT		3178		121.0	119.0		OK		
59DBT		3186		121.0	118.5		OK		
59DCT		3176		121.0	118.4		OK		

TEST EQUIP.		TVA #	DUE DATE
FLUKE	8600 A	486433	2-16-84
DOBLE F-3C TEST SET		512761	7-19-84

NICHOLS
ROUTINE MAINT 3/2/94 DEV AX 216
PER DPSO-SMT-3E P.U. = 112.8V D.O. = 109.3V

Attachment 6 Sheet 37 of 52
Loop/Identifier 27DAT

2A-A

TVA 6472 (PO-4-68)

INSPECTION REPORT - - RELAYS

REPORT No. CA-1649
SHEET No. D6 OF D12

REASON FOR TEST INITIAL [✓] SPECIAL [ ] ROUTINE [ ]

LOCATION [illegible] DATE [illegible] TIME [illegible]
CIRCUIT & VOLTAGE [illegible] VOLTAGE RELAYS TRIPS OCB. OR DEVICE (SEE SCHEMATIC)
DATA BY [illegible] CHECKED BY [illegible] APPROVED BY [illegible]
COPIES SENT TO [illegible], WAB, CCM

TYPE RELAYS 27/59 DEVICE No. (SEE BELOW) SETTING SHEET No. 3019 DATED 8-25-83

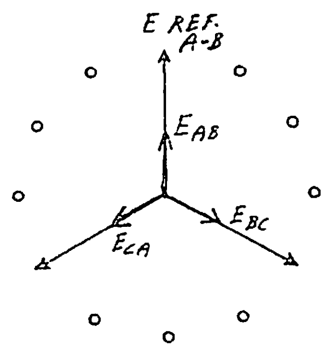
CIRCUIT	PRIMARY LOAD DATA					CT RATIO		
	AMP.	MW		MVAR		RELAY CT	AUX. CT	OVERALL RATIO
		IN	OUT	IN	OUT			
6.9 KV								
KV								
KV								

RELAY PHASING DATA

RELAY ~~C OR Z~~ DEVICE NO.	POTENTIAL (SEE NOTE 1)				~~CURRENT~~ E. REF.				PHASE ANGLE
	PHASE	WIRE DESIG.	STUDS	VOLTS	PHASE	WIRE DESIG.	STUD	~~AMPS~~ VOLTS	E ~~I~~ LAGS E REF.
27DAT	A-B		3-4	123.4	A-B	2P-A BUS	2-1	123.4	0.3°
27DBT	B-C		3-4	123.2	↓	VOLTMETER	↓	↓	120.5°
27DCT	C-A		4-3	123.1		LOCATED			240.2°
						ON PAN. 12			
59DAT	A-B		3-4	123.6					0.5°
59DBT	B-C		3-4	123.4					120.5°
59DCT	C-A		4-3	122.9					240.2°

CURRENT POLARITY ON THE PHASE ANGLE METER WAS
[ ] TOWARD
[ ] AWAY FROM THE LAST CURRENT TRANSFORMER POLARITY MARK.

CURRENT WAS READ [ ] ENTERING
[ ] LEAVING THE RELAY.



DIFFERENTIAL RELAY TAP SETTINGS:

TRANSF. WDG.	RELAY TAP	STUD No.
HI		
LO		
TER		

NOTE 1: LIST FIRST THE POTENTIAL STUD NO. WHICH IS CONNECTED TO POLARITY ON THE PHASE ANGLE METER. FOR EXAMPLE: 7-8; 7 IS POLARITY.

NOTE 2: PHASING SHOULD BE TAKEN AT THE SAME PLACE IN THE CIRCUIT THAT CALIBRATION WAS MADE ON THE RELAYS, IF POSSIBLE.

		TVA #	DUE DATE
REMARKS.	TEST EQUIP: FLUKE	486433	2-16-84
	FLUKE	462251	2-16-84
	∅ METER	489411	12-9-83

TVA 6646 (PO-1-69)

6 [illegible] 38 52
27 DAT

CA-A

TEST RECORD -- GENERAL

REPORT No. CA-1649
SHEET No. 010 of 012 SHEETS
DATE OF TEST 8-25-83
DATE OF REPORT 8-30-83

LOCATION: SEQUOYAH - NUCLEAR PLANT
SUBJECT: 6.9 KV S.D. BD. 2A-A DEGRADED VOLTAGE TIMERS
GENERAL DATA: DS1-2 AGASTAT E7012 EC002 1.5-15 SEC.
DV1-2 " 7012 PK 1-300 "
LV1-2 " 7012 PB .5-5 "
DA1-2 " 7012 PD 5-50 "
COPIES SENT TO: EBA, FLE, WBM, WAD, CCM
TESTED BY: M. CALLAHAM
CHECKED BY: DEL
APPROVED BY: GRC

S.S. 2992 & 3019
8-17-83 8-25-83

SHUT DOWN BOARD 2A-A

TIMER	TIME IN SEC.
DS1	10
DS2	10
DV1	296
DV2	305
DA1	30
DA2	30
LV1	3
LV2	3

TEST EQUIP.:		TVA#	DUE DATE
	RELAY TEST SET	266151	3-25-83
	FLUKE	486433	2-16-84

Attachment No. 6 39 of 52
Loop #/Identifier 27DA

2A-A

TVA 6472 (PC-4-68)

TEST RECORD -- GENERAL

REPORT No.: SI-235
SHEET No.: ___ OF ___ SHEETS

LOCATION: SNP
SUBJECT: 6.9 KV SD BD 2B-B OVERVOLTAGE RELAYS
DATE OF TEST: 4/8/86
DATE OF REPORT: / /
GENERAL DATA:

SETTING SHEET # 3020 DATE OF SETTING SHEET 8-25-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE

TESTED BY: [illegible] NICHOLS
CHECKED BY:
APPROVED BY:

	AΦ	BΦ	CΦ	*PERCENT OFF SET POINT (AS FOUND)	
DEVICE	59DAT	59DBT	59DCT		
SERIAL #	3175	3108	3188		
TARGET	ok	ok	ok	AΦ	.99%
AS FOUND P.U.	122.2	121.6	121.9	BΦ	.41%
AS FOUND D.O.	119.5	118.4	118.9	CΦ	.74%
AS LEFT P.U.	120.9	121.0	121.1		
AS LEFT D.O.	118.0	118.4	118.2		
TAP	120V	120V	120V		

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-1	57,218	6-25-86

* PERCENT OFF SET POINT FORMULA

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{SET POINT VALUE})} \times 100 = \%\ \text{OFF SET POINT}$$

Attachment No. 6 Sheet 40 of 52
Loop # [illegible] 27 DAT

TVA 6472 (PO-4-68)

2B-B

TEST RECORD -- GENERAL

REPORT No.: SI-235
SHEET No.: ____ OF ____ SHEETS

LOCATION: SNP
SUBJECT: 6.9 KV SD BD 1B-B UNDERVOLTAGE RELAYS
DATE OF TEST: 4/3/86
DATE OF REPORT:
GENERAL DATA:
SETTING SHEET # 3015 DATE OF SETTING SHEET 8-25-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE
TESTED BY: COX & NICHOLS
CHECKED BY:
APPROVED BY:

	AΦ	BΦ	CΦ
DEVICE	27DAT	27DBT	27DCT
SERIAL #	1031	1023	1023
TARGET	OK	OK	OK
AS FOUND P.U.	109.9	110.0	110.0
AS FOUND D.O.	109.3	109.3	109.3
AS LEFT P.U.	109.9	110.0	110.0
AS LEFT D.O.	109.3	109.3	109.3
TAP	99%	99%	99%

* PERCENT OFF SET POINT (AS FOUND)

	P.U.	D.O.
AΦ	.09%	0%
BΦ	0%	0%
CΦ	0%	0%

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-1	831818	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{SET POINT VALUE})} \times 100 = \% \text{ OFF SET POINT}$$

TVA 6472 (PO-4-68)

Attachment No. 6 Sheet 91 of 52
Loop #/Identifier 27 DAT

2B-B

TEST RE ORD -- GENERAL

REPORT NO.: SI-235
SHEET NO.:
____ OF ____ SHEET
DATE OF TEST: 4/8/86
DATE OF REPORT:

LOCATION: SNP
SUBJECT: 6.9 KV SD BD 2B-B VOLTAGE RELAYS
GENERAL DATA:
SETTING SHEET # 309C DATE OF SETTING SHEET 4-7-85

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE
TESTED BY: COX & NICHOLS
CHECKED BY:
APPROVED BY:

	AΦ	CΦ	* PERCENT OFF SET POINT (AS FOUND)
DEVICE	AX 72B	CX 72B	
SERIAL #	3830	3885	
TARGET	OK	OK	AΦ = .18%
AS FOUND P.U.	112.4	112.7	CΦ = 0%
AS FOUND D.O.	109.1	109.3	
AS LEFT P.U.	112.4	112.7	
AS LEFT D.O.	109.1	109.3	
TAP	110 V	110 V	

DEVICE - 27RSIA APPLY 115V & REDUCE VOLTAGE TO CLOSE CONTACTS AT 35V
AS FOUND 34.5 AS LEFT 35V

EQUIPMENT	TVA #	CALIBRATION DUE DATE
600-H-1	531818	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

(AS FOUND VALUE) - (SET POINT VALUE) / (AS FOUND VALUE) X 100 = % OFF SET POINT

Attachment ___ 6 ___ Sheet 44 of 52
Loop ... 27 DAT

TEST RECORD -- GENERAL

REPORT No.: SI-235
SHEET No.: ____ of ____ SHEETS

LOCATION: SNP
SUBJECT: 6.9 KV SD BD 2B-B VOLTAGE RELAYS
DATE OF TEST: 4/8/86
DATE OF REPORT:
GENERAL DATA:
SETTING SHEET # 3090 DATE OF SETTING SHEET 9-7-83

COPIES SENT TO: UNIT FILE, SI-235 DATA PACKAGE
TESTED BY: Cox + Nichols
CHECKED BY:
APPROVED BY:

	AΦ	BΦ	CΦ	* PERCENT OFF SET POINT (AS FOUND)	
DEVICE	27TS1A	27TS1B	27TS1C		
SERIAL #	3853	3884			
TARGET	ok	ok	ok	AΦ	.54%
AS FOUND P.U.	95.0V	95	95	BΦ	.22%
AS FOUND D.O.	92.5V	93.2	92.4	CΦ	.43%
AS LEFT P.U.	94.6V	95	94.8		
AS LEFT D.O.	93.1V	92.2	92.2		
TAP					

EQUIPMENT	TVA #	CALIBRATION DUE DATE
EPOCH-1	53183	6/25/86

* FORMULA FOR PERCENT OFF SET POINT

$$\frac{(\text{AS FOUND VALUE}) - (\text{SET POINT VALUE})}{(\text{SET POINT VALUE})} \times 100 = \% \text{ OFF SET POINT}$$

Attachment No. 6 Sheet 43 of 52
Loop ... 27 DAT

2B-B

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

Attachment 6 Sheet 94 of 52
Loop #/Identifier 27DAT

LOCATION Sequoyah Nuclear Plant
CIRCUIT 6.9 KV SDBD 2BB Voltage Relays VOLTAGE 6.9 KV
SETTING SHEET NO. 3090 DATED 4-7-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage		Voltage		Voltage				Voltage	
PHASE	A		B		C				A, B & C	
TAP	90V		90V		90V					

ROUTINE TEST BY MNC & LAE DATE 3-20-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST. SETTING~~ Device	27TS1A		27TS1B		27TSC				27RS1A	
~~CURRENT IN SEC.~~ Target	ok		ok		ok					
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU	DO	PU	DO	PU	DO			Apply 115V	
200% " " " " As Found	94.6	92.6	94.4	92.0	95.2	92.8			Reduce Voltage	
300% " " " " As Left	94.3	92.0	94.4	92.0	94.4	92.0			3 Contacts	
400% " " " "									close @	
500% " " " "			SI-235						35V	
1000% " " " " *		0.65%		0.0%		0.9%				

* OUT OF TOLERANCE PERCENT (AS FOUND)

ROUTINE TEST BY JFN, MWP DATE 9-18-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER							SI-235			
INST. SETTING DEVICE	27TS1A		27TS1B		27TS1C				27RS1A	
CURRENT IN SEC. TAGET	ok		ok		ok					
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY 115V	
200% " " " " AS FOUND	94.4	92.0	94.7	92.0	94.3	91.8			3φ Reduce	
300% " " " " AS LEFT	94.4	92.0	94.7	92.0	94.5	92.0			VOLTAGE	
400% " " " "		SI-235							CONTACT CLOSE	
500% " " " " *	0%		0%			.22%			AT	
1000% " " " "									35 V	

* OUT OF TOLERANCE % (AS FOUND)

ROUTINE TEST BY MHH & TNL DATE 3-20-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	27TS1A		27TS1B		27TS1C		SI-235		27RS1A	
CURRENT IN SEC. TARGET		OK		OK		OK				
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.			APPLY 115 V	
200% " " " " As FOUND	95.77	93.46	95.97	93.36	95.78	93.27			3φ Reduce	
300% " " " " AS LEFT	~~95.08~~ 94.56	92.05	94.75	92.06	94.57	92.07			VOLTAGE	
400% " " " "									CONTACT CLOSE	
500% " " " " MHH 3-20-85									@	
1000% " " " " *		1.67%		1.5%		1.4%			35 V	

* PERCENT ~~OF~~ OUT OF TOLERANCE (AS FOUND) MHH 3-20-85

ROUTINE TEST BY Cox / Lewis DATE 9-12-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ Device	27 TS1A		27TS1B		27TS1C				27RS1A	
~~INST. SETTING~~ Target				ok						
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU	DO	PU	D.O.	PU	DO			Apply 115v	
200% " " " " As Found	94.0	91.5	94.5	91.7	94.1	91.5			3φ Reduse	
300% " " " " AS LEFT	94.7	92.1	94.9	92.1	94.6	91.9			Voltage Contact	
400%									Close @	
500%										
1000% " " " " *		0.5%		0.32%		0.5%			35.1 volts	

2B-B

* PERCENT OUT OF TOLERANCE (AS FOUND)

TVA 6471A (PO-2-56)

TYPE OF RELAYING

PHASE

ROUTINE TEST BY Cox / Lewis DATE 9/12/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ Device	AX 716		CX 716							
~~INST. SETTING~~ Target	OK		OK							
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU	DO	P.U.	D.O.						
200% " " " " As Found	112.4	109.1	112.4	109.0						
300% " " " " As Left	112.4	109.1	112.6	101.3						
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY DATE DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY DATE DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

ROUTINE TEST BY DATE DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING										
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "										
300% " " " "										
400% " " " "										
500% " " " "										
1000% " " " "										

REMARKS

Attachment No. 6 Sheet 95 of 52

Loop #/Number 27DAT

2B-B

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

Attachment No. 6 Sheet 40 of 5
Loop #/Identifier 27DAT

LOCATION Sequoyah Nuclear Plant
CIRCUIT 69 KV SDBD 2BB Voltage Relays VOLTAGE 69 KV
SETTING SHEET NO. 3090 DATED 9-7-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage	Voltage			
PHASE	A	B			
TAP	UCV	UCV			

ROUTINE TEST BY LAC & MNC DATE 3-20-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST. SETTING~~ Device	AX716		CX716							
~~CURRENT IN SEC.~~ Target	OK		OK							
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU	DO	PU	DO						
200% " " " " As Found	112.8	110.0	112.6	109.7						
300% " " " " As Left	112.2	109.3	112.2	109.3						
400% " " " "										
500% " " " "			SI-235							
1000% " " " " *		0.6%		0.4%						

* Percent out of tolerance (As found)

ROUTINE TEST BY JEN & OLC DATE 7/31/84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	AX716		CX716		DPSO-SMI-3E					
CURRENT IN SEC. TARGET	OK		OK							
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	EQUIP		TVA NO		DATE DUE	
200% " " " " AS FOUND	112.2	109.3	110.8	108.9	FLUKE		462251		9/14/84	
300% " " " " AS LEFT	112.2	109.3	112.3	109.3	MULTI AMP SSR-72		516525		3/2/85	
400% " " " "										
500% " " " "										
1000% " " " "		0%		0.4%						

* Percent out of tolerance (AS FOUND)

ROUTINE TEST BY JEN, MWP DATE 9/18/84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	AX716		CX716							
CURRENT IN SEC. TARGET	OK		OK							
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.						
200% " " " " AS FOUND	112.9	109.9	112.5	109.8		SI-235				
300% " " " " AS LEFT	112.3	109.3	112.4	109.3						
400% " " " "										
500% " " " " *		.54%		.46%						
1000% " " " "										

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY TNL & MHH DATE 3-20-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	AX716		CX716							
CURRENT IN SEC. TARGET	OK		OK							
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "	P.U.	D.O.	P.U.	D.O.						
300% " " " " AS FOUND	113.32	110.19	113.49	110.39						
400% " " " " AS LEFT	112.39	109.21	112.49	109.31						
500% " " " "										
1000% " " " " *		.81%		1.0%						

28-C

TVA 6471A (RO-2-83)

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

Attachment No. 6 Sheet 47 of 52
Loop #/Identifier 27DAT

LOCATION Sequoyah Nuclear Plant
CIRCUIT 6.9KV SDBD 2BB Voltage Relays VOLTAGE 6.9 KV
SETTING SHEET NO. 3020 DATED ~~Feb 20~~ 8-25-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING	Voltage		Voltage		Voltage					
PHASE	A		B		C					
TAP	120V		120V		120V					

ROUTINE TEST BY LAC & MNC DATE 3 20 84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
~~INST. SETTING~~ Device	59DAT		59DBT		59DCT					
~~CURRENT IN SEC.~~ Target	ok		ok							
TEST RECORD	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " As Found	123.1	120.7	121.2	~~121.5~~	121.5	118.9				
300% " " " " As Left	121.0	118.5	121.0	~~118.4~~ 118.2	121.0	118.5				
400% " " " "										
500% " " " "			SI-235							
1000% " " " " *	1.7%		0.3%		0.4%					

* Percent out of tolerance (As Found)

ROUTINE TEST BY JFN & MWW DATE 9-15-84 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	59DAT		59DBT		59DCT					
CURRENT IN SEC. TARGET	OK		ok		ok					
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " " AS FOUND	119.7	117.2	120.6	117.6	120.5	118.0	SI-235			
300% " " " " AS LEFT	121.0	118.5	121.0	118.0	121.0	118.5				
400% " " " "										
500% " " " " *	1.07%		.33%		-.41%					
1000% " " " " *	PERCENT OUT OF TOLERANCE (AS FOUND)									

ROUTINE TEST BY MHH & TNL DATE 3-20-85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER										
INST. SETTING DEVICE	59DCT		59DBT		59DAT					
CURRENT IN SEC. TARGET	OK		OK		OK					
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME										
200% " " " "	P.U.	D.O.	P.U.	D.O	P.U.	D.O				
300% " " " " AS FOUND	123.3	120.57	123.26	120.07	124.26	121.66				
400% " " " " AS LEFT	120.97	118.18	120.95	117.76	121.08	118.16				
500% " " " "										
1000% " " " " *	1.99%		1.9%		2.7%					

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY Cox / Lewis DATE 9/12/85 DATE TRIP TEST

SETTING RECORD	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~ DEVICE	59DAT		59DBT		59DCT					
~~INST. SETTING~~ TARGET	ok		ok		ok					
CURRENT IN SEC.										
TEST RECORD	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME	PU	DO	PU	DO	PU	DO				
200% " " " " As Found	119.8	116.8	120.1	116.8	120.1	117.1	SI-235			
300% " " " " As Left	120.9	117.9	121.1	117.8	121	118.1				
400% " " " "										
500% " " " "										
1000% " " " " *	0.99%		0.79%		0.79%					

2B-B

TVA 6471A (PO-2-64) * PERCENT OFF Set Pt. (as Found)

ROUTINE RELAY TEST RECORD
Electrical Laboratory and Test Branch

Attachment No. 6 Sheet 48 of 52
Loop #/Identifier 27 DAT

LOCATION Sequoyah Nuclear Plant
CIRCUIT 6.9KV USD BD 1BB Voltage Relays VOLTAGE 6.9 KV
SETTING SHEET NO. 3018 DATED 8-25-83 NORMAL TRIP SUPPLY 125VDC

TYPE OF RELAYING		Voltage		Voltage		Voltage					
PHASE		A		B		C					
TAP	D.O.	99V		99V		99V					
	P.U.	110V		110V		110V					

ROUTINE TEST BY LAC & MAC DATE 3-20-84 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~	S/N	1031		1023		1028					
~~INST. SETTING~~	Device	27DAT		27DBT		27DCT					
~~CURRENT IN SEC.~~	Target	ok		ok		ok					
TEST RECORD		~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	~~AMPS~~	~~CYCLES~~	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " "	As Found	109.5	108.8	109.4	108.75	109.4	108.76				
300% " " " "	As Left	110.0	109.3	110.0	109.3	110.0	109.3				
400% " " " "											
500% " " " "				SI-235							
1000% " " " "	*	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%				

* Percent out of Tolerance (As Found)

ROUTINE TEST BY JFN & MLSP DATE 9/19/84 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER											
INST. SETTING	DEVICE	27DAT		27DBT		27DCT					
CURRENT IN SEC.	TARGET	OK		OK		OK					
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " "	AS FOUND	110.55	109.8	110.37	109.76	110.35	109.77	SI-235			
300% " " " "	AS LEFT	110.0	109.3	110.0	109.3	110.0	109.3				
400% " " " "											
500% " " " "	*	.5%	.45%	.34%	.42%	.32%	.43%				
1000% " " " "	*	PERCENT OUT OF TOLERANCE (AS FOUND)									

ROUTINE TEST BY TNL & MHH DATE 3/19/85 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
TIME LEVER											
INST. SETTING	DEVICE	27DAT		27DBT		27DCT					
CURRENT IN SEC.	TARGET	OK		OK		OK					
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O.	P.U.	D.O.	P.U.	D.O.				
200% " " " "	AS FOUND	111.18	110.26	111.25	110.35	111.15	110.34	SI-235			
300% " " " "	AS LEFT	110.05	109.35	110.04	109.35	110.4	109.34				
400% " " " "											
500% " " " "											
1000% " " " "	*	1.1%	.87%	1.1%	.96%	1.0%	.95%				

* PERCENT OUT OF TOLERANCE (AS FOUND)

ROUTINE TEST BY COX / LEWIS DATE 9/12/85 DATE TRIP TEST

SETTING RECORD		FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT	FOUND	LEFT
~~TIME LEVER~~	DEVICE	27DAT		27DBT		27DCT					
INST. SETTING	TARGET	OK		OK							
CURRENT IN SEC.											
TEST RECORD		AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES	AMPS	CYCLES
150% SET TAP SET TIME		P.U.	D.O	P.U.	D.O	P.U.	D.O.	SI-235			
200% " " " "	As Found	110.1	109.4	110.0	109.4	110.0	109.4				
300% " " " "	As Left	110.0	109.3	110.0	109.3	110.0	109.3				
400% " " " "											
500% " " " "											
1000% " " " "	*	0.09%		0.09%		0.09%					

* Percent out of Tolerance (As Found)

28-B

TEST RECORD -- GENERAL

REPORT No.:

SHEET No.: ____ OF ____ SHEETS

DATE OF TEST: 5/17/82

DATE OF REPORT:

LOCATION: SEQUOYAH NUCLEAR PLANT

SUBJECT: 6.9 KV SDBD 2BB VOLTAGE RELAYS

GENERAL DATA: (27TS2B) W CV-7 STYLE 187554A 120V 60~ .2-2A TARGET
(27RS2B) GE RAV 12RAV11B2A MAX 95V D.O. 25-50V

COPIES SENT TO:

TESTED BY:	CHECKED BY:	APPROVED BY:
Cox & NICHOLS		

SS#7596 Date 9-19-79

SI 235

Dev. 27TS2B

PU = 81 V TARGET 0.2A

Contact Closes in 2.6 Sec on Complete Loss of Voltage

Dev 27RS2B

Reducing Voltage From 115V Contact 2-3 Closes At 35 V.

EQUIPMENT	TVA #	DATE DUE
Relay Test Set	239666	2-24-83
VARIAC	489536	11-17-82
VOLT METER	189600	5-6-83

Attachment No. 6 Sheet 49 of 52
Loop Identifier 27DAT

2B-B

TVA 6472 (PO-4-68)

TEST RECORD -- GENERAL

REPORT No.:

SHEET No. ___ OF ___ SHEETS

DATE OF TEST:

DATE OF REPORT:

LOCATION: SEQUOYAH NUCLEAR PLANT

SUBJECT: 6.9KV SD BD 2BB VOLTAGE RELAYS

GENERAL DATA: W CV-7 STYLE 187554A 120V 60N TARGET .2-2

GE RAV 12RAV 11B2A MAX 95V DO, 25-50V

COPIES SENT TO:

TESTED BY:

CHECKED BY:

APPROVED BY:

SSH 7596

SI-235

DEVICE	PICKUP	TARGET
27TS2B	81V	

LOSS OF POT CONTACT ~~2-3~~ 9-7 8/18/83 CLOSES IN 2.6 SEC

27RS2B

REDUCING VOLTAGE FROM 115V CONTACT 2-3 CLOSES AT 35 VOLT

EQUIPMENT	TVA #	DATE DUE
RELAY TEST SET	266157	2-25-84
VOLTMETER	486433	2-16-84
VARIAC	429536	3-7-84

Attachment No. 6 Sheet 50 of 52

Loop #/Identifier 27 DAT

2B-B

TVA 6472 (PO-4-68)

TEST RECORD -- GENERAL

REPORT No.: CA-1649
SHEET No.: 04 of 012 SHEETS
DATE OF TEST: 4-22-83
DATE OF REPORT: 8-30-83

LOCATION: SEQUOYAH NUC [illegible]
SUBJECT: [illegible]
GENERAL DATA: 27DAT, DBT, DCT [illegible] ITE 27N CAT. 211T0175
59DAT, DBT, DCT - [illegible] ITE 59H CAT. 211C0175
27TSIA, SIB, SIC AND AX, CX [illegible]OWN BOVERI, ITE 27H, CAT 211B0175

COPIES SENT TO: EBA, FLF, WBM, WEH, CCM

TESTED BY: M. CALLAHAM
CHECKED BY: BRK
APPROVED BY: BRK

S.S. 2993 & 3020
8-17-83 8-25-83

DEVICE NO.	S/N	P.U.	D.O.	TARGET
DEGRADED VOLTAGE (BUS)				
27DAT	1032	110.0	109.3	OK
27DBT	1026	110.0	109.3	OK
27DCT	1030	110.0	109.3	OK
LOSS OF VOLTAGE (ALT. FDR)				
AX424	3880	112.7	109.3	OK
CX828	3885	112.4	109.3	OK
LOSS OF VOLTAGE (NOR FDR)				
27TSIA	3853	94.6	92.0	OK
27TSIB	3844	94.3	92.0	OK
27TSIC	3870	94.4	92.0	OK
OVERVOLTAGE (BUS)				
59DAT	3175	121.0	118.3	OK
59DBT	3149	121.0	118.9	OK
59DCT	3190	121.0	118.9	OK

TEST EQUIP.	TVA #	DUE DATE
FLUKE 8600 A	486433	2-16-84
DOBLE F-3C TEST SET	512761	7-14-84

Attachment No. 6 Sheet 51 of 52
[illegible] Identifier 27DAT

2B-B

TVA 6472 (PO-4-68)

INSPECTION REPORT - - RELAYS

REPORT No. CA-1649
SHEET No. D8 OF D12

REASON FOR TEST: INITIAL [X] SPECIAL [ ] ROUTINE [ ]

LOCATION [illegible] NUCLEAR PLANT DATE 9-[illegible]-83 TIME 3:30 Pm
CIRCUIT & VOLTAGE [illegible] 2B-B VOLTAGE RELAYS TRIPS OCB. OR DEVICE (SEE SCHEMATIC)
DATA BY M. CALLAHAM CHECKED BY [illegible] APPROVED BY [illegible]
COPIES SENT TO EBA, ELE, [illegible], WAD, CCM

TYPE RELAYS 27N/59H DEVICE No. (SEE BELOW) SETTING SHEET No. 3020 DATED 8-25-83

CIRCUIT	PRIMARY LOAD DATA					CT RATIO		
	AMP.	MW		MVAR		RELAY CT	AUX. CT	OVERALL RATIO
		IN	OUT	IN	OUT			
6.9 KV								
KV								
KV								

RELAY PHASING DATA

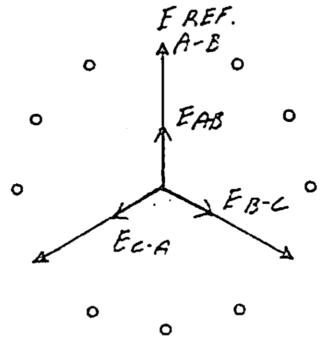
RELAY ~~Φ OR Z~~ DEVICE #	POTENTIAL (SEE NOTE 1)				~~CURRENT~~ E REF				PHASE ANGLE
	PHASE	WIRE DESIG.	STUDS	VOLTS	PHASE	WIRE DESIG.	STUD	~~AMPS~~ VOLTS	E Φ LAGS E REF.
27DAT	A-B		3-4	124.3	A-B	2B-B BUS	2-1	123.9	0.3°
27DBT	B-C		3-4	124.2	↓	VOLTMETER	↓	↓	120.8°
27DCT	C-A		4-3	123.7	↓	LOCATED	↓	↓	240.3°
					↓	ON PAN. 12	↓	↓	
59DAT	A-B		3-4	124.5	↓		↓	↓	0.2°
59DBT	B-C		3-4	123.9	↓		↓	↓	120.4°
59DCT	C-A		4-3	122.6	↓		↓	↓	240.2°

CURRENT POLARITY ON THE PHASE ANGLE METER WAS
[ ] TOWARD
[ ] AWAY FROM THE LAST CURRENT TRANSFORMER POLARITY MARK.

CURRENT WAS READ [ ] ENTERING
[ ] LEAVING THE RELAY.

DIFFERENTIAL RELAY TAP SETTINGS:

TRANSF. WDG.	RELAY TAP	STUD No.
HI		
LO		
TER		



NOTE 1: LIST FIRST THE POTENTIAL STUD NO. WHICH IS CONNECTED TO POLARITY ON THE PHASE ANGLE METER. FOR EXAMPLE: 7-8: 7 IS POLARITY.

NOTE 2: PHASING SHOULD BE TAKEN AT THE SAME PLACE IN THE CIRCUIT THAT CALIBRATION WAS MADE ON THE RELAYS, IF POSSIBLE.

REMARKS:		TVA #	DUE DATE
TEST EQUIP:	FLUKE	486433	2-16-84
	FLUKE	462251	2-16-84
	ΦL METER	489411	12-9-83

TVA 6646 (PO-1-69)

Attachment No. 6 Page 52 of 52
Load Identifier 27DAT

2B-B

DEGRADED VOLTAGE POTENTIAL TRANSFORMERS 6.9KV SHUTDOWN BOARDS

TYPE VIZ 75

ACCURACY CLASS 0.3 W,X,M,Y,Z

RATIO 60:1

7200 VOLT

PREPARED BY [illegible] 4/30/93

CHECKED BY Gregory G. Mailen 4/30/93

Attachment No. 2 Sheet 1 of 3
27DAT

LOSS OF VOLTAGE POTENTIAL TRANSFORMERS
6.9 KV SHUTDOWN BOARDS

STYLE : PTM 249A990GO5

15KV INSULATION CLASS

RATIO: 60:1

7200/12470Y

11.44-060-2-LINE 3

PREPARED BY Jim B. Mu... 4/22/93

CHECKED BY N.D. Black Jr. 4/22/93

Attachment No. 7 ... 2 ... 3
27 DAT

ABB

FACSIMILE COVER SHEET

TO David Murray DATE 4-22-93

LOCATION TVA SQNP NUMBER OF PAGES 1 (INCLUDING TRANSMITTAL SHEET)

FAX NO 843-8024 FAX NO (615) 265-6907 (WIN) 255-1077

PHONE NO X8045

FROM JUDITH (JUDI) COLEMAN

PHONE NO. (615) 265-6905 (WIN) 255-1075

TN TOLL FREE 1-800-331-5827

SUBJECT ABB P.T. #PTM 249A990G05 Accuracy Class

MESSAGE Per your request —

.03 W, X, M, Y, Z

This info per our Pinetops NC Engineering Dept.

Regards
Judi

ABB Power T&D Company Inc.

1201 Riverfront Parkway
Building No. 2
Chattanooga, TN 37402

Telephone (615) 265-6905
Fax (615) 265-6907

Attachment No. 7 Sheet 3 of 3
27DAT

TVA 488 (EN DES 3 77)

SHEET ____ OF ____

Drift Data from 1 & 2-SI-TDC-202-006.A and -006.B

COMPUTED ____ DATE ____

CHECKED ____ DATE ____

Board 1A-A

DAT

	3-4-92	7-25-90	2-8-89	9-5-87
AF PU	110.10	110.15	110.3	110.2
AL PU	110.10	110.15	110.3	110.2
AF DO	109.46	109.55	109.6	109.5
AL DO	109.46	109.55	109.6	109.5

DBT

	3-4-92	7-25-90	2-8-89	9-5-87
AF PU	110.16	110.15	110.3	110.49
AL PU	110.16	110.15	110.3	110.17
AF DO	109.26	109.2	109.3	109.52
AL DO	109.26	109.2	109.3	109.35

DCT

	3-4-92	7-25-90	2-8-89	9-5-87
AF PU	109.96	110.06	110.4	110.7
AL PU	109.96	110.06	110.4	110.25
AF DO	109.27	109.2	109.3	109.46
AL DO	109.27	109.2	109.3	109.35

Attachment No. 8 1 / 10
27DAT

Board 1B-B

DAT

	3-11-92	6-6-90	3-15-89	8-24-87
AF PU	110.03	109.7	110.0	109.98
AL PU	110.03	110.0	110.0	109.98
AF DO	109.52	109.25	109.3	109.38
AL DO	109.52	109.25	109.3	109.38

DBT

	3-11-92	6-6-90	3-15-89	8-24-87
AF PU	110.03	109.92	110.0	110.08
AL PU	110.03	109.92	110.0	110.08
AF DO	109.42	109.3	109.4	109.37
AL DO	109.42	109.3	109.4	109.37

DCT

	3-11-92	6-6-90	3-15-89	8-24-87
AF PU	110.03	109.92	110.0	110.08
AL PU	110.03	109.92	110.0	110.08
AF DO	109.42	109.33	109.5	109.38
AL DO	109.42	109.33	109.5	109.38

COMPUTED ______ DATE ______

CHECKED ______ DATE ______

BOARD 2A-A

DAT

	3-18-93	4-2-92	7-12-90	2-27-89	8-13-87
AF PU	109.88	110.0	110.02	110.06	110.27
AL PU	109.88	110.0	110.02	110.06	109.96
AF DO	109.5	109.33	109.31	109.2	109.56
AL DO	109.5	109.33	109.31	109.2	109.37

DBT

	3-18-93	4-2-92	7-12-90	2-27-89	8-13-87
AF PU	110.11	110.0	109.72	109.8	110.36
AL PU	110.11	110.0	109.72	110.07	110.05
AF DO	109.51	109.0	109.03	109.0	109.76
AL DO	109.51	109.34	109.03	109.2	109.36

DCT

	3-18-93	4-2-92	7-12-90	2-27-89	8-13-87
AF PU	109.88	110.2	110.02	109.9	110.46
AL PU	109.88	110.0	110.02	109.9	109.96
AF DO	109.28	108.9	109.21	109.2	109.55
AL DO	109.28	109.3	109.21	109.2	109.26

TVA 488 (EN DES 3-77)

SHEET ____ OF ____

COMPUTED ____ DATE ____

CHECKED ____ DATE ____

BOARD 2B-B

DAT

	3-30-92	6-20-90	2-2-89	8-3-87
AF PU	110.13	110.03	110	110.1
AL PU	110.13	110.03	110	110.1
AF DO	109.42	109.3	109.3	109.3
AL DO	109.42	109.3	109.3	109.3

DBT

	3-30-92	6-20-90	2-2-89	8-3-87
AF PU	110.27	110.06	110.19	110.16
AL PU	110.27	110.06	110.19	110.16
AF DO	109.47	109.43	109.39	109.37
AL DO	109.47	109.43	109.39	109.37

DCT

	3-30-92	6-20-90	2-2-89	8-3-87
AF PU	110.0	109.97	109.9	110.1
AL PU	110.0	109.97	109.9	110.1
AF DO	109.3	109.33	109.29	109.3
AL DO	109.3	109.33	109.29	109.3

Attachment No. 8 Sheet 4 of 10
27PAT

BOARD 1A-A

Pickup Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
-0.35	-0.32	-0.49	-0.45	-0.35	-0.32	6.00
0.37	0.34	0.48	0.44	0.52	0.47	6.00
0.04	0.04	0.06	0.05	0.01	0.01	6.00
-0.10	-0.09	0.00	0.00	0.05	0.05	6.00
0.30	0.27	0.29	0.26	0.40	0.36	18.00
0.10	0.09	0.13	0.12	0.15	0.14	17.00
-0.15	-0.14	-0.15	-0.14	-0.34	-0.31	17.00
-0.05	-0.05	0.01	0.01	-0.10	-0.09	20.00

Drop out Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
-0.35	-0.32	-0.44	-0.40	-0.37	-0.34	6.00
0.48	0.44	0.26	0.24	0.52	0.48	6.00
0.03	0.03	0.01	0.01	-0.05	-0.05	6.00
-0.15	-0.14	-0.05	-0.05	-0.05	-0.05	6.00
0.30	0.27	0.32	0.29	0.26	0.24	18.00
0.10	0.09	-0.03	-0.03	-0.05	-0.05	17.00
-0.05	-0.05	-0.10	-0.09	-0.10	-0.09	17.00
-0.09	-0.08	0.06	0.05	0.07	0.06	20.00

BOARD 1B-B

Pickup Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
0.40	0.36	0.40	0.36	0.40	0.36	6.00
-0.90	-0.82	0.01	0.01	0.01	0.01	6.00
0.10	0.09	0.10	0.09	0.00	0.00	7.00
0.12	0.11	-0.12	-0.11	-0.02	-0.02	16.00
0.02	0.02	0.12	0.11	0.20	0.18	19.00
-0.30	-0.27	-0.08	-0.07	-0.08	-0.07	16.00
0.03	0.03	0.11	0.10	0.11	0.10	18.00

Drop out Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
0.45	0.41	0.44	0.40	0.47	0.43	6.00
-0.03	-0.03	0.01	0.01	0.01	0.01	6.00
0.00	0.00	0.00	0.00	-0.10	-0.09	7.00
0.08	0.07	0.07	0.06	0.18	0.16	16.00
-0.08	-0.07	0.03	0.03	0.12	0.11	19.00
-0.05	-0.05	-0.10	-0.09	-0.17	-0.16	16.00
0.27	0.25	0.12	0.11	0.11	0.10	18.00

BOARD 2A-A

Pickup Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
-0.43	-0.39	-0.33	-0.30	-0.45	-0.41	6.00
0.47	0.43	0.43	0.39	0.26	0.24	6.00
-0.10	-0.09	0.10	0.09	0.00	0.00	12.00
0.27	0.25	0.36	0.33	0.16	0.15	17.00
0.10	0.09	-0.25	-0.23	-0.06	-0.05	18.00
-0.04	-0.04	-0.35	-0.32	0.12	0.11	17.00
-0.02	-0.02	0.28	0.25	0.00	0.00	21.00
-0.12	-0.11	0.11	0.10	-0.12	-0.11	11.00

Drop out Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
-0.36	-0.33	-0.32	-0.29	-0.40	-0.37	6.00
0.25	0.23	0.26	0.24	0.07	0.06	6.00
-0.05	-0.05	0.05	0.05	-0.05	-0.05	12.00
0.26	0.24	0.46	0.42	0.25	0.23	17.00
-0.17	-0.16	-0.36	-0.33	-0.06	-0.05	18.00
0.11	0.10	-0.17	-0.16	0.01	0.01	17.00
0.02	0.02	-0.03	-0.03	-0.31	-0.28	21.00
0.17	0.16	0.17	0.16	-0.02	-0.02	11.00

OARD 2B-B

Pickup Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
0.55	0.50	0.37	0.34	0.35	0.32	6.00
0.05	0.05	-0.04	-0.04	-0.40	-0.36	6.00
-0.10	-0.09	0.00	0.00	0.00	0.00	7.00
0.20	0.18	0.16	0.15	0.10	0.09	16.00
-0.10	-0.09	0.03	0.03	-0.20	-0.18	18.00
0.03	0.03	-0.13	-0.12	0.07	0.06	16.00
0.10	0.09	0.19	0.17	0.03	0.03	21.00

Drop out Deviations:

DAT	% of SP	DBT	% of SP	DCT	% of SP	Months
0.50	0.46	0.46	0.42	0.47	0.43	6.00
0.05	0.05	0.06	0.05	0.06	0.05	6.00
0.00	0.00	0.00	0.00	0.00	0.00	7.00
0.00	0.00	0.07	0.06	0.00	0.00	16.00
0.00	0.00	0.02	0.02	-0.01	-0.01	18.00
0.00	0.00	0.04	0.04	0.04	0.04	16.00
0.12	0.11	0.04	0.04	-0.30	-0.27	21.00

Board 1A-A Pickup Average Deviation= 0.0314
Board 1B-B Pickup Average Deviation= 0.0273
Board 2A-A Pickup Average Deviation= 0.0148
Board 2B-B Pickup Average Deviation= 0.0545
Average Deviation= 0.0320

Standard Deviation= 0.2267

95% Factor is 2 x Std. Dev.
= 0.4534

95% Factor Value = 95% Factor + Avg. Dev.
= 0.4854 % of SP

Pickup value = +/- 0.4854 % of SP

Board 1A-A Dropout Avg Deviation= 0.0203
Board 1B-B Dropout Avg Deviation= 0.0797
Board 2A-A Dropout Avg Deviation= -0.0084
Board 2B-B Dropout Avg Deviation= 0.0706
Average Deviation= 0.0406

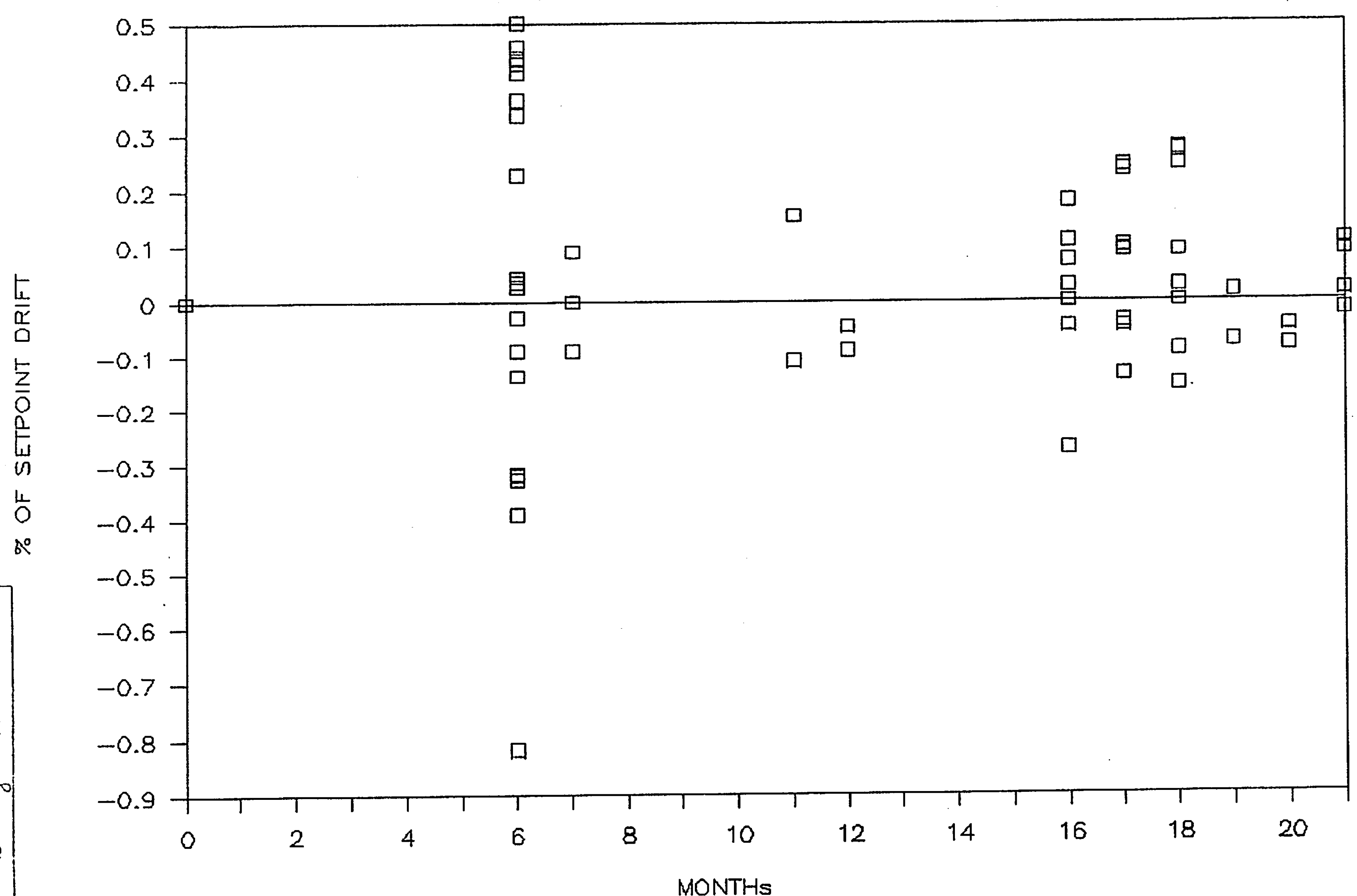
Standard Deviation= 0.1952

95% Factor is 2 x Std. Dev.
= 0.3903

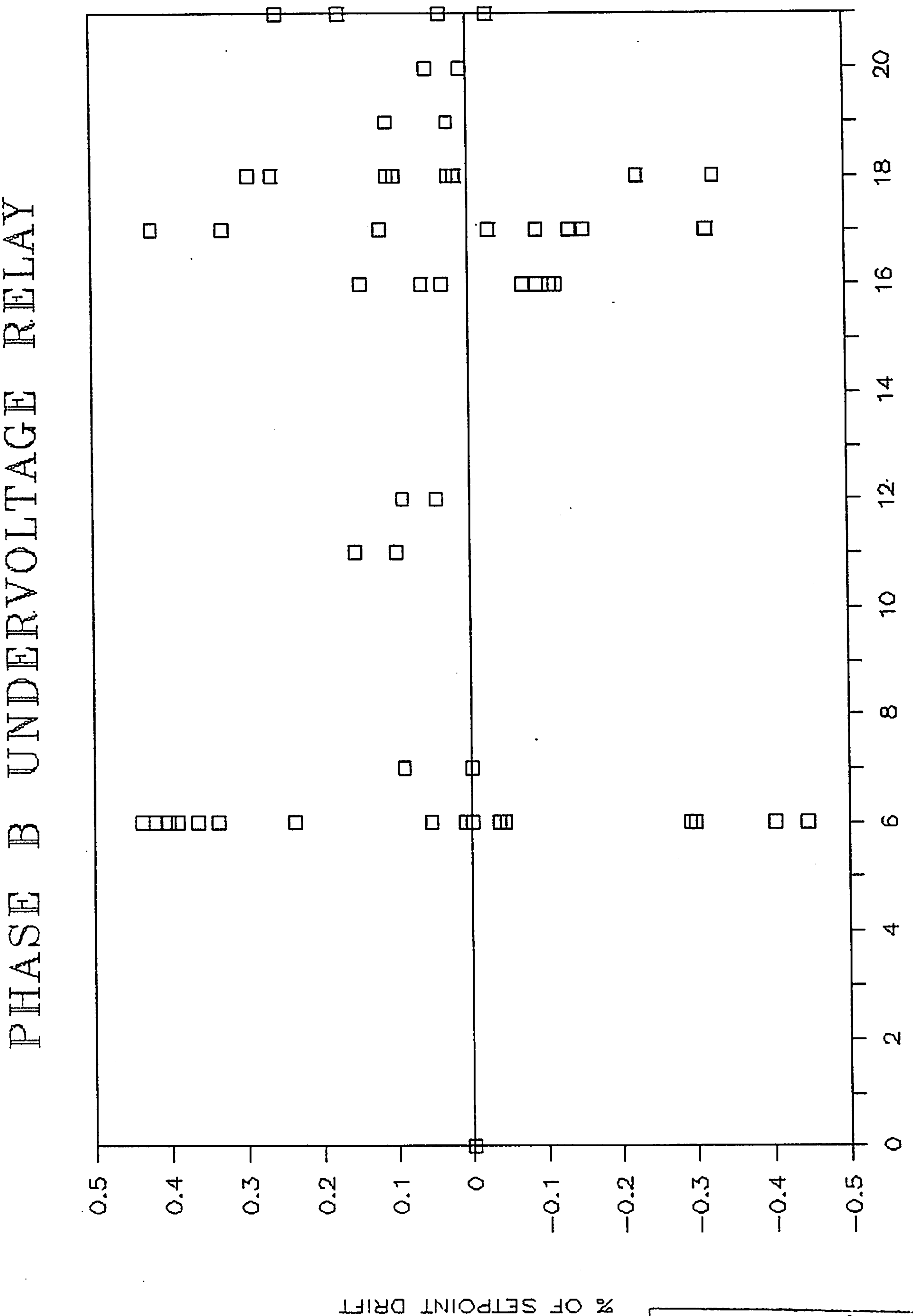
95% Factor Value = 95% Factor + Avg. Dev.
= 0.4309 % of SP

Drop Out value = +/- 0.4309 % of SP

PHASE A UNDERVOLTAGE RELAY

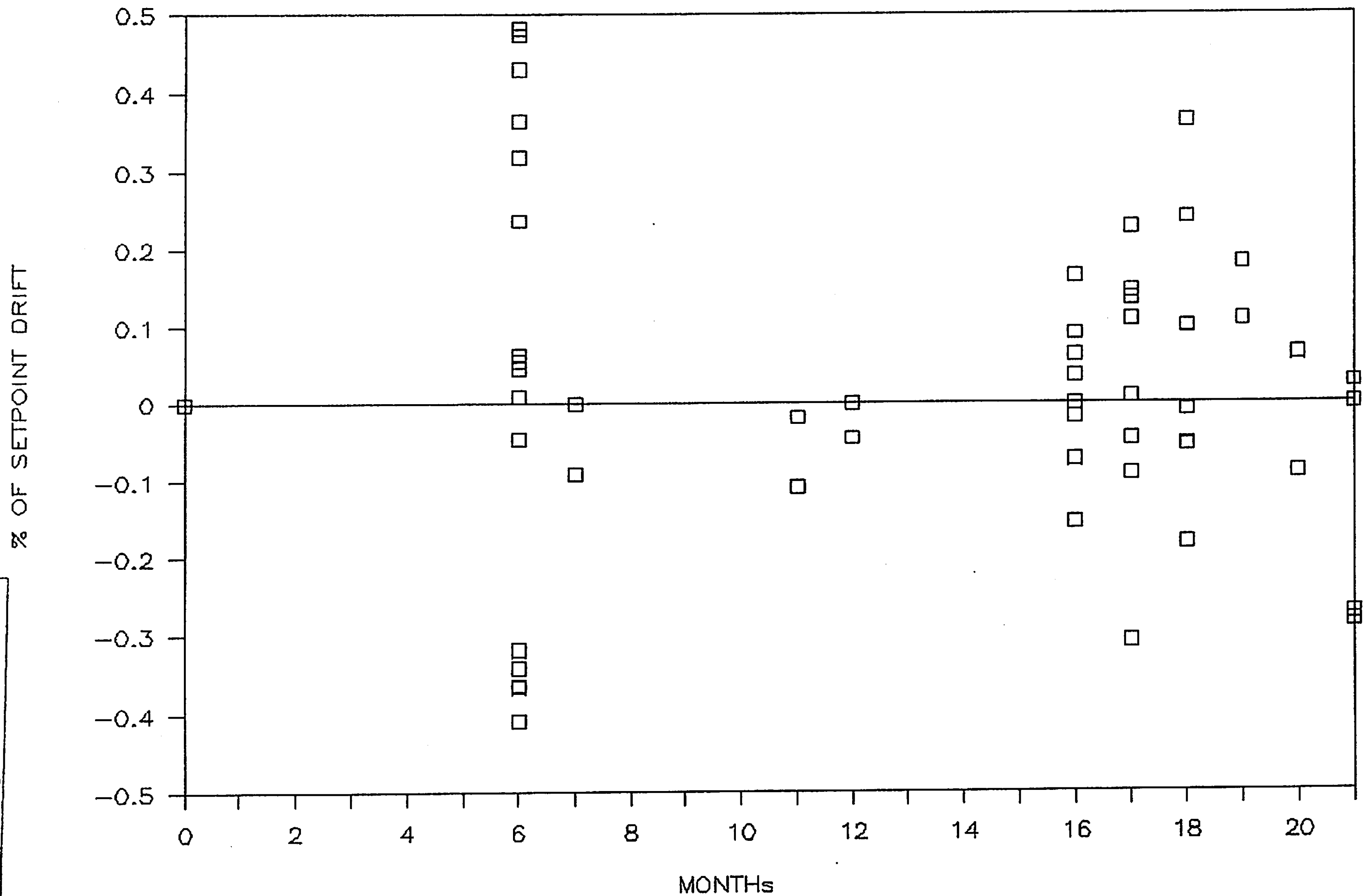


Attachment No. 8 Sheet 8 of 10
27 DAT



Attachment No. 8 Sheet 9 of 10
27 DAT

PHASE C UNDERVOLTAGE RELAY



Attachment No. 8 Sheet 10 of 10
27DAT

![ABB logo] ASEA BROWN BOVERI

IB 7.4.1.7-7
Issue D

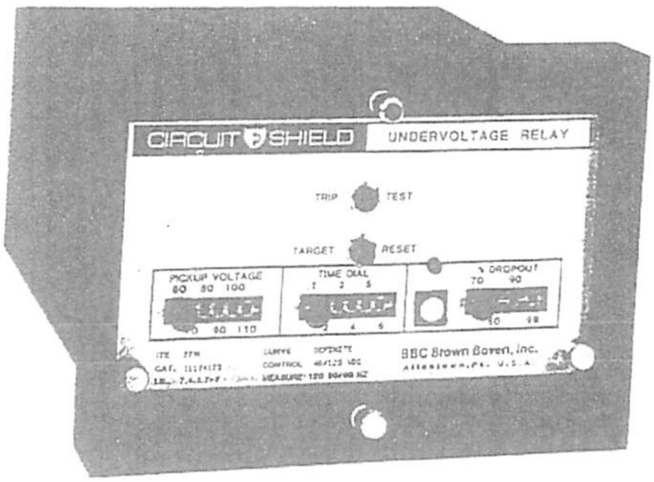
INSTRUCTIONS

Single Phase Voltage Relays

Type 27N HIGH ACCURACY UNDERVOLTAGE RELAY

Type 59N HIGH ACCURACY OVERVOLTAGE RELAY

Type 27N	Catalog Series 211T	Standard Case
Type 27N	Catalog Series 411T	Test Case
Type 59N	Catalog Series 211U	Standard Case
Type 59N	Catalog Series 411U	Test Case



Attachment No. 9 Sheet 1 of 12
Identifier 27DAT

ASEA BROWN BOVERI

TABLE OF CONTENTS

INTRODUCTION

These instructions contain the information required to properly install, operate, and test certain single-phase undervoltage relays type 27N, catalog series 211T and 411T; and overvoltage relays, type 59N, catalog series 211U and 411U.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 411T, and 411U catalog series are similar to relays of the 211T, and 211U series. Both series provide the same basic functions and are of totally drawout construction; however, the 411T and 411U series relays provide integral test facilities. Also, sequenced disconnects on the 410 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

Basic settings are made on the front panel of the relay, behind a removable clear plastic cover. Additional adjustment is provided by means of calibration potentiometers inside the relay on the circuit board. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing.

2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.

4. High voltage insulation tests are not recommended. See the section on testing for additional information.

5. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

6. Follow test instructions to verify that the relay is in proper working order.

CAUTION: *since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competant technicians familiar with good safety practices should service these devices.*

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

Attachment No. 7 Sheet 2 of 12
Identifier 270AT

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.

Connections:
Typical external connections are shown in Figure 2. Internal connections and contact logic are shown in Figure 3. Control power must be connected in the proper polarity.

For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the link should be placed in the position marked 125vdc.)

These relays have an external resistor wired to terminals 1 and 9 which must be in place for normal operation. The resistor is supplied mounted on the relay.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

3. SETTINGS

PICKUP
The pickup voltage taps identify the voltage level which the relay will cause the output contacts to transfer.

DROPOUT
The dropout voltage taps are identified as a percentage of the pickup voltage. Taps are provided for 70%, 80%, 90%, and 99% of pickup, or, 30%, 40%, 50%, and 60% of pickup.

Note: operating voltage values other than the specific values provided by the taps can be obtained by means of an internal adjustment potentiometer. See section on testing for setting procedure.

TIME DIAL
The time dial taps are identified as 1,2,3,4,5,6. Refer to the time-voltage characteristic curves in the Application section. Time dial selection is not provided on relays with an Instantaneous operating characteristic. The time delay may also be varied from that provided by the fixed tap by using the internal calibration adjustment.

4. OPERATION INDICATORS

The types 27N and 59N provide a target indicator that is electronically actuated at the time the output contacts transfer to the trip condition. The target must be manually reset. The target can be reset only if control power is available, AND if the input voltage to the relay returns to the "normal" condition.

An led indicator is provided for convenience in testing and calibrating the relay and to give operating personnel information on the status of the relay. See Figure 4 for the operation of this indicator.

Units with a "-L" suffix on the catalog number provide a green led to indicate the presence of control power and internal power supply voltage.

Attachment No. 9 Sheet 3 of 12
Identifier 27DAT

APPLICATION DATA

Single-phase undervoltage relays and overvoltage relays are used to provide a wide range of protective functions, including the protection of motors and generators, and to initiate bus transfer. The type 27N undervoltage relay and type 59N overvoltage relay are designed for those applications where exceptional accuracy, repeatability, and long-term stability are required.

Tolerances and repeatability are given in the Ratings section. Remember that the accuracy of the pickup and dropout settings with respect to the printed dial markings is generally not a factor, as these relays are usually calibrated in the field to obtain the particular operating values for the application. At the time of field calibration, the accuracy of the instruments used to set the relays is the important factor. Multiturn internal calibration potentiometers provide means for accurate adjustment of the relay operating points, and allow the difference between pickup and dropout to be set as low as 0.5%.

The relays are supplied with instantaneous operating time, or with definite-time delay characteristic. The definite-time units are offered in two time delay ranges: 1-10 seconds, or 0.1-1 second.

An accurate peak detector is used in the types 27N and 59N. Harmonic distortion in the AC waveform can have a noticible effect on the relay operating point and on measuring instruments used to set the relay. An internal harmonic filter is available as an option for those applications where waveform distortion is a factor. The harmonic filter attenuates all harmonics of the 50/60 Hz. input. The relay then basically operates on the fundamental component of the input voltage signal. See figure 5 for the typical filter response curve. To specify the harmonic filter add the suffix "-HF" to the catalog number. Note in the section on ratings that the addition of the harmonic filter does reduce somewhat the repeatability of the relay vs. temperature variation. In applications where waveform distortion is a factor, it may be desirable to operate on the peak voltage. In these cases, the harmonic filter would not be used.

CHARACTERISTICS OF COMMON UNITS

Type	Pickup Range	Dropout Range	Time Delay Pickup	Time Delay Dropout	Catalog Numbers Std Case	Catalog Numbers Test Case
27N	60 - 110 v	70% - 99%	Inst	Inst	211T01x5	411T01x5
			Inst	1 - 10 sec	211T41x5	411T41x5
			Inst	0.1 - 1 sec	211T51x5	411T61x5
	70 - 120 v	70% - 99%	Inst	Inst	211T03x5	411T03x5
			Inst	1 - 10 sec	211T43x5	411T43x5
			Inst	0.1 - 1 sec	211T63x5	411T63x5
	60 - 110 v	30% - 60%	Inst	Inst	211T02x5	411T02x5
			Inst	1 - 10 sec	211T42x5	411T42x5
			Inst	0.1 - 1 sec	211T62x5	411T62x5
59N	100 - 150 v	70% - 99%	Inst	Inst	211U01x5	411U01x5
			1 - 10 s	Inst	211U41x5	411U41x5
			0.1 - 1 s	Inst	211U61x5	411U61x5

IMPORTANT NOTES:

1. Each of the listed catalog numbers for the types 27N and 59N contains an "x" for the control voltage designation. To complete the catalog number, replace the "x" with the proper control voltage code digit:

   48/125 vdc 7
   250 vdc 5
   220 vdc 2
   48/110 vdc 0

2. To specify the addition of the harmonic filter module, add the suffix "-HF". For example: 411T4175-HF. Harmonic filter not available on type 27N with instantaneous delay timing characteristic.

Attachment No. 9 Sheet 4 of 12
Identifier 27DPT

SPECIFICATIONS

Input Circuit: Rating: type 27N 150v maximum continuous.
type 59N 160v maximum continuous.

Burden: less than 0.5 VA at 120 vac.

Frequency: 50/60 Hz.

Taps: available models include:
Type 27N: pickup - 60, 70, 80, 90, 100, 110 volts.
70, 80, 90, 100, 110, 120 volts.
dropout- 60, 70, 80, 90, 99 percent of pickup.
30, 40, 50, 60 percent of pickup.

Type 59N: pickup - 100, 110, 120, 130, 140, 150 volts.
dropout- 60, 70, 80, 90, 99 percent of pickup.

Operating Time: See Time-Voltage characteristic curves that follow.
Instantaneous models: 3 cycles or less.

Reset Time: 27N: less than 2 cycles; 59N: less than 3 cycles.
(Type 27N resets when input voltage goes above pickup setting.)
(Type 59N resets when input voltage goes below dropout setting.)

Output Circuit: Each contact

@ 120 vac	@ 125 vdc	@ 250 vdc	
30 amps.	30 amps.	30 amps.	tripping duty.
5 amps.	5 amps.	5 amps.	continuous.
3 amps.	1 amp.	0.3 amp.	break, resistive.
2 amps.	0.3 amp.	0.1 amp.	break, inductive.

Operating Temperature Range: -30 to +70 deg. C.

Control Power: Models available for
48/125 vdc @ 0.05 A max.
48/110 vdc @ 0.05 A max.
220 vdc @ 0.05 A max.
250 vdc @ 0.05 A max.

Allowable variation:		
48	vdc nominal	38- 58 vdc
110	vdc "	88-125 vdc
125	vdc "	100-140 vdc
220	vdc "	176-246 vdc
250	vdc "	200-280 vdc

Tolerances: (without harmonic filter option, after 10 minute warm-up)

Pickup and dropout settings with respect to printed dial markings (factory calibration) = +/- 2%.

Pickup and dropout settings, repeatability at constant temperature and constant control voltage = +/- 0.1%. (see note below)

Pickup and dropout settings, repeatability over "allowable" dc control power range: +/- 0.1%. (see note below)

Pickup and dropout settings, repeatability over temperature range:
-20 to +55°C +/- 0.4% -20 to +70°C +/-0.7%
0 to +40°C +/- 0.2% (see note below)

Note: the three tolerances shown should be considered independent and may be cumulative. Tolerances assume pure sine wave input signal.

Time Delay: Instantaneous models: 3 cycles or less.
Definite time models: +/- 10 percent or +/-20 millisecs. whichever is greater.

Harmonic Filter: (optional) All ratings are the same except:
Pickup and dropout settings, repeatability over temperature range:
0 to +55°C +/- 0.75% -20 to +70°C +/-1.5%
+10 to +40°C +/- 0.40%

Dielectric Strength: 2000 vac, 50/60 Hz., 60 seconds, all circuits to ground.

Seismic Capability: More than 6g ZPA biaxial broadband multifrequency vibration without damage or malfunction. (ANSI C37.98-1978)

Attachment No. 4 Sheet 5 of 12
Identifier 27NT

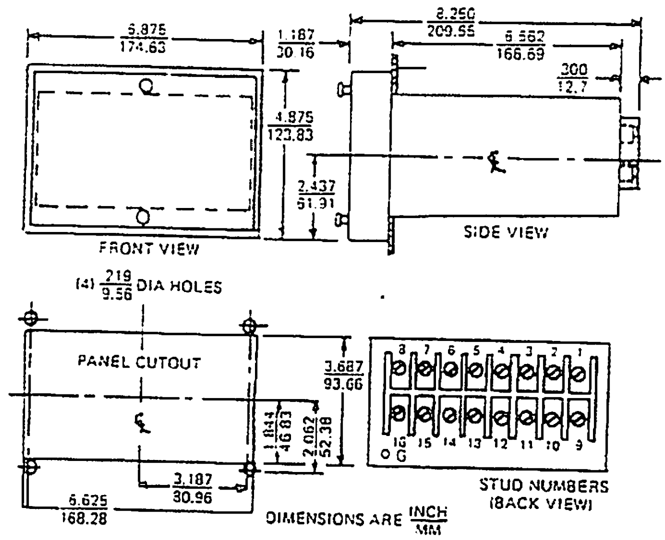


Figure 1: Relay Outline and Panel Drilling

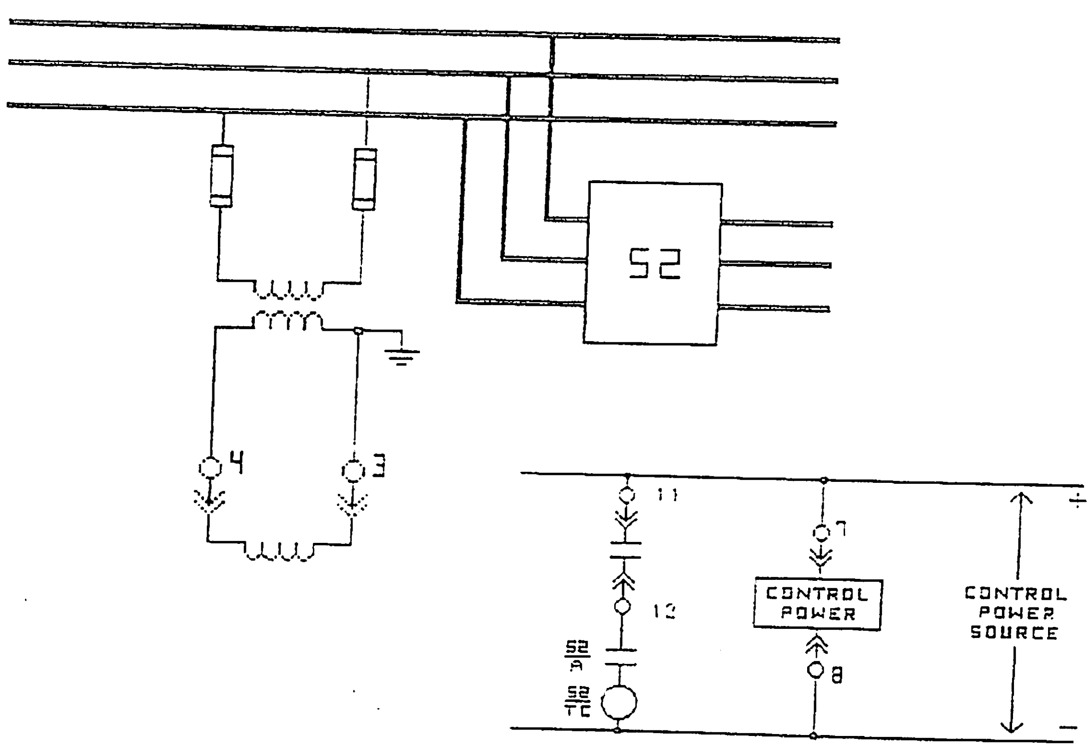


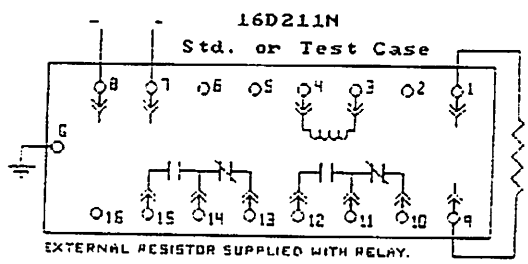
Figure 2: Typical External Connections

Attachment No. 7 Sheet 6 of 12
Identifier 27DAT

Figure 3: INTERNAL CONNECTION DIAGRAM AND OUTPUT CONTACT LOGIC

The following table and diagram define the output contact states under all possible conditions of the measured input voltage and the control power supply. "AS SHOWN" means that the contacts are in the state shown on the internal connection diagram for the relay being considered. "TRANSFERRED" means the contacts are in the opposite state to that shown on the internal connection diagram.

Condition	Contact State	
	Type 27N	Type 59N
Normal Control Power AC Input Voltage Below Setting	Transferred	As Shown
Normal Control Power AC Input Voltage Above Setting	As Shown	Transferred
No Control Voltage	As Shown	As Shown



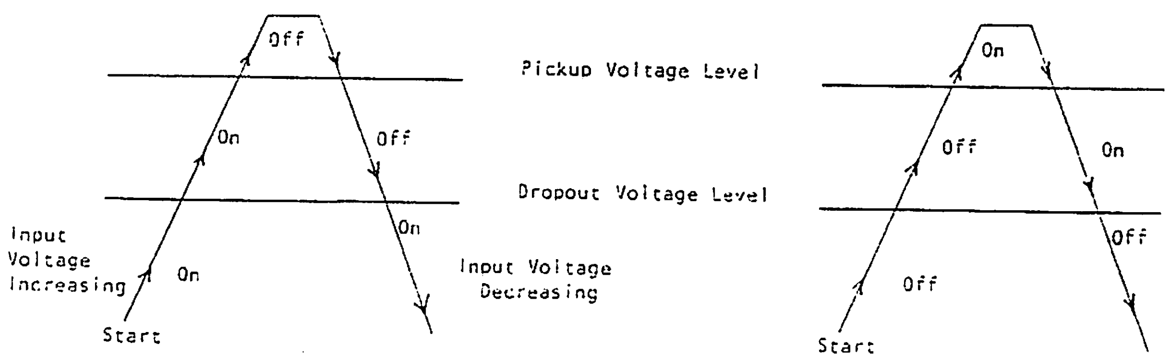
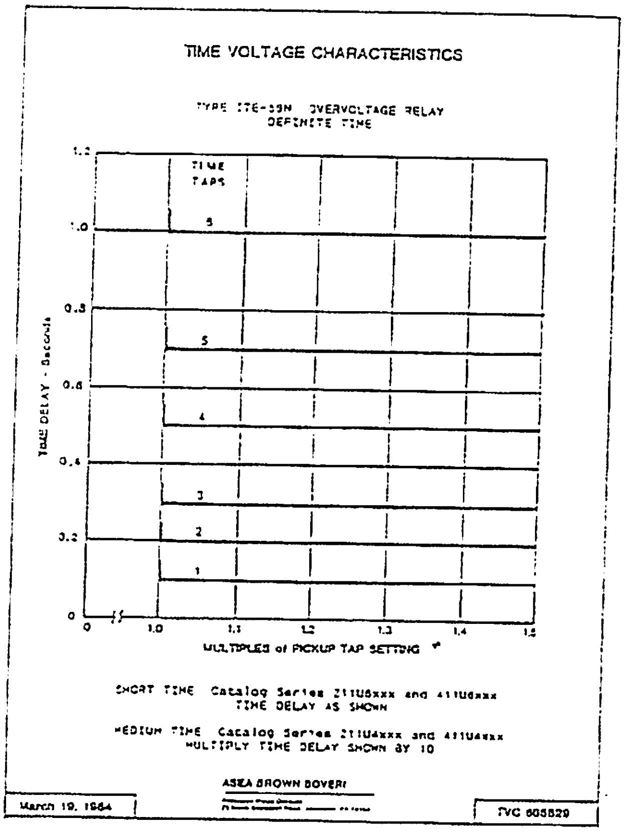


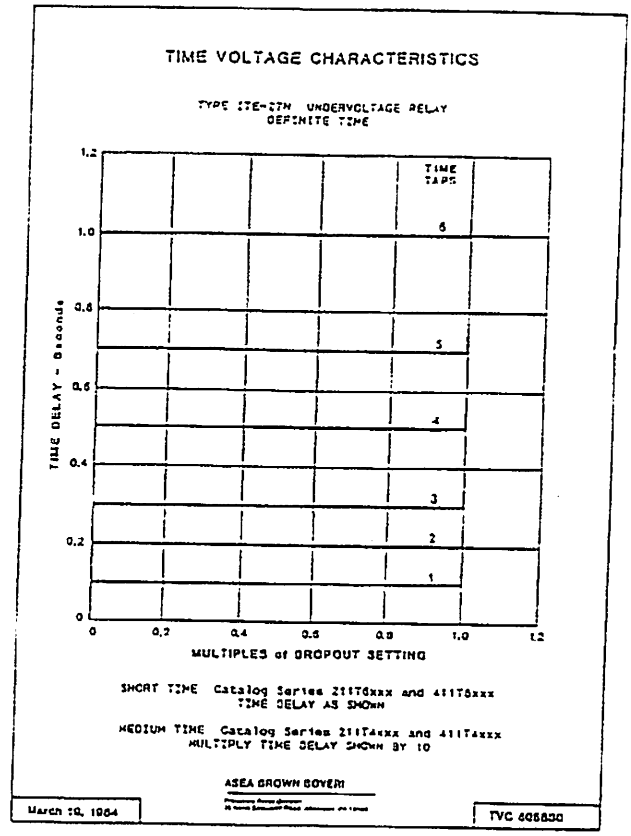
Figure 4a: ITE-27N Operation of Dropout Indicating Light

Figure 4b: ITE-59N Operation of Pickup Indicating Light

Figure 4: Operation of Pickup/Dropout Light-Emitting-Diode Indicator

Attachment No. 7 Sheet 7 of 12
Identifier 27DAT





* NOT TO EXCEED INPUT RATING

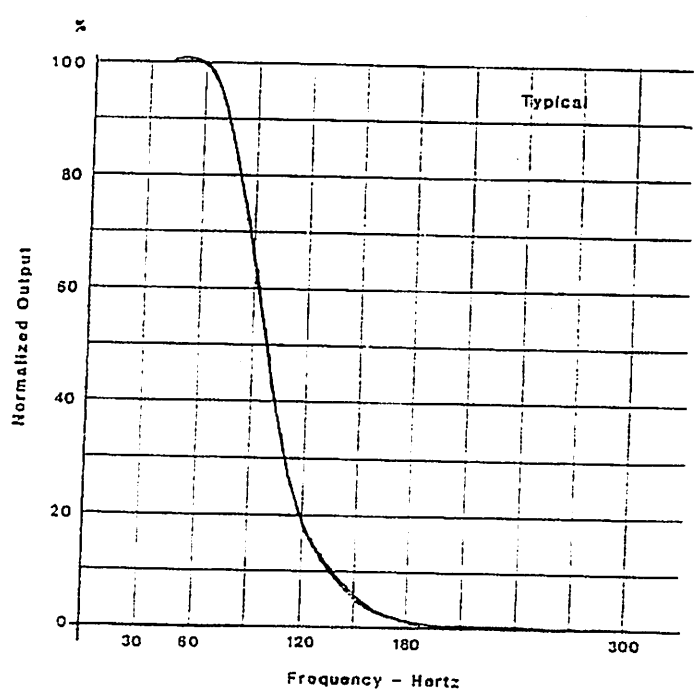


Figure 5: Normalized Frequency Response - Optional Harmonic Filter Module

Attachment No. 9 Sheet 8 of 12
Identifier 27DHT

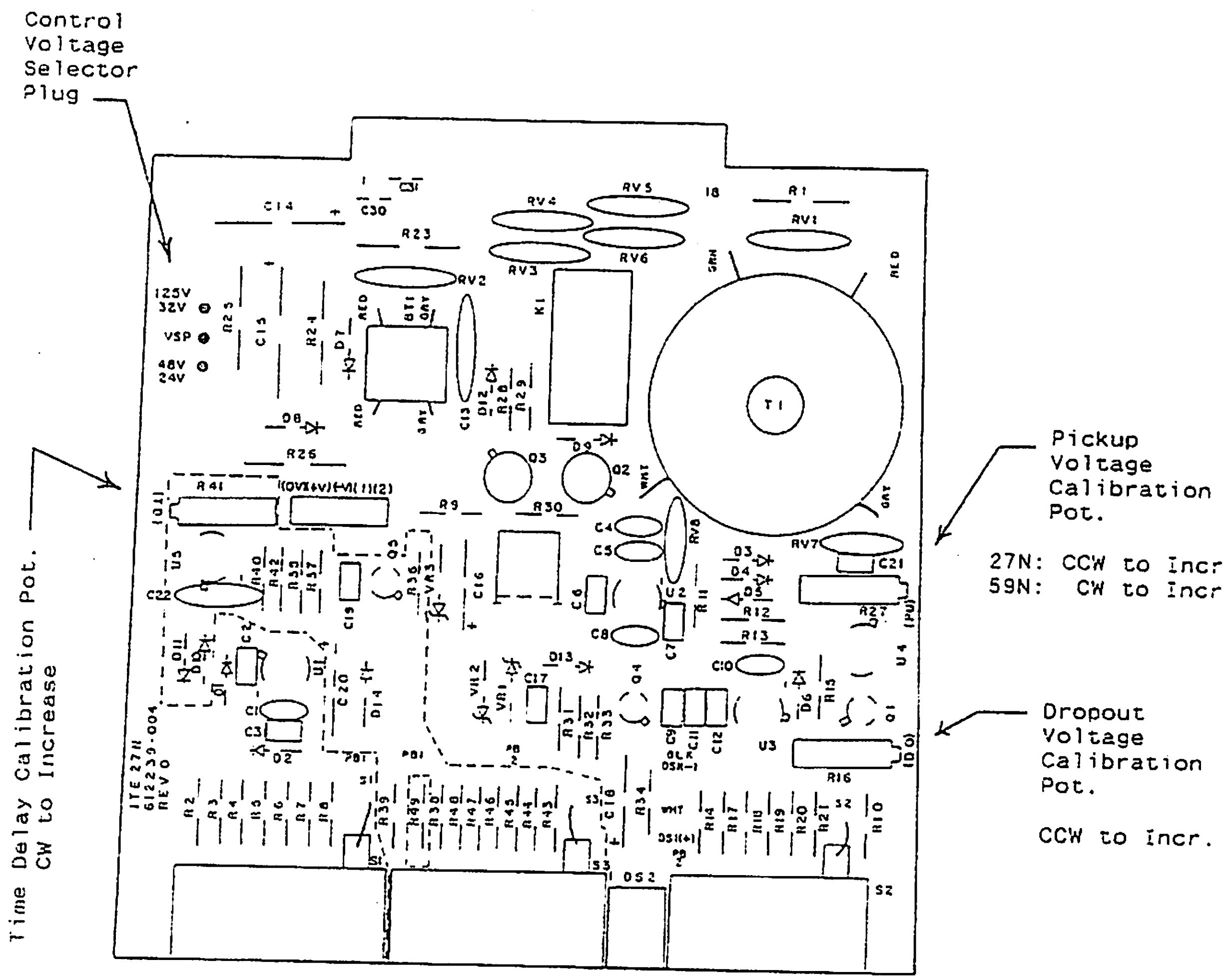


Figure 6: Typical Circuit Board Layouts, types 27N and 59N

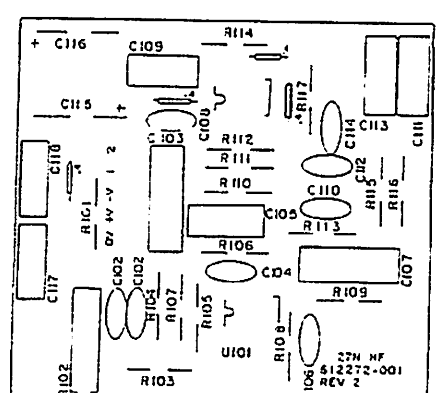


Figure 7: Typical Circuit Board Layout - Harmonic Filter Module

Attachment No. 9 Sheet 4 of 12
Identifier 27DAT

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a circuit description booklet CD7.4.1.7-7 which includes schematic diagrams, can be provided on request. Renewal parts will be quoted by the factory on request.

211 Series Units

Drawout circuit boards of the same catalog number are interchangible. A unit is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom side of the drawout circuit board.

The board is removed by using the metal pull knobs on the front panel. *Removing the board with the unit in service may cause an undesired operation.*

An 18 point extender board (cat 200X0018) is available for use in troubleshooting and calibration of the relay.

411 Series Units

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The assembly is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

Important: these relays have an external resistor mounted on rear terminals 1 and 9. In order to test the drawout unit an equivilent resistor must be connected to terminals 1 & 9 on the rear vertical circuit board of the drawout unit. The resistance value must be the same as the resistor used on the relay. A 25 or 50 watt resistor will be sufficient for testing. If no resistor is available, the resistor assembly mounted on the relay case could be removed and used. *If the resistor from the case is used, be sure to remount it on the case at the conclusion of testing.*

Test Plug:

A test plug assembly, catalog number 400X0002 is available for use with the 410 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if the tests are run with the main circuit energized.

The built-in test is provided as a convenient functional test of the relay and associated circuit. When you depress the button labelled TRIP, the measuring and timing circuits of the relay are actuated. When the relay times out, the output contacts transfer to trip the circuit breaker or other associated circuitry, and the target is displayed. The test button must be held down continuously until operation is obtained.

4. ACCEPTANCE TESTS

Follow the test procedures under paragraph 5. For definite-time units, select Time Dial #3. For the type 27N, check timing by dropping the voltage to 50% of the dropout voltage set (or to zero volts if preferred for simplification of the test). For the type 59N check timing by switching the voltage to 105% of pickup (do not exceed max. input voltage rating.) Tolerances should be within those shown on page 5. If the settings required for the particular application are known, use the procedures in paragraph 5 to make the final adjustments.

5. CALIBRATION TESTS

Test Connections and Test Sources:
Typical test circuit connections are shown in Figure 8. Connect the relay to a proper source of dc control voltage to match its nameplate rating (and internal plug setting for dual-rated units). Generally the types 27N and 59N are used in applications where high accuracy is required. The ac test source must be stable and free of harmonics. A test source with less than 0.3% harmonic distortion, such as a "line-corrector" is recommended. Do not use a voltage source that employs a ferroresonant transformer as the stabilizing and regulating device, as these usually have high harmonic content in their output. The accuracy of the voltage measuring instruments used must also be considered when calibrating these relays.

If the resolution of the ac test source adjustment means is not adequate, the arrangement using two variable transformers shown in Figure 9 to give "coarse" and "fine" adjustments is recommended.

When adjusting the ac test source do not exceed the maximum input voltage rating of the relay.

LED Indicator:
A light emitting diode is provided on the front panel for convenience in determining the pickup and dropout voltages. The action of the indicator depends on the voltage level and the direction of voltage change, and is best explained by referring to Figure 4.

The calibration potentiometers mentioned in the following procedures are of the multi-turn type for excellent resolution and ease of setting. For catalog series 211 units, the 18 point extender board provides easier access to the calibration pots. If desired, the calibration potentiometers can be resealed with a drop of nail polish at the completion of the calibration procedure.

Setting Pickup and Dropout Voltages:
Pickup may be varied between the fixed taps by adjusting the pickup calibration potentiometer R27. Pickup should be set first, with the dropout tap set at 99% (60% on "low dropout units"). Set the pickup tap to the nearest value to the desired setting. The calibration potentiometer has approximately a +/-5% range. Decrease the voltage until dropout occurs, then check pickup by increasing the voltage. Re-adjust and repeat until pickup occurs at precisely the desired voltage.

Potentiometer R16 is provided to adjust dropout. Set the dropout tap to the next lower tap to the desired value. Increase the input voltage to above pickup, and then lower the voltage until dropout occurs. Readjust R16 and repeat until the required setting has been made.

Setting Time Delay:
Similarly, the time delay may be adjusted higher or lower than the values shown on the time-voltage curves by means of the time delay calibration potentiometer R41. On the type 27N, time delay is initiated when the voltage drops from above the pickup value to below the dropout value. On the type 59N, timing is initiated when the voltage increases from below dropout to above the pickup value. Referring to Fig. 4, the relay is "timing out" when the led indicator is lighted.

External Resistor Values: The following resistor values may be used when testing 411 series units. Connect to rear connection points 1 & 9.

Relays rated	48/125 vdc:	5000 ohms;	(-HF models with harmonic filter 4000 ohms)
	48/110 vdc:	4000 ohms;	(-HF models with harmonic filter 3200 ohms)
	250 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)
	220 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)

Attachment No 9 Sheet 11 of 12
Identifier 27DA7

ASEA BROWN BOVERI

ABB Power Transmission Inc.
Protective Relay Division
35 N. Snowdrift Rd.
Allentown, Pa. 18106
215-395-7333

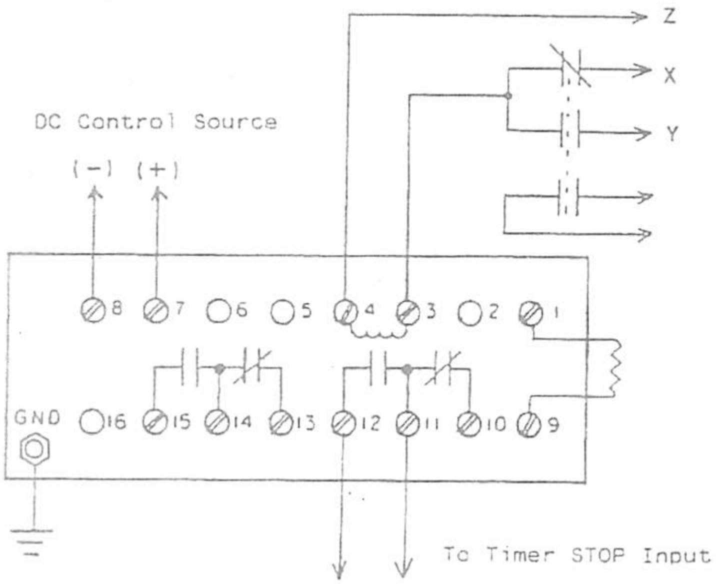


Figure 8: Typical Test Connections

T1, T2	Variable Autotransformers	(1.5 amp rating)
T3	Filament Transformer	(1 amp secondary)
V	Accurate AC Voltmeter	

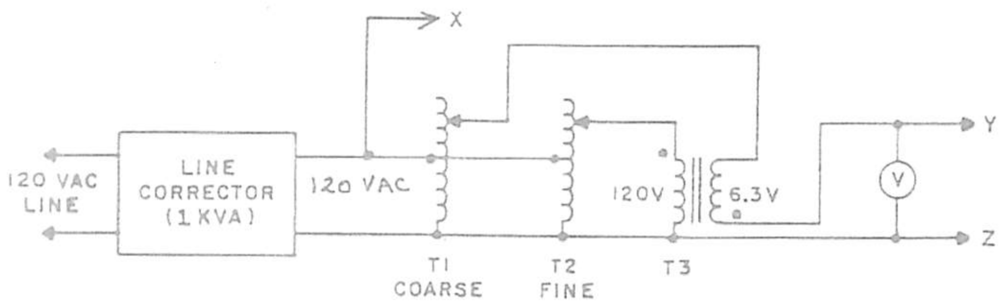


Figure 9: AC Test Source Arrangement

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, or maintenance. Should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Asea Brown Boveri.

Attachment No. 9 Sheet 12 of 12
Identifier 27DAT

METER & INSTRUMENT BUSINESS DEPARTMENT

GENERAL ELECTRIC

SOMERSWORTH, NEW HAMPSHIRE

QC - 41 (6-77)

CERTIFICATE OF COMPLIANCE

Customer: International Switchboard

GE Req. No.: 420-S2582

Customer Order No. or Job Ref.: NN2206-22845

Contract No.:

Item	Qty.	Apparatus	Catalog No.	Serial No.
1	16	JVM-5 Potential Transformers	685 x 42	

CERTIFICATION

We hereby certify that the above equipment has passed our regular quality control inspection and test as attested below.

We further certify that the above transformers have been tested for insulation and accuracy performance and that it is satisfactory for the ANSI (C57.13-1968) insulation and accuracy classes applicable to this transformer.

Attachment No. 10 Sheet 1 of 3
Loop #/Identifier 27DAT

Foreman - Quality Control

Certified by:

Manager - Quality Control

3 1142

GENERAL ELECTRIC

SOMERSWORTH, NEW HAMPSHIRE 03878

REPORT OF TEST

Date of Test 12-14-78

Req. No. 420-82582

Spec. Model No. JVM-5

Cat. No. 685X42

CUSTOMER INTERNATIONAL SWITCHBOARD CORP.

Customer Order No. N2206

Equipment JVM-5

Rating 60 HZ 7200:120 VOLTS 15000 VOLT INSUL. CLASS

The following potential transformers have been tested at 60 hertz, with secondary volts and burdens noted below against General Electric Standards with results as listed:

Serial No.	Secondary Burden VA	Secondary Volts	Ratio Correction Factor	Phase Angle (Min.)
3715390	0 0 Z	120 132 120	0.9975 0.9976 1.0018	+1 +2 0
3715387	0 0 Z	120 132 120	0.9972 0.9973 1.0018	+1 +2 -1
3715433	0 0 Z	120 132 120	0.9973 0.9975 1.0017	+1 +1 -1

The above transformers have been tested for insulation and accuracy performance and are satisfactory for the ANSI (C57.13-1968) insulation and accuracy classes applicable to this transformer.

Certified by John R. Waterhouse

METER Department SOMERSWORTH Works

Attachment No. 10 Sheet 2 of 3

Loop #/Identifier 27DAT

Table 13
Standard Burdens for Potential Transformers

Standard Burdens			Characteristics on 120 Volt Basis			Characteristics on 69.3 Volt Basis		
Designation	Volt-Amperes	Power Factor	Resistance Ohms	Inductance Henrys	Impedance Ohms	Resistance Ohms	Inductance Henrys	Impedance Ohms
W	12.5	0.10	115.2	3.042	1152	38.4	1.014	384
X	25	0.70	403.2	1.092	576	134.4	0.364	192
Y	75	0.85	163.2	0.268	192	54.4	0.0894	64
Z	200	0.85	61.2	0.101	72	20.4	0.0336	24
ZZ	400	0.85	30.6	0.0504	36	10.2	0.0168	12

Table 14
Accuracy Classes and Corresponding Limits of Transformer Correction Factors for Potential Transformers for Metering Service*

Metering Accuracy Classes	Limits of Transformer Correction Factors for Range of 90 to 110 Percent Rated Primary Voltage		Limits of Power Factor (Lag) of Metered Power Load
	Min	Max	
0.3	0.997	1.003	0.6 - 1.0
0.6	0.994	1.006	0.6 - 1.0
1.2	0.988	1.012	0.6 - 1.0

*See Fig. 8

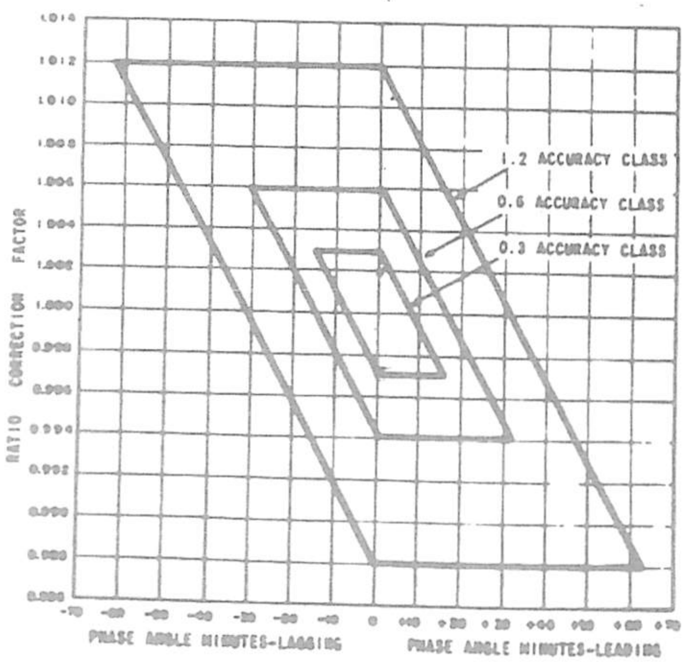


Fig. 8
Limits for Accuracy Classes 0.3, 0.6, and 1.2 for Potential Transformers for Metering Service

Attachment No. 10 Sheet 3 of 3
Loop #/Identifier 27DAT

DATA

1A-A	03-19-86	09-27-85	03-13-85	09-21-84	03-15-84
27TS1A					
AfPU	94.90	93.50	95.90	93.70	95.03
AlPU	94.20	94.40	94.30	94.22	94.00
AfDO	92.70	91.40	93.80	91.57	93.12
AlDO	92.00	92.20	92.10	92.02	92.05
27TS1B					
AfPU	94.30	93.80	95.70	93.65	94.93
AlPU	94.30	94.30	94.30	94.65	94.21
AfDO	92.10	91.50	93.30	91.48	92.83
AlDO	92.10	92.00	91.90	92.03	92.03
27TS1C					
AfPU	94.30	93.50	95.60	93.79	94.50
AlPU	94.30	94.30	94.20	94.19	93.76
AfDO	92.10	91.20	93.40	91.55	92.50
AlDO	92.10	92.00	91.90	92.00	92.02

DATA

1B-B	04-03-86	09-12-85	03-19-85	09-20-84	03-20-84
27TS1A					
AfPU	94.70	93.60	95.45	94.41	94.10
AlPU	94.40	94.10	94.25	94.26	94.10
AfDO	92.30	91.20	93.34	92.10	92.00
AlDO	92.10	91.80	91.85	91.97	92.00
27TS1B					
AfPU	94.70	93.70	95.40	94.79	94.30
AlPU	94.50	94.40	94.10	94.22	94.30
AfDO	92.30	91.30	93.30	92.60	92.30
AlDO	92.20	92.10	91.90	92.00	92.30
27TS1C					
AfPU	95.10	93.80	95.50	95.25	95.00
AlPU	94.70	94.60	94.60	94.41	95.00
AfDO	92.60	91.20	93.20	92.87	92.70
AlDO	92:10	92.00	92.20	92.00	92.70

PREPARED [signature] DATE 10-18-95
CHECKED [signature] DATE 10-25-95

Attachment No. 11 Sheet 1 of 5
Identifier 27DAT

DATA

2A-A	03-19-86	07-13-85	03-14-85	09-24-84	03-14-84
27TS1A					
AfPU	95.00	93.70	96.00	93.60	95.20
AlPU	94.50	94.50	94.50	94.26	94.36
AfDO	92.50	91.30	93.50	91.25	92.95
AlDO	92.10	92.00	92.00	91.96	92.02
27TS1B					
AfPU	94.60	93.90	95.61	93.75	94.45
AlPU	94.60	94.30	94.40	94.28	94.14
AfDO	92.20	91.40	93.31	91.56	92.30
AlDO	92.20	92.00	92.01	92.10	92.04
27TS1C					
AfPU	95.10	94.00	96.00	94.02	95.52
AlPU	94.70	94.70	94.80	94.50	94.45
AfDO	92.30	91.30	93.40	91.45	93.00
AlDO	92.00	92.00	92.00	91.96	91.96

DATA

2B-B	04-03-86	09-12-85	03-19-85	09-20-84	03-20-84
27TS1A					
AfPU	95.00	94.00	95.77	94.40	94.60
AlPU	94.60	94.70	94.56	94.40	94.30
AfDO	92.50	91.50	93.46	92.00	92.60
AlDO	92.10	92.10	92.05	92.00	92.00
27TS1B					
AfPU	95.00	94.50	95.97	94.70	94.40
AlPU	95.00	94.90	94.75	94.70	94.40
AfDO	92.20	91.70	93.36	92.00	92.00
AlDO	92.20	92.10	92.06	92.00	92.00
27TS1C					
AfPU	95.00	94.10	95.78	94.30	95.20
AlPU	94.80	94.60	94.57	94.50	94.40
AfDO	92.40	91.50	93.27	91.80	92.80
AlDO	92.20	91.90	92.07	92.00	92.00

PREPARED [signature] DATE 10-18-95
CHECKED [signature] DATE 10-25-95

Attachment No. 11 Sheet 2 of 5
Identifier 27DAT

Drift Analysis for Undervoltage Relay

Board 1A-A

Afound - Aleft = Deviation

% of SP = Deviation * 100 / Setpoint

Pickup Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
-0.30	-0.32	-0.56	-0.59	0.03	0.03	6.00
1.68	1.79	1.05	1.11	1.41	1.50	6.00
-0.80	-0.85	-0.50	-0.53	-0.70	-0.74	6.00
0.50	0.53	0.00	0.00	0.00	0.00	6.00
Setpoint =	93.60		94.50		94.10	

Dropout Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
-0.48	-0.52	-0.55	-0.60	-0.47	-0.51	6.00
1.78	1.93	1.27	1.38	1.40	1.52	6.00
-0.70	-0.76	-0.40	-0.43	-0.70	-0.76	6.00
0.50	0.54	0.10	0.11	0.10	0.11	6.00
Setpoint =	92.00		92.00		92.00	

Board 1B-B

Afound - Aleft = Deviation

% of SP = Deviation * 100 / Setpoint

Pickup Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
0.31	0.33	0.49	0.52	0.25	0.26	6.00
1.19	1.26	1.18	1.25	1.09	1.15	6.00
-0.65	-0.69	-0.40	-0.42	-0.80	-0.84	6.00
0.60	0.64	0.30	0.32	0.50	0.53	6.00
Setpoint =	94.20		94.50		94.80	

Dropout Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
0.10	0.11	0.30	0.33	0.17	0.18	6.00
1.37	1.49	1.30	1.41	1.20	1.30	6.00
-0.65	-0.71	-0.60	-0.65	-1.00	-1.09	6.00
0.50	0.54	0.20	0.22	0.60	0.65	6.00
Setpoint =	92.00		92.00		92.00	

PREPARED HJ Mailen DATE 10-18-95
CHECKED WMBegley DATE 10-25-95

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Drift Analysis for Undervoltage Relay

Board 2A-A

Afound - Aleft = Deviation

% of SP = Deviation * 100 / Setpoint

Pickup Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
-0.76	-0.81	-0.39	-0.41	-0.43	-0.45	6.00
1.74	1.85	1.33	1.41	1.50	1.58	6.00
-0.80	-0.85	-0.50	-0.53	-0.80	-0.84	6.00
0.50	0.53	0.30	0.32	0.40	0.42	6.00
Setpoint =	94.10		94.10		94.80	

Dropout Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
-0.77	-0.84	-0.48	-0.52	-0.51	-0.55	6.00
1.54	1.67	1.21	1.32	1.44	1.57	6.00
-0.70	-0.76	-0.61	-0.66	-0.70	-0.76	6.00
0.50	0.54	0.20	0.22	0.30	0.33	6.00
Setpoint =	92.00		92.00		92.00	

Board 2B-B

Afound - Aleft = Deviation

% of SP = Deviation * 100 / Setpoint

Pickup Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
0.10	0.11	0.30	0.32	-0.10	-0.11	6.00
1.37	1.45	1.27	1.35	1.28	1.36	6.00
-0.56	-0.59	-0.25	-0.27	-0.47	-0.50	6.00
0.30	0.32	0.10	0.11	0.40	0.42	6.00
Setpoint =	94.60		94.30		94.40	

Dropout Deviations:

27TS1A	% of SP	27TS1B	% of SP	27TS1C	% of SP	Months
0.00	0.00	0.00	0.00	-0.20	-0.22	6.00
1.46	1.59	1.36	1.48	1.27	1.38	6.00
-0.55	-0.60	-0.36	-0.39	-0.57	-0.62	6.00
0.40	0.43	0.10	0.11	0.50	0.54	6.00
Setpoint =	92.00		92.00		92.00	

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CHECKED JM Lyly DATE 10-25-95

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Average Deviation = Sum of (% of SP) / Number of Data points

Board 1A-A Pickup Average Deviation =	0.1608
Board 1B-B Pickup Average Deviation =	0.3581
Board 2A-A Pickup Average Deviation =	0.1846
Board 2B-B Pickup Average Deviation =	0.3301
Average Deviation =	0.2584

Standard Deviation = 0.8028

95% Factor is 2 x Std. Dev. 1.6057

95% Factor Value = 95% Factor + Avg. Dev.
= 1.8641 % of SP

Pickup Value = +/- 1.8641 % of SP

Board 1A-A Dropout Average Deviation =	0.1676
Board 1B-B Dropout Average Deviation =	0.3161
Board 2A-A Dropout Average Deviation =	0.1286
Board 2B-B Dropout Average Deviation =	0.3089
Average Deviation =	0.2303

Standard Deviation = 0.8572

95% Factor is 2 x Std. Dev. 1.7145

95% Factor Value = 95% Factor + Avg. Dev.
= 1.9448 % of SP

Dropout Value = +/- 1.9448 % of SP

PREPARED [signature] DATE 10-18-95
CHECKED [signature] DATE 10-25-95

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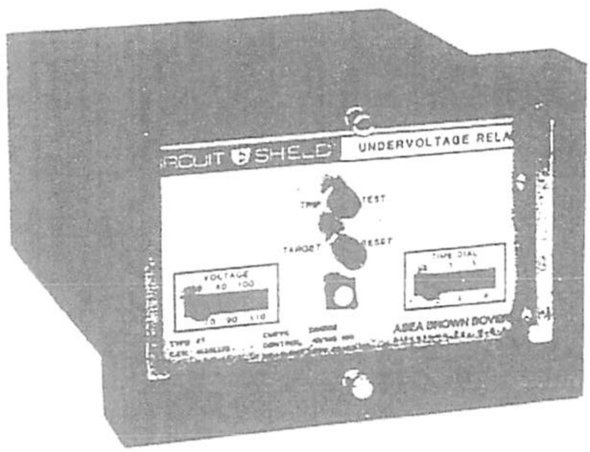
IB 18.4.7-2
Issue E

INSTRUCTIONS

Single-Phase Voltage Relays

UNDERVOLTAGE RELAYS and OVERVOLTAGE RELAYS

TYPE 27, TYPE 27D, TYPE 27H	Catalog Series 211	Standard Case
TYPE 27, TYPE 27D, TYPE 27H	Catalog Series 411	Test Case
TYPE 59D, TYPE 59H	Catalog Series 211	Standard Case
TYPE 59D, TYPE 59H	Catalog Series 411	Test Case



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ASEA BROWN BOVERI

TABLE OF CONTENTS

INTRODUCTION

These instructions contain the information required to properly install, operate, and test certain ABB Circuit-Shield™ single-phase undervoltage and overvoltage relays, Types 27, 27D, 27H, 59D, and 59H. See the section on Testing for single-phase voltage relays covered by earlier issues of this instruction book.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 411B, 411R, and 411C catalog series are similar to relays of the 211B, 211R, and 211C series. Both series provide the same basic functions and are of totally drawout construction; however, the 411B, 411R, and 411C series relays provide integral test facilities. Also, sequenced disconnects on the 411 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

Most settings are made on the front panel of the relay, behind a removable clear plastic cover. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing. *Important: connections for the 411 catalog series units are different from the 211 series units.*

2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.

4. High voltage insulation tests are not recommended. See the section on testing for additional information.

5. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

6. Follow test instructions to verify that the relay is in proper working order.

CAUTION: *since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competant technicians familiar with good safety practices should service these devices.*

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.

Connections:
Internal connections are shown on page 7. Typical external connections are shown in Figure 2. *Important: connections are different for 411B, 411R, and 411C series units compared to 211B, 211R, and 211C units.* Control power must be connected in the proper polarity.

For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the link should be placed in the position marked 125vdc.)

Relays rated for use with 120vac control power have an internal isolation transformer connected to relay terminals 7 and 8. Polarity of the ac control power to these terminals need not be observed.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

3. SETTINGS

PICKUP (VOLTS)
The pickup taps are labelled by the actual value of ac input voltage which will cause the relay to operate. Note: operating voltage values other than the specific values provided by the taps can be obtained by means of an internal adjustment potentiometer. See section on testing for setting procedure.

On these relay models there is no adjustment for the differential between the operate and reset voltage values.

TIME DIAL
The time dial taps are identified as 1,2,3,4,5,6. Refer to the time-voltage characteristic curves in the Application section. Time dial selection is not provided on relays with an Instantaneous operating characteristic.

4. INDICATORS

Target:
An operation target is provided. The target is set electronically when the output contacts transfer. The target will retain its indication on loss of dc control power. In order to reset the target, normal dc control power must be present and a "normal" ac voltage condition must exist; in other words, for an undervoltage relay the voltage must be higher than the set point, and for overvoltage relays, lower.

APPLICATION DATA

The ABB Circuit-Shield™ single-phase voltage relays covered by this instruction book provide a wide range of application including undervoltage protection for motors, over and undervoltage protection for generators, and automatic bus transfer. The relays provide good accuracy and repeatability, and have a flat response over a frequency range of 15 to 400 hertz.

Undervoltage Relay, Type 27, catalog series 211B, 211R, 411B, and 411R:

Typical applications include general purpose undervoltage protection for incoming lines, and initiation of transfer in automatic bus transfer schemes.

Typical external connections are shown in Figures 2.

The relay has an inverse time curve as shown in TVC-605817.

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Undervoltage Relay, Type 27D, catalog series 211B, 211R, 411B and 411R:

Typical applications include the initiation of transfer in automatic bus transfer schemes.

Typical external connections are shown in Figure 3.

The Type 27D relay has a definite-time characteristic with 2 ranges available: 0.1-1 second and 1-10 seconds, as shown in TVC-605820 and TVC-605821.

Undervoltage Relays, Type 27H, catalog series 211B, 211R, 411B, 411R:

Typical applications include instantaneous undervoltage detection for bus transfer schemes, and for generator intertie schemes. The low range relay is used as a residual voltage detector in motor bus transfer schemes.

Typical connections are shwon in Figure 3.

The relay has an instantaneous operating time as shown in TVC-605819.

Overvoltage Relays, Type 59H and Type 59D, catalog series 211C and 411C:

These instantaneous and definite time overvoltage relays are companions to the Type 27H and Type 27D undervoltage relays, and offer similar characteristics where overvoltage protection is required.

The time voltage characteristic for the Type 59D is given in TVC-605839. For the Type 59H the maximum operating time above 1.05 times pickup is 16 milliseconds.

Notes on the Use of AC Control Power

In general the use of a station battery to provide a reliable source of tripping and control power is preferred. However, many of the relay types described in this IB are available for use with 120 vac control power. The output contacts may be used in a 120 vac circuit or in a capacitor trip circuit where the capacitor voltage is no more than 170 vdc nominal. (Consult factory if the higher rating is required: "-CAP" catalog suffix.) The control power for these relays should never be taken from a capacitor trip circuit as the voltage is too high and the relay will drain the capacitor in the event of loss of AC supply.

Type 27 and Type 27D Undervoltage Relays used with 120 vac control power in the "self-powered" mode, with both signal and control power taken from the same source, will not maintain their timing characteristics if the voltage drops below approximately 65 volts. The relay will trip immediately. If this characteristic is undesirable for a particular application, the Type 27H instantaneous relay should be used followed by a pneumatic timer with time delay on dropout. A contact from the timer would be used to trip. The timer would be picked up by a contact of the Type 27H under "normal" line conditions. With undervoltage or loss of voltage, the timer would time out and close its contact in the tripping circuit. If the voltage loss were momentary, the timer would allow riding through the loss without tripping. This arrangement thus makes the time delay independent of control power and retains the benefits of accurate voltage sensing provided by the Type 27H relay.

SPECIFICATIONS

Input Circuit:

Rating: 160V, 50/60 Hz. continuous.
300V, 10 seconds.

Burden: 1.2 VA, 1.0 pf at 120 volts.

Taps: available models include:

Types 27, -27D, -27H :	60, 70, 80, 90, 100, 110v
Types 27D, -27H:	30, 35, 40, 45, 50, 55v
	15, 18, 21, 24, 27, 30v
Types 59D, -59H:	100, 110, 120, 130, 140, 150v
	60, 65, 70, 75, 80, 90v

Differential between Operate and Reset Voltages:
Type 27: less than 0.5 percent.
Types 27D, -27H, ITE-59D, -59H: approximately 3 percent.

Operating Time: See Time-Voltage characteristic curves that follow.

Output Circuit:
Each contact @ 125 Vdc: 30 ampere tripping duty.
5 ampere continuous.
0.3 ampere break.

Operating Temperature Range: -30 to +70 deg. C.

Control Power:
Models available for 48/125 vdc @ 0.08 A max.
48/110 vdc @ 0.08 A max.
24/ 32 vdc @ 0.08 A max.
120 vac 50/60 Hz. @ 0.08 A.

Allowable variation:		
24vdc nominal:	19- 29 vdc
32vdc	"	25- 38
48vdc	"	38- 58
110vdc	"	88-125
125vdc	"	100-140
120vac	"	95-135 vac

Tolerances: Operating Voltage: +/- 5%
Operating Time: +/-10%

These tolerances are based on the printed dial markings. By using the calibration procedures given later in this book, the relay may be set precisely to the desired values of operating voltage and delay with excellent repeatability.

Repeatability: variation in operating voltage for a 10 volt variation in control voltage: 0.2 volt, typical.

variation in operating voltage over the temperature range 20-40 deg C: 0.5 volt, typical.

Dielectric Strength:
1500 vac, 50/60 Hz., all circuits to ground.

Seismic Capability:
More that 6g ZPA biaxial broadband multifrequency vibration without damage or malfunction. (ANSI C37.98-1978)

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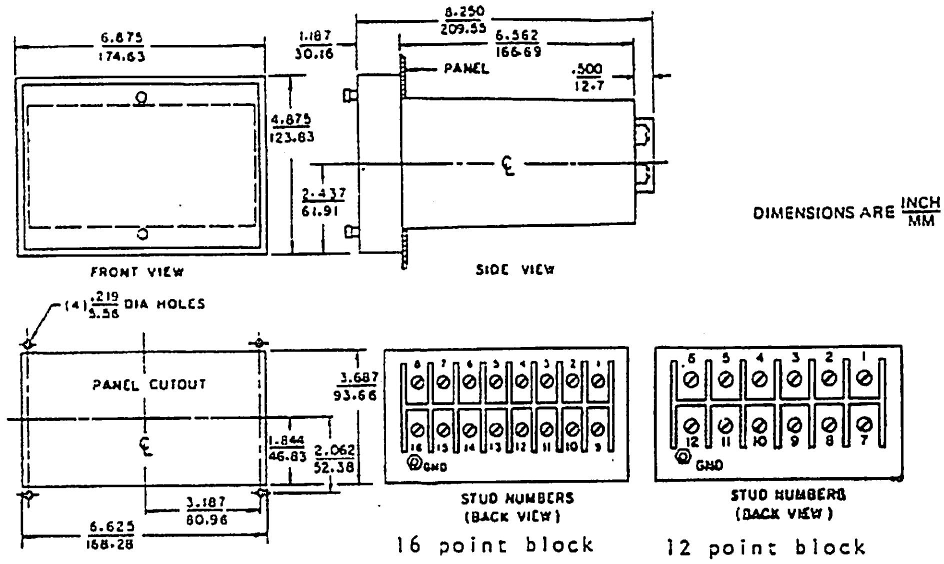

Figure 1: Relay Outline and Drilling

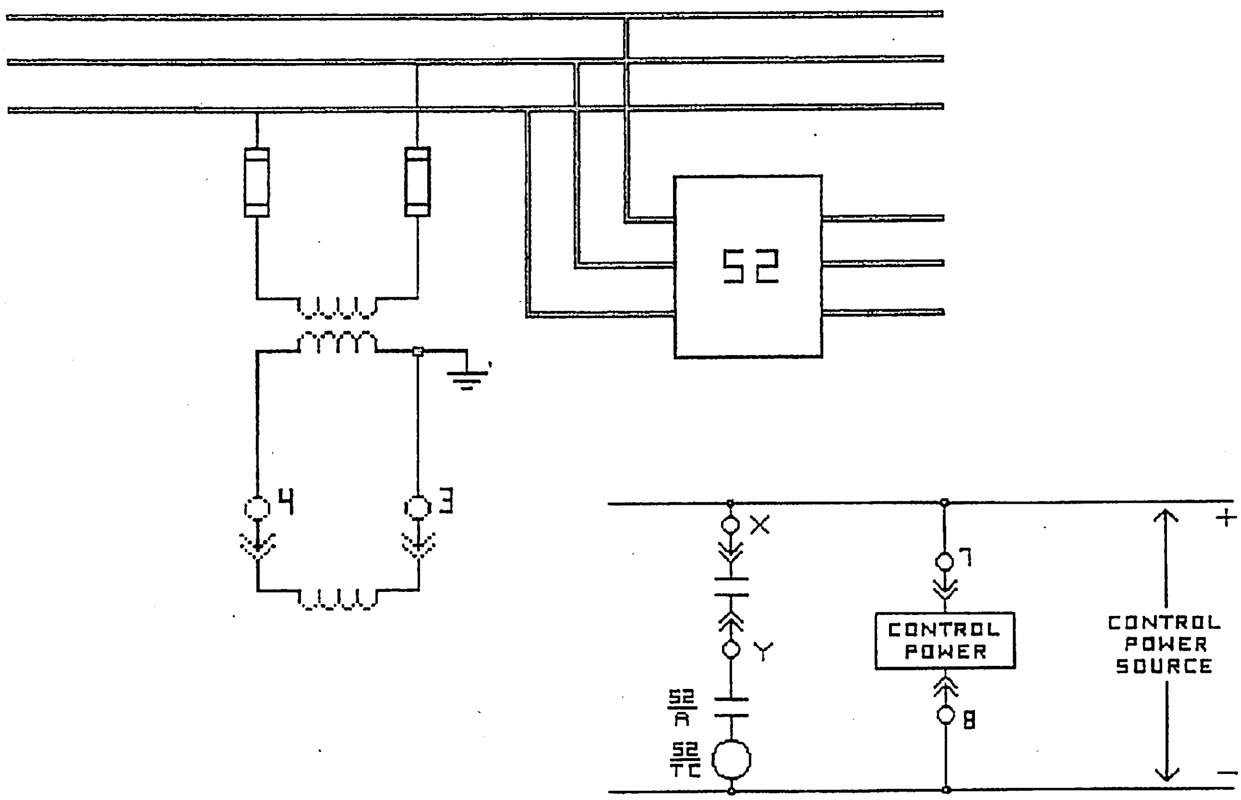

Figure 2: Typical External Connections

Note: Refer to Internal Connection Diagrams and Contact Logic Chart on page 7 to select the specific terminal numbers for the output contact ("X" and "Y") for the particular relay being used. Additionally, a table has been provided on page 15 as a cross-reference.

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INTERNAL CONNECTION DIAGRAMS AND OUTPUT CONTACT LOGIC

The following tables and diagrams define the output contact states under all possible conditions of the measured input voltage and the control power supply. "AS SHOWN" means that the contacts are in the state shown on the internal connection diagram for the relay being considered. "TRANSFERRED" means the contacts are in the opposite state to that shown on the internal connection diagram.

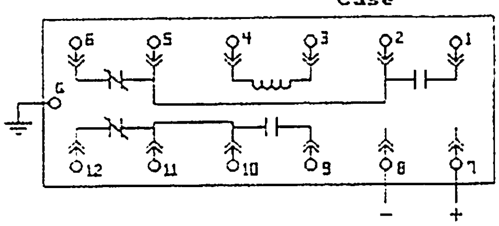
FOR DIAGRAM 12D211C

Condition	Contact State		
Cat. Series:	211Rxxx5	211Bxx65	211Cxxx5
Normal Control Power AC Input Voltage Below Setting	As Shown	As Shown	As Shown
Normal Control Power AC Input Voltage Above Setting	Transferred	Transferred	Transferred
No Control Voltage	Transferred	As Shown	As Shown

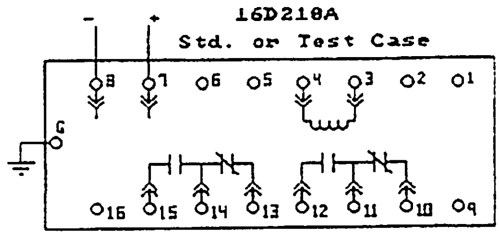
FOR DIAGRAM 16D210A

Condition	Contact State		
Cat. Series:	411Rxxx5	411Bxx65	411Cxxx5
Normal Control Power AC Input Voltage Below Setting	Transferred	Transferred	As Shown
Normal Control Power AC Input Voltage Above Setting	As Shown	As Shown	Transferred
No Control Voltage	As Shown	Transferred	As Shown

Single-Phase Voltage Relays
12D211C Std. Case



Single-Phase Voltage Relays
16D210A
Std. or Test Case



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CHARACTERISTICS OF COMMON UNITS

The following chart gives the basic characteristics of various Circuit-Shield™ single-phase voltage relays from their catalog number breakdown. The relay catalog number will always be found on the front panel of the relay. Do not interpret this chart as a way to specify a relay for purchase as not all combinations are available. For new projects refer to current catalog pages for the latest listing of standard relays, or contact the factory.

Example catalog number: 211 R 1 1 7 5

BASIC FUNCTION AND PACKAGE STYLE

211	Single-phase voltage relay in Standard Case
411	Single-phase voltage relay in Test Case

RELAY TYPE AND FUNCTION

B	TYPES 27, -27D, -27H Undervoltage Relay with Type II contact logic
C	TYPES 59, -59D, -59H Overvoltage Relay
D	TYPE 27/59 Under/Overvoltage Relay (obsolete, replaced by 410D series)
E	TYPE 59G Ground Voltage Relay (obsolete, replaced by 210E/410E series)
L	TYPE 27/59 Undervoltage Relay (obsolete, replaced by TYPE 27N)
Q	TYPE 27G 180 Hz. Undervoltage Relay (obsolete, replaced by 410Q)
R	TYPES 27, -27D, -27H Undervoltage Relay with Type I logic

TIME DELAY CHARACTERISTIC

1	Inverse Time Delay Characteristic
4	Definite Time Characteristic 1-10 second range
6	Definite Time Characteristic 0.1-1 second range
0	Instantaneous Characteristic

VOLTAGE TAP RANGE

1	Standard Range: Types 27,-27D,-27H = 60-110v; Types 59,-59D,-59H = 100-150v; Type 59G = 3-18v
2	Low Range: Types 27D,-27H = 30-55v; Types 59D,-59H = 60-90v, Type 27G = 1-12v; Type 59G = 1-6v
5	Special Range: Types 27D,-27H = 15-30v

CONTROL VOLTAGE

5	120 vac
7	48/125 vdc
9	24/ 32 vdc
0	48/110 vdc

OUTPUT CONTACTS

1	2 normally open
5	2 form C

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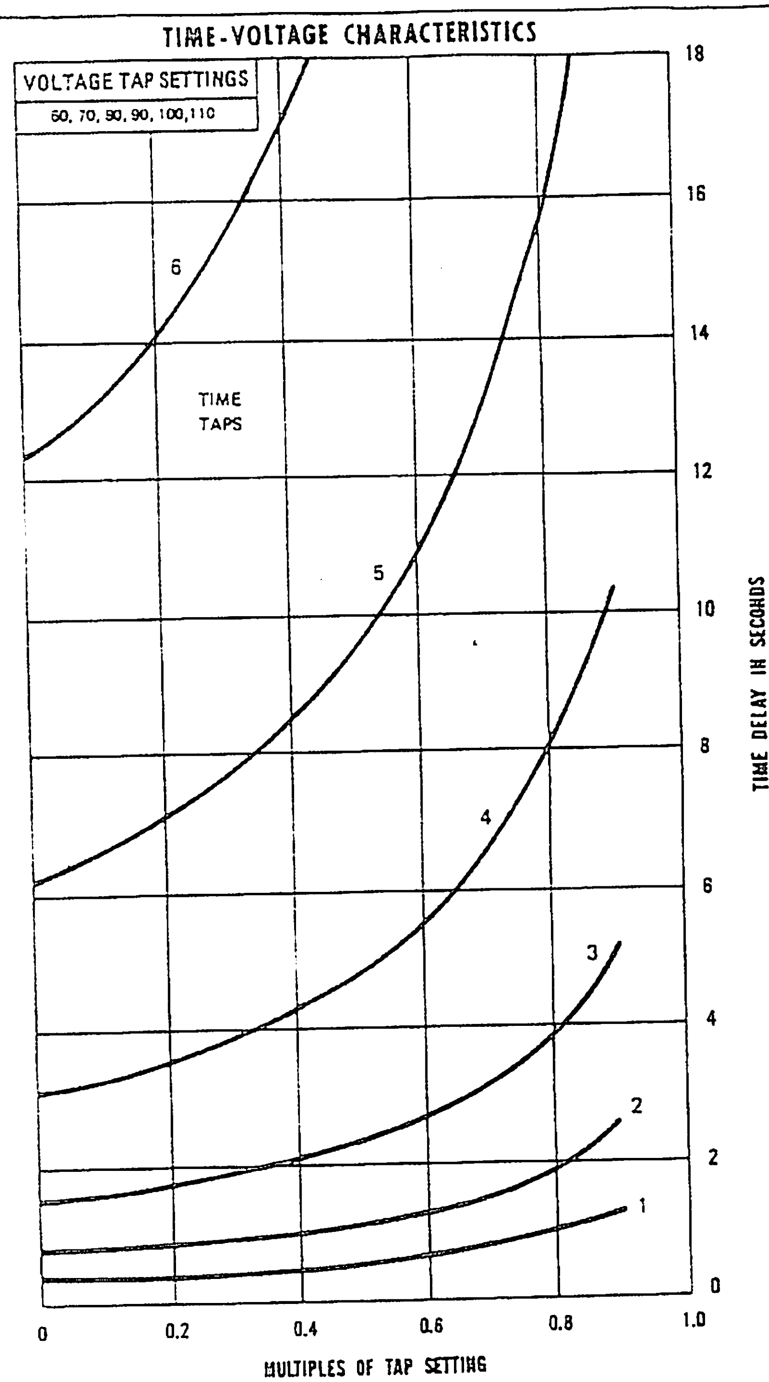

ABB Circuit-Shield™ TYPE 27 UNDERVOLTAGE RELAY

INVERSE (Medium Time)

MAY 1, 1975

TVC—606817

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TIME-VOLTAGE CHARACTERISTICS

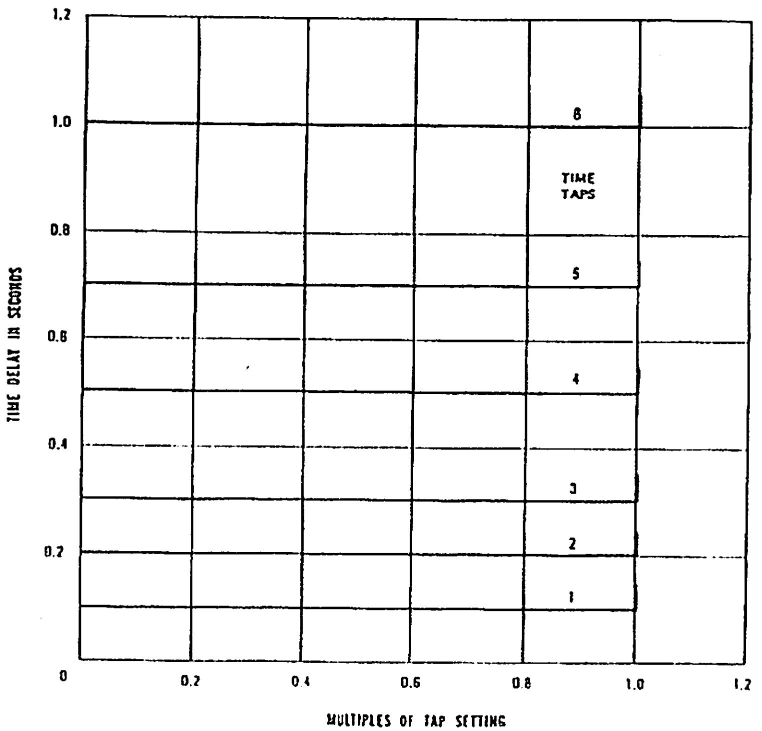

ABB Circuit-Shield™ TYPE 27D UNDERVOLTAGE RELAY
DEFINITE TIME (Short)

Catalog Series 211x6xxx and 411x6xxx

ASEA BROWN BOVERI

MAY 1, 1975 TVC-605820

TIME-VOLTAGE CHARACTERISTICS

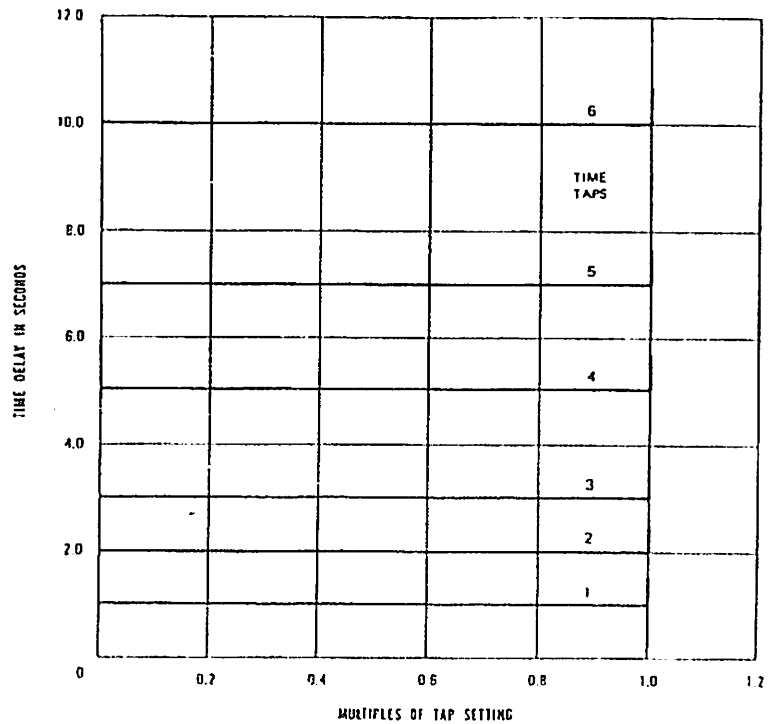

ABB Circuit-Shield™ TYPE 27D UNDERVOLTAGE RELAY
DEFINITE TIME (Medium)

Catalog Series 211x4xxx and 411x4xxx

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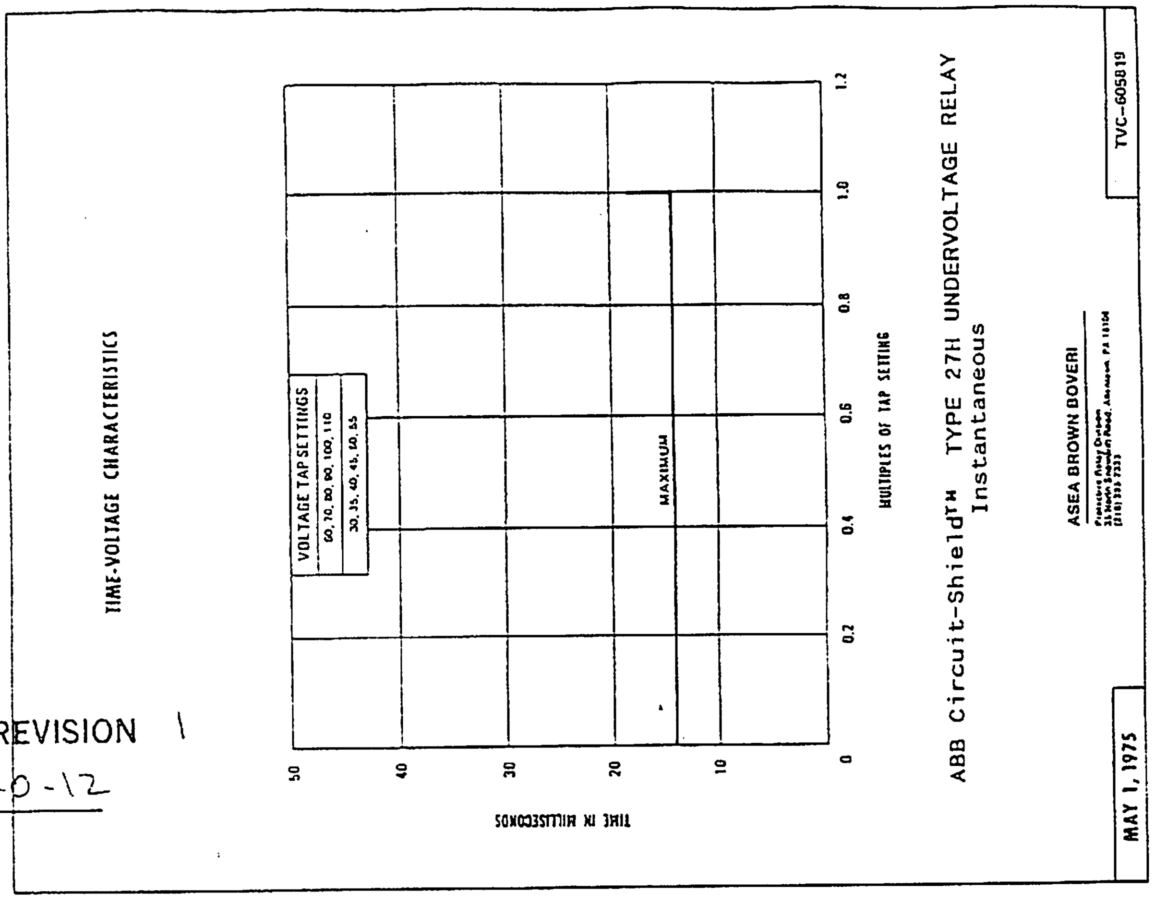
MAY 1, 1975 TVC-605821



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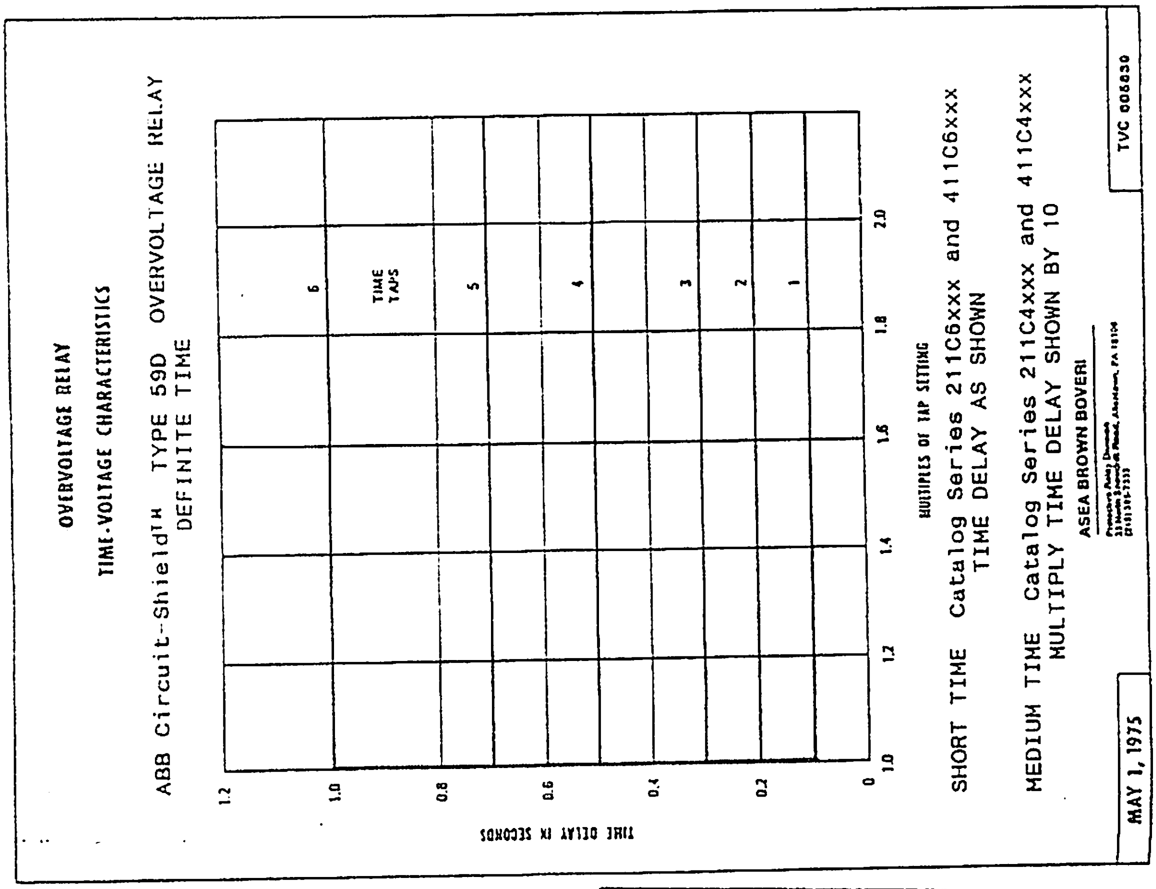

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TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram, and in some cases a circuit description, can be provided on request. Renewal parts will be quoted by the factory on request.

There are many earlier versions of these single-phase voltage relays which are now obsolete and have been superseded. If you have a relay which has its front panel stamped with Instruction Book IB 18.4.7-2, but which is not covered by this Issue E of the book, you should request Issue D from the factory. Also see paragraph 6 on obsolete relays.

211 Series Units

Drawout circuit boards of the same catalog number are interchangible. A unit is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom side of the drawout circuit board.

The board is removed by using the metal pull knobs on the front panel. *Removing the board with the unit in service may cause an undesired operation.*

An 18 point extender board (cat 200X0018) is available for use in troubleshooting and calibration of the relay.

411 Series Units

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The assembly is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

A test plug assembly, catalog 400X0002 is available for use with the 411 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if tests are run with the main circuit energized.

The built-in test is provided as a convenient functional test of the relay and associated circuit. When you depress the button labelled TRIP, the measuring and timing circuits of the relay are actuated. When the relay times out, the output contacts transfer to trip the circuit breaker or other associated circuitry, and the target is displayed. The test button must be held down continuously until operation is obtained. For the undervoltage relays, the timing is equivilent to that for a complete loss of voltage.

4. ACCEPTANCE TESTS

Follow calibration procedures under paragraph 5. On inverse or definite-time relays, select Time Dial #3. For undervoltage relays check timing by dropping voltage from 120 to 0 volts. For overvoltage relays check timing by increasing voltage to 150% of pickup. Tolerances should be within +/-5% for pickup and +/-10% for timing. Calibration may be adjusted to the final settings required by the application at this time.

5. CALIBRATION

A typical test circuit is shown in Figure 3. Connect the relay to a proper source of control voltage to match its nameplate rating and internal plug setting for dual-rated units. The ac test source should be harmonic-free. Sources using ferro-resonant-transformer regulators should not be used due to high harmonic content.

For relays with time delay, the time-dial tap pin should be placed in position #1 (fastest) when checking pickup and dropout voltages. The voltage should be varied slowly to remove the effect of the time delay from the voltage measurements.

Pickup may be varied between the fixed tap values by adjusting the internal pickup calibration potentiometer. For 211 series units the 18 point extender board provides easier access to the internal pots. Place the voltage tap pin in the nearest value and adjust the internal pot, repeating the test until the desired operating voltage is obtained. If the internal pot has insufficient range, move the tap pin to the next closest value and try again. Similarly the time delay may be adjusted higher or lower than the values shown on the time-voltage curves by means of the internal pot.

The internal calibration pots are identified as follows:

Relay Type	Pickup	Time Delay
Type 27, Type 59	R10	R25 *
Types -27D, -27H Types -59D, -59H	R13	R38

* Note: RT can also be used as a secondary means of adjustment.

6. OBSOLETE UNITS

The chart on page 8 indicates that certain of the 211 and 411 series single-phase voltage relays have been replaced by improved versions. The following gives a quick reference to the instruction books for the newer units. Should you need the instruction book for the earlier units that are nameplated to call for IB 18.4.7-2, request issue D from the factory.

Type 59, Inverse-time Overvoltage Relay:
Catalog series 211C11xx replaced by 210C11x5 and 410C11x5 series, see IB 7.4.1.7-1.

Type 59G, Ground Overvoltage Relay:
Catalog series 211E replaced by 210E and 410E series, see IB 7.4.1.7-9.

Type 27G, Third Harmonic Undervoltage Relay:
Catalog series 211Q replaced by 410Q series, see IB 7.4.1.7-9.

Type 27/59, Under/Overvoltage Relay:
Catalog series 211D replaced by 410D series, see IB 7.4.1.7-1.

Types 27/59A, -27/59D, -27/59H Under/Overvoltage Relay:
Catalog series 211L replaced by Type 27N, catalog series 211T and 411T, see IB 7.4.1.7-7. (Note: the 211L relays were not used for overvoltage protection; they were undervoltage relays with adjustable pickup and dropout voltages.)

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Attachment No. 12 Sheet 13 of 16
Identifier 27DAT

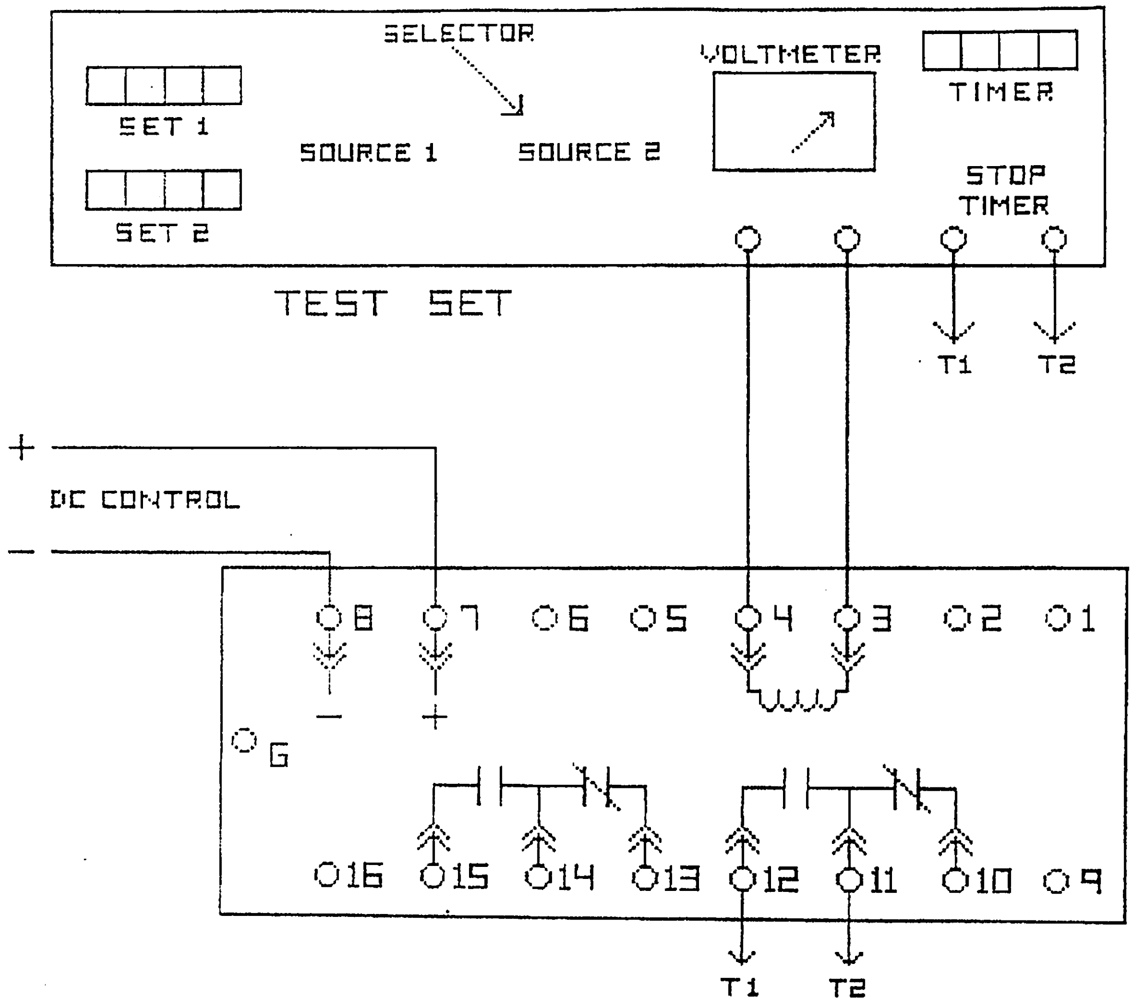

Figure 3: Typical Test Connections

Notes: Test connections shown for a 411C or 411R series unit. For other relays consult the Internal Connection Diagrams and Contact Logic Chart on pg 7 before selecting the output contact to use to stop the timer.

If the test set voltage level adjustment does not have sufficient resolution to properly check and set the pickup voltage, then insert a Variac (adjustable autotransformer) and external voltmeter between the test source and the relay input terminals.

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Identifier 27DAT

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Additional Notes on Figure 2, Typical External Connections:

The note with Figure 2 indicates that the terminal numbers associated with the output contact labelled "X" and "Y" in the diagram must be selected by referring to the internal connection diagram and contact logic chart for the particular relay being considered. As a cross-reference in this selection, the following table lists the terminals associated with the normally-open contacts that close for tripping for the basic relay function. In other words, for an undervoltage relay, the contacts that close for undervoltage, and for an overvoltage relay the contacts that close on overvoltage. An "x" in the catalog number represents any digit ("don't care").

Undervoltage Relays		Contacts that CLOSE on Undervoltage *	
Cat Series	211Rxxx5	5 - 6	11 - 12
	211Bxx65	5 - 6	11 - 12
	411Rxxx5	11 - 12	14 - 15
	411Bxxx5	11 - 12	14 - 15
Overvoltage Relays		**Contacts that CLOSE on overvoltage ***	
Cat Series	211Cxxx5	1 - 2	9 - 10
	411Cxxx5	11 - 12	14 - 15

* (Contact closure is after appropriate time delay.)

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Pg. 40-16

ASEA BROWN BOVERI

ABB Power T&D Company Inc.
Protective Relay Division
35 N. Snowdrift Rd.
Allentown, PA. 18106
215-395-7333 Fax 215-395-1055

Issue E (7/88)
Supersedes Issue D
Minor Revisions 11/90

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, or maintenance. Should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Asea Brown Boveri.

SQN REVISION 1
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Attachment No. 12 Sheet 16 of 16
Identifier 27DAT

To: Greg Mailen TVA
cc:
From: Cliff L. Downs/ALL/USTRA/ABB
Date: 08/22/95 10:06:41 AM
Subject: Type 27H

Confirming our discussion of IB 18.4.7-2 Issue E:

Regarding our use of the term repeatability: you are correct in stating that in one instance we are really talking about variations with temperature, and in the other case we are giving variations with changes in dc control voltage level. This is not "repeatability" in the usual sense of the technical meaning of that word.

True repeatability, with temperature and dc control voltage held constant should be better than 0.25%. However, I'm not sure if settability better than 0.5% can be achieved, as a single-turn adjustment potentiometer is used for calibration. This type of adjustment is fairly coarse. (The high accuracy relay Type 27N uses a multiturn pot to gain resolution.)

Best Regards,

Cliff Downs

Cliff Downs
Mgr - Technical Support
ABB Allentown
Protective Relay Division

Tel: 610-395-7333
Fax: 610-395-1055

Attachment No. 13 Sheet 1 of 2
Identifier 27DAT

Oct. 2, 1995

Tennessee Valley Authority
Sequoyah Nuclear Plant
P.O. Box 2000
Soddy Daisy, TN 37379

ABB POWER T&D COMPANY INC
PROTECTIVE RELAY DIVISION
7036 Snowdrift Road
Allentown, PA 18106
FAX 610-395-1055

Cliff Downs

I appreciate your help on the undervoltage type 27H relay you provided to me August 25. I have one more question on the information provided in instruction bulletin IB 18.4.7-2 Issue E. How should I interrupt the seismic capability? Does it mean that the relay operates within its repeatability during and/or after a seismic event? In my demonstrated accuracy calculation, I plan to state the inaccuracy contribution for seismic effect is negligible due to the bulletin and your statement on my interruption. ✓

Would you respond to this request today if possible by FAX?

Thank you again.

Gregory G. Mailen

Gregory G. Mailen
Telephone 423-843-8065
FAX 423-843-8024

YOUR CONCLUSION IS CORRECT.

Cliff Downs
2 Oct 95

Attachment No. 13	Sheet 2 of 2
Identifier 27DAT	

TVA-SQN-TS-02-01 10 CFR 50.90

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

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - UNITS 1 AND 2 - TECHNICAL SPECIFICATION (TS) CHANGE NO. 02-01 - NOMINAL TRIPS SETPOINTS FOR REACTOR PROTECTION SYSTEM (RPS) AND ENGINEERED SAFETY FEATURES (ESF) INSTRUMENTATION AND RELOCATION OF LOSS OF POWER AND RADIATION MONITORING INSTRUMENTATION REQUIREMENTS

In accordance with the provisions of 10 CFR 50.90, TVA is submitting a request for an amendment to SQN's licenses DPR-77 and 79 to change the TSs for Units 1 and 2. The proposed change will revise the trip setpoint column of the RPS and ESF instrumentation tables to utilize a nominal setpoint value and revise the associated Bases discussions. The column will be relabeled "Nominal Trip Setpoint" with the inequalities removed from applicable values. The term "trip setpoint" has been evaluated throughout the TSs and has been revised to "nominal trip setpoint" as necessary and the use of the term "nominal" has been eliminated as appropriate. This change is being requested in response to NRC concerns regarding the use of inequalities for RPS and ESF nominal trip setpoint values. This concern was identified in NRC

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	*NOMINAL* TRIP SETPOINT	ALLOWABLE VALUES
14. Deleted		
15. Undervoltage-Reactor Coolant Pumps	≥ 5022 volts-each bus	*4952* ≥ ~~4739~~ volts-each bus
16. Underfrequency-Reactor Coolant Pumps	*57.0* ≥ ~~56.0~~ Hz - each bus	*56.3* ≥ ~~55.9~~ Hz - each bus
17. Turbine Trip		
A. Low Trip System Pressure	≥ 45 psig	≥ 43 psig
B. Turbine Stop Valve Closure	≥ 1% open	≥ 1% open
18. Safety Injection Input from ESF	Not Applicable	Not Applicable
19. Intermediate Range Neutron Flux - (P-6) Enable Block Source Range Reactor Trip	≥ 1 x 10-5% of RATED THERMAL POWER	≥ 6 x 10-6% of RATED THERMAL POWER
20. Power Range Neutron Flux (not P-10) Input to Low Power Reactor Trips Block P-7	≤ 10% of RATED THERMAL POWER	≤ 12.4% of RATED THERMAL POWER

Add Insert 1

New Page

INSTRUMENTATION

LOSS OF POWER (LOP) DIESEL GENERATOR (DG) START INSTRUMENTATION

LIMITING CONDITION FOR OPERATION

3.3.3.14 The LOP DG start instrumentation for each function in Table 3.3-17 shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4,
When associated DG is required to be OPERABLE by LCO 3.8.1.2, "AC Sources - Shutdown."

ACTION:

a. With the number of OPERABLE channels one less than the Required Channels for voltage sensors, restore the inoperable channel to OPERABLE status within 6 hours or enter applicable Limiting Condition(s) For Operation and Action(s) for the associated DG set made inoperable by the channel.

b. With the number of OPERABLE channels less than the Required Channels by more than one for voltage sensors or with the number of OPERABLE channels one less than the Required Channels for timers, restore all but one channel of voltage sensors and at least one timer for each function to OPERABLE status within 1 hour or enter applicable Limiting Condition(s) For Operation and Action(s) for the associated DG set made inoperable by the channels.

c. Separate entry is allowed for each function.

d. Enter applicable Actions of LCO 3.3.2, "Engineered Safety Feature Actuation System Instrumentation," for Auxiliary Feedwater Loss of Power Start Instrumentation made inoperable by LOP DG Start Instrumentation.

SURVEILLANCE REQUIREMENTS

4.3.3.14.1 Each LOP DG Start Instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3-13.

4.3.3.14.2 The ENGINEERED SAFETY FEATURES RESPONSE TIME of each LOP DG Start Instrumentation function shall be verified to be within the limit at least once per 18 months. Each verification shall include at least one train such that both trains are verified at least once per 36 months and one channel per function such that all channels are verified at least once every N times 18 months where N is the total number of redundant channels.

New Page

TABLE 3.3-17

LOSS OF POWER DIESEL GENERATOR START INSTRUMENTATION

FUNCTIONAL UNIT	APPLICABLE MODES OR CONDITIONS	REQUIRED CHANNELS	NOMINAL TRIP SETPOINT*	ALLOWABLE VALUES
1. 6.9 kv Shutdown Board - Loss of Voltage				
a. Voltage Sensors	1, 2, 3, 4, #	3/Shutdown Board	5520	≥ 5331 volts and ≤ 5688.9 volts
b. Diesel Generator Start and Load Shed Timer	1, 2, 3, 4, #	1/Shutdown Board	1.25 seconds	≥ 1.00 seconds and ≤ 1.50 seconds
2. 6.9 kv Shutdown Board - Degraded Voltage				
a. Voltage Sensors	1, 2, 3, 4, #	3/Shutdown Board	6456 volts	≥ 6403.5 volts and ≤ 6522.5 volts
b. Diesel Generator Start and Load Shed Timer	1, 2, 3, 4, #	1/Shutdown Board	300 seconds	≥ 218.6 seconds and ≤ 370 seconds
c. SI/Degraded Voltage Logic Enable Timer	1, 2, 3, 4	1/Shutdown Board	9.5 seconds	≥ 7.5 seconds and ≤ 11.5 seconds

* A channel is OPERABLE with an actual Trip Setpoint value outside its calibration tolerance band provided the Trip Setpoint value is conservative with respect to its associated Allowable Value and the channel is readjusted to within the established calibration tolerance band of the Nominal Trip Setpoint. A Trip Setpoint may be set more conservative than the Nominal Trip Setpoint as necessary in response to plant conditions.

When associated DG is required to be OPERABLE by LCO 3.8.1.2, "AC Sources - Shutdown."

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	*NOMINAL* TRIP SETPOINT #	ALLOWABLE VALUES
b. RCS Loop ΔT Equivalent to Power > 50% RTP		
Coincident with Steam Generator Water Level--Low-Low(Adverse) and	~~≥~~ 15.0% of narrow range instrument span	≥ 14.4% of narrow range instrument span
Containment Pressure (EAM)	~~≤~~ 0.5 psig	≤ 0.6 psig
or		
Steam Generator Water Level--Low-Low (EAM)	~~≥~~ 10.7% of narrow range instrument span	≥ 10.1% of narrow range instrument span
14. Deleted		
15. Undervoltage-Reactor Coolant Pumps	~~≥~~ 5022 volts-each bus	*4952* ~~≥ 4739~~ ~~volts~~ - each bus
16. Underfrequency-Reactor Coolant Pumps	*57.0* ~~≥ 56 Hz~~ - each bus	*56.3* ~~≥ 55.9 Hz~~ - each bus
17. Turbine Trip		
A. Low Trip System Pressure	~~≥~~ 45 psig	≥ 43 psig
B. Turbine Stop Valve Closure	~~≥~~ 1% open	> 1% open
18. Safety Injection Input from ESF	Not Applicable	Not Applicable

Add Insert 1

New Page

LOSS OF POWER (LOP) DIESEL GENERATOR (DG) START INSTRUMENTATION

LIMITING CONDITION FOR OPERATION

3.3.3.14 The LOP DG start instrumentation for each function in Table 3.3-17 shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4,
When associated DG is required to be OPERABLE by LCO 3.8.1.2, "AC Sources - Shutdown."

ACTION:

a. With the number of OPERABLE channels one less than the Required Channels for voltage sensors, restore the inoperable channel to OPERABLE status within 6 hours or enter applicable Limiting Condition(s) For Operation and Action(s) for the associated DG set made inoperable by the channel.

b. With the number of OPERABLE channels less than the Required Channels by more than one for voltage sensors or with the number of OPERABLE channels one less than the Required Channels for timers, restore all but one channel of voltage sensors and at least one timer for each function to OPERABLE status within 1 hour or enter applicable Limiting Condition(s) For Operation and Action(s) for the associated DG set made inoperable by the channels.

c. Separate entry is allowed for each function.

d. Enter applicable Actions of LCO 3.3.2, "Engineered Safety Feature Actuation System Instrumentation," for Auxiliary Feedwater Loss of Power Start Instrumentation made inoperable by LOP DG Start Instrumentation.

SURVEILLANCE REQUIREMENTS

4.3.3.14.1 Each LOP DG Start Instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3-13.

4.3.3.14.2 The ENGINEERED SAFETY FEATURES RESPONSE TIME of each LOP DG Start Instrumentation function shall be verified to be within the limit at least once per 18 months. Each verification shall include at least one train such that both trains are verified at least once per 36 months and one channel per function such that all channels are verified at least once every N times 18 months where N is the total number of redundant channels.

New Page

TABLE 3.3-17

LOSS OF POWER DIESEL GENERATOR START INSTRUMENTATION

FUNCTIONAL UNIT	APPLICABLE MODES OR CONDITIONS	REQUIRED CHANNELS	NOMINAL TRIP SETPOINT*	ALLOWABLE VALUES
1. 6.9 kv Shutdown Board - Loss of Voltage				
a. Voltage Sensors	1, 2, 3, 4, #	3/Shutdown Board	5520	≥ 5331 volts and ≤ 5793.9 volts
b. Diesel Generator Start and Load Shed Timer	1, 2, 3, 4, #	1/Shutdown Board	1.25 seconds	≥ 1.00 seconds and ≤ 1.50 seconds
2. 6.9 kv Shutdown Board - Degraded Voltage				
a. Voltage Sensors	1, 2, 3, 4, #	3/Shutdown Board	6456 volts	≥ 6403.5 volts and ≤ 6522.5 volts
b. Diesel Generator Start and Load Shed Timer	1, 2, 3, 4, #	1/Shutdown Board	300 seconds	≥ 218.6 seconds and ≤ 370 seconds
c. SI/Degraded Voltage Logic Enable Timer	1, 2, 3, 4	1/Shutdown Board	9.5 seconds	≥ 7.5 seconds and ≤ 11.5 seconds

* A channel is OPERABLE with an actual Trip Setpoint value outside its calibration tolerance band provided the Trip Setpoint value is conservative with respect to its associated Allowable Value and the channel is readjusted to within the established calibration tolerance band of the Nominal Trip Setpoint. A Trip Setpoint may be set more conservative than the Nominal Trip Setpoint as necessary in response to plant conditions.

\# When associated DG is required to be OPERABLE by LCO 3.8.1.2, "AC Sources - Shutdown."

SARGENT & LUNDY - AC ELMS PROG ** UTIL:TENNESSE VALLEY AUTHORITY
PROJ NO: SQNP STATION: SQN-EEB-MS-TI06-0002 (2SQ01T6.003) R51 UNIT: 2

MAIN MENU

****

1) VIEW/EDIT .... TITLES AND CALC CONSTANTS
2) VIEW/ADD/REMOVE .... SYSTEM CODES
3) VIEW/EDIT/ADD/REMOVE ..... BUSES
4) VIEW/EDIT/ADD/REMOVE ..... BUS INTERCONNECTIONS
5) VIEW/EDIT/ADD/REMOVE ..... LOADS

S) SAVE ALL DATA (TO DISK FILE)
L) LOAD NEW DATA (FROM DISK FILE)
P) CREATE PRINTED REPORTS

I) INITIALIZE RUNNING VOLTAGE AND SHORT CIRCUIT (FOR ALL CASES)
E) EVALUATE LOAD ADDITION OR MODIFICATION (FOR ONE CASE)
G) EVALUATE A GROUP OF NEW OR MODIFIED LOADS
M) VOLTAGE DURING START OF ONE USER SELECTED MOTOR
B) VOLTAGE DURING START OF A BLOCK OF MOTORS

Q) QUIT

****

ENTER YOUR SELECTION : ▯

SARGENT & LUNDY - AC ELMS PROG ** UTIL:TENNESSE VALLEY AUTHORITY
PROJ NO: SQNP STATION: SQN-EEB-MS-TI06-0002 (2SQ01T6.003) R51 UNIT: 2

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B) VOLTAGE DURING START OF A BLOCK OF MOTORS

Q) QUIT

****

ENTER YOUR SELECTION : ▯

SARGENT & LUNDY - AC ELMS PROG ** UTIL:TENNESSE VALLEY AUTHORITY
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****

1) VIEW/EDIT .... TITLES AND CALC CONSTANTS
2) VIEW/ADD/REMOVE .... SYSTEM CODES
3) VIEW/EDIT/ADD/REMOVE ..... BUSES
4) VIEW/EDIT/ADD/REMOVE ..... BUS INTERCONNECTIONS
5) VIEW/EDIT/ADD/REMOVE ..... LOADS

S) SAVE ALL DATA (TO DISK FILE)
L) LOAD NEW DATA (FROM DISK FILE)
P) CREATE PRINTED REPORTS

Attachment No. 15 Sheet 1 of 2
Identifier 27DAT

SARGENT & LUNDY ELMS-AC ** MOTOR START VOLTAGE SUMMARY ** SOURCE : 2 COND : 4

@ Time = 6 sec.

File 2SQ01T6.003
2SQBST5.003

INTERNAL BUS NUMBER		BUS NAME	BUS RUNNING VOLTS	BUS RATED VOLTS	% OF RATED
2	SOURCE	161KV SWYD	153000.0	161000.0	95.0
3		6.9KV COM.BD.B	6636.3	6900.0	96.2
4		6.9KV SHTDN.BD.2A-A	6625.0	6900.0	96.0 ←
5		6.9KV SHTDN.BD.2B-B	6649.4	6900.0	96.4
6		6.9KV UNIT BD.2A	6661.6	6900.0	96.5
7		6.9KV UNIT BD.2B	6636.9	6900.0	96.2
8		6.9KV UNIT BD.2C	6662.3	6900.0	96.6
9		6.9KV UNIT BD.2D	6639.7	6900.0	96.2
10		480V AB COM.BD.B1600	431.6	480.0	89.9
11		480V AB COM.BD.B1200	419.9	480.0	87.5
12		480V PR HT BU GR 2AA	460.9	480.0	96.0
13		480V PR HT BU GR 2BB	462.6	480.0	96.4
14		480V PR HT BU GR 2C	462.6	480.0	96.4
15		480V PR HT CNT GR 2D	460.9	480.0	96.0
16		480V SB MN.BD.B 1600	437.6	480.0	91.2
17		480V SB MN.BD.B 1200	437.6	480.0	91.2
18		480V SDBD 2A1-A	447.7	480.0	93.3
19		480V SDBD 2A2-A	459.0	480.0	95.6
20		480V SDBD 2B1-B	449.1	480.0	93.6
21		480V SDBD 2B2-B	456.0	480.0	95.0

Press Enter to Continue ***

Prepared: M.C. Aguirre
checked: R.D. Nethery
07-25-00

SARGENT & LUNDY **** ELMS-AC PROGRAM

BUS : 4 6.9KV SHTDN.BD.2A-A

BUS REVIEW OPTIONS

****

1) Loading (Loads & Downstream Buses)
2) Running Voltage
3) Short Circuit

X) Exit To Main Menu

****

ENTER SELECTION :

SARGENT & LUNDY -- ELMS-AC **** RUNNING VOLTAGE SUMMARY ****

BUS : 4 6.9KV SHTDN.BD.2A-A RATED VOLTS : 6900.0

SOURCE	COND 1	COND 2	COND 3	COND 4
1	6653.5 V	6653.6 V	6643.2 V	6639.3 V
	96.4 %	96.4 %	96.3 %	96.2 %
2	6663.9 V	6669.0 V	6655.3 V	6650.2 V
	96.6 %	96.7 %	96.5 %	96.4 %

Attachment No. 15 Sheet 2 of 2
Identifier 27DAT

TABLE 1 Page T1.137	AUXILIARY BUILDING EL 734 A2 6.9 kV Shutdown board room A						MILD ENVIRONMENT	
OPERATIONAL CONDITIONS/EVENTS	PRESSURE (psia)	Ref.	TEMPERATURE (deg F)	Ref.	HUMIDITY (%)	Ref.	RADIATION (rads)	Ref.
LOCA/HELB IN CONT			104	2.7			5.00E+2 (accident)	1.2
NORMAL-MAX	ATM (+)	2.7	80	2.7	60	2.7	1.8E+3 (40-yr)	1.5
NORMAL-MIN	ATM (+)	2.7	65	2.7	40	2.7		
ABNORMAL-MAX	ATM (+)	2.7	104	2.7	90	2.7		
ABNORMAL-MIN	ATM (+)	2.7	60	2.7	10	2.7		
TORNADO (delta P)	0.9	4.1						
							FLOOD (1) (inches)	Ref.
HIGH ENGY LINE BREAK (2)								
ABS	NA	2.7	NA	2.7	NA	2.7	NA	2.7
AFW	NA	2.7	NA	2.7	NA	2.7	NA	2.7
CVCS	NA	2.7	NA	2.7	NA	2.7	NA	2.7
RHR	NA	2.7	NA	2.7	NA	2.7	NA	2.7
MSLB/MFLB	NA	5.1	NA	5.1	NA	5.1	NA	5.1
MOD ENGY LINE BREAK							2	3.1

(1) This area is above Elevation 724.0 and will not experience a natural phenomena flood. See Section 6.3.11 for additional information.
(2) Short term or long term moisture intrusion into unsealed conduits will not occur in this area.

91
27DAT 2

TABLE 1 Page T1.159	AUXILIARY BUILDING EL 734 A24 6.9 kV Shutdown board room B						MILD ENVIRONMENT	
OPERATIONAL CONDITIONS/EVENTS	PRESSURE (psia)	Ref.	TEMPERATURE (deg F)	Ref.	HUMIDITY (%)	Ref.	RADIATION (rads)	Ref.
LOCA/HELB IN CONT			104	2.7			5.00E+2 (accident)	1.2
NORMAL-MAX	ATM (+)	2.7	80	2.7	60	2.7	1.8E+3 (40-yr)	1.5
NORMAL-MIN	ATM (+)	2.7	65	2.7	40	2.7		
ABNORMAL-MAX	ATM (+)	2.7	104	2.7	90	2.7		
ABNORMAL-MIN	ATM (+)	2.7	60	2.7	10	2.7		
TORNADO (delta P)	0.9	4.1						
							FLOOD (1) (inches)	Ref.
HIGH ENGY LINE BREAK (2)								
ABS	NA	2.7	NA	2.7	NA	2.7	NA	2.7
AFW	NA	2.7	NA	2.7	NA	2.7	NA	2.7
CVCS	NA	2.7	NA	2.7	NA	2.7	NA	2.7
RHR	NA	2.7	NA	2.7	NA	2.7	NA	2.7
MSLB/MFLB	NA	5.1	NA	5.1	NA	5.1	NA	5.1
MOD ENGY LINE BREAK							2	3.1

(1) This area is above Elevation 724.0 and will not experience a natural phenomena flood. See Section 6.3.11 for additional information.
(2) Short term or long term moisture intrusion into unsealed conduits will not occur in this area.

91
27DAT 2 2

ORIGINAL

QA Record

NPG CALCULATION COVERSHEET / CTS UPDATE

Page 1-A

REV 0 EDMS/RIMS NO.	CTS TYPE:	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
B87 020731 001	Calculation	CALCULATIONS (NUCLEAR)	B 87 120927 019

Calc Title: AUXILIARY POWER SYSTEM

	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV
CALC ID	NUC	SQN	EEB	SQNETAPAC	52	53

CTS UPDATE ONLY ☐ (Verifier and Approval Signatures Not Required)

NO CTS CHANGES ☐ (For calc revision, CTS has been reviewed and no CTS changes required)

UNIT (check one)	SYSTEMS	UNIDS
0 ☒, 1 ☐, 2 ☐, 3 ☐	63 27 30 43 47 67 72 74 201 999	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
22544	N/A	E

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

CALCULATION NUMBER REQUESTOR	PREPARING DISCIPLINE	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
Name: PHONE:	E	Design Review	☐ Yes ☒ No

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
Dale Baese *Dale Baese*	08/31/12	Ken Greene *K Greene*	9/6/12
VERIFIER (PRINT NAME AND SIGN)	**DATE**	**APPROVAL (PRINT NAME AND SIGN)**	**DATE**
Ken Greene *K Greene*	9/6/12	*SOS RLT* [signature]	9/7/12

STATEMENT OF PROBLEM/ABSTRACT

Documentation of the Auxiliary Power System (APS) and load information in a controlled computer based program with required analysis to show the adequacy of the APS for 2-unit operation.

This calculation also evaluates acceptability of loading on the Diesel Generators with regards to their capabilities for the following design basis events:

- Loss of Offsite Power (LOOP)
- Loss of Offsite Power with simultaneous safety injection signal and containment isolation phase A (LOOP/SIA)
- Loss of Offsite Power with simultaneous safety injection signal and containment isolation phase B (LOOP/SIB)

This ETAP database/analysis is a qualified program which is used to supersede previously used database & calculation, TELAS (EEB-SQN-MS-TI05-001) and ELMS (SQN-EEB-MS-TI06-0002), respectively. It also supersedes, as of revision 17, electrical calculation DGAP (SQN-E3-002).

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

Attachment No. 17 Sheet 1 of 4
Loop #/Identifier 27DAT

6.1.3 Scope - Loads Included in Analysis

The only loads considered in the Degraded Voltage analysis will be loads that are fed from safety related boards. The loads considered in these analyses are fed from the following boards: Medium Voltage SDBDs (nodes 8-11), Low Voltage SDBDs (nodes 119-126), RMOV Bds (nodes 247-254), Diesel Aux Bds (nodes 218-225), C&A Vent Bds (nodes 203-210), ERCW Bds (nodes 229-232), and Reactor Vent Bds (nodes 255-258).

No GL89-10 valve will be considered in these analyses. This is because they are already analyzed for adequate starting voltage in section 6.5.

6.1.4 Criteria & Methodology

The table below, "Degraded Voltage Protection Scheme Relay Criteria", defines the criteria that must be used to establish limits for each setpoint.

Degraded Voltage Protection Scheme Relay Criteria[1]

Name	Lower Limit[2]	Upper Limit[2]
Degraded Voltage (dropout)	> ***Minimum Operating Voltage***	NA
Degraded Voltage (reset)	NA	< Worst Case ***Transient Voltage***[3] ≤ ***Minimum Starting Voltage***
Degraded Voltage (Non-Accident Time Delay)	NA	- see Section 6.1.4.5, Protective Devices
Degraded Voltage (Accident Time Delay)	> ***Transient Voltage*** recovery time[3]	< Safety Analysis Time for Diesel Generators to be ready to accept load - see Section 6.1.4.5, Protective Devices
Loss of Voltage (dropout)	> ***Stall Voltage***	< Worst Case ***Transient Voltage*** Dip
Loss of Voltage (reset)	No Requirement	No Requirement
Loss of Voltage (Time Delay)	Must Allow Time for Short Circuits and other Short Time Transients	< Safety Analysis Time for Loss of Voltage Detection

Notes
(1) An explanation for these requirements can be found in section 6.1.2. The requirements in bold and italics are analyses which are defined in section 6.1.2. The following subsections give the criteria for these analyses.
(2) The limits established here define the ranges for the corresponding relays to comply with.
(3) If the ***Transient Voltage*** falls below the Degraded Voltage Dropout Lower Boundary setting then it must recover above the Degraded Voltage Reset Upper Boundary before the time limit of the Degraded Voltage (Accident Time Delay) Relay Lower Boundary expires.

6.1.4.1 Minimum Operating Voltage

6.1.4.1.1 Criteria

- The 6900V Shutdown Boards voltage shall be set at the established Lower Limit of the Degraded Voltage Dropout Relays, 6400V. Or, as low as possible in order to establish a new limit.
- From section 3.1.2, Acceptable Voltage Ranges, Minimum Operating Voltages. Though Range A requirements are preferable, and the APS is designed to meet them, operation outside of Range A is acceptable so long as they are limited in extent, frequency, and duration. Range B requirements shall be met:

6600V Motors	> 5940V
460V Motors	> 416V
480V Static Loads	> 432V

6.1.4.1.2 Methodology

This evaluation is performed using the ETAP program, reference 2.1-1, and the SQN database. Appendix 10.2, section 2.1.1 contains the exact instructions used to perform the evaluation.

Using a Voltage Control utility the 6900V Shutdown Boards are locked into the previously established DV Dropout Lower Limit (6400V) and a Load Flow analysis is run using normal, SIA, and SIB loading. From this the voltages at the 480V Safety Related boards are provided. The 480V Safety Related boards then have their respective voltage "locked" into them. All loads are turned on and a Load Flow is run which provides the voltage at the terminal of every load on the safety related boards. These voltages are then evaluated for adequacy in the Results and Conclusions sections. If necessary, this process can be implemented iteratively until the correct limit is determined. If the previous limit is acceptable, no further iterative analysis is necessary.

6.1.4.2 Minimum Starting Voltage

6.1.4.2.1 Criteria

- The 6900V Shutdown Boards voltage shall be set at the established Upper Limit of the Degraded Voltage Reset Relays, 6558.8V. Or, as low or high as possible in order to establish a new limit.
- From section 3.1.3, Acceptable Voltage Ranges, Minimum Motor Starting Voltages.

6.6kV Motors	460V Air Comp. / MOV's	All Other Motors
≥ 5280V (80%)	≥ 368V (80%)	≥ 391V (85%)

6.1.4.2.2 Methodology

This evaluation is performed using the ETAP program, reference 2.1-1, and the SQN database. Appendix 10.2, section 2.1.2 contains the exact instructions used to perform the evaluation.

Using a Voltage Control utility the 6900V Shutdown Boards are locked into the Degraded Voltage Reset Upper Limit (6558.8V) and a Load Flow analysis is run using normal, SIA, and SIB loading. From this the voltages at the 480V Safety Related boards are provided. The 480V Safety Related boards then have their respective voltage "locked" into them. All loads are turned on and a Load Flow is run which provides the starting voltage (voltage at the terminals considering full load Amps (FLA)) at the terminal of every load on the safety related boards. These voltages are then evaluated for adequacy in the Results and Conclusions sections. If necessary, this process can be implemented iteratively until the correct limit is determined. If the previous limit is acceptable, no further iterative analysis is necessary.

6.1.4.3 "Stall" Voltage

6.1.4.3.1 Criteria

- The 6900V Shutdown Boards voltage shall be set at the established Lower Limit of the Loss of Voltage Dropout Relays, 5300V. Or, as low or high as possible in order to establish a new limit.
- From section 3.1.4, Acceptable Voltage Ranges, Motor Stall Voltage. All LV motors must maintain a terminal voltage above 70.7% of motor rated voltage, excluding the following exceptions:
  - SDBD Rm Water Chiller Packages must have 75.6%.
    - Loads 122-3D, 124-5D
  - Fire/Flood Mode Pumps must have 75.6%.
    - Loads 120-3C, 126-3C
- Medium Voltage Motors must have their current curves reviewed to show that they do not stall.

6.1.4.3.2 Methodology

This evaluation is performed using the ETAP program, reference 2.1-1, and the SQN database.

Attachment No. 17 Sheet 3 of 4
Identifier 27DAT

related loads in the plant to start and accelerate so that steady state conditions have been attained. Therefore, the recovery time depends only on the Load Tap Changers and not on the motors acceleration times.

6.4.2.6 Protective Device Evaluation

Evaluate for no actuation for a duration equal to upper limit of DV Accident Time Delay (11.5s) plus motor acceleration time when applied on the diesel with Safety Bus Voltage at lower limit of DV dropout (6400V). This analysis is contained in appendix 10.1. Also see section 6.1.4.5.1.

6.4.3 Criteria & Methodology

Criteria

- All Safety Related motors must receive adequate starting voltage and attain full speed before actuating overload heaters.
- If the voltage on any of the 6.9kV Shutdown Boards drops below the upper boundary of the Degraded Voltage Dropout, 6511.8V (94.37%), it must recover above the upper limit of the Degraded Voltage Reset, 6558.8V (95.06%), before the lower limit of the Degraded Voltage Accident Time Delay expires, within 7.5s.
- The voltage level on all of the 6.9kV Shutdown Boards must remain above the upper limit of the Loss of Voltage Dropout relays, 5700V (82.61%).
- Loads 279-6, 277-18, & 280-10 (CSST Load Tap Changers) must receive greater than 70% of 480V at $t=0^{+}$ seconds.

Methodology

This evaluation is performed using the ETAP program, reference 2.1-1, and the SQN database. Appendix 10.2, section 2.4 contains the exact instructions used to perform the evaluation.

Using ETAP's Motor Starting Module the parameters as described in section 6.4.2 a transient case model is run yielding terminal voltages and currents for every load running from 0 to 10 seconds. ETAP renders an accurate model of the APS as it goes through a transient.

By reviewing the 6.9kV Shutdown Board bus voltage graphs it can be shown that though the voltage may drop below the Degraded Voltage Relay Dropout it recovers within the allotted time. The same graph will also show that the minimum voltage must remain above the Loss of Voltage Relay Dropout Upper Boundary. Reviewing the slip curves will adequately demonstrate that each Safety Related motor receiving an SI actuation signal receives adequate starting voltage and attains full speed within the time period before tripping from its Protective Device (see Results and Conclusions sections).

The Protective Device time analysis can be found in appendix 10.1.

Licensee Response/NRC Response/NRC Question Closure

Id	**365**
NRC Question Number	**KAB064**
Select Application	**NRC Response**
Attachment 1	
Attachment 2	

Response Statement

Page 10 of the Calculation B87 140924 017, Revision 9, dated September 24, 2104 notes 4 and 4a state:

4. An Ab = ±0.5% of value is a requirement of the calculation. Applies to 27DAT, 27DBT, 27DCT.

4a. Per Requirement 1, the acceptance band for calibration of the under voltage relays shall be set equal to the Re (±0.2% of value) per the requirements of TSTF-493. However, an acceptance band of 0.5% of value is conservatively retained from previous revisions in the calculation of the accuracy values for determination of the Allowable Values. Applies to 271A, 271B, 272A, 272B.

Ab493 = Re = ±0.2% of value (for use in calibration tolerances) Ab = ±0.5% of value (for use in accuracy calculations)

With regard to note 4 on sheet 10 of the calculation, please clarify the definition of An Ab. These are two different terms per the definitions and abbreviations on sheet 4 of the calculation. The note also states that it is a requirement of the calculation. NRC staff understands that the calculation is normally performed to find the requirements for the setting. Please explain what is meant by "is the requirement of the calculation".

Note 4a states Ab493 to be ±0.2% but uses an Ab of ±0.5%. The statement that an "acceptance band of 0.5% of value is conservatively retained" is confusing. Regulatory Information Summary (RIS) 2006-17 provides the guidance to calculate the as-left value. RIS 2006-17 in part states, "the setting tolerance band is less than or equal to the square root of the sum of the squares of reference accuracy, measurement and test equipment, and readability uncertainties". Please explain how you meet the guidance contained in RIS 2006-17.

Response Date/Time	**10/6/2014 6:00 PM**
Closure Statement	
Question Closure Date	
Notification	**Scott Bowman** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon**

	Lynn Mynatt **Ray Schiele** **Roger Scott**
Added By	**Kristy Bucholtz**
Date Added	**10/6/2014 1:00 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**377**
NRC Question Number	**KAB064**
Select Application	**Licensee Response**
Attachment 1	
Attachment 2	
Response Statement	**The following information is provided concerning the Staff's comments to the response to RAI KAB064 and SQN calculation B87 140924 017, Revision 9.**

1. With regard to note 4 on sheet 10 of the calculation, please clarify the definition of An Ab. These are two different terms per the definitions and abbreviations on sheet 4 of the calculation.

Response

As it pertains to Note 4, "An Ab," is not defining two different terms. "An" is the beginning article for the sentence. Note 4 explains that for calculation B87 140924 017, Revision 9, the term Ab (Acceptance band - the range of values around the correct value determined to be acceptable without recalibration) equals ± 0.5% of value.

2. The note also states that it is a requirement of the calculation. NRC staff understands that the calculation is normally performed to find the requirements for the setting. Please explain what is meant by "is the requirement of the calculation".

Response

Note 4 applies to relays 27DAT, 27DBT, and 27DCT. These relays are not within the scope of TSTF-493. Therefore, for these instruments, an acceptance band

(Ab) = 0.5% must be used for the as-left tolerance and will be documented in an output configuration control document.

3. ***Note 4a states Ab493 to be ±0.2% but uses an Ab of ±0.5%. The statement that an "acceptance band of 0.5% of value is conservatively retained" is confusing.***

Response

The calculation was revised to incorporate the requirements of TSTF-493. The term Ab_{493} was added to determine the acceptance band for the As-Left tolerance to comply with TSTF-493. Ab_{493} is smaller than Ab, which produces a tighter As-Left tolerance. An Ab of ±0.5% is maintained in the calculation for the determination of the Allowable Value. A larger Ab is more conservative for the determination of the Allowable Value.

4. ***Regulatory Information Summary (RIS) 2006-17 provides the guidance to calculate the as-left value. RIS 2006-17 in part states, "the setting tolerance band is less than or equal to the square root of the sum of the squares of reference accuracy, measurement and test equipment, and readability uncertainties". Please explain how you meet the guidance contained in RIS 2006-17.***

Response

TVA is adopting NUREG-1431, Revision 4, which incorporates TSTF-493. TSTF-493 satisfies the guidance of RIS 2006-17 when calculating As-Left tolerances. For the As-Left tolerances, TVA is setting the tolerance band equal to the square root sum of the squares (SRSS) of the reference accuracy and measuring and test equipment (M&TE) inaccuracies. In some calculation, the M&TE inaccuracies may be set to zero, which will cause a tighter As-Left tolerance.

Response Date/Time **10/22/2014 2:30 PM**

Closure Statement

Question Closure Date	
Notification	**Scott Bowman** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Scott Bowman**
Date Added	**10/22/2014 1:28 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id **389**

NRC Question Number **KAB064**

Select Application **NRC Response**

Attachment 1

Attachment 2

Response Statement

1. Item 1 of the licensee response stated the term "AnAb" is not defining two different terms. Sheet 4 of calculation 27DAT, Revision 9, defines "An" as the normal accuracy of the device and "Ab" as the acceptance band - the range of values around the correct value determined to be acceptable without recalibration. These are clearly two separate terms with different meanings. The use of term "AnAb" is confusing. Response to Item 1 also stated "the term Ab (Acceptance band – the range of values around the correct value determined to be acceptable without recalibration) equals ±0.5% of value." Staff agrees with the use of term Ab for this explanation as cited by the licensee. Licensee explanation used the correct term "Ab" as opposed to "AnAb". Please update the calculation to avoid any confusion. If the licensee plans to continue the use of term "AnAb" then it must be clearly defined as a single term in the definitions and abbreviations section of the calculation.

Further please clarify that the term "Ab – acceptance band without calibration" is the same as the term "as-left" used in TSTF-493. If not clarify the difference and provide the values of the term "as-left".

2. The licensee response that acceptance band for TSTF-493, Ab_{493} =±0.2% is acceptable as used in the calculation. However, the term "acceptance band for allowable value" is confusing. The licensee seems to be discussing the tolerance for allowable value or setting tolerance for allowable value. Since the allowable value has to consider drift and should avoid unnecessary reportability, its value will be somewhat larger than Ab, the acceptance band around the setpoint that is acceptable without recalibration.

Hence the use of Ab = ±0.5% for allowable value allowance or tolerance is confusing and undesirable. Staff suggests the calculation be changed to prevent confusion by using terms Ab with two different meanings.

3. **TSTF-493 Notes 1 and 2 have not been added to the technical specifications (TS) to address as-left and as-found values. Please add these notes to the technical specifications. If these notes are detailed in another document then reference the appropriate documents in the TS affected pages. Also please provide the wording of the notes and the values for “as-left” and “as-found” terms for staff review. These notes apply to reactor coolant pump (RCP) undervoltage loops (271A, 271B, 272A, and 272B) and 6.9kV shutdown board loss of voltage relays (27TS1A, 27TS1B, 27TS1C).**

4. **Definitions of Westinghouse methodology related terms have not been included in the definitions and abbreviations section of the calculation. These definitions should be included for completeness and to prevent confusion while reviewing the calculation.**

5. **Calculation sheets 4 and 5 provide definitions and abbreviations. However, these sheets do not include terms Lan and Las which are used on sheet 39 of the calculation. Also the term Afc used on sheets 23 and 39 of the calculation is not included in the definitions and abbreviations section. Please define these and any other abbreviations that have been used but not included in the definitions and abbreviations section of the calculation.**

6. **On page 23A of the calculation it is stated that An=As where An is the normal accuracy and As is the seismic accuracy as defined on sheet 4 of the calculation. Normally these two values are different unless the seismic accuracy is negligible. If the seismic accuracy is negligible then it should be so stated in the calculation. If not, the two values will be different. Please clarify.**

Response Date/Time	**12/1/2014 6:00 PM**
Closure Statement	
Question Closure Date	

Notification	**Scott Bowman** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Kristy Bucholtz**
Date Added	**12/1/2014 1:01 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**402**
NRC Question Number	**KAB064**
Select Application	**Licensee Response**
Attachment 1	
Attachment 2	
Response Statement	

1. Calculation 27DAT does not use the term, "AnAb" anywhere. In three different locations, the calculation uses the phrase, "An Ab…," not "AnAb" (difference is the space between An and Ab). In all three of these cases, the "An" is the article used in a sentence (such as "a," "an," or "the"), not the defined calculation term, "An." The only calculation term used in those three instances is the term, "Ab." Therefore, since the calculation does not use any term designated as "AnAb" no clarifications are required in the definitions or abbreviations.

"Ab - acceptance band without calibration" is the same as the term "as-left" used in TSTF-493, and is defined in Branch Technical Instruction, BTI-EEB-TI-28, R10. BTI-EEB-TI-28, R10 has a specific section that addresses TSTF-493 requirements and indicates that the As-Left Tolerance is equivalent to the Acceptance Band (Ab). Calculation 27DAT, provided in the SQN response to KAB064 on October 21, 2014, as Attachment 2, contains the value of Ab_{493} for the relays subject to TSTF-493 requirements.

2. There is no term "acceptance band for allowable value" used in calculation 27DAT. Note 4a on page 37 of the pdf (sheet 10) of calculation 27DAT states that, "the acceptance band [As-Left] for calibration of the under voltage relays shall be set to the Re (±0.2% of value) per the requirements of TSTF-493." Where Re (repeatability inaccuracy) = Ab_{493}. This value of ±0.2% is more conservative than the previous value of ±0.5%, in that it establishes a tighter tolerance for the As-Left acceptance criteria. Therefore, in terms of the calibration tolerances, the tighter requirements for TSTF-493 (Ab_{493}) are used.

Note 4a further states that "an acceptance band of 0.5% of value is conservatively retained from previous revisions *in the calculation*

of the accuracy values for determination of the **Allowable Values" [emphasis added]. Note 4a shows, "Ab = ±0.5% of value (for use in accuracy calculations)." These statements do not mean that the Allowable Value (AV) is equal to the acceptance band of ±0.5%.**

The inclusion of any Ab term within the accuracy computation addresses the fact that uncertainty can be imparted to the measurement of the process in question due to the calibration process, including tolerances. When used in an accuracy computation that will be used for the derivation of Setpoints and Allowable Values, the use of a larger uncertainty term is conservative because it produces more separation between the Analytical Limit and the Setpoint. Therefore, the larger Ab term is retained for use in the accuracy computations for the Setpoint and Allowable Value. Although the Setpoint is specifically defined in another calculation, the summary of results on pdf page 88, of calculation 27DAT, (Sheet 49B) shows that margin exists between the Setpoint and Analytical Limit, considering the uncertainty values (An and As), which include the larger Ab value within their computations, as shown on pdf page 59 (Sheet 23A) of the calculation. In calculation 27DAT, page 80 of the pdf (Sheet 40) shows the computation of the Allowable Value using accuracies, based on the larger Ab. Therefore, Ab has been conservatively applied to the accuracy computations for the Setpoint and Allowable Value, and Ab_{493} has been conservatively applied for the calibration tolerances.

3. As part of the original submittal for the ITS LAR, the two TSTF-493 notes were included in ITS LCO 3.3.1 and 3.3.2 for all the functions that are required to meet TSTF-493. The functions have the (b) and (c) footnote annotation and the footnotes are at the bottom of the pages. See page 5 and 6 of Attachment 1 to the initial response for RAI KAB064 for examples of these footnotes. As stated in footnote (c), the methodologies used to determine the as-found and as-left values are specified in UFSAR Section 7.1.2. An FSAR change is currently in progress to provide the methodologies in Section 7.1.2 of the UFSAR, and will be complete prior to implementation of ITS. In calculation 27DAT, the As-Found value for the RCP Undervoltage loops (271A, 271B, 272A, and 272B) is found on page 59 of the pdf (Sheet 23A), As-Found is equal to ±0.57% of setpoint. The As-Left value for the RCP Undervoltage loops is found on page 22 of the pdf (Sheet 2), the As-Left is equal to ±0.2% of value. The As-Found value for the

6.9kV shutdown board loss of voltage relays (27TS1A, 27TS1B, 27TS1C) is found on page 60 of the pdf (Sheet 24), As-Found is equal to ±1.926% of setpoint. The As-Left value for the 6.9kV shutdown board loss of voltage relays is found on page 22 of the pdf (Sheet 2), As-Left is equal to ±0.5% of value.

As-Found and As-Left values are controlled through Setpoint and Scaling Documents (SSDs). SSDs serve as the design output document to transmit the requirements to site organizations to ensure values assessed in the safety analyses and/or other design documents relative to instrument setpoints, scaling and calibration are in fact incorporated in the plant as assessed in the relevant design documents. Changes to As-Found and/or As-Left values require a Design Change to be processed via the Engineering Change Process. The As-Found and As-Left values listed in the SSDs are incorporated into Surveillance Instructions (SIs) that are performed to verify Technical Specification Surveillance Requirements. The SIs are annotated with requirements to evaluate setpoints found outside the As-Found tolerances to verify the channel is functioning as required before returning the channel to service. Additionally, this condition will be entered into the Corrective Action Program. The SIs also require that an instrument channel shall be declared inoperable if it cannot be reset to within the As-Left tolerance.

4. TVA's process for describing the method for determining the acceptability of setpoints for nuclear safety-related and Technical Specification instrumentation channels is governed by Branch Technical Instruction BTI-EEB-TI-28. Calculations under the scope of this instruction must follow the process outlined in this branch instruction. In some cases, terms and definitions are specified within the individual calculations; however, any term not specified within the individual calculation is defined in this branch technical instruction.

5. The terms LAn and LAs are defined in BTI-EEB-TI-28, Revision 10. LAn is the Normal Loop Accuracy. LAs is the Post-Seismic Loop Accuracy. The term Afc is defined on pdf page 59 (sheet 23A) of calculation 27DAT. Afc is the Acceptable-As-Found, Component. Therefore, Afc is the As-Found value for a particular component. BTI-EEB-TI-28, Rev. 10 also defines the term A_{fc} as the Acceptable As-Found - Component.

6. Calculation 27DAT defines the term Se on pdf page 27 (Sheet 5)

as the inaccuracy following a seismic event. Page 36 of the pdf (Sheet 9) states that Se is negligible and refers to Note 6, which is on pdf page 38 (Sheet 11). Note 6 states that post-seismic effects are negligible for this solid state relay. Therefore, An = As, as stated in the calculation.

Response Date/Time	**12/16/2014 5:00 PM**
Closure Statement	
Question Closure Date	
Notification	**Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Scott Bowman**
Date Added	**12/16/2014 3:58 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**403**
NRC Question Number	**KAB064**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**12/18/2014**
Notification	**Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**12/18/2014 2:31 PM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**174**
NRC Question Number	**KAB065**
Category	**Technical**
ITS Section	**3.3**
ITS Number	**3.3.1**
DOC Number	
JFD Number	
JFD Bases Number	
Page Number(s)	
NRC Reviewer Supervisor	**Rob Elliott**
Technical Branch POC	**Gursharan Singh**
Conf Call Requested	**N**
NRC Question	**Request for additional information regarding Sequoyah RCP Underfrequency Relays setpoint calculation number SQN-EEB-MS-T128-0076, Rev. 5**

The above calculation was provided in support of the Sequoyah ITS request. Staff requests the following clarifications with request to this calculation:

1. **Note 2 on page number 14 of the calculation justifies the use of a drift value of ±0.553 Hz. In its letter dated June 3, 1994 ABB stated that ABB Type 81 Frequency Relay employs a very stable crystal controlled oscillator as frequency reference. It further stated that a drift value of 0.01 Hz over a period of 22.5 months will be very conservative. ABB also stated that the suggested drift of high magnitude suggested by the licensee would be indicative of a defective relay. In note 2, the licensee states that the drift value of ±0.553 Hz is highly conservative.**

   Please note that using a high drift value will mask the potential degrading of the instrument. The deviation in the as-found value should be based on regulatory information summary (RIS) 2006-17. The deviation number selected should be high enough to prevent unwanted excursions beyond the allowable value while it should be low enough to detect potential degradation of the instrument. The licensee is requested to use a drift number using the guidance of

RIS 2006-17.

2. **Please note that ISA RP-67.04.02 recommends that the accuracy of measurement and test equipment should be four times better than the accuracy of the instrument that is being calibrated. IEEE-498 also recommends this accuracy. The staff notes that the accuracy of the underfrequency relay is 0.008Hz whereas the accuracy of the test instrument is 0.05 Hz. The selection of a calibration instrument that is six times more inaccurate than the instrument being calibrated is highly undesirable and must be justified within the calculation.**

Attach File 1	
Attach File 2	
Issue Date	**7/15/2014**
Added By	**Kristy Bucholtz**
Date Modified	
Modified By	
Date Added	**7/15/2014 8:18 AM**
Notification	**Scott Bowman** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**

Licensee Response/NRC Response/NRC Question Closure

Id	**371**
NRC Question Number	**KAB065**
Select Application	**Licensee Response**
Attachment 1	**Attachment 1 to KAB065.pdf** (81KB)
Attachment 2	**Attachment 2 SQN-EEB-MS-T128-0076.pdf** (14MB)
Response Statement	**In response to KAB065, the RCP Underfrequency Relay setpoint calculation number SQN-EEB-MS-TI28-0076, Revision 5, has been revised . Revision 7 revises the RCP underfrequency relay drift, Measuring and Test Equipment (M&TE) values and calibration tolerances to support the implementation of TSTF-493. Due to the reference accuracy of the relay greatly exceeding the minimum increment available to adjust the relay setpoint, the drift value is considered negligible and set to zero. This drift value has been factored into the as-found value calculation using the square root sum of the squares method based on TSTF-493, Revision 4, which incorporated the guidance of RIS 2006-17. The accuracy of the M&TE is also addressed in the calculation revision. The reference accuracy of the underfrequency relay is ±0.008 Hz, the M&TE will be at least as accurate as the underfrequency relay. TVA's standard program and processes dictates that the calibration standards shall have an accuracy of at least four times the required accuracy of the M&TE being calibrated. When it is not possible to have a 4:1 ratio, standards shall have an accuracy that ensures that the plant equipment being calibrated will be within its required tolerances. The basis for acceptance of standards with accuracies less than four times that of the M&TE will be documented and authorized by the responsible TVA management. With the calibration requirements of the M&TE to a reference standard and the M&TE being at least as accurate as the underfrequency relay, which is in compliance with TVA's calibration program, the as-found values will be low enough to detect potential degradation of the instrument.** **Additionally, as a result of the increased accuracy used in calculation, SQN-EEB-MS-TI28-0076, Revision 7, the Allowable Value (AV) for ITS Table 3.3.1-1, Function 12 (Underfrequency RCPs), on pages 120 and 152 of Enclosure 2, Volume 8, will be revised. The AV will be revised from the originally proposed value of 56.3 Hz to 56.973 Hz. Corresponding changes will be made to the CTS markups for CTS Table 2.2-1, Functional Unit 16 (Underfrequency-Reactor Coolant Pumps), and Discussion of Change M24.** **See Attachment 1 for the draft revised CTS and ISTS markups.** **See Attachment 2 for the revised calculation for the RCP underfrequency relays.**
Response Date/Time	**10/16/2014 2:05 PM**

Closure Statement	
Question Closure Date	
Notification	**Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Scott Bowman**
Date Added	**10/16/2014 1:05 PM**
Date Modified	
Modified By	

ITS | A01 | ITS 3.3.1

Table 3.3.1-1

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

	FUNCTIONAL UNIT	NOMINAL TRIP SETPOINT	ALLOWABLE VALUES
	14. Deleted		
11	15. Undervoltage-Reactor Coolant Pumps	5022 volts-each bus	≥ 4739 volts-each bus
12	16. Underfrequency-Reactor Coolant Pumps	~~56.0~~ 57.0 Hz - each bus	≥ ~~55.9~~ ~~56.3~~ 56.973 Hz - each bus (M24)
14	17. Turbine Trip		
	A. Low Trip System Pressure	45 psig	≥ 39.5 psig
	B. Turbine Stop Valve Closure	1% open	≥ 1% open
15	18. Safety Injection Input from ESF	Not Applicable	Not Applicable
16.a	19. Intermediate Range Neutron Flux - (P-6) ~~Enable Block Source Range Reactor Trip~~ (LA07)	1 x 10^{-4}% of RATED THERMAL POWER	≥ 6 x 10^{-5}% of RATED THERMAL POWER
16.e	20. Power Range Neutron Flux (~~not~~ P-10) ~~Input to Low Power Reactor Trips Block P-7~~ (LA07, A21)	10% of RATED THERMAL POWER	≤ 12.4% of RATED THERMAL POWER

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ITS

A01

ITS 3.3.1

Table 3.3.1-1

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

	FUNCTIONAL UNIT	NOMINAL TRIP SETPOINT	ALLOWABLE VALUES
	b. RCS Loop ΔT Equivalent to Power > 50% RTP		
	Coincident with		
	Steam Generator Water Level -- Low-Low (Adverse)	15.0% of narrow range instrument span	≥ 14.4% of narrow range instrument span
	and		
	Containment Pressure (EAM)	0.5 psig	≤ 0.6 psig
	or		
	Steam Generator Water Level -- Low-Low (EAM)	10.7% of narrow range instrument span	≥ 10.1% of narrow range instrument
	14. Deleted		
11	15. Undervoltage-Reactor Coolant Pumps	5022 volts-each bus	≥ 4739 volts - each bus
12	16. Underfrequency-Reactor Coolant Pumps	~~56.0~~ 57.0 Hz - each bus	≥ ~~55.9~~ 56.3 56.973 Hz - each bus
14	17. Turbine Trip		
14.a	A. Low Trip System Pressure	45 psig	≥ 39.5 psig
14.b	B. Turbine Stop Valve Closure	1% open	> 1% open
15	18. Safety Injection Input from ESF	Not Applicable	Not Applicable

M24

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DISCUSSION OF CHANGES
ITS 3.3.1, REACTOR TRIP SYSTEM (RTS) INSTRUMENTATION

requirements to ensure that the automatic protective action will correct the abnormal situation before a safety limit is exceeded. This change is consistent with TSTF-493 Option A. This change is considered a more restrictive change because additional requirements have been added to Surveillance Requirements.

56.973

M24 CTS Table 2.2-1 for Functional Unit 16 (Underfrequency-Reactor Coolant Pumps) lists the Nominal Trip Setpoint as 56.0 Hz – each bus, and the Allowable Value as ≥ 55.9 Hz – each bus. ITS Table 3.3.1-1 for Function 12 (Underfrequency RCPs) lists the Nominal Trip Setpoint as 57.0 Hz and the Allowable Value as ≥ ~~56.3~~ Hz. This changes the CTS by increasing the Nominal Trip Setpoint and the Allowable Value for the Underfrequency RCP reactor trip.

Additionally, TVA is proposing to change the Allowable Value based on TVA's revised calculations necessary to support the implementation of TSTF-493.

The purpose of the Underfrequency RCP reactor trip is to ensure that protection is provided against violating the DNBR limit due to a loss of flow in two or more RCS loops from a major network frequency disturbance. TVA has determined that to provide adequate protection changes to the Underfrequency RCP Nominal Trip Setpoint and the Allowable Value are needed. This change was previously proposed in SQN license amendment request TVA-SQN-TS-02-01, Revision 1 (ADAMS Accession No. 042430467) but later withdrawn in TVA-SQN-TS-02-01, Revision 2 (ADAMS Accession No. ML061990303) pending resolution of issues with TSTF-493. In Revision 2 TVA stated that a new TS amendment request would be submitted to the NRC once TSTF-493 receives NRC approval. As TSTF-493 has been approved by the NRC and is being adopted under this conversion, TVA is proposing to change the setpoints to these proposed in the previous submittal. ~~This change is~~ acceptable because the revised Allowable Value and Nominal Trip Setpoint continue to provide assurance that the safety limit for the underfrequency reactor trip function is not impacted. In addition, this change ensures instrument uncertainties have been included in the as-found tolerance calculations in a manner that is acceptable and the surveillance Note requirements also ensure that there will be a reasonable expectation that these instruments will perform their safety function if required. This change is designated as more restrictive because more stringent acceptance requirements are being applied in the ITS than were applied in the CTS.

value

These changes are

Nominal Trip S

RELOCATED SPECIFICATIONS

None

REMOVED DETAIL CHANGES

LA01 *(Type 5 – Removal of SR Frequency to the Surveillance Frequency Control Program)* The proposed change removes all designated periodic Surveillance Frequencies from CTS 4.3.1.1.1, as addressed in CTS Table 4.3-1, CTS 4.3.1.1.2, and CTS 4.3.1.1.3, and places the Frequencies under licensee control in accordance with a new program, the Surveillance Frequency Control Program. ITS 3.3.1 Surveillance Requirements require similar Surveillances and, except for special or conditional frequencies stated in the individual surveillance, specifies the periodic Frequency as, "In accordance with the Surveillance Frequency

CTS

RTS Instrumentation (Without Setpoint Control Program) 1
3.3.1A

56.973

Table 3.3-1
Table 4.3-1

Table 3.3.1-1 (page 4 of 8)
Reactor Trip System Instrumentation

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	[NOMINAL(l) TRIP SETPOINT]	
								3
17 Table 2.2-1 Function 16	12 ~~13~~. Underfrequency RCPs	1(g)	~~[3]~~ per bus 1	K	SR 3.3.1.9 SR 3.3.1.10(b)(c) SR 3.3.1.~~16~~ 14	≥ ~~[57.1]~~ 56.3 Hz	~~[57.5]~~ 57.0 Hz	2 3 9
14 Table 2.2-1 Function 13	13 ~~14~~. Steam Generator (SG) Water Level - ~~Low Low~~ INSERT 4	~~1,2~~	~~[4 per SG]~~	~~E~~	~~SR 3.3.1.1~~ ~~SR 3.3.1.7(b)(c)~~ ~~SR 3.3.1.10(b)(c)~~ ~~SR 3.3.1.16~~	~~≥ [30.4]%~~	~~[32.3]%~~	14 2
	INSERT 5 ~~15. SG Water Level - Low~~	~~1,2~~	~~2 per SG~~	~~E~~	~~SR 3.3.1.1~~ ~~SR 3.3.1.7(b)(c)~~ ~~SR 3.3.1.10(b)(c)~~ ~~SR 3.3.1.16~~	~~≥ [30.4]%~~	~~[32.3]%~~	
	~~Coincident with Steam Flow/Feedwater Flow Mismatch~~	~~1,2~~	~~2 per SG~~	~~E~~	~~SR 3.3.1.1~~ ~~SR 3.3.1.7(b)(c)~~ ~~SR 3.3.1.10(b)(c)~~ ~~SR 3.3.1.16~~	~~≤ [42.5]% full steam flow at RTP~~	~~[40]% full steam flow at RTP~~	
18 Table 2.2-1 Function 17	14 ~~16~~. Turbine Trip							2
	a. Low Fluid Oil Pressure	1(~~j~~) h	3	~~N~~ L	SR 3.3.1.10(b)(c) SR 3.3.1.~~15~~ 13	≥ ~~[750]~~ 39.5 psig	~~[800]~~ 45 psig	2 3
	b. Turbine Stop Valve Closure	1(~~j~~)	4	~~N~~	SR 3.3.1.10 SR 3.3.1.~~15~~ 13	≥ ~~[~~1~~]~~% open	~~[~~1~~]~~% open	2 3 2
19 Table 2.2-1 Function 18	15 ~~17~~. Safety Injection (SI) Input from Engineered Safety Feature Actuation System (ESFAS)	1,2	2 trains	~~O~~ M	SR 3.3.1.~~14~~ 12	NA	NA	2

DOC M22 (b) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

DOC M23 (c) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the NTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures (field setting) to confirm channel performance. The ~~NTSP and the~~ methodologies used to determine the as-found and as-left tolerances are specified in ~~[insert the facility FSAR reference or the name of any document incorporated into the facility FSAR by reference]~~ UFSAR Section 7.1.2. 10 3

DOC L02 (g) Above the P-7 (Low Power Reactor Trips Block) interlock.

Note ** (~~j~~ h) Above the P-9 (Power Range Neutron Flux) interlock. 2

~~REVIEWER'S NOTE~~

~~(l) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.~~ 4

CTS

RTS Instrumentation (Without Setpoint Control Program) 1
3.3.1A

Table 3.3-1
Table 4.3-1

Table 3.3.1-1 (page 4 of 8)
Reactor Trip System Instrumentation

56.973

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	[NOMINAL(f) TRIP SETPOINT]	
17 Table 2.2-1 Function 16	12 13. Underfrequency RCPs	1(g)	[3] per bus (1)	K	SR 3.3.1.9 SR 3.3.1.10(b)(c) SR 3.3.1.16 (14)	≥ [57.1] 56.3 Hz	[57.5] 57.0 Hz	2 3 9
14 Table 2.2-1 Function 13	13 14. Steam Generator (SG) Water Level - Low Low (INSERT 4)	1,2	[4 per SG]	E	SR 3.3.1.1 SR 3.3.1.7(b)(c) SR 3.3.1.10(b)(c) SR 3.3.1.16	≥ [30.4]%	[32.3]%	14 2
	(INSERT 5) 15. SG Water Level - Low	1,2	2 per SG	E	SR 3.3.1.1 SR 3.3.1.7(b)(c) SR 3.3.1.10(b)(c) SR 3.3.1.16	≥ [30.4]%	[32.3]%	
	Coincident with Steam Flow/Feedwater Flow Mismatch	1,2	2 per SG	E	SR 3.3.1.1 SR 3.3.1.7(b)(c) SR 3.3.1.10(b)(c) SR 3.3.1.16	≤ [42.5]% full steam flow at RTP	[40]% full steam flow at RTP	
18 Table 2.2-1 Function 17	14 16. Turbine Trip							2
	a. Low Fluid Oil Pressure	1(j) h	3	N L	SR 3.3.1.10(b)(c) SR 3.3.1.15 (13)	≥ [750] 39.5 psig	[800] 45 psig	2 3
	b. Turbine Stop Valve Closure	1(j)	4	N L	SR 3.3.1.10 SR 3.3.1.15 (13)	≥ [1]% open	[1]% open	2 3 2
19 Table 2.2-1 Function 18	15 17. Safety Injection (SI) Input from Engineered Safety Feature Actuation System (ESFAS)	1,2	2 trains	O M	SR 3.3.1.14 (12)	NA	NA	2

DOC M22 (b) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

DOC M23 (c) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the NTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures (field setting) to confirm channel performance. The NTSP and the methodologies used to determine the as-found and as-left tolerances are specified in [insert the facility FSAR reference or the name of any document incorporated into the facility FSAR by reference] UFSAR Section 7.1.2. 10 3

DOC L02 (g) Above the P-7 (Low Power Reactor Trips Block) interlock.

Note ** (j) h Above the P-9 (Power Range Neutron Flux) interlock. 2

REVIEWER'S NOTE

(f) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit. 4

ORIGINAL QA Record

NPG CALCULATION COVERSHEET / CTS UPDATE

REV 0 EDMS/RIMS NO.	CTS TYPE:	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
B87940628001	Calculation	CALCULATIONS (NUCLEAR)	B87 140930 013

Calc Title: Demonstrated Accuracy Calculation
RCP UNDERFREQUENCY RELAYS

	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV
CALC ID	NUC	SQN	EEB	SQN-EEB-MS-TI28-0076	006	007

CTS UPDATE ONLY ☐ (Verifier and Approval Signatures Not Required)

NO CTS CHANGES ☐ (For calc revision, CTS has been reviewed and no CTS changes required)

UNIT (check one)	SYSTEMS	UNIDS
0 ☒, 1 ☐, 2 ☐, 3 ☐	068 202 250	Various

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
DCN D23339	N/A	EM

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

CALCULATION NUMBER REQUESTOR	PREPARING DISCIPLINE	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
Name: PHONE:	E	Design Review	☐ Yes ☒ No

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
DuWayne Wacha [signature]	9/24/14	Kirk R. Melson [signature]	9/24/14
VERIFIER (PRINT NAME AND SIGN)	**DATE**	**APPROVAL (PRINT NAME AND SIGN)**	**DATE**
Kirk R. Melson [signature]	9/24/14	JANICE CRUZ [signature]	9/25/2014

STATEMENT OF PROBLEM/ABSTRACT

Determine the accuracy of the subject instrument loops and demonstrate that the accuracy is adequate for the intended purpose. Primary elements are not located in a Harsh environment. The subject devices are not part of PAM.

RCP UNDERFREQUENCY RELAYS
Calculations were performed to determine the accuracy of the subject instrument loops. The determined accuracies were compared to the required accuracies, setpoints, safety limits and/or operating limits and the accuracy for the loops listed below were demonstrated to be acceptable for the intended function:

1-81-068-344D
1-81-068-346E
1-81-068-348F
1-81-068-350G
2-81-068-344D
2-81-068-346E
2-81-068-348F
2-81-068-350G

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

NPG CALCULATION COVERSHEET / CTS UPDATE

CALC ID	ORG	PLANT	BRANCH	NUMBER	REV
	NUC	SQN	EEB	SQN-EEB-MS-TI28-0076	007

BUILDING	ROOM	ELEVATION	COORD/AZIM	FIRM

CATEGORIES D09

KEYWORDS (A-add, D-delete)

ACTION (A/D)	KEYWORD	A/D	KEYWORD

CROSS-REFERENCES (A-add, D-delete)

ACTION (A/D)	XREF CODE	XREF PLANT	XREF TYPE	XREF NUMBER	XREF REV
A	P	SQN	DCN	D23339	

CTS ONLY UPDATES:
Following are required only when making keyword/cross reference CTS updates and page 1 of form NEDP-2-1 is not included:

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
N/A	N/A	N/A	N/A

PREPARER PHONE NO.	EDMS ACCESSION NO.
N/A	N/A

ORIGINAL

QA Record

NPG CALCULATION COVERSHEET/CTS UPDATE

Page ~~A1~~ A3 |R7

REV 0 EDMS/RIMS NO.	CTS TYPE:	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
B87 940628 001	Calculations	Calculations(Nuclear)	L57 140613 002

Calc Title: Demonstrated Accuracy Calculation
RCP UNDERFREQUENCY RELAYS

	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV
CALC ID	NUC	SQN	EEB	SQN-EEB-MS-TI28-0076	5	6

CTS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)

No CTS Changes ☒ (For calc revision, CTS been reviewed and no CTS changes required)

UNITS	SYSTEMS	UNIDS
0 ☐, 1 ☒, 2 ☒, 3 ☐	068, 202, 250	Various

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
N/A	N/A	EM

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

CALCULATION NUMBER REQUESTOR	PREPARING DISCIPLINE	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
Name: Gregory G. Mailen Phone: 843-8065	ELECTRICAL	DESIGN REVIEW	☐ Yes ☒ No

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
Gregory G. Mailen *Gregory G. Mailen*	1/16/14	JOHN M. CAMPBELL *[signature]*	5/21/14
VERIFIER (PRINT NAME AND SIGN)	**DATE**	**APPROVAL (PRINT NAME AND SIGN)**	**DATE**
JOHN M. CAMPBELL *[signature]*	5/21/14	*[signature]* Janice D. Cruz	5/21/2014

STATEMENT OF PROBLEM/ABSTRACT

Determine the accuracy of the subject instrument loops and demonstrate that the accuracy is adequate for the intended purpose. Primary elements are not located in a Harsh environment. The subject devices are not part of PAM.

RCP UNDERFREQUENCY RELAYS

Calculations were performed to determine the accuracy of the subject instrument loops. The determined accuracies were compared to the required accuracies, setpoints, safety limits and/or operating limits and the accuracy for the loops listed below.

1-81-068-344D
1-81-068-346E
1-81-068-348F
1-81-068-350G
2-81-068-344D
2-81-068-346E
2-81-068-348F
2-81-068-350G

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

NPG CALCULATION COVERSHEET/CTS UPDATE

CALC ID	ORG	PLANT	BRANCH	NUMBER	REV
	NUC	SQN	EEB	SQN-EEB-MS-TI28-0076	6

ALTERNATE CALCULATION IDENTIFICATION

BUILDING	ROOM	ELEVATION	COORD/AZIM	FIRM

KEY NOUNS (A-add, D-delete)

ACTION (A/D)	KEY NOUN	A/D	KEY NOUN

CROSS-REFERENCES (A-add, C-change, D-delete)

ACTION (A/C/D)	XREF CODE	XREF TYPE	XREF PLANT	XREF BRANCH	XREF NUMBER	XREF REV

CTS ONLY UPDATES:
Following are required only when making keyword/cross reference CCRIS updates and page 1 of form NEDP-2-1 is not included:

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
PREPARER PHONE NO.	EDMS ACCESSION NO.		

ORIGINAL

QA Record

NPG CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	CTS TYPE:	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
B87 940628 001	Calculations	Calculations(Nuclear)	B87 140131 001

Calc Title: Demonstrated Accuracy Calculation
RCP UNDERFREQUENCY RELAYS

	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV
CALC ID	NUC	SQN	EEB	SQN-EEB-MS-TI28-0076	4	5

CTS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)

No CTS Changes ☐ (For calc revision, CTS been reviewed and no CTS changes required)

UNITS	SYSTEMS	UNIDS
0 ☐, 1 ☐, 2 ☐ 3 ☐	068, 202, 250	Various

DCN.EDC.N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
N/A	N/A	EM

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

CALCULATION NUMBER REQUESTOR	PREPARING DISCIPLINE	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
Name: Gregory G. Mailen Phone: 843-8065	ELECTRICAL	DESIGN REVIEW	☐ Yes ☒ No

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
Gregory G. Mailen *Gregory G. Mailen*	1/16/14	NAVIN S. SHAH *N S Shah*	1-23-14
VERIFIER (PRINT NAME AND SIGN)	**DATE**	**APPROVAL (PRINT NAME AND SIGN)**	**DATE**
NAVIN S. SHAH *N S Shah*	1-23-14	JANICE CRUZ *Janice Cruz*	1/23/14

STATEMENT OF PROBLEM/ABSTRACT

Determine the accuracy of the subject instrument loops and demonstrate that the accuracy is adequate for the intended purpose. Primary elements are not located in a Harsh environment. The subject devices are not part of PAM.

RCP UNDERFREQUENCY RELAYS

Calculations were performed to determine the accuracy of the subject instrument loops. The determined accuracies were compared to the required accuracies, setpoints, safety limits and/or operating limits and the accuracy for the loops listed below.

1-81-068-344D
1-81-068-346E
1-81-068-348F
1-81-068-350G
2-81-068-344D
2-81-068-346E
2-81-068-348F
2-81-068-350G

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

NPG CALCULATION COVERSHEET/CTS UPDATE

CALC ID	ORG	PLANT	BRANCH	NUMBER	REV
	NUC	SQN	EEB	SQN-EEB-MS-TI28-0076	5

ALTERNATE CALCULATION IDENTIFICATION

BUILDING	ROOM	ELEVATION	COORD/AZIM	FIRM

CATEGORIES D09

KEY NOUNS (A-add, D-delete)

ACTION (A/D)	KEY NOUN	A/D	KEY NOUN

CROSS-REFERENCES (A-add, C-change, D-delete)

ACTION (A/C/D)	XREF CODE	XREF TYPE	XREF PLANT	XREF BRANCH	XREF NUMBER	XREF REV

CTS ONLY UPDATES:
Following are required only when making keyword/cross reference CCRIS updates and page 1 of form NEDP-2-1 is not included:

PREPARER (PRINT NAME AND SIGN)	DATE	CHECKER (PRINT NAME AND SIGN)	DATE
PREPARER PHONE NO.	EDMS ACCESSION NO		

ORIGINAL

QA Record
A7 ~~A5~~ |R7

TVAN CALCULATION COVERSHEET

Title DEMONSTRATED ACCURACY CALCULATION RCP UNDERFREQUENCY RELAYS	Plant SQN Unit 1&2
Preparing Organization EEB-I&C	Key Nouns (For RIMS) I&C, INSTR, CALIBRATION,SETPOINT, ACCURACY
Branch/Project Identifiers SQN-EEB-MS-TI28-0076	Each time these calculations are issued, preparer must ensure that the original (R0) RIMS accession number is filled in.

Applicable Design Document(s)	Rev	(for RIMS use)	RIMS Accession Number
SQN-DC-V-27.9	R0	'940711G0001	B87 940628 001
	R3		B87 980612 016
SAR affected: ☐ Yes ☒ No; Section(s): TABLE CH. 7, 8, 15 — UNID System(s) 068, 202, 250	R4		B87 000327 002
	R		

	Revision 0	R3	R4	R
Design Change Document No. (or indicate Not Applicable)		N/A	N/A	
Prepared	DAVID E. HAUN	[signature]	[signature]	
Checked	ALAN P. JANNEY	[signature]	[signature]	
Reviewed	M. J. SCHELDROTH	[signature]	[signature]	
Approved	CRAIG R. BUTCHER	[signature]	[signature]	
Date	6/24/94	5/15/98	11/9/98	

	Yes	No
Quality Related?	☒	☐
Safety Related?	☒	☐
These calculations contain unverified assumption(s) that must be verified later?	☐	☒
These calculations contain special requirements and/or limiting conditions?	☐	☒
These calculations contain a design output attachment?	☐	☒
Calculation Revision		
Entire Calculation	☒	
Selected pages	☐	
Not Applicable	☐	

Statement of Problem:

Determine the accuracy of the subject instrument loop(s) and demonstrate that the accuracy is adequate for the intended purpose. Primary elements ☐ are ☒ are not located in a Harsh environment. Subject devices ☐ are ☒ are not part of PAM.

RCP UNDERFREQUENCY RELAYS

Abstract

Calculations were performed to determine the accuracy of the subject instrument loop(s). The determined accuracies were compared to the required accuracies, setpoints, safety limits and/or operating limits and the accuracy for the loops listed below were demonstrated to be acceptable for the intended function of the instrument loops listed below.

1-81-068-344D
1-81-068-346E
1-81-068-348F
1-81-068-350G
2-81-068-344D
2-81-068-346E
2-81-068-348F
2-81-068-350G

☒ Microfilm and return calculation to Calculation Library. Address:OPS 1A-SQN
☐ Microfilm and return calculation to:
☐ Microfilm and destroy.

TVA 10697 (DNE-QA-6-86) QA Record DNE CALCULATIONS ORIGINAL A8 ~~A6~~ R7

Title: DEMONSTRATED ACCURACY CALCULATION RCP UNDERFREQUENCY RELAYS		Plant/Unit: SQN / UNIT 2 + 1
Preparing Organization: EEB-I&C	KEY NOUNS (Consult RIMS Descriptors List): I&C, INSTR, CALIBRATION, SETPOINT, ACCURACY	
Branch/Project Identifiers: SQN-EEB-MS-TI28-0076	Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.	

Rev	(for RIMS' use)	rims accession number
~~R0~~		~~B87 940627 008~~ 6/27/94
R0	'94 0711G0001	B87 940629 001
R1	'95 0320G0036	B87 950313 009
R2		B87 980305 002

Applicable Design Document(s): SQN-DC-V-27.9

SAR Section(s): CH. 7, 8, 15 | UNID System(s): 068, 202, 250

Safety-related? Yes (✓) No ( )

	Revision 0	R1	R2	R3
ECN No. (or Indicate Not Applicable)	DCN M-10396-A	DCN M10441A	NA	NA
Prepared	David E. Haun (DAVID E. HAUN)	[signature]	[signature]	[signature]
Checked	Alan P. [signature]	Alan P. [signature]	[signature]	[signature]
Reviewed	MJ [signature]	MJ [signature]	[signature]	[signature]
Approved	[signature]	[signature]	[signature]	[signature]
Date	6/21/94	2/23/95	2/25/98	6/15/99
USE FORM TVA 10534 IF MORE SPACE REQUIRED: List all pages added by this revision		SEE REV LOG	See Rev Log	See Rev Log
List all pages deleted by this revision				
List all pages changed by this revision				

Statement of Problem

Determine the accuracy of the subject instrument loop(s) and demonstrate that the accuracy is adequate for the intended purpose. Primary elements are located in a HARSH environment. Subject devices / /are /X/are not part of PAM.

RCP UNDERFREQUENCY RELAYS

R1 Revises Entire Calculation

R2 Revises Entire Calculation

These calculations contain an unverified assumption(s) that must be verified later. Yes ( ) No (X)

ABSTRACT [These calculations contain an unverified assumption(s) that must be verified later. Calculations were performed to determine the accuracy of the subject instrument loop(s). The determined accuracies were compared to the required accuracies, setpoints, safety limits and/or operating limits and the accuracy for the loop(s) listed below were demonstrated to be acceptable for the intended function of the instrument loop(s). This calculation applies to the instrument loop(s) listed below:

2-81-068-344D
2-81-068-346E
2-81-068-348F
2-81-068-350G

1-81-068-344D
1-81-068-346E
1-81-068-348F
1-81-068-350G

R2

R1

Calculation contains Special Requirements or Limiting Conditions
YES ☒ NO
DDM 11-7-97

( ) Microfilm and store calculations in RIMS Service Center

(X) Microfilm and return calculations to: ERCW

Microfilm and destroy. ( )

Address: ~~DSK 1A~~ - SQN OPS-1B

DNE1 - 2548M

cc: RIMS, SL 26 C-K

TVA

Title: DEMONSTRATED ACCURACY CALCULATION
RCP UNDERFREQUENCY RELAYS SQN-EEB-MS-TI28-0076

REVISION LOG

Revision No.	DESCRIPTION OF REVISION	Date Approved
0	Initial Issue per DCN M-10396-A. This calculation consists of 141 pages. Legibility Evaluated and Accepted for Issue — [signature] LE Signature — 6/24/94 Date FSAR Compliance Review — [signature] LE Signature — 6/24/94 Date **NOTE** Upon the next major revision of this calculation, as-found data shall be retrieved from past performances of 2-SI-TFT-068-230.0 (Reference 25) in accordance with requirement 4 of this calculation. This data is to be evaluated to determine the amount of conservatism in the existing drift error analysis and to ensure compliance with the allowable value. – CHANGED CALCULATION NUMBER FROM SQN-EEB-MS-TI28-0075 TO SQN-EEB-MS-TI28-0076 AFTER INITIAL APPROVAL. [signature] PREPARED — 6-27-94 DATE — C.R. Butcher / [initials] LE SIGNATURE — 6-27-94 DATE	

R2

REVISION LOG

Title: Demonstrated Accuracy Calculation RCP Underfrequency Relays SQN-EEB-MS-TI28-0076

Revision No.	DESCRIPTION OF REVISION	Date Approved
1.	DCN M10441A adds the Unit 1 information for the UF relay replacement. The values used in the Unit 2 calculations are the same as the Unit 1 values, therefore the resulting setpoint and allowable values are the same for both units. This revision adds the Unit 1 references. The following documents were added for Unit 1: Attachment 3: Unit 1 Tech Spec Table 2.2.1 and section 3/4.3.1; FSAR Table 7.5.2-1 (FSAR Change 11-42) Attachment 5: 1,2-45N763-2 R9 (DCA from M10441A) Attachment 8: Excerpts from 1-SI-TDC-068-218.0 Attachment 9: Excerpts from 1-SI-IRT-099-400.0 Attachment 15: Excerpts from 1-SI-TFT-068-230.0 The Unit 2 Technical Specification Table 2.2.1 referenced in Revision 0 has been deleted from the Tech Specs and added to the FSAR. Therefore, this table has been deleted from this calculation and the appropriate FSAR change added. The information in the Attachments listed above has been reorganized as necessary to group like tables and information together and all the pages of the subject Attachments have been renumbered. Pages Deleted: FSAR Compliance Review R0 Independent Review form R0 Pages Added: Attachment 3 pages 1-3 were replaced by Attachment 3 pages 1-18. Attachment 5 page 1 of 1 was replaced by pages 1 and 2. Attachment 8 pages 1 thur 9 have been replaced by pages 1 thru 21. Attachment 9 page 1 of 1 has been replaced by Attachment 9 pages 1 and 2.	1-23-95 1/23/95

REVISION LOG

Title: Demonstrated Accuracy Calculation
~~RCP Underfrequency Relays SQN-EEB-MS-TI28-0076~~

Revision No.	DESCRIPTION OF REVISION	Date Approved
1. (Cont.)	Attachment 15 pages 1 thru 10 have been replaced by pages 1 thru 20. Independent Review form R1 FSAR Compliance Review R1 Revision 1 Rev Log (2 pages) Revision 1 Reference Review page 6A Pages Revised: 3, 3A, 4 - 6, 9, 11, 14A, 14B, 21 Changed page number 6A to 6B Table of Contents Total Pages: 182 Legibility evaluated and accepted for issue: Barry G Kimsey 2/23/95	1-23-95 1/31/95

Title: DEMONSTRATED ACCURRACY CALCULATION RCP UNDERFREQUENCY RELAYS SQN-EEB-MS-TI28-0076	REVISION LOG	
Revision No.	DESCRIPTION OF REVISION	Date Approved
2	This calculation has been revised for SQ962528PER corrective action to remove requirement number 4, which required the conservatism for relay drift value to be determined based on actual field data. Requirement 4 stated the functional test would be used to collect data, the functional test was not modified to take values so the 1 and 2-SI-TDC-068-218.0 surveillance values were used. This change also resolves the R0 revision log request. Pages Added: Attachment 17, 10B Pages Changed: Cover sheet, Independent Review, FSAR review, 1, 2, 3, 3A, 5, 6-6A, 14A, 27A, 11, 17, 10A, 27 Pages Removed: 6B Legibility Evaluated and Accepted for Issue. [signature] LE Signature 2/25/98 Date This calculation consists of ~~214~~ 215 pages. 2-25-98	/ /

Title: DEMONSTRATED ACCURRACY CALCULATION RCP UNDERFREQUENCY RELAYS SQN-EEB-MS-TI28-0076		REVISION LOG
Revision No.	**DESCRIPTION OF REVISION**	**Date Approved**
3	This calculation has been revised to establish the Tech Spec Allowable value and setpoint (no change to Calculated Av and setpoint used in setpoint and scaling documents). Also, removed old Tech Spec values. Pages Added: 24A, Rev log, Coversheet Pages Changed: Independent Review, FSAR review, 10, 24, 26, 27A Pages Removed: None Legibility Evaluated and Accepted for Issue. [signature] LE Signature 5/15/98 Date This calculation consists of ~~216~~ 217 pages. DDm 5-15-98	/ /

NPG CALCULATION RECORD OF REVISION

CALCULATION IDENTIFIER	SQN-EEB-MS-TI28-0076
Title	Demonstrated Accuracy Calculation RCP UNDERFREQUENCY RELAYS SQN-EEB-MS-TI28-0076

Revision No.	DESCRIPTION OF REVISION
4	This calculation has been revised to correct the Tech Spec Allowable value to the Westinghouse Setpoint Methodology. Added Pages: Rev Log Pages Changed: Independent Review, FSAR Review, 10, 26, 27A Pages Removed: 24A Legibility Evaluated and Accepted for Issue. J.H. Rinnie 11/9/98 Signature Date This calculation consists of 217 sheets.
5	This calculation has been revised to support Tech Spec format change and TSFT-493 implementation for Tech Spec Table 2.2-1 item 16 'Underfrequency-Reactor Coolant Pumps'. This change will determine new component "As Found" calibration value using the square root sum of the squares (SRSS) methodology. The "As Left" value is not changed as it is based on a single term, Ab only. The analysis will maintain the existing Westinghouse methodology. This change will be incorporated by an EDC for the TSFT-493 changes. Pages Added: Cover / CTS sheets, Att. 18 Pages Changed: Rev Log, Independent Review, 3A, 4, 5, 6, 10, 24, 26 Pages Removed: FSAR review FSAR section(s): 7.2 and 15.3 were reviewed and are not impacted by the results of this calculation. This calculation consists of 222 sheets.
6	PER 866536 was written due to the cover sheet's UNITS boxes and CTS boxes were not checked on revision 5. The calculation is for both Unit 1 and 2 and the UNITS boxes are being marked on this revision. There is no change to the CTS for this revision therefore the CTS box will be checked for No CTS Changes. This revision also cleans up 24VDC power supply information in note 5 on page 14B and attachments 1 and 4. The information clarification does not change any calculation results. Pages Added: Cover / CTS sheets Pages Changed: Rev Log, 14B, Attachment 1 pages 3 and 6, Attachment 4 page 7 Pages Removed Independent Review FSAR section(s) 7.2 and 15.3 were reviewed and are not impacted by the results of this calculation. This calculation consists of 223 sheets.

NPG CALCULATION RECORD OF REVISION

CALCULATION IDENTIFIER SQN-EEB-MS-TI28-0076

Title DEMONSTRATED ACCURACY CALCULATION
RCP UNDERFREQUENCY RELAYS SQN-EEB-MS-TI28-0076

Revision No.	DESCRIPTION OF REVISION
7	This revision is being performed to revise the underfrequency relay drift, M&TE values, and calibration tolerances to support TSTF-493 implementation for Units 1 & 2. Attachment 8 is updated with pages from the current revision of the SIs. Attachment 15 is removed as this is a functional test which does not verify setpoints. Attachment 16 is removed as drift values are not based on this relay model. Pages Added: R7 Coversheet/CTS Update (A1, A2), B7, R7 Calculation Verification (C), 24A Pages Deleted: 14, 14A, Attachment 15, Attachment 16 Pages Changed: 1, 2, 6, 10A, 12, 13A, 15, 16A, 21, 24, 26, 27A, Attachment 8 This revision contains 204 sheets Note: FSAR compliance review has been conducted within the scope of DCN D23339.

NPG CALCULATION VERIFICATION FORM

Calculation Identifier SQN-EEB-MS-TI28-0076 Revision 007

Method of verification used:		Verifier / Date
1. Design Review	☒	Kirk R. Melson (signature)
2. Alternate Calculation	☐	Verifier Kirk R. Melson Date 9/24/14
3. Qualification Test	☐	

Comments:
All comments between me and the preparer have been resolved. This calculation revision is found to be in compliance with NEDP-2. The FSAR compliance review has been performed. The methodology utilized in this calculation revision is commensurate with the guidelines provided in Branch Technical Instruction EEB-TI-28.

TABLE OF CONTENTS

PURPOSE

The purpose of this calculation is a) to determine the accuracy of the instrumentation covered by this calculation, and b) to demonstrate that the instrumentation is sufficiently accurate to perform its intended function without safety or operational limits being exceeded.

ASSUMPTIONS

_X_ This calculation contains no assumptions.

____ The following assumptions were used in the performance of this calculation. These assumptions require further analysis. This calculation may require revision if the assumptions below are shown to be invalid.

CALCULATION REQUIREMENTS

1. Calibration Frequency must not exceed 22.5 months (i.e. 18 months + 25% extension).

2. The relay operating adjustment must have 3 consecutive incorrect cycles before timing begins. New relay setting is 10 cycles per Sheet 22 of this calculation (excluding 3 consecutive measurement cycles). Time delay counter will reset if one cycle occurs above the trip frequency.

3. Relay Acceptance Band for the under frequency function is calculated as the Square Root Sum of the Squares (SRSS) combination of the Reference Accuracy (Re), M&TE error (ICTe and OCTe), and M&TE readability (ICRe and OCRe) per the requirements of TSTF-493 (see Reference 10). See Note 14 on Sheet 16A for determination of Ab.

4. M&TE required accuracy (under frequency function) is to be equal to or better than the relay Re. Therefore, ICTe = ±0.008 Hz. R7

5. The underfrequency relay has no indication for when an underfrequency condition has been detected and the time delay begins; the only trip point indication is when the relay has timed out. In order for the time delay to not affect the measured trip point, the frequency of the test source must be adjusted slowly enough for the relay to time out, such that the actual trip point equals the measured trip point.

(Continued)

Entire page replaced by Revision 1. R1

REQUIREMENTS (Continued)

~~4) Reference 25, 1-SI-TFT-068-230.0 and 2-SI-TFT-068-230.0, shall be revised to record and document the actual as-found relay trip point during functional testing, while verifying that this trip point does not violate the allowable value of 56.3 Hz. This data will be evaluated upon the next major revision of this calculation, provided enough data exists, to determine the amount of conservatism in the existing drift error analysis and to ensure compliance with the Technical Specification allowable value. (See Sheet 14A)~~ R1 R2 R1

Special Requirements/Limiting Conditions None R2

REV	1	PREP	tdh	DATE	1-23-95	CHECK	APT	DATE	1/23/95	SHEET	3	C/O	3A
REV	2	PREP	GGM	DATE	11-4-97	CHECK	[illegible]	DATE	12/4/97	SHEET	3	C/O	3A
REV		PREP		DATE		CHECK		DATE		SHEET		C/O	

SOURCE OF DESIGN INPUT INFORMATION
(References)

REF	ATT	REFERENCE (RIMS #)	
1	1	DCN M10396A (Excerpts) DCN M10441A (Excerpts)	
2	2	SQN-DC-V-27.9 Rev. 4 (Excerpts)	
3	3	Technical Specifications Unit 1 Table 2.2-1 and Section 3/4.3.1 and Unit 2 Table 2.2-1 and Section 3/4.3.1; FSAR Table 7.2.1-5 (Change No. 11-42)	
4	-	SQN-EEB-PL&S Rev. 49	R5
5	4	ABB Technical Bulletin 7.4.6-1F and 7.4.1.7-5	
6	5	1,2-45N763-2 Rev. 6 and Rev. 9 (DCN M10396A and DCN M10441A DCA's respectively)	
7	-	ENVIRONMENTAL DESIGN CRITERIA SQN-DC-V-21.0 Rev 22	R5
8	6	RPS Circuit Protector UF Relays Setpoint and Scaling Calculation ED-Q2099-890137 Rev. 0 (RIMs # B22900315102)	
9	-	Calculation 72186RDM Rev. 0, Review of Electronic Components in a Radiation Environment <5 x 10^4 RADs (RIMs # B4360721903)	

SOURCE OF DESIGN INPUT INFORMATION
(References)

REF	ATT	REFERENCE (RIMS #)	
10	-	Branch Technical Instruction, Setpoint Calculations, BTI-EEB-TI-28 Rev. 10	R5
11	7	ABB Seismic Qualification Report RC-5524-A	
12	8	RCP UF Relay Calibration 1-SI-TDC-068-218.0 and 2-SI-TDC-068-218.0 (Excerpts)	
13	9	Response Time Scheduling and Verification of Reactor Trip and Engineering Safety Feature Systems 1-SI-IRT-099-400.0 and 2-SI-IRT-099-400.0 (Acceptance criteria for RCP UF System).	
14	-	Calculation SQN-EQP-39 "Effects of Cable Insulation Resistance on Instrument Accuracy", Rev. 3 (RIMs # B87021011002)	R5
15	-	"6.9 kV RCP Relay Boards 10CFR50.49 Category and Operating Times", SQN-0SG7-0035 Rev. 5	
16	10	"Demonstrated Accuracy Calculation for RCP RF Relays (81)" WBPE0689009008 Rev. 3 (RIMs # B18940104255)	

SOURCE OF DESIGN INPUT INFORMATION
(References)

REF	ATT	REFERENCE (RIMS #)	
17	-	Instrument Setpoint, Scaling And Calibration Program, NPG-SPP-06.7	R5
18	-	NEDP-2	
19	-	NTB Calculation "40 Year Normal Operating Radiation Dose to RCP UV and UF Panels" SQNAPS3-093 Rev. 1 (RIMs # B87930121015)	
20	-	NTB Calculation "Interim Normal Operating Radiation Dose for Equipment Outside the Shield Building" SQNNAL3-017 Rev. 13 (RIMs # B87100322006)	R5
21	11	"Off-Frequency Turbine Operation Curve" TI-28 Curve Book Rev. 79	
22	12	0-AR-ECB6-B Rev. 1 (Excerpts for window 19)	
23	13	ABB Statement regarding relay drift and seismic report (RIMS # B27940607001)	
24	14	Report No. S298-RP-01 (Excerpts) Southern Testing Services "Nuclear Environmental and Seismic Qualification ABB 422B1295 Type 81 Relay" (RIMs # T49911120821)	

SOURCE OF DESIGN INPUT INFORMATION
(REFERENCES)

REF	ATT	REFERENCE (RIMS #)	
25	-	Deleted	R7
26	-	Deleted	
27	17	Determination of relay drift value using field data.	
28	18	Proposed Technical Specification Change Request 11-08 cover sheet (Changes setpoint from 56 to 57 Hertz)	

D E S I G N   I N P U T   D A T A

A) DEFINITIONS & ABBREVIATIONS

Aa	ACCIDENT ACCURACY-ACCURACY OF A DEVICE IN A HARSH ENVIRONMENT CAUSED BY AN ACCIDENT
Aas	COMBINED ACCIDENT AND SEISMIC ACCURACY
Ab	ACCEPTANCE BAND-THE RANGE OF VALUES AROUND THE CORRECT VALUE DETERMINED TO BE ACCEPTABLE WITHOUT RECALIBRATION
AB	AUXILIARY BOILER LINE BREAK
AF	AFW PUMP TURBINE STEAM SUPPLY LINE BREAK
An	NORMAL ACCURACY-ACCURACY OF A DEVICE LOCATED IN A ENVIRONMENT NOT AFFECTED BY AN ACCIDENT OR PRIOR TO AN ACCIDENT
As	POST SEISMIC ACCURACY
AV	ALLOWABLE VALUE-SAFETY LIMIT/REQUIRED ACCURACY MINUS NON-MEASUREABLES; USED FOR THE PURPOSE OF DETERMINING REPORTABILITY ONLY.
CV	CVCS LETDOWN LINE BREAK
De	DRIFT INACCURACY
HELB	HIGH ENERGY LINE BREAK
IAD	INTEGRATED ACCIDENT DOSE
ICRe	INPUT TEST INSTRUMENT READING INACCURACY
ICTe	INPUT TEST INSTRUMENT CALIBRATION INACCURACY
INDRe	INDICATOR READING ERROR
IRe	INACCURACY DUE TO CABLE LEAKAGE
L	LOSS OF COOLANT ACCIDENT
M	MARGIN-THE DIFFERENCE BETWEEN THE SAFETY LIMIT/OPERATING LIMIT AND THE NORMAL/ACCIDENT ACCURACY (Mn=NORMAL MARGIN Ma=ACCIDENT MARGIN)
N/A	NOT APPLICABLE
OCRe	OUTPUT TEST INSTRUMENT READING INACCURACY

D E S I G N   I N P U T   D A T A

A) DEFINITIONS & ABBREVIATIONS CONTINUED

OCTe	OUTPUT TEST INSTRUMENT CALIBRATION INACCURACY
PRCSe	PROCESS UNCERTAINTY
PSEe	INACCURACY DUE TO POWER SUPPLY VARIATIONS
PV	PROCESS VALUE (ACTUAL)
RADe	INACCURACY DUE TO ACCIDENT RADIATION EXPOSURE
Re	REPEATABILITY INACCURACY
RH	RHR LINE BREAK
RNDe	NORMAL RADIATION DOSE BETWEEN CALIBRATION
Se	INACCURACY FOLLOWING A SEISMIC EVENT
SECu	SPAN ERROR CORRECTION UNCERTAINTY
SL	SAFETY LIMIT
SP	SETPOINT
SPEe	ZERO ERROR DUE TO EFFECTS OF OPERATING PRESSURE
TAe	TEMPERATURE EFFECT AT ACCIDENT CONDITIONS
TID	TOTAL 40 YEARS INTEGRATED DOSE
TNe	TEMPERATURE EFFECT IN THE MAXIMUM/MINIMUM ABNORMAL TEMPERATURE RANGES
TPRe	TEST POINT RESISTOR ERROR
WLe	WATERLEG UNCERTAINTY
WLHP	WATERLEG HIGH POINT
WLLP	WATERLEG LOW POINT
EMI	ELECTROMAGNETIC INTERFERENCE
RFI	RADIO FREQUENCY INTERFERENCE

DESIGN INPUT DATA

A) DEFINITIONS & ABBREVIATIONS CONTINUED

THE FOLLOWING DEFINITIONS ARE RELEVANT TO THE WESTINGHOUSE SETPOINT METHODOLOGY (CONTAINED AS PART OF REFERENCE 4):

CSA	=	Channel Statistical Allowance
PMA	=	Process Measurement Accuracy
PEA	=	Primary Element Accuracy
SCA	=	Sensor Calibration Accuracy
SMTE	=	Sensor Measurement and Test Equipment Accuracy
SD	=	Sensor Drift
STE	=	Sensor Temperature Effects
SPE	=	Sensor Pressure Effects
RCA	=	Rack Calibration Accuracy
RMTE	=	Rack Measurement and Test Equipment Accuracy
RCSA	=	Rack Comparator Setting Accuracy
RD	=	Rack Drift
RTE	=	Rack Temperature Effects
EA	=	Environmental Allowance
TA	=	TOTAL ALLOWANCE

$$CSA = EA + [(PMA)^2 + (PEA)^2 + (SCA+SMTE+SD)^2 + (STE)^2 + (SPE)^2 + (RCA+RMTE+RCSA+RD)^2 + (RTE)^2]^{1/2}$$

D E S I G N   I N P U T   D A T A

B) LOOP COMPONENT LIST

LOOP ID#	COMPONENT ID#
2-81-068-344D (RCP 1)	2-81-068-344D (RELAY PNL 1A)
2-81-068-346E (RCP 2)	2-81-068-346E (RELAY PNL 1B)
2-81-068-348F (RCP 3)	2-81-068-348F (RELAY PNL 2A)
2-81-068-350G (RCP 4)	2-81-068-350G (RELAY PNL 2B)
1-81-068-344D (RCP 1)	1-81-068-344D (Relay Pnl 1A)
1-81-068-346E (RCP 2)	1-81-068-346E (Relay Pnl 1B)
1-81-068-348F (RCP 3)	1-81-068-348F (Relay Pnl 2A)
1-81-068-350G (RCP 4)	1-81-068-350G (Relay Pnl 2B)

R1

DESIGN INPUT DATA
C) LOOP FUNCTION

Reactor coolant pump under frequency trip protects against low flow resulting from bus under frequency. This trip opens the reactor coolant pump (RCP) breakers and trips the reactor on under frequency condition. Two of four inputs detecting an under frequency condition will initiate a reactor trip above 10% power (Reference 2).

C) LOOP REQUIREMENTS AND LIMITS (BISTABLE)

RESPONSE TIME: ≤ 0.6 SECONDS (Reference 3)

(See response time discussion on sheet 22)
New relay setting = 10 cycles
Note: Settings excludes 3 cycles measurement

SAFETY LIMITS: 55.8 Hertz (Reference 4) Lower Safety Limit — R5

OPERATING LIMITS: 58.5 Hertz Upper Operational Limit (See sheet 10A)

SETPOINT: 57 Hertz (Established by this calculation)

UPPER OPERATIONAL LIMIT

The primary concern with the RCP Underfrequency setpoint change is that there may exist a possibility of erroneous reactor trips due to normal frequency fluctuations. Based on the results of this calculation, the worst case inaccuracy would allow the relay to trip as high as 57 + 0.028 = 57.028 Hz. Although the set point could be as low as 55.85 (55.8 Hz safety limit + 0.028 Hz , rounded to the nearest 0.05 Hz for field attainability) without violating the safety limit, 57 Hz was selected to allow for any calibration frequency extensions that may be necessary in the future. In order to lower the setpoint below 55.85 Hz, coordination with Westinghouse would be required to determine the possibility of lowering the safety limit of 55.8 Hz and the impacts on their safety analysis. | R7 | R7

The relay has a time delay function to help in preventing spurious trips. The timer begins when the relay detects three consecutive bad cycles. This time delay counter (set at 10 cycles) will fully reset if one good cycle occurs prior to the relay timing out and tripping. In order to meet response time requirements, analysis (see sheet 22) has determined total relay operating time to be 0.228 seconds (13 cycles including 3 cycles measurement). | R7

In order to establish an upper operational limit, it is necessary to define normal occurring plant frequency fluctuations:

The operators receive a MCR alarm when frequency drops below 59.85 Hz. This provides 59.85 - 57.028 = 2.822 Hz of margin between alarm and worst case RCP reactor trip (See Reference 22). | R7

The Off-Frequency Turbine Operation curve (Reference 21) allows for 50 minutes total accumulated time limit during unit life (40 yrs) as low as 58.5 Hz and 10 minutes as low as 56 Hz. This equates to 0.00024% (58.5 Hz) and 0.00005% (56 Hz) of the time. Normal continuous operation is shown to be 59.5 to 60.5 Hz. Per Reference 21, any frequency less than 59 Hz would be seen as vibration problems on the turbine and require the unit to be taken off-line unless load was critical.

Current Technical Specifications Section 3/4.8 (Improved Technical Specifications Section 3.8.1) requires 60 ± 1.2 Hz for Diesel Generator operation and Design Criteria SQN-DC-V-11.6 specifies 60 ± 0.6 Hz as the continuous operating frequency for the 120-V AC Vital Instrument power system. Although these systems are not directly related to the 6900-V Unit Boards supplying the RCP's, they are cited as examples of normal occurring plant frequencies. | R7

Based on the above, an RCP Underfrequency setpoint of 57 Hz (57.028 maximum) is not within the region of normal occurring frequencies. The plant would be aware of frequency problems prior to reaching a frequency as low as 57 Hz. Therefore, it is highly unlikely that an erroneous trip will result from this setpoint. The Upper Operational Limit for the RCP Underfrequency Relays is established at 58.5 Hz. This value is considered conservative with regard to the normal occurring plant frequencies referenced above. | R7

LOWER OPERATIONAL LIMIT (TIME)

N/A

The total system response time must be less ≤ 0.6 seconds (Ref. 3 and page 22 of this calculation). Therefore, lower operational limit time value less than 0.6 seconds is conservative and does not require analysis.

BRANCH/PROJECT IDENTIFIER SQN-EEB-MS-TI28-0076
DEMONSTRATED ACCURACY CALCULATION

DESIGN INPUT DATA
D) COMPONENT DATA

VALID FOR DEVICES IDENTIFIED ON SHEET(S): 9

COMPONENT: RCP UF RELAYS CONTRACT #: SE-1899 REFERENCE #: 1

MANUFACTURER/MODEL: ASEA BROWN BOVERI / 422B1215 (TYPE 81) REFERENCE #: 1

INPUT RANGE & UNITS: 54-63 HZ. NOTE #: — REFERENCE #: 5

OUTPUT RANGE & UNITS: CONTACT OPEN NOTE #: — REFERENCE #: 6

OVERRANGE LIMIT: N/A NOTE #: — REFERENCE #: —

CALIBRATED SPAN: N/A NOTE #: — REFERENCE #: —

ROOM #/ PANEL #: ROOM A1 / PNLS 1A, 1B, 2A, 2B NOTE #: — REFERENCE #: 1,6

ELEVATION/ COORDINATE: EL 714' / A3-Q A14-Q NOTE #: — REFERENCE #: 1,6,7 |R1

MIN/MAX ABNORMAL TEMP: 50 / 110°F NOTE #: — REFERENCE #: 7

ACCIDENT TEMPERATURE: 115°F NOTE #: — REFERENCE #: 7

RADIATION TID (RAD): 1.8×10^3 NOTE #: 16 REFERENCE #:

RADIATION IAD (RAD): 5.45×10^2 NOTE #: — REFERENCE #: 7 |R2

INSTRUMENT TAP INFORMATION REFERENCE #: N/A

WLHP TAP ELEVATION: N/A WLHP CONDENSING POT ELEVATION: N/A

WLLP TAP ELEVATION: N/A WLLP CONDENSING POT ELEVATION: N/A

EVENT/CATEGORY/OPERATING TIME: NOTE #: — REFERENCE #: 15

N/A	N/A	N/A
↓	↓	↓

REV 0	PREP DEH	DATE 3-14-94	CHECK APT	DATE 3/15/94	SHEET 11	C/O 12
REV 1	PREP VCH	DATE 1-23-95	CHECK ART	DATE 1/23/95	SHEET 11	C/O 12
REV 2	PREP [illegible]	DATE 2/23/98	CHECK [illegible]	DATE 2/23/98	SHEET 11	C/O 12

DESIGN INPUT DATA
D) COMPONENT DATA CONTINUED

COMPONENT: RCP UF RELAYS (Trip Point)

PARAMETER	VALUE/UNITS	NOTE #	Reference #	
Re (RCA)	±0.008 Hz	1	5	
De (RD)	0	2	-	R7
TNe (RTE)	±0.008 Hz	3	5, 7	
SPEe	N/A	4	-	
SECu	N/A	4	-	
PSEe	0	5	5	
RNDe	N/A	6, 16	9, 7	
TPRe	N/A	7	-	
ICTe (RMTE)	±0.008 Hz	8	-	R7
ICRe (RMTE)	0	8	-	
OCTe (RMTe)	N/A	9	6	
OCRe (RMTe)	N/A	9	6	
Ab (RCSA)	±0.011 Hz	14	-	R7
Se	±0.2 Hz	13	11, 24	
RADe	N/A	6	9, 7	
TAe	N/A	3	1, 5, 7	
WLe	N/A	10	-	
PRCSe	N/A	11	-	
INDRe	0	12	-	
IRe	Negligible	15	7, 14	
EMI/RFI (errors)	Negligible	17	24	

DESIGN INPUT DATA
D) COMPONENT DATA CONTINUED

COMPONENT: RCP UF RELAYS (TIMER)

PARAMETER	VALUE/UNITS	NOTE #	REFERENCE #
Re (RCA)	± 1 CYCLE	18	5
De (RD)	± 1 CYCLE	19	5
TNe (RTE)	± 1 CYCLE	20	5,7
SPEe	N/A	4	—
SECu	N/A	4	—
PSEe	0	5	5
RNDe	N/A	6,16	9,7
TPRe	N/A	7	—
ICTe (RMTE)	± 1 CYCLE	21	5,10
ICRe (RMTE)	± 1 CYCLE	21	5,10
OCTe (RMTE)	N/A	9	6
OCRe (RMTE)	N/A	9	6
Ab (RCSA)	± 1 CYCLE	22	5,10
Se	± 0.5 CYCLES	23	11,24
RADe	N/A	6	9,7
TAe	N/A	20	5,7
WLe	N/A	10	—
PRCSe	N/A	11	—
INDRe	0	12	—
IRe	NEGLIGIBLE	15	7,14
EMI/RFI (ERRORS)	NEGLIGIBLE	24	24

DESIGN INPUT DATA
E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
1	Per Reference 5, the relay has a Reference Accuracy of ±0.008 Hz. Therefore, Re = ±0.008 Hz.
2	No drift specification is provided for the underfrequency trip setting. Per Reference 5, the minimum increment that can be set at the operating point is 0.05 Hz, which far exceeds the Reference Accuracy of ±0.008 Hz. Since the underfrequency trip setting cannot be adjusted in increments other than 0.05 Hz, any drift in the underfrequency trip setpoint is considered negligible. Therefore, De = 0.

R7

BRANCH/PROJECT IDENTIFIER SQN-EEB-MS-TI28-0076
DEMONSTRATED ACCURACY CALCULATION

DESIGN INPUT DATA

E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
3	THE SUBJECT RELAY IS LOCATED IN AN ENVIRONMENT WHERE MIN./MAX. ABNORMAL TEMPERATURES 50°F / 110°F AND ACCIDENT TEMPERATURE 115°F ARE WITHIN THE MANUFACTURER SPECIFIED RELAY ACCURACY RANGE OF −20°C TO +55°C (−4°F TO +131°F) PER REFERENCE 5.
	THEREFORE, $TNc = Rc = \pm 0.008$ Hz.
	PER REFERENCE 1 - SAFETY ASSESSMENT, THESE COMPONENTS ARE NOT REQUIRED TO OPERATE TO MITIGATE AN ACCIDENT, THEREFORE, TAc = N/A.
4	THIS DEVICE DOES NOT MEASURE PRESSURE, THEREFORE, $SPEc$ & $SECu$ = N/A.
5	THE RELAY CIRCUIT POWER SUPPLY PROVIDED BY THE MANUFACTURER HAS AN ALLOWABLE VARIATION OF 19-29 Vdc (REFERENCES 1, 5), HOWEVER, THERE IS NO EFFECT ON FREQUENCY FROM THIS VOLTAGE VARIATION DUE TO THE DIGITAL COUNTING TECHNIQUE. THEREFORE, $PSEc = 0$. R6

REV 0	PREP DEH	DATE 6-3-94	CHECK ADT	DATE 6/7/94	SHEET 14B	C/O 15
REV 1	PREP VAL	DATE 1-18-96	CHECK APT	DATE 1/23/96	SHEET 14B	C/O 15
REV 6	PREP MDM	DATE 5-20-14	CHECK [illegible]	DATE 5-21-14	SHEET 14B	C/O 15

DESIGN INPUT DATA
E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
6	The device is located in an environment where the Total Integrated Dose (TID) and Integrated Accident Dose (IAD) do not exceed $5x10^4$ RADS over the device's calibration interval of 22.5 months. Based on information in Reference 9, Radiation Effects need not be considered. Therefore, RNDe & RADe = N/A.
7	There is no test point resistor in the measuring circuit. Therefore, TPRe = N/A.
8	Per Requirement 4, calibration equipment should have an accuracy equal to or better than the Re of the relay. Therefore, ICTe = ±0.008 Hz The M&TE used has a digital indication with a 0.001 Hz resolution. The reading resolution is negligible with respect to the ICTe. Therefore, ICRe = 0 Hz
9	The output of the device is contact open. No calibration errors are associated with it. Therefore, OCTe & OCRe = N/A

R7

D E S I G N I N P U T D A T A
E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
10	THESE RELAYS HAVE NO WATERLEG, THEREFORE, WLc = N/A.
11	THERE IS NO PROCESS UNCERTAINTY ASSOCIATED WITH THIS DEVICE. FREQUENCY IS MEASURED DIRECTLY, THEREFORE, PRCSc = N/A.
12	THE ONLY INDICATOR IS THE ADJUSTMENT SCREWS DURING CALIBRATION. THE ACTUAL FREQUENCY AND NOT THE ADJUSTMENT SCREWS WILL BE USED, THEREFORE, INDRc = 0.
13	PER VENDOR SEISMIC QUALIFICATION REPORT (REFERENCE 11), NO FRAGILITY OR MIS-OPERATION WAS FOUND WITHIN THE 6g ZPA LIMITATION OF THE ACTUATOR. ADDITIONALLY, TEST RESULTS SHOW THAT RELAY RESPONSE WAS NORMAL WITH NO CONTACT CHATTER OR DAMAGE DURING ANY PHASE OF TESTING. PER REFERENCE 23, BECAUSE THE ENTIRE MEASURING CIRCUITRY OF THE RELAY IS SOLID-STATE, IT IS THE VENDOR'S OPINION THAT THE RELAY WOULD HAVE MAINTAINED ITS PUBLISHED ACCURACY OF ±0.008 HZ DURING THE VIBRATION AND A SEISMIC ERROR OF 0.1 HZ WOULD BE VERY CONSERVATIVE. HOWEVER, NO ATTEMPT WAS MADE TO DETERMINE THE RELAY'S OPERATING POINT WITH THE HIGH ACCURACY NECESSARY TO DOCUMENT AN ERROR AS SMALL AS ±0.008HZ. (CONTINUED)

DESIGN INPUT DATA
E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
13 (cont)	Reference 24, Seismic Qualification of ABB 422B1295 Relay, records test data before, during, and after the seismic test. Results indicate that the relay maintained structural integrity, proper operation, electrical continuity, and no contact chatter. This report documents a trip point between 56.8 to 57 Hz both before and after the test with proper operation at the trip point during testing. There was no documented change in the trip point before, during, or after the test. However the trip point was not documented with an accuracy high enough to detect small errors. For the purpose of conservatism, the seismic error shall equal the deviation by which the trip point was recorded (57 - 56.8 = 0.2 Hz). Therefore, Se = ±0.2 Hz.
14	Per Reference 10, the Relay Acceptance Band for the under frequency function is calculated as the Square Root Sum of the Squares (SRSS) combination of the Reference Accuracy (Re), M&TE error (ICTe and OCTe), and M&TE readability (ICRe and OCRe) per the requirements of TSTF-493.

R7

$$Ab = \pm(Re^2 + ICTe^2)^{1/2}$$
$$= \pm(0.008^2 + 0.008^2)^{1/2}$$
$$= \pm 0.0113 \text{ Hz}$$

This is conservatively rounded: Ab = ±0.011 Hz

DESIGN INPUT DATA

E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
15	PER REFERENCE 14, CABLES ROUTED THROUGH AREAS WHICH HAVE ACCIDENT TEMPERATURES LESS THAN OR EQUAL TO 231°F HAVE NEGLIGIBLE EFFECTS DUE TO LOWER INSULATION RESISTANCE. THE SUBJECT DEVICE EXPERIENCES A MAXIMUM TEMPERATURE OF 115°F (REFERENCE 7), WHICH IS WELL BENEATH 231°F AND WITHIN THE MANUFACTURER SPECIFIED RELAY ACCURACY RANGE OF -4°F TO +131°F. (REFERENCE 5). BASED ON THIS INFORMATION, IRe = NEGLIGIBLE
16	REFERENCE 7 LISTS A TOTAL INTEGRATED DOSE OF (TID) = 1.8×10^3 RADs. R2
17	PER REFERENCE 24, THE EMI/RFI TESTING PERFORMED REVEALED PROPER OPERATION WITH NO FAILURES AND NO LOSS OF OPERABILITY AT ANY TIME BEFORE, DURING AND AFTER TESTING. TEST RESULTS SHOW THAT THE RELAY TRIP POINT REMAINED UNCHANGED BEFORE, DURING AND AFTER TESTING. THEREFORE, EMI/RFI ERRORS ARE DEEMED NEGLIGIBLE.

DESIGN INPUT DATA

E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
18	PER REFERENCE 5, THE RELAY TIMER HAS A TYPICAL ACCURACY OF ±1 CYCLE. THEREFORE, Re = ±1 CYCLE.
19	PER REFERENCE 5 (ATTACHMENT 4 - SHEET 19), AFTER THE RELAY HAS BEEN PROPERLY SET BY TEST, THE ACCURACY AND REPEATABILITY WOULD STAY WITHIN ±1 CYCLE FOR 2 YEAR INTERVALS OR LONGER. THEREFORE, De = ±1 CYCLE (CONSERVATIVELY).
20	THE SUBJECT RELAY IS LOCATED IN AN ENVIRONMENT WHERE MIN/MAX ABNORMAL TEMPERATURES 50°F/110°F AND ACCIDENT TEMPERATURE 115°F ARE WITHIN THE MANUFACTURER SPECIFIED RELAY ACCURACY RANGE OF -20°C TO +55°C (-4°F TO +131°F) PER REFERENCE 5. THEREFORE, TNc = Re = ±1 CYCLE. PER REFERENCE 1 - SAFETY ASSESSMENT, THESE COMPONENTS ARE NOT REQUIRED TO OPERATE TO MITIGATE AN ACCIDENT. THEREFORE, TAe = N/A.
21	PER REFERENCE 10, CALIBRATION EQUIPMENT SHALL HAVE AN ACCURACY BETTER THAN OR EQUAL TO THE DEVICE BEING CALIBRATED. THEREFORE, ICTc AND ICRe = ±1 CYCLE.

DESIGN INPUT DATA

E) COMPONENT DATA NOTES

COMPONENT: ECP UF RELAYS

#	NOTE
22	PER REFERENCE 10, THE ACCEPTANCE BAND SHOULD BE ESTABLISHED GREATER THAN OR EQUAL TO THE DEVICE REFERENCE ACCURACY. THEREFORE, Ab = ± 1 CYCLE THIS VALUE IS FIELD ATTAINABLE SINCE THE TIMER IS ADJUSTABLE TO 1 CYCLE INCREMENTS. (REFERENCE 5).
23	REFERENCE 24, SEISMIC QUALIFICATION OF ABB 422B1295 RELAY, RECORDS TEST DATA BEFORE, DURING AND AFTER THE SEISMIC TEST. RESULTS INDICATE THAT THE RELAY MAINTAINED STRUCTURAL INTEGRITY, PROPER OPERATION, ELECTRICAL CONTINUITY AND NO CONTACT CHATTER. THIS REPORT DOCUMENTS TIMER ACTIVATION OF 59.5 CYCLES BEFORE THE TEST AND 60 CYCLES AFTER THE TEST FOR A TOTAL POSSIBLE SHIFT OF 0.5 CYCLES. THEREFORE, FOR THE PURPOSE OF CONSERVATISM, Se = ± 0.5 CYCLES

D E S I G N   I N P U T   D A T A

E) COMPONENT DATA NOTES

COMPONENT: RCP UF RELAYS

#	NOTE
24	PER REFERENCE 24, THE EMI/RFI TESTING PERFORMED REVEALED PROPER OPERATION WITH NO FAILURES AND NO LOSS OF OPERABILITY AT ANY TIME BEFORE, DURING AND AFTER TESTING. THIS REPORT DOCUMENTS TIMER ACTIVATION OF 54 CYCLES BOTH BEFORE AND AFTER THE TEST. NO SHIFT IN TIME DELAY WAS DOCUMENTED AS A RESULT OF THIS TEST. THEREFORE, EMI/RFI ERRORS ARE DEEMED NEGLIGIBLE.

C O M P U T A T I O N S / A N A L Y S E S

A) PROCESS UNCERTAINTY DISCUSSION/CALCULATION

✓ NO PROCESS UNCERTAINTY EXISTS FOR THIS CALCULATION BECAUSE:

✓ THE MEASURED PARAMETER IS THE PARAMETER OF CONCERN; THEREFORE, PROCESS VARIATIONS ARE ACCOUNTED FOR IN THE DETERMINATION OF SAFETY AND/OR OPERATIONAL LIMITS.

___ OTHER: SEE DISCUSSION BELOW.

___ PROCESS UNCERTAINTY DOES EXIST AND IS DETAILED IN THE FOLLOWING DISCUSSION/CALCULATION.

COMPUTATIONS/ANALYSES

B) WATERLEG UNCERTAINTY DISCUSSION/CALCULATION

✓ APPLICABLE TO ALL LOOPS LISTED ON SHEET 9

___ APPLICABLE ONLY TO LOOPS: ___

✓ WATERLEG UNCERTAINTY IS NOT CONSIDERED FOR THE CALCULATION BECAUSE:

- ✓ NO WATERLEG EXISTS FOR THIS CALCULATION.
- ___ THE EFFECTS OF WATERLEG CHANGES ARE INSIGNIFICANT. SEE DISCUSSION/CALCULATION BELOW.
- ___ OTHER. SEE DISCUSSION/CALCULATION BELOW.

___ A WATERLEG UNCERTAINTY DOES EXIST FOR THIS LOOP. SEE CALCULATION/DISCUSSION BELOW.

___ SEE SENSING LINE DIAGRAM ON SHEET ___ OF THIS CALCULATION.

COMPUTATIONS / ANALYSES

C) ACCURACY DISCUSSION

✓ The accuracy of this instrument for normal, post seismic and accident conditions will be determined by considering the parameters tabulated in the design input section of this calculation.

The accuracy calculation for seismic (As) is bounding for all seismic events.

✓ The square root of the sum of the squares method shall be used in this calculation for calculating accuracy since the factors affecting accuracy are independent variables.

✓ Bi-directional errors and uni-directional errors will be combined in a manner such that the sum of the positive uni-directional errors will be added to the positive portion of the bi-directional error (obtained from the square root of the sum of the squares method), and the sum of the negative uni-directional errors will be added to the negative portion of the bi-directional error.

This method is conservative. Therefore, it will be used in this calculation.

Example: (+/-) 10 = bi-directional error
+5 = first uni-directional error
-2 = second uni-directional error

Total Error = (+10 +5) to (-10 -2) = +15 to -12

✓ other: PARAMETERS ARE COMBINED BY THE METHODOLOGY EMPLOYED IN WESTINGHOUSE SETPOINT METHODOLOGY (CONTAINED IN REFERENCE 4) TO ENSURE CONSERVATIVE CALCULATION ANALYSIS CONSISTENT WITH THAT WHICH EXISTS IN REF. 4 FOR THE PREVIOUSLY INSTALLED RELAYS.

For the purpose of this calculation, accuracy is defined as the range of actual process values that may exist for a given indicated or bistable trip value, e.g. an accuracy of +10 psig to -5 psig means that for a indicated or bistable trip value of 100 psig, the actual process pressure may be anywhere between 95 and 110 psig.

All system analysis based on or using accuracy values from this calculation should take into account the fact that operator action and/or automatic initiations may occur at a process value differing from the indicated or setpoint values by the amount of the calculated inaccuracies.

COMPUTATIONS / ANALYSES
C) ACCURACY DISCUSSION (CONTINUED)

X The following devices are calibrated individually.
Their Acceptance Bands are as follows:

DEVICE	Ab	REFERENCE
2-81-068-344D	±0.011 Hz	Sheet 16A, Note 14
2-81-068-346E	±0.011 Hz	Sheet 16A, Note 14
2-81-068-348F	±0.011 Hz	Sheet 16A, Note 14
2-81-068-350G	±0.011 Hz	Sheet 16A, Note 14
1-81-068-344D	±0.011 Hz	Sheet 16A, Note 14
1-81-068-346E	±0.011 Hz	Sheet 16A, Note 14
1-81-068-348F	±0.011 Hz	Sheet 16A, Note 14
1-81-068-350G	±0.011 Hz	Sheet 16A, Note 14

R7

N/A The following devices are calibrated together.
The Acceptance Band for the combination of these devices are as follows:

DEVICE	Ab	REFERENCE

RESPONSE TIME DISCUSSION

Per Reference 3, total system response time must be ≤ 0.6 seconds. This is verified by reference 13 which divides total system response time into three categories:

Rack Time with an acceptance criteria of 0.435 seconds, SSPS logic time with an acceptance criteria of 0.006 seconds and RX Trip time with an acceptance criteria of 0.150 seconds. Combining these three times yields 0.591 seconds, which is less than the required 0.6 seconds. Rack Time consists of the response time of the underfrequency relay and the SSPS input relay. Per reference 13, the SSPS input relays have an acceptance criteria of 0.05 seconds. Therefore, the underfrequency relay must have a response time less than (0.435 - 0.05) = 0.385 seconds to comply with overall system response time requirements.

Reference 12 calibrates and tests response time for the underfrequency relays. If the relay response time exceeds 300 ms an engineering evaluation of total system response time is performed to determine if 0.6 seconds has been exceeded.

Per reference 5, the relay experiences 3 cycles of measurement in addition to its setting (timer begins after relay has detected 3 "bad" cycles). In addition, the relay has a worst-case (seismic) inaccuracy of ± 5.12 cycles associated with its setting and a reference accuracy of ± 1 cycle per this calculation.

Based on the above, a relay setting of 10 cycles yields the following including worst-case (seismic) inaccuracies):

3 cycles measurement + 10 ± 5.12 cycles setting = 13 ± 5.12 cycles total (7.88 - 18.12 cycles)

1/57 Hz = 0.0175 seconds/cycle

7.88 cycles (0.0175 seconds/cycle) = 0.138 seconds

13 cycles (0.0175 seconds/cycle) = 0.228 seconds

18.12 cycles (0.0175 seconds/cycle) = 0.318 seconds

This corresponds to a worst case (seismic) relay response time between 0.138 and 0.318 seconds at a setting of 0.228 seconds.

Using the reference accuracy of ± 1 cycle at a setting of 10 cycles yields the following:

3 cycles measurement + 10 ± 1 cycle setting = 13 ± 1 cycles total (12 - 14 cycles)

12 cycles (0.0175 seconds/cycle) = 0.210 seconds

14 cycles (0.0175 seconds/cycle) = 0.246 seconds

This corresponds to a typical (as-left) relay response time between 0.210 and 0.246 seconds at a setting of 0.228 seconds.

The worst-case response time of 0.318 seconds is within the 0.385 second requirement derived above.

Based on this analysis, a relay setting of 10 cycles is considered acceptable with regard to overall system response time requirements.

COMPUTATIONS/ANALYSES
D) ACCURACY CALCULATION INDEX

RCP UNDERFREQUENCY RELAYS

I. (setpoint)
A. Re (RCA)
B. De (RD)
C. TNe (RTE)
D. ICTe (RMTE)
E. ICRe (RMTE)
F. Ab (RCSA)
G. Se

II. (setpoint)
A. An (CSA)
B. Aa
C. As
D. Aas
E. Anf
F. Afc
G. Alc
H. AV

III. (timer)
A. Re (RCA)
B. De (RD)
C. TNe (RTE)
D. ICTe (RMTE)
E. ICRe (RMTE)
F. Ab (RCSA)
G. Se

IV. (timer)
A. An (CSA)
B. Aa
C. As
D. Aas
E. Anf
F. Afc
G. Alc
H. AV

COMPUTATIONS / ANALYSES
D) ACCURACY CALCULATIONS

RCP UNDER FREQUENCY RELAYS

I. (setpoint)

A.	Re (RCA)	=	±0.008	Hz
B.	De (RD)	=	0	Hz
C.	TNe (RTE)	=	±0.008	Hz
D.	ICTe (RMTE)	=	±0.008	Hz
E.	ICRe (RMTE)	=	0	Hz
F.	Ab (RCSA)	=	±0.011	Hz
G.	Se	=	±0.2	Hz

R7
R7

II. (setpoint) Westinghouse Setpoint Methodology (contained as part of Reference 4) is used to combine error components for this device. See accuracy discussion of sheet 20. There is no sensor associated with this channel; therefore, Sensor accuracy is not applicable. Per Westinghouse Setpoint Methodology, the total statistical error allowance for this channel is as follows:

A. An = CSA

$$= \sqrt{[(RCA) + (RMTE) + (RD) + (RCSA)]^2 + [(RTE)]^2}$$
$$= \sqrt{[(0.008) + (0.008 + 0) + (0.0) + (0.011)]^2 + [(0.008)]^2}$$
$$= \sqrt{[(0.027)]^2 + [(0.008)]^2} = \pm 0.028 \text{ Hz}$$

B. As $= \sqrt{[(An)]^2 + [(Se)]^2} = \sqrt{[(0.028)]^2 + [(0.2)]^2} = \pm 0.202$ Hz

C. Aa = An = ±0.028 Hz

D. Aas = As = ±0.202 Hz

E. To determine the As Found tolerances per the requirements of TSTF-493, the Re, ICTe, ICRe, and De terms are combined using the SRSS method.

Anf $= \sqrt{Re^2 + ICTe^2 + ICRe^2 + De^2}$
$= \sqrt{0.008^2 + 0.008^2 + 0^2 + 0^2}$
= ± 0.011 Hz

F. Afc = Anf = ±0.011 Hz

G. Alc = Ab = ±0.011 Hz

R7

COMPUTATIONS / ANALYSES
D) ACCURACY CALCULATIONS

RCP UNDER FREQUENCY RELAYS (continued)

H. Per Westinghouse Setpoint Methodology, to provide a conservative trigger value the difference between the STS trip setpoint and the STS Allowable Value is determined by two methods. The first is simply the values used in the statistical calculation,

$T_1 = (RD) + (RCA) + (RMTE) + (RCSA)$.

The second extracts these values from the calculations and compares these numbers statistically against the total allowance as follows:

$T_2 = TA - \{(PMA)^2+(PEA)^2+(SCA+SMTE+SD)^2+(SPE)^2+(STE)^2+(RTE)^2\}^{1/2} - EA$.

The lowest of the two values is used for the trigger value.

$T_1 = (0.0) + (0.008) + (0.008) + (0.011) = 0.027$ Hz | R7

Total Allowance (TA) = Setpoint – Value used in the analysis for Reactor Trip Safety Limit (Ref. 4)

TA = 57 Hz - 55.8 Hz = 1.2 Hz

Note: all terms except TA and RTE are not applicable in T_2

$T_2 = 1.2 - [(0.008)^2]^{1/2} = 1.192$ Hz

The lowest of the two trigger values is 0.027 Hz, therefore,

Allowable Value = Setpoint - 0.027 Hz = 57 Hz - 0.027 Hz = 56.973 Hz | R7

COMPUTATIONS / ANALYSES
D) ACCURACY CALCULATIONS

RCP UNDERFREQUENCY RELAYS

III. (timer)	A.	Re (RCA)	=	± 1 cycle
	B.	De (RD)	=	± 1 cycle
	C.	TNe (RTE)	=	± 1 cycle
	D.	ICTe (RMTE)	=	± 1 cycle
	E.	ICRe (RMTE)	=	± 1 cycle
	F.	Ab (RCSA)	=	± 1 cycle
	G.	Se	=	± 0.5 cycles

IV. (timer) Westinghouse Setpoint Methodology (contained as part of Reference 4) is used to combine error components for this device. See accuracy discussion on sheet 20. There is no sensor associated with this channel, therefore, Sensor accuracy is not applicable. Per Westinghouse Setpoint Methodology, the total statistical error allowance for this channel is as follows:

A. An = CSA

$$= \sqrt{[(RCA) + (RMTE) + (RD) + (RCSA)]^2 + [(RTE)]^2}$$

$$= \sqrt{[(1) + (1 + 1) + (1) + (1)]^2 + [(1)]^2}$$

$$= \sqrt{[5]^2 + [1]^2} = \pm 5.099 \approx \pm 5.10 \text{ cycles}$$

$$= \pm 5.10 \text{ cycles (1/57 seconds/cycle)} = \pm 0.089 \text{ seconds}$$

B. As $= \sqrt{An^2 + Se^2} = \sqrt{5.1^2 + 0.5^2} = \pm 5.12$ cycles $= \pm 0.090$ seconds

C.	Aa	= An	= ± 5.10 cycles	= ± 0.089 seconds
D.	Aas	= As	= ± 5.12 cycles	= ± 0.090 seconds
E.	Anf	= An	= ± 5.10 cycles	= ± 0.089 seconds
F.	Afc	= Anf	= ± 5.10 cycles	= ± 0.089 seconds
G.	Alc	= Ab	= ± 1 cycle	= + 0.018 seconds

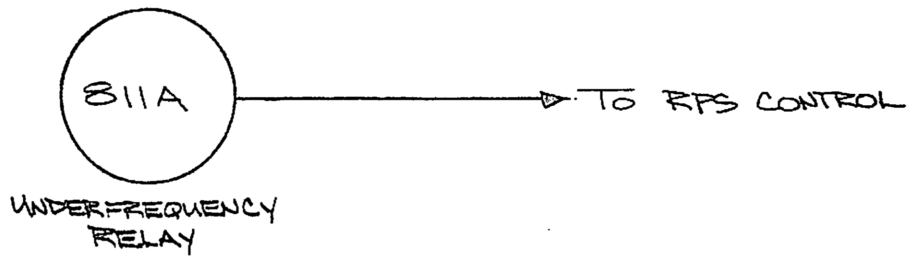
H. AV $\leq$ 0.6 seconds total system response time per technical specifications (reference 3).

SUPPORTING GRAPHICS

A) LOOP DIAGRAM

✓ APPLICABLE TO ALL LOOPS LISTED ON SHEET 9.

___ APPLICABLE ONLY TO LOOPS: ____________



(SAME FOR RCP'S 1,2,3 & 4)

SUMMARY 0F RESULTS (BISTABLE - DECREASING SETPOINT)

x APPLICABLE TO ALL LOOPS LISTED ON SHEET 9

___ APPLICABLE ONLY TO LOOPS: ______________

OPERATIONAL LIMIT	58.5
PV = SP + Aa	57.028
PV = SP + As	57.202
PV = SP + An	57.028
SETPOINT (SP)	57
PV = SP - An	56.972
PV = SP - As	56.798
PV = SP - Aa	56.972
SAFETY LIMIT	55.8

R7

R7

MARGIN 1.172 (normal)
0.998 (seismic)

ALL VALUES SHOWN ARE Hz

(REFER TO ACCURACY DISCUSSION, SHEET 20 FOR CLARIFICATION OF ABOVE)

-Av 56.973 (Per Sheet 24A) -Aas 0.202

AS FOUND AND AS LEFT TOLERANCE FOR COMPLIANCE WITH TSTF-493: R7

Ab = ± 0.011 Hz Afc = ±0.011 Hz

BRANCH/PROJECT IDENTIFIER SQN-EEB-MS-TI28-0076
DEMONSTRATED ACCURACY CALCULATION

S U M M A R Y O F R E S U L T S (BISTABLE- INCREASING SETPOINT)

✓ APPLICABLE TO ALL LOOPS LISTED ON SHEET 9.

___ APPLICABLE ONLY TO LOOPS: ________

	ANALYTICAL LIMIT	0.385 (SHEET 22)
	PV = SP + Aa	0.317
	PV = SP + As	0.318
	PV = SP + An	0.317
(TIMER)	SETPOINT (SP)	0.228
	PV = SP - An	0.139
	PV = SP - As	0.138
	PV = SP - Aa	0.139
	OPERATIONAL LIMIT	~~ø~~ N/A

MARGIN 0.068 (NORMAL)
0.067 (SEISMIC)

R2

ALL VALUES SHOWN ARE SECONDS

(REFER TO ACCURACY DISCUSSION, SHEET 20,22 FOR CLARIFICATION OF ABOVE)

+ AV ≤ 0.6 TOTAL SYSTEM RESPONSE TIME PER TECH. SPECS.

+ Aas 0.090

REV 0	PREP DEH	DATE 6-22-94	CHECK APT	DATE 6/22/94	SHEET 27	C/O 27A
REV ~~1~~ 2	PREP SDM	DATE 2-25-98	CHECK MMS	DATE 2/26/98	SHEET 27	C/O 27A
REV 2	PREP	DATE	CHECK	DATE	SHEET	C/O

CONCLUSIONS

_x_ APPLICABLE TO ALL LOOPS LISTED ON SHEET _9_

___ APPLICABLE ONLY TO LOOPS: ____________________

The worst case normal inaccuracy of the RCP Underfrequency Relay determined by this calculation is ±0.028 Hz with a worst case seismic inaccuracy of ±0.202 Hz. This calculation has demonstrated that the subject devices are adequate for their intended function by determining that positive margins of 1.172 Hz (normal) and 0.998 Hz (seismic) are maintained at the setpoint of 57 Hz. R7

The loop response time is primarily dependent on the time delay setting of the subject relay. The relay time-delay setting is established by this calculation as 10 cycles (excluding the additional 3 cycle measurement period). See response time discussion on sheet 22. The Setpoint (57 Hz) and Calculation Allowable Value (56.973 Hz) are the Technical Specification values. R7

Additionally, the issue of erroneous trips has been addressed by this calculation and the setpoint of 57 Hz has been shown acceptable with regard to the Upper Operational Limit of 58.5 Hz established on sheet 10A. It should be noted references 16 and 8 document setpoints of 57.5 Hz for WBN and 57 Hz for BFN respectively. R7

PROCUREMENT REQUEST FORM

TO: R.C. Jenkins, PEG MANAGER, OPS-1A, SQN

FROM: V. Hudgins, NE, DSP-1B, SQN

DATE: 1-5-94

SUBJECT: PROCUREMENT OF ITEMS AND/OR MATERIALS FOR Sequoyah NUCLEAR PLANT, UNITS 2,1

PR NUMBER: SE-1899 REVISION: 0

DCN M10396A
Page

PLEASE TAKE THE NECESSARY ACTION TO PROCURE THE ITEM(S) AND/OR MATERIAL DESCRIBED HEREIN.

CHECK AS REQUIRED:
- [x] THIS PR IS OUTAGE RELATED: UNIT 2 CYCLE 6
- [ ] THIS PR IS FOR EMERGENCY PURCHASE *(Documented justification required, see line 9).*

SCHEDULE DATES	NEED DATES	EXPECTED DATE *(BY PEG or M&P)*
PEG PACKAGE ISSUE DATE *(Released to M&P or Purchasing)*	N/A	
AWARD OF CONTRACT	N/A	
VENDOR TECHNICAL DATA SUBMITTALS		
DELIVERED TO SITE/APPROVED FOR ISSUE (AFI)	/	/

LEAD ENGINEER / ENGINEERING MANAGER
[signature] 1/25/94

cc (Attachment): R. Quirk, ENGINEERING TASK MANAGER, DSE-1A

(BELOW INFORMATION BY PEG)

QA Record

RIMS ACCESSION NUMBER B25 940208 109
(Required)

TO: V. Hudgins, DSP 1B-SQN
(Address)

FROM: R. Jenkins, PEG MANAGER, OPS1A-SQN

DATE: FEB 08 1994

Attachment No. 1 Sheet 1 of 9
Identifier SQN-PEB-MG-TI28-0016

CHECK AS REQUIRED:
- [x] WE ACKNOWLEDGE THIS PROCUREMENT REQUEST. ADDITIONAL PROCUREMENT PACKAGE INFORMATION IS INDICATED ON LINE 10
- [ ] THIS PR IS BEING REJECTED AND RETURNED PER THE FOLLOWING REMARKS:

Mickey G Hazelwood
Assigned Procurement Engineer

Allen W. Thomas
for *Procurement Engineering Group Manager*

cc (Attachment): RIMS, ET SLP-K

PEG FILES, OPS1A-SQN

M.G. Hazelwood, PROCUREMENT ENGINEER, OPS1A-SQN

MGH

TVA 10606 (NP 8/92)

PROJECT	UNIT(s) ☐ 0 ☒ 1 ☒ 2 ☐ 3	DATE	PR NUMBER and REVISION
SQN		1-5-94	SE-1899

PREPARED BY / EXTENSION	CHECKED BY / EXTENSION	PROJECT CONTROL NO. (PCN)
Vickie Hudgins x8243	Alan Janney x8083	498

DCN M10396A
Page ______

DESCRIPTIVE TITLE
Underfrequency relays for Reactor Coolant Pumps

1\. END USE (Equipment UNID and description if applicable)
RCP PT and relay Bds. (1,2-PX-068-344-D; -346-E; -348-F; -350-G / 1,2-RLY-068-344-D; -346-E; -348-F; -350-G)

A. BUILDING OR AREA (include room nos.) AB / room A11 — C. COLUMN LINES A3, A14 / Q

B. ELEVATION 714 — D. SYSTEMS 68, 250, 202

2\. ATTACHMENT(s) ☐ PR CONTINUATION SHEET INCLUDED ☐ N/A

OTHER: Bill of Material (2 sheets); Data Sheets 1 and 2; Environmental Data sheet 1-24-94

3\. ECN/DCN NUMBERS: M10396A, M10441A — REFERENCE DOCUMENTS:

4\. DESIGN BASIS FOR END USE (HOST) EQUIPMENT

A. SAFETY CLASSIFICATION: ☒ SAFETY-RELATED ☐ NOT SAFETY-RELATED

B. ASME SECTION III CLASS ☐ 1 ☐ 2 ☐ 3 ☒ N/A

C. TVA PIPING CLASS ______ ☐ N/A

D. IEEE CLASS 1E ☒ YES ☐ NO — IF YES, ATTACH ENVIRONMENTAL SHEET

E. 10 CFR 50.49 ☐ YES ☒ NO — IF YES, ATTACH ENVIRONMENTAL SHEET

F. ☐ MECHANICAL EQ ☒ N/A

G. SEISMIC QUALIFICATION REQUIRED: ☐ NO (nonseismic)
- ☒ YES: ☐ by TVA ☐ in DCN pkg ☒ by vendor
- ☒ SEISMIC CAT. I: ☐ ACTIVE, must operate (1-21-94): ☒ before SSE ☒ during SSE ☐ after SSE
- ☐ PASSIVE: ☐ Remain structurally intact all phases of SSE
- ☐ SEISMIC CAT. I (L) / II: ☐ I (L)–A must retain position & pressure ☐ I (L)–B position ONLY

5\. DESIGN CRITERIA (List referenced paragraphs) SQN-DC-V-41, 3.1; SQN-DC-V-21.0, 1.2
SQN-DC-V-27.9, 4b; SQN-DC-V-27.4, 3.5; SQN-DC-V-11.3, 4.3, 3.2.4

6\. IDENTICAL OR SIMILAR PROCUREMENTS WERE PURCHASED ON: ☐ N/A
CONTRACT NO. SE-1716 DCN/ECN M09394A, M09395A PROJECT: ______

7\. DESIGN BASIS VERIFIED BY (for NE cross discipline reviews or if PR is initiated outside NE [i.e., MODS]) ☒ N/A
NE ORG./SIGNATURE(s)/INTL(s).

8\. BUDGET AUTHORIZATION (Project Mgr. signature, account no. for material and processing costs, or other accounting designation)
NUMBER ______ SIGNATURE ______ ☒ N/A
ESTIMATED TOTAL MATERIAL COST $

9\. ☐ EMERGENCY PURCHASE JUSTIFICATION
☐ SOLE SOURCE JUSTIFICATION
☐ OTHER
☐ SEE ATTACHED

Attachment No. 1 Page 2 of 9
Identifier SQN-EEB-MS-TI28-0016

VENDOR MANUALS:
☐ Not required
☒ Required for items 1, 2, 6

TO BE SUPPLIED:
☐ With equipment
☒ By (Date) 4-4-94

10\. PEG ACKNOWLEDGE INFORMATION:
(1) Relays & mounting Kits procured on PEG PKG SE-1899A.
(2) Cable & terminal lugs reserved in stores under PEG PKG SE-1899-1.
(3) Test Blocks procured on PEG PKG SE-1899B.

TVA 10606 (NP 8/92)

CONTRACT REFERENCE OR REQUISITION NO	ITEM	CLASSIFICATION	DESCRIPTION	QUANTITY	UNITS	MARK NO.
SE-1899A BWP332Y	1	IE	Underfrequency Relay, type 81, operating range 54-60HZ adjustable in 0.05 Hz increments; operating time/time delay adjustable in 1-99 cycles (1 cycle increments); 48/125 VDC control voltage; 2 form B or C contacts with .3 amp inductive interrupting rating; EMI resistant in accordance with TVA SS-E18.14.01; ASEA Brown Boveri catalog number 422B1295, or equal (4 spares included)	12	ea	
SE-1899A ~~BWP111M~~ MLH 2/7/94 BVP111M	2	IE	AC-DC converter, ITE-96, accessory power supply for use with ITE protective relays from 120 VAC source provides unregulated 48 VDC for one relay, catalog no. 200B1248, ASEA Brow Boveri or equal (4 spares included)	12	ea	
BWP267F SE-1899A	3	IE	Mounting kit for type 81 relay (4 spares included)	12	ea	
SE-1899-1 BJK234H	4	IE	Cable, No. 14 AWG, 1/C, Type SIS, 600V, Irradiated cross-linked polyethylene, Class IE-LOCA	1000	ft	WJG-6

DCN M10396A
Page

Attachment No. 1 Sheet 3 of 9
Identifier SQN-EEB-MS-TI28-0075

Electrical BILL OF MATERIAL

PROJECT UF Relay for Reactor Coolant Pumps

DWG NO

REV NO	DCN/ECN NO.	DATE	MADE	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR
3										
2										
1										
0	M10396A M10441A	1-20-94	[illegible]	APT						

KNOXVILLE, TENN DATE 1-24-94

SH 1 OF 2 SE-1899 R0

TENNESSEE VALLEY AUTHORITY - OFFICE OF ENGINEERING

CONTRACT REFERENCE OR REQUISITION NO	ITEM	CLASSIFICATION	DESCRIPTION	QUANTITY	UNITS	MARK NO.
SE-1899-1	5		Ring tongue terminal lug	400	ea	
ARM608L			for No. 14 AWG wire (14-16 #10			
			stud)			
SE-1899B	6	1E	Test Block, 6 P, with cover	12	ea	
BWP969E			class 1E, semiflushed type			
			PK2, ~~GE # 64221208~~ *			
			or equal			
			(4 spares included)			
			* Appears to be an error in P/N.			
			Vendor will assign P/N after			
			award. MWH 2/7/94			

DCN M10396A
Page

Attachment No. 1 Sheet 4 of 9
Identifier SQN-EEB-MS-TI26-0075

REV NO	ECN NO.	DATE	MADE	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR
3										
2										
1										
0	M10396A M10444A	1-24-94	wh	APS						

Electrical BILL OF MATERIAL

PROJECT UF Relay for Reactor Coolant Pumps

DWG NO

KNOXVILLE, TENN DATE 1-24-94

SH 2 OF 2 SE-1899 R0

TVA 10581-01 (EN DES-2-84) REQUISITION NO. ____

GENERAL	1 ITEM NO.	
	2 QUANTITY	12
	3 INSTRUMENT NO.	See Below
	4 IEEE CLASS	(X) 1E ( ) NA
	5 SEISMIC CATEGORY	(X) 1 ( ) 1(L) ( ) NA
	6 ASME CODE CLASS	NA ( ) NA
	7 MANUFACTURER	ABB
	8 MODEL NO.	422B1295
	9 CASE STYLE/MATL	MS
	10 ENCLOSURE	MS
	11 MOUNTING	MS

DCN M10396A

Page ____

12

13 1,2-81-068-344-D

14 1,2-81-068-346-F

15 1,2-81-068-348-F

16 1,2-81-068-350-G

17

18 Type 81 Underfrequency Relay with an operating

19 range of 54-60 Hz adjustable in 0.05 increments;

20 an operating time/time delay adjustable in

21 1-99 cycles (1 cycle increments); control voltage of

22 48/125 VDC; two form B or C contacts with 3

23 amp inductive interrupting rating; EMI resistent

24 in accordance with TVA Standard SS-E18.14.01.

25 ASEA Brown Boveri Catalog number 422B1295

26 or equal

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48

X---DATA BY BIDDER
*---OR EQUAL
NA--NOT APPLICABLE
MS--MFR STANDARD

NOTES: (1)

Attachment No. 1 Sheet 5 of 7
Identifier SQN-EEB-MS-TI28-0076

DSGNR: vdh DATE: 1-24-94
CHKR: APJ DATE: 1/24/94

SPECIFICATION NO.

PLANT: SQN

PR NO. SE-1899 R0

ECN NO. M10396 M10441

DATA SHEET NO. 1

TVA 10581-01 (EN DES-2-84)

REQUISITION NO. ____

DCN M103966A

Page

GENERAL	1	ITEM NO.	
	2	QUANTITY	12
	3	INSTRUMENT NO.	See Below
	4	IEEE CLASS	(X)1E ( )NA
	5	SEISMIC CATEGORY	(X)1 ( )1(L) ( )NA
	6	ASME CODE CLASS	NA ( )NA
	7	MANUFACTURER	ASEA Brown Boveri
	8	MODEL NO.	200B1248
	9	CASE STYLE/MATL	MS
	10	ENCLOSURE	MS
	11	MOUNTING	MS
	12		
	13	1,2-PX-068-344-D	
	14	1,2-PX-068-346-E	
	15	1,2-PX-068-348-F	
	16	1,2-PX-068-350-G (4 spares)	
	17		
	18	ITE-96, AC-DC Converter, accessory power supply for	
	19	use with ITE protective relays from 120 VAC source;	
	20	provide unregulated 48VDC for one relay	
	21	ABB catalog No. 200B1248	
	22		
	23		
	24		
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	46		
	47		
	48		

X---DATA BY BIDDER
*---OR EQUAL
NA--NOT APPLICABLE
MS--MFR STANDARD

DSGNR: vdh DATE: 1-24-94
CHKR: APJ DATE: 1/24/94

PLANT: SQN

NOTES: (1)

Attachment No. 1 Sheet 6 of 9
Identifier SQN-EEB-MS-TI28-0076

SPECIFICATION NO.

PR NO. SE-1899 R0

~~ECN~~ DCN NO. M10396A/M10441A 1-24-94

DATA SHEET NO. 2

TVA 10581-30 (EN DES 2-84)

REQUISITION NO. ________

DCN M10396A
Page ________

#						
1	ITEM NO.					
2	INSTRUMENT NO.		SEE BELOW			
3						
4			Maximum			
5						
6	NORMAL	TEMPERATURE	104°F			
7		PRESSURE	—			
8		HUMIDITY	80%			
9		RADIATION	1.8X10^3 RADS			
10		DUST	( )YES (X)NO	( )YES ( )NO	( )YES ( )NO	( )YES ( )NO
11						
12						
13						
14	ABNORMAL	TEMPERATURE	110°F			
15		PRESSURE	—			
16		HUMIDITY	90%			
17		RADIATION				
18		OPERATE SUBMERGED	( )YES (X)NO	( )YES ( )NO	( )YES ( )NO	( )YES ( )NO
19		NON-OPERATE SUB	( )YES (X)NO	( )YES ( )NO	( )YES ( )NO	( )YES ( )NO
20		DEPTH				
21	ACCIDENT	TEMPERATURE	NA			
22		PRESSURE	NA			
23		HUMIDITY	NA			
24		RADIATION DOSE	1X10^4 RADS			
25		MAX RAD DOSE RATE/TIME	NA			
26		CAUSTIC SPRAY	( )YES (X)NO	( )YES ( )NO	( )YES ( )NO	( )YES ( )NO
27		OPRG TIME (1)	NA			
28		SUBMERGENCE DEPTH	NA			
29		REQ'D ACCURACY	NA			
30						

ITEM NO.:

INSTRUMENT NO.: 1,2-PX-068-344-D, 1,2-PX-068-346-E, 1,2-PX-068-348-F, 1,2-PX-068-350-G; 1,2-81-068-344-D, 1,2-81-068-346-E, 1,2-81-068-348-F, 1,2-81-068-350G

FUNCTION:

REMARKS:

Information above is relative to RCP Panels located on elevation 714 of the Auxiliary Bldg. per 47E235-49

Attachment No. 1 Sheet 7 of 9
Identifier ~~SQN-EEB-MS-TI28-0076~~

CAUSTIC SPRAY COMPOSITION:
NA

NOTES: (1) OPERATING TIME IS TIME AFTER THE BEGINNING OF THE ACCIDENT

DSGNR: [initials] DATE: 1-24-94
CHKR: ART DATE: 1/24/94

SPECIFICATION NO.
ENVIRONMENTAL CONDITIONS
FOR CLASS 1E EQPT

PLANT: SQN

PR NO. SE-1899 R0

~~ECN~~ DCN NO. M10396A/M10441A

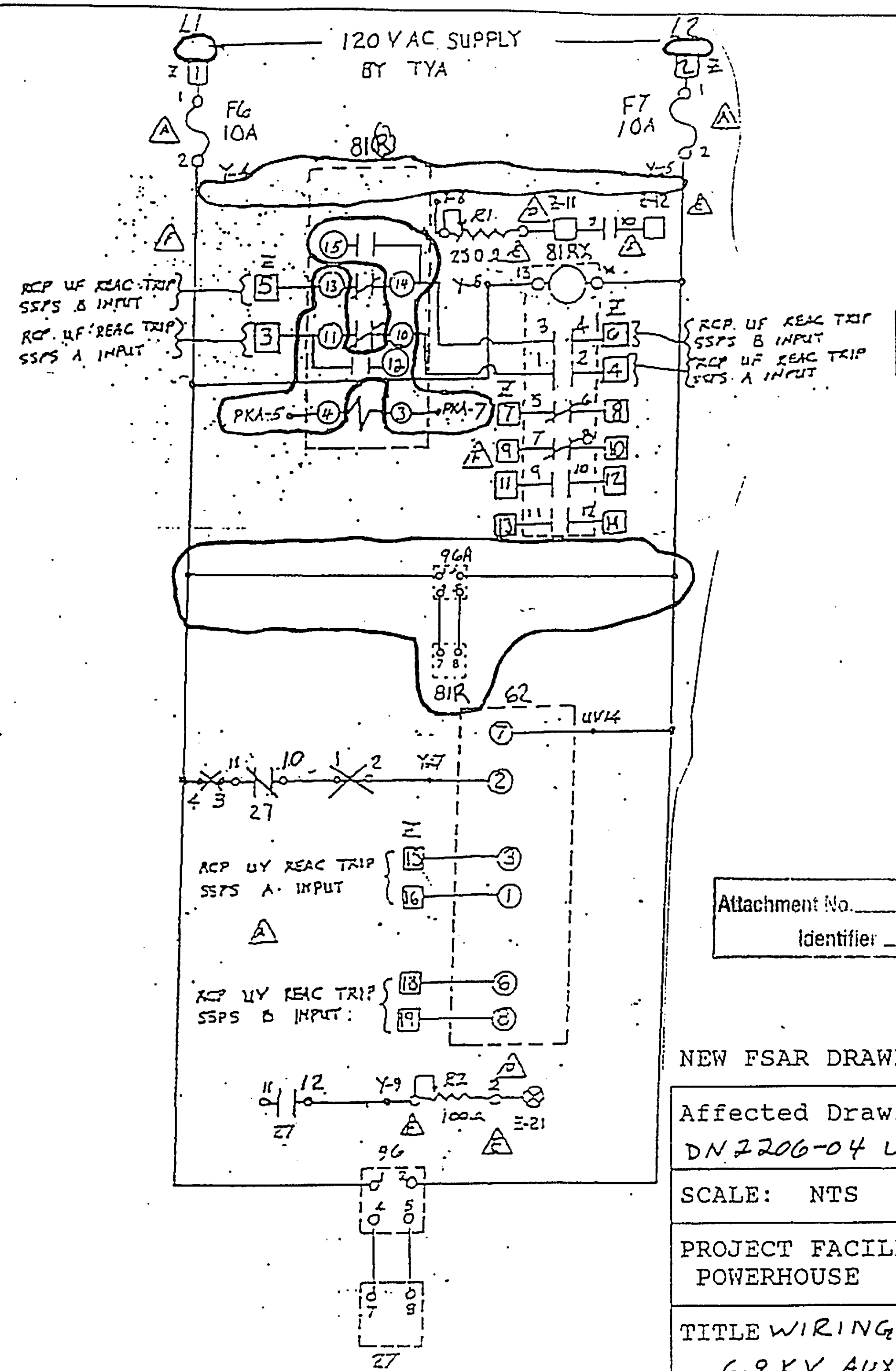
DATA SHEET NO. ~~1~~3 SHEET 1 R0

[initials] 1-24-94

[initials] 1/31/94

DCN NO. M10396A

SHEET



Attachment No. 1 Sheet 8 of 9
Identifier SQN-EEB-MS-TI28-0076

NEW FSAR DRAWING: ☐ Yes ☒ No

Affected Drawing	Category
DN 2206-04 UO MD R.F	3

SCALE: NTS EXCEPT AS NOTED

PROJECT FACILITY POWERHOUSE — UNIT 2

TITLE WIRING SCHEMATIC 6.9 KV AUX POWER RELAY

DCA M10396-

SEQUOYAH NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY — N

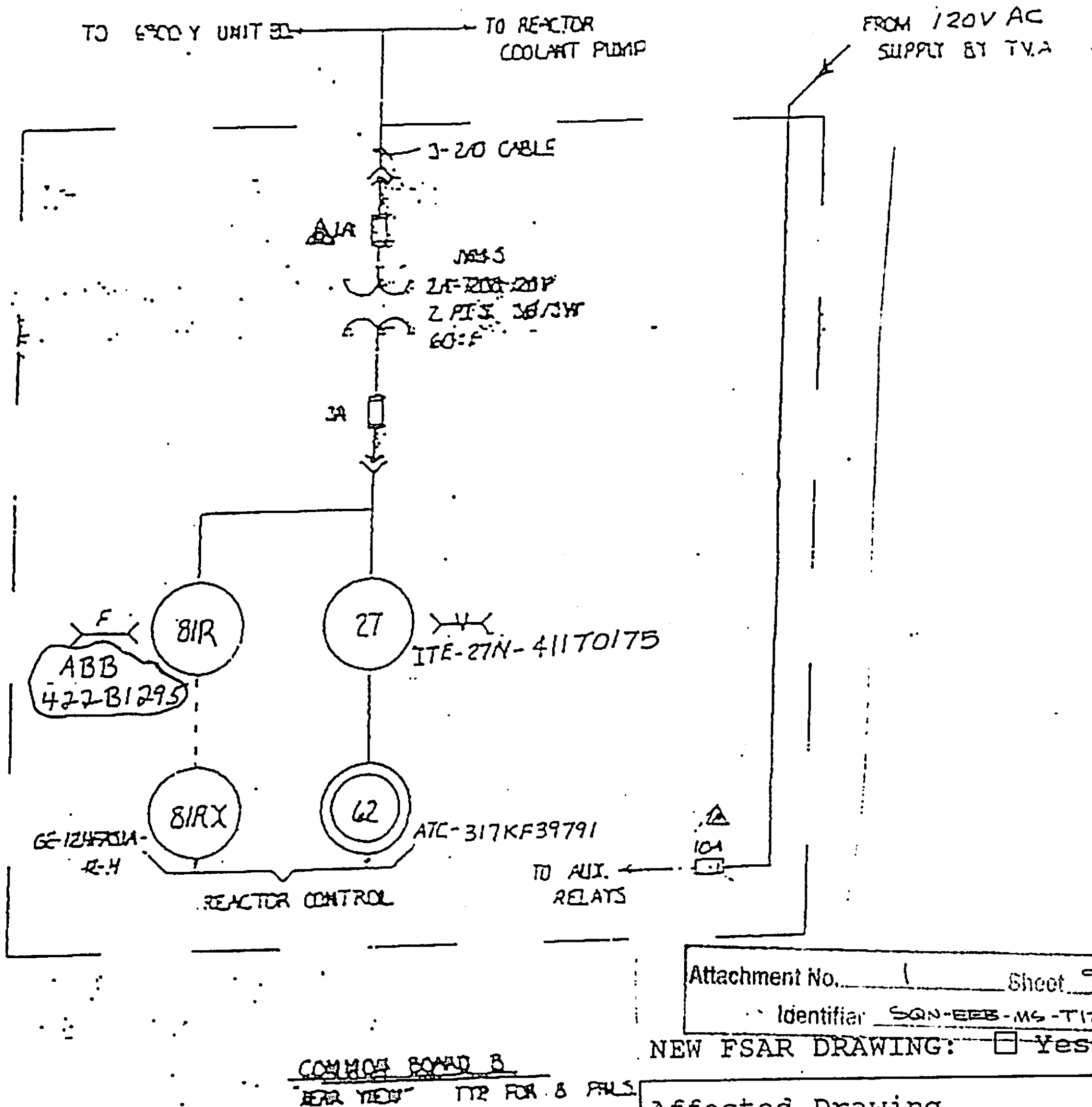
Contract No. 823380
Prerequisites DCN M09395A

Anticipated CCDs 1,2-DN2206-04

REVISION	RESP. ENGR.	DESIGN VERIFIED	CHANGE REFERENCE
0	[signature]	[signature]	DCN M10396A

DCN NO. M10396A

SHEET



Attachment No. 1 Sheet 9 of 9

Identifier SQN-EEB-MS-TI26-0076

NEW FSAR DRAWING: ☐ Yes ☒ No

Affected Drawing: DN 2206-03 UO MD R.0

Category: 3

SCALE: NTS EXCEPT AS NOTED

PROJECT FACILITY: POWERHOUSE

UNIT: 2

TITLE ONE LINE DIAGRAM 6.9 KV AUX POWER RELAY PANEL

DCA M10396-

SEQUOYAH NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

N

Contract No. 823380

Prerequisites DCN M09395A

Anticipated CCDs 1,2-DN2206-03

REVISION	RESP. ENGR.	DESIGN VERIFIED	CHANGE REFERENCE
0	[signature]	[signature]	DCN M10396A

Attachment No. 2 Sheet 1 of 3
Identifier SQN-EEB-MS-TI28-0076

c. Reactor coolant pump underfrequency trip

This trip is required to protect against low flow resulting from bus underfrequency; for example, a major power grid frequency disturbance. The function of this trip shall be to open the reactor coolant pump (RCP) breakers and trip the reactor for an under-frequency condition. The setpoint of the underfrequency relays is adjustable between 54 and 59 Hz.

There shall be one underfrequency sensing relay connected to the load side of each Reactor Coolant Pump breaker. Power level above the P-7 setpoint and an underfrequency condition sensed by more than one Reactor Coolant Pump motor shall result in the tripping of all of the Reactor Coolant Pump breakers as well as directly tripping the reactor. Signals from these relays shall be time delayed to prevent spurious trips caused by short-term frequency perturbations. Undervoltage sensing relays shall be provided across the power feed to each underfrequency sensor in order to ensure that each underfrequency input to the Reactor Protection System will indicate an underfrequency condition exists on loss of power to the sensing device. The contacts of this undervoltage relay shall be in series with the output of the underfrequency sensing relays in each channel. Reference 8.1.3.17, Sheet 5 shows the logic. Functional requirements for the RCP underfrequency trip are provided in Reference 8.1.3.16.

The only inputs to the Reactor Protection System associated with the Reactor Coolant Pumps come from the undervoltage and underfrequency sensors. These sensors are located on the load side of the Reactor Coolant Pump breakers, within a Seismic Category I structure, and shall be designed in accordance with the requirements of IEEE 279-1971.

The trip signal for the Reactor Coolant Pump breakers, associated with the underfrequency condition, is an output from the Reactor Trip System, as shown in Reference 8.1.3.17.

The Westinghouse analysis of the loss of flow accident has shown that for frequency decay rates less than 6.8 Hz per second no Reactor Coolant Pump trip is necessary. TVA has performed an analysis to confirm that the worst case frequency decay rate at the RCP input terminals is below this limit. The results of the TVA analysis shows a frequency decay rate of less than 5 Hz per second.

5. Low-Low Steam Generator Water Level Reactor Trip

This trip shall protect the reactor from loss of heat sink in the event of a major feedwater line rupture or a loss of feedwater to one or more steam generators. This trip shall be actuated on two out of three low-low water level signals occurring in any steam generator. If a

Table 3.2.1-1 (Continued)
LIST OF REACTOR TRIPS

Reactor Trip	Coincidence Logic	Interlocks	Comments
12. Reactor coolant pump undervoltage	2/4	Interlocked with P-7	Low voltage on all buses permitted below P-7.
13. Reactor coolant pump underfrequency	2/4	Interlocked with P-7	Underfrequency on 2 buses will cause reactor trip; reactor trip blocked below P-7.
14. Low-low steam generator water level	2/3 per loop	No interlocks	See Section 3.2.1 for a discussion of Environmental Allowance Modifier and Trip Time Delay
15. Safety injection signal	Coincident with actuation of safety injection	No interlocks	(See FSAR Section 7.3 for Engineered Safety Features actuation conditions)
16. Turbine-generator trip			
a. Low auto stop oil pressure	2/3	Interlocked with P-9	Blocked below P-9
b. Turbine stop valve	4/4	Interlocked with P-9	Blocked below P-9
17. Manual	1/2	No interlocks	

Note: See Table 3.2.1-2, Protection System Interlocks for definition of designations

Attachment No. 2 Sheet 2 of 3
Identifier SQN-EEB-MS-TI28-0076

Table 3.2.1-2
PROTECTION SYSTEM INTERLOCKS

Designation	Derivation	Function
	Power Escalation Permissives	
P-6	1/2 Neutron flux (intermediate range) above setpoint	Allows manual block of source range reactor trip
	2/2 Neutron flux (intermediate range) below setpoint	Defeats the block of source range reactor trip
P-10	2/4 Neutron flux (power range) above setpoint	Allows manual block of power range (low setpoint reactor trip)
		Allows manual block of intermediate range reactor trip and intermediate range rod stops (C-1)
		Blocks source range reactor trip (back-up for P-6)
	3/4 Neutron flux (power range) below setpoint	Defeats the block of power range (low setpoint) reactor trip
		Defeats the block of intermediate range reactor trip and intermediate range rod stops (C-1)
		Input to P-7
P-7	3/4 Neutron flux, power range below setpoint (from P-10) and 2/2 Turbine impulse chamber pressure below setpoint (from P-13)	Blocks reactor trip on: Low flow, reactor coolant and pump undervoltage and underfrequency, pressurizer low pressure, and pressurizer high level
P-8	3/4 Neutron flux (power range) below setpoint	Blocks low primary coolant flow reactor trip for low flow in a single loop.

Attachment No. 2 Sheet 3 of 3
Identifier SQN-EEB-MS-TI28-0076

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
14. Deleted		
15. Undervoltage-Reactor Coolant Pumps	≥ 5022 volts-each bus	≥ 4739 volts-each bus
16. Underfrequency-Reactor Coolant Pumps	≥ 56.0 Hz - each bus	≥ 55.9 Hz - each bus
17. Turbine Trip		
A. Low Trip System Pressure	≥ 45 psig	≥ 43 psig
B. Turbine Stop Valve Closure	≥ 1% open	≥ 1% open
18. Safety Injection Input from ESF	Not Applicable	Not Applicable
19. Intermediate Range Neutron Flux - (P-6) Enable Block Source Range Reactor Trip	≥ 1 x 10-5% of RATED THERMAL POWER	≥ 6 x 10-6% of RATED THERMAL POWER
20. Power Range Neutron Flux (not P-10) Input to Low Power Reactor Trips Block P-7	< 10% of RATED THERMAL POWER	< 12.4% of RATED THERMAL POWER

R145

R145

Attachment No. 3 Sheet 1 of 16
Identifier SQN-EEB-MS-TI28-0076

MAY 16 1990

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
b. RCS Loop ΔT Equivalent to Power > 50% RTP		
Coincident with Steam Generator Water Level--Low-Low (Adverse)	≥ 15.0% of narrow range instrument span	≥ 14.4% of narrow range instrument span
and Containment Pressure (EAM)	≤ 0.5 psig	≤ 0.6 psig
or		
Steam Generator Water Level--Low-Low (EAM)	≥ 10.7% of narrow range instrument span	≥ 10.1% of narrow range instrument span
14. Deleted		
15. Undervoltage-Reactor Coolant Pumps	≥ 5022 volts-each bus	≥ 4739 volts - each bus
16. Underfrequency-Reactor Coolant Pumps	≥ 56 Hz - each bus	≥ 55.9 Hz - each bus
17. Turbine Trip		
A. Low Trip System Pressure	≥ 45 psig	≥ 43 psig
B. Turbine Stop Valve Closure	≥ 1% open	> 1% open
18. Safety Injection Input from ESF	Not Applicable	Not Applicable

R132

R76

Attachment No. 3 Sheet 2 of 18
Identifier SQN-EEB-MS-TI28-0076

OCT 3 1 1990

3/4.3 INSTRUMENTATION

3/4.3.1 REACTOR TRIP SYSTEM INSTRUMENTATION

LIMITING CONDITION FOR OPERATION

3.3.1.1 As a minimum, the reactor trip system instrumentation channels and interlocks of Table 3.3-1 shall be OPERABLE. R194

APPLICABILITY: As shown in Table 3.3-1.

ACTION:

As shown in Table 3.3-1.

SURVEILLANCE REQUIREMENTS

4.3.1.1.1 Each reactor trip system instrumentation channel and interlock shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations for the MODES and at the frequencies shown in Table 4.3-1. R16

4.3.1.1.2 The logic for the interlocks shall be demonstrated OPERABLE prior to each reactor startup unless performed during the preceeding 92 days. The total interlock function shall be demonstrated OPERABLE at least once per 18 months during CHANNEL CALIBRATION testing of each channel affected by interlock operation.

4.3.1.1.3 The REACTOR TRIP SYSTEM RESPONSE TIME of each reactor trip function shall be demonstrated to be within its limit at least once per 18 months. Neutron detectors are exempt from response time testing. Each test shall include at least one logic train such that both logic trains are tested at least once per 36 months and one channel per function such that all channels are tested at least once every N times 18 months where N is the total number of redundant channels in a specific reactor trip function as shown in the "Total No. of Channels" column of Table 3.3.1. R194

Attachment No. 3 Sheet 3 of 18
Identifier SQN-EEB-MS-TI28-0016

3/4.3 INSTRUMENTATION

3/4.3.1 REACTOR TRIP SYSTEM INSTRUMENTATION

LIMITING CONDITION FOR OPERATION

3.3.1 As a minimum, the reactor trip system instrumentation channels and interlocks of Table 3.3-1 shall be OPERABLE. R182

APPLICABILITY: As shown in Table 3.3-1.

ACTION:

As shown in Table 3.3-1.

SURVEILLANCE REQUIREMENTS

4.3.1.1.1 Each reactor trip system instrumentation channel and interlock shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations for the MODES and at the frequencies shown in Table 4.3-1.

4.3.1.1.2 The logic for the interlocks shall be demonstrated OPERABLE prior to each reactor startup unless performed during the preceeding 92 days. The total interlock function shall be demonstrated OPERABLE at least once per 18 months during CHANNEL CALIBRATION testing of each channel affected by interlock operation.

4.3.1.1.3 The REACTOR TRIP SYSTEM RESPONSE TIME of each reactor trip function shall be demonstrated to be within its limit at least once per 18 months. Neutron detectors are exempt from response time testing. Each test shall include at least one logic train such that both logic trains are tested at least once per 36 months and one channel per function such that all channels are tested at least once every N times 18 months where N is the total number of redundant channels in a specific reactor trip function as shown in the "Total No. of Channels" column of Table 3.3.1. R182

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APPENDIX A

11-42
Change No.

REQUEST FOR SAR CHANGE

REQUESTED BY: Gregory G. Mailen DATE: July 25, 1994

SECTION: NE-EE PHONE: 843-8065

CHANGE REQUIRED DUE TO:

☐ *DCN or Plant Modification. Explain: ______

☑ *Technical Specification Change. Explain: The Tech Spec has been revised by letter TVA-SQN-TS-94-03 (RIMs S64 940511 802).

☐ *Inaccurate or inadequate information contained in the current FSAR.
Explain: ______

☐ *Nonintent Change.
Explain: ______

☐ *Typographical error.

* Attach a marked up copy of FSAR page and revised figures (if applicable) indicating proposed change.

NOTE: Justification is required to accompany any proposed SAR change with the exception of typographical corrections. Contact site licensing organization if confusion or uncertainty exists over whether an error is typographical or nonintent.

Gregory G. Mailen (signature)	July 25, 1994	(signature)	10/26/94
(Preparer)	Date	Reviewer	Date
(signature)	10/27/94	(signature)	11/4/94
DOR Section Supervisor	Date	**Licensing Approval	Date

REFERENCES (base on design document, if possible): ______

COMMENTS: ______

Transmit to: Site Licensing Manager
**Forward to: DCRM - Living FSAR Notebook
Originator

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flood (DBF) or within a nonflooded structure or are designed for submerged operation.

7.2.1.2.6 Minimum Performance Requirements

The performance requirements are as follows:

1. System response times:

The reactor trip system response time shall be the time interval from when the monitored parameter exceeds its trip setpoint at the channel sensor until loss of stationary gripper coil voltage. 6

Typical maximum allowable time delays in generating the reactor trip signal:

		Time (sec)
a.	Power range nuclear power (High and low setpoint)	0.5
b.	Neutron flux rates (positive and negative)	0.5
c.	Overtemperature ΔT (Maximum)	8.0
d.	Overpower ΔT (Maximum)	8.0
e.	Pressurizer Pressure (low and high)	2.0
f.	Pressurizer high water level	2.0
g.	Low reactor coolant flow	1.0
h.	Reactor coolant pump bus under frequency	0.6
i.	Reactor coolant pump bus undervoltage	1.2
j.	Low-low steam generator water level	2.0*
k.	Turbine trip	1.0
l.	Steam generator water level high turbine trip-reactor trip	≤2.5

*Does not include Trip Time Delay Function 8

The reactor trip system instrumentation response time values are provided in Table 7.2.1-5.

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Item No. SQN-EEB-MS-TI28-0076

REACTOR TRIP SYSTEM INSTRUMENTATION RESPONSE TIMES

FUNCTIONAL UNIT	RESPONSE TIME
1. Manual Reactor Trip	Not Applicable
2. Power Range Neutron Flux	≤ 0.5 seconds ⋆
3. Power Range, Neutron Flux, High Positive Rate	Not Applicable
4. Power Range, Neutron Flux, High Negative Rate	≤ 0.5 seconds ⋆
5. Intermediate Range, Neutron Flux	Not Applicable
6. Source Range, Neutron Flux	Not Applicable
7. Overtemperature Delta T	≤ 8.0 seconds ⋆
8. Overpower Delta T	≤ 8.0 seconds
9. Pressurizer Pressure -- Low	≤ 2.0 seconds
10. Pressurizer Pressure -- High	≤ 2.0 seconds
11. Pressurizer Water Level -- High	Not Applicable
12. Loss of Flow - Single Loop (Above P-8)	≤ 1.0 seconds

⋆ Neutron detectors are exempt from response time testing. Response time of the neutron flux signal portion of the channel shall be measured from detector output or input of first electronic component in channel.

REACTOR TRIP SYSTEM INSTRUMENTATION RESPONSE TIMES

FUNCTIONAL UNIT	RESPONSE TIME
13. Loss of Flow - Two Loops (Above P-7 and below P-8)	≤ 1.0 seconds
14. Main Steam Generator Water Level -- Low - Low	
A. RCS Loop ΔT (P ≤ 50% RTP: P > 50% RTP)	≤ 8.0 seconds (1)
B. Steam Generator Water Level -- Low-Low (Adverse EAM)	≤ 2.0 seconds (1)
C. Containment Pressure (EAM)	≤ 2.0 seconds (1)
15. Deleted	
16. Undervoltage - Reactor Coolant Pumps	≤ 1.2 seconds
17. Underfrequency - Reactor Coolant Pumps	≤ 0.6 seconds
18. Turbine Trip	
A. Low Fluid Oil Pressure	Not Applicable
B. Turbine Stop Valve	Not Applicable
19. Safety Injection Input from ESF	Not Applicable
20. Reactor Trip Breakers	Not Applicable
21. Automatic Trip Logic	Not Applicable
22. Reactor Trip System Interlocks	Not Applicable

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(1) Does not include Trip Time Delays. Response times noted include the transmitters, Eagle-21 process protection cabinets, solid state protection cabinets, and actuation devices. This reflects the response time necessary for THERMAL POWER in excess of 50% RTP.

b. Containment pressure (not required for Steam Generator tube rupture) 6

2. Secondary System Accidents

   a. Pressurizer pressure
   b. Steam line pressures
   c. Steam line pressure rate
   d. Reactor coolant average temperature (T_{avg}) 8
   e. Containment pressure

7.3.1.2.3 Spatially Dependent Variables

The only variable sensed by the Engineered Safety Features Actuation System which has spatial dependence is reactor coolant temperature. The effect on the measurement is negated by taking multiple samples from the reactor coolant hot leg and electronically averaging these samples in the process protection system. 8

7.3.1.2.4 Limits, Margins and Levels

Prudent operational limits, available margins and setpoints before onset of unsafe conditions or requiring protective action are discussed in Chapters 15 and the SQN Technical Specifications. (Refer also to Subparagraph 7.1.2.1.9)

7.3.1.2.5 Abnormal Events

The malfunctions, accidents, or other unusual events which could physically damage protection system components or could cause environmental changes are as follows:

1. Loss of coolant accident (See Sections 15.3 and 15.4)
2. Steam breaks (See Sections 15.3 and 15.4)
3. Earthquakes (See Chapter 3 and Chapter 2)
4. Fire (See Subsection 9.5.1)
5. Explosion (Hydrogen buildup inside containment) (See Section 15.4)
6. Missiles (See Section 3.5 and 10.2.3)
7. Flood (See Chapters 2 and 3)

7.3.1.2.6 Minimum Performance Requirements

Minimum performance requirements are as follows:

1. System response times:

   The Engineered Safety Features actuation system response time, or time delay, is defined as the interval required for the Engineered Safety Features sequence to be initiated subsequent to the point in time that the appropriate variables(s) exceed setpoint(s). The delay

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time includes sensor, process and logic (digital) delay plus, the time delay associated with tripping open the reactor trip breakers, although the reactor trip (on Engineered Safety Feature Actuation Signal) theoretically occurs before or simultaneously with Engineered Safety Features sequence initiation (See Figure 7.2.1-1, Sheet 8). The ESFAS response time values are provided in ~~Chapter 16 (Technical Specifications).~~ Table 7.3.1-4. 6

Add Insert A →

2. System accuracies:

<u>Loss of Coolant Protection Actuation Signals</u>

a. Pressurizer low pressure (1)

<u>Steam Break Protection Actuation Signals</u>

a. Steam line pressure (1)

b. T_{avg} (1) 8

c. Containment pressure signal (1)

<u>NOTE (1)</u>

See "Westinghouse Setpoint Methodology for Protection Systems, Sequoyah Units 1 and 2," WCAP 11239.

3. Ranges of sensed variables to be accommodated until conclusion of protection action is assured:

Typical ranges required in generating the required actuation signals for loss of coolant protection are given:

a. Pressurizer pressure	1700 to 2500 psig
b. Containment pressure (Ice Condenser System)	-1 to 15 psig

Typical ranges required in generating the required actuation signals for steam break protection are given:

a. T_{avg}	530 to 630°F
b. Steam line pressure	0 to 1200 psig
c. Containment pressure (Ice Condenser System)	-1 to 15 psig

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Insert A

The design of the alternating current distribution system in conjunction with the worst-case accident conditions introduces a potential five-second delay in achieving minimum equipment operating voltage for 480-volt safety-related loads with offsite power available. This potential delay results from the worst-case automatic tap changer movement on the common station service transformers. The response times shown in Table 7.3.1-4 support surveillance test conditions with the onsite power system at normal voltage levels. The accident analysis supports an additional five-second duration for safety related equipment that is affected by the potential in achieving adequate voltage.

ENGINEERED SAFETY FEATURES RESPONSE TIMES

INITIATING SIGNAL AND FUNCTION			RESPONSE TIME IN SECONDS
1.	Manual		
	a.	Safety Injection (ECCS)	Not Applicable
		Feedwater Isolation	Not Applicable
		Reactor Trip (SI)	Not Applicable
		Containment Isolation-Phase "A"	Not Applicable
		Containment Ventilation Isolation	Not Applicable
		Auxiliary Feedwater Pumps	Not Applicable
		Essential Raw Cooling Water System	Not Applicable
		Emergency Gas Treatment System	Not Applicable
	b.	Containment Spray	Not Applicable
		Containment Isolation-Phase "B"	Not Applicable
		Containment Ventilation Isolation	Not Applicable
		Containment Air Return Fan	Not Applicable
	c.	Containment Isolation-Phase "A"	Not Applicable
		Emergency Gas Treatment System	Not Applicable
		Containment Ventilation Isolation	Not Applicable
	d.	Steam Line Isolation	Not Applicable
2.	Containment Pressure - High		
	a.	Safety Injection (ECCS)	≤ 32.0 (1)
	b.	Reactor Trip (from SI)	≤ 3.0
	c.	Feedwater Isolation	≤ 8.0 (2)
	d.	Containment Isolation-Phase "A" (3)	≤ 18.0 (8) (15) / 28.0 (9)
	e.	Containment Ventilation Isolation	≤ 5.5 (8) (13)
	f.	Auxiliary Feedwater Pumps	≤ 60.0 (11)
	g.	Essential Raw Cooling Water System (16)	≤ 60.0 (8) (15) / 75.0 (9)
	h.	Emergency Gas Treatment System	≤ 38.0 (9)

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Number SQN-EEB-MS-TI28-0076

ENGINEERED SAFETY FEATURES RESPONSE TIMES

INITIATING SIGNAL AND FUNCTION	RESPONSE TIME IN SECONDS
3. Pressurizer Pressure - Low	
a. Safety Injection (ECCS)	≤ 32.0 (1) / 28.0 (7) (15)
b. Reactor Trip (from SI)	≤ 3.0
c. Feedwater Isolation	≤ 8.0 (2)
d. Containment Isolation-Phase "A" (3)	≤ 18.0 (8) (15)
e. Containment Ventilation Isolation	≤ 5.5 (8) (13)
f. Auxiliary Feedwater Pumps	≤ 60.0 (11)
g. Essential Raw Cooling Water System (16)	≤ 60.0 (8) (15) / 75.0 (9)
h. Emergency Gas Treatment System	≤ 28.0 (8) (15)
4. Deleted	
5. Negative Steam Line Pressure Rate - High	
a. Steam Line Isolation	≤ 8.0

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ENGINEERED SAFETY FEATURES RESPONSE TIMES

INITIATING SIGNAL AND FUNCTION		RESPONSE TIME IN SECONDS
6.	Steam Line Pressure - Low	
a.	Safety Injection (ECCS)	≤ 28.0 (7) (15) / 28.0 (1)
b.	Reactor Trip (from SI)	≤ 3.0
c.	Feedwater Isolation	≤ 8.0 (2)
d.	Containment Isolation-Phase "A" (3)	≤ 18.0 (8) (15) / 28.0 (9)
e.	Containment Ventilation Isolation	Not Applicable
f.	Auxiliary Feedwater Pumps	≤ 60.0 (11)
g.	Essential Raw Cooling Water System (16)	≤ 60.0 (8) (15) / 75.0 (9)
h.	Steam Line Isolation	≤ 8.0
i.	Emergency Gas Treatment System	≤ 38.0 (9)
7.	Containment Pressure -- High - High	
a.	Containment Spray	≤ 208 (9)
b.	Containment Isolation-Phase "B" (12)	≤ 65 (8) (15) / 75 (9)
c.	Steam Line Isolation	≤ 7.0
d.	Containment Air Return Fan	≥ 540.0 and ≤ 660
8.	Steam Generator Water Level -- High-High	
a.	Turbine Trip	≤ 2.5
b.	Feedwater Isolation	≤ 11.0 (2)
9.	Main Steam Generator Water Level -- Low-Low	
a.	Motor - driven Auxiliary Feedwater Pumps (4)	≤ 60.0 (14)
b.	Turbine - driven Auxiliary Feedwater Pumps (5) (11)	≤ 60.0 (14)

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TABLE 7.3.1 - 4 (Sheet 4)

ENGINEERED SAFETY FEATURES RESPONSE TIMES

INITIATING SIGNAL AND FUNCTION	RESPONSE TIME IN SECONDS
10. Station Blackout	
a. Auxiliary Feedwater Pumps	≤ 60 (11)
11. Trip of Main Feedwater Pumps	
a. Auxiliary Feedwater Pumps	≤ 60 (11)
12. Loss of Power	
a. 6.9 kv Shutdown Board - Degraded Voltage of 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)

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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. The ESFAS instrumentation channel RESPONSE TIME requirement for specific feedwater air-operated valve(s) can also be met when the associated air-operated valve is either closed with air supply(s) isolated, isolated by a closed manual valve, or isolated by a closed feedwater isolation valve with power removed. When using one of these provisions for satisfying the air-operated valve response time, the closed or isolated condition described above will be verified at least once per 7 days.

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) (15) / 31(9)
	3.d.	22 (8) (15)
	6.d.	21 (8) (15) / 31(9)

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

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

Valve: FCV-70-143

Response times:	2.d.	61 (8) (15) / 71(9)
	3.d.	62 (8) (15)
	6.d.	61 (8) (15) / 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 and closing 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 is covered by the requirements on their setpoints.

11. The provisions of Technical Specification 4.0.4 are not applicable for entry into MODE 3 for the turbine-driven Auxiliary Feedwater Pump.

12. 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 the function indicated:

    Valves: FCV-67-89, -90, -105, -106
    Response times: 7.b. 75 (8) (15) / 85 (9)

    Valve: FCV-70-141
    Response times: 7.b. 70 (8) (15) / 80 (9)

13. Containment purge valves only. Containment radiation monitor valves have a response time of 6.5 seconds or less.

14. Does not include Trip Time Delays. Response times noted include the transmitters, Eagle-21 process protection cabinets, solid state protection cabinets, and actuation devices (up to and including pumps). This reflects the response times necessary for THERMAL POWER in excess of 50% RTP.

15. The response time shown is for system/valve response with normal equipment operating voltage available during periodic testing. Additional margin is included in the analysis to account for potential delays in achieving minimum equipment operating voltage.

16. The Essential Raw Cooling Water system 6.9 kv pumps are exceptions to the response times shown in the table and will have the values listed in seconds for the initiating signals and the function indicated:

Essential Raw Cooling Water System Pumps

Response times:	2.g.	65.0 (8) / 75.0 (9)
	3.g.	65.0 (8) / 75.0 (9)
	6.g.	65.0 (8) / 75.0 (9)

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Identifier SQN-EEB-MS-TI28-0016

ABB
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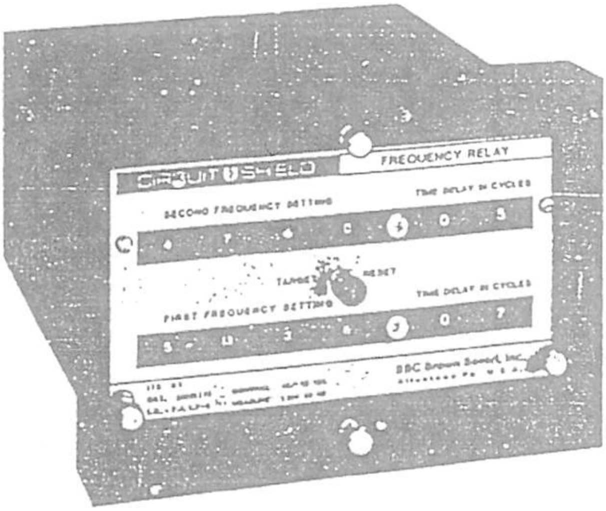
Protective Relays
Drawout

Type 81
One and Two Step Frequency Relays



Features

- High accuracy
- Easy to set
- Low burden
- High seismic capability - 6g ZPA
- Transient immunity
- Available in one stage or two stage models

2 YEAR WARRANTY

Application

The Type 81 Frequency Relay is a reliable solid state relay designed to provide accurate detection of abnormal frequency conditions on electrical power systems. The Type 81 is available in one stage and two stage models. Single step models are provided with means to select either underfrequency or overfrequency operation. Two stage models may be set up for either two steps of underfrequency detection, two steps of overfrequency detection or for overfrequency and underfrequency protection.

The relay has operating characteristics which make it ideal for application on closely coordinated system load shedding programs. The accuracy and stability of the relay characteristics permits settings much closer to system frequency, and closer steps between settings of relays in a load shedding program, than possible with electromechanical relays.

Another application is typical to large industrial plants which have some local generation. Normally, they depend on a tie line with a utility for some portion of their power needs. If the tie breaker at the utility end should open, the generator in the plant would be overloaded especially if it also attempts to pick up utility load tapped on the tie line. This overload causes an underfrequency condition on the industrial system. The Type 81 can be used to open the tie to the utility system and drop non-essential load. Essential loads can be maintained to the limit of the generator capability.

In DSG applications, typical protection includes a two step Type 81 providing an under and overfrequency window and a Type 27/59 providing an under and overvoltage window.

The relay uses digital counting techniques to provide an accurate measure of frequency. The time base measurement is provided by an extremely stable crystal oscillator reference. The set point accuracy is 0.008 Hz. The relay is provided with TRIP POINT and TIME DELAY settings. These settings are easily made on the front panel of the relay. For underfrequency operation the time delay period begins when the relay has counted three consecutive cycles below the trip frequency. The time delay counter will be fully reset if one cycle occurs above the trip frequency.

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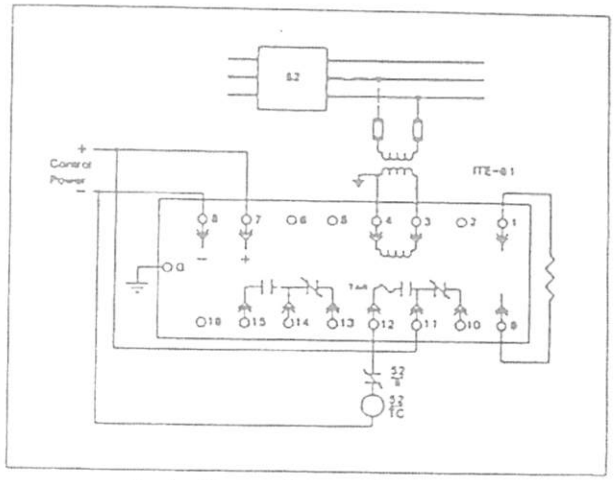
Identifier SQN-EEB-MS-TI28-0076

ASEA BROWN BOVERI

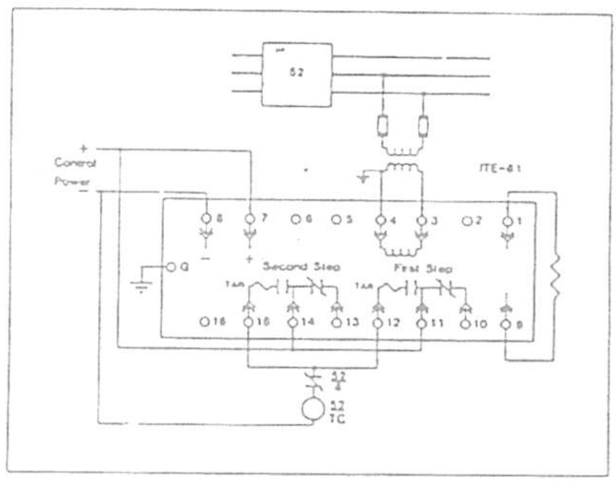
Type 81 Frequency Relays

SPECIFICATIONS

Operating Range:	Models available for: 45 - 52 Hz 54 - 63 Hz
Input Circuit Rating:	60-140 Vac
Undervoltage Cutoff Function:	Adjustable 60 - 100 volts Factory set at 60 volts
Burden:	0.7 VA
Control Power:	Models available for: 48/125 Vdc @ 0.06A. 24/32 Vdc @ 0.10A.
Operating Time:	Adjustable 1 - 99 cycles (must have 3 consecutive incorrect cycles before timing begins)
Output Contacts:	2 Form C contacts (for 1 step unit) 1 Form C contact for each step (for 2 step unit)
Output Circuit Rating:	@ 125 Vdc 30A tripping 5A continuous 1A opening resistive 0.3A opening inductive
Temperature:	Minus 20 to Plus 70°C
Seismic Capability:	More than 6g ZPA biaxial multi-frequency vibration without damage or malfunction. (ANSI/IEEE C37.98)
Transient Immunity:	More than 3000 V, 1 MHz bursts at 60 Hz repetition rate, continuous (ANSI C37.90a - 1974); fast transient test; EMI immunity.
Dielectric:	2000 Vac RMS, 60 seconds all circuits to ground
Weight:	Unboxed - 3.3 lbs (1.5 Kg) Boxed - 4.0 lbs (1.8 Kg)
Volume:	0.26 cubic feet



Typical Connections—1 Step Relay



Typical Connections—2 Step Relay

HOW TO SPECIFY

Frequency Relay shall be Asea Brown Boveri Type 81 or approved equal. Relay operating point shall be settable in 0.05 Hz increments. Time delay shall be adjustable in 1 cycle increments. Relay shall be capable of withstanding 6g ZPA seismic stress without malfunctions. Operation indicator shall be provided. An undervoltage cutoff function shall be provided to block operation for low line voltage conditions.

ADDITIONAL INFORMATION

Instruction Book	IB 7.4.1.7-5
Relay Selection Sheet	7.4.0.3
Prices	7.10.0.5

HOW TO ORDER

For a complete listing of available frequency relays, see selection sheet 7.4.0.3.

To place an order, or for further information, contact your nearest District Office, or the Sales Manager, Protective Relays.

Attachment No. 4 Sheet 2 of 19
Identifier SQN-EEB-MS-TI28-0075

ABB Power Transmission Inc.
Protective Relay Division
35 N. Snowdrift Road, Allentown, PA 18106
Telephone (215) 395-6888
FAX 215-395-1055

Supersedes Issue E Printed in U.S.A. 1088

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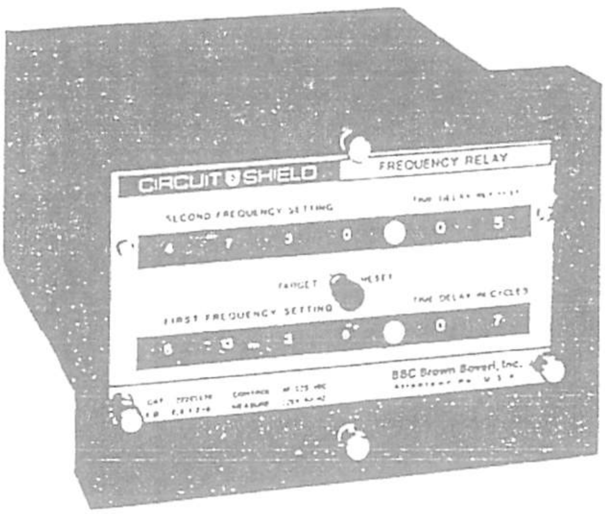
ASEA BROWN BOVERI

IB 7.4.1.7-5
Issue C

INSTRUCTIONS

Frequency Relays

TYPE 81   Catalog Series 422



Two Step Frequency Relay

Attachment No. 4 Sheet 3 of 19
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ASEA BROWN BOVERI

TABLE OF CONTENTS

INTRODUCTION

These instructions contain the information required to properly install, operate, and test the ABB Circuit-Shield™ Type 81 Frequency Relay, catalog series 422.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 422 catalog series are similar to earlier designs of the 222 series. Both series provide the same basic functions and are of totally drawout construction; however, the 422 series relays provide integral test facilities. Also, sequenced disconnects on the 422 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

All settings are made on the front panel of the relay, behind a removable clear plastic cover. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing. *Important: connections for the 422 catalog series units are different than the 222 series units.*

2. Apply only the rated voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.

4. Internal movable links are used to set up the mode of operation of the relay. Be sure to inspect and set the links prior to placing the relay in service. See section on connections for more information.

5. High voltage insulation tests are not recommended. See section on testing for additional information.

6. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

7. Follow test instructions to verify that the relay is in proper working order.

CAUTION: *since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competent technicians familiar with good safety practices should service these devices.*

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.

Connections:
Internal connections are shown in Figure 2. Typical external connections are shown in Figure 3. *Important: connections are different for 422 series units compared to 222 series units.*

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

Internal selector plugs are provided to set up various operating modes. The relay must be withdrawn from its case and the plugs set properly for the application. See Figure 4 for the locations of the selector plugs.

Control Power Selector Plug:
Control power must be connected in the proper polarity. For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the plug should be placed in the position marked 125vdc.)

Operating Mode Selector Plug:
An internal selector plug is provided to choose whether the relay will function as an underfrequency relay or overfrequency relay. If the relay has two stages, a plug will be provided for each stage. The operation of each stage is independently set. In other words, the relay may be set for (2) steps of underfrequency operation, or for (1) step of overfrequency and (1) step of underfrequency operation, or (2) steps of overfrequency operation.

Target Operation Selector Plug:
This plug sets the mode of operation of the target. This is a new feature not previously available on 222 series units. Setting the plug in the SHUNT or INT position provides for the target to be operated electronically at the same time the output relay is energized. With the plug in the SERIES or EXT position, a trip circuit current of 1 ampere or more is required in the coil labelled TAR on the internal connection diagram. (The polarity of this current does not matter.)

(Note: a number of units, catalog number 422xx1xx have been produced without the trip current operated target feature. Targets on these units are electronically activated when the tripping outpu is energized.)

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3. SETTINGS

Coded Trip Point Frequency Setting

For 60 Hertz models, Table 1 provides setting codes for frequencies between 54 and 63 Hz in steps of 0.05 Hz. Table 2 provides settings for 50 Hz. models for frequencies between 45 and 52 Hz. These tables include the settings commonly used in most applications. Should special settings be required outside these ranges, or between two values given, the codes may be requested from the factory.

Trip point adjustment is accomplished by setting the four thumbwheel switches to the numbers shown in the table which corresponds to the desired trip frequency. Each of the thumbwheel switches is labelled 0 to 15. Settings are shown in the tables in the same arrangement left to right as they are to be made on the relay.

Time Delay Setting

The time delay thumbwheel switches are labelled directly in cycles. The adjustment range is 1 to 99 cycles. The time delay period will not start until (3) consecutive "bad" cycles have been detected. Therefore the *total operating time* is the dial setting plus 3 cycles. The timing function will reset upon receiving one "good" cycle. *Do not set the time delay to 00". This will cause a constant trip.*

IMPORTANT: THE SETTINGS SHOULD NOT BE CHANGED WITH THE RELAY IN SERVICE. AN INCORRECT OPERATION MAY OCCUR DURING THE TRANSITION FROM ONE SETTING TO ANOTHER.

Undervoltage Cutoff Function

The undervoltage cutoff function will block operation of the frequency relay when the input line voltage drops below its setting. This is an internal adjustment that must be set by test. The factory setting is 60 vac nominal. Refer to the section on testing for re-calibration procedure.

APPLICATION DATA

The ABB Circuit-Shield™ Type 81 Frequency Relay is a reliable solid-state relay designed to provide accurate detection of abnormal frequency conditions on electrical power systems. The Type 81 is available in one-stage and two-stage models. Single-stage models are provided with means to select either underfrequency operation or overfrequency operation. Two-stage models may be set up for either two steps of underfrequency operation as might be found in load-shedding applications; or, for one step of underfrequency and one step of overfrequency operation as would typically be found in generator protection; or, for two steps of overfrequency.

These relays use solid-state technology and digital counting techniques to provide accurate frequency measurement. The time base for measurement is provided by a very stable crystal oscillator. Standard set point accuracy is 0.008 Hz. Models with an accuracy of 0.005 Hz. can be supplied on request. Trip frequency and time delay settings are easily made on the front panel of the relay by means of thumbwheel switches. The timer begins when the relay has detected 3 consecutive "bad" cycles; therefore, the total operating time of the relay is the delay set on the front panel plus 3 cycles. The time delay counter is fully reset if one "good" cycle occurs prior to the relay timing out and tripping.

The Type 81 has operating characteristics which make it ideal for application on closely coordinated system load shedding programs. The accuracy and stability of the relay characteristic permits settings much closer to normal system frequency, and closer steps between settings of relays in a load shedding program than possible with electromechanical relays.

Another application is typical to large industrial plants which have some local generation. Normally they depend on a tie line to a utility for some portion of their power needs. If the breaker at the utility end should open, the generator in the plant would be overloaded, especially if it also attempts to pick up utility load tapped on the tie line. This overload causes an underfrequency condition on the industrial system. The Type 81 can be used to open the tie to the utility system and to drop non-essential loads in the plant. Essential loads can by maintained to the limit of the generator capability.

In DSG applications, typical protection includes a two step Type 81 providing an under and overfrequency window and an ABB Type 27/59 providing an under and overvoltage window. If the frequency or voltage deviates from within either of these windows the tie to the utility system is opened.

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CHARACTERISTICS OF COMMON UNITS

Nominal System Frequency	Number of Steps	Output Contacts	Connection Diagram	Control Voltage	Catalog Number
60 Hz	1	2 form C	16D422A	48/125 vdc	422B1275
				48/110 vdc	422B1205
				24/ 32 vdc	422B1295 ⟸
				24/125 vdc	422B1285
				250 vdc	422B1255
50 Hz	1	2 form C	16D422A	48/125 vdc	422D1275
				48/110 vdc	422D1205
				24/ 32 vdc	422D1295
				110/220 vdc	422D1225
				250 vdc	422D1255
60 Hz	2	1 form C for each step	16D422B	48/125 vdc	422C1276
				48/110 vdc	422C1206
				24/ 32 vdc	422C1296
				250 vdc	422C1256
50 Hz	2	1 form C for each step	16D422B	48/125 vdc	422E1276
				48/110 vdc	422E1206
				24/ 32 vdc	422E1296
				110/220 vdc	422E1226
				250 vdc	422E1255

SPECIFICATIONS:

Input Circuit: 60-140 Vac Continuous; 300 Vac for 10 seconds.

Input Burden: 0.7 VA

Undervoltage Cutoff Function: adjustable 60-100 vac, factory setting 60 volts.
operating time: approximately 30 milliseconds.
reset time: approximately 65 milliseconds.

Trip Point Setting Range: 60 Hz. models - see Table 1 for settings 63.00-54.00 Hz.
50 Hz. models - see Table 2 for settings 52.00-45.00 Hz.
(Settings outside these ranges are possible. Consult factory for feasibility and setting codes.)

Trip Point Accuracy and Repeatability: +/-0.008 Hz., -20 to +55 deg C.
(+/-0.005 Hz. available on request)

Time Delay Range: Adjustable 1 to 99 cycles; (add 3 cycles measurement time for total operating time.)

Accuracy and repeatability: typical: +/-1 cycle,
limits: +3/-2 cycles.

Operating Temperature Range: -30 to +75 deg. C.

Output Circuit:

Contact ratings at	125 Vdc	250 Vdc
Tripping	30 amperes	30 amperes
Continuous	5 amperes	5 amperes
Break	0.3 ampere	0.1 ampere

Note: 250vdc contact ratings apply only to units rated for 250 vdc control and for other units with catalog suffix "-CAP"; eg: 422C1276-CAP.

Series Target Coil: 1 ampere or more trip circuit current will insure target operation. Withstand: 30 amperes, 1 second.
Coil resistance: negligible.

For output circuits with less than 1 ampere current, set relay selector plug for Internal (shunt) operation.

Control Power: models available for
48/125 vdc at 0.03 ampere standby, 0.07 ampere max.
48/110 vdc at 0.03 ampere standby, 0.07 ampere max.
24/ 32 vdc at 0.04 ampere standby, 0.11 ampere max.
24/125 vdc at 0.04 ampere standby, 0.11 ampere max.
110/220 vdc at 0.03 ampere standby, 0.07 ampere max.
250 vdc at 0.03 ampere standby, 0.06 ampere max.
120 vac - consult factory.

Allowable variation:
24v nominal: 19- 29 vdc.
32v nominal: 25- 38 vdc.
48v nominal: 38- 58 vdc.
110v nominal: 88-125 vdc.
125v nominal: 100-140 vdc.
220v nominal: 175-246 vdc.
250v nominal: 200-280 vdc.

Dielectric Strength: 2000 vac, 50/60 Hz., 60 seconds, all circuits to ground.

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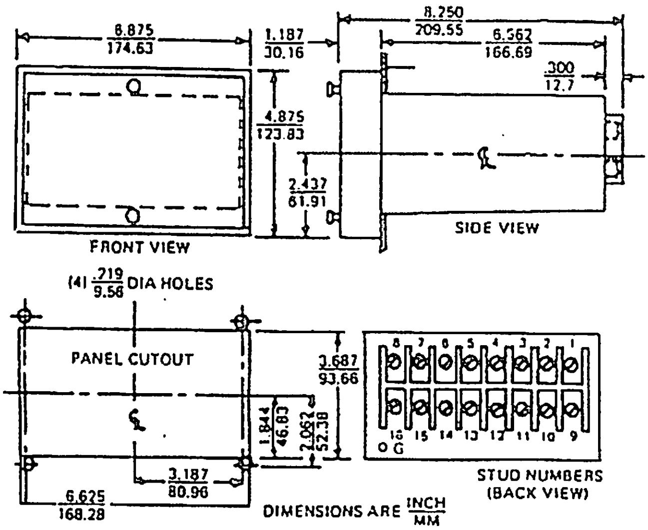

Figure 1: Relay Outline and Drilling

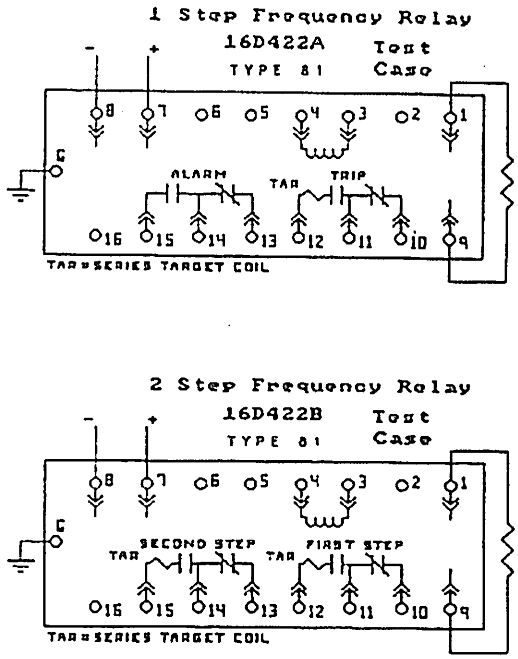

Figure 2: Internal Connections

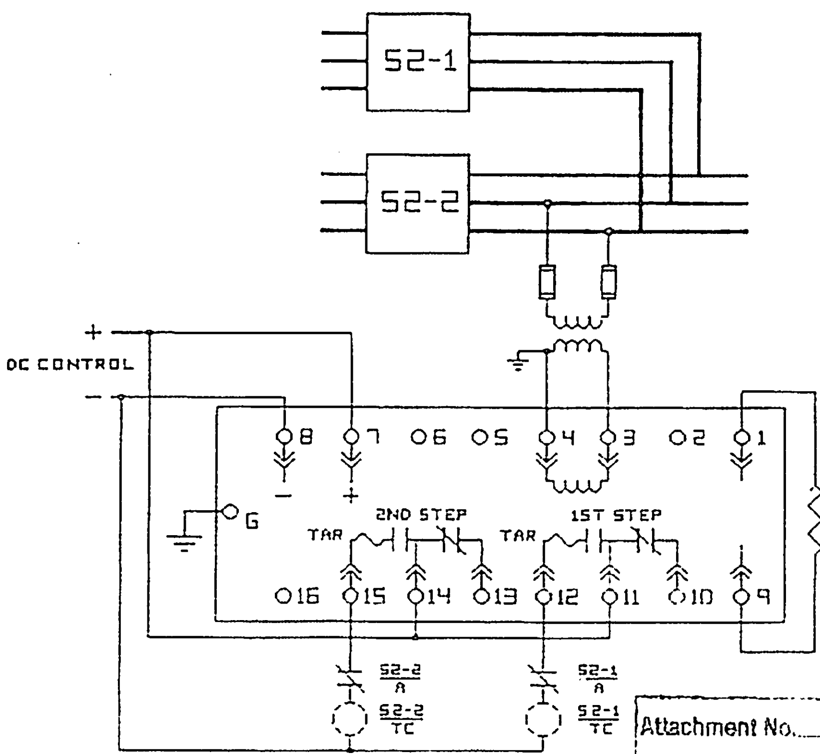

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Figure 3a: Typical External Connections

Load Shedding Application
Relay Set for 2 Steps of Underfrequency

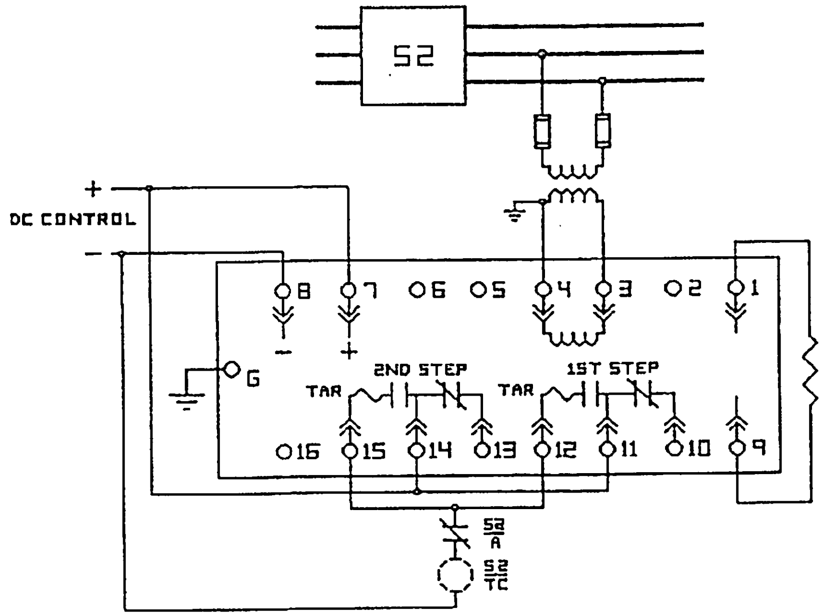
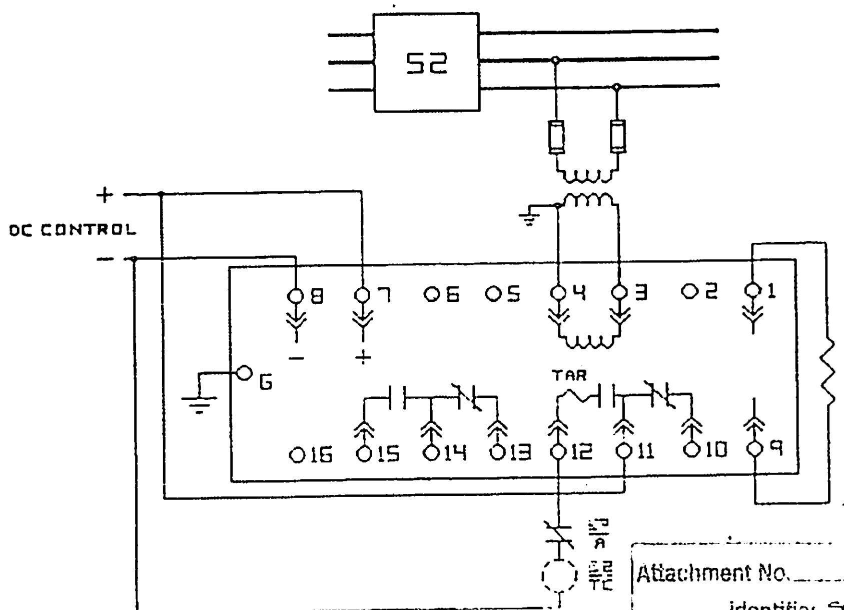


Figure 3b: Typical External Connections

Generator Protection Application
2 Step Relay Set for Under and Overfrequency Operation



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identifier SQN-EEB-MS-TI28-0076

Figure 3c: Typical External Connections

Single Step Relay

TABLE 1 - TRIP POINT FREQUENCY CODES *For 60Hz Units Only*

TRIP POINT FREQ	SWITCH SETTINGS			
63.00	15	7	6	9
62.95	12	1	7	9
62.90	12	4	7	9
62.85	13	7	7	9
62.80	14	0	8	9
62.75	14	3	8	9
62.70	15	6	8	9
62.65	12	10	8	9
62.60	12	3	9	9
62.55	13	6	9	9
62.50	14	9	9	9
62.45	15	2	0	10
62.40	12	6	0	10
62.35	12	9	0	10
62.30	13	2	1	10
62.25	14	5	1	10
62.20	15	8	1	10
62.15	12	2	2	10
62.10	13	5	2	10
62.05	14	8	2	10
62.00	15	1	3	10
61.95	12	5	3	10
61.90	13	8	3	10
61.85	14	1	4	10
61.80	15	4	4	10
61.75	12	8	4	10
61.70	13	1	5	10
61.65	15	4	5	10
61.60	12	8	5	10
61.55	13	1	6	10
61.50	14	4	6	10
61.45	15	7	6	10
61.40	13	1	7	10
61.35	14	4	7	10
61.30	15	7	7	10
61.25	13	1	8	1
61.20	14	4	8	1u
61.15	15	7	8	10
61.10	13	1	9	10
61.05	14	4	9	10
61.00	15	7	9	10
60.95	13	1	0	11
60.90	14	4	0	11
60.85	12	8	0	11
60.80	13	1	1	11
60.75	15	4	1	11
60.70	12	8	1	11
60.65	14	1	2	11
60.60	12	5	2	11
60.55	13	8	2	11
60.50	15	1	3	11
60.45	13	5	3	11
60.40	14	8	3	11
60.35	12	2	4	11
60.30	14	5	4	11
60.25	12	9	4	11
60.20	13	2	5	11
60.15	15	5	5	11
60.10	13	9	5	11
60.05	15	2	6	11

TRIP POINT FREQ	SWITCH SETTINGS			
60.00	13	6	6	11
59.95	15	9	6	11
59.90	12	3	7	11
59.85	14	6	7	11
59.80	12	0	8	11
59.75	14	3	8	11
59.70	12	7	8	11
59.65	14	0	9	11
59.60	13	4	9	11
59.55	15	7	9	11
59.50	13	1	0	12
59.45	15	4	0	12
59.40	13	8	0	12
59.35	15	1	1	12
59.30	13	5	1	12
59.25	12	9	1	12
59.20	14	2	2	12
59.15	12	6	2	12
59.10	14	9	2	12
59.05	13	3	3	12
59.00	15	6	3	12
58.95	14	0	4	12
58.90	12	4	4	12
58.85	14	7	4	12
58.80	13	1	5	12
58.75	15	4	5	12
58.70	14	8	5	12
58.65	12	2	6	12
58.60	15	5	6	12
58.55	13	9	6	12
58.50	12	3	7	12
58.45	15	6	7	12
58.40	13	0	8	12
58.35	12	4	8	12
58.30	15	7	8	12
58.25	13	1	9	12
58.20	12	5	9	12
58.15	15	8	9	12
58.10	14	2	0	13
58.05	13	6	0	13
58.00	15	9	0	13
57.95	14	3	1	13
57.90	13	7	1	13
57.85	12	1	2	13
57.80	15	4	2	13
57.75	14	8	2	13
57.70	13	2	3	13
57.65	12	6	3	13
57.60	15	9	3	13
57.55	14	3	4	13
57.50	13	7	4	13
57.45	12	1	5	13
57.40	12	5	5	13
57.35	15	8	5	13
57.30	14	2	6	13
57.25	13	6	6	13
57.20	13	0	7	13
57.15	12	4	7	13
57.10	15	7	7	13
57.05	14	1	8	13

TRIP POINT FREQ	SWITCH SETTINGS			
57.00	14	5	8	13
56.95	13	9	8	13
56.90	13	3	9	13
56.85	12	7	9	13
56.80	12	1	0	14
56.75	15	4	0	14
56.70	15	8	0	14
56.65	14	2	1	14
56.60	14	6	1	14
56.55	13	0	2	14
56.50	13	4	2	14
56.45	13	8	2	14
56.40	12	2	3	14
56.35	12	6	3	14
56.30	12	10	3	14
56.25	12	4	4	14
56.20	12	8	4	14
56.15	15	1	5	14
56.10	15	5	5	14
56.05	15	9	5	14
56.00	15	3	6	14
55.95	15	7	6	14
55.90	15	1	7	14
55.85	15	5	7	14
55.80	15	9	7	14
55.75	15	3	8	14
55.70	15	7	8	14
55.65	15	1	9	14
55.60	12	6	9	14
55.55	12	10	9	14
55.50	12	4	0	15
55.45	12	8	0	15
55.40	13	2	1	15
55.35	13	6	1	15
55.30	13	0	2	15
55.25	14	4	2	15
55.20	14	8	2	15
55.15	14	2	3	15
55.10	15	6	3	15
55.05	15	0	4	15
55.00	12	5	4	15
54.95	12	9	4	15
54.90	13	3	5	15
54.85	14	7	5	15
54.80	14	1	6	15
54.75	15	5	6	15
54.70	12	10	6	15
54.65	12	4	7	15
54.60	13	8	7	15
54.55	14	2	8	15
54.50	15	6	8	15
54.45	15	0	9	15
54.40	12	5	9	15
54.35	13	9	9	15
54.30	14	3	10	15
54.25	15	7	10	15
54.70	12	2	11	15
54.15	13	6	11	15
54.10	14	0	12	15
54.05	15	4	12	15
54.00	13	9	12	15

DIAL SETTINGS ARE SHOWN IN THE SAME ARRANGEMENT AS THEY ARE TO BE MADE ON THE FRONT PANEL OF THE RELAY.

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TABLE 2 - TRIP POINT FREQUENCY CODES *For 50Hz Units Only*

TRIP POINT FREQ	SWITCH SETTINGS			
52.00	15	6	4	9
51.95	14	8	4	9
51.90	13	0	5	9
51.85	12	2	5	9
51.80	11	4	5	9
51.75	10	6	5	9
51.70	9	8	5	9
51.65	8	0	6	9
51.60	8	2	6	9
51.55	16	3	6	9
51.50	14	5	6	9
51.45	13	7	6	9
51.40	13	9	6	9
51.35	12	1	7	9
51.30	11	3	7	9
51.25	11	5	7	9
51.20	10	7	7	9
51.15	10	9	7	9
51.10	9	1	8	9
51.05	9	3	8	9
51.00	8	5	8	9
50.95	8	7	8	9
50.90	8	9	8	9
50.85	15	0	9	9
50.80	15	2	9	9
50.75	15	4	9	9
50.70	14	6	9	9
50.65	14	8	9	9
50.60	14	0	0	10
50.55	14	2	0	10
50.50	14	4	0	10
50.45	14	6	0	10
50.40	13	8	0	10
50.35	13	0	1	10
50.30	13	2	1	10
50.25	13	4	1	[illegible]
50.20	13	6	1	10
50.15	14	8	1	10
50.10	14	0	2	10
50.05	14	2	2	10
50.00	14	4	2	10
49.95	14	6	2	10
49.90	14	8	2	10
49.85	15	0	3	10
49.80	15	2	3	10

TRIP POINT FREQ	SWITCH SETTINGS			
49.75	15	4	3	10
49.70	8	7	3	10
49.65	8	9	3	10
49.60	9	1	4	10
49.55	9	3	4	10
49.50	10	5	4	10
49.45	10	7	4	10
49.40	11	9	4	10
49.35	11	1	5	10
49.30	12	3	5	10
49.25	13	5	5	10
49.20	13	7	5	10
49.15	14	9	5	10
49.10	15	1	6	10
49.05	8	4	6	10
49.00	9	6	6	10
48.95	9	8	6	10
48.90	10	0	7	10
48.85	11	2	7	10
48.80	12	4	7	10
48.75	13	6	7	10
48.70	14	9	7	10
48.65	8	1	8	10
48.60	9	3	8	10
48.55	10	5	8	10
48.50	11	7	8	10
48.45	12	9	8	10
48.40	14	1	9	10
48.35	15	3	9	10
48.30	8	6	9	10
48.25	10	8	9	10
48.20	11	0	0	11
48.15	12	2	0	11
48.10	14	4	0	11
48.05	15	6	0	11
48.00	9	9	0	11
47.95	11	1	1	11
47.90	12	3	1	11
47.85	14	5	1	11
47.80	8	8	1	11
47.75	9	0	2	11
47.70	11	2	2	11
47.65	13	4	2	11
47.60	15	6	2	11
47.55	9	9	2	11
47.50	11	1	3	11
47.45	13	3	3	11
47.40	15	5	3	11
47.35	9	8	3	11
47.30	11	0	4	11

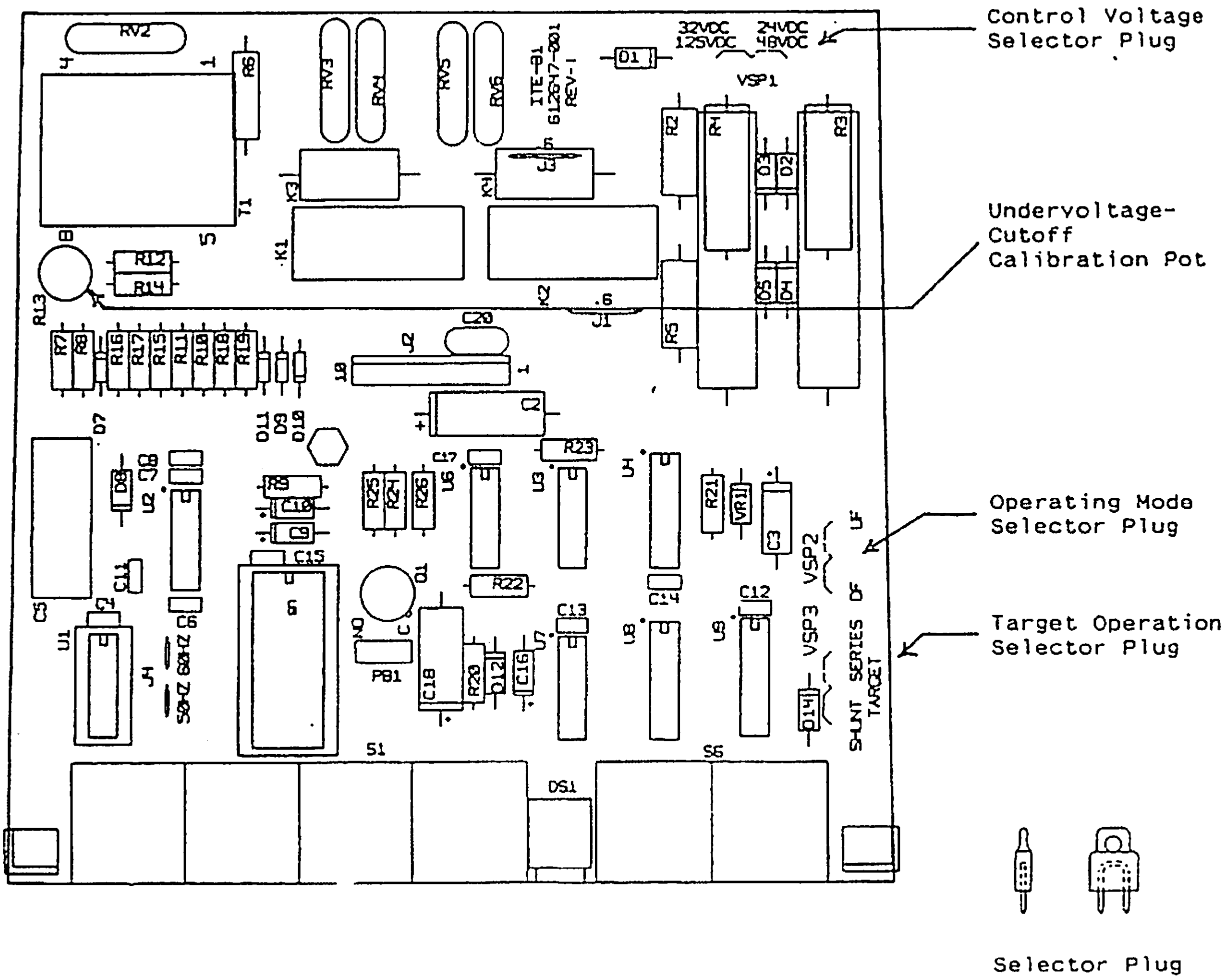
TRIP POINT FREQ	SWITCH SETTINGS			
47.25	13	2	4	11
47.20	15	4	4	11
47.15	9	7	4	11
47.10	11	9	4	11
47.05	14	1	5	11
47.00	8	4	5	11
46.95	10	6	5	11
46.90	13	8	5	11
46.85	15	0	6	11
46.80	10	3	6	11
46.75	12	5	6	11
46.70	15	7	6	11
46.65	9	0	7	11
46.60	12	2	7	11
46.55	15	4	7	11
46.50	9	7	7	11
46.45	12	9	7	11
46.40	15	1	8	11
46.35	10	4	8	11
46.30	13	6	8	11
46.25	8	9	8	11
46.20	10	1	9	11
46.15	13	3	9	11
46.10	8	6	9	11
46.05	12	8	9	11
46.00	15	0	0	12
45.95	10	3	0	12
45.90	13	5	0	12
45.85	8	8	0	12
45.80	12	0	1	12
45.75	15	2	1	12
45.70	10	5	1	12
45.65	14	7	1	12
45.60	9	0	2	12
45.55	13	2	2	12
45.50	8	5	2	12
45.45	12	7	2	12
45.40	15	9	2	12
45.35	11	2	3	12
45.30	15	4	3	12
45.25	11	7	3	12
45.20	14	9	3	12
45.15	10	2	4	12
45.10	14	4	4	12
45.05	10	7	4	12
45.00	14	9	4	12

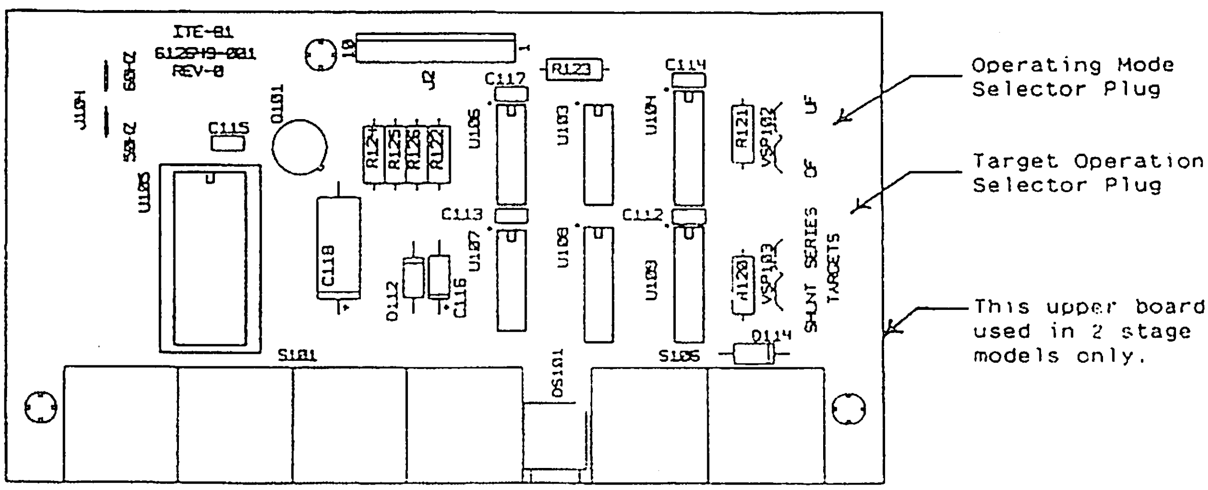
DIAL SETTINGS ARE SHOWN IN THE SAME ARRANGEMENT AS THEY ARE TO BE MADE ON THE FRONT PANEL OF THE RELAY

Note:
The ABB Circuit-Shield Type 81 relay is capable of a setting resolution of 0.01 Hertz. Contact the factory if you need a setting code for a frequency set point not listed in the tables.

Figure 4: Location of Selector Plugs

These drawings represent typical printed circuit board layouts for relays of catalog series 422 units. The selector plugs must be positioned properly for the desired modes of operation. Refer to page 3 for a description of plug functions.





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Calculation of TIME DELAY switch settings:

If the required operating time of the relay has been given in *seconds*, this value must be converted to the proper switch settings in *cycles*. Use the following formula:

Setting in cycles = (t * f) - 3   where t = desired operating time in seconds
f = set point frequency

For example: with a set point of 58.5 Hz, a total operating time of 0.20 seconds is desired. Setting = (0.2 * 58.5) - 3 = 11.7 - 3 = 8.7 cycles; therefore set the TIME DELAY switches to "09" cycles.

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on the Type 81 relay. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram and circuit description will be provided on request. Renewal parts will be quoted by the factory on request.

See Paragraph 4 for basic information on units of catalog series 222 which are no longer in production.

Drawout Element - Catalog Series 422

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses the normally-closed contact will cause an operation. The assembly is identified by the catalog number stamped on the front panel of the unit and by a serial number stamped on the bottom of the board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

Important: in order to test the drawout unit, a resistor must be connected temporarily between terminals 1 and 9 on the rear vertical circuit board. The value of this resistor depends on the control voltage rating of the relay and should be marked on the rear board. A 25 watt resistor is sufficient. If no resistor is available, the resistor assembly mounted on the rear of the relay case could be removed and used. *If the resistor from the case is used, be sure to remount it on the case at the conclusion of testing.*

> *Exception:* for dual rated relays (48/125 vdc, 24/32 vdc, 48/110 vdc, 24/125vdc, 110/220 vdc), the resistor is required only when the relay is set up for the *higher* of the two voltage ratings.

External Resistor Values:

Relay rating:	24/32 vdc	48/125 v	48/110 v	24/125 v	110/220 v	250 vdc
Resistor value:	250 ohm	3500 ohm	3000 ohm	3500 ohm	4500 ohm	8000 ohm

Test Plug:
A test plug assembly, catalog number 400X0002 is available for use with the 422 series unit. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details of this device.

Attachment No. 4 Sheet 13 of 19
Identifier SQN-EEB-MS-TI28-0076

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from the case sufficient to break the rear connections before applying the test voltage.

On 422 series units, a link on the rear vertical circuit board is removed temporarily when high potential tests are conducted at the factory. After testing, the link is restored to its position to connect certain surge suppression components to ground for normal operation. The link is labelled "remove for hipot".

3. ACCEPTANCE TESTS

Functional Test without Variable Frequency Source:

A typical test circuit is shown in Figure 5. Set the relay for the desired modes of operation. If target operation is to be by trip circuit current, reset the plugs for Series (External) operation, and connect a lockout relay as a load on the output contacts. If a lockout relay is not available, set the target for Shunt (Internal) operation at this time. Set the frequency codes and the time delay per the following chart:

Relay Model	Internal Plug Set for	Frequency Codes	Time Delay Setting
60 Hz.	Underfrequency	15 1 3 10 (62.00 Hz)	90 cycles
	Overfrequency	15 9 0 13 (58.00 Hz)	90 cycles
50 Hz.	Underfrequency	15 6 4 9 (52.00 Hz)	75 cycles
	Overfrequency	9 9 0 11 (48.00 Hz)	75 cycles

Apply rated dc control voltage to the relay. (Be sure voltage selector plug is in the proper position. Reset the target. Apply a 120 vac 60 Hz input signal for 60 Hz units, or 120 vac 50Hz for 50 Hz. units. After approximately a 1.5 second delay, the relay contacts should transfer to the trip condition and the target should set.

Lower the input voltage. At 66-54 volts input, the contacts should transfer back to the "normal" state as the undervoltage blocking function operates. If a different value is required for the application, adjust internal trimmer potentiometer R13 and repeat the test.

At the conclusion of these tests be sure to reset the relay to the values required for the application. Also recheck the positions of the selector plugs.

Calibration Tests with Variable Frequency Source:

A typical test circuit is shown in Figure 6. Set the internal plugs for the desired modes of operation and for the dc control voltage. Set the target for internal (Shunt) operation. Follow the same basic procedure given above in "Functional Testing" to confirm basic operation and undervoltage cutoff functions.

Operating Point Test: Set the desired frequency codes on the thumbwheel switches. Set the time delay switches to 01 cycle. Apply dc control voltage. Set the level of the variable frequency source to approximately 120 vac. Raise and lower the frequency of the test source slowly to determine the relay's operating point. The operating point should be within +/- 0.008 Hz of the setpoint.

Time Delay Test: Set the desired time delay on the thumbwheel switches. Apply rated dc control power. Reset the target. For underfrequency operation, set the variable frequency source to 0.2 Hertz below the relay's frequency setting. For overfrequency operation, set the variable frequency source to 0.2 Hertz above the frequency setting. Set the voltage levels of both sources at approximately 120vac. Switch relay input from the line frequency source to the variable source. Record the operating time of the relay. Compare to the expected delay time.

For example: if the time delay switches were set for 20 cycles, and the frequency of the variable source were set to 58.8 Hertz, the total operating time expected would be calculated as follows:

1 cycle of 58.8 Hz = 1/58.8 = 17.0 milliseconds.

Total operating time = 3 cycles measurement + time delay switch setting
= 3 cycles measurement + 20 cycles timer setting
= 23 cycles total X 17.0 milliseconds per cycle
= 391 milliseconds

Allowable tolerance = +3/-2 cycles: which in this example gives 357-442 ms.

Note: for settings below about 6 cycles, point-on-wave switching effects and inherent limitations of the test equipment can make accurate measurement difficult. In such cases, a longer delay setting should be used to confirm basic relay operation.

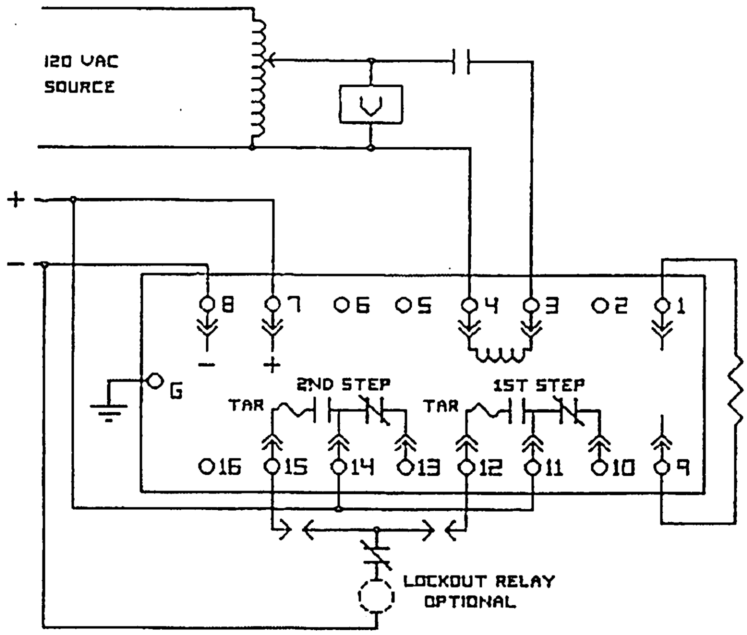


Figure 5: Typical Test Circuit - Functional Test
(2 Stage Relay Shown)

Attachment No. 4 Sheet 15 of 19
Identifier SQN-EEB-MS-TI28-0075

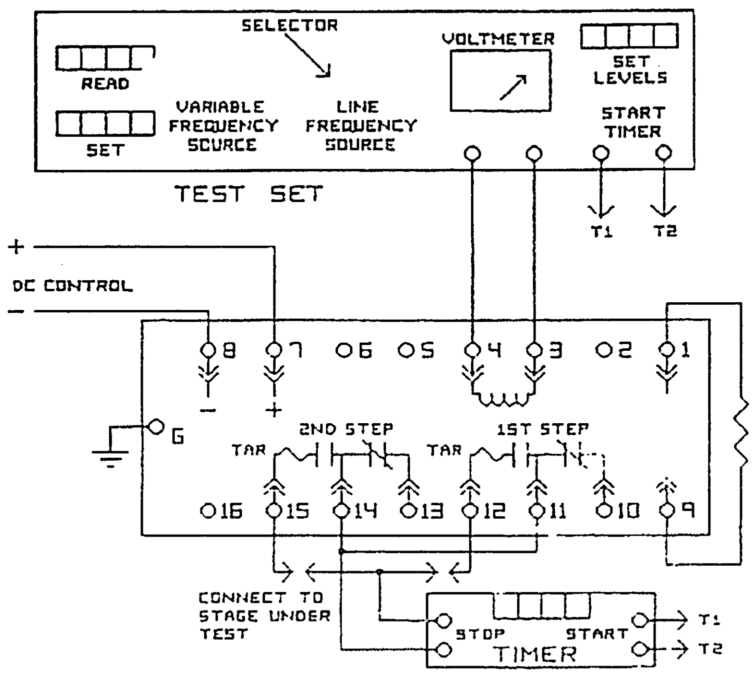


Figure 6: Typical Test Circuit - Calibration Test
(2 Stage Relay Shown)

4. OBSOLETE RELAYS - CATALOG SERIES 222

Type 81 relays of catalog series 222 are no longer in production. The information that follows is a guide to the functions and connections in the event you are setting or testing the older series, or should you need to replace a 222 series with a 422 series unit.

Connections: if replacing a 222 series unit with the newer 422 series, note the differences in connections, and rewire accordingly.

Settings: the frequency setting codes given in Tables 1 and 2 apply to both the 222 and 422 series units. The undervoltage cutoff function is adusted using internal pot R11. Using the 18 point extender board, catalog 200X0018, will make it easier to adjust R11.

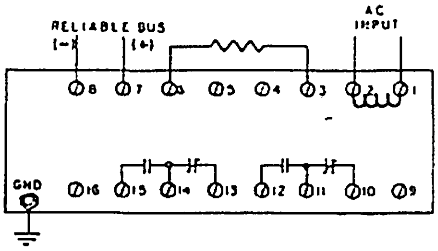
Testing: test procedures for the 222 series units are fundamentally the same as those given for the 422 series. Modify the test connections as necessary.

SUMMARY OF CHARACTERISTICS - CATALOG SERIES 222 (Obsolete)

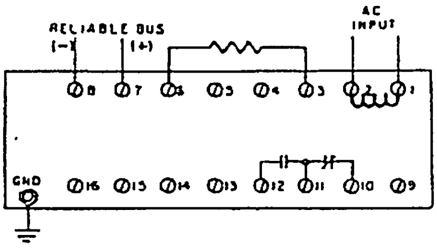
Function	Rated Frequency	Number of Steps	Connection Diagram	Control Voltage	Catalog Number
Underfrequency Only	60 Hz	1	16D222A	48/125 vdc	222A1075 222A1175
				24/125 vdc	222A1085
	50 Hz			48/125 vdc	222F1175
Under or Overfrequency	60 Hz	1	16D222B	48/125 vdc 24/ 32 vdc	222B1176 222B1196
	50 Hz			48/125 vdc 24/ 32 vdc	222D1176 222D1196
	60 Hz	1	16D222A	48/125 vdc 24/ 32 vdc	222E1175 222B1195
	50 Hz			48/125 vdc 48/110 vdc 24/ 32 vdc	222D1175 222D1105 222D1195
	60 Hz	2	16D222C	48/125 vdc 24/ 32 vdc	222C1176 222C1196
	50 Hz			48/125 vdc 48/110 vdc 24/ 32 vdc	222E1176 222E1106 222E1196

Attachment No. 4 Sheet 16 of 19
Identifier SQN-EEB-MS-TI28-0075

Internal Connection Diagrams - Catalog Series 222 (obsolete)

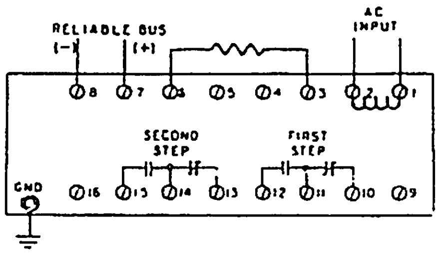


16D222A
Note: the external resistor is not required on catalog numbers 222A1175, 222F1175, and 222A1085.



16D222B

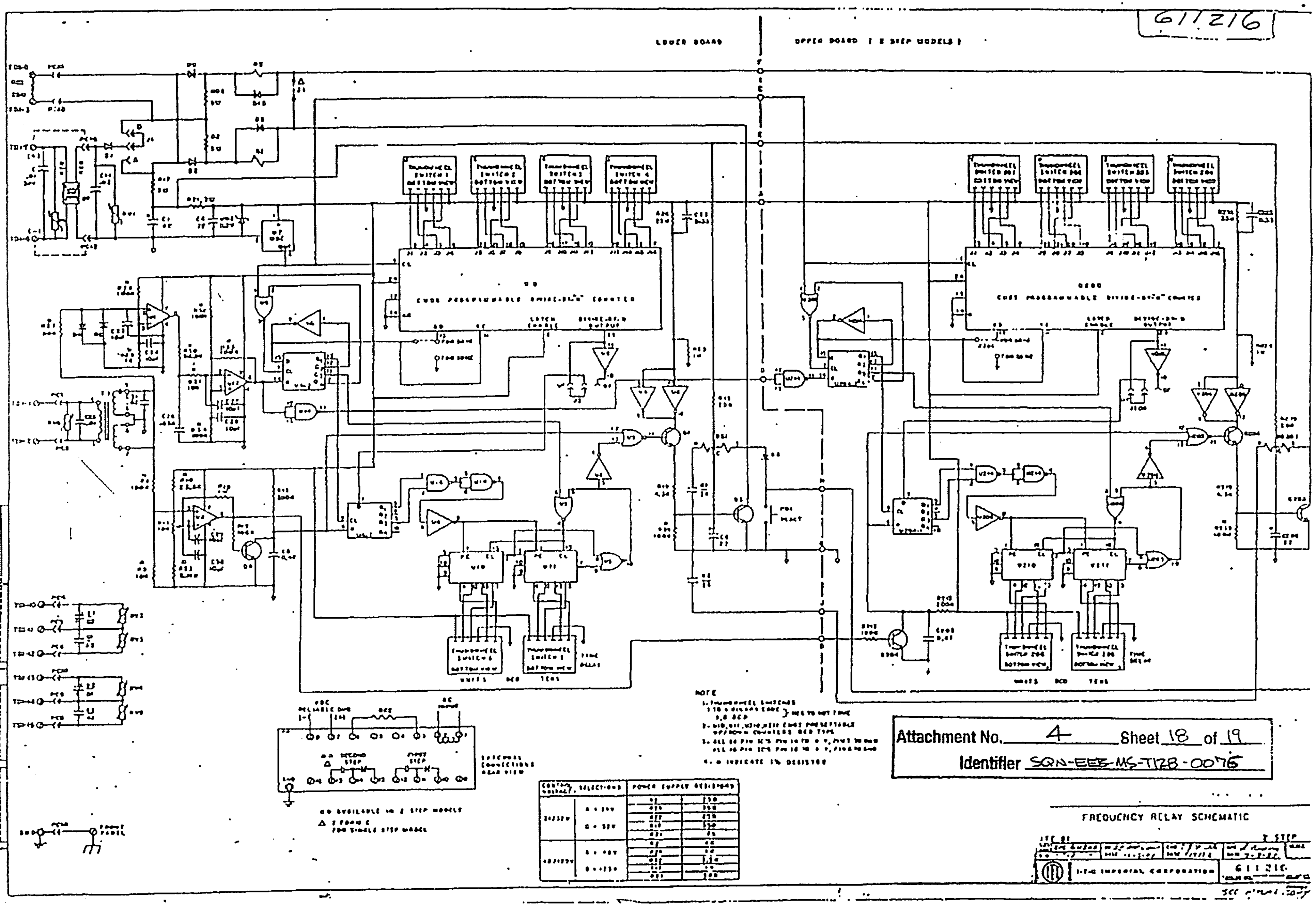
16D222C



Contacts labelled "First Step" are associated with the bottom row of setting switches on the front panel. Contacts labelled "Second Step" are associated with the top row. Contacts shown in "normal" condition. If function set for underfrequency, contacts will transfer when frequency drops below setting. If function set for overfrequency, contacts will transfer when frequency exceeds setting.

Note: Where used, external resistor is supplied mounted and wired on the relay. Resistor must be in place for proper relay operation.

Attachment No. 4 Sheet 17 of 19
Identifier SQN-EEB-MS-TI28-0078


611216
LOWER BOARD
UPPER BOARD (2 STEP MODELS)
Attachment No. 4 Sheet 18 of 19
Identifier SQN-EEB-MS-T12B-0076
FREQUENCY RELAY SCHEMATIC
ITE IMPERIAL CORPORATION
611216

P. 1

ABB Power T & D Company Inc.
Protective Relay Division

36 North Snowdrift Road
Allentown, PA 18106

Telephone: (215) 395-7333
FAX: 215-395-1055

B27 940622 001

Date: 10 - 12 - 90

Page 1 of 1

Sending to FAX # 615-365-1142

Attention of: ASIHT BOWMICK X1026, TRAILER A-1, EBASCO SGR.

From: R. CONRAD

Reference: TYPE 81 ACCURACY AND REPEATABILITY

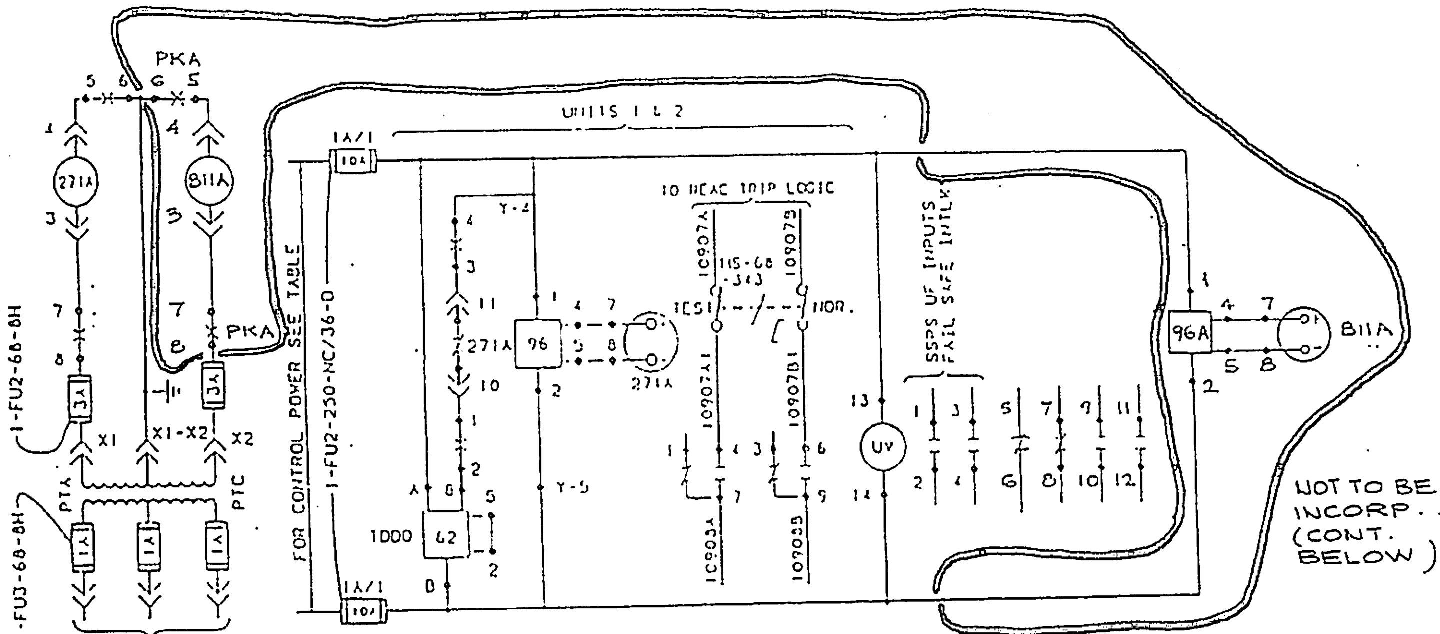
Message: THE ACCURACY LIMIT OF +3/-2 CYCLES STATED IN INSTRUCTION BOOK 7.4.1.7-5 WAS INTENDED TO COVER ALL POSSIBLE CONTINGENCIES INCLUDING COMMON TEST SET-UP PROBLEMS AND SOME MARGIN. IN ACTUAL OPERATION, AFTER THE RELAY HAS BEEN PROPERLY SET BY TEST, THE ACCURACY & REPEATABILITY WOULD STAY WITHIN +/- 1 ~ FOR 2 YEAR INTERVALS OR LONGER. THE TEST SET-UP MUST BE OF THE TYPE WHERE THE FREQUENCY IS CHANGED WITH A CLEAN TRANSITION FROM ONE FREQUENCY TO ANOTHER. IT SHOULD NOT BE SIMPLY SWITCHED BETWEEN TWO DIFFERENT SOURCES OPERATING AT DIFFERENT FREQUENCIES.

Attachment No. 4 Sheet 19 of 19
Identifier SQN-EEB-MS-TI28-0075

I CONCUR WITH THE ABOVE STATEMENT MADE BY MR CONRAD.

Clifford Downs
Mgr - Technical Support
ABB Allentown
6/21/94

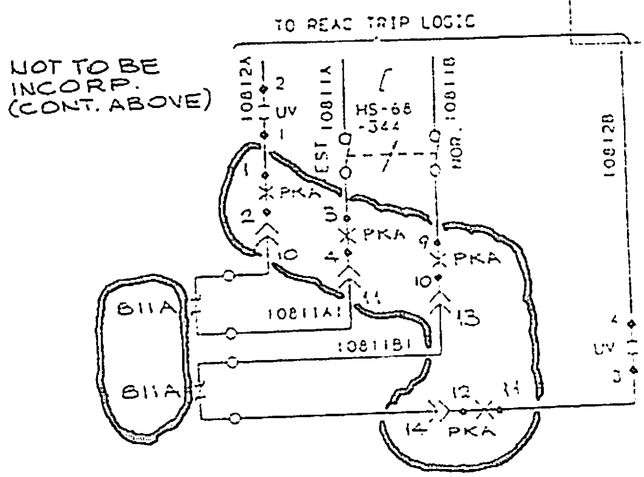
DCN-M10441A
PAGE



RCP UV & UF RELAYS

Attachment No. 5 Sheet 1 of 2

Identifier SQN-EEB-MS-TI28-0076



NEW FSAR DRAWING: YES ☐ NO ☒
DCA SPLITS/COMBINES
FSAR DRAWING: YES ☐ NO ☐

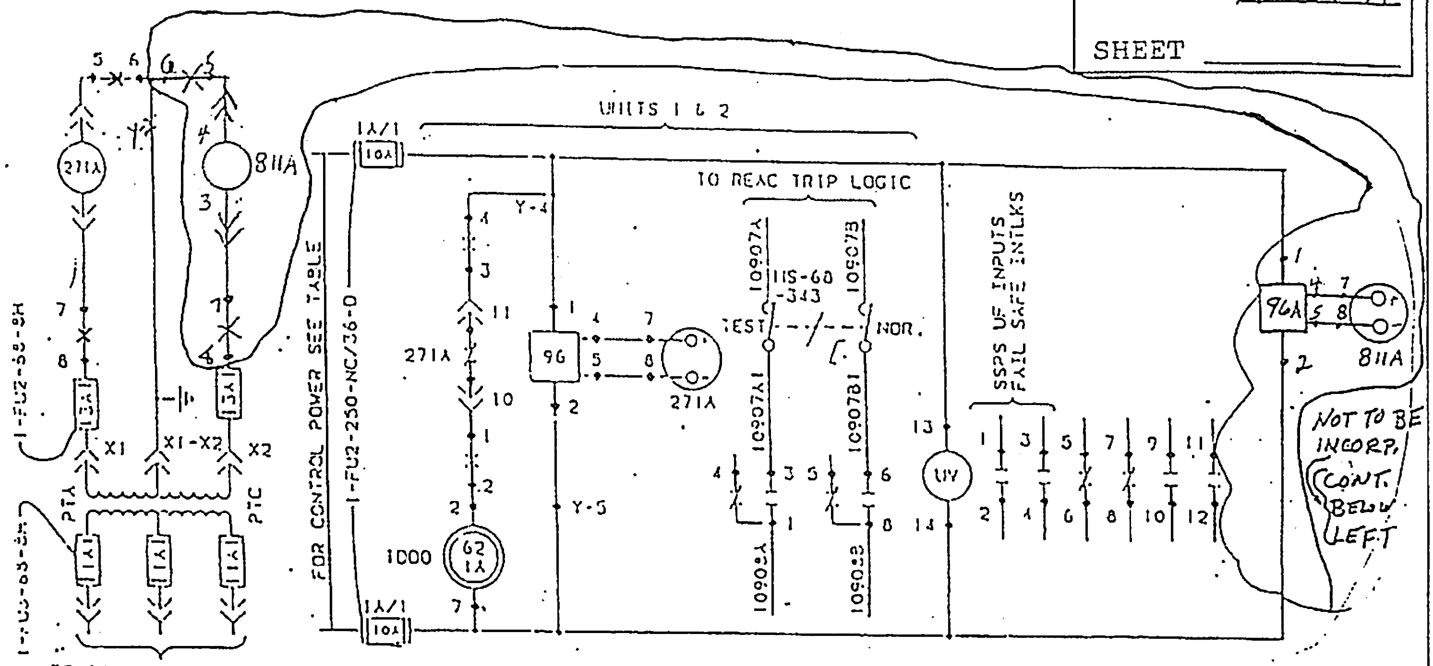
AFFECTED DRAWING CCD-1,2-45N763-2 R.9	CATEGORY 1
DCA-M10441-	
SEQUOYAH NUCLEAR PLANT TENNESSEE VALLEY AUTHORITY	

DISCIPLINE ELECTRICAL
CONTRACT NO. N/A
PREREQUISITES N/A
ANTICIPATED CCD N/A

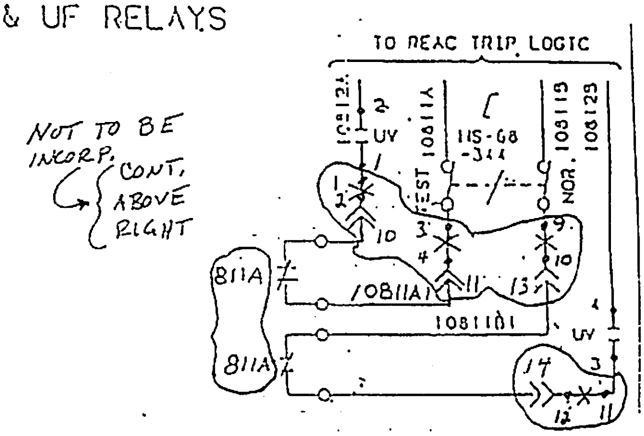
REV	RESP ENGR	DESIGN VERIFIED	CHANGE REFERENCE
0	[signature]		DCN M10441A

DCN NO. M10396A

SHEET



RCP UV & UF RELAYS



Attachment No. 5	Sheet 2 of 2
Identifier SQN-~~EEB~~-MS-TI28-0076	

NEW FSAR DRAWING: ☐ Yes ☐ No

Affected Drawing CCD-1,2-45N763-2 R.6	Category 1
SCALE: NTS EXCEPT AS NOTED	
PROJECT FACILITY POWERHOUSE	UNIT 2
TITLE WIRING DIAGRAMS 6900V UNIT AUX POWER SCHEMATIC DIAGRAMS	
DCA M10396-	
SEQUOYAH NUCLEAR PLANT TENNESSEE VALLEY AUTHORITY	9

Contract No. N/A
Prerequisites NONE

Anticipated CCDs N/A

REVISION	RESP. ENGR.	DESIGN VERIFIED	CHANGE REFERENCE
0	[signature]	[signature]	DCN M10396A

QA Record

TVA 10697 (DNE-QA-6-86)

DNE CALCULATIONS

Title: RPS Circuit Protector Under Frequency Relays SETPOINT AND SCALING CALCULATION

Plant/Unit: WBNP / Unit 1, 2

Preparing Organization: EEB-I&C

KEY NOUNS (Consult RIMS Descriptors List): I&C, INSTR, CALIBRATION, SETPOINT, ACCURACY

Branch/Project Identifiers: ED-Q2099-890137

Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.

Rev (for RIMS' use)	RIMS accession number	
RO	900330F0010	B22 '90 0315 102
R		
R		
R		

Applicable Design Document(s): EEB-TI-28 REV L

SAR Section(s): See Review Sheet | UNID System(s): 99

	Revision 0	R1	R2	R3
ECN No. (or Indicate Not Applicable)	P0432, DCN-W9831A (U2)	DCN-M7769A (U1) DCN-M7770A (U3)		
Prepared	[signature]	-		
Checked	[signature]			
Reviewed	[signature]			
Approved	[signature]			
Date	3/12/90			
USE FORM TVA 10534 IF MORE SPACE REQUIRED — List all pages added by this revision				
List all pages deleted by this revision				
List all pages changed by this revision				

Safety-related? Yes (X) No ( )

Statement of Problem

Determine the accuracy of the subject instrument loop(s) and demonstrate that the accuracy is adequate for the intended purpose. Primary elements are located in a Mild environment.

ORIGINAL

ABSTRACT (These calculations contain an unverified assumption(s) that must be verified later. Yes ( ) No (X))

Calculations were performed to determine the accuracy of the subject instrument loop(s). The determined accuracies were compared to the required accuracies, setpoints, safety limits and/or operating limits and the accuracy for the loop(s) listed below were demonstrated to be acceptable for the intended function of the instrument loop(s). This calculation applies to the instrument loop(s) listed below.

Under Frequency (81) Relays which provide trip functions for RPS Circuit protectors Units 1, 2, 3 (See page 7).

ESSENTIAL CALCULATION
DIRECT DESIGN INPUT
FSAR COMPLIANCE REVIEW [signature] 3/12/90
LEAD ELECTRICAL ENGINEER

SEE SHEET 6 FOR LIST OF REFERENCES AND ATTACHMENTS. REV 0 OF THIS CALCULATION CONSISTS OF 51 SHEETS, 37 ATTACHMENTS AND NA APPENDICES FOR A TOTAL OF 88 SHEETS.

( ) Microfilm and store calculations in RIMS Service Center.
(X) Microfilm and return calculations to: ...

cc: RIMS, SL 26 C-K

ENGINEERING RECORDS PROCESSING
CALCULATION CONTROL
ANNEX C BFN

Attachment No. 6 Sheet 1 of 1
Identifier SQN-EEB-MS-TI28-0076

ASEA BROWN BOVERI	SEISMIC QUALIFICATION REPORT	Number: RC-5524-A
		Page: 1 of 4
Title: 81 FREQUENCY RELAY		Date: 4/6/83
		Prep. by: R. Conrad

Test Model : Cat. # 222C1176

Test Procedure : Per ABB Specification RC-2051-B to meet the requirements of ANSI C37.98 (IEEE-501-1978).

Test Facility : NTS, Acton Division, Acton, Mass.

Documentation : NTS/ACTON report 18333-83N
Relay Settings and Status Monitoring (Page 2)
Test Response Spectra (Page 3)

Testing : A broad-band, multi-frequency vibration, of 30 seconds duration, imposed biaxial at 45°, in four orientations:

1) Left-to-right
2) Front-to-back
3) Right-to-left
4) Back-to-front

Attachment No. 7 Sheet 1 of 5
Identifier SQN-EEB-MS-TI78-0076

For each orientation, the relay status is tested and monitored in three functional states:

1) Non-operating (i.e. not picked up, etc.)
2) Operated (i.e. tripped, etc.)
3) Transitional

The required combinations total 12 full-level tests.

Results : No fragility or mis-operation was found within the 6g ZPA limitation of the actuator.

Notes : The biaxial motion produces an acceleration with equal vertical and horizontal components, thus yielding a total ZPA of 8.5g at 45°. The TRS shows the vertical component, as analyzed at one third octave intervals between 1 and 100 Hz. The analysis is shown for damping factors of 5, 3, 2, and 1%.

Generic : Other relays qualified by this test series:

All ABB type 81 relays, 222 series
All ABB type 40 relays, 226 series

Test case models are also qualified by this report in conjunction with supplementary tests (Acton 24839-89N, 5/25/88), using test levels equal to or greater than the TRS shown on page 3 of this report:

All ABB type 81 relays, 422 series
All ABB type 40 relays, 426 series

ASEA BROWN BOVERI	IEEE-501 SEISMIC QUALIFICATION	Number: RC-5524-A Page: 2 of 4
Title: Type 81 FREQUENCY RELAY		

TEST SET-UP

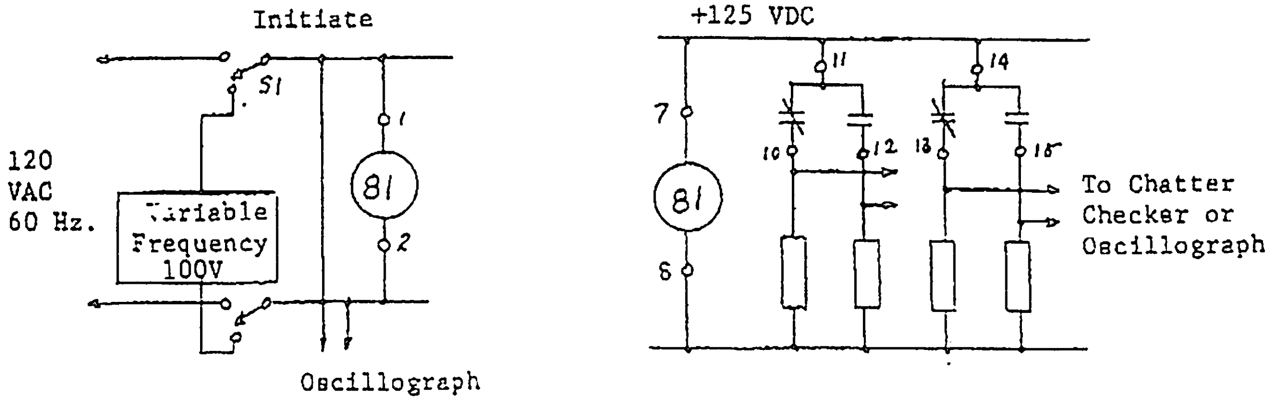
RELAY SETTINGS

Step 1: Underfrequency, 59 Hz., (Code 15, 6, 3, 12), Time Delay: 4 Cycles
Step 2: Overfrequency, 61 Hz., (Code 5, 7, 9, 10), Time Delay: 4 Cycles
Undervoltage Cut-Off: 60 VAC

Attachment No. 7 Sheet 2 of 5
Identifier SON-EEB-MS-TI28-0078

RELAY CONNECTIONS

INPUT | OUTPUT

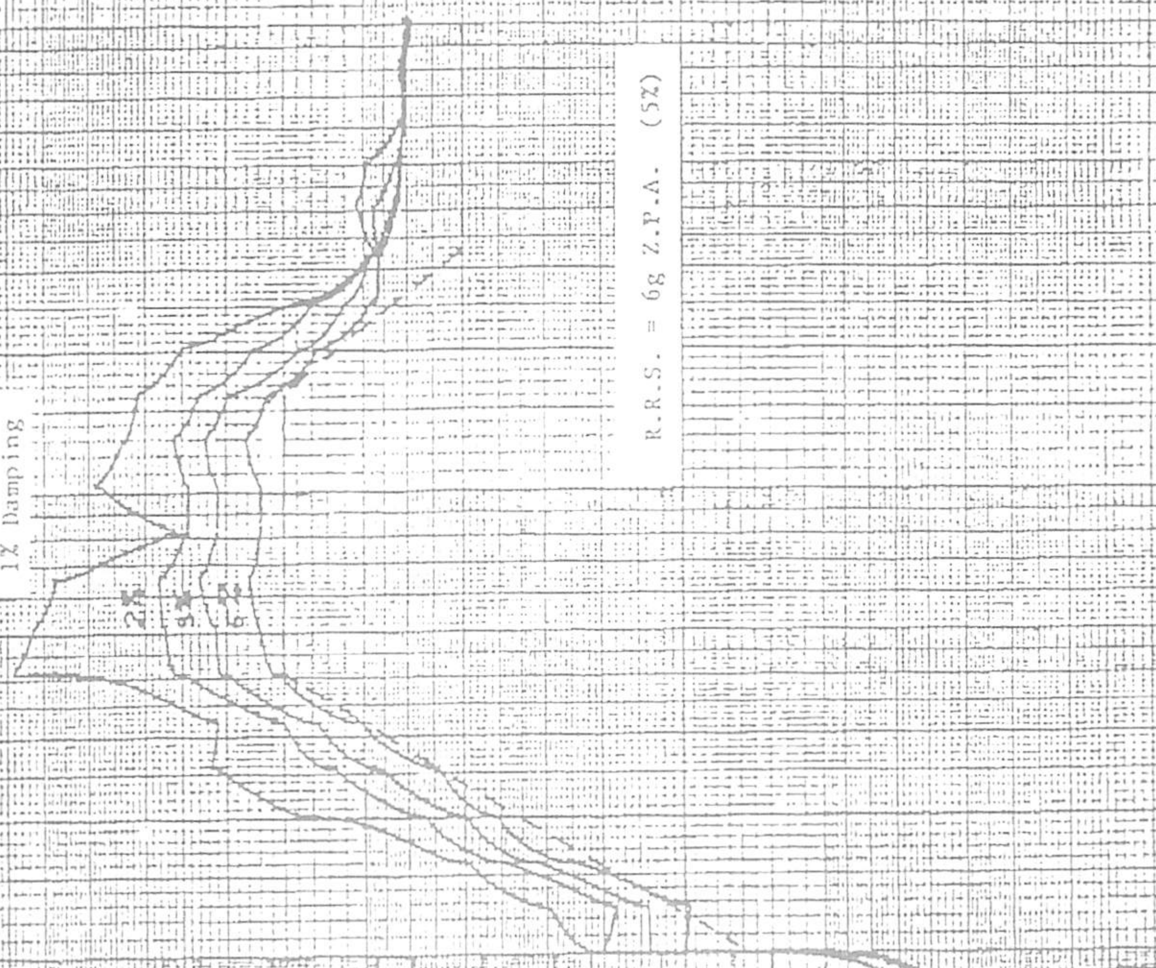


DATA LOG: (Lab Report - Acton #18333-83N)

Relay State	Test Motion	Relay Input AC, Volts	Relay Response	Contact Chatter	Oscillo-graph Record	Damage
Non-Operate	L-R	60 Hz, 120V (100%)	Normal	None	-	None
↓	F-B	↓	↓	↓	-	↓
↓	R-L	↓	↓	↓	-	↓
↓	B-F	↓	↓	↓	-	↓
Operate	L-R	57 Hz, 100V (85%)	Normal	None	-	None
↓	F-B	↓	↓	↓	-	↓
↓	R-L	↓	↓	↓	-	↓
↓	B-F	↓	↓	↓	-	↓
Transition	L-R	Sweep, 57-63 Hz.	Normal	-	Timing	None
↓	F-B	↓	↓	-	↓	↓
↓	R-L	↓	↓	-	↓	↓
↓	B-F	↓	↓	-	↓	↓

ASEA BROWN BOVERI

Attachment No. 7 Sheet 3 of 5
Identifier SQN-EEB-MS-TI28-0076



Test No.	18333-83N
Date	3/30/83
Customer	B.B.E.
Test Item P/N	222C1176
Test Item S/N	1270
Type of Test	Random
Spec. No.	RC-2051-B
Para. No.	-
Conditions	All Modes
Temperature	70°F
Period of Test	30 Seconds
Control Axis	Vertical
Pickup No.	2
Pickup Axis	Vertical
Operator	B. Griffith
Engineer	B. McGinnis
Coordinator	
GRMS	

ASEA BROWN BOVERI	SEISMIC QUALIFICATION REPORT	Number: RC-5524-A
		Page: 4 of 4
Title: 81 FREQUENCY RELAY		

Attachment No. 7 Sheet 4 of 5
Identifier SQN-EEB-MS-TI28-0076

INTERPRETATION OF TEST RESULTS AND CONCLUSION

This Seismic Qualification Report describes a test program in which the ABB Protective Relay was tested to meet the requirements of ANSI C37.98 (formerly IEEE 501) "Seismic Testing of Relays". The purpose of this test was to determine the fragility level of the relay, that is, the highest level of seismic excitation that the relay can withstand and still perform its required Class 1E functions.

The relay was mounted in a rigid test fixture using standard panel mounting methods. The testing was performed with a repeatable, 30 second duration, broad-band multi-frequency input motion. The analysis was made at 1/3 octave intervals for frequencies between 1 and 100 hertz at 5% damping. The TRS was also analyzed at several other damping factors.

All test runs used biaxial motion (at an angle of 45^{o} above the horizontal) in four input orientations. In each orientation the relay was tested in three operating states: non-operating, operating and transitional modes for a total of 12 test runs. For each test run, the input motion was applied for a duration of 30 seconds. This subjected the device to 6 horizontal and 12 vertical excitations in each direction at maximum level which is more than equivalent to 5 OBE's and 1 SSE in each direction. Therefore, the referenced test program exceeds the seismic aging requirements for 5 OBE's before SSE testing as specfied for qualification programs per ANSI C37.98 and IEEE 344-1975. Page 2 of the report summarizes the results of the 12 test runs performed on the relay.

It should be further noted that these 12 tests were conducted at the maximum limit of the test equipment. Therefore, this test report demonstrates a more severe test than required by the Standards, since ANSI C37.98 defines the OBE level to the 1/2 the SSE level.

As shown on page 3 of the report, the TRS for the relay represents the table limits since no fragility limits or mis-operations were found.

In conclusion, this test program demonstrates the seismic qualification of this device to the requirements of ANSI C37.98 and IEEE 344-1975.

ASEA BROWN BOVERI	CERTIFICATION	Number: RC-5024-D
		Page: 1 of 4

Title: EQUIPMENT PERFORMANCE SPECIFICATIONS
81 FREQUENCY RELAYS

CLASS 1E ELECTRICAL EQUIPMENT CERTIFICATION

Attachment No. 7 Sheet 5 of 5
Identifier SQN-EEB-MS-TI28-0076

IDENTIFICATION

ABB S.O. FILE# ISSUED:
CUSTOMER
STATION
ORDER NO.
SPECIFICATION --
AGENT/A&E --

SAMPLE

MATERIAL

ABB ITEM	CUST. ITEM	QUANTITY	DEVICE	CATALOG NO.

QUALIFIED LIFE: 40 years

The above material is hereby certified to be qualified in accordance with the principles of IEEE Standard 323-1974 for application as Class 1E Equipment in Nuclear Generating Stations. This certification is limited to the devices identified above when used within the limits of the ratings and conditions detailed by the attached equipment performance specifications, including seismic levels and recommended surveillance and maintenance. Substantiating documentation is on file at the factory location in the form of Qualification Summary report RC-5124-D, and Seismic Test Report RC-5524-A.

CERTIFIED BY:

R. Conrad
Q. A. Manager

Wm. Kotheimer
Director of Engineering

1.0 INTRODUCTION

1.1 Purpose

This Instruction describes the operability testing requirements for Unit 1, Reactor Coolant Pump Under frequency (UF) Relays associated with System 68.

1.2 Scope

This Instruction covers calibration of the Reactor Coolant Pump Under frequency Relays. Underfrequency Relays covered by this Instruction include the following:

UNID	RELAY	LOCATION
1-81-068-0344-D	81-1A	RCP Relay Panel 1A
1-81-068-0346-E	81-1B	RCP Relay Panel 1B
1-81-068-0348-F	81-2A	RCP Relay Panel 2A
1-81-068-0350-G	81-2B	RCP Relay Panel 2B

This Instruction partially satisfies Surveillance Requirement (SR) 4.3.1.1.1.B.17. Applicability Mode 1. Performance Modes are 1 through 6.

1.3 Frequency/Condition

This Instruction shall be performed at least every 18 months **or** as required.

2.0 REFERENCES

2.1 Performance References

None

2.2 Developmental References

A. SQN Technical Specifications (TS) Unit 1, 2.2 table 2.2-1 item 16.

B. SQN Technical Specifications, Unit 1, 3.3.1.1 table 3.3-1 item 17.

C. SQN Technical Specifications, Unit 1, 4.3.1.1.1 table 4.3-1 item 17, and 4.3.1.1.3.A.17.

D. SQN FSAR Sections 7.2.1.2.6, 7.2.3.1.4 and Table 7.2.1-5

E. PRG Relay Setting Sheets 3205-95, 3206-95, 3207-95, and 3208-95.

F. Westinghouse Setpoint Methodology for Protection Systems Sequoyah Units 1 and 2 (WCAP-11239).

G. TVA drawings: 45N763-2, 45N721-1, and 45N721-3

H. Mfr. drawings: D-N2206-05, (Contract Number 823380).

I. 1-SI-TFT-068-230.0, "Periodic Functional Test of RCP Underfrequency Relays Unit 1."

J. TVA Field Test Manual.

K. SPP-8.1, "Conduct of Testing."

L. SPP-10.7, "Housekeeping/Temporary Equipment Control".

M. I.L. 1B 7.4.1.7-5 Asea Brown Boveri "Type 81 Frequency Relay" and I.L. RC-5047-A ABB Power T & D Company Inc. "Type 86 AC-DC converter".

N. 1-SI-IRT-099-21A.0, 1-SI-IRT-099-21B.0, and 1-SI-IRT-099-21C.0 Response Time Test.

O. DCN M10441A.

3.0 PRECAUTIONS AND LIMITATIONS

A. All standard safety practices shall be observed while working on or near electrically energized equipment.

B. All conditions and restraints imposed by Technical Specifications 3.3.1.1 shall be met during Instruction performance.

C. This Instruction shall be performed in accordance with SPP-8.1: Conduct of Testing.

D. Test equipment used to perform calibration on UF Relays for RCP 1 and 2 cannot be used in calibration of UF Relays for RCP 3 and 4 unless the particular equipment is used strictly as a source.

E. Removal of 2 out of 4 Underfrequency Relays will cause a Reactor Trip with Reactor Power greater than 10%.

F. Only one (1) Underfrequency Relay at a time shall be removed from service for calibration during Modes 1 and 2.

4.0 PREREQUISITES

4.1 Initial Actions

[1] **RECORD** Work Initiating Document (WID) number implementing this Instruction.

WID No. __________
(**N/A** if not required) ________

[2] **VERIFY** the following:

A. Instruction copy is a verified copy. ☐

B. **PRETEST** briefing in accordance with SPP-8.1. ☐

____

[3] **RECORD** performer and participant identification on Data Package Cover Sheet. ☐

Date ________

4.2 Special Tools, Measuring and Test Equipment (M&TE), Parts, and Supplies

[1] **OBTAIN** the following M&TE for Train A and Train B. ☐

Description		TVA ID No.	Cal. Due
Doble Relay Test Set			
F2000 Series or F6000	RCP's # 1 & 2 - TRAIN A		
Series or equivalent	RCP's # 3 & 4 - TRAIN B		

4.3 Field Preparations

None

4.4 Approvals and Notifications

[1] **DETERMINE** status light(s) to be actuated during this test **AND**

NOTIFY Unit 1 US/SRO of status light(s) to be actuated during this test. Limiting condition for operation 3.3.1.1 shall apply during performance of this Instruction, if in Mode 1.

A. **RCP Bus 1 Under**frequency Panel 1-M-6, 1-XX-55-6A Window 2 (Alarm for Relay 81-1A, Section 6.2).

B. **RCP Bus 2 Under**frequency Panel 1-M-6, 1-XX-55-6A Window 22 (Alarm for Relay 81-1B Section 6.3).

C. **RCP Bus 3 Under**frequency Panel 1-M-6, 1-XX-55-6A Window 42 (Alarm for Relay 81-2A Section 6.4).

D. **RCP Bus 4 Under**frequency Panel 1-M-6, 1-XX-55-6A Window 62 (Alarm for Relay 81-2B Section 6.5).

E. **RCP Bus Under**frequency/**Undervoltage** Panel 1-M-6, 1-XA-55-6A Window 32 ________

Date ________

4.4 Approvals and Notifications (continued)

[2] **OBTAIN** approval from the following prior to beginning Section 6.0 of this Instruction. **REQUEST** Unit 1 US/SRO to EVALUATE LCO 3.3.1.1 and **VERIFY** that the performance of this Instruction will **NOT** adversely affect plant.

Position	Signature	Date	Time
Unit 1 US/SRO	____________________	________	________

5.0 ACCEPTANCE CRITERIA

A. The Underfrequency Relays are considered acceptable if they are within the required tolerances specified in Instruction.

B. All identified adverse conditions shall be documented on Deficiency Log and WO initiated, as required to repair/replace defective component.

C. US and PRG Cognizant Supervisor shall be informed of all deficiencies.

6.0 PERFORMANCE

NOTES

1) Sections 6.2 through 6.5 may be performed non-sequentially as determined by the Test Director.

2) Only one (1) Underfrequency Relay at a time shall be removed from service for calibration during Modes 1 or 2.

3) Sections 6.2 through 6.5 may be performed in parallel if in Modes 3 through 6 at the discretion of the Test Director.

6.1 Pre-work Instructions

[1] **VERIFY** the following:

A. Precautions and Limitations in Section 3.0 have been reviewed. ☐

B. Prerequisites in Section 4.0 are met. ☐

Date ________

6.1 Pre-work Instructions (continued)

CAUTION

A Trip on 2 of 4 channels will cause a Reactor Trip if Reactor Power is greater than 10%.

[2] **IF** instruction is being performed in Modes 2 through 6, **THEN**

ENSURE no other instruction is being performed which could simulate Reactor Power greater than 10% prior to removal of any Relays. ________

[3] **PLACE** orange sticker on status light: **RCP Bus Underfrequency/Undervoltage** Panel 1-M-6, 1-XA-55-6A Window 32 (E-4). ☐

6.2 Calibration of Underfrequency Relay 81-1A

[1] **PLACE** orange sticker on status light: **RCP Bus 1 Underfrequency** Panel 1-M-6, 1-XX-55-6A Window 2. ☐

NOTE

Step 6.2[2] through 6.2[5] may be marked N/A, if instruction is being performed in Modes 2 through 6.

[2] **VERIFY** the following status lights **are NOT** in ALARM condition.

A. **RCP BUS 2 UNDERFREQUENCY** Panel 1-M-6, 1-XX-55-6A Window 22. ☐

B. **RCP BUS 3 UNDERFREQUENCY** Panel 1-M-6, 1-XX-55-6A Window 42. ☐

C. **RCP BUS 4 UNDERFREQUENCY** Panel 1-M-6, 1-XX-55-6A Window 62. ☐

____

Date ________

6.2 Calibration of Underfrequency Relay 81-1A (continued)

[3] **INFORM** UO that the following status lights will actuate when RCP test switch **HS-68-344** is placed in TRIP POSITION:

A. **RCP Bus 1 Under**frequency Panel 1-M-6, 1-XX-55-6A window 2. ☐

B. **RCP Bus Under**frequency/**Undervoltage**, Reactor Protection and Safeguards, Panel 1-M-6, 1-XA-55-6A window 32 (E-4). ☐

____

[4] **PLACE <u>HS-68-344</u>,** RCP 1, Test Switch (Elev. 685, Box 3420) in TRIP POSITION. ☐

[5] **VERIFY** the following alarm energized:

A. **RCP BUS 1 UNDERFREQUENCY**, Panel 1-M-6, 1-XX-55-6A window 2. ☐

B. **RCP BUS UNDERFREQUENCY/UNDERVOLTAGE**, Reactor Protection and Safeguards, Panel 1-M-6, 1-XA-55-6A window 32 (E-4). ☐

____

[6] **REMOVE** PK block cover **(1-PK-068-0344-D)** for UF Relay Device 81-1A (1-81-068-0344-D) located on RCP Panel 1A. ________

____
CV

[7] **REMOVE** UF Relay Device 81-1A **(1-81-068-0344-D)** from RCP Panel 1A. ________

____
CV

[8] **ENSURE** switch settings on Relays are 14, 5, 8, and 13 **AND CONNECT** test equipment to UF Relay Device 81-1A **(1-81-068-0344-D)**. ________

Date ________

6.2 Calibration of Underfrequency Relay 81-1A (continued)

[9] **ADJUST** voltage to approximately 120Vac on frequency test set and **VARY** frequency of test set as necessary, **AND RECORD** "As Found" pick up frequency.

As Found Pick-up Frequency:________Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.) ________

[10] **ADJUST** Relay test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac, **AND**

MEASURE, AND RECORD "As Found" time delay for Relay Pick-up below.
As Found Trip time:________msec.
Acceptance Criteria: Less than or equal to 300 msec. ________

[11] **IF** As Found Trip time in Step 6.2[10] exceeds 300 msec, **INITIATE** a Test Deficiency **THEN PERFORM** Step 6.2[12]. □

NOTE
Step 6.2[12] may be N/A if time did **NOT** exceed 300 msec in Step 6.2[10].

HOLD POINT

[12] **PERFORM** engineering evaluation, **AND IF** FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN DOCUMENT** evaluation on Problem Evaluation Report.

____
Test Director

NOTE
Step 6.2[13] test the Undervoltage detector.

[13] **SET** Relay test set output to approximately 56Hz and 120 volts, **AND DECREASE** test set output voltage source until Relay drops out, **THEN RECORD** Undervoltage detector drop out voltage.
Dropout Voltage:________Vac.
Acceptance Criteria: 55 to 75Vac.

Date ________

6.2 Calibration of Underfrequency Relay 81-1A (continued)

[14] **CALIBRATE** UF Relay 81-1A **(1-81-068-0344-D)** to tolerance specified in Step 6.2[15]. **N/A** this step if no adjustments are required or performed. ________

[15] **RECORD** as left data below.

As Left Pick-up Frequency:________Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) ________

[16] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND CALIBRATE** UF Relay Device 81-1A **(1-81-068-0344-D)** to tolerance specified in Step 6.2[17]. **N/A** this step if no adjustments are required or performed. ________

[17] **RECORD** as left data below.

As Left Trip time:________msec.
Acceptance Criteria: 228 msec ± 18 msec (210 to 246)
(14.25 cycles ± 1.125 cycles (13.125 to 15.375) ________

[18] **REINSTALL** UF Relay Device 81-1A **(1-81-068-0344-D)** into RCP Panel 1A. ________

____
CV

[19] **REPLACE** cover on PK disconnect block **(1-PK-068-0344-D)** for Device 81-1A **(1-81-068-0344-D)**. ________

____
CV

[20] **RETURN** **HS-68-344**, RCP 1, Test Switch, (Elev. 685, Box 3420) to **NORMAL POSITION**. (This step may be marked as **N/A**, if switch was left in normal position)

____
Operations

____
CV

1.0 INTRODUCTION

1.1 Purpose

This Instruction describes the operability testing requirements for Unit 2, Reactor Coolant Pump under frequency (UF) relays associated with system 68.

1.2 Scope

This Instruction covers calibration of the Reactor Coolant Pump under frequency relays. Under frequency relays covered by this Instruction include the following:

RELAY	LOCATION
81-1A	RCP Relay Panel 1A
81-1B	RCP Relay Panel 1B
81-2A	RCP Relay Panel 2A
81-2B	RCP Relay Panel 2B

This Instruction partially satisfies Surveillance Requirement (SR) 4.3.1.1.1.B.17. Applicability mode 1. Performance modes are 1 through 6.

1.3 Frequency/Condition

This Instruction shall be performed at least every 18 months **or** as required.

2.0 REFERENCES

2.1 Performance References

None

2.2 Developmental References

A. SQN Technical Specifications (TS) Unit 2, 2.2 table 2.2-1 item 16.

B. SQN Technical Specifications, Unit 2, 3.3.1 table 3.3-1 item 17.

C. SQN Technical Specifications, Unit 2, 4.3.1.1.1 table 4.3-1 item 17, and 4.3.1.1.3.A.17.

D. SQN FSAR Sections 7.2.1.2.6, 7.2.3.1.4 and Table 7.2.1-5

E. Relay Setting Sheets 2943-94, 2944-94, 2945-94, and 2946-94.

F. Westinghouse Set-point Methodology for Protection systems Sequoyah Units 1 and 2 (WCAP-11239).

G. TVA drawings: 45N763-2, 45N721-2, and 45N721-4

H. Mfr. drawings: D-N2206-05, (Contract Number 823380).

I. 2-SI-TFT-068-230.0, "Periodic Functional Test of RCP Under frequency Relays Unit 2."

J. TVA Field Test Manual.

K. NPG-SPP-06.9.1, "Conduct of Testing."

L. NPG-SPP-01.3 "Housekeeping/Temporary Equipment Control".

M. I.L. 1B 7.4.1.7-5 Asea Brown Boveri "Type 81 Frequency Relay" and I.L. RC-5047-A ABB Power T & D Company Inc. "Type 86 AC-DC converter".

N. 2-SI-IRT-099-21A.0, 2-SI-IRT-099-21B.0, and 2-SI-IRT-099-21C.0

O. Response Time Test.

P. DCN M10396.

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Precautions

A. All standard safety practices shall be observed while working on or near electrically energized equipment.

B. All conditions and restraints imposed by Technical Specifications 3.3.1 shall be met during Instruction performance.

C. This Instruction shall be performed in accordance with NPG-SPP-06.9.1: Conduct of Testing.

D. Test equipment used to perform calibration on UF Relays for RCP 1and 2 cannot be used in calibration of UF relays for RCP 3 and 4 unless the particular equipment is used strictly as a source.

E. Removal of 2 out of 4 under frequency relays will cause a reactor trip with reactor power greater than 10%.

F. Only one (1) under frequency relay at a time shall be removed from service for calibration during Modes 1 and 2.

Date ________

4.0 PREREQUISITES

4.1 Preliminary Actions

[1] **ENSURE** this Instruction copy is the latest revision. ________

[2] **CONDUCT** a pretest briefing in accordance with NPG-SPP-06.9.1. ________

[3] **RECORD** performer and participant identification on Data Package Cover Sheet. ☐

4.2 Special Tools, Measuring and Test Equipment (M&TE), Parts, and Supplies

[1] **OBTAIN** the following M&TE for Train A and Train B. ☐

Description		TVA ID No.	Cal. Due
Doble Relay Test Set F2100, F2200, F2500, F2350 or equivalent			
	RCP's # 1 & 2 - TRAIN A		
	RCP's # 3 & 4 - TRAIN B		

Date ________

4.3 Approvals and Notifications

[1] **DETERMINE** status light(s) to be actuated at 2-M-6 during this test and

NOTIFY Unit 2 US/SRO of status light(s) to be actuated during this test. Limiting condition for operation 3.3.1 shall apply during performance of this Instruction, if in mode 1.

Panel/Window #	Description	Section	
2-XX-55-6A Window 2, 2 Panel 2-M-6	RCP Bus 1 Under Frequency	6.2	☐
2-XX-55-6A Window 22 Panel 2-M-6	RCP Bus 2 Under Frequency	6.3	☐
2-XX-55-6A Window 42 Panel 2-M-6	RCP Bus 3 Under Frequency	6.4	☐
2-XX-55-6A Window 62 Panel 2-M-6	RCP Bus 4 Under Frequency	6.5	☐
2-XA-55-6A Window 32 Panel 2-M-6	RCP Bus Underfrequency/ Undervoltage	6.2 thru 6.5	☐

____

Date ________

4.3 Approvals and Notifications (continued)

[2] **OBTAIN** approval from the following prior to beginning section of this Instruction and

REQUEST Unit 2 US/SM to

EVALUATE LCO 3.3.1 and

CONFIRM that the performance of this Instruction will NOT adversely affect plant.

Position			
Unit 2 US/SM	________________ / Signature	______ / Date	______ Time

4.4 Field Preparations

[1] None

5.0 ACCEPTANCE CRITERIA

[1] The Underfrequency relays are considered acceptable if they are within the required tolerances specified in Instruction.

[2] All identified adverse conditions shall be documented on Deficiency Log and SR/WO initiated, as required to repair/replace defective component.

[3] US and PRG cognizant supervisor shall be informed of all deficiencies.

Date ________

6.0 PERFORMANCE

NOTES

1) Sections 6.2 through 6.5 may be performed non-sequentially as determined necessary by the test director.
2) Only one (1) Underfrequency relay at a time shall be removed from service for calibration during modes 1 or 2.
3) Sections 6.2 through 6.5 may be performed in parallel if in modes 3 through 6 at the discretion of the test director.

6.1 Pre-work Instructions

[1] **CONFIRM** the following:

A. Precautions and Limitations in Section 3.0 have been reviewed. ☐

B. Prerequisites in Section 4.0 are met. ☐

____

CAUTION

A trip on 2 of 4 channels will cause a reactor trip if reactor power is greater than 10%.

[2] **IF** instruction is being performed in modes 2 through 6, **THEN**

ENSURE no other instruction is being performed which could simulate reactor power greater than 10% prior to removal of any relays.

____

[3] **PLACE** orange sticker on the following annunciator. ☐

Panel/Window #	Description
2-XA-55-6A, Window 32 (E-4) Panel 2-M-6	RCP Bus Under frequency/ Undervoltage

Date ________

6.2 Calibration of Underfrequency Relay 81-1A

[1] **PLACE** orange sticker on the following status light. ☐

Panel/Window #	Description
2-XX-55-6A, Window 2 Panel 2-M-6	RCP Bus 1 Under Frequency

NOTE

Step 6.2[2] through 6.2[5] may be marked N/A, if instruction is being performed in modes 2 through 6.

[2] **CONFIRM** the following status lights Are Not in alarm condition.

Panel/Window #	Description	
2-XX-55-6A, Window 22 Panel 2-M-6	RCP Bus 2 Under Frequency	☐
2-XX-55-6A, Window 42 Panel 2-M-6	RCP Bus 3 Under Frequency	☐
2-XX-55-6A, Window 62 Panel 2-M-6	RCP Bus 4 Under Frequency	☐

____

Date ________

6.2 Calibration of Underfrequency Relay 81-1A (continued)

[3] **INFORM** UO that the following status lights will actuate when RCP test switch HS-68-344 is placed in TRIP POSITION:

Panel/Window #	Description
2-XX-55-6A, Window 2 Panel 2-M-6	RCP Bus 1 Under Frequency
2-XA-55-6A, Window 32 (E-4) Panel 2-M-6	RCP Bus Under frequency/ Undervoltage

____

[4] **PLACE** HS-68-344, RCP 1, Test Switch (Elev. 685, Box 3424) in TRIP POSITION.

____
Ops

[5] **CONFIRM** the following alarm energized:

Panel/Window #	Description	
2-XX-55-6A, Window 2 Panel 2-M-6	RCP Bus 1 Under Frequency	☐
2-XA-55-6A, Window 32 (E-4) Panel 2-M-6	RCP Bus Under frequency/ Undervoltage	☐

____

[6] **REMOVE** PK block cover 2-PK-68-344-D for UF relay device 81-1A, (2-81-68-344-D) located on RCP panel 1A.

____

____
PC

[7] **REMOVE** UF relay device 81-1A, (2-81-68-344-D) from RCP panel 1A.

____

____
PC

Date ________

6.2 **Calibration of Underfrequency Relay 81-1A (continued)**

[8] **ENSURE** switch settings on relays are 14, 5, 8, and 13 and

CONNECT test equipment to UF Relay Device 81-1A 2-81-68-344-D ________

[9] **ADJUST** voltage to approximately 120Vac on frequency test set and

VARY frequency of test set as necessary, and

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: ________Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.) ________

[10] **ADJUST** relay test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac, and

MEASURE, and **RECORD** "As Found" time delay for relay Pick-up below.

As Found trip time:________ msec.
Acceptance Criteria: Less than or equal to 300 msec. ________

[11] **IF** As Found trip time in Step 6.2[10] exceeds 300 msec,

INITIATE a Test Deficiency **THEN**

PERFORM Step 6.2[12]. ________

NOTE
Step 6.2[12] may be N/A if time did not exceed 300 msec in Step 6.2[10]

HOLD POINT

[12] **PERFORM** engineering evaluation, and

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN**

DOCUMENT evaluation on Problem Evaluation Report.

____
Test Director

Date ________

6.2 Calibration of Underfrequency Relay 81-1A (continued)

NOTE

Step 6.2[13] test the undervoltage detector.

[13] **SET** relay test set output to approximately 56Hz and 120 volts, and

LOWER test set output voltage source until relay drops out, and

RECORD undervoltage detector drop out voltage.

Dropout Voltage: ________Vac.
Acceptance Criteria: 55 to 75Vac. ________

[14] **CALIBRATE** UF relay 81-1A, (2-81-68-344-D) to tolerance specified in Step 6.2[15]. N/A this step if no adjustments are required or performed. ________

[15] **RECORD** as left data below.

As Left Pick-up Frequency: ________Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) ________

[16] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, and

CALIBRATE UF relay device 81-1A, (2-81-68-344-D) to tolerance specified in Step 6.2[17]. N/A this step if no adjustments are required or performed. ________

[17] **RECORD** as left data below.

As Left trip time:________ msec.
Acceptance Criteria: 228 msec ± 18 msec (210 to 246)

14.25 cycles ± 1.125 cycles (13.125 to 15.375) ________

Date ________

6.2 Calibration of Underfrequency Relay 81-1A (continued)

[18] **REINSTALL** UF relay device 81-1A, (2-81-68-344-D) into RCP panel 1A. ________

________ IV

[19] **REPLACE** cover on PK disconnect block 2-PK-68-344-D for device 81-1A, (2-81-68-344-D). ________

________ IV

[20] **RETURN** HS-68-344, RCP 1, Test Switch, (Elev. 685, Box 3424) to Normal Position. (This step may be marked as N/A, if switch was left in normal position)

________ Ops

________ CV

ACCEPTANCE CRITERIA

REACTOR TRIP

	REACTOR TRIP FUNCTION	SENSE LINE	XMTR	EAGLE 21	RACK	INPUT RELAY	SSPS LOGIC	RX TRIP	TOTAL	DESIRED MAXIMUM	TECH SPEC ALLOWABLE
	PWR RNG HI NEUTRON FLUX	N/A	N/A	N/A	0.336	** N/A	0.006	0.150	0.492	0.492	0.50 sec.
	PWR RNG LO NEUTRON FLUX	N/A	N/A	N/A	0.336	** N/A	0.006	0.150	0.492	0.492	0.50 sec.
	PWR RNG HI NEG RATE	N/A	N/A	N/A	0.336	** N/A	0.006	0.150	0.492	0.492	0.50 sec.
	PRZR PRESS LOW	0.200	0.695	0.309	N/A	0.05	0.006	0.150	1.410	1.970	2.00 sec.
	PRZR PRESS HIGH	0.200	0.695	0.309	N/A	0.05	0.006	0.150	1.410	1.970	2.00 sec.
	LOSS OF FLOW RCS	0.056	* 0.414	0.309	N/A	0.05	0.006	0.150	0.985	0.985	1.00 sec.
	RCP UNDERVOLTAGE	N/A	N/A	N/A	1.026	** N/A	0.006	0.150	1.182	1.182	1.20 sec.
	RCP UNDERFREQUENCY	N/A	N/A	N/A	0.435	** N/A	0.006	0.150	0.591	0.591	0.60 sec.
[C.1]	OVERTEMP ΔT PRZR PRESS	0.200	0.695	0.309	N/A	0.05	0.006	0.150	1.410	7.880	8.00 sec.
[C.1]	OVERTEMP ΔT NEUTRON FLUX IMBALANCE	N/A	0.336	0.309	N/A	0.05	0.006	0.150	0.851	7.880	8.00 sec.
	OVERTEMP ΔT, T AVG	N/A	7.365	0.309	N/A	0.05	0.006	0.150	7.880	7.880	8.00 sec.
	OVERPOWER ΔT, T AVG	N/A	7.365	0.309	N/A	0.05	0.006	0.150	7.880	7.880	8.00 sec.
	SG LVL LO LO RCS LOOP ΔT	N/A	7.365	0.309	N/A	0.05	0.006	0.150	7.880	7.880	8.00 sec.
	SG LVL LO LO ADVERSE EAM	0.280	0.450	0.309	N/A	0.05	0.006	0.150	1.245	1.970	2.00 sec.
	SG LVL LO LO CONTMT PRESS	0.139	0.500	0.309	N/A	0.05	0.006	0.150	1.154	1.970	2.00 sec.

NOTE 1 Barton transmitters are used for SG Level and PRZR Pressure. When using the AMS Noise Analysis methodology to test these transmitters, the sense line time can be added to the Acceptance Criteria for the transmitters. The transmitter Noise Analysis time includes sense line delays and will be reflected in the SI for these transmitters.

NOTE 2 The Reactor Trip time is measured from the loss of UV voltage at the SSPS through the Reactor Trip Breaker to the loss of voltage at the control rod drive gripper coil.

* Denotes the most restrictive transmitter time.

** Input Relay is included in rack times for these functions.

Attachment No. 9 Sheet 1 of 2
Identifier SQN-EEB-MS-TI28-0076

ACCEPTANCE CRITERIA

REACTOR TRIP

	REACTOR TRIP FUNCTION	SENSE LINE	XMTR	EAGLE 21	RACK	INPUT RELAY	SSPS LOGIC	RX TRIP	TOTAL	DESIRED MAXIMUM	TECH SPEC ALLOWABLE
	PWR RNG HI NEUTRON FLUX	N/A	N/A	N/A	0.336	** N/A	0.006	0.150	0.492	0.492	0.50 sec.
	PWR RNG LO NEUTRON FLUX	N/A	N/A	N/A	0.336	** N/A	0.006	0.150	0.492	0.492	0.50 sec.
	PWR RNG HI NEG RATE	N/A	N/A	N/A	0.336	** N/A	0.006	0.150	0.492	0.492	0.50 sec.
	PRZR PRESS LOW	0.200	0.695	0.309	N/A	0.05	0.006	0.150	1.410	1.970	2.00 sec.
	PRZR PRESS HIGH	0.200	0.695	0.309	N/A	0.05	0.006	0.150	1.410	1.970	2.00 sec.
	LOSS OF FLOW RCS	0.056	* 0.414	0.309	N/A	0.05	0.006	0.150	0.985	0.985	1.00 sec.
	RCP UNDERVOLTAGE	N/A	N/A	N/A	1.026	** N/A	0.006	0.150	1.182	1.182	1.20 sec.
	RCP UNDERFREQUENCY	N/A	N/A	N/A	0.435	** N/A	0.006	0.150	0.591	0.591	0.60 sec.
[C.1]	OVERTEMP ΔT PRZR PRESS	0.200	0.695	0.309	N/A	0.05	0.006	0.150	1.410	7.880	8.00 sec.
[C.1]	OVERTEMP ΔT NEUTRON FLUX IMBALANCE	N/A	0.336	0.309	N/A	0.05	0.006	0.150	0.851	7.880	8.00 sec.
	OVERTEMP ΔT, T AVG	N/A	7.365	0.309	N/A	0.05	0.006	0.150	7.880	7.880	8.00 sec.
	OVERPOWER ΔT, T AVG	N/A	7.365	0.309	N/A	0.05	0.006	0.150	7.880	7.880	8.00 sec.
	SG LVL LO LO RCS LOOP ΔT	N/A	7.365	0.309	N/A	0.05	0.006	0.150	7.880	7.880	8.00 sec.
	SG LVL LO LO ADVERSE EAM	0.280	0.450	0.309	N/A	0.05	0.006	0.150	1.245	1.970	2.00 sec.
	SG LVL LO LO CONTMT PRESS	0.139	0.500	0.309	N/A	0.05	0.006	0.150	1.154	1.970	2.00 sec.

NOTE 1 Barton transmitters are used for SG Level and PRZR Pressure. When using the AMS Noise Analysis methodology to test these transmitters, the sense line time can be added to the Acceptance Criteria for the transmitters. The transmitter Noise Analysis time includes sense line delays and will be reflected in the SI for these transmitters.

NOTE 2 The Reactor Trip time is measured from the loss of UV voltage at the SSPS through the Reactor Trip Breaker to the loss of voltage at the control rod drive gripper coil.

* Denotes the most restrictive transmitter time.

** Input Relay is included in rack times for these functions.

Attachment No. 9 Sheet 2 of 2
Identifier SQN-EEB-MS-TI28-0076

QA_Record

EBASCO SERVICES INCORPORATED
CALCULATION COVER SHEET

Sheet 1 c/o 1a

Title: DEMONSTRATED ACCURACY CALCULATION FOR REACTOR COOLANT PUMPS UNDERFREQUENCY RELAYS (81)	Plant/ Unit WBNP/1

PREPARING ORGANIZATION EEB, Ebasco, I & C	KEY NOUNS (Consult RIMS DESCRIPTORS LIST) CALC, I&C, ACCURACY; RELAYS, RCP			
BRANCH PROJECT IDENTIFIERS WBPE0689009008	Each time these calculations are issued, preparers must ensure that the original (R0) RIMS accession number is filled in			
	Rev	(for RIMS' use)	RIMS accession number	
	R0	901116C0027	B18901012251	
APPLICABLE DESIGN DOCUMENT(S) N3-68-4001	R2	SEP 0 9 1993	(102) B18 '93 0825 259	
	R3		(7) B18 '94 0[illegible] 255	
SAR SECTION(S) 5.5.1 / UNID SYSTEM(S) 068	R			

Revision 0	R2	R3	R	Safety related? Yes [✓] No [ ]
ECN NO. (or indicate Not Applicable) P-04237-A	N/A	N/A		Statement of Problem: DETERMINE THE ACCURACY OF THE INSTRUMENT(s) AND DEMONSTRATE THAT THE ACCURACY IS ADEQUATE FOR THE INTENDED SAFETY FUNCTION
Prepared A. Brownack, EJB	David P. Thornhill	[signature]		
Checked/Verified Terry Moreland	[signature]	David B. Thornhill		
Reviewed Howard Oberholtzer	[signature] 8/23/93	[signature] 1/4/94		RCP UNDERFREQUENCY RELAYS: 1-81—68-8, 1-81—68-50, 1-81—68-31, 1-81—68-73
Approved [illegible] Gupta	[signature]	[signature] for P. Anders		
Date: 10.12.90	8/23/93	1/4/94		
USE FORM TVA 10534 IF MORE SPACE REQUIRED — List all pages added by this revision	See Rev Log	SEE REV LOG		
List all pages added	See Rev Log	SEE REV LOG		ORIGINAL
List all pages added by this revision	See Rev Log	SEE REV LOG		

ABSTRACT: These calculations contain an unverified assumption(s) that must be verified later. Yes [ ] No [✓]

This calculation contains special requirements and/or limiting conditions. Yes [ ] No [✓]

Revision 3 is a Rev Log Revision and must be worked in conjunction with Rev 2 to establish the complete calculation.

Calculations were performed to determine the accuracy of the subject instrument loop(s). The determined accuracies were compared to the required accuracies and the accuracy for the loop(s) listed below were demonstrated to be adequate for the intended safety function of the loop(s). This calculation applies to the instrument loop(s) listed below

RCP UNDERFREQUENCY
RELAYS: 1-81—68-8, 1-81—68-50
1-81—68-31, 1-81—68-73

Attachment No. 10 Sheet 1 of 1
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FSAR Compliance Review for Revision 2

FSAR compliance R3: [signature] 1/4/94

FSAR Section 5.5.1 has been reviewed and this calculation is in compliance with the FSAR. OPT 8/20/93 PHA 8/23/93

This calculation consists of 41 pages and 12 Attachments of 61 pages for a Grand Total of ~~103~~ 102 OPT 8/20/93 pages.

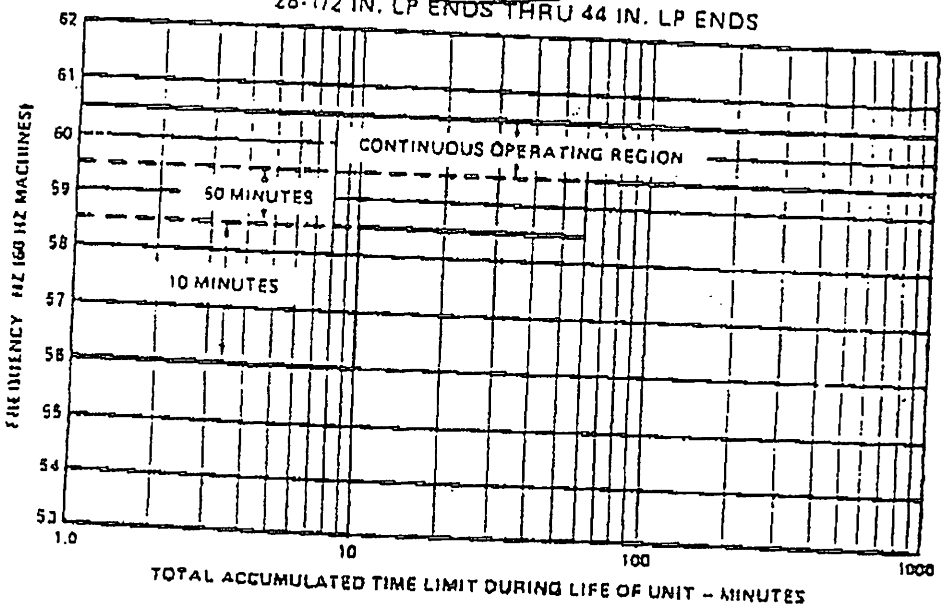
[ ] Microfilm and store calculations in RIMS Service Center
[X] Microfilm and return calculation to: Calculation Library

Microfilm and destroy. [ ]
Address: A-IOB

FIGURE A.26
Page 1 of 1

Attachment No. 11 Sheet 1 of 1
Identifier SQN-EEB-MS-TI28-0075

OFF-FREQUENCY TURBINE OPERATION
28-1/2 IN. LP ENDS THRU 44 IN. LP ENDS



You can see any off normal < 60 Hz requires trending on the main turbine. With Unit on line any Hz < 59 would be seen by vibration problems on the turbine and require me to take the unit off line unless load was critical.

[signature] 4-19-94

Source

SER 2692
Station frequency recorder

Setpoint

High 60.15
Low 59.85

STA FREQ EXCESSIVE ERROR

Attachment No. 17 Sheet 1 of 1
Identifier SQN-EEB-MS-TI28-0076

Probable Causes

1. System disturbance.
2. Recorder malfunction.

Corrective Actions

[1] **CONFIRM** alarm by checking 1-XI-68-8, 1-XI-68-31, 1-XI-68-50, and 1-XI-68-73. RCP frequency indications (M-5).

[2] **CONTACT** Power system Dispatcher to verify system disturbance and to recieve instructions to assist in restoring system to normal frequency.

[3] **REFER** to Switchyard letter 15, Emergency Operating Instructions for 500kV and 161kV Switchyards.

References

45N541,
45B655-ECB6-B

B27 940607 001

Q A RECORDS

Q A RECORDS

To: David Haun Stone & Webster
Cc:
Bcc:
From: CLIFF DOWNS@MARKETING@ABB Allentown
Subject: ABB Type 81 Frequency Relay
Date: Friday, June 3, 1994 15:26:22 EDT
Attach:
Certify: N
Forwarded by:

Confirming our telephone conversation, your assumption of a 0.5Hz setpoint drift over a 22.5 month period (excluding temperature and radiation effects) is too conservative.

This relay employs a very stable crystal controlled oscillator as the frequency reference. A change in characteristics of that magnitude would be an indication of a "defective" relay.

I believe you should use the figure 0.1Hz and you will still be very conservative.

Regarding relay accuracy during seismic vibration, I reviewed the original test report and can add nothing to what is shown in the summary report you have. No attempt was made to determine the relay's operating point with the high accuracy needed to give you the kind of answer you are looking for. However, since the entire measuring circuitry of the Type 81 is solid-state, it is my opinion that the relay would have maintained its published accuracy of 0.008Hz during the vibration. If you use a figure of 0.1Hz here you will again be very conservative.

Cliff Downs

Clifford Downs
Mgr - Technical Support

Tel: 610-395-7333
Fax: 610-395-1055

Attachment No. 13 Sheet 1 of 1
Identifier SQN-EEB-MS-TI78-0076

QA Record

T49 911120 821

STS

SOUTHERN TESTING SERVICES, INC.

Report No. S298-RP-01
TVA Contract No.
91NNA-75865A
April 24, 1991
Revision 0

(68)

911204S0009

ref = T49 911120 820

Attachment No. 14 Sheet 1 of 31
Identifier SQN-EEB-MS-TI28-0076

NUCLEAR ENVIRONMENTAL AND SEISMIC QUALIFICATION
FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81
PART NUMBER 422B1295 WITH A POWER ONE, INC. POWER
SUPPLY PART NUMBER HA24-0.5-A

REVIEWED BY:

Darrin R. Martin

DARRIN R. MARTIN, QUALIFICATION TEST SPECIALIST

REVIEWED BY:

Joseph A. Keck

JOSEPH A. KECK, TECHNICAL REVIEWER

REVIEWED BY:

John W. Mashburn

JOHN W. MASHBURN, QUALITY ASSURANCE

APPROVED BY:

Fredrick J. Slagle

FREDRICK J. SLAGLE, PRESIDENT
SOUTHERN TESTING SERVICES, INC.
TENNESSEE PROFESSIONAL ENGINEER
LICENSE NUMBER 014873

DATE: April 24, 1991

Prepared for:

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
SPRING CITY, TN 37381

P.O. BOX 22010 KNOXVILLE, TENNESSEE 37933 (615) 966-5330

EXECUTIVE SUMMARY

Nuclear environmental and seismic qualification testing and electromagnetic interference (EMI) testing was performed on an ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 with a Power One, Inc. Power Supply Part Number HA24-0.5-A (Item Number 1). The environmental qualification of the frequency relay and power supply consisted of nuclear environmental qualification testing in accordance with the Tennessee Valley Authority (TVA) Specification SS-E18.10.01, "Environmental Qualification Requirements for Safety-Related Electrical Equipment," Revision 2, dated October 28, 1986, and seismic qualification (type testing) which meets or exceeds the requirements of TVA Design Criteria WB-DC-40-31.2, "Seismic Qualification of Category I Fluid System Components and Electrical or Mechanical Equipment," Revision 4, dated May 22, 1990. Electromagnetic interference testing was performed in accordance with Tennessee Valley Authority Standard Specification SS-E18.14.01, "Electromagnetic Interference (EMI) Testing Requirements for Electronic Devices," Revision 1, dated August 18, 1986. The frequency relay and power supply successfully completed the seismic and EMI qualification test program and are certified to be Class 1E environmentally and seismically qualified for service in a mild environment.

Attachment No. 14	Sheet 2 of 31
Identifier SQN-EEB-MS-TI28-0076	

P/N HA24-0.5-A," Revision 0, dated April 2, 1991. The functional operation of the frequency relay and power supply was tested utilizing the test configuration as shown in Figure 1.1. The power supply was energized with 120 VAC, and 24 VDC was verified at the output. The functional operation of the frequency relay was tested utilizing the 24 VDC output of the power supply as the relay control power. The relay was set up for 24 VDC control power, underfrequency relay operation, internal shunt target operation, and factory set undervoltage cutoff (60 VAC). The under-frequency trip point was set at 57.00 Hertz (thumbwheel switches set at 14, 5, 8, and 13) and the time delay switches was set at 54 cycles (1 second total delay). The input circuit to the relay was set for 120 VAC and the frequency was variable between 55 and 60 Hertz (Hz). Proper operation of the relay test specimen was verified by decreasing the input frequency from 60 to 55 Hz and monitoring the output contacts utilizing a digital multimeter. Both the alarm and trip output contacts should change state one (1) second after the input reaches 57 Hz. The input frequency was then returned to 60 Hz and the output contacts returned to their normal state instantaneously. The test specimens were energized with rated coil voltage and tested in the de-energized and energized states. Two (2) sets of contacts on the relay test specimen were monitored for contact chatter before, during, and after seismic testing. A 24 VDC continuity signal was utilized for contact chatter monitoring. The 24 VDC continuity signals were monitored before, during, and after seismic testing and recorded on a strip chart recorder for evaluation. The completed seismic test procedure is contained in Appendix A.

3.0 TEST PROCEDURE

The test specimens were mounted on a hydraulically operated shaker table in a manner that simulates normal in-plant mounting. This test setup is shown in Figure 3.1. A piezoelectric accelerometer was mounted near the test specimens for vibration measurements. The accelerometer was connected to a vibration analysis system operated and monitored by Southern Testing Services, Inc. A list of test instrumentation utilized for system functionality data measurements is provided in Appendix C. The Southern Testing Services, Inc. seismic test procedure is contained in Appendix A.

The acceptance criteria are the safety-related function of the components and are identified below:

(1) Sine sweep acceleration levels shall be met or exceeded as allowable by the test equipment.

(2) No failure is detected during seismic testing (i.e., no loss of structural integrity or contact chatter).

(3) The components will show proof of operability by operating before, during, and after seismic testing.

The test methodology utilized for seismic qualification was sine sweep testing in accordance with Section 3.2.1.5.c of TVA Design Criteria WB-DC-40-31.2, "Seismic Qualification of Category I Fluid System Components and Electrical or Mechanical Equipment," Revision 4, dated May 22, 1990. This seismic testing consisted of subjecting the test specimens to accelerations of 3.0 g in both horizontal axes and the vertical axis over the frequency range of 1 to 35 to 1 Hz at a sweep rate of one (1) octave

per minute. The test specimens were tested in four (4) horizontal orientations. Each 90-degree rotation advanced the test specimens to the next orientation.

Seismic testing was performed on the STS seismic simulation test system. This test system is a psuedo-biaxial seismic test system where the direction of motion of the mounting platform is inclined at an angle of 45-degrees from the horizontal. The mounting platform itself is parallel to the floor. A schematic diagram of the system is presented in Figure 3.2.

Based on a technical assessment of these device by experienced laboratory personnel and on previous test results of similar devices, these specimens does not have any closely spaced modes of vibration within the seismic frequency range of excitation. Therefore, resonance of response in one mode of vibration will not add to or influence the responses in another mode of vibration. For these devices, the high amplitude sine sweep seismic testing methodology is appropriate for seismic qualification.

The test specimens were subject to EMI testing to meet the requirements of Tennessee Valley Authority Standard Specification SS-E18.14.01. The test setups utilized for EMI testing are shown in Figures 5.1 through 5.7 of STS Test Procedure S298-TP-02 which is contained in Appendix B. A list of test instrumentation utilized for EMI testing is also contained in Appendix B.

4.0 TEST RESULTS

The results of the nuclear environmental and seismic and EMI qualification testing program are presented in summary. Detailed results of the visual and functional performance of the test specimens and seismic test program are contained in Appendix A. This appendix contains the seismic test procedure and the detailed results of all baseline and functional electrical testing. Baseline electrical testing was performed before and after each phase of the seismic testing. Functional electrical testing was performed during seismic testing and demonstrated the operability of the test specimens during each phase of the seismic testing. This report provides the vibration data measurements that were performed to achieve seismic qualification of the test specimens. A summary of each test phase of the seismic test program is shown in Table 4.1. Figures 4.1 through 4.8 show the input acceleration levels for each orientation of the seismic test program. Detailed results of the EMI test program are contained in Appendix B.

The visual inspections performed during each phase of the test program revealed no visible defects and no loss of structural integrity at any time before, during, or after seismic testing. Results of the visual inspections are shown in Table 4.2.

The electrical testing performed revealed no failures and no loss of electrical continuity at any time before, during, or after seismic testing. Results of the electrical testing are shown in Table 4.3. A portion of the strip chart recording of the electrical continuity signals is shown in Figure 4.9.

TABLE 4.3

ELECTRICAL TESTING SUMMARY

TEST RUN NO.	TEST SPECIMEN ORIENTATION	DESCRIPTION
1.	H1/V TEST RUN 1	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
2.	H1/V TEST RUN 2	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
3.	H2/V TEST RUN 3	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
4.	H2/V TEST RUN 4	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
5.	H3/V TEST RUN 5	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
6.	H3/V TEST RUN 6	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
7.	H4/V TEST RUN 7	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING
8.	H4/V TEST RUN 8	NO LOSS OF ELECTRICAL CONTINUITY BEFORE, DURING, OR AFTER SEISMIC TESTING

The EMI testing performed revealed no failures and no loss of operability at any time before, during, or after EMI testing. Results of the EMI testing are shown in Table 4.4. Detailed results of the EMI testing are contained in Appendix B.

TABLE 4.4

EMI TESTING SUMMARY

EMI TEST PROGRAM PHASE	TEST RESULTS
1. CONDUCTED EMI TRANSIENT SUSCEPTIBILITY	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY
2. CONDUCTED RF EMI SUSCEPTIBILITY	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY
3. LINE COUPLED TRANSIENT EMI SUSCEPTIBILITY	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY
4. LINE COUPLED RF EMI SUSCEPTIBILITY	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY
5. CONDUCTED EMISSIONS TESTING	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY
6. SURGE WITHSTAND CAPABILITY (SWC) TESTING	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY
7. RADIATED RF EMI FIELD SUSCEPTIBILITY	NO LOSS OF FREQUENCY RELAY OR POWER SUPPLY OPERABILITY

5.0 CONCLUSION

The ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 with a Power One, Inc. Power Supply Part Number HA24-0.5-A (Item Number 1) test specimens successfully completed the nuclear environmental and seismic qualification testing program described in Section 1.0, INTRODUCTION, of this report. It was demonstrated that the test specimens possessed sufficient integrity to withstand, without compromise of structure or function, the simulated seismic and EMI environment. All acceptance criteria identified in Section 3.0, TEST PROCEDURE, were met by the test specimens during the test program. This test program resulted in the frequency relay with power supply being certified as Class 1E nuclear environmentally and seismically qualified for service in a mild environment.

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

PROCEDURE NO. S298-TP-01
REVISION NO. 0
PAGE 1 OF 8

PREPARED BY:	Joseph A. Keck	DATE:	April 2, 1991
REVIEWED BY:	Dennis R. Mast	DATE:	April 2, 1991
REVIEWED BY:	John W. Mashburn (QA)	DATE:	April 2, 1991
APPROVED BY:	[signature]	DATE:	April 2, 1991

1.0 PURPOSE:

This test procedure identifies the methodology to be utilized to perform seismic testing of an ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 with a Power One, Inc. Power Supply Part Number HA24-0.5-A.

2.0 EQUIPMENT DESCRIPTION:

The equipment to be tested consists of an ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 with a Power One, Inc. Power Supply Part Number HA24-0.5-A. The components identified above are utilized in control circuit applications.

3.0 TEST SPECIMEN:

The test specimens consist of one (1) ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 Serial Number 00422-07 and one (1) Power One, Inc. Power Supply Part Number HA24-0.5-A Serial Number 00454-07. The test specimens shall be mounted on a seismic test fixture fabricated by Southern Testing Services, Inc. with functional test configuration as shown in Figure 3.1. The seismic test fixture shall be bolted into place.

4.0 DATA RECORDING INSTRUMENTATION:

MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION LAST	CALIBRATION DUE
Trig-Tek, Inc. Compressor	801B	594	12/07/90	12/07/91
Trig-Tek, Inc. Vibration Monitor	610B	555	12/07/90	12/07/91
Trig-Tek, Inc. Sweep Generator	701LM	608	12/07/90	12/07/91
PCB Piezotronics Accelerometer	308B10	23744	11/26/90	11/26/91
CEC/Bell & Howell Galvanometer Amplifier	1-172-26	3014	10/22/90	04/22/91
Honeywell Visicorder	1508	15-806	10/22/90	04/22/91

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Identifier SQN-EEB-MS-TI28-0076

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

PROCEDURE NO. S298-TP-01
REVISION NO. 0
PAGE 2 OF 8

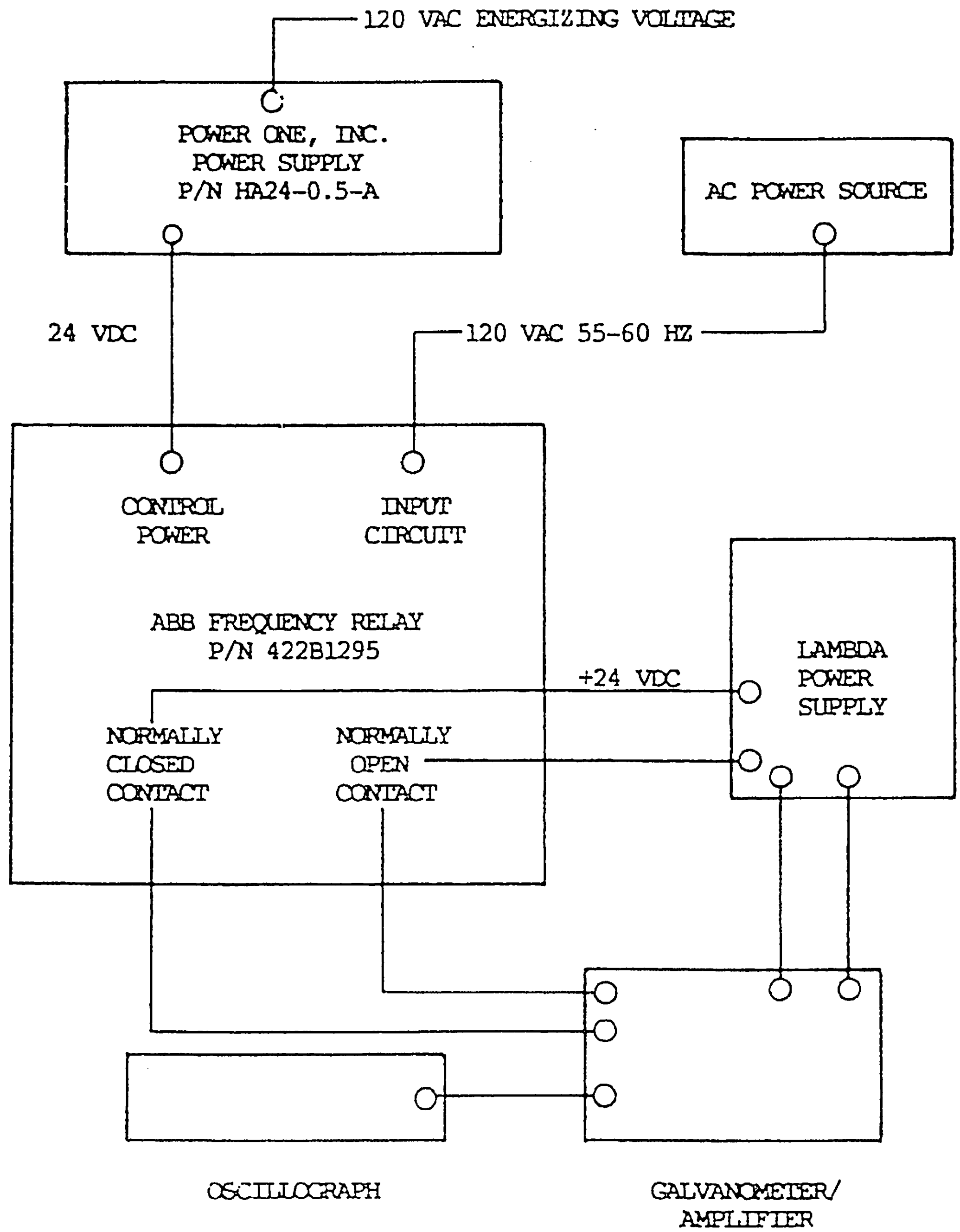

FIGURE 3.1 FUNCTIONAL TEST CONFIGURATION

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

4.0 DATA RECORDING INSTRUMENTATION:

MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION LAST	CALIBRATION DUE
Lambda Power Supply	LMF24-OVMYB-3126	D90665	N.A.	N.A.
Fluke Digital Multimeter	87	48400998	09/25/90	09/25/91
Honeywell XY Plotter	540TPRXYY	1186	12/17/90	06/17/91
California Instruments AC Power	1001TC	L33966	N.A.	N.A.
Source w/ Precision Oscillator	847T	X62588	N.A.	N.A.
General Radio Counter	1191	00374	09/21/90	09/21/91

5.0 TEST PROCEDURE:

5.1 The test specimens shall be visually examined and functionally tested for determination of baseline physical condition. The functional operation of the frequency relay and power supply shall be tested utilizing the test configuration as shown in Figure 3.1. The power supply shall be energized with 120 VAC and 24 VDC shall be verified at the output. The functional operation of the frequency relay shall be tested utilizing the 24 VDC output of the power supply as the relay control power. The relay shall be set up for 24 VDC control power, underfrequency relay operation, internal shunt target operation, and factory set undervoltage cutoff (60 VAC). The underfrequency trip point shall be set at 57.00 Hertz (thumbwheel switches set at 14, 5, 8, and 13) and the time delay switches shall be set at 54 cycles (1 second total delay). The input circuit to the relay shall be set for 120 VAC and the frequency shall be variable between 55 and 60 Hertz (Hz). Proper operation of the relay test specimen shall be verified by decreasing the input frequency from 60 to 55 Hz and monitoring the output contacts utilizing a digital multimeter. Both the alarm and trip output contacts should change state one (1) second after the input reaches 57 Hz. The input frequency shall [illegible] returned to 60 Hz and the output contacts should return to their normal state instantaneously. Proper operation of the

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

PROCEDURE NO. S298-TP-01
REVISION NO. 0

5.0 TEST PROCEDURE:

5.1 test specimens as described above will be the failure criteria for the components. The results of the visual examination and the functional testing shall be recorded in Data Section 5.1.

JAK Initials — 4/4/91 Date

5.2 The test specimens shall be mounted on the seismic simulation table in a manner which duplicates the normal in-plant mounting.

JAK Initials — 4/4/91 Date

5.3 The test specimens shall be subjected to sine sweep seismic testing with input accelerations of 3.0 g in both horizontal axes and in the vertical axis from 1 to 35 to 1 Hz at a sweep rate of 1 octave per minute. The power supply test specimen shall be energized with 120 VAC during seismic testing and the 24 VDC output shall be connected to the control power input of the frequency relay test specimen. The frequency relay shall be set up as described in Section 5.1. The relay test specimen shall be tested in the normal (60 Hz input) and trip (equal to or below 57 Hz input) operating conditions. One (1) normally open and one (1) normally closed set of contacts on the relay shall be monitored for contact chatter utilizing 24 VDC continuity signals. The 24 VDC signals shall be recorded before, during, and after seismic testing. The test specimens shall be rotated through four horizontal orientations with the seismic testing described above performed for each orientation. Testing shall be performed in the sequence most convenient to test operations. Following each orientation the test specimens shall be functionally tested as described in Section 5.1 to verify proper operation. Proper operation of the power supply and frequency relay test specimens as described above, and retention of structural integrity will be the failure criteria for the components. Visual examination and functional testing results shall be recorded in Data Section 5.3.

JAK Initials — 11/11/91 Date

Attachment No. 14 Sheet 14 of 31
Identifier [illegible]

5.0 TEST PROCEDURE:

5.4 After completion of seismic testing the test specimens shall be removed from the seismic simulation table and visually examined as described in Section 5.1. The results of the examination shall be recorded in Data Section 5.4.

GAK /Initials 4/4/91 Date

5.5 All personnel initialing any section of this test procedure have initialed and signed Data Section 5.5.

GAK /Initials 4/4/91 Date

6.0 REFERENCES:

6.1 IEEE 344-1975, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," dated January 31, 1975.

6.2 Tennessee Valley Authority Design Criteria WB-DC-40-31.2, "Seismic Qualification of Category I Fluid System Components and Electrical or Mechanical Equipment," Revision 4, dated May 22, 1990.

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

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DATA SECTION 5.1

VISUAL INSPECTION:
No visible defects were observed.

FUNCTIONAL TESTING:

POWER SUPPLY:

OUTPUT: 24.0 VDC

PROPER OPERATION: (YES) NO

FREQUENCY RELAY:

TRIP FREQUENCY: 56.8-57 HZ TIME DELAY: 59.5 CYCLES

PROPER OPERATION: (YES) NO

JAK (Initials) 4/4/91 (Date)

DATA SECTION 5.3

ORIENTATION #1: H1/V RUN NO'S. 1 (NORMAL) AND 2 (TRIP)

VISUAL INSPECTION:
No visible defects were observed.

LOSS OF STRUCTURAL INTEGRITY: YES (NO)

FUNCTIONAL TESTING:

CONTACT CHATTER: YES (NO)

PROPER OPERATION: (YES) NO

ORIENTATION #2: H2/V RUN NO'S. 3 (NORMAL) AND 4 (TRIP)

VISUAL INSPECTION:
No visible defects were observed.

LOSS OF STRUCTURAL INTEGRITY: YES (NO)

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Identifier SQN-DEB-MS-T128-0096

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

DATA SECTION 5.3

ORIENTATION #2: H2/V RUN NO'S. 3 (NORMAL) AND 4 (TRIP)

FUNCTIONAL TESTING:

CONTACT CHATTER: YES (NO) [circled]

PROPER OPERATION: (YES) [circled] NO

ORIENTATION #3: H3/V RUN NO'S. 5 (NORMAL) AND 6 (TRIP)

VISUAL INSPECTION:

No visible defects were observed.

LOSS OF STRUCTURAL INTEGRITY: YES (NO) [circled]

FUNCTIONAL TESTING:

CONTACT CHATTER: YES (NO) [circled]

PROPER OPERATION: (YES) [circled] NO

ORIENTATION #4: H4/V RUN NO'S. 7 (NORMAL) AND 8 (TRIP)

VISUAL INSPECTION:

No visible defects were observed.

LOSS OF STRUCTURAL INTEGRITY: YES (NO) [circled]

FUNCTIONAL TESTING:

CONTACT CHATTER: YES (NO) [circled]

PROPER OPERATION: (YES) [circled] NO

JAK — Initials   4/4/91 — Date

DATA SECTION 5.4

VISUAL INSPECTION:

No visible defects were observed.

Attachment No. 1A Sheet 17 of 31
Identifier [illegible]76

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: SEISMIC TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

PROCEDURE NO. S298-TP-01
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DATA SECTION 5.4

FUNCTIONAL TESTING:

POWER SUPPLY:

OUTPUT: 24.0 VDC

PROPER OPERATION: (YES) NO

FREQUENCY RELAY:

TRIP FREQUENCY: 56.8-57 HZ TIME DELAY: 60 CYCLES

PROPER OPERATION: (YES) NO

JAK
Initials

4/4/91
Date

DATA SECTION 5.5

Name (Print)	Signature	Initials
Joseph A. Keck	Joseph A. Keck	JAK
WILLIAM R SCHMIDT	William Schmidt	WLS

SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: ELECTROMAGNETIC INTERFERENCE TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

PROCEDURE NO. S298-TP-02
REVISION NO. 0
PAGE 1 OF 21

PREPARED BY: Joseph A. Keck DATE: April 2, 1991

REVIEWED BY: Dennis R. Marts DATE: April 2, 1991

REVIEWED BY: John W. Mashburn (QA) DATE: April 2, 1991

APPROVED BY: [illegible] DATE: April 2, 1991

1.0 PURPOSE:

This test procedure identifies the methodology to be utilized to perform electromagnetic interference (EMI) testing of an ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 with a Power One, Inc. Power Supply Part Number HA24-0.5-A.

2.0 EQUIPMENT DESCRIPTION:

The equipment to be tested consists of an ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 with a Power One, Inc. Power Supply Part Number HA24-0.5-A. The components identified above are utilized in control circuit applications.

3.0 TEST SPECIMEN:

The test specimens consist of one (1) ASEA Brown Boveri Frequency Relay Type 81 Part Number 422B1295 Serial Number 00422-07 and one (1) Power One, Inc. Power Supply Part Number HA24-0.5-A Serial Number 00454-07. The test specimens shall be panel mounted to simulate actual in-plant mounting. The functional test configuration shall be as shown in Figure 3.1. The panel shall be positioned as necessary to facilitate EMI testing.

4.0 DATA RECORDING INSTRUMENTATION:

MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION LAST	CALIBRATION DUE
Electro Metrics, Receiver	EMC-25MKIII	613	12/3/90	12/3/91
RSR, [illegible]	705	9160-14	5/16/90	5/16/91
Tektronix Oscilloscope	475	B22092	12/5/90	12/5/91
Tektronix [illegible]	P6015	94509	9/26/90	9/26/91
Hewlett Packard [illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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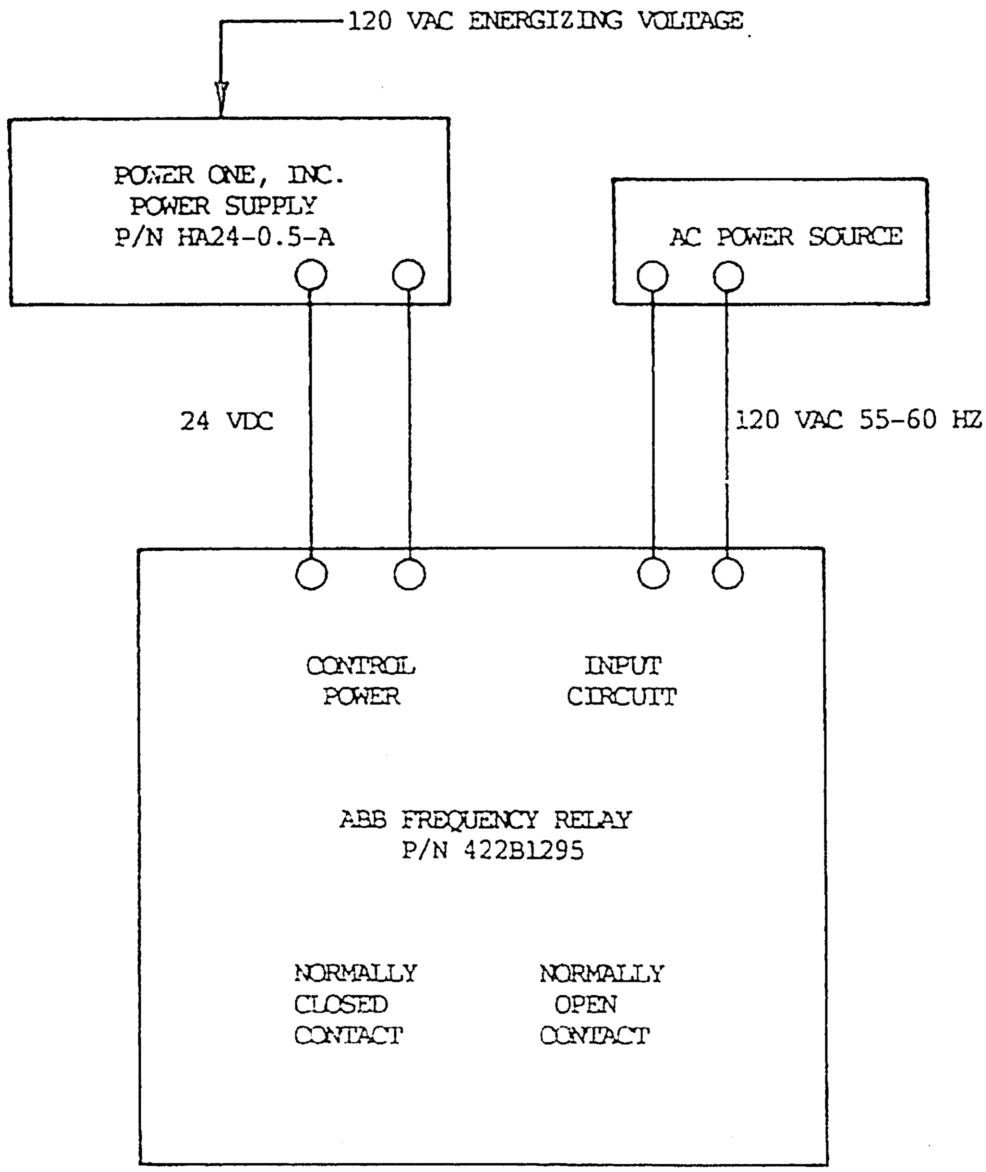

FIGURE 3.1 FUNCTIONAL TEST CONFIGURATION

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4.0 DATA RECORDING INSTRUMENTATION:

MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION LAST	CALIBRATION DUE
IFI Electric Field Sensor	EFS-1	660-C	7/9/9[illegible]	7/9/91
IFI Light Modulator	LMT-B	353	7/9/9[illegible]	7/9/91
IFI Light Modulator	LMT	[illegible] 222	7/9/9[illegible]	7/9/91

5.0 TEST PROCEDURE:

5.1 The test specimens shall be visually examined and functionally tested for determination of baseline physical condition. The functional operation of the frequency relay and power supply shall be tested utilizing the test configuration as shown in Figure 3.1. The power supply shall be energized with 120 VAC and 24 VDC shall be verified at the output. The functional operation of the frequency relay shall be tested utilizing the 24 VDC output of the power supply as the relay control power. The relay shall be set up for 24 VDC control power, underfrequency relay operation, internal shunt target operation, and factory set undervoltage cutoff (60 VAC). The underfrequency trip point shall be set at 57.00 Hertz (thumbwheel switches set at 14, 5, 8, and 13) and the time delay switches shall be set at 54 cycles (1 second total delay). The input circuit to the relay shall be set for 120 VAC and the frequency shall be variable between 55 and 60 Hertz (Hz). Proper operation of the relay test specimen shall be verified by decreasing the input frequency from 60 to 55 Hz and monitoring the output contacts utilizing a digital multimeter. Both the alarm and trip output contacts should change state one (1) second after the input reaches 57 Hz. The input frequency shall then be returned to 60 Hz and the output contacts should return to their normal state instantaneously. Proper operation of the

5.0 TEST PROCEDURE:

5.1 test specimens as described above will be the failure criteria for the components. The results of the visual examination and the functional testing shall be recorded in Data Section 5.1.

JK	4/6/91
Initials	Date

5.2 The test specimens shall be mounted on the EMI testing platform in a manner which duplicates the normal in-plant mounting.

JK	4/6/91
Initials	Date

5.3 The test specimens shall be subjected to seven (7) phases of electromagnetic interference (EMI) testing in accordance with TVA Standard Specification SS-E18.14.01, Revision 1. The power supply and frequency relay shall be tested to meet SWC Class C and SAMA Class 2-b:MFR SPEC. requirements. The 120 VAC input voltage for the power supply shall be considered the power line for the test specimen combination. The 120 VAC 55-60 Hz input circuit to the relay test specimen shall be considered the only input line. Output lines from the frequency relay alarm and trip contacts shall not be subjected to EMI testing. The power supply shall be energized with 120 VAC during EMI testing and the 24 VDC output shall be connected to the control power input of the frequency relay. The frequency relay shall be set up as described in Section 5.1. Each phase of the EMI testing shall be of long enough duration to allow for the input to the frequency relay to be changed from normal (60 Hz input) to trip (equal to or below 57 Hz input) and back to normal operating conditions. Both the alarm and trip output contacts shall be monitored for proper operation before, during, and after EMI testing. The contacts should change state one (1) second (57 cycles) after the input reaches 57 Hz and return to their normal state instantaneously once the input is returned to 60 Hz. Proper operation of the power supply and frequency relay test specimens as described above shall be the failure criteria for the components during each phase of EMI testing. The seven (7) phases of EMI testing are identified below.

5.3.1 The test specimens shall be subjected to Conducted EMI Transient Susceptibility testing to verify that the devices are not susceptible to conducted electromagnetic

5.0 TEST PROCEDURE:

5.3.1 transients injected on the power input leads. The test configuration for this phase is shown in Figure 5.1. Excitation for this test shall consist of one or more damped oscillatory waves, 100 to 500 KHz, 6 to 7 cycles, 300 V peak-to-peak amplitude from a bipolar wave transient generator with a 150-ohm output impedance applied to each ungrounded power input lead. The EMI transients shall be of long enough duration to ensure that a transient occurs at enough points throughout the 360° cycle of AC lines to ensure worst case conditions. The EMI transients shall have a repetition rate from 0.5 to 1 Hz and shall be conducted at 100, 200, 300, 400, and 500 KHz. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens shall function properly before, during, and after testing with no malfunctions, undesired responses, degradation of performance, or permanent damage when subjected to this excitation. Visual examination and functional testing results shall be recorded in Data Section 5.3.1.

[signature] JK — Initials　　4/12/91 — Date

5.3.2 The test specimens shall be subjected to Conducted RF EMI Susceptibility testing to verify that the devices are not susceptible to conducted RF EMI injected on the power input leads. The test configuration for this phase is shown in Figure 5.2. Excitation for this test shall consist of a sine wave, 0.5 to 100 MHZ, continuous wave (5 V peak-to-peak), amplitude modulated (0 to 5 V), frequency modulated (+or- 20 KHz), sweep rate of 1 to 5 MHz per second, from a signal generator with a 47-ohm output impedance applied to each ungrounded power input lead. The type of signals and sweep rate shall be selected for the maximum anticipated effects on the test specimens. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens shall function properly before, during, and after testing with no malfunctions, undesired responses, degradation of performance, or permanent damage when subjected to this excitation. Visual examination and functional testing results shall be recorded in Data Section 5.3.2.

JK — Initials　　4/12/91 — Date

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SOUTHERN TESTING SERVICES, INC. (STS)

TITLE: ELECTROMAGNETIC INTERFERENCE TEST PROCEDURE FOR AN ASEA BROWN BOVERI FREQUENCY RELAY TYPE 81 P/N 422B1295 WITH A POWER ONE, INC. POWER SUPPLY P/N HA24-0.5-A

5.0 TEST PROCEDURE:

5.3.3 The test specimens shall be subjected to Line Coupled Transient EMI Susceptibility testing to verify that the devices are not susceptible to radiated transient electromagnetic fields on the input and output lines. The test configuration for this phase is shown in Figure 5.3. Excitation for this test shall consist of one or more damped oscillatory waves, 100 to 500 KHZ, 6 to 7 cycles, 300 V peak-to-peak amplitude from a bipolar wave transient generator with a 150-ohm output impedance introduced on conductors parallel and in intimate contact with each input and output line. The EMI transients shall have a repetition rate from 0.5 to 1 Hz and shall be conducted at 100, 200, 300, 400, and 500 KHz. The 150-ohm load connected to the transient generator output shall be a pure resistive load. The 50' of plastic tubing containing the 4 parallel conductors must be kept as straight as possible and any surplus length of wire must not be folded, coiled, or placed in a U-shaped position. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens shall function properly before, during, and after testing with no malfunctions, undesired responses, degradation of performance, or permanent damage when subjected to this excitation. Visual examination and functional testing results shall be recorded in Data Section 5.3.3.

[signature] JK — Initials

4/11/91 — Date

5.3.4 The test specimens shall be subjected to Line Coupled RF EMI Susceptibility testing to verify that the devices are not susceptible to radiated RF electromagnetic fields on the input and output lines. The test configuration for this phase is shown in Figure 5.4. Excitation for this test shall consist of a sine wave, 0.5 to 100 MHZ, continuous wave (5 V peak-to-peak), amplitude modulated (0 to 5 V), frequency modulated (+or- 20 KHz), sweep rate of 1 to 5 MHz per second, from a signal generator with a 47-ohm output impedance introduced on conductors parallel and in intimate contact with each input and output line. The type of signals and sweep rate shall be selected for the maximum anticipated effects on the test specimens. The 47-ohm load connected to the signal generator output shall be a pure resistive load. The 50' of plastic tubing

SOUTHERN TESTING SERVICES, INC. (STS)

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5.0 TEST PROCEDURE:

5.3.4 containing the 4 parallel conductors must be kept as straight as possibly and any surplus length of wire must not be folded, coiled, or placed in a U-shaped position. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens shall function properly before, during, and after testing with no malfunctions, undesired responses, degradation of performance, or permanent damage when subjected to this excitation. Visual examination and functional testing results shall be recorded in Data Section 5.3.4.

Initials	Date
MJK. JJK	4/12/91

5.3.5 The test specimens shall be subjected to Conducted Emissions testing to verify that the devices do not generate electromagnetic emission on the AC power leads. The test configuration for this phase is shown in Figure 5.5.a. No excitation is required. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens operation shall be considered acceptable if the broadband electromagnetic emission on the AC power leads does not exceed the values shown on Figure 5.4.b. The test specimens shall function properly before, during, and after testing. Visual examination and functional testing results shall be recorded in Data Section 5.3.5.

Initials	Date
JK	4/12/91

5.3.6 The test specimens shall be subjected to a Surge Withstand Capability (SWC) test to verify that the devices can withstand surges on the signal and power input leads. The test configuration for this phase is shown in Figure 5.6. Excitation for this test shall consist of the application of surges of 2.5 KV peak oscillatory wave at a frequency of 1.5 MHz. The envelope of the oscillatory wave will decay to 50% of the peak value of the first crest within 6 to 10 cycles from the start of the wave. The source impedance of the surge generator shall be 150-ohms. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens shall function properly before, during, and after testing and shall meet the requirements

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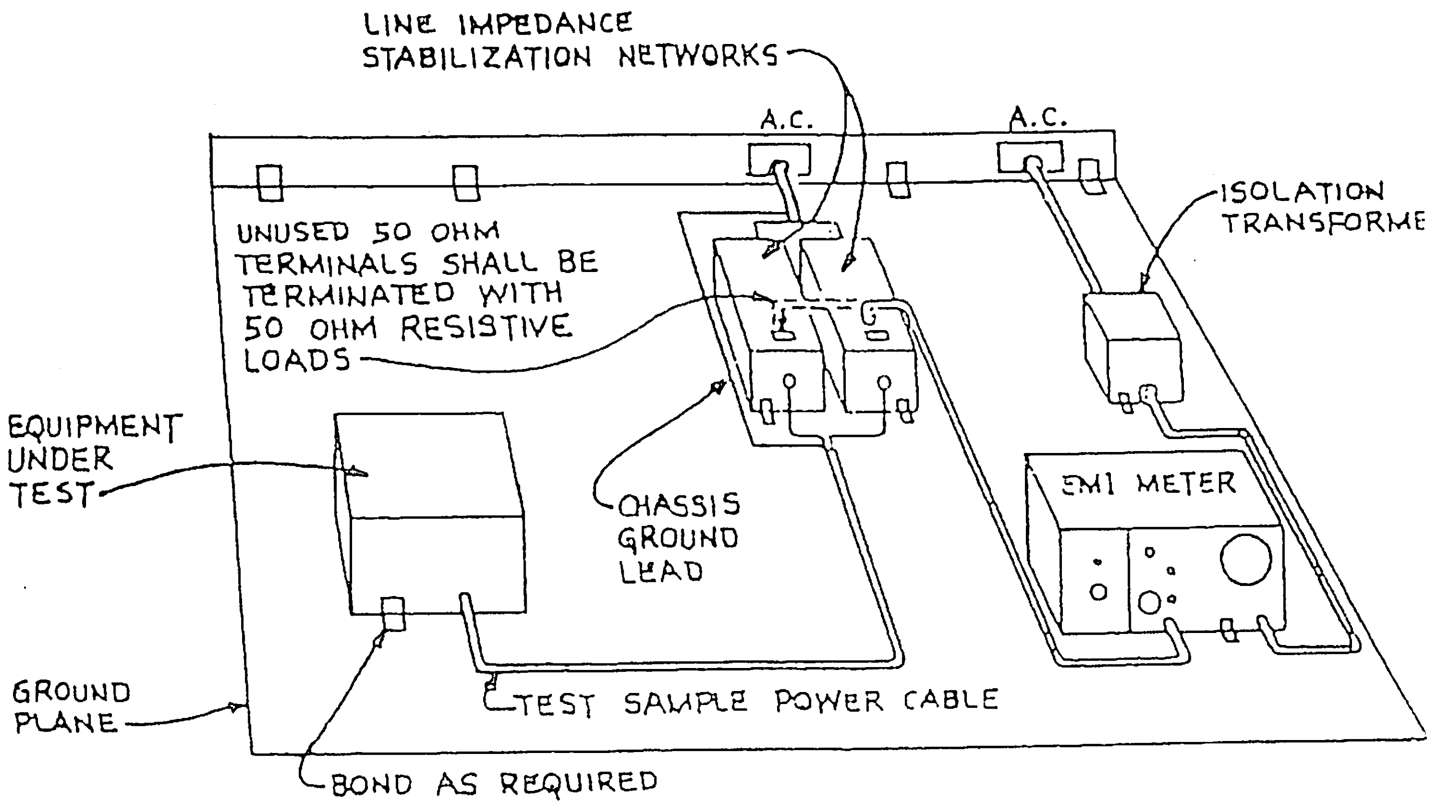

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Figure 5.5.a Conducted Emissions Test Setup

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5.0 TEST PROCEDURE:

5.3.6 of their SWC classification as listed in Section 5.3. Visual examination and functional testing results shall be recorded in Data Section 5.3.6.

JGK. + JK	4/12/91
Initials	Date

5.3.7 The test specimens shall be subjected to Radiated RF EMI Field Susceptibility testing to verify the level of susceptability of the devices to RF fields. The test configuration for this phase is shown in Figure 5.7. Excitation for this test shall be as defined by the SAMA classification for these devices as listed in Section 5.3. Functional testing of the test specimens shall be as described in Section 5.3. The test specimens shall function properly before, during, and after testing with no deviations from the normal operational characteristics in excess of those specified by the SAMA classification referenced above. Visual examination and functional testing results shall be recorded in Data Section 5.3.7.

JK	4/12/91
Initials	Date

5.4 After completion of electromagnetic interference (EMI) testing the test specimens shall be removed from the test panel and visually examined as described in Section 5.1. The results of the examination shall be recorded in Data Section 5.4.

JK	4/16/91
Initials	Date

5.5 All personnel initialing any section of this test procedure have initialed and signed Data Section 5.5.

+ JK	4/16/91
Initials	Date

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DATA SECTION 5.1

VISUAL INSPECTION: ok

FUNCTIONAL TESTING:

POWER SUPPLY:

OUTPUT: 24 VDC

PROPER OPERATION: (YES) NO

FREQUENCY RELAY:

TRIP FREQUENCY: 57 HZ TIME DELAY: 54 CYCLES

PROPER OPERATION: (YES) NO

JK — Initials 4/12/91 — Date

DATA SECTION 5.3.1

VISUAL INSPECTION: ok

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

M.J.K. + JK — Initials 4/12/91 — Date

DATA SECTION 5.3.2

VISUAL INSPECTION: OK

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DATA SECTION 5.3.2

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

JK — Initials 4/16/91 — Date

DATA SECTION 5.3.3

VISUAL INSPECTION: OK

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

[illegible] + JK — Initials 4/16/91 — Date

DATA SECTION 5.3.4

VISUAL INSPECTION: OK

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

JK — Initials 4/15/91 — Date

DATA SECTION 5.3.5

VISUAL INSPECTION: OK

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DATA SECTION 5.3.5

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

JK — Initials   4/10/91 — Date

DATA SECTION 5.3.6

VISUAL INSPECTION: OK

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

JK JK — Initials   4/16/91 — Date

DATA SECTION 5.3.7

VISUAL INSPECTION: OK

FUNCTIONAL TESTING:

PROPER OPERATION: (YES) NO

JK — Initials   4/11/91 — Date

DATA SECTION 5.4

VISUAL INSPECTION: OK

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DATA SECTION 5.4

FUNCTIONAL TESTING:

POWER SUPPLY:

OUTPUT: 24 VDC

PROPER OPERATION: (YES) NO

FREQUENCY RELAY:

TRIP FREQUENCY: 57 HZ TIME DELAY: 54 CYCLES

PROPER OPERATION: (YES) NO

JK — Initials
4/16/91 — Date

DATA SECTION 5.5

Name (Print)	Signature	Initials
JOHN KAVALOSKY	John Kavalosky	J.K.
Mark J. Komp	Mark J. Komp	M.J.K.

Determination of drift in Hertz based on field data.

UF Relay	10/10/95		4/26/97		Months 18.54247	Drift in 22.5	Drift squared	30.41667
Unit 1	As Found	As left	As Found	As left	delta	months		Avg days
81-1A	56.995	56.995	56.97	56.97	-0.025	-0.03034	0.00092	per month
81-1B	56.99	56.99	56.97	56.97	-0.02	-0.02427	0.000589	
81-2A	56.999	56.999	56.97	56.97	-0.029	-0.03519	0.001238	
81-2B	56.996	56.996	56.97	56.97	-0.026	-0.03155	0.000995	

delta = As-Found - As-Left

UF Relay	5/18/96		10/8/97		16.70137	22.5	
Unit 2	As Found	As left	As Found	As left			
81-1A	56.994	56.99	56.98	56.98	-0.01	-0.01347	0.000181
81-1B	56.99	56.99	56.98	56.98	-0.01	-0.01347	0.000181
81-2A	56.99	56.99	56.98	56.98	-0.01	-0.01347	0.000181
81-2B	56.99	56.99	56.98	56.98	-0.01	-0.01347	0.000181

Standard Deviation = Sqrt { [n Sum(X^2) - (Sum x)^2] / [n(n-1)] }

n = 8 Number of samples.

S = 0.00949

Factor with 8 samples for a 95% level of confidence is 3.732

Therefore, An = 0.00949148808024783 x 3.732 0.035 Hertz

Add bias of Sum(x)/n -0.0219

An = 0.0354222335154849 + 0.0219038600477514

An = +/- 0.057 Hertz

Prepared H F Maixen 12-3-97

Checked K. M. Bryan 12-4-97

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10-10-85
Date

6.2 Calibration of Underfrequency Relay 81-1A (continued)

[9] ADJUST voltage to approximately 120Vac on frequency test set. IT

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found pick-up Frequency: 56.995 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

BRP

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. IT

[12] MEASURE, AND RECORD "As Found" time delay for relay pick-up below.

As Found trip time: 210 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

BRP

[13] DETERMINE if relay time response was greater than 300 msec.

BRP

[14] IF time in step 6.2 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.2 [15]. IT N/A

NOTE Step 6.2 [15] may be N/A if time did not exceed 300 msec in step 6.2 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Cognizant Engineer

10-10-93
Date

6.2 Calibration of Underfrequency Relay 81-1A (continued)

NOTE Steps 6.2 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. BRP

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 61.9 Vac.
Acceptance Criteria: 55 to 75Vac.

BRP

NOTE N/A step 6.2 [18] if no calibration and record as left data in step 6.2 [19].

[18] CALIBRATE UF relay 81-1A to tolerance specified in step 6.2 [19]. BRP N/A

[19] RECORD as left data below.

As Left pick-up Frequency: 56.995 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

BRP

NOTE N/A step 6.2 [20] if no calibration required and record as left data in step 6.2 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND N/A

CALIBRATE UF relay device 81-1A to tolerance specified in step 6.2 [21]. IT N/A

17 3 33
SQN-EEB-MS-TI28-0076

10-16-95
Date

6.3 Calibration of Underfrequency Relay 81-1B (continued)

[9] ADJUST voltage to approximately 120Vac on frequency test set. [✓]

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found pick-up Frequency: 56.99 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

BRP

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] MEASURE, AND RECORD "As Found" time delay for relay pick-up below.

As Found trip time: 214 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

BRP

[13] DETERMINE if relay time response was greater than 300 msec.

BRP

[14] IF time in step 6.3 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.3 [15]. [✓ N/A

NOTE Step 6.3 [15] may be N/A if time did not exceed 300 msec in step 6.3 [12].

HOLD
POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A

Cognizant Engineer

0204E/bsm

10-10-90
Date

6.3 Calibration of Underfrequency Relay 81-1B (continued)

NOTE Steps 6.3 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. BRP

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60 Vac.
Acceptance Criteria: 55 to 75Vac.

BRP

NOTE N/A step 6.3 [18] if no calibration and record as left data in step 6.3 [19].

[18] CALIBRATE UF relay 81-1B to tolerance specified in step 6.3 [19]. N/A

[19] RECORD as left data below.

As Left pick-up Frequency: 56.99 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

BRP

NOTE N/A step 6.3 [20] if no calibration required and record as left data in step 6.3 [21]

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-1B to tolerance specified in step 6.3 [21]. N/A

17 5 33
SQN-EEB-MS-TI28-0076

10-10-95
Date

6.4 Calibration of Underfrequency Relay 81-2A (continued)

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found pick-up Frequency: 56.999 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

BRP

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] MEASURE, AND RECORD "As Found" time delay for relay pick-up below.

As Found trip time: 224 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

BRP

[13] DETERMINE if relay time response was greater than 300 msec.

BRP

[14] IF time in step 6.4 [12] exceeds 300 msec,
INITIATE a Test Deficiency THEN

PERFORM step 6.4 [15].

N/A [✓]

NOTE Step 6.4 [15] may be N/A if time did not exceed 300 msec in step 6.4 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Cognizant Engineer

17 6 33
SQN-EEB-MS-TI28-0076

10-10-95
Date

6.4 Calibration of Underfrequency Relay 81-2A (continued)

NOTE Steps 6.4 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. BRP

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60 Vac.
Acceptance Criteria: 55 to 75Vac.

BRP

NOTE N/A step 6.4 [18] if no calibration and record as left data in step 6.4 [19].

[18] CALIBRATE UF relay 81-2A to tolerance specified in step 6.4 [19]. BRP N/A

[19] RECORD as left data below.

As Left pick-up Frequency: 56.999 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

BRP

NOTE N/A step 6.4 [20] if no calibration required and record as left data in step 6.4 [2_].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-2A to tolerance specified in step 6.4 [21]. N/A

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Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found pick-up Frequency: 56.996 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

BRP

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] MEASURE, AND RECORD "As Found" time delay for relay pick-up below.

As Found trip time: 216 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

BRP

[13] DETERMINE if relay time response was greater than 300 msec.

BRP

[14] IF time in step 6.5 [12] exceeds 300 msec,
INITIATE a Test Deficiency THEN

PERFORM step 6.5 [15]. N/A [✓]

NOTE Step 6.5 [15] may be N/A if time did not exceed 300 msec in step 6.5 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Cognizant Engineer

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Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

NOTE Steps 6.5 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz.

BRP

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 62 Vac.
Acceptance Criteria: 55 to 75Vac.

BRP

NOTE N/A step 6.5 [18] if no calibration and record as left data in step 6.5 [19].

[18] CALIBRATE UF relay 81-2B to tolerance specified in step 6.5 [19].

BRP N/A

[19] RECORD as left data below.

As Left pick-up Frequency: 56.996 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

BRP

NOTE N/A step 6.5 [20] if no calibration required and record as left data in step 6.5 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-2B to tolerance specified in step 6.5 [21].

BRP N/A

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6.2 Calibration of Underfrequency Relay 81-1A (continued)

[9] **ADJUST** voltage to approximately 120Vac on frequency test set. [✓]

[10] **VARY** frequency of test set as necessary, **AND**

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.97 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

gtn

[11] **ADJUST** frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] **MEASURE, AND RECORD** "As Found" time delay for relay Pick-up below.

As Found trip time: 220.1 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

gtn

[13] **DETERMINE** if relay time response was greater than 300 msec. NO

gtn

[14] IF time in step 6.2 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.2 [15]. [✓]

NOTE Step 6.2 [15] may be N/A if time did not exceed 300 msec in step 6.2 [12].

HOLD POINT

[15] **PERFORM** engineering evaluation, **AND**

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN**

DOCUMENT evaluation on Problem Evaluation Report.

NA
Test Director

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6.2 Calibration of Underfrequency Relay 81-1A (continued)

NOTE Steps 6.2 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. gtm

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 62.7 Vac.
Acceptance Criteria: 55 to 75Vac.

gtm

NOTE N/A step 6.2 [18] if no calibration and record as left data in step 6.2 [19].

[18] **CALIBRATE** UF relay 81-1A to tolerance specified in step 6.2 [19]. gtm

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.97 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

gtm

NOTE N/A step 6.2 [20] if no calibration required and record as left data in step 6.2 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-1A to tolerance specified in step 6.2 [21]. [ ]

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6.3 Calibration of Underfrequency Relay 81-1B (continued)

[9] **ADJUST** voltage to approximately 120Vac on frequency test set. [✓]

[10] **VARY** frequency of test set as necessary, **AND**

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.97 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

gm

[11] **ADJUST** frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] **MEASURE, AND RECORD** "As Found" time delay for relay Pick-up below.

As Found trip time: 220.38 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

gm

[13] **DETERMINE** if relay time response was greater than 300 msec.

gm
NO

[14] **IF** time in step 6.3 [12] exceeds 300 msec, **INITIATE** a Test Deficiency **THEN**

PERFORM step 6.3 [15]. [✓]

NOTE Step 6.3 [15] may be N/A if time did not exceed 300 msec in step 6.3 [12].

HOLD POINT

[15] **PERFORM** engineering evaluation, **AND**

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN**

DOCUMENT evaluation on Problem Evaluation Report.

NA
Test Director

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Date

6.3 Calibration of Underfrequency Relay 81-1B (continued)

NOTE Steps 6.3 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. ________ JM

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 62.6 Vac.
Acceptance Criteria: 55 to 75Vac.

________ JM

NOTE N/A step 6.3 [18] if no calibration and record as left data in step 6.3 [19].

[18] **CALIBRATE** UF relay 81-1B to tolerance specified in step 6.3 [19]. ________ JM

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.97 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

________ JM

NOTE N/A step 6.3 [20] if no calibration required and record as left data in step 6.3 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-1B to tolerance specified in step 6.3 [21]. [ ]

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6.4 Calibration of Underfrequency Relay 81-2A (continued)

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.97 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

_____

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: 219.83 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

_____

[13] DETERMINE if relay time response was greater than 300 msec.

_____ NO

[14] IF time in step 6.4 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.4 [15]. [✓]

NOTE Step 6.4 [15] may be N/A if time did not exceed 300 msec in step 6.4 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

NA
Test Director

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1683 . 3493

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6.4 Calibration of Underfrequency Relay 81-2A (continued)

NOTE Steps 6.4 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. gtm

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 62.6 Vac.
Acceptance Criteria: 55 to 75Vac. gtm

NOTE N/A step 6.4 [18] if no calibration and record as left data in step 6.4 [19].

[18] CALIBRATE UF relay 81-2A to tolerance specified in step 6.4 [19]. gtm

[19] RECORD as left data below.

As Left Pick-up Frequency: 56.97 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) gtm

NOTE N/A step 6.4 [20] if no calibration required and record as left data in step 6.4 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-2A to tolerance specified in step 6.4 [21]. N/A

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Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

[10] **VARY** frequency of test set as necessary, **AND**

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.97 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

gm

[11] **ADJUST** frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [ ]

[12] **MEASURE, AND RECORD** "As Found" time delay for relay Pick-up below.

As Found trip time: 220.1 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

gm

[13] **DETERMINE** if relay time response was greater than 300 msec.

gm

NO

[14] **IF** time in step 6.5 [12] exceeds 300 msec, **INITIATE** a Test Deficiency **THEN**

PERFORM step 6.5 [15]. [ ]

NOTE Step 6.5 [15] may be N/A if time did not exceed 300 msec in step 6.5 [12].

HOLD POINT

[15] **PERFORM** engineering evaluation, **AND**

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN**

DOCUMENT evaluation on Problem Evaluation Report.

NA
Test Director

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6.5 Calibration of Underfrequency Relay 81-2B (continued)

NOTE Steps 6.5 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. ________

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 62.6 Vac.
Acceptance Criteria: 55 to 75Vac.

____

NOTE N/A step 6.5 [18] if no calibration and record as left data in step 6.5 [19].

[18] **CALIBRATE** UF relay 81-2B to tolerance specified in step 6.5 [19]. ________

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.97 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

____

NOTE N/A step 6.5 [20] if no calibration required and record as left data in step 6.5 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-2B to tolerance specified in step 6.5 [21]. [ ]

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1683.3500

5/18/96
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6.2 Calibration of Underfrequency Relay 81-1A (continued)

[9] ADJUST voltage to approximately 120Vac on frequency test set. [✓]

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.994 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

gtm

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: 215 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

gtm

[13] DETERMINE if relay time response was greater than 300 msec.

gtm

[14] IF time in step 6.2 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.2 [15]. [NA]

NOTE Step 6.2 [15] may be N/A if time did not exceed 300 msec in step 6.2 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

NA
Test Director

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5/8/96
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6.2 Calibration of Underfrequency Relay 81-1A (continued)

NOTE Steps 6.2 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. gtm

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60 Vac.
Acceptance Criteria: 55 to 75Vac.

gtm

NOTE N/A step 6.2 [18] if no calibration and record as left data in step 6.2 [19].

[18] CALIBRATE UF relay 81-1A to tolerance specified in step 6.2 [19]. gtm

[19] RECORD as left data below.

As Left Pick-up Frequency: 56.99 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

gtm

NOTE N/A step 6.2 [20] if no calibration required and record as left data in step 6.2 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-1A to tolerance specified in step 6.2 [21]. NA [ ]

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1643.2582

5/18/96
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6.3 Calibration of Underfrequency Relay 81-1B (continued)

[9] ADJUST voltage to approximately 120Vac on frequency test set. [✓] ______

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.99 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

______

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓] ______

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: ~~219~~ 213 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

______

[13] DETERMINE if relay time response was greater than 300 msec. ______

[14] IF time in step 6.3 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.3 [15]. NA

NOTE Step 6.3 [15] may be N/A if time did not exceed 300 msec in step 6.3 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-3, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report. NA

______
Test Director

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0206E/bsm

1643.2687

5/18/96
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6.3 Calibration of Underfrequency Relay 81-1B (continued)

NOTE Steps 6.3 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. ________

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60 Vac.
Acceptance Criteria: 55 to 75Vac. ________

NOTE N/A step 6.3 [18] if no calibration and record as left data in step 6.3 [19].

[18] CALIBRATE UF relay 81-1B to tolerance specified in step 6.3 [19]. NA

[19] RECORD as left data below.

As Left Pick-up Frequency: 56.99 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) ________

NOTE N/A step 6.3 [20] if no calibration required and record as left data in step 6.3 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-1B to tolerance specified in step 6.3 [21]. NA

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Date

6.4 Calibration of Underfrequency Relay 81-2A (continued)

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.99 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

[initials]

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [initials]

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: ~~218~~ 213 [initials] 5/18/96 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

[initials]

[13] DETERMINE if relay time response was greater than 300 msec.

[initials]

[14] IF time in step 6.4 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.4 [15]. N/A

NOTE Step 6.4 [15] may be N/A if time did not exceed 300 msec in step 6.4 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report. N/A

Test Director

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0206E/bsm

1643.2693

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6.4 Calibration of Underfrequency Relay 81-2A (continued)

NOTE Steps 6.4 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz. CAC

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60 Vac.
Acceptance Criteria: 55 to 75Vac. CAC

NOTE N/A step 6.4 [18] if no calibration and record as left data in step 6.4 [19].

[18] CALIBRATE UF relay 81-2A to tolerance specified in step 6.4 [19]. N/A

[19] RECORD as left data below.

As Left Pick-up Frequency: 56.99 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) CAC

NOTE N/A step 6.4 [20] if no calibration required and record as left data in step 6.4 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-2A to tolerance specified in step 6.4 [21]. N/A

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Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.99 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

jtr

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac.

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: 209 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

~~209~~ jtr 5/18/96

[13] DETERMINE if relay time response was greater than 300 msec.

jtr

[14] IF time in step 6.5 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.5 [15].

NOTE Step 6.5 [15] may be N/A if time did not exceed 300 msec in step 6.5 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Test Director

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Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

NOTE Steps 6.5 [16] and [17] test the undervoltage detector.

[16] ADJUST frequency test set output to 120 volts, AND

VERIFY UF relay picks up at approximately 56Hz.

[17] DECREASE frequency test set output voltage source as required until relay drops out, THEN

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60 Vac.
Acceptance Criteria: 55 to 75Vac.

NOTE N/A step 6.5 [18] if no calibration and record as left data in step 6.5 [19].

[18] CALIBRATE UF relay 81-2B to tolerance specified in step 6.5 [19].

[19] RECORD as left data below.

As Left Pick-up Frequency: 56.99 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

NOTE N/A step 6.5 [20] if no calibration required and record as left data in step 6.5 [21].

[20] ADJUST frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, AND

CALIBRATE UF relay device 81-2B to tolerance specified in step 6.5 [21].

NA [ ]

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6.2 Calibration of Underfrequency Relay 81-1A (continued)

[9] ADJUST voltage to approximately 120Vac on frequency test set. [✓]

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.98 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: 207.58 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

[13] DETERMINE if relay time response was greater than 300 msec.

[14] IF time in step 6.2 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.2 [15]. N/A [ ]

NOTE Step 6.2 [15] may be N/A if time did not exceed 300 msec in step 6.2 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Test Director

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Date

6.2 Calibration of Underfrequency Relay 81-1A (continued)

NOTE Steps 6.2 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. gjm

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60.1 Vac.
Acceptance Criteria: 55 to 75Vac. gjm

NOTE N/A step 6.2 [18] if no calibration and record as left data in step 6.2 [19].

[18] **CALIBRATE** UF relay 81-1A to tolerance specified in step 6.2 [19]. gjm

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.98 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) gjm

NOTE N/A step 6.2 [20] if no calibration required and record as left data in step 6.2 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-1A to tolerance specified in step 6.2 [21]. NA [ ]

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MS
gjm 11-4-97

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Date

6.3 Calibration of Underfrequency Relay 81-1B (continued)

[9] **ADJUST** voltage to approximately 120Vac on frequency test set. [ ]

[10] **VARY** frequency of test set as necessary, **AND**

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.98 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

JFM

[11] **ADJUST** frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [ ]

[12] **MEASURE, AND RECORD** "As Found" time delay for relay Pick-up below.

As Found trip time: 206.68 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

JFM

[13] **DETERMINE** if relay time response was greater than 300 msec.

JFM

[14] **IF** time in step 6.3 [12] exceeds 300 msec, **INITIATE** a Test Deficiency **THEN**

PERFORM step 6.3 [15]. N/A [ ]

NOTE Step 6.3 [15] may be N/A if time did not exceed 300 msec in step 6.3 [12].

HOLD POINT

[15] **PERFORM** engineering evaluation, **AND**

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN**

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Test Director

Attachment No. 17 Sheet 38 of 33
Identifier SQN-EEB-MS-TI28-0076

10/8/97
Date

6.3 Calibration of Underfrequency Relay 81-1B (continued)

NOTE Steps 6.3 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. ______

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60.2 Vac.
Acceptance Criteria: 55 to 75Vac. ______

NOTE N/A step 6.3 [18] if no calibration and record as left data in step 6.3 [19].

[18] **CALIBRATE** UF relay 81-1B to tolerance specified in step 6.3 [19]. NA

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.98 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) ______

NOTE N/A step 6.3 [20] if no calibration required and record as left data in step 6.3 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-1B to tolerance specified in step 6.3 [21]. NA

Attachment No. 17 Sheet 29 of 33
Identifier SQN-EEB-MS-TI28-0076

10/8/91
Date

6.4 Calibration of Underfrequency Relay 81-2A (continued)

[10] **VARY** frequency of test set as necessary, **AND**

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.98 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

[11] **ADJUST** frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [✓]

[12] **MEASURE, AND RECORD** "As Found" time delay for relay Pick-up below.

As Found trip time: 207.74 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

[13] **DETERMINE** if relay time response was greater than 300 msec.

[14] **IF** time in step 6.4 [12] exceeds 300 msec, **INITIATE** a Test Deficiency **THEN**

PERFORM step 6.4 [15]. N/A [ ].

NOTE Step 6.4 [15] may be N/A if time did not exceed 300 msec in step 6.4 [12].

HOLD POINT

[15] **PERFORM** engineering evaluation, **AND**

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) **THEN**

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Test Director

Attachment No. 17 Sheet 30 of 33
Identifier SQN-EEB-MS-TI28-0076

10/8/97
Date

6.4 Calibration of Underfrequency Relay 81-2A (continued)

NOTE Steps 6.4 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. ________

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage.

Dropout Voltage: 60.5 Vac.
Acceptance Criteria: 55 to 75Vac.

____

NOTE N/A step 6.4 [18] if no calibration and record as left data in step 6.4 [19].

[18] **CALIBRATE** UF relay 81-2A to tolerance specified in step 6.4 [19]. NA

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.98 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05)

____

NOTE N/A step 6.4 [20] if no calibration required and record as left data in step 6.4 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-2A to tolerance specified in step 6.4 [21]. NA [ ]

Attachment No. 17 Sheet 31 of 33
Identifier SQN-EEB-MS-TI28-0076

10/3/97
Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

[10] VARY frequency of test set as necessary, AND

RECORD "As Found" pick up frequency.

As Found Pick-up Frequency: 56.98 Hz.
Acceptance Criteria: 57 Hz ± 0.1 Hz (56.9 to 57.1Hz.)

[11] ADJUST frequency test set for normal frequency of 60Hz @ 120V and fault frequency of 56Hz @ 120Vac. [ ]

[12] MEASURE, AND RECORD "As Found" time delay for relay Pick-up below.

As Found trip time: 208.02 msec.
Acceptance Criteria: 216 msec ± 10 msec (206 to 226 msec.)
(13 cycles ± 0.6 cycles (12.4 to 13.6 cycles)

[13] DETERMINE if relay time response was greater than 300 msec.

[14] IF time in step 6.5 [12] exceeds 300 msec, INITIATE a Test Deficiency THEN

PERFORM step 6.5 [15]. N/A [ ]

NOTE Step 6.5 [15] may be N/A if time did not exceed 300 msec in step 6.5 [12].

HOLD POINT

[15] PERFORM engineering evaluation, AND

IF FSAR table 7.2.1-5, item 17 was exceeded, (greater than 600 msec, 36 cycles, total loop response time) THEN

DOCUMENT evaluation on Problem Evaluation Report.

N/A
Test Director

Attachment No. 17 Sheet 32 of 33
Identifier SQN-~~DC-V~~ TI28-0076 EER-MS

10/8/97
Date

6.5 Calibration of Underfrequency Relay 81-2B (continued)

NOTE Steps 6.5 [16] and [17] test the undervoltage detector.

[16] **ADJUST** frequency test set output to 120 volts, **AND**

VERIFY UF relay picks up at approximately 56Hz. ______

[17] **DECREASE** frequency test set output voltage source as required until relay drops out, **THEN**

RECORD undervoltage detector drop out voltage..

Dropout Voltage: 60.0 Vac.
Acceptance Criteria: 55 to 75Vac. ______

NOTE N/A step 6.5 [18] if no calibration and record as left data in step 6.5 [19].

[18] **CALIBRATE** UF relay 81-2B to tolerance specified in step 6.5 [19]. NA

[19] **RECORD** as left data below.

As Left Pick-up Frequency: 56.98 Hz.
Setpoint: 57 Hz.
Acceptance Criteria: (56.95 to 57.05) ______

NOTE N/A step 6.5 [20] if no calibration required and record as left data in step 6.5 [21].

[20] **ADJUST** frequency test set for normal/frequency to 60Hz @ 120V and fault frequency to 56Hz @ 120Vac, **AND**

CALIBRATE UF relay device 81-2B to tolerance specified in step 6.5 [21]. NA [ ]

Attachment No. 17 Sheet 33 of 33
Identifier SQN-EEB-MS-TI28-0076

PROPOSED TECHNICAL SPECIFICATION CHANGE OR LICENSE AMENDMENT REQUEST

Form Instruction: This form is not complete until all sections (i.e., questions, check boxes and prescribed concurrences) are addressed.

Requested Priority:	Actual Assigned by Site Licensing Priority:	Tracking No. 11-08 (assigned by Site Licensing)
____ Emergency	____ Emergency	
____ Exigent	____ Exigent	
X Routine	X Routine	
	____ Reject (Justification Attached)	

A. Affected portion(s) of Tech Spec (attach marked-up pages):
Table 2.2-1 Reactor Trip System Instrumentation Trip Setpoints, item No. 16 Underfrequency-Reactor Coolant Pumps.

B. Reason Tech Spec change is necessary:
The underfrequency relays were replaced and the calculated demonstrated accuracy values were changed and caused the setpoint and allowable values to change. This change should have been made when the Tech Spec was revised to remove inequalities.

C. Why change is justifiable (attach any analysis/correspondence to support the justification):
Demonstrated Accuracy Calculation determined values and DCNs M10396A & D10441A.

D. Milestone dates requested/required and basis for milestone or date:
PER action 248460-001 date is 6/15/2011 to evaluate and submit change request.

E. Cost/Benefit Information (as necessary):
Must fix the Tech Spec.

F. Any known FSAR Impact:
The actual values are not used in the FSAR.

G. Originator Signature Gregory G. [signature] Date May 4, 2011

H. Department Manager [signature] Date 5/6/2011

I. Accepted ☒ Rejected ☐ [signature] Date 6/2/11

Basis for rejection:

Technical Lead Sponsor and Co-Sponsors [signature]

TVA 40526 [10-2008] Page 1 of 1 NLDP-1-1 [10-22-2008]

Attachment No. 18 Sheet 1 of 1
Loop # Identifier SQN-EEB-MS-TI28-0076

Licensee Response/NRC Response/NRC Question Closure

Id	**379**
NRC Question Number	**KAB065**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**11/19/2014**
Notification	**Scott Bowman** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Kristy Bucholtz**
Date Added	**11/19/2014 6:48 AM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**388**
NRC Question Number	**KAB065**
Select Application	**NRC Response**
Attachment 1	
Attachment 2	
Response Statement	**KAB-065 was inadvertantly closed. Please respond to the following response:** **Calculation number SQN-EEB-MS-TI28-0076, Revision 7 was provided as part for response to RAI KAB-065 along with the affected TS pages. Please note that TSTF-493 notes pertaining to as-left and as-found values were not included as part of the TS changes. Please add these notes to the technical specifications. If these notes are detailed in another document then reference the appropriate documents in the TS affected pages. Also please provide the wording of the notes and the values for "as-left" and "as-found" terms for staff review.**
Response Date/Time	**12/1/2014 6:00 PM**
Closure Statement	
Question Closure Date	
Notification	**Scott Bowman** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Kristy Bucholtz**
Date Added	**12/1/2014 12:58 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**400**
NRC Question Number	**KAB065**
Select Application	**Licensee Response**
Attachment 1	
Attachment 2	
Response Statement	

By response dated October 16, 2014, SQN responded to RAI KAB065. As part of the response, SQN provided Attachments 1 and 2. Attachment 1 contained a portion of ITS Table 3.3.1-1. The table reflects that SR 3.3.1.10 is required for ITS 3.3.1, Function 12 (Underfrequency RCP). SR 3.3.1.10 (Perform CHANNEL CALIBRATION) has two associated footnotes, (b) and (c). Footnote (b) states, "If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service." Footnote (c) states, "The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the NTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures (field setting) to confirm channel performance. The methodologies used to determine the as-found and as-left tolerances are specified in UFSAR Section 7.1.2." An FSAR change is currently in progress to provide the methodologies in Section 7.1.2 of the UFSAR, and will be complete prior to implementation of ITS.

Attachment 2 (previously provided), is calculation SQN-EEB-MS-TI28-0076, Revision 7, *Demonstrated Accuracy Calculation RCP UNDERFREQUENCY RELAYS*. The As-Found and As-Left values are located on pdf page 53

(sheet 26) of Attachment 2. The As-Found (Afc) value is ±0.011 Hz. The calculation for the As-Found value is performed on pdf page 49 (sheet 24). The As-Left (Ab) value is ±0.011 Hz. The calculation for the As-Left value is performed on pdf page 38 (sheet 16A).

As-Found and As-Left values are controlled through Setpoint and Scaling Documents (SSDs). SSDs serve as the design output document to transmit the requirements to site organizations to ensure values assessed in the safety analyses and/or other design documents relative to instrument setpoints, scaling and calibration are in fact incorporated in the plant as assessed in the relevant design documents. Changes to As-Found and/or As-Left values require a Design Change to be processed via the Engineering Change Process. The As-Found and As-Left values listed in the SSDs are incorporated into Surveillance Instructions (SIs) that are performed to verify Technical Specification Surveillance Requirements. The SIs are annotated with requirements to evaluate setpoints found outside the As-Found tolerances to verify the channel is functioning as required before returning the channel to service. Additionally, this condition will be entered into the Corrective Action Program. The SIs also require that an instrument channel shall be declared inoperable if it cannot be reset to within the As-Left tolerance.

Response Date/Time	**12/16/2014 2:00 PM**
Closure Statement	
Question Closure Date	
Notification	**Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Scott Bowman**

Date Added	**12/16/2014 12:56 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**404**
NRC Question Number	**KAB065**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**12/18/2014**
Notification	**Scott Bowman Kristy Bucholtz Michelle Conner Khadijah Hemphill Andrew Hon Lynn Mynatt Ray Schiele Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**12/18/2014 2:32 PM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**190**
NRC Question Number	**KAB066**
Category	**Technical**
ITS Section	**AST**
ITS Number	
DOC Number	
JFD Number	
JFD Bases Number	
Page Number(s)	
NRC Reviewer Supervisor	**Roger Pederson**
Technical Branch POC	**Mark Blumberg**
Conf Call Requested	**N**
NRC Question	RAI ARCB2-1 <u>(in response to KAB-044)</u>

In a letter dated November 7, 2013 (ADAMS Accession No. ML13246A358), the NRC informed the Technical Specifications Task Force of concerns that the NRC staff had recently identified during a review of plant-specific license amendments requesting adoption of three travelers including traveler TSTF-51, Revision 2, "Revise Containment Requirements during Handling Irradiated Fuel and Core Alterations."

TSTF-51 states, in part, that

> **The addition of the term "recently" associated with handling irradiated fuel in all of the containment function Technical Specification requirements is only applicable to those licensees who have demonstrated by analysis that after sufficient radioactive decay has occurred, off-site doses resulting from a fuel handling accident remain below the Standard Review Plan limits (well within 10CFR100). [or 10 CFR 50.67]**

NUREG-0800, Standard Review Plan (SRP) 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms," July 2000 (ADAMS Accession No. ML003734190), states, in part, that

> **The models, assumptions, and parameter inputs used by the licensee should be reviewed to ensure that the conservative design basis assumptions outlined in RG-1.183 have been incorporated.**

Appendix B of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," dated July 2000 (ADAMS Accession No. ML003716792), Regulatory Position 1.1 states:

> **The number of fuel rods damaged during the accident should be based on a conservative analysis that considers the most limiting case. This analysis should consider parameters such as the weight of the dropped heavy load or weight of a dropped fuel assembly...**

After reviewing the information submitted by the licensee to adopt changes to the Improved Technical Specifications (ITS) (that incorporated TSTF-51), the Nuclear Regulatory Commission (NRC) Staff is concerned that the licensee has not provided an analysis that will provide the NRC Staff reasonable assurance that the fuel handling accident (FHA) doses remain within regulatory limits (i.e. when to reference to “irradiated fuel” and Mode 6 are removed from the APPLICABILITY of several technical specifications and the words “suspend all operations involving movement of fuel within the spent fuel pit or crane operations with loads over the spent fuel pit” are removed from ACTION statements). The analysis provided in Calculation LTR-CRA-02-219, Revision 1, “Radiological Consequences of Fuel Handling Accidents for the Sequoyah Nuclear Plant, Units 1 and 2,” does not appear to address this scenario and therefore, does not justify the proposed changes.

For the proposed change please provide an FHA analysis that evaluates the dropping of loads allowed over irradiated fuel assemblies (i.e. sources, new fuel, tools, reactivity control components) onto irradiated fuel assemblies. The analysis should only credit those safety systems required to be operable as required by technical specification. Provide the inputs, assumptions and methodology used, and the results. Provide a justification for any assumptions made. Although it is not required the staff has found it more efficient if the licensee’s calculation is provided. A calculation may not need to be performed if Sequoyah chooses to limit the movement of loads over irradiated fuel prior to the decay time assumed in the accident analysis. If this option is chosen, please provide the appropriate licensing changes.

Attach File 1	
Attach File 2	
Issue Date	**9/30/2014**
Added By	**Khadijah Hemphill**
Date Modified	

Modified By	
Date Added	**9/30/2014 4:00 PM**
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**

Licensee Response/NRC Response/NRC Question Closure

Id	**413**
NRC Question Number	**KAB066**
Select Application	**Licensee Response**
Attachment 1	**Attachment 1 for KAB066 12_17_2014.pdf** (1MB)
Attachment 2	**Attachment 2 for KAB066 12_18_2014.pdf** (2MB)
Response Statement	

In response to RAI KAB066, the following information is provided. The SQN fuel handling accident (FHA) dose consequences analysis is based on damage to an irradiated fuel assembly that has met a decay time of 100 hours and a decontamination factor (DCF) of 200 that is applied to the overall iodine inventory release to the pool. The SQN ITS license amendment request, as submitted, does not provide a specific technical specification to verify that fuel assemblies decay for 100 hours prior to movement, and does not ensure that irradiated fuel assemblies in the spent fuel pool are covered by at least 23 feet of water, at all times. Therefore, the following changes are proposed for the SQN ITS.

CTS 3.9.3, Decay Time, will be retained in ITS as ITS 3.9.8, Decay Time. CTS 3.9.3 Applicability will be revised to, "During CORE ALTERATIONS." The Frequency for CTS 4.9.3 will be revised to, "Prior to CORE ALTERATIONS." Discussion of Change (DOC) M01, as well as DOC M01 indicators, will be added to the submittal to justify the changes to the CTS Mode of Applicability and Frequency. As a result of the addition of ITS 3.9.8, the following changes will be necessary:

1. **The CTS markups will be revised. (Pages 232 and 233 of Enclosure 2, Volume 14)**
2. **The Discussion of Changes Section will be retitled, "Discussion of Changes ITS 3.9.8, Decay Time." DOCs A01 and M01 will be added to this section as Inserts 1 and 2. DOC LA01 will be revised, as shown in Insert 3. (Page 234 of Enclosure 2, Volume 14)**
3. **ITS 3.9.8 and the Bases for ITS 3.9.8 will be added to the submittal. (Insert 4 located after the inserts for CTS 3.9.3 Discussion of Changes in Enclosure 2, Volume 14)**

The CTS definition for CORE ALTERATION (CTS 1.9 CORE ALTERATION) will be retained in the ITS 1.1 Definitions Section (pages 55 and 85 of Enclosure 2, Volume 3). A new Justification for Deviation (JFD) 7, as well as JFD 7 indicators, will be added to justify the change to the ISTS. As a result of the addition of the definition for CORE ALTERATION, the following changes will be necessary:

1. **The CTS markups will be revised. (Pages 7 and 24 of Enclosure 2, Volume 3)**
2. **DOC A06 will be revised to remove CORE ALTERATION from the list of deleted CTS definitions. (Page 45 of Enclosure 2, Volume 3)**
3. **JFD 7 will be added to the Justification for Deviations ITS 1.0, Use and Application. (Page 114 of Enclosure 2, Volume 3)**

ITS 3.7.13 (ISTS 3.7.15), on pages 513 and 514 of Enclosure 2, Volume 12, will be revised to change the Mode of Applicability and add ITS 3.7.13 Required Action A.2. The Mode of Applicability will be revised to, "Whenever irradiated fuel assemblies are in the spent fuel pool." ITS 3.7.13 ACTION A will be revised to include Required Action A.2. ITS 3.7.13 Required Action A.2 will require restoration of the spent fuel pool level to within the limit within 4 hours if the spent fuel pool water level is less than 23 feet. Additionally, ITS 3.7.13 ACTION A will be revised so that the NOTE, "LCO 3.0.3 is not applicable," applies to both ITS Required Action A.1 and A.2. JFDs 4 and 5 will be added to the Justification for Deviations Section to justify the change to the Mode of Applicability and the addition of Required Action A.2. The changes to ITS 3.7.13 Mode of Applicability and ACTION A reflect SQN's current licensing basis as reflected in CTS 3.9.11. As a result of the revisions described above, the following changes will be necessary:

1. **The CTS markups will be revised. (Pages 487 and 498 of Enclosure 2, Volume 12)**
2. **DOC L01, associated with changes to the CTS Mode of Applicability and the action to restore the spent fuel pool water level, will be deleted, as well as DOC L01 indicators. (Pages 487, 498, and 510 of Enclosure 2, Volume 12)**
3. **The ISTS markups will be revised, as discussed above, and JFD 4 and 5 indicators will be added. (Pages 513 and 514 of Enclosure 2, Volume 12)**

4. **JFDs 4 and 5 will be added to the Justification for Deviations Section. (Page 515 of Enclosure 2, Volume 12)**
5. **The ISTS 3.7.15 Bases will be revised to align with changes made to the Specification. (Pages 518 and 521 of Enclosure 2, Volume 12)**
6. **JFDs 6 and 7, as well as JFD 6 and 7 indicators, will be added to the Justification for Deviations Bases Section. (Pages 518, 521, and 523 of Enclosure 2, Volume 12)**

Additionally, ITS LCO 3.0.3 Bases, on pages 45 and 60 of Enclosure 2, Volume 5, will be revised. The Bases for LCO 3.0.3 describes exceptions to LCO 3.0.3 and provides ITS LCO 3.7.13 as an example. Because of the changes described above to ITS 3.7.13, the example in the Bases for LCO 3.0.3 has been revised to align with changes made to ITS 3.7.13 Specification.

The changes to ITS 3.9.8 and the addition of the definition for CORE ALTERATION provide an explicit requirement that the decay time of the reactor be greater than or equal to 100 hours prior to commencing of CORE ALTERATIONS. In a letter dated November 7, 2013, (ADAMS Accession No. ML13246A358), the NRC stated a concern with CORE ALTERATIONS prior to the assumed decay time. Specifically, the NRC's concerns were associated with related changes with the following Technical Specification Task Force (TSTF) changes:

1. **TSTF-51, Revision 2, "Revise Containment Requirements during Handling Irradiated Fuel and Core Alterations," approved on November 1, 1999 (ADAMS Accession No. ML993190284), and**

2. **TSTF-471, Revision 1, "Eliminate Use of Term Core Alterations in Actions and Notes," approved on December 7, 2006 (ADAMS Accession No. ML062860320).**

In this letter the NRC stated, "The NRC staff is concerned that a dropped source, fuel assembly, or component (or any other item allowed to be moved by CORE ALTERATIONS) could damage or break a fuel assembly creating a radioactive source term. Additionally, a dropped source, component, or fuel assembly could add reactivity if it is dropped over or in the vicinity of other fuel." Therefore, SQN will limit CORE ALTERATIONS to a decay time of ≥ 100 hours.

In addition, as established in the "Radiological Consequences of Fuel Handling Accidents for the Sequoyah Nuclear Plant Unit 1 and 2, LTR-CRA-02-219 Revision 2," the minimum decay time of 100 hours prior to CORE ALTERATIONS, in conjunction with the requirements of LCO 3.3.7, "Control Room Emergency Ventilation System (CREVS) Actuation Instrumentation," LCO 3.7.10, "Control Room Emergency Ventilation System (CREVS)," LCO 3.7.11, "Control Room Air-Conditioning System (CRACS)," LCO 3.8.2, "AC Sources-Shutdown," LCO 3.8.10, "Distribution Systems-Shutdown," LCO 3.9.1, "Boron Concentration," LCO 3.9.3, "Nuclear Instrumentation," LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation-High Water Level," LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation-Low Water Level," and LCO 3.9.7, "Refueling Cavity Water Level," ensures that the release of fission product radioactivity from a FHA at SQN results in doses that are within the requirments of 10 CFR 50.67 and Regulatory Position C.4.4 of Regulatory Guide 1.183.

The change to ITS 3.7.13 ensures that the DCF (200) used in the radiological consequences of a FHA at SQN remain valid. ITS 3.7.13 will ensure that there is 23 feet of water above the top of the irradiated fuel assemblies stored in the racks in the spent fuel pool.

See Attachment 1 for draft changes associated with ITS 3.9.8 and the inclusion of the definition of CORE ALTERATIONS in ITS 1.1.

See Attachment 2 for draft changes associated with ITS 3.7.13 and the Bases for ITS LCO 3.0.3.

Response Date/Time	**12/30/2014 9:25 PM**
Closure Statement	
Question Closure Date	
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Margaret Chernoff** **Michelle Conner** **Robert Elliott** **Ravinder Grover** **Matthew Hardgrove** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Amrit Patel** **Ray Schiele**

Added By	**Michelle Conner**
Date Added	**12/30/2014 8:26 PM**
Date Modified	**1/5/2015 9:49 AM**
Modified By	**Scott Bowman**

DEFINITIONS OPERATIONAL A04

CHANNEL OPERATIONAL TEST

CHANNEL FUNCTIONAL TEST (COT) A01

1.6 A CHANNEL FUNCTIONAL TEST COT shall be: L01

or actual

a. Analog channels - the injection of a simulated signal into the channel as close to the sensor as practicable to verify OPERABILITY including alarm and/or trip functions. A04

INSERT 3

b. Bistable channels - the injection of a simulated signal into the sensor to verify OPERABILITY including alarm and/or trip functions. A05

c. Digital channels - the injection of a simulated signal into the channel as close to the sensor input to the process racks as practicable to verify OPERABILITY including alarm and/or trip functions. A04

CONTAINMENT INTEGRITY

1.7 CONTAINMENT INTEGRITY shall exist when:

a. All penetrations required to be closed during accident conditions are either:

1) Capable of being closed by an OPERABLE containment automatic isolation valve system, or

2) Closed by manual valves, blind flanges, or deactivated automatic valves secured in their closed positions, except for valves that are open under administrative control as permitted by Specification 3.6.3.

b. All equipment hatches are closed and sealed. A06

c. Each air lock is in compliance with the requirements of Specification 3.6.1.3,

d. The containment leakage rates are within the limits of Specification 4.6.1.1.c,

e. The sealing mechanism associated with each penetration (e.g., welds, bellows, or O-rings) is OPERABLE, and

f. Secondary containment bypass leakage is within the limits of Specification 3.6.3.

CONTROLLED LEAKAGE

1.8 This definition has been deleted. stet A07

CORE ALTERATION

CORE ALTERATION

1.9 CORE ALTERATION shall be the movement of any fuel, sources, reactivity control components, or other components affecting reactivity within the reactor vessel with the head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position. A01 A06

CORE OPERATING LIMITS REPORT

S

CORE OPERATING LIMIT REPORT (COLR)

parameter

1.10 The CORE OPERATING LIMITS REPORT (COLR) is the unit-specific document that provides core operating limits for the current operating reload cycle. These cycle-specific core operating limits shall be determined for each reload cycle in accordance with Specification 6.9.1.14. Unit operation within these operating limits is addressed in individual specifications. A01

cycle specific parameter

5.6.3. Plant

DEFINITIONS

A04 A01 L01

CHANNEL OPERATIONAL TEST

CHANNEL ~~FUNCTIONAL~~ OPERATIONAL TEST (COT)

1.6 A ~~CHANNEL FUNCTIONAL TEST~~ COT shall be:

~~a.~~ ~~Analog channels -~~ the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY ~~including alarm and/or trip functions~~. INSERT 3 — A04

~~b.~~ ~~Bistable channels - the injection of a simulated signal into the sensor to verify OPERABILITY including alarm and/or trip functions.~~ — A05

~~c.~~ ~~Digital channels - the injection of a simulated signal into the channel as close to the sensor input to the process racks as practicable to verify OPERABILITY including alarm and/or trip functions.~~ — A04

~~CONTAINMENT INTEGRITY~~

~~1.7~~ ~~CONTAINMENT INTEGRITY shall exist when:~~

~~a.~~ ~~All penetrations required to be closed during accident conditions are either:~~

~~1)~~ ~~Capable of being closed by an OPERABLE containment automatic isolation valve system, or~~

~~2)~~ ~~Closed by manual valves, blind flanges, or deactivated automatic valves secured in their closed positions, except for valves that are open under administrative control as permitted by Specification 3.6.3.~~

~~b.~~ ~~All equipment hatches are closed and sealed.~~

~~c.~~ ~~Each air lock is in compliance with the requirements of Specification 3.6.1.3,~~

~~d.~~ ~~The containment leakage rates are within the limits of Specification 4.6.1.1.c,~~

~~e.~~ ~~The sealing mechanism associated with each penetration (e.g., welds, bellows, or O-rings) is OPERABLE, and~~

~~f.~~ ~~Secondary containment bypass leakage is within the limits of Specification 3.6.3.~~ — A06

~~CONTROLLED LEAKAGE~~

~~1.8 This definition has been deleted~~. — A07

stet

CORE ALTERATION

~~CORE ALTERATION~~

~~1.9~~ ~~CORE ALTERATION shall be the movement of any fuel, sources, reactivity control components, or other components affecting reactivity within the reactor vessel with the head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position.~~ — A01 ~~A06~~

CORE OPERATING LIMITS REPORT

CORE OPERATING LIMITS REPORT (COLR)

~~1.10~~ The ~~CORE OPERATING LIMITS REPORT (~~COLR~~)~~ is the unit-specific document that provides ~~core operating~~ cycle specific parameter limits for the current ~~operating~~ reload cycle. These cycle-specific ~~core operating~~ parameter limits shall be determined for each reload cycle in accordance with Specification ~~6.9.1.14. Unit~~ 5.6.3. Plant operation within these ~~operating~~ limits is addressed in individual specifications. — A01

SEQUOYAH - UNIT 2 1-2 April 13, 2009
Amendment Nos. 63, 117, 132, 146, 167, 191, 193, 250, 315

DISCUSSION OF CHANGES
ITS 1.0, USE AND APPLICATIONS

to the CHANNEL FUNCTIONAL TEST for digital channels was consistent with the existing channel functional test definition and therefore acceptable.

These changes are designated as administrative because they do not result in a technical change to the Technical Specifications.

A05 CTS Section 1.0 includes a CHANNEL FUNCTIONAL TEST definition for bistable channels. The definition of CHANNEL FUNCTIONAL TEST for bistable channels requires "the injection of a simulated signal into the channel sensor to verify OPERABILITY including alarm and/or trip functions." However, this CTS definition is essentially duplicative of the TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) definition. ITS Section 1.1 does not include this definition, since the requirements for bistable channels are covered by the TADOT definition.

This change is acceptable because the TADOT definition adequately covers bistable channels, and does not impose any new requirements or alter any existing requirements. This change is categorized as administrative because the bistable portion of the definition is duplicative of the TADOT definition.

A06 CTS Section 1.0 includes the following definitions:

- CONTAINMENT INTEGRITY
- GASEOUS RADWASTE TREATMENT SYSTEM
- PURGE – PURGING
- SITE BOUNDARY
- UNRESTRICTED AREA
- VENTILATION EXHAUST TREATMENT SYSTEM
- VENTING
- $\bar{E}$ - AVERAGE DISINTEGRATION ENERGY
- ~~CORE ALTERATION~~

The ITS does not use this terminology and ITS Section 1.1 does not contain these definitions.

These changes are acceptable because the terms are not used as defined terms in the ITS. Discussions of any technical changes related to the deletion of these terms are included in the DOCs for the CTS sections in which the terms are used. These changes are designated as administrative because they eliminate defined terms that are no longer used.

A07 CTS Section 1.0 shows the following definitions as being deleted:

- CONTROLLED LEAKAGE
- MEMBER(S) OF THE PUBLIC
- PROCESS CONTROL PROGRAM (PCP)
- REPORTABLE EVENT
- SOLIDIFICATION
- SOURCE CHECK

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CTS

1.1 Definitions

1.6	CHANNEL OPERATIONAL TEST (COT)	A COT shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY of all devices in the channel required for channel OPERABILITY. The COT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for channel OPERABILITY such that the setpoints are within the necessary range and accuracy. The COT may be performed by means of any series of sequential, overlapping, or total channel steps.
1.9	CORE ALTERATION	(7)
1.10	CORE OPERATING LIMITS REPORT (COLR)	The COLR is the unit specific document that provides cycle specific parameter limits for the current reload cycle. These cycle specific parameter limits shall be determined for each reload cycle in accordance with Specification 5.6.3. Plant operation within these limits is addressed in individual Specifications.
1.11	DOSE EQUIVALENT I-131	~~DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries/gram) that alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in [Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or those listed in Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or ICRP 30, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity"].~~ INSERT 1 (TSTF-490) (TSTF-490)
	~~Ē - AVERAGE DISINTEGRATION ENERGY~~	~~Ē shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half lives > [15] minutes, making up at least 95% of the total noniodine activity in the coolant.~~ (TSTF-490)

CORE ALTERATION shall be the movement of any fuel, sources, reactivity control components, or other components affecting reactivity within the reactor vessel with the head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position.

CTS

1.1 Definitions

1.6	CHANNEL OPERATIONAL TEST (COT)	A COT shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY of all devices in the channel required for channel OPERABILITY. The COT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for channel OPERABILITY such that the setpoints are within the necessary range and accuracy. The COT may be performed by means of any series of sequential, overlapping, or total channel steps.
1.9	CORE ALTERATION	CORE ALTERATION shall be the movement of any fuel, sources, reactivity control components, or other components affecting reactivity within the reactor vessel with the head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position. (7)
1.10	CORE OPERATING LIMITS REPORT (COLR)	The COLR is the unit specific document that provides cycle specific parameter limits for the current reload cycle. These cycle specific parameter limits shall be determined for each reload cycle in accordance with Specification 5.6.3. Plant operation within these limits is addressed in individual Specifications.
1.11	DOSE EQUIVALENT I-131	~~DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries/gram) that alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in [Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or those listed in Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or ICRP 30, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity"].~~ INSERT 1 (TSTF-490) (TSTF-490)
	~~Ē - AVERAGE DISINTEGRATION ENERGY~~	~~Ē shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half lives > [15] minutes, making up at least 95% of the total noniodine activity in the coolant.~~ (TSTF-490)

JUSTIFICATION FOR DEVIATIONS
ITS 1.0, USE AND APPLICATION

1. Changes are made (additions, deletions, and/or changes) to the ISTS that reflect the plant specific nomenclature, number, reference, system description, analysis, or licensing basis description.

2. The ISTS contains bracketed information and/or values that are generic to all Westinghouse vintage plants. The brackets are removed and the proper plant specific information/value is provided. This is acceptable since the information/value is changed to reflect the current licensing basis.

3. Typographical error is corrected. The proper section for Surveillance Requirement (SR) Applicability is Section 3.0.

4. These punctuation corrections have been made consistent with the Writers Guide for the Improved Technical Specifications, TSTF-GG-05-01, Section 5.1.3.

5. Typographical error is corrected.

6. The ISTS definition of Shutdown Margin states in part, "However, with all RCCAs verified fully inserted by two independent means, it is not necessary to account for a stuck RCCA in the SDM calculation." The CTS definition of Shutdown Margin does not contain this allowance, therefore the ITS does not include this allowance. This is acceptable since the information is changed to reflect the current licensing basis.

7. The ISTS does not contain a definition for CORE ALTERATION. The CTS definition for CORE ALTERATION has been included in ITS. This change is acceptable because the information reflects the current licensing basis.

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LIST OF ATTACHMENTS

ATTACHMENT 8

ITS 3.9.8, DECAY TIME

~~RELOCATED/DELETED CURRENT TECHNICAL SPECIFICATIONS~~

~~CTS 3/4.9.3, DECAY TIME~~

Current Technical Specification (CTS) Markup and Discussion of Changes (DOCs)

ITS

A01

CTS 3/4.9.3

REFUELING OPERATIONS

3/4 9.3 DECAY TIME

LIMITING CONDITION FOR OPERATION

STET

LCO 3.9.8

3.9.3 The reactor shall be subcritical for at least 100 hours.

APPLICABILITY

APPLICABILITY: During movement or irradiated fuel in the reactor pressure vessel.

APPLICABILITY: During CORE ALTERATIONS

M01

ACTION:

STET

ACTION A

With the reactor subcritical for less than 100 hours, suspend all operations involving movement of irradiated fuel in the reactor pressure vessel. The provisions of Specification 3.0.3 are not applicable.

LA01

Suspend CORE ALTERATIONS

M01

SURVEILLANCE REQUIREMENTS

STET

SR 3.9.8.1

4.9.3 The reactor shall be determined to have been subcritical for at least 100 hours by verification of the date and time of subcriticality prior to movement of irradiated fuel in the reactor pressure vessel.

Prior to CORE ALTERATIONS

M01

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ITS

A01

CTS 3/4.9.3

REFUELING OPERATIONS

3/4.9.3 DECAY TIME

LIMITING CONDITION FOR OPERATION

STET

LCO 3.9.8

3.9.3 The reactor shall be subcritical for at least 100 hours.

APPLICABILITY

APPLICABILITY: During movement of irradiated fuel in the reactor pressure vessel.

APPLICABILITY: During CORE ALTERATIONS

M01

ACTION:

STET

ACTION A

With the reactor subcritical for less than 100 hours, suspend all operations involving movement of irradiated fuel in the reactor pressure vessel. The provisions of Specification 3.0.3 are not applicable.

LA01

Suspend CORE ALTERATIONS

M01

SURVEILLANCE REQUIREMENT

STET

SR 3.9.8.1

4.9.3 The reactor shall be determined to have been subcritical for at least 100 hours by verification of the date and time of subcriticality prior to movement of irradiated fuel in the reactor pressure vessel.

Prior to CORE ALTERATIONS

M01

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DISCUSSION OF CHANGES

ITS 3.9.8 → **~~CTS 3/4.9.3~~, DECAY TIME**

INSERT 1

ADMINISTRATIVE CHANGES

~~None~~

INSERT 2

MORE RESTRICTIVE CHANGES

~~None~~

RELOCATED SPECIFICATIONS

None

INSERT 3

REMOVED DETAIL CHANGES

LA01 ~~*(Type 4 – Removal of LCO, SR, or other TS Requirement to the TRM, UFSAR, ODCM, NQAP, CLRT Program, IST Program, or ISI Program)* CTS 3.9.3 requires the reactor to be subcritical for at least 100 hours during movement or irradiated fuel in the reactor pressure vessel. ITS 3.9 does not include the requirement for decay time. This changes the CTS by moving the explicit decay time requirements from the Technical Specifications to the Technical Requirements Manual (TRM).~~

~~The removal of these details from the Technical Specifications is acceptable because this type of information is not necessary to provide adequate protection of public health and safety. The purpose of CTS LCO 3.9.3 is to ensure that sufficient time has elapsed to allow radioactive decay of the short-lived fission products in the irradiated fuel consistent with the assumptions used in the fuel handling accident analysis. This change is acceptable because the removed information will be adequately controlled in the TRM. Changes to the TRM are controlled by the provisions of 10 CFR 50.59, which ensures changes are properly evaluated. This change is designated as less restrictive removal of detail change because a requirement is being removed from the Technical Specifications.~~

LESS RESTRICTIVE CHANGES

None

INSERT 1

A01

In the conversion of the Sequoyah Nuclear Plant (SQN) Current Technical Specifications (CTS) to the plant specific Improved Technical Specifications (ITS), certain changes (wording preferences, editorial changes, reformatting, revised numbering, etc.) are made to obtain consistency with NUREG-1431, Rev. 4.0, "Standard Technical Specifications-Westinghouse Plants" (ISTS) and additional Technical Specification Task Force (TSTF) travelers included in this submittal.

INSERT 2

M01

CTS LCO 3.9.3 Applicability is, “During movement of [SIC for SQN Unit 1] irradiated fuel in the reactor pressure vessel.” CTS 3.9.3 ACTION requires, in part, “suspending all operations involving the movement of irradiated fuel in the reactor pressure vessel,” when the 100 hour decay time is not met. CTS Surveillance Requirement 4.9.3 states, “The reactor shall be determined to have been subcritical for at least 100 hours by verification of the date and time of subcriticality prior to the movement of irradiated fuel in the reactor pressure vessel.” ITS LCO 3.9.8 Applicability is, “During CORE ALTERATIONS.” ITS 3.9.8 Required Action A.1 requires the suspension of CORE ALTERATIONS. ITS SR 3.9.8.1 requires verification that the reactor has been subcritical for ≥ 100 hours with a Frequency of prior to CORE ALTERATIONS (See DOC LA01 for a discussion concerning the removal of the requirement to verify subcriticality by date and time). This changes the CTS Applicability, ACTION, and Surveillance Requirement by replacing the phrase, “during movement of irradiated fuel in the reactor pressure vessel,” with the phrase, “during CORE ALTERATIONS.”

These changes provide an explicit requirement that the decay time of the reactor be greater than or equal to 100 hours prior to commencing CORE ALTERATIONS. In a letter dated November 7, 2013, (ADAMS Accession No. ML13246A358), the NRC stated a concern with CORE ALTERATIONS prior to the assumed decay time. Specifically, the Staff's concerns were associated with related changes with the following Technical Specification Task Force (TSTF) changes:

1. TSTF-51, Revision 2, "Revise Containment Requirements during Handling Irradiated Fuel and Core Alterations," approved on November 1, 1999 (ADAMS Accession No. ML993190284), and

2. TSTF-471, Revision 1, "Eliminate Use of Term Core Alterations in Actions and Notes," approved on December 7, 2006 (ADAMS Accession No. ML062860320).

In this letter the NRC stated, "The NRC staff is concerned that a dropped source, fuel assembly, or component (or any other item allowed to be moved by CORE ALTERATIONS) could damage or break a fuel assembly creating a radioactive source term. Additionally, a dropped source, component, or fuel assembly could add reactivity if it is dropped over or in the vicinity of other fuel.” Therefore, SQN will limit both the movement of irradiated fuel assemblies in the reactor pressure vessel and CORE ALTERATIONS to a decay time of ≥ 100 hours. This change is designated as more restrictive because the Applicability of the Specification has been expanded.

<u>INSERT 3</u>

<u>LA01</u>

(*Type 3 – Removing Procedural Details for Meeting TS Requirements or Reporting Requirements)* CTS Surveillance Requirement 4.9.3 states that, "The reactor shall be determined to have been subcritical for at least 100 hours by verification of the date and time of subcriticality prior to the movement of irradiated fuel in the reactor pressure vessel." ITS SR 3.9.8.1 states, "Verify the reactor has been subcritical for ≥ 100 hours." ITS SR 3.9.8.1 does not contain the details on the methods of verification of subcriticality. This changes the CTS by moving details on methods of verification of subcriticality to the ITS 3.9.8 Bases. Additionally, the Frequency of "prior to movement of irradiated fuel in the reactor pressure vessel," is being changed to, "Prior to CORE ALTERATIONS." This change is discussed in Discussion of Change (DOC) M01.

The removal of these details for performing Surveillance Requirements from the Technical Specifications is acceptable, because this type of information is not necessary to be included in the Technical Specifications to provide adequate protection of public health and safety. The ITS still retains the requirement to determine that the reactor has been subcritical for at least 100 hours prior to commencing CORE ALTERATIONS. This change is acceptable, because these types of procedural details will be adequately controlled in the ITS Bases. Changes to the Bases are controlled by the Technical Specification Bases Control Program in Chapter 5. This program provides for the evaluation of changes to ensure the Bases are properly controlled. This change is designated as a less restrictive removal of detail change, because details for meeting Technical Specification requirements are being removed from the Technical Specifications to the ITS Bases.

3.9 REFUELING OPERATIONS

3.9.8 Decay Time

3.9.3 LCO 3.9.8 The reactor shall be subcritical for ≥ 100 hours.

Applicability M01 APPLICABILITY: During CORE ALTERATIONS.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Reactor subcritical for < 100 hours.	A.1 Suspend CORE ALTERATIONS.	Immediately

ACTION M01

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.9.8.1	Verify the reactor has been subcritical for ≥ 100 hours.	Prior to CORE ALTERATIONS

4.9.3 M01

3.9 REFUELING OPERATIONS

3.9.8 Decay Time

3.9.3 LCO 3.9.8 The reactor shall be subcritical for ≥ 100 hours.

Applicability M01 APPLICABILITY: During CORE ALTERATIONS.

ACTIONS

	CONDITION	REQUIRED ACTION	COMPLETION TIME
ACTION M01	A. Reactor subcritical for < 100 hours.	A.1 Suspend CORE ALTERATIONS.	Immediately

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
4.9.3 M01	SR 3.9.8.1 Verify the reactor has been subcritical for ≥ 100 hours.	Prior to CORE ALTERATIONS

JUSTIFICATION FOR DEVIATIONS
ITS 3.9.8, DECAY TIME

1. None.

B 3.9 REFUELING OPERATIONS

B 3.9.8 Decay Time

BASES

BACKGROUND	The primary purpose of the decay time requirement is to ensure that the fission product inventories assumed in the fuel handling accident analysis are met. As soon as the reactor is subcritical, the quantity of fission products in the core decreases as the fission products undergo natural radioactive decay. As long as the reactor remains subcritical, this decrease will continue and the radiation levels will also decrease.
APPLICABLE SAFETY ANALYSES	The fuel handling accident is the postulated event of concern in MODE 6 during fuel handling operations (Ref. 1). It establishes the minimum decay time. It is assumed that all of the fuel rods in the equivalent of one fuel assembly are damaged to the extent that all the gap activity in the rods is released. The damaged fuel assembly is assumed to be the assembly with the highest fission product inventory. The fission product inventories are those assumed to be present 100 hours after the reactor becomes subcritical. The decay time satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).
LCO	The LCO requires that the reactor be subcritical for at least 100 hours prior to commencing CORE ALTERATIONS. The requirement to be subcritical for greater than or equal to 100 hours ensures that the fission product radioactivity has undergone natural radioactive decay and that the consequences of a fuel handling accident will be within the bounds of the safety analysis.
APPLICABILITY	This LCO applies during CORE ALTERATIONS, since the potential for a release of fission products exists.
ACTIONS	A.1 With the reactor subcritical for less than 100 hours, there shall be no operations involving CORE ALTERATIONS. This will preclude a fuel handling accident with fuel containing more fission product radioactivity than assumed in the safety analysis. The immediate Completion Time is consistent with the required times for actions to be performed without delay and in a controlled manner.

BASES

SURVEILLANCE REQUIREMENTS	SR 3.9.8.1 Prior to CORE ALTERATIONS, the reactor must be determined to be subcritical for greater than or equal to 100 hours by verifying the date and time that the reactor achieved subcritical conditions.
REFERENCES	1. UFSAR, Section 15.5.6.

B 3.9 REFUELING OPERATIONS

B 3.9.8 Decay Time

BASES

BACKGROUND	The primary purpose of the decay time requirement is to ensure that the fission product inventories assumed in the fuel handling accident analysis are met. As soon as the reactor is subcritical, the quantity of fission products in the core decreases as the fission products undergo natural radioactive decay. As long as the reactor remains subcritical, this decrease will continue and the radiation levels will also decrease.
APPLICABLE SAFETY ANALYSES	The fuel handling accident is the postulated event of concern in MODE 6 during fuel handling operations (Ref. 1). It establishes the minimum decay time. It is assumed that all of the fuel rods in the equivalent of one fuel assembly are damaged to the extent that all the gap activity in the rods is released. The damaged fuel assembly is assumed to be the assembly with the highest fission product inventory. The fission product inventories are those assumed to be present 100 hours after the reactor becomes subcritical. The decay time satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).
LCO	The LCO requires that the reactor be subcritical for at least 100 hours prior to commencing CORE ALTERATIONS. The requirement to be subcritical for greater than or equal to 100 hours ensures that the fission product radioactivity has undergone natural radioactive decay and that the consequences of a fuel handling accident will be within the bounds of the safety analysis.
APPLICABILITY	This LCO applies during CORE ALTERATIONS, since the potential for a release of fission products exists.
ACTIONS	<u>A.1</u> With the reactor subcritical for less than 100 hours, there shall be no operations involving CORE ALTERATIONS. This will preclude a fuel handling accident with fuel containing more fission product radioactivity than assumed in the safety analysis. The immediate Completion Time is consistent with the required times for actions to be performed without delay and in a controlled manner.

BASES

SURVEILLANCE REQUIREMENTS	SR 3.9.8.1 Prior to CORE ALTERATIONS, the reactor must be determined to be subcritical for greater than or equal to 100 hours by verifying the date and time that the reactor achieved subcritical conditions.
REFERENCES	1. UFSAR, Section 15.5.6.

JUSTIFICATION FOR DEVIATIONS
ITS 3.9.8 BASES, DECAY TIME

1. None.

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATIONS

ITS 3.9.8 → **~~CTS 3/4.9.3~~, DECAY TIME**

There are no specific No Significant Hazards Considerations for this Specification.

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ITS A01 ITS 3.7.13

REFUELING OPERATIONS

3/4.9.11 SPENT FUEL PIT WATER LEVEL

POOL A01

LIMITING CONDITION FOR OPERATION

LCO 3.7.13 3.9.11 At least 23 feet of water shall be maintained over the top of irradiated fuel assemblies seated in the storage racks.

During movement of irradiated fuel assemblies in the spent fuel pool. L01

Applicability APPLICABILITY: Whenever irradiated fuel assemblies are in the spent fuel pit.

stet pool A01 irradiated L02 immediately A02

ACTION:

ACTION A With the requirements of the specification not satisfied, suspend all movement of fuel assemblies and crane operations with loads in the fuel storage areas and restore the water level to within its limit within 4 hours. The provisions of Specification 3.0.3 are not applicable.

L02 stet L01

ACTION A Note

SURVEILLANCE REQUIREMENTS

pool A01

SR 3.7.13.1 4.9.11 The water level in the spent fuel pit shall be determined to be at least its minimum required depth at least once per 7 days when irradiated fuel assemblies are in the spent fuel pit.

L01 stet pool A01

in accordance with the Surveillance Frequency Control Program LA01

ITS

A01

ITS 3.7.13

REFUELING OPERATIONS

3/4.9.11 WATER LEVEL-SPENT FUEL ~~PIT~~

POOL — A01

LIMITING CONDITION FOR OPERATION

LCO 3.7.13 — 3.9.11 At least 23 feet of water shall be maintained over the top of irradiated fuel assemblies seated in the storage racks.

~~During movement of irradiated fuel assemblies in the spent fuel pool.~~ — ~~L01~~

Applicability — APPLICABILITY: ~~Whenever irradiated fuel assemblies are in the spent fuel pit.~~

stet — pool — A01

irradiated — L02

ACTION:

immediately — A02

ACTION A — With the requirements of the above specification not satisfied, suspend all movement of fuel assemblies ~~and crane operations with loads in the fuel storage areas~~ ~~and restore the water level to within its limit within 4 hours~~. The provisions of Specification 3.0.3 are not applicable.

L02

stet — ~~L01~~

ACTION A Note

SURVEILLANCE REQUIREMENTS

pool — A01

SR 3.7.13.1 — 4.9.11 The water level in the spent fuel ~~pit~~ shall be determined to be at least its minimum required depth ~~at least once per 7 days~~ ~~when irradiated fuel assemblies are in the spent fuel pit~~.

~~L01~~

stet — pool — A01

in accordance with the Surveillance Frequency Control Program — LA01

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DISCUSSION OF CHANGES
ITS 3.7.13, SPENT FUEL POOL WATER LEVEL

The removal of these details related to Surveillance Requirement Frequencies from the Technical Specifications is acceptable, because this type of information is not necessary to be included in the Technical Specifications to provide adequate protection of public health and safety. The existing Surveillance Frequencies are removed from Technical Specifications and placed under licensee control pursuant to the methodology described in NEI 04-10. A new program (Surveillance Frequency Control Program) is being added to the Administrative Controls section of the Technical Specifications describing the control of Surveillance Frequencies. The surveillance test requirements remain in the Technical Specifications. The control of changes to the Surveillance Frequencies will be in accordance with the Surveillance Frequency Control Program. The Program shall ensure that Surveillance Requirements specified in the Technical Specifications are performed at intervals sufficient to assure the associated Limiting Conditions for Operation are met. This change is designated as a less restrictive removal of detail change, because the Surveillance Frequency is being removed from the Technical Specifications.

LESS RESTRICTIVE CHANGES

Not Used

L01 ~~*(Category 2 – Relaxation of Applicability)* CTS 3.9.11 Applicability states "Whenever irradiated fuel assemblies are in the spent fuel pit." CTS SR 4.9.11 requires the water level in the spent fuel pit to be verified every 7 days when irradiated fuel assemblies are in the spent fuel pit. ITS 3.7.13 is applicable "During movement of irradiated fuel assemblies in the spent fuel pool." ITS SR 3.0.1 requires ITS SR 3.7.13.1 to be met during the MODES or other specified conditions in the Applicability for individual LCOs, unless otherwise stated in the SR. In addition, since the Applicability is now limited to when irradiated fuel is being moved, the CTS ACTION to "restore water level to within its limit within 4 hours after movement of fuel has been suspended" has also been deleted. This changes the CTS by restricting the Applicability of the spent fuel pool water level Specification and performance of the Surveillance to when there is a potential for a fuel handling accident, i.e., during the movement of irradiated fuel assemblies in the spent fuel pool.~~

~~The purpose of CTS 3.9.11 is to ensure that the minimum spent fuel pit water level assumption in the fuel handling accident analysis is met. This change is acceptable because the requirements continue to ensure that the conditions assumed in the safety analyses and licensing basis are maintained. The SQN fuel handling accident analysis (outside containment) assumes that a single fuel assembly is damaged. A key assumption in the analysis is that there is ≥ 23 feet of water over the damaged assembly, as this depth is directly related to the cleanup of the fission products before release from the spent fuel pool. A fuel handling accident is only assumed to occur when an irradiated fuel assembly is being moved. Therefore, ITS 3.7.13 imposes controls on minimum spent fuel pool water level only during the movement of irradiated fuel assemblies in the spent fuel pool. ITS 4.3.2 specifies the requirement that the spent fuel pool be designed and maintained to prevent inadvertent draining of the pool below elevation 722. This change is designated as less restrictive because the ITS LCO requirements are applicable in fewer operating conditions than in the CTS.~~

DISCUSSION OF CHANGES
ITS 3.7.13, SPENT FUEL POOL WATER LEVEL

L02 *(Category 4 – Relaxation of Required Action)* CTS 3.9.11 ACTION states that when the spent fuel pit water level is not met, suspend all movement of fuel assemblies and crane operations with loads in the fuel storage areas. ITS 3.7.13 Required Action A.1 states that when spent fuel pool water level is not within limits, immediately suspend movement of irradiated fuel assemblies in the spent fuel pool. This changes the CTS by deleting the requirements to suspend movement of new fuel and to suspend crane operation over the spent fuel storage areas.

The purpose of the CTS 3.9.11 ACTION is to preclude a fuel handling accident from occurring when the initial conditions for that accident are not met. A fuel handling accident is only assumed to occur when an irradiated fuel assembly is being moved. ITS 3.7.13 ACTION A continues to require suspending movement of irradiated fuel. However, damaging a fuel assembly which has not been irradiated has no significant radiological effects and is not assumed in the fuel handling accident analysis. Therefore, stopping the handling of fuel assemblies which have not been irradiated when the spent fuel pool water level is less than the limit is not required.

The dropping of loads onto fuel assemblies in the spent fuel pool is not an initiator that is assumed in the fuel handling accident analysis. The movement of heavy loads is addressed by NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," and Generic Letter 81-07. In the closeout of Generic Letter 81-07, the NRC concluded that restrictions on heavy loads over the spent fuel pool need not be included in the Technical Specifications. Therefore, these activities are not restricted in the Technical Specifications when the spent fuel pool water level is not within limit. This change is designated as less restrictive because less stringent Required Actions are being applied in the ITS than were applied in the CTS.

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CTS

Fuel ~~Storage~~ Pool Water Level Spent 1
3.7.~~15~~ 13

3.7 PLANT SYSTEMS

3.7.~~15~~ Fuel ~~Storage~~ Pool Water Level Spent 13 1

3.9.11 LCO 3.7.~~15~~ 13 The spent fuel ~~storage~~ pool water level shall be ≥ 23 ft over the top of irradiated fuel assemblies seated in the storage racks. 1

APPLICABILITY APPLICABILITY: Whenever ~~During movement of~~ irradiated fuel assemblies are in the spent fuel ~~storage~~ pool. 4 1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Spent Fuel ~~storage~~ pool water level not within limit.	~~A.1~~ -----NOTE----- LCO 3.0.3 is not applicable. ------	
	A.1 Suspend movement of irradiated fuel assemblies in the spent fuel ~~storage~~ pool.	Immediately

ACTION; Insert 1; 1 5; 5; 1; 5

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.7.~~15~~.1 13 Verify the spent fuel ~~storage~~ pool water level is ≥ 23 ft above the top of the irradiated fuel assemblies seated in the storage racks.	~~[7 days~~ ~~OR~~ In accordance with the Surveillance Frequency Control Program ~~]~~

SR 4.9.11; 1; 2

5 INSERT 1

AND		
A.2	Restore ~~the~~ spent fuel pool water level to within limit.	4 hours

CTS

Fuel ~~Storage~~ Spent Pool Water Level 1
3.7.~~15~~ 13

3.7 PLANT SYSTEMS

3.7.~~15~~ 13 Fuel ~~Storage~~ Spent Pool Water Level 1

3.9.11 LCO 3.7.~~15~~ 13 The spent fuel ~~storage~~ pool water level shall be ≥ 23 ft over the top of irradiated fuel assemblies seated in the storage racks. 1

APPLICABILITY APPLICABILITY: ~~During movement of~~ Whenever irradiated fuel assemblies are in the spent fuel ~~storage~~ pool. 4 1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
ACTION A. Fuel ~~storage~~ Spent pool water level not within limit.	~~A.1~~ ------NOTE------ LCO 3.0.3 is not applicable. ------ (1) (5)	
Insert 1	A.1 Suspend movement of irradiated fuel assemblies in the spent fuel ~~storage~~ pool.	Immediately (5) (1) (5)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 4.9.11 SR 3.7.~~15~~ 13.1 Verify the spent fuel ~~storage~~ pool water level is ≥ 23 ft above the top of the irradiated fuel assemblies seated in the storage racks.	~~[7 days~~ ~~OR~~ In accordance with the Surveillance Frequency Control Program ~~]~~ (1) (2)

5 INSERT 1

AND	
A.2 Restore ~~the~~ spent fuel pool water level to within limit.	4 hours

JUSTIFICATION FOR DEVIATIONS
ITS 3.7.13, SPENT FUEL STORAGE POOL WATER LEVEL

1. Sequoyah Nuclear Plant (SQN) design does not include ISTS 3.7.12, "Emergency Core Cooling System (ECCS) Pump Room Exhaust Air Cleanup System (PREACS)" and ISTS 3.7.14, "Penetration Room Exhaust Air Cleanup System (PREACS)." Therefore, ISTS 3.7.15 has been renumbered as ITS 3.7.13. Additionally, the title "Fuel Storage Pool Water Level" has been changed to "Spent Fuel Pool Water Level."

2. ISTS SR 3.7.15.1 provides two options for controlling the Frequencies of Surveillance Requirements. SQN is proposing to control the Surveillance Frequencies under the Surveillance Frequency Control Program.

3. Changes are made (additions, deletions, and/or changes) to the ISTS which reflect the plant specific nomenclature, number, reference, system description, analysis, or licensing basis description.

4. ISTS 3.7.15 Applicability is "During movement of irradiated fuel assemblies in the fuel storage pool." ITS 3.7.13 Applicability is "Whenever irradiated fuel assemblies are in the spent fuel pool." The change in the Mode of Applicability from "During movement of irradiated fuel assemblies in the fuel storage pool," to "Whenever irradiated fuel assemblies are in the spent fuel pool," is acceptable because this reflects SQN's current licensing basis as reflected in CTS 3.9.11.

5. ISTS 3.7.15 has a single Required Action, A.1, "Suspend movement of irradiated fuel assemblies in the spent fuel storage pool." ITS 3.7.13 adds an additional Required Action, A.2, "Restore spent fuel pool water level to within limit." This additional Required Action is acceptable because it reflects SQN's current licensing basis as reflected in CTS 3.9.11 Actions. With the addition of ITS 3.7.13 Required Action A.2, the NOTE for Condition A becomes applicable to both ITS 3.7.13 Required Action A.1 and A.2. Therefore, the "A.1" designator has been moved down to the Required Action and the NOTE expanded to address the entire column of Condition A, Required Actions. As discussed in the ISTS Bases for LCO 3.0.3, ISTS LCO 3.7.15 (ITS LCO 3.7.13) can be applicable in any or all MODES. If the LCO and Required Actions of ISTS LCO 3.7.15 are not met while in MODE 1, 2, or 3, there is no safety benefit to be gained by placing the unit in a shutdown condition.

BASES

APPLICABILITY

This LCO applies during movement of whenever irradiated fuel assemblies are in the spent fuel storage pool, since the potential for a release of fission products exists. 6 1

ACTIONS

A.1 and A.2 6

The Required Action A.1 is Actions are modified by a Note indicating that LCO 3.0.3 does not apply. 6

When the initial conditions for prevention of an accident cannot be met, steps should be taken to preclude the accident from occurring. When the spent fuel storage pool water level is lower than the required level, the movement of irradiated fuel assemblies in the spent fuel storage pool is immediately suspended to a safe position. This action effectively precludes the occurrence of a fuel handling accident. This does not preclude movement of a fuel assembly to a safe position. 1

If moving irradiated fuel assemblies spent fuel pool level is not within the limit while in MODE 5 or 6, LCO 3.0.3 would not specify any action. If moving irradiated fuel assemblies spent fuel pool level is not within the limit while in MODES 1, 2, 3, and 4, the fuel movement is Required Actions are independent of reactor operations. Therefore, inability to suspend movement of irradiated fuel assemblies or restore spent fuel pool level to within the limit is not sufficient reason to require a reactor shutdown. 7

Insert 2

SURVEILLANCE REQUIREMENTS

SR 3.7.15.1 13 1

This SR verifies sufficient spent fuel storage pool water is available in the event of a fuel handling accident. The water level in the spent fuel storage pool must be checked periodically. [The 7 day Frequency is appropriate because the volume in the pool is normally stable. Water level changes are controlled by plant procedures and are acceptable based on operating experience. 1 4

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

-----REVIEWER'S NOTE-----
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
--] 5

During refueling operations, the level in the spent fuel storage pool is in equilibrium with the refueling canal, and the level in the refueling canal is checked daily in accordance with SR 3.9.6.1. 1

7 INSERT 2

With the spent fuel pool water level less than 23 feet above the top of irradiated fuel assemblies seated in storage racks, the assumptions of iodine decontamination factors following a fuel handling accident cannot be met.

Required Action A.2 requires the restoration of the spent fuel pool water level to the minimum required level to preserve the assumptions of the fuel handling accident analysis (Ref. 3). The completion time of 4 hours is considered sufficient to correct minor problems and restore the water level.

Completion Time

assumption in the design basis fuel handling accident analysis

The design basis fuel handling accident assumes the drop and damage of an irradiated fuel assembly; however, there are other potential failure mechanisms of the irradiated fuel in the spent fuel pool that could result in the release of fission product gases, which are bounded by the design basis fuel handling accident. As a result, with

BASES

APPLICABILITY This LCO applies ~~during movement of~~ whenever irradiated fuel assemblies are in the spent fuel ~~storage~~ pool, since the potential for a release of fission products exists. (6) (1)

ACTIONS A.1 and A.2 (6)

~~Required Action A.1 is~~ The Required Actions are modified by a Note indicating that LCO 3.0.3 does not apply. (6)

When the initial conditions for prevention of an accident cannot be met, steps should be taken to preclude the accident from occurring. When the spent fuel ~~storage~~ pool water level is lower than the required level, the movement of irradiated fuel assemblies in the spent fuel ~~storage~~ pool is immediately suspended to a safe position. This action effectively precludes the occurrence of a fuel handling accident. This does not preclude movement of a fuel assembly to a safe position. (1)

If ~~moving irradiated fuel assemblies~~ spent fuel pool level is not within the limit while in MODE 5 or 6, LCO 3.0.3 would not specify any action. If ~~moving irradiated fuel assemblies~~ spent fuel pool level is not within the limit while in MODES 1, 2, 3, and 4, the ~~fuel movement is~~ Required Actions are independent of reactor operations. Therefore, inability to suspend movement of irradiated fuel assemblies or restore spent fuel pool level to within the limit is not sufficient reason to require a reactor shutdown. Insert 2 (7)

SURVEILLANCE REQUIREMENTS SR 3.7.~~15~~ 13.1 (1)

This SR verifies sufficient spent fuel ~~storage~~ pool water is available in the event of a fuel handling accident. The water level in the spent fuel ~~storage~~ pool must be checked periodically. ~~[The 7 day Frequency is appropriate because the volume in the pool is normally stable. Water level changes are controlled by plant procedures and are acceptable based on operating experience.~~ (1) (4)

~~OR~~

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

~~-----REVIEWER'S NOTE-----~~
~~Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.~~
~~--]~~ (5)

During refueling operations, the level in the spent fuel ~~storage~~ pool is in equilibrium with the refueling canal, and the level in the refueling canal is checked daily in accordance with SR 3.9.6.1. (1)

7 INSERT 2

With the spent fuel pool water level less than 23 feet above the top of irradiated fuel assemblies seated in storage racks, the assumptions of iodine decontamination factors following a fuel handling accident cannot be met.

Required Action A.2 requires the restoration of the spent fuel pool water level to the minimum required level to preserve the assumptions of the fuel handling accident analysis (Ref. 3). The completion time of 4 hours is considered sufficient to correct minor problems and restore the water level.

Completion Time

assumption in the design basis fuel handling accident analysis

The design basis fuel handling accident assumes the drop and damage of an irradiated fuel assembly; however, there are other potential failure mechanisms of the irradiated fuel in the spent fuel pool that could result in the release of fission product gases, which are bounded by the design basis fuel handling accident. As a result, with

JUSTIFICATION FOR DEVIATIONS
ITS 3.7.13 BASES, FUEL STORAGE POOL WATER LEVEL

1. Sequoyah Nuclear Plant (SQN) design does not include ISTS B 3.7.12, "Emergency Core Cooling System (ECCS) Pump Room Exhaust Air Cleanup System (PREACS)" and ISTS B 3.7.14, "Penetration Room Exhaust Air Cleanup System (PREACS)." Therefore, ISTS B 3.7.15, "Fuel Storage Pool Water Level" has been renumbered as ITS B 3.7.13, "Fuel Storage Pool Water Level."
2. Changes are made (additions, deletions, and/or changes) to the ISTS Bases that reflect the plant specific nomenclature, number, reference, system description, analysis, or licensing basis description.
3. The ISTS Bases contains bracketed information and/or values that are generic to Westinghouse vintage plants. The brackets are removed and the proper plant specific information/value is inserted to reflect the current licensing basis.
4. ISTS SR 3.7.15.1 (ITS SR 3.7.13.1) provides two options for controlling the Frequencies of Surveillance Requirements. SQN is proposing to control the Surveillance Frequencies under the Surveillance Frequency Control Program. Therefore, the Frequency for ITS SR 3.7.13.1 is accordance with the Surveillance Frequency Control Program.
5. The Reviewer's Note has been deleted. This information is for the NRC reviewer to be keyed into what is needed to meet this requirement. This Note is not meant to be retained in the final version of the plant specific submittal.
6. Changes are made to be consistent with changes made to the Specification.
7. ISTS 3.7.15 has a single Required Action, A.1, "Suspend movement of irradiated fuel assemblies in the spent fuel pool. ITS 3.7.13 adds an additional Required Action A.2, "Restore spent fuel pool water level to within limit." Therefore, the ISTS Bases have been revised to include a discussion concerning ITS 3.7.13 Required Action A.2.

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BASES

LCO 3.0.3 (continued)

MODE 4 is not reduced from the allowable limit of 13 hours. Therefore, if remedial measures are completed that would permit a return to MODE 1, a penalty is not incurred by having to reach a lower MODE of operation in less than the total time allowed.

In MODES 1, 2, 3, and 4, LCO 3.0.3 provides actions for Conditions not covered in other Specifications. The requirements of LCO 3.0.3 do not apply in MODES 5 and 6 because the unit is already in the most restrictive Condition required by LCO 3.0.3. The requirements of LCO 3.0.3 do not apply in other specified conditions of the Applicability (unless in MODE 1, 2, 3, or 4) because the ACTIONS of individual Specifications sufficiently define the remedial measures to be taken.

Exceptions to LCO 3.0.3 are provided in instances where requiring a unit shutdown, in accordance with LCO 3.0.3, would not provide appropriate remedial measures for the associated condition of the unit. An example of this is in LCO 3.7.~~15~~ 13, "Spent Fuel ~~Storage~~ Pool Water Level." LCO 3.7.~~15~~ 13 has an Applicability of ~~"During movement of~~ Whenever irradiated fuel assemblies are in the spent fuel ~~storage~~ pool." Therefore, this LCO can be applicable in any or all MODES. If the LCO and the Required Actions of LCO 3.7.~~15~~ 13 are not met while in MODE 1, 2, or 3, there is no safety benefit to be gained by placing the unit in a shutdown condition. The Required ActionS of LCO 3.7.~~15~~ 13 of "Suspend movement of irradiated fuel assemblies in the spent fuel ~~storage~~ pool" and "Restore spent fuel pool water level to within limit" are ~~is~~ the appropriate Required Actions ~~to~~ complete in lieu of the actions of LCO 3.0.3. These exceptions are addressed in the individual Specifications. (1)

LCO 3.0.4

LCO 3.0.4 establishes limitations on changes in MODES or other specified conditions in the Applicability when an LCO is not met. It allows placing the unit in a MODE or other specified condition stated in that Applicability (e.g., the Applicability desired to be entered) when unit conditions are such that the requirements of the LCO would not be met, in accordance with LCO 3.0.4.a, LCO 3.0.4.b, or LCO 3.0.4.c.

LCO 3.0.4.a allows entry into a MODE or other specified condition in the Applicability with the LCO not met when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Compliance with Required Actions that permit continued operation of the unit for an unlimited period of time in a MODE or other specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the unit before or after the MODE change. Therefore, in such cases, entry into a MODE or other specified condition in the Applicability may be made in accordance with the provisions of the Required Actions.

BASES

LCO 3.0.3 (continued)

MODE 4 is not reduced from the allowable limit of 13 hours. Therefore, if remedial measures are completed that would permit a return to MODE 1, a penalty is not incurred by having to reach a lower MODE of operation in less than the total time allowed.

In MODES 1, 2, 3, and 4, LCO 3.0.3 provides actions for Conditions not covered in other Specifications. The requirements of LCO 3.0.3 do not apply in MODES 5 and 6 because the unit is already in the most restrictive Condition required by LCO 3.0.3. The requirements of LCO 3.0.3 do not apply in other specified conditions of the Applicability (unless in MODE 1, 2, 3, or 4) because the ACTIONS of individual Specifications sufficiently define the remedial measures to be taken.

Whenever

Exceptions to LCO 3.0.3 are provided in instances where requiring a unit shutdown, in accordance with LCO 3.0.3, would not provide appropriate remedial measures for the associated condition of the unit. An example of this is in LCO 3.7.~~15~~ 13, "Spent Fuel ~~Storage~~ Pool Water Level." LCO 3.7.~~15~~ 13 has an Applicability of "~~During movement of~~ irradiated fuel assemblies are in the spent fuel ~~storage~~ pool." Therefore, this LCO can be applicable in any or all MODES. If the LCO and the Required Actions of LCO 3.7.~~15~~ 13 are not met while in MODE 1, 2, or 3, there is no safety benefit to be gained by placing the unit in a shutdown condition. The Required Actions of LCO 3.7.~~15~~ 13 of "Suspend movement of irradiated fuel assemblies in the spent fuel ~~storage~~ pool" and "Restore spent fuel pool water level to within limit" are ~~is~~ the appropriate Required Actions ~~to~~ complete in lieu of the actions of LCO 3.0.3. These exceptions are addressed in the individual Specifications. 1

LCO 3.0.4

LCO 3.0.4 establishes limitations on changes in MODES or other specified conditions in the Applicability when an LCO is not met. It allows placing the unit in a MODE or other specified condition stated in that Applicability (e.g., the Applicability desired to be entered) when unit conditions are such that the requirements of the LCO would not be met, in accordance with LCO 3.0.4.a, LCO 3.0.4.b, or LCO 3.0.4.c.

LCO 3.0.4.a allows entry into a MODE or other specified condition in the Applicability with the LCO not met when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Compliance with Required Actions that permit continued operation of the unit for an unlimited period of time in a MODE or other specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the unit before or after the MODE change. Therefore, in such cases, entry into a MODE or other specified condition in the Applicability may be made in accordance with the provisions of the Required Actions.

Licensee Response/NRC Response/NRC Question Closure

Id	**419**
NRC Question Number	**KAB066**
Select Application	**Licensee Response**
Attachment 1	**Attachment 1 supplement for KAB066 01_12_2015 - Copy.pdf** (2MB)
Attachment 2	
Response Statement	

This response supplements the response to RAI KAB066. During review, it was identified that Attachment 2 to the response for RAI KAB066 required additional revisions. Specifically, ITS 3.7.13 (ISTS 3.7.15), on pages 513 and 514 of Enclosure 2, Volume 12, will be revised to retain current licensing basis in ITS 3.7.13 ACTION A. ITS 3.7.13 Required Action A.1 will be revised to retain CTS 3.9.11 ACTION to "suspend all movement of fuel assemblies and crane operations with loads in the fuel storage areas." Justification for Deviations (JFDs) 3 and 5 will be revised to justify the changes to ISTS 3.7.15 (ITS 3.7.13) ACTION A to reflect SQN's current licensing basis. As a result of the revisions described above, the following changes will be necessary:

1. **The CTS 3.9.11 markups will be revised. (Pages 487 and 498 of Enclosure 2, Volume 12)**
2. **Discussion of Change (DOC) L02, associated with changes made to CTS 3.9.11 ACTION regarding restrictions on the movement of new fuel and the use of crane operation with loads over the spent fuel pool, will be deleted, as well as the DOC L02 indicators. (pages 487, 498 and 511 of Enclosure 2, Volume 12)**
3. **The ISTS 3.7.15 markups will be revised, as discussed above, and JFD 3 and 5 indicators will be revised. (Pages 513 and 514 of Enclosure 2, Volume 12)**
4. **The ISTS 3.7.15 Bases will be revised to align with changes made to the Specification, and JFD 6 indicators will be added to justify the changes. (Pages 518 and 521 of Enclosure 2, Volume 12)**
5. **JFD 7 will be revised in the Justification for Deviations ITS 3.7.13 Bases Section. (Pages 518, 521, and 523 of Enclosure 2, Volume 12)**

Additionally, ITS LCO 3.0.3 Bases, on pages 45 and 66 of Enclosure 2, Volume 5, will be revised. The Bases for LCO 3.0.3 describes exceptions to LCO 3.0.3 and provides ITS LCO 3.7.13 as an example. Because of the changes described above to ITS 3.7.13, the example in the Bases for LCO 3.0.3 will be revised to align with changes made to the ITS 3.7.13 Specification.

See Attachment 1 for the draft revised changes associated with ITS 3.7.13 and the Bases for ITS LCO 3.0.3.

Response Date/Time	**1/14/2015 6:25 AM**
Closure Statement	
Question Closure Date	
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Scott Bowman**
Date Added	**1/14/2015 5:24 AM**
Date Modified	
Modified By	

ITS | A01 | ITS 3.7.13

REFUELING OPERATIONS

3/4.9.11 SPENT FUEL ~~PIT~~ WATER LEVEL

POOL — A01

LIMITING CONDITION FOR OPERATION

LCO 3.7.13 — 3.9.11 At least 23 feet of water shall be maintained over the top of irradiated fuel assemblies seated in the storage racks.

~~During movement of irradiated fuel assemblies in the spent fuel pool.~~ — ~~L01~~

Applicability — APPLICABILITY: ~~Whenever irradiated fuel assemblies are in the spent fuel pit.~~

stet — pool — A01

~~irradiated~~ — ~~L02~~

immediately — A02

ACTION:

ACTION A — With the requirements of the specification not satisfied, suspend all movement of fuel assemblies ~~and crane operations with loads in the fuel storage areas~~ ~~and restore the water level to within its limit within 4 hours~~. The provisions of Specification 3.0.3 are not applicable.

~~L02~~

~~L01~~

stet — stet

ACTION A Note

SURVEILLANCE REQUIREMENTS

pool — A01

SR 3.7.13.1 — 4.9.11 The water level in the spent fuel ~~pit~~ shall be determined to be at least its minimum required depth ~~at least once per 7 days~~ ~~when irradiated fuel assemblies are in the spent fuel pit~~.

~~L01~~

stet — pool — A01

in accordance with the Surveillance Frequency Control Program — LA01

ITS — A01 — ITS 3.7.13

REFUELING OPERATIONS

3/4.9.11 WATER LEVEL-SPENT FUEL ~~PIT~~ POOL (A01)

LIMITING CONDITION FOR OPERATION

LCO 3.7.13 — 3.9.11 At least 23 feet of water shall be maintained over the top of irradiated fuel assemblies seated in the storage racks.

Applicability — APPLICABILITY: ~~Whenever irradiated fuel assemblies are in the spent fuel pit.~~ [stet] pool (A01) ~~During movement of irradiated fuel assemblies in the spent fuel pool.~~ (L01)

ACTION:

ACTION A — With the requirements of the above specification not satisfied, suspend all movement of ~~irradiated~~ (L02) fuel assemblies immediately (A02) ~~and crane operations with loads in the fuel storage areas~~ [stet] (L02) ~~and restore the water level to within its limit within 4 hours~~ [stet] (L01). The provisions of Specification 3.0.3 are not applicable.

ACTION A Note

SURVEILLANCE REQUIREMENTS

SR 3.7.13.1 — 4.9.11 The water level in the spent fuel ~~pit~~ pool (A01) shall be determined to be at least its minimum required depth ~~at least once per 7 days~~ in accordance with the Surveillance Frequency Control Program (LA01) ~~when irradiated fuel assemblies are in the spent fuel pit~~ [stet] pool (A01) (L01).

DISCUSSION OF CHANGES
ITS 3.7.13, SPENT FUEL POOL WATER LEVEL

The removal of these details related to Surveillance Requirement Frequencies from the Technical Specifications is acceptable, because this type of information is not necessary to be included in the Technical Specifications to provide adequate protection of public health and safety. The existing Surveillance Frequencies are removed from Technical Specifications and placed under licensee control pursuant to the methodology described in NEI 04-10. A new program (Surveillance Frequency Control Program) is being added to the Administrative Controls section of the Technical Specifications describing the control of Surveillance Frequencies. The surveillance test requirements remain in the Technical Specifications. The control of changes to the Surveillance Frequencies will be in accordance with the Surveillance Frequency Control Program. The Program shall ensure that Surveillance Requirements specified in the Technical Specifications are performed at intervals sufficient to assure the associated Limiting Conditions for Operation are met. This change is designated as a less restrictive removal of detail change, because the Surveillance Frequency is being removed from the Technical Specifications.

LESS RESTRICTIVE CHANGES

Not Used

L01 ~~*(Category 2 – Relaxation of Applicability)* CTS 3.9.11 Applicability states "Whenever irradiated fuel assemblies are in the spent fuel pit." CTS SR 4.9.11 requires the water level in the spent fuel pit to be verified every 7 days when irradiated fuel assemblies are in the spent fuel pit. ITS 3.7.13 is applicable "During movement of irradiated fuel assemblies in the spent fuel pool." ITS SR 3.0.1 requires ITS SR 3.7.13.1 to be met during the MODES or other specified conditions in the Applicability for individual LCOs, unless otherwise stated in the SR. In addition, since the Applicability is now limited to when irradiated fuel is being moved, the CTS ACTION to "restore water level to within its limit within 4 hours after movement of fuel has been suspended" has also been deleted. This changes the CTS by restricting the Applicability of the spent fuel pool water level Specification and performance of the Surveillance to when there is a potential for a fuel handling accident, i.e., during the movement of irradiated fuel assemblies in the spent fuel pool.~~

~~The purpose of CTS 3.9.11 is to ensure that the minimum spent fuel pit water level assumption in the fuel handling accident analysis is met. This change is acceptable because the requirements continue to ensure that the conditions assumed in the safety analyses and licensing basis are maintained. The SQN fuel handling accident analysis (outside containment) assumes that a single fuel assembly is damaged. A key assumption in the analysis is that there is ≥ 23 feet of water over the damaged assembly, as this depth is directly related to the cleanup of the fission products before release from the spent fuel pool. A fuel handling accident is only assumed to occur when an irradiated fuel assembly is being moved. Therefore, ITS 3.7.13 imposes controls on minimum spent fuel pool water level only during the movement of irradiated fuel assemblies in the spent fuel pool. ITS 4.3.2 specifies the requirement that the spent fuel pool be designed and maintained to prevent inadvertent draining of the pool below elevation 722. This change is designated as less restrictive because the ITS LCO requirements are applicable in fewer operating conditions than in the CTS.~~

DISCUSSION OF CHANGES
ITS 3.7.13, SPENT FUEL POOL WATER LEVEL

L02 Not Used

~~*(Category 4 – Relaxation of Required Action)* CTS 3.9.11 ACTION states that when the spent fuel pit water level is not met, suspend all movement of fuel assemblies and crane operations with loads in the fuel storage areas. ITS 3.7.13 Required Action A.1 states that when spent fuel pool water level is not within limits, immediately suspend movement of irradiated fuel assemblies in the spent fuel pool. This changes the CTS by deleting the requirements to suspend movement of new fuel and to suspend crane operation over the spent fuel storage areas.~~

~~The purpose of the CTS 3.9.11 ACTION is to preclude a fuel handling accident from occurring when the initial conditions for that accident are not met. A fuel handling accident is only assumed to occur when an irradiated fuel assembly is being moved. ITS 3.7.13 ACTION A continues to require suspending movement of irradiated fuel. However, damaging a fuel assembly which has not been irradiated has no significant radiological effects and is not assumed in the fuel handling accident analysis. Therefore, stopping the handling of fuel assemblies which have not been irradiated when the spent fuel pool water level is less than the limit is not required.~~

~~The dropping of loads onto fuel assemblies in the spent fuel pool is not an initiator that is assumed in the fuel handling accident analysis. The movement of heavy loads is addressed by NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," and Generic Letter 81-07. In the closeout of Generic Letter 81-07, the NRC concluded that restrictions on heavy loads over the spent fuel pool need not be included in the Technical Specifications. Therefore, these activities are not restricted in the Technical Specifications when the spent fuel pool water level is not within limit. This change is designated as less restrictive because less stringent Required Actions are being applied in the ITS than were applied in the CTS.~~

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CTS

Fuel Storage Pool Water Level Spent
3.7.15 13 (1)

3.7 PLANT SYSTEMS

3.7.15 13 Spent Fuel Storage Pool Water Level (1)

3.9.11 LCO 3.7.15 13 The spent fuel storage pool water level shall be ≥ 23 ft over the top of irradiated fuel assemblies seated in the storage racks. (1)

APPLICABILITY APPLICABILITY: During movement of Whenever irradiated fuel assemblies are in the spent fuel storage pool. (4) (1)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Spent Fuel storage pool water level not within limit.	A.1 ------------NOTE------------ LCO 3.0.3 is not applicable. ------------------------------------	
Insert 1	A.1 Suspend all movement of irradiated fuel assemblies and crane operations with loads in the spent fuel storage pool areas. (stet)	Immediately

ACTION (1) (5) (5) (1) (5) (3)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.7.15.1 13 Verify the spent fuel storage pool water level is ≥ 23 ft above the top of the irradiated fuel assemblies seated in the storage racks.	[7 days OR In accordance with the Surveillance Frequency Control Program]

SR 4.9.11 (1) (2)

5 INSERT 1

AND		
A.2	Restore spent fuel pool water level to within limit.	4 hours

CTS

Fuel ~~Storage~~ Pool Water Level Spent 1
3.7.~~15~~ 13

3.7 PLANT SYSTEMS

3.7.~~15~~ 13 Fuel ~~Storage~~ Spent Pool Water Level 1

3.9.11 LCO 3.7.~~15~~ 13 The spent fuel ~~storage~~ pool water level shall be ≥ 23 ft over the top of irradiated fuel assemblies seated in the storage racks. 1

APPLICABILITY APPLICABILITY: ~~During movement of~~ Whenever irradiated fuel assemblies are in the spent fuel ~~storage~~ pool. 4 1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Spent Fuel ~~storage~~ pool water level not within limit.	~~A.1~~ ----------NOTE---------- LCO 3.0.3 is not applicable. ---------- Insert 1	
	A.1 Suspend all movement of ~~irradiated~~ fuel assemblies and crane operations with loads in the ~~spent~~ (stet) fuel ~~storage~~ ~~pool~~ areas.	Immediately

ACTION 1 5; 5 1 5 3

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.7.~~15~~13.1 Verify the spent fuel ~~storage~~ pool water level is ≥ 23 ft above the top of the irradiated fuel assemblies seated in the storage racks.	~~[7 days~~ ~~OR~~ In accordance with the Surveillance Frequency Control Program ~~]~~

SR 4.9.11 1 2

5 INSERT 1

AND		
A.2	Restore spent fuel pool water level to within limit.	4 hours

JUSTIFICATION FOR DEVIATIONS
ITS 3.7.13, SPENT FUEL STORAGE POOL WATER LEVEL

1. Sequoyah Nuclear Plant (SQN) design does not include ISTS 3.7.12, "Emergency Core Cooling System (ECCS) Pump Room Exhaust Air Cleanup System (PREACS)" and ISTS 3.7.14, "Penetration Room Exhaust Air Cleanup System (PREACS)." Therefore, ISTS 3.7.15 has been renumbered as ITS 3.7.13. Additionally, the title "Fuel Storage Pool Water Level" has been changed to "Spent Fuel Pool Water Level."

2. ISTS SR 3.7.15.1 provides two options for controlling the Frequencies of Surveillance Requirements. SQN is proposing to control the Surveillance Frequencies under the Surveillance Frequency Control Program.

3. ~~Changes are made (additions, deletions, and/or changes) to the ISTS which reflect the plant specific nomenclature, number, reference, system description, analysis, or licensing basis description.~~

4. ISTS 3.7.15 Applicability is "During movement of irradiated fuel assemblies in the fuel storage pool." ITS 3.7.13 Applicability is "Whenever irradiated fuel assemblies are in the spent fuel pool." The change in the Mode of Applicability from "During movement of irradiated fuel assemblies in the fuel storage pool," to "Whenever irradiated fuel assemblies are in the spent fuel pool," is acceptable because this reflects SQN's current licensing basis as reflected in CTS 3.9.11.

5. ISTS 3.7.15 has a single Required Action, A.1. ITS 3.7.13 adds an additional Required Action, A.2, "Restore spent fuel pool water level to within limit." This additional Required Action is acceptable because it reflects SQN's current licensing basis as reflected in CTS 3.9.11 Actions. With the addition of ITS 3.7.13 Required Action A.2, the NOTE for Condition A becomes applicable to both ITS 3.7.13 Required Action A.1 and A.2. Therefore, the "A.1" designator has been moved down to the Required Action and the NOTE expanded to address the entire column of Condition A, Required Actions. As discussed in the ISTS Bases for LCO 3.0.3, ISTS LCO 3.7.15 (ITS LCO 3.7.13) can be applicable in any or all MODES. If the LCO and Required Actions of ISTS LCO 3.7.15 are not met while in MODE 1, 2, or 3, there is no safety benefit to be gained by placing the unit in a shutdown condition.

ISTS 3.7.15 Required Action A.1 is, "Suspend movement of irradiated fuel assemblies in the spent fuel storage pool." ITS 3.7.13 Required Action A.1 is, "Suspend all movement of fuel assemblies and crane operations with loads in the fuel storage areas." The change in Required Action A.1 from, "Suspend movement of irradiated fuel assemblies in the spent fuel storage pool," to "Suspend all movement of fuel assemblies and crane operations with loads in the fuel storage areas," is acceptable because this reflects SQN's current licensing basis as reflected in CTS 3.9.11.

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BASES

APPLICABILITY — This LCO applies during movement of [whenever] irradiated fuel assemblies [are] in the [spent] fuel storage pool, since the potential for a release of fission products exists.

ACTIONS — A.1 and A.2

[The] Required Action A.1 is [Actions are] modified by a Note indicating that LCO 3.0.3 does not apply.

When the initial conditions for prevention of an accident cannot be met, steps should be taken to preclude the accident from occurring. When the [spent] fuel storage pool water level is lower than the required level, the movement of irradiated [stet] fuel assemblies [and crane operations with loads] in the fuel storage pool [areas] is immediately suspended to a safe position. This action effectively precludes the occurrence of a fuel handling accident. This does not preclude movement of a fuel assembly [or crane load] to a safe position.

If moving irradiated fuel assemblies [the spent fuel pool water level is not within the limit] while in MODE 5 or 6, LCO 3.0.3 would not specify any action. If moving irradiated fuel assemblies while in MODES 1, 2, 3, and 4, the fuel movement is [Required Actions are] independent of reactor operations. Therefore, inability to suspend movement of irradiated fuel assemblies [, suspend crane operations with loads, or restore spent fuel pool water level to within the limit] is not sufficient reason to require a reactor shutdown.

Insert 2

SURVEILLANCE REQUIREMENTS — SR 3.7.15.1 [13]

This SR verifies sufficient [spent] fuel storage pool water is available in the event of a fuel handling accident. The water level in the [spent] fuel storage pool must be checked periodically. [The 7 day Frequency is appropriate because the volume in the pool is normally stable. Water level changes are controlled by plant procedures and are acceptable based on operating experience.

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

-----------------------------------REVIEWER'S NOTE-----------------------------------
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
--]

During refueling operations, the level in the [spent] fuel storage pool is in equilibrium with the refueling canal, and the level in the refueling canal is checked daily in accordance with SR 3.9.6.1.

7 INSERT 2

The design basis fuel handling accident assumes the drop and damage of an irradiated fuel assembly; however, there are other potential failure mechanisms of the irradiated fuel in the spent fuel pool that could result in the release of fission product gases, which are bounded by the design basis fuel handling accident. As a result, with the spent fuel pool water level less than 23 feet above the top of irradiated fuel assemblies seated in storage racks, the iodine decontamination factor assumption in the design basis fuel handling accident analysis cannot be met.

Required Action A.2 requires the restoration of the spent fuel pool water level to the minimum required level to preserve the assumptions of the fuel handling accident analysis (Ref. 3). The Completion Time of 4 hours is considered sufficient to correct minor problems and restore the water level.

BASES

APPLICABILITY This LCO applies [whenever] ~~during movement of~~ irradiated fuel assemblies [are] in the [spent] fuel ~~storage~~ pool, since the potential for a release of fission products exists. 6 1

ACTIONS A.1 and A.2 6

[The] Required ~~Action A.1 is~~ [Actions are] modified by a Note indicating that LCO 3.0.3 does not apply. 6

When the initial conditions for prevention of an accident cannot be met, steps should be taken to preclude the accident from occurring. When the [spent] fuel ~~storage~~ pool water level is lower than the required level, the movement of ~~irradiated~~ fuel assemblies [and crane operations with loads] in the fuel ~~storage~~ pool [stet] [areas] is immediately suspended ~~to a safe position~~. This action effectively precludes the occurrence of a fuel handling accident. This does not preclude movement of a fuel assembly [or crane load] to a safe position. 1 6 6

If ~~moving irradiated fuel assemblies~~ [the spent fuel pool water level is not within the limit] while in MODE 5 or 6, LCO 3.0.3 would not specify any action. If ~~moving irradiated fuel assemblies~~ while in MODES 1, 2, 3, and 4, the ~~fuel movement is~~ [Required Actions are] independent of reactor operations. Therefore, inability to suspend movement of ~~irradiated~~ fuel assemblies [, suspend crane operations with loads, or restore spent fuel pool water level to within the limit] is not sufficient reason to require a reactor shutdown. 6

[Insert 2] 7

SURVEILLANCE REQUIREMENTS SR 3.7.~~15~~[13].1 1

This SR verifies sufficient [spent] fuel ~~storage~~ pool water is available in the event of a fuel handling accident. The water level in the [spent] fuel ~~storage~~ pool must be checked periodically. ~~[The 7 day Frequency is appropriate because the volume in the pool is normally stable. Water level changes are controlled by plant procedures and are acceptable based on operating experience.~~ 1 4

~~OR~~

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

~~-----------------------------------REVIEWER'S NOTE-----------------------------------~~
~~Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.~~
~~--]~~ 5

During refueling operations, the level in the [spent] fuel ~~storage~~ pool is in equilibrium with the refueling canal, and the level in the refueling canal is checked daily in accordance with SR 3.9.6.1. 1

7 INSERT 2

The design basis fuel handling accident assumes the drop and damage of an irradiated fuel assembly; however, there are other potential failure mechanisms of the irradiated fuel in the spent fuel pool that could result in the release of fission product gases, which are bounded by the design basis fuel handling accident. As a result, with the spent fuel pool water level less than 23 feet above the top of irradiated fuel assemblies seated in storage racks, the iodine decontamination factor assumption in the design basis fuel handling accident analysis cannot be met.

Required Action A.2 requires the restoration of the spent fuel pool water level to the minimum required level to preserve the assumptions of the fuel handling accident analysis (Ref. 3). The Completion Time of 4 hours is considered sufficient to correct minor problems and restore the water level.

JUSTIFICATION FOR DEVIATIONS
ITS 3.7.13 BASES, FUEL STORAGE POOL WATER LEVEL

1. Sequoyah Nuclear Plant (SQN) design does not include ISTS B 3.7.12, "Emergency Core Cooling System (ECCS) Pump Room Exhaust Air Cleanup System (PREACS)" and ISTS B 3.7.14, "Penetration Room Exhaust Air Cleanup System (PREACS)." Therefore, ISTS B 3.7.15, "Fuel Storage Pool Water Level" has been renumbered as ITS B 3.7.13, "Fuel Storage Pool Water Level."
2. Changes are made (additions, deletions, and/or changes) to the ISTS Bases that reflect the plant specific nomenclature, number, reference, system description, analysis, or licensing basis description.
3. The ISTS Bases contains bracketed information and/or values that are generic to Westinghouse vintage plants. The brackets are removed and the proper plant specific information/value is inserted to reflect the current licensing basis.
4. ISTS SR 3.7.15.1 (ITS SR 3.7.13.1) provides two options for controlling the Frequencies of Surveillance Requirements. SQN is proposing to control the Surveillance Frequencies under the Surveillance Frequency Control Program. Therefore, the Frequency for ITS SR 3.7.13.1 is accordance with the Surveillance Frequency Control Program.
5. The Reviewer's Note has been deleted. This information is for the NRC reviewer to be keyed into what is needed to meet this requirement. This Note is not meant to be retained in the final version of the plant specific submittal.
6. Changes are made to be consistent with changes made to the Specification.
7. ISTS 3.7.15 has a single Required Action, A.1. ITS 3.7.13 adds an additional Required Action A.2, "Restore spent fuel pool water level to within limit." Therefore, the ISTS Bases have been revised to include a discussion concerning ITS 3.7.13 Required Action A.2.

BASES

LCO 3.0.3 (continued)

MODE 4 is not reduced from the allowable limit of 13 hours. Therefore, if remedial measures are completed that would permit a return to MODE 1, a penalty is not incurred by having to reach a lower MODE of operation in less than the total time allowed.

In MODES 1, 2, 3, and 4, LCO 3.0.3 provides actions for Conditions not covered in other Specifications. The requirements of LCO 3.0.3 do not apply in MODES 5 and 6 because the unit is already in the most restrictive Condition required by LCO 3.0.3. The requirements of LCO 3.0.3 do not apply in other specified conditions of the Applicability (unless in MODE 1, 2, 3, or 4) because the ACTIONS of individual Specifications sufficiently define the remedial measures to be taken.

Whenever

Exceptions to LCO 3.0.3 are provided in instances where requiring a unit shutdown, in accordance with LCO 3.0.3, would not provide appropriate remedial measures for the associated condition of the unit. An example of this is in LCO 3.7.15, "Fuel Storage Pool Water Level." LCO 3.7.15 has an Applicability of "During movement of irradiated fuel assemblies in the fuel storage pool." Therefore, this LCO can be applicable in any or all MODES. If the LCO and the Required Actions of LCO 3.7.15 are not met while in MODE 1, 2, or 3, there is no safety benefit to be gained by placing the unit in a shutdown condition. The Required Action of LCO 3.7.15 of "Suspend movement of irradiated fuel assemblies in the fuel storage pool" is the appropriate Required Action to complete in lieu of the actions of LCO 3.0.3. These exceptions are addressed in the individual Specifications.

Spent 13 spent 13 are S all 13 spent stet areas s and crane operations with loads 1 5

and "Restore spent fuel pool water level to within limit" are

LCO 3.0.4

LCO 3.0.4 establishes limitations on changes in MODES or other specified conditions in the Applicability when an LCO is not met. It allows placing the unit in a MODE or other specified condition stated in that Applicability (e.g., the Applicability desired to be entered) when unit conditions are such that the requirements of the LCO would not be met, in accordance with LCO 3.0.4.a, LCO 3.0.4.b, or LCO 3.0.4.c.

LCO 3.0.4.a allows entry into a MODE or other specified condition in the Applicability with the LCO not met when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Compliance with Required Actions that permit continued operation of the unit for an unlimited period of time in a MODE or other specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the unit before or after the MODE change. Therefore, in such cases, entry into a MODE or other specified condition in the Applicability may be made in accordance with the provisions of the Required Actions.

BASES

LCO 3.0.3 (continued)

MODE 4 is not reduced from the allowable limit of 13 hours. Therefore, if remedial measures are completed that would permit a return to MODE 1, a penalty is not incurred by having to reach a lower MODE of operation in less than the total time allowed.

In MODES 1, 2, 3, and 4, LCO 3.0.3 provides actions for Conditions not covered in other Specifications. The requirements of LCO 3.0.3 do not apply in MODES 5 and 6 because the unit is already in the most restrictive Condition required by LCO 3.0.3. The requirements of LCO 3.0.3 do not apply in other specified conditions of the Applicability (unless in MODE 1, 2, 3, or 4) because the ACTIONS of individual Specifications sufficiently define the remedial measures to be taken.

Exceptions to LCO 3.0.3 are provided in instances where requiring a unit shutdown, in accordance with LCO 3.0.3, would not provide appropriate remedial measures for the associated condition of the unit. An example of this is in LCO 3.7.~~15~~ 13, "Spent Fuel ~~Storage~~ Pool Water Level." LCO 3.7.~~15~~ 13 has an Applicability of "~~During movement of~~ Whenever irradiated fuel assemblies are in the spent fuel ~~storage~~ pool." Therefore, this LCO can be applicable in any or all MODES. If the LCO and the Required Actions of LCO 3.7.~~15~~ 13 are not met while in MODE 1, 2, or 3, there is no safety benefit to be gained by placing the unit in a shutdown condition. The Required Actions of LCO 3.7.~~15~~ 13 of "Suspend all movement of ~~irradiated~~ fuel assemblies and crane operations with loads in the ~~fuel storage pool~~ spent fuel pool areas" and "Restore spent fuel pool water level to within limit" are ~~is~~ the appropriate Required Actions to complete in lieu of the actions of LCO 3.0.3. These exceptions are addressed in the individual Specifications.

1 5

LCO 3.0.4

LCO 3.0.4 establishes limitations on changes in MODES or other specified conditions in the Applicability when an LCO is not met. It allows placing the unit in a MODE or other specified condition stated in that Applicability (e.g., the Applicability desired to be entered) when unit conditions are such that the requirements of the LCO would not be met, in accordance with LCO 3.0.4.a, LCO 3.0.4.b, or LCO 3.0.4.c.

LCO 3.0.4.a allows entry into a MODE or other specified condition in the Applicability with the LCO not met when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Compliance with Required Actions that permit continued operation of the unit for an unlimited period of time in a MODE or other specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the unit before or after the MODE change. Therefore, in such cases, entry into a MODE or other specified condition in the Applicability may be made in accordance with the provisions of the Required Actions.

Licensee Response/NRC Response/NRC Question Closure

Id	**437**
NRC Question Number	**KAB066**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This RAI is being closed at this time. However, the follow-up RAIs for KAB066 have been posted under MHC003 and MHC004.**
Question Closure Date	**4/23/2015**
Notification	**Mark Blumberg** **Scott Bowman** **Margaret Chernoff** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**4/23/2015 11:26 AM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**191**
NRC Question Number	**KAB067**
Category	**Technical**
ITS Section	**AST**
ITS Number	
DOC Number	
JFD Number	
JFD Bases Number	
Page Number(s)	
NRC Reviewer Supervisor	**Roger Pederson**
Technical Branch POC	**Mark Blumberg**
Conf Call Requested	**N**
NRC Question	**RAI ARCB/SCVB2-2 (in response to KAB-044)**

Calculation LTR-CRA-02-219, Revision 1 assumes a mixing volume for the fuel handling accident in containment that is 10 times higher (325,500 versus 32,550 cubic feet) than was credited in license amendment 288/278 (Unit 1/Unit 2) (ADAMS Accession No. ML033070057), but does not justify the proposed change.

Appendix B of RG 1.183, Regulatory Position 5.5 states:

> **Credit for dilution or mixing of the activity released from the reactor cavity by natural or forced convection inside the containment may be considered on a case-by-case basis. Such credit is generally limited to 50% of the containment free volume. This evaluation should consider the magnitude of the containment volume and exhaust rate, the potential for bypass to the environment, the location of exhaust plenums relative to the surface of the reactor cavity, recirculation ventilation systems, and internal walls and floors that impede stream flow between the surface of the reactor cavity and the exhaust plenums.**

The calculation does not address the magnitude of the containment volume and exhaust rate, the potential for bypass to the environment, the location of exhaust plenums relative to the surface of the reactor cavity, recirculation ventilation systems, and internal walls and floors that impede stream flow between the

surface of the reactor cavity and the exhaust plenums. Please provide a justification of why the revised mixing volume is appropriate.

Attach File 1	
Attach File 2	
Issue Date	**9/30/2014**
Added By	**Khadijah Hemphill**
Date Modified	
Modified By	
Date Added	**9/30/2014 4:02 PM**
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**

Licensee Response/NRC Response/NRC Question Closure

Id	**405**
NRC Question Number	**KAB067**
Select Application	**Licensee Response**
Attachment 1	
Attachment 2	
Response Statement	**In response to RAI KAB-067, "Sequoyah Nuclear Plants, Units 1 and 2 Technical Specifications Conversion to NUREG-1431, Rev 4.0 (SQN-TS-11-10) – Supplement 1" was submitted to the NRC for review on December 16, 2014.Attachment 1 of the supplement contains LTR-CRA-02-219, Revision 2, "Radiological Consequences of Fuel Handling Accidents for the Sequoyah Nuclear Plant Units 1 and 2," which revised the containment mixing volume assumption such that for a Fuel Handling Accident (FHA) inside the containment, the containment mixing volume assumption has been deleted and the activity released from the damaged fuel not retained in the water pool is assumed to be released linearly from the pool to the environment within two hours.No credit is taken for mixing in the containment volume.**
Response Date/Time	**12/18/2014 4:00 PM**
Closure Statement	
Question Closure Date	
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Margaret Chernoff** **Michelle Conner** **Robert Elliott** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Michelle Conner**
Date Added	**12/18/2014 3:04 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**438**
NRC Question Number	**KAB067**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**4/23/2015**
Notification	**Mark Blumberg** **Scott Bowman** **Margaret Chernoff** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**4/23/2015 11:27 AM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**192**
NRC Question Number	**KAB068**
Category	**Technical**
ITS Section	**AST**
ITS Number	
DOC Number	
JFD Number	
JFD Bases Number	
Page Number(s)	
NRC Reviewer Supervisor	**Roger Pederson**
Technical Branch POC	**Mark Blumberg**
Conf Call Requested	**N**

NRC Question

RAI ARCB2-3 (in response to KAB-044)

Enclosure 2, Volume 14, Rev. 0, page 135 of 236 proposed making the following modification:

> **Fuel handling accidents, analyzed in Reference 3, include dropping a single irradiated fuel assembly.**

The justification provided is given below:

> **Changes are made (additions, deletions, and/or changes) to the ISTS [or ITS] that reflect the plant specific nomenclature, number, reference, system description, analysis, or licensing basis description.**

The staff is concerned that the above justification conflicts with the staff's assessment of Sequoyah's licensing bases. The dropping of heavy objects appears to be in the licensing bases and the need to consider heavy objects is addressed in the SRP and RG 1.183, as discussed above (RAI ARCB2-1 or KAB066). Please modify the justification to address the NRC staff's concern, or replace the text proposed to be removed.

Attach File 1	
Attach File 2	
Issue Date	**9/30/2014**

Added By	**Khadijah Hemphill**
Date Modified	
Modified By	
Date Added	**9/30/2014 4:03 PM**
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**

Licensee Response/NRC Response/NRC Question Closure

Id	**380**
NRC Question Number	**KAB068**
Select Application	**Licensee Response**
Attachment 1	**Attachment 1 for RAI KAB068.pdf** (31KB)
Attachment 2	
Response Statement	**In response to KAB068, the ITS 3.9.4 Bases Applicable Safety Analyses Section, on pages 124 and 135 of Enclosure 2, Volume 14, will be revised to retain the words "and handling tool or a heavy object onto other irradiated fuel assemblies." The Justification for Deviations 2 indicator will be deleted because the previously deleted text will be retained.** **See Attachment 1 for the draft revised ITS 3.9.4 Bases.**
Response Date/Time	**11/24/2014 4:55 AM**
Closure Statement	
Question Closure Date	
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Scott Bowman**
Date Added	**11/24/2014 3:55 AM**
Date Modified	
Modified By	

BASES

BACKGROUND (continued)

The requirements for containment penetration closure ensure that a release of fission product radioactivity within containment will be restricted to within regulatory limits.

~~The Containment Purge and Exhaust System includes two subsystems. The normal subsystem includes a 42 inch purge penetration and a 42 inch exhaust penetration. The second subsystem, a minipurge system, includes an 8 inch purge penetration and an 8 inch exhaust penetration. During MODES 1, 2, 3, and 4, the two valves in each of the normal purge and exhaust penetrations are secured in the closed position. The two valves in each of the two minipurge penetrations can be opened intermittently, but are closed automatically by the Engineered Safety Features Actuation System (ESFAS). Neither of the subsystems is subject to a Specification in MODE 5.~~

~~In MODE 6, large air exchangers are necessary to conduct refueling operations. The normal 42 inch purge system is used for this purpose, and all four valves are closed by the ESFAS in accordance with LCO 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation."~~

~~[The minipurge system remains operational in MODE 6, and all four valves are also closed by the ESFAS.~~

~~[or]~~

~~The minipurge system is not used in MODE 6. All four 8 inch valves are secured in the closed position.]~~ 2

INSERT 1

The other containment penetrations that provide direct access from containment atmosphere to outside atmosphere must be isolated on at least one side. Isolation may be achieved by an OPERABLE automatic isolation valve (either open or closed), or by a manual isolation valve, blind flange, or equivalent. 2 Equivalent isolation methods must be approved and may include use of a material that can provide a temporary, atmospheric pressure, ventilation barrier for the other containment penetrations during ~~[~~recently~~]~~ irradiated 1 fuel movements (Ref. 1).

APPLICABLE SAFETY ANALYSES

During movement of irradiated fuel assemblies within containment, the most severe radiological consequences result from a fuel handling accident ~~[~~involving handling recently irradiated fuel~~]~~. The fuel handling 1 accident is a postulated event that involves damage to irradiated fuel (Ref. 2). Fuel handling accidents, analyzed in Reference 3, include dropping a single irradiated fuel assembly ~~and handling tool or a heavy object onto other irradiated fuel assemblies~~. The requirements of LCO 3.9.7, "Refueling Cavity Water Level," in conjunction with a minimum

stet ~~2~~

BASES

BACKGROUND (continued)

The requirements for containment penetration closure ensure that a release of fission product radioactivity within containment will be restricted to within regulatory limits.

The Containment Purge and Exhaust System includes two subsystems. The normal subsystem includes a 42 inch purge penetration and a 42 inch exhaust penetration. The second subsystem, a minipurge system, includes an 8 inch purge penetration and an 8 inch exhaust penetration. During MODES 1, 2, 3, and 4, the two valves in each of the normal purge and exhaust penetrations are secured in the closed position. The two valves in each of the two minipurge penetrations can be opened intermittently, but are closed automatically by the Engineered Safety Features Actuation System (ESFAS). Neither of the subsystems is subject to a Specification in MODE 5.

In MODE 6, large air exchangers are necessary to conduct refueling operations. The normal 42 inch purge system is used for this purpose, and all four valves are closed by the ESFAS in accordance with LCO 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation."

[The minipurge system remains operational in MODE 6, and all four valves are also closed by the ESFAS.

[or]

The minipurge system is not used in MODE 6. All four 8 inch valves are secured in the closed position.] 2

INSERT 1

The other containment penetrations that provide direct access from containment atmosphere to outside atmosphere must be isolated on at least one side. Isolation may be achieved by an OPERABLE automatic isolation valve (either open or closed), or by a manual isolation valve, blind flange, or equivalent. 2 Equivalent isolation methods must be approved and may include use of a material that can provide a temporary, atmospheric pressure, ventilation barrier for the other containment penetrations during [recently] irradiated 1 fuel movements (Ref. 1).

APPLICABLE SAFETY ANALYSES

During movement of irradiated fuel assemblies within containment, the most severe radiological consequences result from a fuel handling accident [involving handling recently irradiated fuel]. The fuel handling 1 accident is a postulated event that involves damage to irradiated fuel (Ref. 2). Fuel handling accidents, analyzed in Reference 3, include dropping a single irradiated fuel assembly and handling tool or a heavy object onto other irradiated fuel assemblies. The requirements of LCO 3.9.7, "Refueling Cavity Water Level," in conjunction with a minimum

stet 2

Licensee Response/NRC Response/NRC Question Closure

Id	**406**
NRC Question Number	**KAB068**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**12/19/2014**
Notification	**Mark Blumberg Scott Bowman Margaret Chernoff Michelle Conner Khadijah Hemphill Andrew Hon Lynn Mynatt Ray Schiele Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**12/19/2014 7:21 AM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**194**
NRC Question Number	**KAB070**
Category	**Technical**
ITS Section	**AST**
ITS Number	
DOC Number	
JFD Number	
JFD Bases Number	
Page Number(s)	
NRC Reviewer Supervisor	**Roger Pederson**
Technical Branch POC	**Mark Blumberg**
Conf Call Requested	**N**

NRC Question

RAI ARCB2-5/SCVB2-5 (in response to KAB-044)

The proposed changes discussed in the previous question (ARCB2-4) impact the pressure in adjacent areas to the control room envelope. With these systems inoperable there are no technical specification controls to assure that the systems will function. Regulatory Guide 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors," dated May 2003 (ADAMS Accession No. ML031490664) states:

> **Any test to determine CRE [control room envelope] integrity should be performed while the CRE, its associated ventilation systems, and the ventilation systems located in, traversing, or serving areas adjacent to the CRE are functioning in a manner that reflects CRE inleakage when these ventilation systems are operating in response to a particular challenge.**

and,

> **In addition to the above, CRE testing should be performed when changes are made to the structures, systems, components, and procedures that could impact CRE integrity. The structures, systems, and components could be within the envelope itself or could serve or be within areas adjacent to the envelope. Additional testing may be warranted if the conditions associated with a particular challenge result in a change in operating mode, alignment, or response that could result in a new limiting condition. Testing should be**

> **commensurate with the type and degree of modification or repair that has been made. For some changes, a new baseline test may be required.**

Please provide a justification for the control room unfiltered inleakage assumed for the FHA in the unit with the inoperable ABGTS and/or ABGTS actuation equipment. The changes requested may have an impact on the unfiltered inleakage of a common shared control room, therefore, impacting both units. Please provide a justification for the control room unfiltered inleakage values assumed for any applicable design basis accident in one unit with an inoperable ABGTS and/or ABGTS actuation instrumentation in opposite unit.

Attach File 1	
Attach File 2	
Issue Date	**9/30/2014**
Added By	**Khadijah Hemphill**
Date Modified	
Modified By	
Date Added	**9/30/2014 4:06 PM**
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**

Licensee Response/NRC Response/NRC Question Closure

Id	**416**
NRC Question Number	**KAB070**
Select Application	**Licensee Response**
Attachment 1	**KAB070 Attachment 1.pdf** (188KB)
Attachment 2	
Response Statement	

An inoperable Auxiliary Building Gas Treatment System (ABGTS) or inoperable ABGTS actuation instrumentation does not affect operation of the Control Room Emergency Ventilation System (CREVS) or alter the main control room (MCR) unfiltered inleakage assumptions in the Sequoyah Nuclear Plant (SQN) design basis accident (DBA) analyses. The only DBA that is postulated to occur when ABGTS and the associated actuation instrumentation are not required by Technical Specifications is a fuel handling accident (FHA) when both units are shutdown with average reactor coolant temperature at or below 200°F. Current Technical Specifications (CTS) and the proposed Improved Technical Specifications (ITS) require the common ABGTS and the associated actuation instrumentation to be Operable when either unit is in Mode 1, 2, 3, or 4.

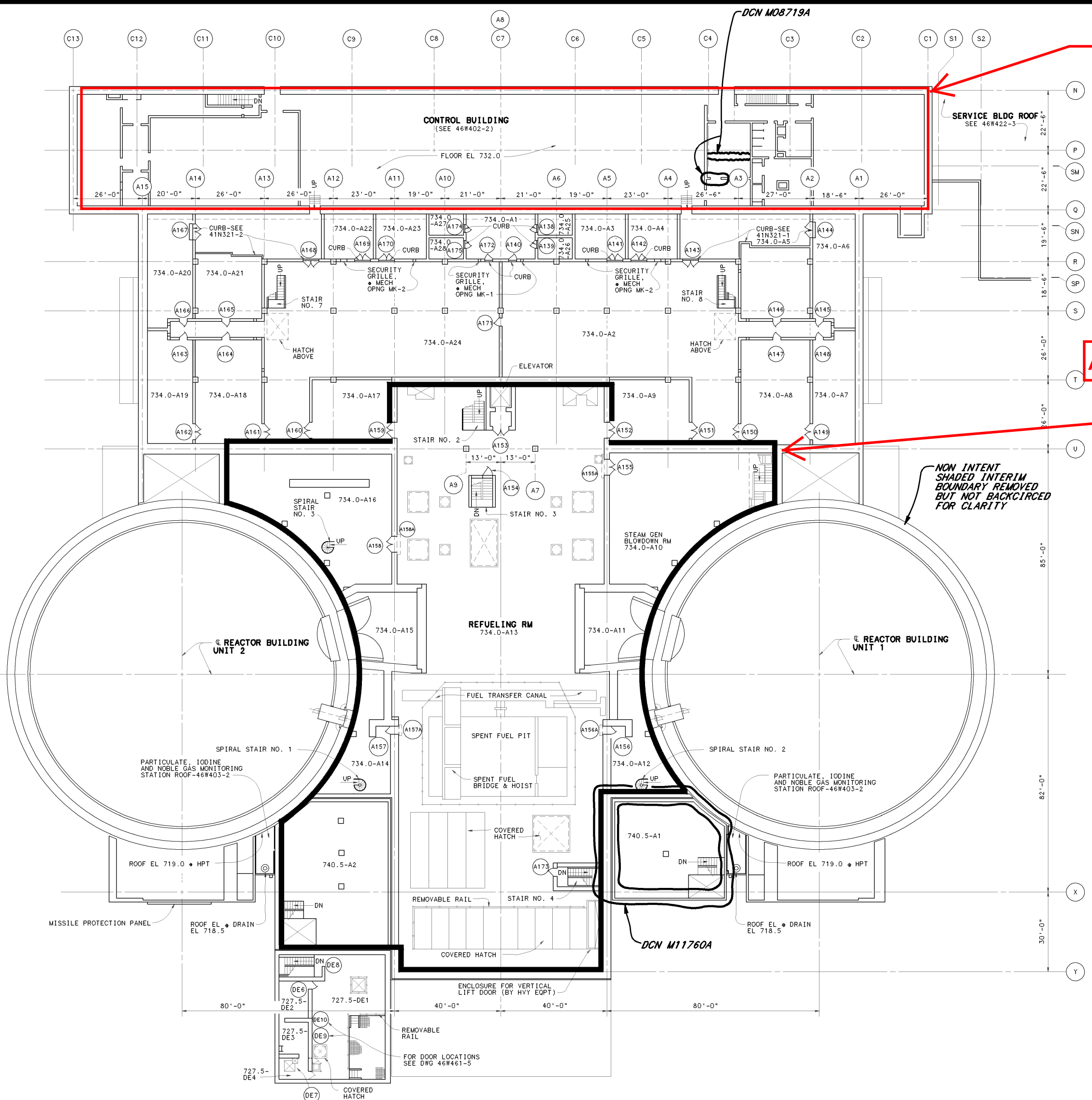
As indicated in SQN Updated Final Safety Analysis Report (UFSAR), Table 15.5.6-1, "Parameters Used in Fuel Handling Accident Analyses," 51 cfm unfiltered MCR inleakage is assumed following the swap to the CREVS. This unfiltered air flow value is consistent with the value listed in Table 2, "Fuel Handling Accident Assumptions," of the revised Calculation LTR-CRA-02-219, Revision 2, "Radiological Consequences of Fuel Handling Accidents for the Sequoyah Nuclear Plant Units 1 and 2."

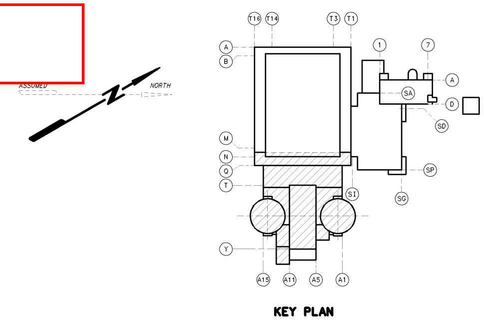
CTS 6.17.c of the Control Room Envelope (CRE) Habitability Program requires, in part, determining the unfiltered air inleakage past the CRE boundary into the CRE in accordance with the testing methods and at the frequencies specified in Sections C.1 and C.2 of Regulatory Guide (RG) 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors," Revision 0, May 2003. The most recently recorded CRE inleakage during performance of the SQN CREVS tracer gas test was 22 ±9 cfm for

Train A and 15 ±7 for Train B; i.e., a 39% margin and a 50% margin for Train A and Train B, respectively, when including the cfm error) between the measured CRE inleakage and the unfiltered MCR inleakage assumption in the design basis FHA. ITS 5.5.16.c (CTS 6.17.c) will continue to require determining the unfiltered air inleakage past the CRE boundary into the CRE in accordance with the testing methods and frequencies specified in RG 1.197.

As discussed in Section 6.4.1.2 of the SQN UFSAR; during operation in the emergency mode, the CREVS maintains a positive pressure of at least 1/8 inch water gauge in the CRE relative to the outside atmosphere and a slightly positive pressure relative to adjoining spaces. The CRE boundary consists of the walls, ceiling, and floor in the areas adjacent to the MCR. Adjacent areas are those areas between the ABSCE and the MCR envelope including the Unit 1 and 2 cable spreading rooms, the stairwells, and the 6900 V shutdown board rooms. These adjacent areas (see Attachment 1) are not in the auxiliary building secondary containment enclosure and therefore, are not affected by ABGTS operation. As such, an inoperable ABGTS or inoperable ABGTS actuation instrumentation will not affect operation of the CREVS or alter the MCR unfiltered inleakage assumptions in any SQN DBA analysis, including the FHA.

Response Date/Time	**1/4/2015 8:20 PM**
Closure Statement	
Question Closure Date	
Notification	**Mark Blumberg Scott Bowman Kristy Bucholtz Margaret Chernoff Michelle Conner Robert Elliott Matthew Hamm Khadijah Hemphill Andrew Hon Lynn Mynatt Ray Schiele**
Added By	**Michelle Conner**
Date Added	**1/4/2015 7:20 PM**
Date Modified	
Modified By	





ROOM NO.	ROOM NAME
727.5-DE1	CONDENSER ROOM
727.5-DE2	ENTM SEPARATOR ROOM
727.5-DE3	VAPOR BODY ROOM
727.5-DE4	HEATER ROOM
734.0-A1	AUXILIARY CONTROL ROOM
734.0-A2	69KV SHUTDOWN BD ROOM A
734.0-A3	125V VITAL BTRY BD ROOM II
734.0-A4	125V VITAL BTRY BD ROOM I
734.0-A5	480V SHUTDOWN BD ROOM 1B2
734.0-A6	480V SHUTDOWN BD ROOM 1B1
734.0-A7	480V SHUTDOWN BD ROOM 1A1
734.0-A8	480V SHUTDOWN BD ROOM 1A2
734,0-A9	PERSONNEL & EQPT ACCESS
734.0-A10	STEAM GEN BLOWDOWN
734.0-A11	REACTOR BLDG EQPT HATCH
734.0-A12	REACTOR BLDG ACCESS ROOM
734.0-A13	REFUELING ROOM
734.0-A14	REACTOR BLDG ACCESS ROOM
734.0-A15	REACTOR BLDG EQPT HATCH
734.0-A16	EMER GAS TREATMENT FILTER
734.0-A17	PERSONNEL & EQPT ACCESS
734.0-A18	480V SHUTDOWN BD ROOM 2B2
734.0-A19	480V SHUTDOWN BD ROOM 2B1
734.0-A20	480V SHUTDWON BD ROOM 2A1
734.0-A21	480V SHUTDOWN BD ROOM 2A2
734.0-A22	125V VITAL BTRY BD RM IV
734.0-A23	125V VITAL BTRY BD RM III
734.0-A24	6.9KV SHUTDOWN BD ROOM B
734.0-A25	AUX CONTROL INSTR ROOM 1A
734.0-A26	AUX CONTROL INSTR ROOM 1B
734.0-A27	AUX CONTROL INSTR ROOM 2A
734.0-A28	AUX CONTROL INSTR ROOM 2B
740.5-A1	UHI EQUIPMENT ROOM
740.5-A2	ICE BIN EQUIPMENT RM

	NON-INTENT					
	DCN M08719A					
*0	DCN M11760A	N/A	SEE TITLE BLOCK			
INC: DCA M11760-02 R0, DCA M08719-077 R0 NON-INTENT: REMOVED OLD INTERIM ABSCE BOUNDARY. RESOLVES 96DD0004 (B38 960116 804). CHANGED CATEGORY TO 3						
REV	ECN/DCN	CHG DOC	DRWN	CHKD	APPD	DATE

SCALE: NONE EXCEPT AS NOTED

AUX, REACTOR & CONTROL BUILDINGS CATEGORY 3

UNITS 1 & 2 NON-INTENT

ARCHITECTURAL
PLAN EL 732.0 & 734.0
BOUNDARY-ABSCE

SEQUOYAH NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
NUCLEAR ENGINEERING

N

DESIGN		INITIAL ISSUE	ENGINEERING APPROVAL
DRAFTER: M. BEATY	CHECKER:	RO ISSUE PER: DRAWING MADE A CCD FROM UO AC RD 46W501-4 AND CCD 1,2-46W401-7 RO	1 N/A
DESIGNER: N/A	REVIEWER: N/A	*ADDITTIONAL INFO INC	2
			3

ISSUED BY: N/A

DATE | 45 | A | **CCD NO: 1,2-46W501-4** R0

45 | A | 1,2-46W501-4

Licensee Response/NRC Response/NRC Question Closure

Id	**442**
NRC Question Number	**KAB070**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**4/29/2015**
Notification	**Mark Blumberg** **Margaret Chernoff** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**4/29/2015 10:06 AM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**195**
NRC Question Number	**KAB071**
Category	**Technical**
ITS Section	**AST**
ITS Number	
DOC Number	
JFD Number	
JFD Bases Number	
Page Number(s)	
NRC Reviewer Supervisor	**Roger Pedersen**
Technical Branch POC	**Mark Blumberg**
Conf Call Requested	**N**

NRC Question

RAI ARCB2-7 (in response to KAB-044)

The proposed technical specification changes allow the containment building airlocks and penetrations to be open and the containment ventilation isolation instrumentation to be non-operational after 100 hours of fuel decay time (ITS 3.9.4 and ITS 3.3.6, respectively). Previously, only the containment equipment door was allowed to be open during the movement of fuel after 100 hours of fuel decay time (TS 3.9.4).

Presumably, Calculation LTR-CRA-02-219, Revision 0, assumed that all releases from a FHA within containment would be through the containment equipment door after 30 seconds. Calculation LTR-CRA-02-219, Revision 1, uses the same X/Q value (1.80E-3 sec/m3) to model containment releases from the now open containment building airlocks and penetrations after 300 seconds.

Please justify that the 1.80E-3 sec/m3 X/Q value used in Calculation LTR-CRA-02-219, Revision 1, to model FHA releases inside containment beyond 300 seconds bounds all potential containment release pathways (such as the containment equipment door, airlocks, and penetrations) or provide a revised limiting X/Q value for all containment release pathways. If a revised limiting X/Q value is provided, please update the doses analysis in Calculation LTR-CRA-02-219 to utilize the revised X/Q value.

Attach File 1

Attach File 2

Issue Date	**9/30/2014**
Added By	**Khadijah Hemphill**
Date Modified	
Modified By	
Date Added	**9/30/2014 4:07 PM**
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Michelle Conner** **Ravinder Grover** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**

Licensee Response/NRC Response/NRC Question Closure

Id	**417**
NRC Question Number	**KAB071**
Select Application	**Licensee Response**
Attachment 1	
Attachment 2	
Response Statement	**TVA provided a revised limiting atmospheric dispersion factor, χ/Q value, for all containment release pathways in a letter; "Sequoyah Nuclear Plants, Units 1 and 2 Technical Specifications Conversion to NUREG-1431, Rev 4.0 (SQN-TS-11-10) - Supplement 1," dated December 16, 2014 (ADAMS Accession No. ML14350B364). Attachment 1 of the supplement provided the revised Westinghouse report, "LTR-CRA-02-219 Revision 2: Radiological Consequences of Fuel Handling Accidents for the Sequoyah Nuclear Plant Units 1 and 2."** **The analysis demonstrates that a design basis fuel handling accident (FHA) whether inside containment or in the Auxiliary Building (AB) have the same offsite dose consequence since the accident occurring in different locations does not change the amount of activity released over the two-hour period. The AB vent stack release point provides the limiting release point for the Main Control Room (MCR) dose because of less atmospheric dispersion and more severe MCR dose consequences than a containment purge release. As stated in Section 2.1 of LTR-CRA-02-219, based on a review of containment penetrations as potential point source release locations, the AB vent stack is the limiting location for the calculation of MCR doses based on its proximity to the MCR air intake locations. Therefore, any release from containment would be bounded by the release from the AB vent stack. The revised χ/Q value of 2.56E-3 sec/m^3 is the limiting atmospheric dispersion value for calculating the radiological consequences to personnel in the MCR following a design basis FHA at Sequoyah Nuclear Plant, Units 1 and 2.**
Response Date/Time	**1/4/2015 8:30 PM**
Closure Statement	
Question Closure Date	
Notification	**Mark Blumberg** **Scott Bowman** **Kristy Bucholtz** **Margaret Chernoff** **Michelle Conner** **Robert Elliott**

	Khadijah Hemphill **Andrew Hon** **Lynn Mynatt** **Ray Schiele**
Added By	**Michelle Conner**
Date Added	**1/4/2015 7:31 PM**
Date Modified	
Modified By	

Licensee Response/NRC Response/NRC Question Closure

Id	**447**
NRC Question Number	**KAB071**
Select Application	**NRC Question Closure**
Attachment 1	
Attachment 2	
Response Statement	
Response Date/Time	
Closure Statement	**This question is closed and no further information is required at this time to draft the Safety Evaluation.**
Question Closure Date	**5/6/2015**
Notification	**Mark Blumberg** **Margaret Chernoff** **Michelle Conner** **Khadijah Hemphill** **Andrew Hon** **Lynn Mynatt** **Ray Schiele** **Roger Scott**
Added By	**Khadijah Hemphill**
Date Added	**5/6/2015 4:32 PM**
Date Modified	
Modified By	

ITS NRC Questions

Id	**6**
NRC Question Number	**KNH-001**
Category	**Technical**
ITS Section	**TSTF-425 - PRA**
ITS Number	
DOC Number	
JFD Number	
JFD Bases Number	
Page Number (s)	
NRC Reviewer Supervisor	**Rob Elliott**
Technical Branch POC	**Jonathan Evans**
Conf Call Requested	**N**
NRC Question	**In Enclosure 10, the proposed changes indicate that TSTF-425, Revision 3 is included in the change. However, the Sequoyah Nuclear Plant Submittal does not appear to include the documentation regarding the probabilistic risk assessment technical adequacy consistent with the guidance in NEI 04-10. Please provide documentation.**
Attach File 1	
Attach File 2	
Issue Date	**2/4/2014**
Added By	**Khadijah Hemphill**
Date Modified	
Modified By	
Date Added	**2/4/2014 4:04 PM**
Notification	**Michelle Conner** **Khadijah Hemphill** **Ray Schiele** **Gerald Waig**

Licensee Response/NRC Response/NRC Question Closure

Id	**5**
NRC Question Number	**KNH-001**
Select Application	**Licensee Response**
Attachment 1	**Cover Letter from Westinghouse LTR-RAM-II-11-010.pdf** (94KB)
Attachment 2	**Appendix A NUC-SQN-MEB-MDN-000-2010-0200 REV 1.pdf** (485KB)
Response Statement	**Enclosure 10 for TSTF-425 refers to Reference 7, Westinghouse LTR–RAM-II-11-010, "RG 1.200 PRA Peer Review Against the ASME/ANS PRA Standard Requirements for the Sequoyah Nuclear Plant Probabilistic Risk Assessment," dated March 18, 2011, and Reference 8, NUC–SQN–MEB–MDN–000–000–2010–0200 Revision 1, "SQN Probabilistic Risk Assessment - Summary Document." Attachment 1 is the cover letter for Reference 7. Attachment 2 is Appendix A, Resolution of F&Os, for Reference 8.** **Additionally, Sequoyah Nuclear Plant, Units 1 and 2 - License Renewal Application, Attachments C, D and E, Part 8 of 8 (ML13024A010) contains Attachment E.1, Evaluation of SQN PRA Model. This Attachment begins on page 95 of the .pdf file.**
Response Date/Time	**2/5/2014 12:30 PM**
Closure Statement	
Question Closure Date	
Notification	**Scott Bowman Michelle Conner Robert Elliott Khadijah Hemphill Lynn Mynatt Lisa Regner Ray Schiele Roger Scott Gerald Waig**
Added By	**Scott Bowman**
Date Added	**2/5/2014 11:24 AM**
Date Modified	
Modified By	

Westinghouse

Date: March 18, 2011

To: Tom Zachariah
cc: Paul Hijeck, David Finnicum

From: David E. McCoy
Ext: 205-664-3020
Fax: 860-731-2498

Your ref: NA
Our ref: LTR-RAM-II-11-010

Subject: **RG 1.200 PRA Peer Review Against the ASME/ANS PRA Standard Requirements for the Sequoyah Nuclear Plant Probabilistic Risk Assessment**

Attached is the final report documenting the results of the full scope Regulatory Guide (RG) 1.200 peer review for the Sequoyah Nuclear Plant (SQN) Probabilistic Risk Assessment (PRA). This peer review process was performed under Task PA-RMSC-0386. Please transmit this report to Tennessee Valley Authority for their use.

This report is proprietary to Tennessee Valley Authority because it contains plant-specific information for the Sequoyah Nuclear Plant. This report cannot be released to anyone outside Tennessee Valley Authority without their express written permission.

Questions may be referred to the undersigned.

Regards,

David E. McCoy*
Author
Risk Applications & Methods II

* Electronically Approved Records are authenticated in the Electronic Document Management System

Appendix A – Resolution of F&Os

Finding Level F&Os

F&O Number	F&O Details
1-4	MDN-000-000-2010-0203 does not document an assessment of the impact of flooding events on existing HFEs carried over from the internal events scenario used to represent the flooding event. (This F&O originated from SR IFQU-A6) **Associated SR(s)** IFQU-A6 **Basis for Significance** Although this is a documentation issue, it is important to an understanding of the results and to show that the technical element is satisfied. **Possible Resolution** Document a process for assessment of the impact of the flood scenarios on existing HFEs from the internal events PRA sequences used to represent the flood scenarios. EPRI 1019194 Section 7.3 describes the types of HFE adjustments to be considered. **Response** To address human actions and their modification due to flooding events Section 9.3 was added to the document. Section 9.3 addresses the changes to the human actions in the model by accounting for: 1. Human actions that are influenced by HRA actions, these are events that occur within an hour of flood initiation. 2. Human actions that are failed due flooding.

F&O Number	F&O Details

1-7

Dependency analysis was performed for the post-initiator HEPs using the EPRI HRA Calculator. However, several issues were identified including:

1) Use of the same cue for two actions can result in conservative dependency values. For example, the use of the same cue for actions HARR1 and AFWOP3 resulted in complete dependency between the actions. However, review of the cues indicated that the cue for AFWOP3 should be different than that for HARR1.
2) Inconsistent entry of the timing information creates results that may appear invalid. For example, the timing entries for actions HARR2 and AFWOP3 make it appear that core damage as a result of failure of HARR2 would occur before the cue for AFWOP3 is received. Discussion revealed that the Tsw for HARR2 is based on the time at which the RWST would empty rather than core damage as stated in the HRA Calculator.
3) Inclusion of screening HFEs in the dependency analysis can result in errors. The screening HEPs do not have information that is necessary for the dependency analysis (e.g., timing inputs). This can result in the wrong event being treated as the independent event in the combination. For example, review of dependency combination 41 shows that the dependency analysis treats HACD1 as the first or independent HFE in the combination and AFWOP5 as following HACD1. This results in a joint HEP of 1.0 based on complete dependency. However, the description of HFE HACD1, "Perform cooldown with main feedwater following AFW failure," indicates that AFWOP5 should be the first event. This would result in a joint HEP of 2.9E-03.
4) The dependency level of the cognitive recoveries were not entered in the HRA Calculator database for the post-initiators. This requires manual entry by the analyst and does not default to the recommended dependence level. Failure to enter this information may underestimate or overestimate the HEP depending on the applicable dependence level.

Some of these items were corrected during the review but they are documented in an F&O due to the need to evaluate the extent of the condition.

(This F&O originated from SR HR-G7)

Associated SR(s)

HR-G7

Basis for Significance

Incorrect assignment of cues, timing, and resource entries can result in incorrect dependency analysis results.

Possible Resolution

1) Review the cues, timing assumptions, and resource requirements for significant HEPs to ensure that the factors are correctly assessed in the dependency analysis.
2) For combinations where the timing indicates Tsw is reached for the first action before the cue for the second is received, document the basis for acceptability of the dependent combination.
3) Ensure all information affecting the dependency analysis is entered into the HRA Calculator for the screening HFEs to ensure they are treated correctly in the dependency analysis.
4) Ensure that the dependence level between cognitive actions and applicable recoveries is set in the HRA Calculator database.

Response

1. Cue for AFWOP3 has been updated to correct cue. Review has been performed for all remaining actions to determine if any additional cues need to be updated. This review verified the accuracy of HRA cues and updated six of the identified cues.
2. The end point for Tsw is an irreversible damage state. For HARR2, this irreversible damage state is the loss of all ECCS pumps when the RWST is depleted and autoswap has failed. This is the correct irreversible damage state as the operator does not have until core damage to perform that action if the pumps fail when their suction source runs dry. The dependency analysis was reviewed for overlapping timeframes.
3. Screening value HEPs were removed from the database if there values were set to 1.0. The HEPs that were originally in the model were no longer required and were deleted from the fault tree.
4. This has been corrected for all of the actions in the SQN HRA.

F&O Number	F&O Details
1-8	MDN-000-000-2010-0203 Section 9.5 only addresses quantification and results for CDF. There is no discussion of LERF for the flooding scenarios or documentation indicating that the flood scenarios were reviewed to determine if they would have an impact on the Level 2 CETs. The linked fault tree model should have the capability to produce LERF results, but this had not been done at the time of the review. In addition, there was no discussion in the Level 2 Notebook (MDN-000-000-2010-0206) that indicates the results include the internal flood scenarios.

(This F&O originated from SR IFQU-A10)

Associated SR(s)

IFQU-A10

Basis for Significance

No LERF results for internal flooding scenarios was provided for review.

Possible Resolution

1) Document a review of the top events in the Level 2 model to confirm that there are no unique flooding impacts that affect the CETs.
2) Document the LERF results for the internal flood scenarios similar to the results for other initiators in Section 11 of MDN-000-000-2010-0206. This can be done in the flood notebook or the Level 2 notebook, but, if done in the Level 2 notebook this should be referenced in the Internal Flooding Analysis notebook.

Response

The internal flooding calculation was revised to add Section 10 (Results Analysis for Large Early Release Frequency).

Section 10.1 addresses the eighteen questions concerning LERF and their impact.

Section 10.3 and 10.4 address the LERF results due to flooding

To address the additional information the following Appendices were added to the model:

Appendix Q - Significant Cutset Review for Large Early Release

Appendix R - Non-Significant Cutset Review for Large Early Release

Appendix S - Importance Reports for Large Early Release

F&O Number	F&O Details
1-10	MDN-000-000-2010-0206 Section 5.6 notes that credit was taken for scrubbing of releases from a ruptured SG. However, the technical justification for this credit needs to be strengthened. The current basis compares the zero power collapsed level to the top of the SG tubes. However, ES-3.1, Post-SGTR Cooldown Using Backfill allows the level in the ruptured SG to be between 20% narrow range and 75% narrow range during the cooldown (Step 7). The expected levels during SGTR recovery should be used to justify the scrubbing credit. It also appears that the analysis implicitly assumes that if FW will be applied to the ruptured SG if FW is available. No consideration of operator failure to provide FW flow to the ruptured generator is included in the analysis. (This F&O originated from SR LE-C4) **Associated SR(s)** LE-C4 LE-C13 LE-E3 **Basis for Significance** The technical basis of the credit for scrubbing of SGTR releases does not consider the levels allowed in the EOPs. **Possible Resolution** Revise the justification in MDN-000-000-2010-0206 Section 5.6 to include consideration of the SG levels maintained during recovery using the applicable EOPs. **Response** The documentation has been updated to include a discussion of the water levels above the steam generator tubes during tube rupture recovery actions. These water levels (between 4.7 and 9.8 feet) should be sufficient to take credit for fission product scrubbing. This analysis assumes that the operator is successful in providing feedwater flow to the ruptured steam generator.

F&O Number	F&O Details
1-11	The total LERF is compared with other Westinghouse 4-loop plants and with other Ice Condenser plants. However, there is no comparison at the level of significant contributors or plant damage states. Without the contributor information, it is not really possible to determine how similar the LERF results are to other plants. (This F&O originated from SR LE-F2) **Associated SR(s)** LE-F2 **Basis for Significance** There is no review of the contributors to LERF with the results for similar plants to ensure that plant-specific modeling choices have not skewed the results. **Possible Resolution** Document a comparison of the LERF results to plants of similar design at the significant contributor and PDS levels (similar to Tables 11-1 and 11-3). **Response** The documentation has been updated to include comparisons by initiating event for several other PWRs in Table 11-7.

F&O Number	F&O Details

1-14

Demand data is obtained directly from the plant process computer for most components, as described in Section 7.3 of the data notebook (MDN-000-000-2010-0202). The status change information from the computer is filtered and used to determine the number of demands.

The use of automatic data collection, however, means that start and run events that occur in all modes of operation are included. In addition, post-maintenance test starts are also included in the data set. This is identified as a source of uncertainty in the sensitivities and uncertainties notebook (MDN-000-000-2010-0209) and a specific set of sensitivity studies were performed that assumed that various numbers of successful starts were invalid. The results show that the impact on CDF is relatively small, unless the number of successful starts is overestimated by a large amount. However, this SR is explicit in its requirement to not count post-maintenance test events.

(This F&O originated from SR DA-C6)

Associated SR(s)

DA-C6

Basis for Significance

This is considered to be a finding since a specific technical requirement of the SR is not met.

Possible Resolution

To comply with this SR, the post-maintenance test starts (following a component failure) should be removed. It would also be more correct to also screen out component demands that occur during shutdown periods (e.g., by filtering out data based on the date of the event).

Response

The work orders for the components that were credited for success in the data analysis were reviewed to discover the number of post maintenance tests that were performed on the components. Table 15 was added to document the number of post maintenance tests that were removed from the analysis.

F&O Number	F&O Details

1-15

The super initiator "general transient" may overlook certain differences among its contributors. For example, the impact of specific IEs like LOSP and Loss of DC that may prevent PORV operation and challenge the Pressurizer Safeties do not appear to be captured.

In addition, failure to provide a separate event tree for SBO may overestimate the success of power recovery by not addressing the operation of systems such as charging and AFW following power recovery.

(This F&O originated from SR AS-A10)

Associated SR(s)

AS-A10

AS-B1

SC-B3

Basis for Significance

The accident sequences do not contain sufficient detail to capture important system requirements and required operator interactions for all initiating events.

Possible Resolution

1) Subdivide the General Transients event tree to better represent the unique challenges presented by specific initiating events (e.g., Transient with Loss of PCS, Transient with PCS Available, LOSP) or document how those challenges are addressed in the top logic model.
2) Modify the existing event sequence and/or linked fault tree to ensure that the challenge to the Pressurizer Safeties is captured for initiating events that would prevent the PORVs from opening.
3) Explicitly model the SBO sequences to ensure that the necessary mitigating systems are addressed following power recovery.

Response

GTRAN was restructured to address this comment. The tree was updated to explicitly ask demand for PORVs and Safeties

F&O Number	F&O Details

1-19

It was noted that HFE HAPRZ (discussed in Section 6.8 and Section 7.2) is not calculated using HRA Calculator. This event seems to have been carried over from the Watts Bar analysis and is treated as basic event U1_L2_NOTRCSDEPNOSBO.

In addition, although Section 6.8 says that the No RCS Dep branch is set to a value of 1 for SBO cases, the value of basic event U1_L2_NOTRCSDEPSBO in the provided MASTERL2.CAF fault tree was set to 0.9995. This also appears to be a carryover from Watts Bar.

(This F&O originated from SR LE-C7)

Associated SR(s)

LE-C7

Basis for Significance

The HFEs for intentional depressurization needs to be evaluated to determine their applicability to SQN.

Possible Resolution

1) Include HAPRZ in the HRA analysis for SQN or justify the applicability of the Watts Bar value and provide an appropriate reference to the source.

2) Verify that the proper value of basic event U1_L2_NOTRCSDEPSBO is being used in the quantification.

Response

The current analysis has been updated to change the value of failure to depressurize the RCS during SBO scenarios to 1.0 (assumed failure) in the model. The basic event HAPRZ, which represents failure to depressurize for non-SBO scenarios, uses a value of 0.1 for failure to depressurize, which was taken from WCAP 16341-P, revision 0. The level 2 event trees also uses the compliment to this action called HAPRZ-SUC which has a probability of 0.9.

F&O Number	F&O Details
2-1	Section 7.0 of the Initiating Events Analysis observes a decreasing trend in initiator frequency in the more recent generic data sources. However, there is no comparison of the SQN results against the generic results nor an explanation of any significant differences. (This F&O originated from SR IE-C12) **Associated SR(s)** IE-C12 **Basis for Significance** The current evaluation of the initiator frequency results does not compare SQN results to the generic frequency results. **Possible Resolution** The section 7.0 discussion could be expanded to include a comparison of the SQN results to the generic results and an explanation of any significant differences. **Response** Added text to Initiating events notebook that compares Sequoyah initiator frequencies to generic industry data.

F&O Number	F&O Details

2-3

Section 4.3.1 of the Data Analysis notebook discusses the basic event probability model methodology. Generic data sources selected for use are applicable for SQN.

For those components which had a failure during the analysis time period (1/1/03 - 11/30/09), the distributions are updated via the Bayesian update program built into CAFTA program. However, the intent of this supporting requirement is to assure realistic parameter estimates are calculated for SIGNIFICANT basic events based on relevant generic and plant-specific evidence, not just those for which failures have occurred. Where no failures have occurred, use of the generic data may be conservative since it includes failures from potentially less reliable components across the industry.

(This F&O originated from SR DA-D1)

Associated SR(s)

DA-D1

DA-D3

Basis for Significance

Using potentially conservative failure rates for significant components can skew the risk results. Both generic and plant-specific experience should be considered for the significant basic events.

Possible Resolution

Consider performing a Bayesian update for all significant basic events - not just those for which failures have occurred.

Response

Significant contributors that were not Bayesian updated were identified as:

BATFR - Battery Fails to Operate

BUSFR - Bus Fails to Operate

CBKFO - Circuit Breaker Fails to Open

FNSFD - Standby fan fails to start

HXRPL - Heat Exchanger (River Water) Plugs or Fouls

MOCXC - Motor Operated Valve Transfers Closed

POEFR - ERCW pumps fail to run

PSRFR - RHR pumps fail to run

STRPL - Strainers plug

TSCPL - Traveling water screens plug

XRFR - Transformer fails to operate

These events were Bayesian updated using plant specific data. The notebook has been updated to reflect these additional updates.

F&O Number	F&O Details

2-4

Appendix F of the Data Analysis notebook provides graphs that show the prior and posterior distributions. Table 19 lists generic and Bayesian-updated mean values, along with a ratio of the posterior to prior mean value. However, there are no conclusions drawn about whether or not the posterior distributions are reasonable given the relative weight of evidence provided by the prior and the plant-specific data. (Note: the statement that "There are no significant differences between the industry data from NUREG/CR-6928 and the posterior distributions for the SQN failure rates" in section 11.0 is not judged to be sufficient. For example, the ratio of the posterior to prior mean for the AHUFR type code in Table 19 is 10.6. For type code LSTFR, the ratio is 4.3. The significance of these differences should be discussed.)

(This F&O originated from SR DA-D4)

Associated SR(s)

DA-D4

DA-E2

Basis for Significance

The reasonableness check needs to assess whether the Bayesian updates yield expected results given the relative weight of evidence provided by the prior and the plant-specific data.

Possible Resolution

Discuss the observed differences in the prior and posterior distributions and draw conclusions on the significance associated with those differences.

Response

The posterior distributions were validated using the following process. Using a Monte Carlo simulation, the posterior distributions were samples to see the probability of having a recurrence in the number of events observed in the data window given the number of successes in the data window. If the mean value was within 0.05 to 0.95 the resultant distribution was used within the model.

Appendix F was re-written to address this analysis as well as to present the prior, posterior, and plant specific distributions.

F&O Number	F&O Details
2-5	The method from NUREG/CR-6823 is used to Bayesian-update a Jeffreys noninformative prior distribution with plant-specific experience. However, there is no comparison of the posterior means to plant-specific means. (See the last sentence in NUREG/CR-6823, section 6.7.1.2.) (This F&O originated from SR DA-D4) **Associated SR(s)** DA-D4 DA-E2 **Basis for Significance** A reasonableness check should be performed to assure the Bayesian-updated maintenance unavailabilites yield expected results when compared to plant-specific mean values given the amount of plant-specific data. **Possible Resolution** Compare the Bayesian-updated maintenance unavailabilites to plant-specific mean values, discuss the observed differences and draw conclusions on the significance associated with those differences. **Response** The fundamental assumption used in the Bayesian update process described in the Data Analysis notebook for unavailability calculations is that there is no prior information from which to Bayesian update. Therefore, the methodology used was to use a Jefferys non-informative prior (0.5) as the foundation for the update process. All of the available data that was used was from plant specific data collection, therefore the posterior mean and plant specific mean are directly correlated. The following assumption was added to Section 3.0 to address the non-informative prior. "For unavailability calculations, a Jefferys non-informative prior was used as there was no informative prior information available."

F&O Number	F&O Details
2-8	The importance of components and basic events are identified in sections 5.1 and 5.7 of the Accident Sequence notebook, respectively. However, documentation that determined the importance results make logical sense could not be identified. (This F&O originated from SR QU-D7) **Associated SR(s)** QU-D7 **Basis for Significance** Multiple reviews of the model solution results yielded model changes, as documented in Table 7.0-1 and Appendix F of the Quantification notebook. Importance measures are calculated in section 5.7; however, these need to be evaluated in light of the model solution results. In other words, do the importance measure reports yield the expected results? **Possible Resolution** Document an evaluation of the importance measure results in light of the CDF results. **Response** A review of the importance of components and basic events has been performed to determine that they make logical sense. The review shows that the risk significant components are consistent with the model results and limitations. Significant contributors include basic events associated with diesels, ERCW, Component Cooling, RHR, Atmospheric Relief Valves (ARVs) and Air Compressors. In SQN, failure of the auxiliary control air headers impacts the ARVs that are needed to cooldown/depressurize in LOCA scenarios since the condenser is unavailable from a Phase B isolation. The emergency diesel, ERCW, RCP breakers, and RHR are important since their failure result in scenarios involving SBO and RCP seal LOCAs.

F&O Number	F&O Details
3-1	Section 4.5, "The calculation above provides that the containment 'hole' size must lie between a 1 inch equivalent path and a 4 inch path. Therefore, it is acceptable to use the NRC value of 2 inches." Based on the statement, the 1" equivalent hole should have been considered. (This F&O originated from SR LE-D7) **Associated SR(s)** LE-D7 **Basis for Significance** It is unknown what the applicable break size is between 1" and 4", therefore the conservative approach is to use 1". **Possible Resolution** Perform detailed analysis to ensure the use of the 2" equivalent hole is allowable or use 1" and include the additional penetrations in the containment isolation analysis. **Response** Section 4.4 discusses the reasoning for concluding that the 2" hole size is acceptable for use in the Sequoyah level 2 analysis. The reference shows that the release rate corresponding to a 1771 scfm rate would be represented by a vent line diameter greater than 1" and slightly less than 2". Because the point corresponding to 1771 scfm at 19 psig (which is half of the assumed severe containment challenge pressure) is only slightly below the 2" contour line shown in Reference 33, and there is conservatism built into both the assumed containment failure pressure and the assumed leak rates at that pressure, it is judged appropriate to use 2" as the bounding value for a large leak rate.

F&O Number	F&O Details

3-7

Several areas were identified that need additional discussion with respect to the Success Criteria Analysis. For example:

1) The differences between plant response to a pipe-break SLOCA and a consequential PORV LOCA are not fully discussed. Given the differences in break location, there should be some discussion in the Success Criteria Notebook of why the pipe-break SLOCA analyses bound the consequential PORV LOCA. In addition, while there is a discussion in the TH Notebook comparing the values of some key parameters for the pipe-break SLOCA and the consequential PORV LOCA, this does not fully explore differences in plant response that may affect the success criteria.
2) There needs to be more discussion of why the 480 gpm per pump RCP Seal leaks are included in the Medium LOCA (MLOCA) grouping. It is stated in Section 4.4.10 of the TH Notebook that the 480 gpm seal LOCA meets the MLOCA requirement of not requiring AFW for accident mitigation, but there is no documentation of success criteria analyses that support this statement.
3) The basis for assuming a SGTR flow of 700 gpm in Section 7.2.10 of the TH Notebook needs to be discussed in more detail than simply noting that no historic SGTR has been of the magnitude of a double-ended guillotine rupture of a SG tube.
4) The LOCA analysis is limited to the upper and lower end of the break range for each class. TH analysis at the middle of the break range within the Large, Medium, and Small LOCA categories may provide insights that have not been revealed by the upper and lower end of the break. For instance, it is not clear if sequence MLOCA-011 can be a success path for a break in the 3 to 5 inch range.

(This F&O originated from SR SC-B3)

Associated SR(s)

SC-B3

Basis for Significance

There is a lack of discussion regarding how these items were treated in the success criteria analysis.

Possible Resolution

Expand the discussion of the noted items in the Success Criteria documentation.

Response

1) The small LOCA events assume that he break occurs low within the physical structure of the RCS. These breaks will always have a higher deltaP value than

those of breaks at the top of the RCS (PORV LOCA). Due to the additional pressure and other thermo-hydraulic characteristics the success criteria is bounding for the SLOCA cases.

2) The 480 gpm seal LOCA is now grouped as a SLOCA. This requires the use of AFW for successful accident mitigation.
3) The value of 700 gpm was used as an attempt to bound the analysis. The selection of 700 gpm was done to assure that the analysis was realistic in nature, but conservative as well.
4) The MLOCA event tree has been restructured to require successful injection of the CLAs this is to assure that any break size within the MLOCA range can be successfully mitigated after failure of the CVCS system to inject.

F&O Number	F&O Details
3-9	All mitigation strategies credited in the accident sequence model when the high pressure recirculation has failed are not prescribed by the corresponding EOPs. In other words, the mitigation credit in the event tree model has no basis. This issue has been self-identified by the SQN PRA staff and a corrective action report has been written for the EOP group to resolve this issue. At this stage the PRA group "firmly" believes that the EOP will be modified, not the model. Thus it is a tracking issue. (This F&O originated from SR SC-A3) **Associated SR(s)** SC-A3 **Basis for Significance** There is a CR written by the TVA. **Possible Resolution** Tack the CR and ensure that the procedures are modified or that the model is changed to reflect the as-operated plant. **Response** EOP revisions were approved at the SQN PORC meeting on May 6th 2011.

F&O Number	F&O Details
3-13	Section 4.4.2 of the TH Notebook (MDN-000-000-2010-205) discusses the use of MAAP for LLOCA in the cold leg. The conclusion is that the large LOCA (LLOCA) limitations are not applicable to break sizes < 10 inches. The reference used for this is a MAAP training lecture. Use of MAAP to model the injection phase of the LLOCA needs additional justification with reference to the applicable technical documents. (This F&O originated from SR SC-B4) **Associated SR(s)** SC-B4 **Basis for Significance** MAAP is known to have difficulty modeling the initial phase of the LLOCA events. **Possible Resolution** Use RELAP or other alternative codes to analyze the initial phase of the LLOCA or provide a more comprehensive justification for the use of MAAP which includes benchmarking against other codes. **Response** The limitation noted for MAAP are for the larger end of the LLOCA spectrum per EPRI TR-1020236. The success criteria for the large LOCA was consistent with and largely derived from the SQN design basis analysis and SAR. While this does lead to conservative results in the LLOCA event tree, the expenditure of additional resources for the further refinement using additional codes such as RELAP is not warranted, given that LLOCA events are not risk significant in the SQN model. The low importance of the LLOCA sequences is consistent with other PWRs in the industry. The MAAP analysis for the LLOCA events were used mostly as confirmation of the event trees based on the SQN SAR and for timing of HRA events. Specifically for the HRA events, MAAP was only used to determine depletion of the RWST and long term time to core damage based on failure of hot leg recirculation. Both of these cases are significantly past the initial stages of a LLOCA where MAAP is noted to lack the thermal hydraulic detail required to evaluate the initial blowdown (EPRI-TR1020236).

F&O Number	F&O Details

3-14

Several documentation issues were noted in the Success Criteria and TH Notebooks. Specifically,

1) Figures 7-60 and 7-61 of the TH Notebook (MDN-000-000-2010-205) need to be replaced with updated results.
2) The discussion of accident sequence node LPH in Section 7.3.1 of the TH Notebook (MDN-000-000-2010-205) states that "The time for switchover to hot leg recirculation is specified in the EOP E-1 as 3 hours after the initiation of a large LOCA (Reference 4, Step 31c)." In the paragraph immediately below this statement, the calculation of the time available for recovery from a failure of recirculation uses a switchover time of 5 hours. Discussion with TVA personnel indicated that the 3 hour value was copied from the WBN notebook. The actual time specified in the SQN procedures is 5 hours.
3) Table 7-13 of the TH Notebook (MDN-000-000-2010-205) does not include success path ISLM-014 as shown in Figure 6.4-10 of the Accident Sequence Notebook (MDN-000-000-2010-0201). In addition, success path ISLM-017 in Table 7-13 of the TH Notebook is not shown in Figure 6.4-10 of the Accident Sequence Notebook.
4) Section 4.4.11 of the TH Notebook (MDN-000-000-2010-205) discusses the classification of a Stuck Open PORV as a small LOCA. The basis needs to be provided.

(This F&O originated from SR SC-C1)

Associated SR(s)

SC-C1

Basis for Significance

The documentation needs to match the current analysis.

Possible Resolution

1) Replace figures 7-60 and 7-61 with the correct figures.
2) Revise the text to use the correct information for SQN.
3) Ensure the sequence designations in Table 7-13 of the TH Notebook (MDN-000-000-2010-205) match those in Figure 6.4-10 of the Accident Sequence Notebook (MDN-000-000-2010-0201).
4) Justify the classification of the Stuck open PORV as a SLOCA.

Response

1) Figures 7-60 and 7-61 were revised in the TH calculation MDN-000-000-2010-205.

In the original MAAP runs, the SG ARVs were opened at 30 minutes, this dropped pressure in the RCS. Opening of the SG ARV was not credited in the event tree for the sequences evaluated in figures 7-60 and 7-61. This is applicable to the WBN TH analysis as well.

2) The TH Notebook was revised to be consistent with EOI E-1 step 22. The correct time of switching over to Hot Leg Recirculation of 5 hours was included in Section 7.3.1 of the TH Notebook.

3) Table 7-13 and Figures 6.4-10 were revised to be consistent.

4) Additional information was included in section 4.4.11 of the TH notebook to justify the classification of a Stuck Open PORV. This information includes a comparison of core damage timing and mass/energy release rates through a SOPORV and SLOCA.

F&O Number	F&O Details
3-19	Section 7.2 of the HRA Notebook (MDN-000-000-2010-0204) does not explicitly discuss how the required and available manpower is addressed in the analysis. Manpower requirements are included in the operator interview checklist as item 37. However, it is not clear how this information was used in the development of the HEPs since some instances were observed where the operator interview responses were not used in the HRA calculator (see HFE HARR1). (This F&O originated from SR HR-H2) **Associated SR(s)** HR-H2 **Basis for Significance** Some accident scenarios can require more manpower than others and this is not discussed. **Possible Resolution** Add a discussion of how the manpower requirements are accounted for in the HRA, especially for those HFEs which require local actions. **Response** A discussion of the required and available manpower to perform the actions and equipment manipulations was documented in sections 7.1 and 7.2 of the HRA notebook. Also, HARR1 was revised to match the operator interview for the manpower requirements.

F&O Number	F&O Details
3-20	Several issues related to the TH analyses used to support the HRA were identified. Specifically, 1) Some time windows are buried in MAAP output files which are not included in the TH Notebook and take time to review. For example, the time window for AFWOP5 is not easily available. 2) TH Notebook MDN-000-000-2010-205 Section 7.3.3 discusses the actions required following a failure of high pressure recirculation. The required action related to failure of the automatic recirculation alignment (HARR1) has two big pieces. The first is to stop the pump to avoid pump damage. If the pumps are damaged, high pressure recirculation can't be successful. The time window is short for this action and is related to RWST depletion. If the pumps are stopped on time the next action is to manually establish recirculation. The time window for that action is based on the RCS inventory depletion which is, relatively speaking, much longer. If HP recirculation is not successful, the RCS is depressurized to facilitate low pressure recirculation (AFWOP3). These two actions (HP recirculation and RCS depressurization and establish LP injection/recirculation) are for the same mitigation function. Therefore, it is unclear why there are big differences between the time windows for these two actions. In addition, the HRA Calculator input for these actions appears to be different from the descriptions in Section 7.3.3 of MDN-000-000-2010-205. 3) The use of bounding analyses for the HFEs results in non sequence specific timing information in the HRA. For example, HARR1 is used in the accident sequences after AFWS success in SSBO and SSBI accident sequences. However, the timing window of HARR1 is based on the medium LOCA and it is conservative for these sequences. (This F&O originated from SR HR-I1) **Associated SR(s)** HR-I1 **Basis for Significance** The documentation of the TH analyses performed to support the HRA is difficult to trace and in some cases contains conflicting information. **Possible Resolution** 1) Revise Table 8-1 in the TH Notebook (MDN-000-000-2010-205) to include additional information such as the time to core damage and a reference to the applicable TH cases.

2) Review the results of TH cases supporting the HRA to ensure reasonable consistency of time windows for different actions with the same purpose.
3) Refine the timing analysis as necessary to ensure the results are realistic and represent the accident sequence(s) in which the actions are used.

Response

1) TH notebook revised – all HRA timing in Table 8.1
2) All TH result cases were reviewed to ensure that the time windows in use were consistent between different actions with the same purposes.
3) As stated in the details of the F&O, the analysis used is conservative. The timing analysis is for the most time limiting break for which the action is applied. This conservative timing selection addresses all potential scenarios/break sizes and would only reduce HEP and add additional margin to the analysis. This is considered to be appropriate due to the ranges of break sizes included in the broad bands of initiating event groupings. Evaluation of the recovery of additional margin from developing lower HEP individual analyses for each application of HARR1 will be completed in future revisions of the SQN PRA model.

F&O Number	F&O Details

3-25

Several documentation issues were noted. For example:

1) Sequences ISLM-008 and ISLM-017 were deleted from the ISLOCA event tree. However, there is no discussion of why this was done.
2) Paragraphs in section 6.4.7 need to be revised. Specifically, the first sentence in the first paragraph on page 62, starting with "If the temperature of the RCS is 557°F and dropping, the steam dumps, S/G PORVs and blowdown isolation valves are closed." needs to be finished. There is the "if" but no "then." It is also unclear how this sentence is related to the accident sequence event tree or the following statements in the paragraph related to the PORVs.

   The second paragraph on page 62 has grammatical errors (e.g., "…the possibility of have a RCP Seal LOCA…").
3) The discussion of manual control rod insertion following ATWS in section 7.9 needs to be revised to reflect the intent to remove credit for this action from the model.

(This F&O originated from SR AS-C1)

Associated SR(s)

AS-C1

Basis for Significance

Inconsistencies in the documentation can affect maintenance and update of the model.

Possible Resolution

1) Add a discussion explaining why sequences ISLM-008 and ISLM-017 are not used or re-number the sequences to ensure there are no gaps in the numbering. Also, ensure all related documents (e.g., the SC and TH notebooks) are revised for consistency.
2) Review sections 6.4.7 and 7.9 and revise, as needed, to ensure that the discussion reflects the accident sequence models.

Response

1) The sequences were not re-numbered following the latest update to the event trees. The numbering scheme will be updated in the next revision of the notebook.
2) The grammatically errors noted have been updated and revised.
3) The ATWS discussion of MRI has been updated to state that only the mechanical binding of the control rods or the failure of the automatic control system are

modeled.

F&O Number	F&O Details
4-3	Non-water flood sources are excluded on the basis of Assumption 11 of the notebook. However, the Standard states (in Note 1 for this SR) that non-water sources should be considered, A more detailed basis for excluding these sources should be developed to meet the requirements of this SR. (This F&O originated from SR IFSO-A1) **Associated SR(s)** IFSO-A1 **Basis for Significance** This is considered to be a finding since the requirements of the SR have not been fully met. **Possible Resolution** Update the analysis to consider non-water sources, or better justify why the flooding impacts of these non-water sources are not significant and hence do not require evaluation. **Response** Assumption 11 was reworded to: All sources of fluid within the plant were analyzed for flooding considerations. However, the glycol system is the only system which could have an impact on the flooding analysis. All other sources such a resin did not have enough volume to cause impact to plant operation. The glycol system also has a minimum volume, but the location of the piping, in the control rod drive rooms, causes system to be a source of spray initiating events.

F&O Number	F&O Details
4-7	No discussion of sources of uncertainty associated with the flooding initiating events is currently provided in the flooding notebook (MDN-000-000-2010-0203). It is noted that the notebook includes documentation of sources of uncertainty for other portions of the flooding analysis. Sources of model uncertainty for internal flooding are also documented in MDN-000-000-2010-0209, Uncertainty and Sensitivity Analysis; however, again flood initiator uncertainties are not discussed. If no uncertainties are identified for the flood initiator frequency evaluation, then the notebook should state this to be consistent with the approach used for the IFPP, IPSO, and IFSN tasks. (This F&O originated from SR IFEV-B3) **Associated SR(s)** IFEV-B3 **Basis for Significance** This is considered to be a finding since the requirements of this SR are not met **Possible Resolution** Provide an assessment of sources of modeling uncertainty for the flood initiator frequency determination. **Response** Section 8.8 was added to the Internal Flooding Notebook with the following: The internal flooding frequency calculation has several different uncertainties associated with the calculation. The current model uses a summation of three different frequencies, passive pipe break failures, human induced floods, and maintenance induced flooding. Each of these flooding events has its own inherent uncertainties. For passive pipe break failures rates have been given an uncertainty parameter as presented in Section 8.5. The impact of these uncertainties can be treated by the use of a random sampling Monte Carlo process as discussed in Section 10.1. Human induced flooding events present another difficult challenge. The use of the HRA Calculator program from Scientech creates an assumed uncertainty term for any HRA action. Since the human induced flooding events is a combination of both pre-initiating event and post initiating event, each portion has an independent uncertainty term. The HRA Calculation program also arbitrarily assigns an uncertainty term to HRA actions based on the calculated probabilities, see the HRA Calculation for more information on the uncertainty parameters (Reference 68). The other fundamental issue that is presented in human induced flooding events is the location of work. Depending on where the actual work is being performed in a flood area,

isolation could be a concern as the next available valve could be in an inaccessible area. Additionally, there are no detailed procedures to address having a flood occur during a maintenance event.

Maintenance induced flooding events also present a level of uncertainty. The three main inputs to the calculation of this frequency, failure rate of an MOV, mission time, and frequency of the activity all introduce some level of uncertainty into the calculation. The large internal rupture of an MOV is assumed in NUREG/CR-6928 to be a factor of 0.02 less than that of a small internal leak on an MOV (Reference 104), as there has been no actual large internal rupture events in the industry. The mission time is also assumed based on a seven day repair interval, this number could potentially be greater than that if the component is not covered by an Technical Specification or, more likely, less than the assumed seven day repair time. The final area of uncertainty is the frequency of the activity. Most of the procedures reviewed in Appendix J have frequencies as well as conditions. These conditions could cause the actual maintenance activity to occur more times than the frequency noted in the procedure.

F&O Number	F&O Details
4-11	While the PRA model considers the possibility of two PORVs being blocked at the same time, there does not appear to have been an investigation of whether coincident maintenance can occur in the various SQN systems (or if coincident inter-system maintenance can occur). Therefore this SR is not met. It was also observed that the PORV blocking basis events noted above did not appear to be documented in either the data notebook or the appropriate system notebook. (This F&O originated from SR DA-C14) **Associated SR(s)** DA-C14 **Basis for Significance** This is a finding since the technical requirements of the SR are not met. **Possible Resolution** A study should be conducted to determine if coincident maintenance conditions can occur. If so, the system models may need to be modified and additional basic events to represent the coincident maintenance states would need to be added. If it is determined that no coincident maintenance can occur, then this should be documented in the data notebook or within the system notebooks. Documentation for the calculation of the time that either one or both PORVs can be blocked should also be added to either the system notebook or the data notebook. **Response** The following was added to the data analysis notebook to address coincident maintenance: Coincident maintenance is scheduling maintenance where multiple SSCs are out of service at the same time. Specifically components on the same train, RHR train A and SI train A for example, being out of service for maintenance at the same time. The Outage and Site Scheduling Directive Manual 1.0 (Reference 28) dictates that: Twelve (12) week schedule by FEG groups ensures that within a train week, no two (2) accident mitigating devices are removed from service at the same time [i.e., "A" train Residual Heat Removal (RHR) is not removed from service at the same time as "A" train Containment Spray.] This requirement is further discussed in the Outage and Site Scheduling Directive Manual 4.7 (Reference 29) which states that any systems important to PRA that are unavailable at the same time must meet the requires of the plant risk matrix. Normally maintenance on any systems important to the PRA is not scheduled at the same time. If it is these instances are extremely rare and the current model does not

exclude coincident maintenance events from appearing in a single cutset. Therefore the probability of having coincident maintenance events is extremely rare and accounted for during the normal cutset processing.

F&O Number	F&O Details
5-2	Some HFEs are set to a value of 0.0 for quantification. For example, HACI1 and HAAE1 are recovery actions for automatic signals ANDed with the signal logic. However, the HRA analysis sets the HEP probability to 0.0 based on an analysis that the operator action is not required. This screening approach, combined with the model structure, removes the auto actuation contribution to mitigating system failure during quantification. (This F&O originated from SR HR-G1) **Associated SR(s)** HR-G1 **Basis for Significance** Screening HFEs using a value of 0.0 remove the auto actuation hardware failure contributions in the quantification results. **Possible Resolution** Revise the model to remove non-credited operator recovery actions from the linked fault tree or set all non-credited events to TRUE during quantification. **Response** For those events where 0.0s were used in the model the fault tree was updated to remove the events so that the conflict concerning an AND gate and a zero event will not longer be encountered during normal quantification.

F&O Number	F&O Details
6-2	The justification for excluding plant data prior to July 2002 in the calculation of plant specific IE frequencies is not documented well enough to support IE-C2. (This F&O originated from SR IE-D2) **Associated SR(s)** IE-C2 IE-D2 **Basis for Significance** A justification was provided during the review, but it is not documented in the notebook. **Possible Resolution** Include a justification for excluding data prior to July 2002 in the IE notebook. **Response** Added discussion to notebook stating that date range was adequate to get a good sample of plant data without going too far back and including events that occurred when the plant may have had different procedures and operating practices

F&O Number	F&O Details
6-3	The alignment flags in the ERCW system are not fully implemented to represent the system alignment within the Initiating event portion of the tree. For example, the gates under U0_AEX_G006 should contain flags to indicate which pump is running and which two pumps are not, so that the two non running pumps would have considerations for failures to start. (This F&O originated from SR IE-A6) **Associated SR(s)** IE-A6 IE-C10 **Basis for Significance** The current fault tree configuration does not properly account for the system alignment. **Possible Resolution** Include the alignment flags in the indicated and similar gates. Review the remainder of the tree to ensure that the alignments are properly identified. **Response** The current flag alignment for ERCW has been revised so, for the baseline model, without setting a specific configuration, the flag files were set to the respective time in each configuration to that a probability is now used not a true or false value.

F&O Number | **F&O Details**

6-5

The support system initiating event trees for the most part include provisions for common cause failures and routine system alignments. There are some discrepancies in the modeling of common cause failures in the ERCW and CCS models that require attention, however. For example:

1) While a common cause event for all 3 of the 1A, 1B, and C-S pumps failing to run exists, there are not events for the 1A and C-S pumps or the 1B and C-S pumps.
2) The structure of the ERCW tree is such that pump common cause failures could result in a pump failing due to an independent failure as well as a common cause failure in a single cutset. (See gate U0_AEX_G001)
3) The common cause initiating event group U0_ERW08POEFRI is not valid, since it is entirely based on 8760 hour exposure time for all the components. The common cause failure frequencies are therefore overestimated. The CCS tree uses a different approach than the ERCW tree for common cause initiating events. An alternate approach is also given in EPRI reports 1013490 and 1016741.

(This F&O originated from SR IE-A6)

Associated SR(s)

IE-A6

IE-C10

SY-B3

Basis for Significance

Support system initiating event failures are inconsistently applied among the support system models, and may be giving incorrect results.

Possible Resolution

Review initiating event common cause events and select a consistent modeling approach among the support system initiating event models.

Response

With respect to the common cause failure of the CCS pumps:

The common cause failure of the 1A and the C-S pump or the 1B and the C-S pump would not meet the requirements to cause an initiating event for the CCS system. Only failure of the A train would cause the plant to have to trip as the loads on the common train are not required for operation at power. Therefore only the common cause failure of all three pumps is modeled in the fault tree.

With respect to the common cause failure events from the ERCW fault tree:

The common cause failure events in the ERCW system where common cause failure and independent failures show up in the same cutset present a minimal and conservative impact.

With respect the common cause calculation of basic events:

The common cause failure rates for ERCW pumps failing to run and CCS pumps failing to run were revised based on the EPRI document 1013490 using the discussion presented on page 5-8. The assumptions and calculation of these basic events is noted in Appendix B of each calculation.

F&O Number	F&O Details

6-6

Section 5 of the IE notebook shows a Bayesian process was used to combine plant specific and generic data. However, LOCA frequencies from NUREG-1829 were also updated with plant specific data. Since the frequencies in NUREG-1829 were based on expert judgment and not actual industry data, and it is not expected that a plant would experience such an event, it does not seem appropriate to use the Bayesian update process for these events. The update did not appear to significantly alter the IE frequencies, however, so there is little impact on CDF.

(This F&O originated from SR IE-C4)

Associated SR(s)

IE-C4

Basis for Significance

Frequencies in NUREG-1829 were based on expert judgment and not actual industry data, and it is not expected that a plant would experience such an event, it does not seem appropriate to use the Bayesian update process for these events.

Possible Resolution

Use the frequencies derived from NUREG-1829 without Bayesian updating with plant data.

Response

The frequencies presented in NUREG-1829 represent the best estimates available at that time. There is no restriction on updating an expert solicitation, as the update process will only serve as to better estimate the actual failure rate for the initialing events.

F&O Number	F&O Details

6-7

Section 6 of the Initiating Events Analysis, the associated system notebooks, and the HRA notebook document the use of plant-specific information in the assessment and quantification of recovery actions where available, in a manner consistent with the applicable HR SRs.

An issue was noted with the ERCW initiating event tree. Event HAAEIE "Operator Fails to Start ERCW Pump (Initiating Event)" has been set to zero based on an analysis that found one pump was sufficient to cool plant loads, so if one of the two running pumps trips, operator action is not required to start another pump. Operator action to start a standby pump would be required, however, if flow was to be lost from both running pumps. The current model essentially assumes a successful operator action to start both of those pumps.

(This F&O originated from SR IE-C11)

Associated SR(s)

IE-C11

Basis for Significance

The operator action HAAEIE has inappropriately been assumed to be 100% successful.

Possible Resolution

Re-evaluate the failure rate for operator action HAAEIE, given the revised requirements of the ERCW system with regards to causing an initiating event.

Response

The ERCW initiating event model has been updated.

Calculation CN-NUC-SQN-MEB-MDQ-000-067-2000-0095 revised the existing success criteria used in the initiating event model. The results of the calculation that as long as the containment spray heat exchangers were not in service, the maximum required flow on the ERCW system would be roughly 9,000 gallons. This is within the design flow rate of 10,000 gallons per minute from one ERCW pump. Due to the change in the success criteria, the initiating event model was update to requiring the failure of two running ERCW pumps as well as failure of both standby ERCW pumps to start. The HRA action HAAEIE was added to the model under the appropriate failure to start gate, no longer under an AND gate.

Additionally, the fault tree logic in question was update so that failure to start takes into account the failure of operation action HAAEIE.

F&O Number	F&O Details
6-10	Tables 42 and 43 of MDN-000-000-2010-0209 contain a list of modeling assumptions and their impact on the PRA model. However, the majority of items in Table 43 have an impact of "Unknown." Classification of model impact for these assumptions is necessary to meet this SR. (This F&O originated from SR QU-E4) **Associated SR(s)** QU-E4 QU-F4 **Basis for Significance** The SR requires identification of the impact of identified assumptions on the model. **Possible Resolution** Provide an evaluation of an impact of the items listed as "Unknown" in table 43. **Response** The Uncertainty and Sensitivity Analysis calculation has been updated in the following ways: Text concerning the discussion of Unknown impacts and performing a respective uncertainty analysis was removed from Section 5.0. Table 43 was updated to remove the column "Model Impact" and the column "Comments" was updated to "Model Impacts and Comments" and expanded.

F&O Number	F&O Details
6-12	From the results presented in sections 5.2 and 5.7 of MDN-000-000-2010-0208, it can be inferred that the definition of significant basic event and significant accident sequence are consistent with those listed in Part 2 of the standard. This is not explicitly stated in the documentation, however. The definition of significant cutset is not provided, nor does the 100 cutset list provided in the documentation imply that the part 2 definition was used, as the 100 cutsets do not represent 95% of the risk. (This F&O originated from SR QU-F6) **Associated SR(s)** QU-F6 **Basis for Significance** Documentation of the definition of "significant" is required by the SR. **Possible Resolution** Provide a definition of significant cutset, significant sequence, and significant basic event in the documentation. **Response** The documented definition in Section 1-2.2 of the ASME/ANS combined standard was added to the quantification calculation.

Suggestion Level F&Os

F&O Number	F&O Details
1-1	RG 1.200 Revision 2 documents a qualified acceptance of this SR. The NRC resolution states that to meet Capability Category II, the impacts of flood-induced mechanisms that are not formally addressed (e.g., using the mechanisms listed under Capability Category III of this requirement) must be qualitatively assessed using conservative assumptions. (This F&O originated from SR IFSN-A6) **Associated SR(s)** IFSN-A6 **Basis for Significance** This is an enhancement required to satisfy the RG 1.200 qualification. **Possible Resolution** Document a qualitative assessment of the impacts of jet impingement, pipe whip, humidity, condensation, temperature and other flood-induced mechanisms that are not explicitly modeled. **Response** The analysis was changed so that all components within a flood area are failed on initiation regardless of the equipment qualifications or other HELB mitigation features.

F&O Number	F&O Details

1-2

All components were assumed failed if subjected to submergence. MDN-000-000-2010-0203 Appendix F documents whether components were spray vulnerable. Discussion with the responsible analyst revealed that factors considered in spray vulnerability determinations included shielding, sealing, and equipment qualification records. However, this is not documented in the notebook.

(This F&O originated from SR IFSN-A7)

Associated SR(s)

IFSN-A7

IFSN-B2

Basis for Significance

The technical requirement is met, but the documentation could be enhanced.

Possible Resolution

Document the basis for determining whether a component is "spray vulnerable" in MDN-000-000-2010-0203.

Response

The following text was added to Appendix F:

During the walkdowns spray vulnerability was determined by observations of the components. For MOVs, an obvious seal with water proofing had to be observed to determine if the component was vulnerable to spray.

After the walkdowns were complete a comparison to the EQ database was done to observe if any components which were seen during the walkdowns and noted as being vulnerable to spray actual were environmentally qualified. Those components were removed from the spray analysis as well as Appendix G and Appendix H.

Tables were also added to Appendix F to show those components that are currently listed as environmentally qualified in the MAXIMO database.

F&O Number	F&O Details
1-3	The water depth required to cause failure of doors is documented in the Appendix F walkdown sheets, but the derivation of this value is not documented.

(This F&O originated from SR IFSN-A9)

Associated SR(s)

IFSN-A9

IFSN-B2

Basis for Significance

Discussion with the responsible analyst revealed that holdup of water by doors was not credited in the final analysis. Therefore this is a documentation issue that does not affect the results.

Possible Resolution

Document the basis for the water depth required to cause door failure used in Appendix F.

Response

Door failure height calculations were performed post walkdown. The failure heights were broken into two different sections. If the door was observed to be a fire door, the calculation of failure height used the HELB analysis, if the door was wire mesh or a non fire door then the failure height was assumed to be 0 feet.

The height of water necessary to fail a door is calculated based on if the height will exceed the actual height of the door. For calculations where the height of water is less than the height of the door, the following equation can be used:

$$h_{water} = \frac{2p}{\gamma}$$

Where *p* is the failure pressure and *γ* is the specific weight of water.

For those calculations where the height of water would exceed the actual height of the door, a different equation must be used. The door is now considered to be a completely submerged surface, so the following equation can be used:

$$h_{water} = \frac{p}{\gamma} + \frac{h_{door}}{2}$$

Where *p* is the failure pressure, *γ* is the specific weight of water, and h_{door} is the actual height of the door.

For the purposes of Appendix F, the failure pressure of all fire doors was taken from the HELB analysis, which states that a pressure of 1.5 psid will cause the doors to fail.

Using the equations above, the failure height of water is calculated to be 6.92 feet.

F&O Number	F&O Details
1-5	Documentation of the scenario impacts needs to be strengthened in some areas. For example: 1) In MDN-000-000-2010-0203 Section 9.4.3.3 for flood area 734.0-A13 it is stated that "the flood frequency for those events that impact both ACAS compressors will be 1/3 of the original frequency." No basis is provided for this statement. 2) Section 7.3 makes the general statement that for the Turbine Building "flood originated in any level would propagate freely to the basement of the building without any hindrance." This same assumption was applied in partitioning Auxiliary Building area 930.0-A1, but this is not documented. (This F&O originated from SR IFSN-A6) **Associated SR(s)** IFSN-A6 IFSN-B2 **Basis for Significance** The technical process is acceptable, but the documentation could be strengthened. **Possible Resolution** Document assumptions pertinent to the flood scenarios such as those noted in the F&O description. This could be done in the Notebook or the FRANX database. **Response** The text quoted in the analysis has been updated. A further walkdown of the plant was done to reflect piping that could impact both the ACAS air compressors. Further walkdowns conducted in April 2011 showed there was no piping that was within twenty feet of both air compressors skids on the refuel floor. Therefore the section of the notebook addressing such issues was removed. Additionally, the breaking apart of 690 into zones has been enhanced in the documentation and is discussed in the plant partitioning section. The documentation of the flooding scenarios and the flooding analysis now includes the partitions as part of the analysis, not as a change after review of the cutsets.

F&O Number	F&O Details
1-6	MDN-000-000-2010-0204 Section 7.3 states that a reasonableness check was performed and generally describes the factors considered. However, it would be helpful to provide tables that grouped HEPs by the relevant factors to support the conclusions reached. (This F&O originated from SR HR-G6) **Associated SR(s)** HR-G6 **Basis for Significance** The check was performed, but the results are not documented in a way that supports verification of the conclusions. **Possible Resolution** Include a table that groups the HFEs by the complexity to support the conclusion that "HFEs that are more complex have higher failure probabilities than simple actions." Similarly, a table that groups the HEPs by the available time would support the conclusion that "HFEs with shorter time windows have higher failure probabilities due to factors including insufficient time to credit review from the STA and negative performance shaping factors (e.g., high stress levels). These factors are not included in the referenced Table 10-2. **Response** Tables have been added to HRA notebook section 7.3 for the complexity and time margin comparisons completed for the SQN Rev 5 PRA and HRA model update.

F&O Number	F&O Details
1-9	The CCS system success criteria is modeled as dependent on the temperature of the ERCW system. MDN-000-070-2010-0217 Appendix D documents the derivation of the probability for flag event FLG0070_ERCW_TEMP_GT_70 (FLG_0024SUMMER in the linked fault tree). However, the temperature data is presented in a graphical format rather than a tabular format. A tabular format would make it easier for a reviewer to perform a validation of the data. (This F&O originated from SR SY-A10) **Associated SR(s)** SY-A10 **Basis for Significance** This is a documentation issue not affecting the technical quality of the model. **Possible Resolution** Provide the data used to derive FLG0070_ERCW_TEMP_GT_70 in a tabular format. **Response** The data used to create the graph in the CCS notebook is 111,210 cells long. This data is not feasible to be presented as part of the system notebook. An electronic copy will be kept with the notebook and will be available to any person wishing to review the data.

F&O Number	F&O Details
1-12	Some sources of uncertainty which are characterized as having an impact on LERF are not analyzed using sensitivity analysis (e.g., core melt arrest in vessel and modeling of the ARFs). In addition, Section 5.14.10 states that “Although post-core damage human actions such as intentional depressurization of the RCS are modeled as realistically as possible, the uncertainty related to these actions is addressed in sensitivity studies.” The notebook references the sensitivity and uncertainty analysis notebook as the location for these studies. However, MDN-000-000-2010-0209 performed the uncertainty by setting the values of HEPs in the model to their 5th and 95th percentile values. This does not address uncertainty in the value of the HFE for intentional depressurization of the RCS which is modeled as part of the U1_L2_NOTRCSDEPNOSBO basic event. (This F&O originated from SR LE-F3) **Associated SR(s)** LE-F3 **Basis for Significance** This is a completeness issue which would enhance the analysis. **Possible Resolution** Add sensitivity analyses to address these additional sources of uncertainty in the LERF results. **Response** The HFE for intentional depressurization of the RCS was changed from U1_L2_NOTRCSDEPNOSBO to HAPRZ in the model, and was included in the uncertainty study for the HFEs.

F&O Number	F&O Details
1-13	The operator actions reflected in the event trees, and the sequence specific timing and dependencies that are traceable to the HRA for these actions are discussed in the HRA notebook. The operator actions modeled for each sequence are listed as a separate subsection in MDN-000-000-2010-0201. However, it is suggested that a summary discussion of operator actions affecting the accident sequences, including a discussion of the top events impacted, be included in the AS notebook. (This F&O originated from SR AS-A4) **Associated SR(s)** AS-A4 AS-C2 HR-G4 **Basis for Significance** Documentation enhancement. The links can be identified through cross reference to the system, success criteria, and HRA notebooks. **Possible Resolution** Provide a cross reference for each operator action to the affected event tree top event in the Accident Sequence Notebook. **Response** The operator actions are discussed along with each of the top events for all event trees in the accident sequence notebook.

F&O Number	F&O Details
1-17	Calculation Type 1 is used for mission time events and Type 2 is used for basic events where the probability is based on periodic tests. The CAFTA users manual states that "…it is better to use the more precise formulas of calculation types 3, 4, 5 or 6. This is especially important if you are using larger numbers (e.g., $\lambda t > .05$), or if you will be doing uncertainty analysis." (see CAFTA users manual Tables 6-2a and 6-2b and the text below Table 6-2b.) (This F&O originated from SR QU-E3) **Associated SR(s)** QU-E3 **Basis for Significance** The current method yields a valid approximation of the basic event probabilities, but does not represent the recommended practice for CAFTA. **Possible Resolution** Use the more precise formulas for the time dependent basic event probability calculations. **Response** The current model does not have any events where the lambda*t value approaches 0.05. The models used will have their calculation types updated to 3 and 5 where appropriate when any update is to be performed. For the current model, no events generated a random value greater than 1.0 for the uncertainty graphs.

F&O Number	F&O Details
1-18	The system notebooks typically state that high energy line break (HELB) is considered in the Internal Flooding Analysis (e.g., ERCW Notebook Section 3.4.7.2.6). However, assumption 3.1 of the IF Notebook states that "Additional failure modes; jet impingement, pipe whip, humidity, condensation, and temperature-induced failures are outside the scope of this analysis." (This F&O originated from SR SY-C2) **Associated SR(s)** SY-C2 **Basis for Significance** The treatment of HELB is not clearly documented in the system notebooks. **Possible Resolution** Modify the statements in the system notebooks to clearly state that HELB is not treated and to provide a justification for this. **Response** The assumption was removed from the IF notebook. The HELB events are now addressed in the IF analysis.

F&O Number	F&O Details
1-20	The SQN PRA considered Early containment failure as well as Late containment failure and basemat melt through. After containment failure, there is no additional equipment nor human action credited to mitigate the consequences. There is also no evidence that a review was performed to determine if crediting operation of additional equipment or human actions after containment failure would reduce LERF. (This F&O originated from SR LE-C11) **Associated SR(s)** LE-C11 LE-C12 **Basis for Significance** Recommendation for meeting the requirements for Capability Category II/III. **Possible Resolution** Document a review of the LERF results to determine if credit for equipment operation after containment failure or additional operator action credit would be effective in reducing LERF. **Response** There are no additional actions or equipment currently credited in the level 2 analysis to mitigate the consequences of a release after containment failure. This results in somewhat conservative results. A review has been performed to determine if crediting additional equipment or crediting additional human actions could result in a LERF reduction. An action identified during this review involves crediting manually closing the RCP seal water return outboard isolation valve following core damage in the event that it fails to close on demand. A sensitivity study was performed to determine the effect of this action using various assumed failure probabilities (see Section 12.7), although the feasibility of implementing the action has not been studied in detail.

F&O Number	F&O Details
1-21	A thorough list of references is documented with each system notebook. However, the reference revision level is not always included (see the Diesel Generator and RPS notebooks, for example.) (This F&O originated from SR SY-A2) **Associated SR(s)** SY-A2 SY-C2 **Basis for Significance** The supporting requirement is met, but the documentation could be enhanced. **Possible Resolution** Provide the applicable revision level for each reference to improves traceability of the source documents. **Response** Reference levels were left off of the references in all system notebooks consistent with the TVA practices for PRA calculations.

F&O Number	F&O Details
2-2	Per discussion with the SQN PRA data analyst, maintenance is generally performed on a train basis rather than across redundant components. Where redundant maintenance is permissible, e.g., the ERCW system, which has 8 pumps, the fault tree allows for the generation of cut sets that have multiple pumps in maintenance. However, it would be helpful to document a verification that simultaneous unavailability of redundant equipment is not how work is planned. (This F&O originated from SR SY-A20) **Associated SR(s)** SY-A20 SY-C2 **Basis for Significance** Since maintenance on redundant equipment is not modeled as a planned event, documentation should be provided or referenced that describes how maintenance is planned/coordinated. This assures that any maintenance dependencies are not overlooked. **Possible Resolution** Document the maintenance approach taken on redundant equipment and any impact on the PRA model. **Response** Coincident unavailability is now discussed in Section 7.4.4 of the data analysis notebook.

F&O Number	F&O Details
2-6	No modifications to plant design or operating practices were identified that lead to a condition where past data are no longer representative of current performance. Thus limiting the use of old data was not required. However, for completeness, it is suggested that the data analysis document the consideration of this supporting requirement. (This F&O originated from SR DA-D8) **Associated SR(s)** DA-D8 DA-E2 **Basis for Significance** No documentation addressing this supporting requirement was identified. **Possible Resolution** Document a consideration of modifications to plant design or operating practices that could lead to a condition where past data are no longer representative of current performance in the Data Analysis notebook. **Response** Section 7.2.1 was added to the data analysis notebook to address plant design changes.

F&O Number	F&O Details
2-7	The data analysis aligns well with the PRA Standard requirements and is generally well-documented. Adding a 'roadmap' to the PRA Standard data SRs - as was done elsewhere in the PRA documentation - would enhance the performance of PRA applications, upgrades, and peer review. (This F&O originated from SR DA-E1) **Associated SR(s)** DA-E1 **Basis for Significance** Adding a 'roadmap' to the PRA Standard data SRs would enhance the performance of PRA applications, upgrades, and peer review. **Possible Resolution** In the Data Analysis notebook, add a 'roadmap' to the PRA Standard data SRs. **Response** Appendix I was added to the notebook to address the ASME/ANS standard sections.

F&O Number	F&O Details

3-4

The success criteria description needs to include the boundary conditions such as RCS pressure. In general, it is not clear what the condition is that allows the SI pumps to operate.

(This F&O originated from SR AS-A3)

Associated SR(s)

AS-A3

AS-B2

SC-A3

Basis for Significance

Documentation of required conditions permitting some equipment to operate is not provided.

Possible Resolution

Provide more detailed discussion of the success criteria and mitigation system operating characteristics (e.g. pressure, flow rate) and how the conditions are achieved. For instance, the SI pump injection pressure and how the pressure is achieved in the accident sequence (i.e., by opening pressurizer or SG PORVs) should be discussed.

Response

All boundary conditions are listed in either the parameter file or the input decks electronic copies of these are available on request.

F&O Number	F&O Details
3-10	The EOPs associated with a specific accident sequence success path are not identified in the Thermal Hydraulic Analysis or the Success Criteria Notebook. These are also not explicitly discussed in the Accident Sequence Notebook. (This F&O originated from SR AS-A5) **Associated SR(s)** AS-A5 **Basis for Significance** There is no discussion relating the Emergency Operating Procedure (EOP) with accident progression in AS notebook. **Possible Resolution** Provide discussions relating EOPs to the accident sequence and top events ordering. **Response** The EOP steps are now incorporated into the accident sequence notebook.

Appendix A - Resolution of F&Os

Facts and Observations Summary – Suggestion F&Os

F&O Number	F&O Details
3-11	Use of the design basis for certain success criteria may result in conservative modeling. For example: 1) Section 4.4.3 of the TH Notebook (MDN-000-000-2010-205) discusses the MAAP 4.0.7 limitations which prevent use of MAAP for determining the number of accumulators required for Large LOCA (LLOCA) success. The use of the design basis assumption that 3 of 3 intact loop accumulators are required is likely to be conservative. 2) Section 4.4.7 of the TH Notebook (MDN-000-000-2010-205) discusses the number of lines needed for the Emergency Core Cooling System (ECCS). Based on MAAP limitations, the conclusion is that the current analyses only support ECCS flow through all intact lines. This conclusion is likely to be conservative for some sequences. (This F&O originated from SR SC-B1) **Associated SR(s)** SC-B1 **Basis for Significance** The use of design basis success criteria for the accumulators and for the required number of injection paths may be conservative. **Possible Resolution** Perform PRA specific analysis using an alternative code to determine if success can be achieved with fewer than 3 accumulators or with flow to fewer ECCS injection paths. **Response** MAAP currently is the consensus model of choice for analysis supporting the development of the PRA model. The use of other codes does not facilitate the development of the PRA model. The current success criteria of 3 of 3 CLAs will be retained in the model.

F&O Number	F&O Details
3-22	It is stated that the impacts of the initiating event on mitigation systems are captured in the top events. However, there is no discussion of these impacts in the accident sequence notebook. (This F&O originated from SR AS-B1) **Associated SR(s)** AS-B1 **Basis for Significance** There is no documentation found that explicitly describes the dependencies between the mitigation systems and the initiating events. **Possible Resolution** Discuss the impact of initiating events on individual mitigation systems under each top event. Alternatively, provide an initiating event to mitigating system dependency matrix. **Response** An initiating event impact table was added to the Success Criteria Notebook

F&O Number	F&O Details
3-23	The impact of the phenomenological conditions created by the accident progression is not discussed in the accident sequence notebook. (This F&O originated from SR AS-B3) **Associated SR(s)** AS-B3 **Basis for Significance** There is no discussion of phenomenological conditions in the AS notebook. However, the environmental conditions affecting equipment operation is captured in the system analysis notebooks. **Possible Resolution** Add a discussion of the phenomenological conditions created by the accident sequence and their impact on the credited mitigation equipment. **Response** The current phenomenological conditions, initiator impact, are discussed within each system notebook.

F&O Number	F&O Details
3-24	The intersystem dependencies are embedded in the accident sequences, but there is no explicit discussion of these dependencies. (This F&O originated from SR AS-B5) **Associated SR(s)** AS-B5 **Basis for Significance** There is no intersystem dependency discussion in the AS notebook. **Possible Resolution** 1) Add an explicit discussion of the intersystem dependency to the discussion of each accident sequence, or 2) Include a system dependency matrix in the AS Notebook to illustrate the dependencies. **Response** A system dependency matrix has been included within the SC notebook.

F&O Number	F&O Details
4-1	Section 5.2 of the Internal Flooding notebook (MDN-000-000-2010-0203) considers flood areas in the buildings of both units, and includes all common buildings. At the building level, the text discusses whether the building contains shared equipment; however, the text and tables do not indicate which specific flood areas can impact both units. It would be helpful to enhance the documentation to indicate which flood areas have multi-unit impacts. Similarly, the discussion of food sources should attempt to identify sources with multi-unit impacts. (This F&O originated from SR IFPP-A3) **Associated SR(s)** IFPP-A3 IFSO-A2 **Basis for Significance** This is a suggestion since it pertains solely to enhancement of the documentation of the flood area partitioning and flood source identification process. The flood analysis itself correctly addresses multi-unit impacts. **Possible Resolution** Include (in the text of section 5.2 or within the tables of included areas) indication of what areas have multi-unit impacts. Include similar documentation in section 6.1 for flood sources. **Response** All areas currently analyzed that contain ERCW, CCS, HPFP, RCW or any other infinite source of water are addressed in Section 5.2 The tables provided list all areas of the plant including those where there are and are not multi-unit impacts. No changes were made to the internal flooding document Section 5.2 or 6.1

F&O Number	F&O Details
4-6	The SQN flooding analysis has addressed some, but not all of the requirements for Category II/III. EPRI flooding data based on generic industry experience is used for flood initiating events due to pipe ruptures. Plant-specific data that might influence the pipe failure data (e.g., material condition of the fluid systems and water hammer experience) are not considered. However, a review of plant-specific maintenance-induced flooding events was performed (Appendix G of the flooding notebook) and was considered in the calculation of maintenance flooding frequency. To fully meet Category II/III, an assessment should be made of plant material condition and water hammer experience) and whether plant conditions warrant any adjustments to the generic flood frequencies that are used. (This F&O originated from SR IFEV-A6) **Associated SR(s)** IFEV-A6 **Basis for Significance** This is judged to be a suggestion, since the response to this F&O will most likely only impact documentation. Also, the analysis meets the Category I requirements, which may be sufficient for most applications **Possible Resolution** Review plant-specific experience pertaining to plant material condition and water hammer and document the results of the review in the flooding notebook. **Response** A review of plant specific flooding events was performed in Appendix G. This data was incorporated into the analysis for initiating event frequencies.

F&O Number	F&O Details

4-8

Dependency between pre-initiator events was determined to not be applicable due to the large amount of time between test and maintenance events between various system trains and the use of different crews to perform each train's activities. Dependence between pre-initiators and post-initiators is also not appropriate. The rationale for not considering dependency for pre-initiators seems appropriate.

However, several inconsistencies were noted in the HRA notebook documentation (MDN-000-000-2010-0204) concerning the pre-initiator dependency treatment. Various HRA calculator entries for the pre-initiator events (in Appendix B) indicate that dependency between events is to be considered (see for example, event SHEEMC_4). The introductory material in Appendix F contains some statements indicating pre-initiator dependency will be considered, and other statements explaining why dependency between these events is not expected. These inconsistencies should be corrected.

(This F&O originated from SR HR-D5)

Associated SR(s)

HR-D5

Basis for Significance

This is considered to be a suggestion since it pertains to correcting documentation errors. The underlying analyses themselves are correct and will not be impacted by these errors.

Possible Resolution

Correct the documentation errors in the HRA notebook as noted.

Response

The documentation errors in Appendix B of the HRA notebook were corrected.

F&O Number	F&O Details

4-9

Appropriate generic data sources appear to be used in the SN PRA, as documented in the data analysis notebook (MDN-000-000-2010-0202). Component failure rates are taken primarily from NURG/CR-6928 (with other sources used in cases in which data for specific component types are not available). Common cause data is obtained from recent NRC (INEL) and PWROG data sources. Offsite power recovery data is obtained from NUREG/CR-6890. Component recovery is not used. Table 2 and Appendix A describe the boundaries assumed for each major component type.

The SQN PRA makes use of generic unavailability data from NUREG/CR-6928 for components for which plant-specific data is unavailable (as noted in Table 8). It is assumed (see Assumption 1 in the data notebook) that all generic data is applicable to SQN; however, since this SR requires that the consistency of the SQN practices and philosophies be checked against the generic data source assumptions, additional documentation needs to be provided to better meet the requirements of this SR. It is recognized that assumption 1 is listed as an important uncertainty and is discussed in the Uncertainties notebook(MDN-000-000-2010-0209). However, since the unique attributes concerning the use of generic unavailability data are not discussed, adding an additional assumption item for this issue may be appropriate.

(This F&O originated from SR DA-C1)

Associated SR(s)

DA-C1

DA-E2

Basis for Significance

This is considered to be a suggestion as it pertains primarily to a documentation enhancement. The use of generic unavailability estimates for some plant components is probably acceptable; however documentation of the basis for accepting this data as appropriate to SQN is required.

Possible Resolution

Enhance the documentation in section 6.2 to better describe the acceptability of the generic estimates for SQN. Consideration should be given to specifically identifying this generic data use as an important assumption in the Uncertainties notebook (MDN-000-000-2010-0209) as well. That notebook has an overall item concerning the use of generic data; however, a specific item for the use of generic unavailability data could also be added.

Response

A discussion of the component boundaries and maintenance practices was added to section 6.2.

F&O Number	F&O Details

4-10

Failure data records are obtained from the plant's Cause Determination and Evaluation (CDE) records that are prepared by system engineers in response to failure events. The guidance for CDE development in plant procedure SPP-6.6 describes bases for failures, discusses degraded conditions, and notes that Technical Specification failures or operability issues are not automatically Maintenance Rule functional failures (or PRA failures).

The CDE records are also then reviewed by the PRA staff to determine if a PRA failure has occurred. The CDEs that were used in the data analysis are included in Appendix D of the data notebook (MDN-000-000-2010-0202).

Because there are several DA-C SRs that specify requirements for the data collection and analysis process, it is suggested that the data analysis documentation be enhanced to specifically note these requirements and how they are met, especially since the other plant procedures do not specifically state these requirements (since the procedures are for system engineers and other non-PRA personnel).

(This F&O originated from SR DA-C4)

Associated SR(s)

DA-C4

DA-C5

DA-C11

DA-C12

DA-C13

DA-E2

Basis for Significance

This is a suggestion since it pertains to enhancing the documentation to place all of the data analysis ground rules within the data notebook for clarity.

Possible Resolution

Enhance the data analysis notebook to specifically list the data collection requirements for DA-C4, C5, C6, C11, C12, and C13.

Response

DA-C4

Functional failures are determined based on the system engineer and maintenance rule expert panel. These determinations are outlined in SPP-6.6, and are only made by a qualified individual.

DA-C5

There was an identified event where multiple repeat failures occurred within the same time. Each of these events was assigned a specific CDE, however as noted in the documentation of CDE 1615 the three events were all assigned to one failure event in the PRA model.

DA-C11

Unavailability is defined in the maintenance rule technical instruction TI-4. The definition presented states that unavailability is only counted while at power (mode 1), additionally in the definition, unavailability is credited when the component would not be able to perform its designed function.

DA-C12

The definition of the component boundaries for tracking unavailability are documented in TI-4. For frontline systems only front line impacts are assigned to that system. If the ERCW header or other multi-system impact components are unavailable then the unavailability is tracked at that level.

DA-C13

For all significant unavailabilities, start and finish times are accurately documented in the maintenance rule spreadsheets.