ATTACHMENT 1

(SPAR OUTPUT)

USING SPAR WITH A NEW BASIC EVENT INSERTED INTO THE SSF FAULT TREE AND THE RESULTS SLICED FOR THE NEW BASIC EVENT, THE CDF = 5.96E-12/HR

THE NEW BASIC WAS SSF-PZR-HTR WITH A FAILURE PROBABILITY OF 1.5E-2. THIS IS A SURROGATE FOR 5 PSV LIFTS THAT COULD STICK OPEN. WITH A STUCK OPEN PSV THERE WOULD BE NO MITIGATION FUNCTIONS AVAILABLE & CORE DAMAGE WOULD ENSUE.

5.96E-12/HR * 24 HRS/DAYS * 365 DAYS/YEAR = 5.22E-8/YEAR

ATTACHMENT 2

(FULL SCOPE OUTPUT)

Sort/Slice Cut Set Report

Project-> OCONEE-FT Fault Tree-> COREMELT
Mincut Upper Bound -> 6.772E-005 This Partition -> 2.642E-006
Slice Applied

Cut No.	% Total	% Cut Set	Frequency	Cut Sets
1	0.3	0.3	1.725E-007	IE-T1, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM PACXN01C4O
2	0.5	0.3	1.725E-007	IE-T1, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM PACXN02C4O
3	0.8	0.2	1.495E-007	IE-T1, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM PACN1OPLHE
4	1.0	0.2	1.495E-007	IE-T1, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM PACN2OPLHE
5	1.1	0.2	1.049E-007	FACX3XCDEX, FEFEFW1DHE, IE-T3, NACSFDGDGM PACX3TDBHM
6	1.3	0.2	1.036E-007	HHS0556RGO, IE-T12, NACSFDGDGM, WLSSW12DHE
7	1.4	0.1	4.160E-008	IE-T1, NACSFDGDGM, PAC04KVDHE, PACN1N2COM
8	1.4	0.1	4.027E-008	FEFEFW1DHE, FEFTDFPTPR, IE-T3, NACSFDGDGM PACX3TDBHM
9	1.5	0.1	3.536E-008	IE-T5WEATH, NACSFDGDGM, PACXCT4THF TACWFF2RHE
10	1.5	0.1	3.420E-008	IBSBWSTDHE, IE-FLN, NACSFDGDGM, NSFFLOODHE
11	1.6	0.1	3.420E-008	IE-FLN, NACSFDGDGM, NSFFLOODHE, WHSEWSTDHE
12	1.6	0.0	2.439E-008	HHS0555VVT, IE-T12, NACSFDGDGM, WLSSW12DHE
13	1.7	0.0	2.439E-008	HLS0771VVT, IE-T12, NACSFDGDGM, WLSSW12DHE
14	1.7	0.0	2.414E-008	IE-T1, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM PACS218SWT, PACS226SWT
15	1.8	0.0	2.414E-008	IE-T1, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM PACS219SWT, PACS22TSWT
16	1.8	0.0	2.364E-008	IE-T2, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM PACXN01C4O
17	1.8	0.0	2.364E-008	IE-T2, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM PACXN02C4O
18	1.9	0.0	2.294E-008	IE-T5WEATH, KK1BOTHHYM, NACSFDGDGM PAC0T5WDEX, TACWFF2RHE
19	1.9	0.0	2.048E-008	IE-T2, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM PACN1OPLHE
20	1.9	0.0	2.048E-008	IE-T2, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM PACN2OPLHE
21	2.0	0.0	1.863E-008	IE-T1, NACSFDGDGM, PACE2EPDEX, PACMFB1BHM /PACMFB2BHM, PACS22TSWT
22	2.0	0.0	1.863E-008	IE-T1, NACSFDGDGM, PACE1EPDEX, /PACMFB1BHM PACMFB2BHM, PACS226SWT
23	2.0	0.0	1.684E-008	IE-T1, NACSFDGDGM, PACMFB1BHM, PACMFB2BHF /PACMFB2BHM
24	2.1	0.0	1.684E-008	IE-T1, NACSFDGDGM, PACMFB1BHF, /PACMFB1BHM PACMFB2BHM

25 2.1 0.0 1.389E-008 IE-T5WEATH, NACSFDGDGM, PK0KEORCOM
TACWFF3RHE
26 2.1 0.0 1.258E-008 FEFRCIRDHE, IE-T3, NACSFDGDGM, PACX3TDBHM
27 2.1 0.0 1.118E-008 IE-T1, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM
PACS1CLLHE, PACS218SWT
28 2.2 0.0 1.118E-008 IE-T1, NACSFDGDGM, PACE2CLLHE, PACMFB1BHM

Sort/Slice Cut Set Report

Project-> OCONEE-FT Fault Tree-> COREMELT
Mincut Upper Bound -> 6.772E-005 This Partition -> 2.642E-006
Slice Applied

Cut No.	% Total	% Cut Set	Frequency	Cut Sets
				/PACMFB2BHM, PACS22TSWT
29	2.2	0.0	1.118E-008	IE-T1, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM PACS219SWT, PACS2CLLHE
30	2.2	0.0	1.118E-008	IE-T1, NACSFDGDGM, PACE1CLLHE, /PACMFB1BHM PACMFB2BHM, PACS226SWT
31	2.2	0.0	1.091E-008	FEFTDFPTPS, IE-T3, NACSFDGDGM, PACX3TDBHM
32	2.2	0.0	1.085E-008	FEFTDFPTPR, IE-T12, NACSFDGDGM, TLOMFATDEX WLSLPSWDHE
33	2.3	0.0	1.062E-008	IBSBWSTDHE, IE-FMII, ILSFMIIDEX, NACSFDGDGM NSFFLOODHE
34	2.3	0.0	1.062E-008	IE-FMII, ILSFMIIDEX, NACSFDGDGM, NSFFLOODHE WHSEWSTDHE
35	2.3	0.0	1.040E-008	IE-T1, NACSFDGDGM, PACXN01C4O, PACXN02C4O
36	2.3	0.0	9.416E-009	IE-T5SUBF, NACSFDGDGM, PACS1EPDEX PDC1DIDBDM
37	2.3	0.0	9.416E-009	IE-T5SUBF, NACSFDGDGM, PACS2EPDEX PDC1DICBDM
38	2.4	0.0	9.407E-009	IE-T5SUBF, NACSFDGDGM, PACS2EPDEX /PACXCT3THM, PACXSB1BHM
39	2.4	0.0	9.407E-009	IE-T5SUBF, NACSFDGDGM, PACS1EPDEX /PACXCT3THM, PACXSB2BHM
40	2.4	0.0	9.369E-009	IE-T5SUBF, NACSFDGDGM, /PACMFB1BHM PACMFB2BHM, PACS1EPDEX
41	2.4	0.0	9.369E-009	IE-T5SUBF, NACSFDGDGM, PACMFB1BHM /PACMFB2BHM, PACS2EPDEX
42	2.4	0.0	9.254E-009	IE-T5FEEDF, KK1BOTHHYM, NACSFDGDGM PACLINEDEX
43	2.5	0.0	9.014E-009	IE-T1, NACSFDGDGM, PACN2OPLHE, PACXN01C4O
44	2.5	0.0	9.014E-009	IE-T1, NACSFDGDGM, PACN1OPLHE, PACXN02C4O
45	2.5	0.0	8.986E-009	IE-T5WEATH, NACSFDGDGM, PACS226SWT PACS22TSWT
46	2.5	0.0	8.624E-009	IE-T1, NACSFDGDGM, PACE2EPDEX, PACMFB1BHM /PACMFB2BHM, PACS2CLLHE

47	2.5	0.0	8.624E-009	IE-T1, NACSFDGDGM, PACE1EPDEX, /PACMFB1BHM
				PACMFB2BHM, PACS1CLLHE
48	2.5	0.0	8.474E-009	FEFSWCHDHE, IE-T5SUBF, NACSFDGDGM
				PACLOADDHE
49	2.6	0.0	7.812E-009	IE-T1, NACSFDGDGM, PACN1OPLHE, PACN2OPLHE
50	2.6	0.0	7.698E-009	FEFTDFPTPR, IE-T1, NACSFDGDGM, PACXCT3THM
				WCW3POXRYD
51	2.6	0.0	7.674E-009	IBSBWSTDHE, ICWFMIIDEX, IE-FMII, NACSFDGDGM
				NSFFLOODHE
52	2.6	0.0	7.674E-009	ICWFMIIDEX, IE-FMII, NACSFDGDGM, NSFFLOODHE
				WHSEWSTDHE
53	2.6	0.0	7.488E-009	IE-T1, NACSFDGDGM, PAC04KVDHE, PACEESSCOM
54	2.6	0.0	7.451E-009	IE-T1, NACSFDGDGM, /PACMFB1BHM, PACMFB2BHM
				PACS1EPDEX, PACS218SWT
55	2.7	0.0	7.451E-009	IE-T1, NACSFDGDGM, PACMFB1BHM, /PACMFB2BHM

Sort/Slice Cut Set Report

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Slice Applied

Cut No.	% Total	% Cut Set	Frequency	Cut Sets
				PACS219SWT, PACS2EPDEX
56	2.7	0.0	7.354E-009	DDC1DCBBDM, DDCUN31DIM, IE-T5SUBF
				NACSFDGDGM, TACSFF2RHE
57	2.7	0.0	7.340E-009	FLS0137MVO, IE-T3, NACSFDGDGM, PACX3TDBHM
58	2.7	0.0	7.296E-009	IBSBWSTDHE, ICWFMNXDEX, IE-FMN, NACSFDGDGM
				NSFFLOODHE
59	2.7	0.0	7.296E-009	ICWFMNXDEX, IE-FMN, NACSFDGDGM, NSFFLOODHE
				WHSEWSTDHE
60	2.7	0.0	6.934E-009	IE-T5WEATH, NACSFDGDGM, PACS226SWT
				PDC1DIDBDM
61	2.8	0.0	6.934E-009	IE-T5WEATH, NACSFDGDGM, PACS22TSWT
				PDC1DICBDM
62	2.8	0.0	6.927E-009	IE-T5WEATH, NACSFDGDGM, PACS22TSWT
				/PACXCT3THM, PACXSB1BHM
63	2.8	0.0	6.927E-009	IE-T5WEATH, NACSFDGDGM, PACS226SWT
				/PACXCT3THM, PACXSB2BHM
64	2.8	0.0	6.899E-009	IE-T5WEATH, NACSFDGDGM, /PACMFB1BHM
				PACMFB2BHM, PACS226SWT
65	2.8	0.0	6.899E-009	IE-T5WEATH, NACSFDGDGM, PACMFB1BHM
				/PACMFB2BHM, PACS22TSWT
66	2.8	0.0	6.759E-009	FEF1516COM, HHPHPR0DHE, IE-T2, NACSFDGDGM
67	2.8	0.0	6.699E-009	IE-T5SUBF, NACSFDGDGM, PACLINEDEX
				/PACXCT3THM, PACXCT4THM
68	2.9	0.0	6.501E-009	FCWTBOCGPS, IE-T3, NACSFDGDGM, PACX3TDBHM

69	2.9	0.0	6.405E-009	IE-T5WEATH, NACSFDGDGM, PK0KEOSCOM TACWFF2RHE
70	2.9	0.0	6.292E-009	HHP0TRBLHE, IE-T3, NACSFDGDGM, PACX3TDBHM
71	2.9	0.0	6.292E-009	FEFTDFPLHE, IE-T3, NACSFDGDGM, PACX3TDBHM
72	2.9	0.0	6.250E-009	FMS0087AVT, IE-T3, NACSFDGDGM, PACX3TDBHM
73	2.9	0.0	6.102E-009	FEFSWCHDHE, HHPHPR0DHE, IE-T6, NACSFDGDGM
74	2.9	0.0	5.987E-009	IE-T1, NACSFDGDGM, WCWLAK1DEX, WHS0154RGO WHSEWSTDHE, WHSP1KEDEX
75	3.0	0.0	5.920E-009	IE-T5SUBF, NACSFDGDGM, PACLINEDEX PACXCT4THF
76	3.0	0.0	5.749E-009	IE-T1, NACSFDGDGM, PACE2EPDEX, PACMFB1BHM /PACMFB2BHM, PACS2EPDEX
77	3.0	0.0	5.749E-009	IE-T1, NACSFDGDGM, PACE1EPDEX, /PACMFB1BHM PACMFB2BHM, PACS1EPDEX
78	3.0	0.0	5.701E-009	IE-T2, NACSFDGDGM, PAC04KVDHE, PACN1N2COM
79	3.0	0.0	5.650E-009	IE-T5SUBF, NACSFDGDGM, PACXS01C4C PDC1DIDBDM
80	3.0	0.0	5.650E-009	IE-T5SUBF, NACSFDGDGM, PACXS02C4C PDC1DICBDM
81	3.0	0.0	5.644E-009	IE-T5SUBF, NACSFDGDGM, /PACXCT3THM PACXS01C4C, PACXSB2BHM
82	3.1	0.0	5.644E-009	IE-T5SUBF, NACSFDGDGM, /PACXCT3THM PACXS02C4C, PACXSB1BHM
83	3.1	0.0	5.621E-009	IE-T5SUBF, NACSFDGDGM, /PACMFB1BHM

Sort/Slice Cut Set Report

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Slice Applied

Cut No.	% Total	% Cut Set	Frequency	Cut Sets
				PACMFB2BHM, PACXS01C4C
84	3.1	0.0	5.621E-009	IE-T5SUBF, NACSFDGDGM, PACMFB1BHM /PACMFB2BHM, PACXS02C4C
85	3.1	0.0	5.207E-009	FEFTDFPTPR, IE-T5SUBF, NACSFDGDGM WLSFILTCOM
86	3.1	0.0	5.174E-009	IE-T1, NACSFDGDGM, PACE2CLLHE, PACMFB1BHM /PACMFB2BHM, PACS2CLLHE
87	3.1	0.0	5.174E-009	IE-T1, NACSFDGDGM, PACE1CLLHE, /PACMFB1BHM PACMFB2BHM, PACS1CLLHE
88	3.1	0.0	5.022E-009	FEFTDFPTPR, IE-T5SUBF, NACSFDGDGM TACSFF5RHE, WCW3POXRYD
89	3.1	0.0	4.832E-009	DDCBATADEX, DDCUN31DIM, FEFTDFPTPR, IE-T3 NACSFDGDGM, T3TB1UXDHE
90	3.2	0.0	4.819E-009	IE-T5SUBF, KK1BOTHHYM, NACSFDGDGM PACLEESCTR, TACSFF3RHE

91	3.2	0.0	4.706E-009	DDC1DCBBYF, DDCUN31DIM, IE-T5SUBF NACSFDGDGM, PACLOOPDEX, TACSFF2RHE
92	3.2	0.0	4.706E-009	DDC3DCABYF, DDCUN31DIM, IE-T5SUBF NACSFDGDGM, TACSFF2RHE
93	3.2	0.0	4.614E-009	FMS093BAVO, IE-T3, NACSFDGDGM, PACX3TDBHM
94	3.2	0.0	4.614E-009	FLS0138AVO, IE-T3, NACSFDGDGM, PACX3TDBHM
95	3.2	0.0	4.614E-009	FHS0191RGO, IE-T3, NACSFDGDGM, PACX3TDBHM
96	3.2	0.0	4.614E-009	FMS0093AVO, IE-T3, NACSFDGDGM, PACX3TDBHM
97	3.2	0.0	4.509E-009	HHP0025MVO, IE-T7, NACSFDGDGM, PAC2CS1BLM
98	3.2	0.0	4.509E-009	HHP0025MVO, IE-T8, NACSFDGDGM, PAC2CS1BLM
99	3.3	0.0	4.486E-009	HHP0025MVO, IE-T8, NACSFDGDGM, /PAC3XS1BLM PACX3X8BLM
100	3.3	0.0	4.486E-009	HHP0025MVO, IE-T7, NACSFDGDGM, /PAC3XS1BLM PACX3X8BLM

10	LARGE NO-ISO TB FLD	3.40E-04	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	OA BWST REFILL	5.00E-02					3.42E-08	
11	LARGE NO-ISO TB FLD	3.40E-04	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	WHSEWSTDHE LATENT OA EWST UNAVAILABLE	5.00E-02					3.42E-08	
33	IE-FMII MED ISO COND INLET TB FLD	8.80E-03	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	OA BWST REFILL 5E-2	5.00E-02	ILSFMIIDEX FRACTION FROM LPSW	1.20E-02			1.06E-08	
34	IE-FMII MED ISO COND INLET TB FLD	8.80E-03	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	WHSEWSTDHE LATENT OA EWST UNAVAILABLE 3E-3	5.00E-02	ILSFMIIDEX FRACTION FROM LPSW	1.20E-02			1.06E-08	
51	IE-FMII MED ISO COND INLET TB FLD	8.80E-03	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	OA BWST REFILL 5E-2	5.00E-02	ICWFMIIDEX FRACTION FROM CONDESATE CLR FLOW PATH	8.67E-03			7.67E-09	
52	IE-FMII MED ISO COND INLET TB FLD	8.80E-03	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	WHSEWSTDHE LATENT OA EWST UNAVAILABLE 3E-3	5.00E-02	ICWFMIIDEX FRACTION FROM CONDESATE CLR FLOW PATH	8.67E-03			7.67E-09	
58	IE-FMN MEDIUM NON-ISO TB FLD	6.20E-04	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	OA BWST REFILL 5E-2	5.00E-02	ICWFMNXDEX FRACTION FROM CONDENSATE CLR FLOW PATH	1.17E-01			7.30E-09	
59	IE-FMN MEDIUM NON-ISO TB FLD	6.20E-04	NSFFLOODHE FAILURE TO USE UNIT 2 PWR 4.7E-2	4.70E-02	WHSEWSTDHE LATENT OA EWST UNAVAILABLE 3E-3	5.00E-02	ICWFMNXDEX FRACTION FROM CONDENSATE CLR FLOW PATH	1.17E-01			7.30E-09	
												1.20E-07
16	IE-T2 LOSS OF MAIN FEEDWATER	3.70E-01	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE	5.00E-03	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995	0.995	PACXN01C4O 4160 VAC BKR N1 FTO	3.00E-04			2.36E-08	
17	IE-T2 LOSS OF MAIN FEEDWATER	3.70E-01	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE	5.00E-03	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT	0.995	PACXN02C4O 4160 VAC BKR N2 FTO	3.00E-04			2.36E-08	
19	IE-T2 LOSS OF MAIN FEEDWATER	3.70E-01	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE	5.00E-03	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995	0.995	PACN1OPLHE N1 FTO LATENT OA 2.6E-4	2.60E-04			2.05E-08	
20	IE-T2 LOSS OF MAIN FEEDWATER	3.70E-01	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE	5.00E-03	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT	0.995	PACN2OPLHE N2 FTO LATENT OA 2.6E-4	2.60E-04			2.05E-08	
66	IE-T2 LOSS OF MAIN FEEDWATER	3.70E-01	FEF1516COM CCF EFW MAIN DISCH VALVES 315 & 136	1.30E-04	HHPHPR0DHE OA HPR	2.20E-02					6.62E-09	
78	IE-T2 LOSS OF MAIN FEEDWATER	3.70E-01	CCF N1 & N2 BKRS FTO	1.20E-04	PAC04KVDHE FAIL TO REC FROM 4KV BKR FAILURE	3.00E-03					5.70E-09	
												1.01E-07
1	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACXN01C4O 4160 VAC BKR N1 FTO	3.00E-04			1.72E-07	
2	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACXN02C4O 4160 VAC BKR N2 FTO 3E-4	3.00E-04			1.72E-07	
3	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE	5.00E-03	PACN1OPLHE N1 FTO LATENT OA	2.60E-04			1.49E-07	
4	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACN2OPLHE N2 FTO LATENT OA	2.60E-04			1.49E-07	
7	IE-T1 REACTOR TRIP	2.7	PAC04KVDHE FAIL TO REC FROM 4KV BKR FAILURE	3.00E-03	CCF N1 & N2 BKRS FTO	1.20E-04					4.16E-08	
14	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSF	6.48E-03	PACS218SWT BKR E1 AUTO/MAN SWITCH S218 TRANSFERS OUT OF AUTO	6.48E-03	2.41E-08	
15	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACS219SWT AUTO/MAN SWITCH S219 TRANSFERS OU	6.48E-03	PACS227SWT BKRS2 AUTO/MAN SWITCH S227 TRANSFERS OUT OF AUTO	6.48E-03	2.41E-08	
21	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACE2EPDEX E2 EPSL INTERLOCK FAILS	5.00E-03	PACS227SWT BKRS2 AUTO/MAN SWITCH S227 TRANSFERS OUT OF AUTO	6.48E-03	1.86E-08	
22	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACE1EPDEX E1 EPSL INTERLOCK FAILS	5.00E-03	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSFERS OUT OF AUTO	6.48E-03	1.86E-08	
23	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACMFB2BHF MAIN FDR BUS 2 FAILS	2.93E-05			1.68E-08	
24	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACMFB1BHF MAIN FDR BUS 1 FAILS 2.93E-5	2.93E-05			1.68E-08	
27	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACS1CLLHE BKR S1 FTC LATENT OA	3.00E-03	PACS218SWT BKR E1 AUTO/MAN SWITCH S218 TRANSFERS OUT OF AUTO	6.48E-03	1.12E-08	
28	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACE2CLLHE BKR E2 FTC LATENT OA	3.00E-03	PACS227SWT BKRS2 AUTO/MAN SWITCH S227 TRANS OUT AUTO	6.48E-03	1.12E-08	
29	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACS2CLLHE BKR S2 FTC LATENT OA 3E-3 BKR S2 FTC	3.00E-03	PACS219SWT AUTO/MAN SWITCH S219 TRANSFERS OUT OF AUTO	6.48E-03	1.12E-08	
30	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACE1CLLHE BKR E1 FTC LATENT OA	3.00E-03	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSFERS OUT OF AUTO	6.48E-03	1.12E-08	
35	IE-T1 REACTOR TRIP	2.7	PACXN01C4O 4160 VAC BKR N1 FTO	3.00E-04	PACXN02C4O 4160 VAC BKR N2 FTO 3E-4	3.00E-04					1.04E-08	
43	IE-T1 REACTOR TRIP	2.7	PACXN01C4O 4160 VAC BKR N1 FTO 3E-4	3.00E-04	PACN2OPLHE N2 FTO LATENT OA	2.60E-04					9.01E-09	
44	IE-T1 REACTOR TRIP	2.7	PACN1OPLHE N1 FTO LATENT OA 2.6E-4	2.60E-04	PACXN02C4O 4160 VAC BKR N2 FTO 3E-4	3.00E-04					9.01E-09	
46	IE-T1 REACTOR TRIP	2.7	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	0.995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	5.00E-03	PACS2CLLHE BKR S2 FTC LATENT OA 3E-3 BKR S2 FTC	3.00E-03	PACE2EPDEX E2 EPSL INTERLOCK FAILS	5.00E-03	8.62E-09	
47	IE-T1 REACTOR TRIP	2.7	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	0.995	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	5.00E-03	PACE1CLLHE BKR E1 FTC LATENT OA	3.00E-03	PACE1EPDEX E1 EPSL INTERLOCK FAILS	5.00E-03	8.62E-09	
49	IE-T1 REACTOR TRIP	2.7	PACN1OPLHE N1 FTO LATENT OA 2.6E-4	2.60E-04	PACN2OPLHE N2 FTO LATENT OA 2.6E-4	2.60E-04					7.31E-09	
50	IE-T1 REACTOR TRIP	2.7	FCFTDFPTPR TDEFW PUMP FTR	3.84E-01	PACXCT3THM CT3 IN MAINT	9.13E-04	WDWSPOXTYD RELAY 3PGX3 FAIL TO OPERATE	1.90E-04			7.70E-09	
53	IE-T1 REACTOR TRIP	2.7	PACEESSCOM CCF E1E2S1S2 FTC	2.16E-05	PAC04KVDHE FAIL TO REC FROM 4KV BKR FAILURE	3.00E-03					7.46E-09	

54	IE-T1 REACTOR TRIP	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE	PACS1EPDEX BKR S12 INTERLOCK FAIL	PACS218SWT BKR E1 AUTO/MAN SWITCH S218 TRANSFERS OUT OF AUTO			
	2.7	0.995	5.00E-03	2.00E-03	6.48E-03	7.45E-09		
55	IE-T1 REACTOR TRIP	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	PACS219SWT AUTO/MAN SWITCH S219 TRANSFERS OU	PACS2EPDEX BKR S2 INTERLOCK FAIL			
	2.7	0.995	5.00E-03	6.48E-03	2.00E-03	7.45E-09		
74	IE-T1 REACTOR TRIP	WCWLAK1DEX LAKE KEE < 798.33'	WHS0154RGO REG VLV HPSW 154 FTO	WHSEWSTDHE LATENT OA EWST UNAVAILABLE	WHSP1KEDEX 120VAC PANEL BOARD 1KE PWR LOSS			
	2.7	4.71E-01	2.20E-03	5.00E-02	1.00E-03	5.99E-09		
76	IE-T1 REACTOR TRIP	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE	PACE2EPDEX E2 EPSL INTERLOCK FAILS 5E-3	PACS2EPDEX BKR S2 INTERLOCK FAIL			
	2.7	0.995	5.00E-03	5.00E-03	2.00E-03	5.75E-09		
77	IE-T1 REACTOR TRIP	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	PACE1EPDEX E1 EPSL INTERLOCK FAILS	PACS1EPDEX BKR S12 INTERLOCK FAIL			
	2.7	0.995	5.00E-03	5.00E-03	2.00E-03	5.75E-09		
86	IE-T1 REACTOR TRIP	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT .995	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3	PACE2CLLHE BKR E2 FTC LATENT OA	PACS2CLLHE BKR S2 FTC LATENT OA 3E-3 BKR S2 FTC LATENT OA 3E-3			
	2.7	0.995	5.00E-03	3.00E-03	3.00E-03	5.17E-09		
87	IE-T1 REACTOR TRIP	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT .995 MAIN FEEDER BUS 1 IN MAINTENANCE 5E	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE 5E-3	PACE1CLLHE BKR E1 FTC LATENT OA 3E-3	PACS1CLLHE BKR S1 FTC LATENT OA 3E-3			
	2.7	0.995	5.00E-03	3.00E-03	3.00E-03	5.17E-09		
							9.61E-07	
9	IE-T5WEATH	TRANSFORMER CT4 FAILS	FAIL TO REC FROM KEE DOUBLE START FAILURE (SSHR AVAILABLE)					
	5.00E-03	8.06E-04	2.05E-01			3.54E-08		
18	IE-T5WEATH	KK1BOTHHYM KEE COMMON MAIN	PACOT5WDEX KEE OUTAGE SEVERE WEATH NOT AVOIDED	TACWFF2RHE DOUBLE FTS, SSHR, SEAL L				
	5.00E-03	5.23E-03	1.00E-01	2.05E-01		2.29E-08		
25	IE-T5WEATH	PK0KEORCOM CCF KEE FTR	TACWFF3RHE FAIL TO REC KEE FTR & FTS SSHR SEAL LOCA					
	5.00E-03	7.23E-04	8.98E-02			1.39E-08		
45	IE-T5WEATH	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSFERS OUT OF AUTO	PACS22TSWT BKRS2 AUTO/MAN SWITCH S227 TRANSFERS OUT OF AUTO					
	5.00E-03	6.48E-03	6.48E-03			8.99E-09		
60	IE-T5WEATH	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSFERS OUT OF AUTO	PDC1DIDBDM 125VDC 1DID PANELBD IN MAIN					
	5.00E-03	6.48E-03	5.00E-03			6.93E-09		
61	IE-T5WEATH	PACS22TSWT BKRS2 AUTO/MAN SWITCH S227 TRANSFERS OUT OF AUTO 6.48E-3	PDC1DICBDM 125 VDC 1DIC PANELBD IN MAIN 5E-3					
	5.00E-03	6.48E-03	5.00E-03			6.93E-09		
62	IE-T5WEATH	PACS22TSWT BKRS2 AUTO/MAN SWITCH S227 TRANSFERS OUT OF AUTO 6.48E-3	/PACXCT3THM CT3 IN MAINT	PACXSB1BHM STANDBY BUS IN MAIN				
	5.00E-03	6.48E-03	9.99E-01	5.00E-03		6.93E-09		
63	IE-T5WEATH	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSFERS OUT OF AUTO 6.48E-3	/PACXCT3THM CT3 IN MAINT	PACXSB2BHM STANDBY BUS IN MAIN 5E-3				
	5.00E-03	6.48E-03	9.99E-01	5.00E-03		6.93E-09		
64	IE-T5WEATH	PACS226SWT BKRS1 AUTO/MAN SWITCH S226 TRANSFERS OUT OF AUTO 6.48E-3	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE				
	5.00E-03	6.48E-03	0.995	5.00E-03		6.90E-09		
65	IE-T5WEATH	PACS22TSWT BKRS2 AUTO/MAN SWITCH S227 TRANSFERS OUT OF AUTO 6.48E-3	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT	PACXSB1BHM STANDBY BUS IN MAIN				
	5.00E-03	6.48E-03	0.995	5.00E-03		6.90E-09		
69	IE-T5WEATH	PK0KEOSCOM CCF FTS KEE	FAIL TO REC FROM KEE DOUBLE START FAILURE (SSHR AVAILABLE)					
	5.00E-03	1.46E-04	2.05E-01			6.41E-09		
42	IE-T5FEEDF (GRID)	KK1BOTHHYM KEE COMMON MAIN	PACLINEDEX 100KV LEE LINE FAIL					
	5.30E-03	5.23E-03	7.80E-03			9.25E-09		
36	IE-T5SUBF	PACS1EPDEX BKR S12 INTERLOCK FAIL	PDC1DIDBDM 125VDC 1DID PANELBD IN MAIN					
	2.20E-02	2.00E-03	5.00E-03			9.42E-09		
37	IE-T5SUB	PACS2EPDEX BKR S2 INTERLOCK FAIL 2E-3	PDC1DIDBDM 125VDC 1DID PANELBD IN MAIN					
	2.20E-02	2.00E-03	5.00E-03			9.42E-09		
38	IE-T5SUBF	PACS2EPDEX BKR S2 INTERLOCK FAIL 2E-3	/PACXCT3THM CT3 IN MAINT	PACXSB1BHM STANDBY BUS IN MAIN				
	2.20E-02	2.00E-03	9.99E-01	5.00E-03		9.41E-09		
39	IE-T5SUB	PACS1EPDEX BKR S12 INTERLOCK FAIL 2E-3	/PACXCT3THM CT3 IN MAINT 9.13E-4	PACXSB2BHM STANDBY BUS IN MAIN				
	2.20E-02	2.00E-03	9.99E-01	5.00E-03		9.41E-09		
40	IE-T5SUBF	PACS1EPDEX BKR S12 INTERLOCK FAIL 2E-3	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT				
	2.20E-02	2.00E-03	5.00E-03	0.995		9.37E-09		
41	IE-T5SUB	PACS2EPDEX BKR S2 INTERLOCK FAIL 2E-3	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE				
	2.20E-02	2.00E-03	0.995	5.00E-03		9.37E-09		
48	IE-T5SUBF	FEFSWCHDHE EFW SWITCH TO HOTWELL OA	PACLOADDHE FAIL TO REC 600VAC 3X1,2,3,4					
	2.20E-02	1.50E-03	6.00E-03			8.47E-09		
56	IE-T5SUBF	DDC1DCBBDM 125VDC DISTR CTR 1DCB IN MAIN	DDCUN31DIM BATTERY BACKUP SOURCE ISO @ DIODE FOR	TACSFF2RHE DOUBLE FTS, SSHR AVAIL, SEAL L				
	2.20E-02	5.00E-03	2.00E-02	7.81E-02		7.35E-09		
67	IE-T5SUBF	PACLINEDEX 100KV LEE LINE FAIL	/PACXCT3THM CT3 IN MAINT 9.13E-4	PACXCT4THM CT4 MAINT				
	2.20E-02	7.80E-03	9.99E-01	9.13E-04		6.70E-09		
75	IE-T5SUBF	PACLINEDEX 100KV LEE LINE FAIL 7.8E-3	TRANSFORMER CT4 FAILS					
	2.20E-02	7.80E-03	8.06E-04			5.92E-09		
79	IE-T5SUBF	PACXS01C4C S1 BKR FTC	PDC1DIDBDM 125VDC 1DID PANELBD IN MAIN					
	2.20E-02	1.20E-03	5.00E-03			5.65E-09		
80	IE-T5SUBF	PACXS02C4C S2 BKR FTC 1.2E-3	PDC1DIDBDM 125VDC 1DID PANELBD IN MAIN 5E-3					
	2.20E-02	1.20E-03	5.00E-03			5.65E-09		
81	IE-T5SUBF	PACXS01C4C S1 BKR FTC 1.2E-3	/PACXCT3THM CT3 IN MAINT 9.13E-4	PACXSB2BHM STANDBY BUS IN MAIN 5E-3				
	2.20E-02	1.20E-03	9.99E-01	5.00E-03		5.64E-09		
82	IE-T5SUBF	PACXS02C4C S2 BKR FTC 1.2E-3	/PACXCT3THM CT3 IN MAINT 9.13E-4	PACXSB1BHM STANDBY BUS IN MAIN 5E-3				
	2.20E-02	1.20E-03	9.99E-01	5.00E-03		5.64E-09		
83	IE-T5SUBF	PACXS01C4C S1 BKR FTC 1.2E-3	/PACMFB1BHM MAIN FEEDER BUS 1 NOT IN MAINT	PACMFB2BHM MAIN FEEDER BUS 2 IN MAINTENANCE				
	2.20E-02	1.20E-03	0.995	5.00E-03		5.62E-09		
84	IE-T5SUBF	PACXS02C4C S2 BKR FTC 1.2E-3	/PACMFB2BHM MAIN FEEDER BUS 2 NOT IN MAINT	PACMFB1BHM MAIN FEEDER BUS 1 IN MAINTENANCE 5E-3				
	2.20E-02	1.20E-03	0.995	5.00E-03		5.62E-09		
85	IE-T5SUBF	FEFTDFPTPR TDEFW PUMP FTR	WLSFILTCOM LPSW STRAINERS PLUG					
	2.20E-02	3.84E-01	1.44E-05			5.21E-09		
88	IE-T5SUBF	FEFTDFPTPR TDEFW PUMP FTR	TACSFF5RHE FTS & FTR, NO SSHR, NO F&B	WCW3POXTYD RELAY 3POX3 FAIL TO OPERATE				

	2.20E-02	3.84E-01	7.31E-02	1.90E-04		5.02E-09		
90	IE-T5SUBF	PACLEESCTR FTR LEE COMBUSTION GAS TURBINES	TACSFF3RHE FTS & FTR, SSHR, SEAL L	KK1BOTHHYM KEE COMMON MAIN				
	2.20E-02	1.85E-02	5.29E-02	5.23E-03		4.82E-09		
91	IE-T5SUBF	DDC1DCBBYF BAT 1CB FAILS	DDCUN31DIM BATTERY BACKUP SOURCE ISO @ DIODE FOR	PACLOOPDEX LOSP AFFECTS OTHER UNITS	TACSFF2RHE DOUBLE FTS, SSHR AVAIL, SEAL L			
	2.20E-02	3.20E-03	2.00E-02	1	7.81E-02	4.71E-09		
92	IE-T5SUBF	DDC3DCABYF BAT 3CA FAILS	DDCUN31DIM BATTERY BACKUP SOURCE ISO @ DIODE FOR	TACSFF2RHE DOUBLE FTS, SSHR AVAIL, SEAL L				
	2.20E-02	3.20E-03	2.00E-02	7.81E-02		4.71E-09		
							2.81E-07	
								1.46246E-06

CDF CONTRIBUTION FROM INTERNAL EVENTS REQUIRING THE SSF

ATTACHMENT 3

(COLORED BUS HELB)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 13, 2001

MEMORANDUM TO: John A. Zwolinski, Director, NRR:DLPM
Mark A. Cunningham, Chief, RES:DRAA:PRAB
John H. Flack, Acting Chief, RES: DSARE:REAHFB

FROM: Patrick W. Baranowsky, Chief
Operating Experience Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

SUBJECT: TRANSMITTAL OF PRELIMINARY ASP ANALYSIS OF 1999 OPERATIONAL CONDITION AT OCONEE

Enclosed is a copy of the preliminary Accident Sequence Precursor (ASP) Program analysis of the operational condition which was discovered at Oconee I, 2, and 3, and reported in LER 269/99-001-01. The purpose of this memorandum is to provide you with a copy of the preliminary analysis (attachment 1) for internal review at the same time that it is sent out to the licensee for peer review.

The condition of interest in this analysis involves the potential for a postulated high energy line failure in the turbine building to degrade the ability of adjacent switchgear cabinets to perform their safety function. The risk significance associated with this condition has been analyzed under the Significance Determination Process (SDP) as well. We have identified the differences between the preliminary analyses performed under the SDP and the ASP Program, and communicated these differences to the Senior Reactor Analyst of the Regional Office.

Please review the preliminary ASP analysis and provide us with any comments that you may have. In order to facilitate incorporation of licensee and staff comments and preparation of the final report in a timely manner, consistent with the NRR and RES agreement on peer review, please provide your comments to us within 60 days from the date of receipt of this memorandum.

We are also requesting NRR/DLPM to send the preliminary ASP analysis to the licensee for peer review and comment. The draft of the standard transmittal letter is provided in attachment 2. The associated attachments to the transmittal letter will be provided separately to the NRR ASP Program liaison (Pat Madden).

If you have any questions about the analysis, attachments, or the ASP Program peer review process, please contact Sunil Weerakkody (415-6374) or Don Marksberry (415-6378).

Attachments: As stated

Multiple Addressees 2

MEMORANDUM DATED: 3 /13 /01

SUBJECT: TRANSMITTAL OF PRELIMINARY ASP ANALYSIS OF 1999 OPERATIONAL CONDITION AT OCONEE

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Licensee Event Report 269-99-001

Event Description: Postulated high-energy line breaks in turbine building leading to failure of safety-related 4-kV switchgear

Event Date: February 24, 1999

Plant: Oconee Nuclear Station, Units 1, 2, and 3

Event Summary

Based on NRC inspection findings and subsequent discussions with the NRC staff, the Duke Energy Corporation (the licensee) determined that the emergency feedwater (EFW) system at Oconee may be vulnerable to single failures. On March 26, 1999, the licensee issued a licensee event report (LER) to report this as a condition outside the design basis (Refs. 1, 2). The inspection reports and the LER identified several other conditions at Oconee. One of the conditions identified in the LER was that certain postulated high-energy line breaks (HELBs) in the turbine building could have resulted in the loss of the 4160-volt engineered safeguards switchgear (SWGR). This analysis assesses the risk significance of the postulated breaks.

The conditional core damage probabilities (CCDP) associated with this condition over a one-year period for Oconee Units 1, 2, and 3 are 9.6×10^{-5}, 4.8×10^{-5}, and 4.6×10^{-5} per year, respectively. The nominal core-damage probability (CDP) of Oconee Units 1,2, and 3 over a one-year period is 2.6×10^{-5}.

The differences in the design in Reactor Coolant Pump (RCP) seals cause the difference in the CCDP among the units. The RCPs at Oconee Unit 1 have seal assemblies manufactured by Westinghouse which consist of O-rings that were not qualified for high temperatures and pressures. The RCPs at Oconee Units 2 and 3 have reactor coolant pumps whose seals were manufactured by Bingham.

Event Description

Figures 1 and 2 show the core damage sequences resulting from a HELB in the turbine building, which disables all three 4-kV switchgear trains of a given unit located in Elevation 727 feet of turbine building. As shown in Figure 8-1 of the UFSAR (Ref. 3), all power supplies to the plant from normal and emergency sources (Offsite supply, Keowee Hydro, Lee station) go through these three 4-KV switchgear cabinets. The safe shutdown facility (SSF), which is common to all three units and which has its own AC and DC power supply from the SSF diesel and batteries will not be affected by the postulated HELB. Section 9.6 of the UFSAR (Ref. 3) provides the details of the SSF. Power to an auxiliary switchgear located in the auxiliary building will also remain available. However, manual-local action, which includes establishing connections using cables, is required to use this power source to supply the high-pressure injection pumps. This power source cannot supply power to the emergency feedwater (EFW) pumps. It can supply power to a station auxiliary service water pump (ASW) to inject into steam generators.

The loss of all AC power as a result of the loss of all three trains of SWGR generates an ESF signal, trips the reactor, the turbine, the condensate booster pumps, and the hotwell pumps, and fails the MFW system

{See section 10.4.7.1.2 and 10.4.7.1.3 of the UFSAR (Ref. 3)}. Loss of the 4-kV cabinets cause the loss of the motor-driven EFW pumps. Since the non-safety 250-VDC panel which supports the turbine-driven pump start circuitry is located in the vicinity of the 4-kV switchgear cabinets, that DC supply may fail. Therefore, the turbine-driven emergency feedwater pump may have to be locally-manually started.

The SSF provides the shutdown capability in the event of the postulated HELB which fails all three switchgear cabinets. The reactor coolant makeup pump (RCM) of the SSF which is rated at 29 gpm provides RCP seal cooling and prevents RCP seal failure. There are three RCM pumps (one per each unit). The decay heat removal function will be accomplished by the auxiliary service water (ASW) pump located in the SSF building. There is one ASW pump which can support all three units. This pump is powered from the SSF diesel. In essence, the mitigation actions of this scenario is identical to the mitigating actions of a station black out event with the exception of the DC power unavailability to the turbine-driven emergency pumps[1].

Modeling Details and Key Assumptions

Subset of HELBs that fail the three 4-kV switchgear trains: HELBs can occur inside turbine buildings as a result of breaks in main steam lines, main feedwater lines, and breaks in other lines carrying steam or feedwater between high-pressure heaters, moisture separators, and turbines. A plant walkdown conducted during January 8-10, 2001[2], led to the conclusion that breaks in approximately 20 percent of MFW and breaks in an auxiliary steam system pipe, which is about 200 feet in length, could fail all three SWGR cabinets. Reference 4 provides the basis for this conclusion. Reference 4 is provided as Attachment 2 to this writeup. Section 2 of Attachment 1 provides plant specific experience on HELBs (consequences of three HELBs which occurred at Oconee station). This plant specific experience augments a key conclusion drawn in Reference 4, which states that HELBs that occur in the basement of the turbine building are unlikely to fail all three 4-kV switchgear trains.

Characteristics of the SWGR cabinets considered to select the subset of HELBs that fail the three 4-kV SWGR trains: The three Oconee units received their operating licenses in 1973 (Oconee Units 1 and 2) and 1974 (Oconee Unit 3). Therefore, the 4-kV SWGR cabinets at Oconee are not qualified to the current standards provided by the National Electrical Manufacturer's Association (NEMA). To determine the susceptibility of these cabinets to steam or moisture intrusion and the consequential failures, characteristics of the SWGR cabinets were compared against the current standards. Key conclusions derived from this comparison are as follows:

- The SWGR cabinets have adequate protection against rain down of moisture.

[1] HELBs which fail one or two of the three switchgear trains are of low risk significance compared to the risk significance of those that fail all three switchgear trains. Section 1 of Attachment 1 provides the basis for this conclusion.

[2] An alternative approach to calculate the frequency of a HELBs capable of affecting SWGR cabinets would have been to use actual number of HELB events at nuclear power plants which lead to SWGR cabinet failures. However, since (a) the characteristics of the 4-kV SWGR cabinets at Oconee may differ from those at many other nuclear plants (i.e., SWGR cabinets at Oconee are vulnerable to steam or moisture intrusion,) and (b) the location and configuration of SWGR cabinets at Oconee is different from many other plants (located in turbine building with no separation), a plant specific analysis became necessary.

- The SWGR cabinets do not have adequate protection against steam or moisture intrusion via ventilation inlets and outlets or via other openings such as unsealed doors.

- The risk from inadvertent actuation of fire sprinklers is negligible.

- Any HELB event that can flood the SWGR cabinets would cause SWGR failure due to steam intrusion into the cabinets. Therefore, the risk from flooding of the three 4-kV SWGR cabinets as a result of any HELB is a subset of the risk from steam or moisture intrusion associated with HELBs.

These conclusions were used to select the subset of HELBs capable of affecting all three 4-kV switchgear trains. Section 3 of Attachment 1 provides detail on the above conclusions.

Contribution from MFW system to the frequency of a HELB: Based on nuclear plant operating experience between 1970-2000, the average frequency of a MFW pipe break at a nuclear power plant is approximately 8.3×10^{-4} per critical-year[3]. Based on information collected during a plant walkdown conducted during January 8-10, 2001, approximately 20 percent of the breaks in the MFW system are capable of failing all three SWGR cabinets. Therefore, the frequency of MFW breaks capable of failing SWGR is approximately 1.7×10^{-4} per critical-year (=20% of 8.3×10^{-4}.) Section 4 in Attachment 1 provides details of this frequency calculation.

Contribution from auxiliary steam lines to the frequency of a HELB: A search of the NRC's LER database {Sequence Coding and Search System (SCSS) (Ref. 5)} identified 24 high-energy line failure events (Refs. 6-29). These events occurred between 1985-1999. Of these, ten events occurred at pressurized water reactors (PWRs) in pipes whose attributes are similar to the attributes of the auxiliary steam lines. Section 5 in Attachment 1 provides summaries of these ten events at PWRs and several other events during which electrical cabinets were affected as a result of high-energy line leaks or breaks. Based on this experience and operating reactor critical-years between 1985-1999 (850 PWR critical-years based on References 30, 31, 32, and 33), the frequency of HELBs inside the turbine building similar to those that may occur in the auxiliary steam lines is 1.2×10^{-2} per critical-year (=10.5/850).

Based on expert judgement (See Attachment 2 for details), the length of auxiliary steam piping in the vicinity of the SWGR cabinets is approximately 200 feet. This is about 1.8 percent of total piping similar to auxiliary steam pipes per unit. Therefore, the frequency of auxiliary steam line breaks capable of failing SWGR is approximately 2.2×10^{-4} per critical-year (=$0.018\times 1.2\times10^{-2}$).[4] Section 6 in Attachment 1 provides additional details on this frequency calculation.

In consideration of changes to pipe break prevention programs instituted at nuclear plants (e.g., erosion/corrosion programs), it was necessary to consider if any observable trends in industry performance could be attributed to programs such as erosion/corrosion, etc.. There were no industry

[3] The calculation implicitly assumes that the MFW break frequency at Oconee is equal to the average MFW frequency at nuclear plants. Considering the numbers of MFW equipment and general layout of these equipment in the turbine building at Oconee in comparison to the average nuclear power plant, this is a reasonable assumption.

[4] The calculation implicitly assumes that the break frequency at Oconee is equal to the average frequency at pressurized water reactors. Considering the numbers of equipment and general layout of these equipment in the turbine building at Oconee in comparison to the average pressurized water reactor, this is a reasonable assumption.

wide trends in overall frequency noted (Refs. 44, 56). There were no known plant-specific design or operational features that would indicate that Oconee was outside (better or worse than) the industry norms.

Frequency of HELBs that fail the three 4-kV SWGR cabinets: The total frequency of a HELB capable of failing all three SWGR cabinets is the sum of the frequency contributions from MFW and auxiliary steam pipes. This equates to 3.9×10^{-4} per critical-year ($=1.7\times10^{-4}+2.2\times10^{-4}$).

Probability of recovery of switchgear failures due to harsh environment: To recover the equipment, cabinets must be opened and allowed to dry. The dry-out process may take several hours or days.[5] Furthermore, considering the amount of energy released from a postulated HELB in the vicinity of the SWGR cabinets, the cabinets may sustain significant damage (including structural damage) rather than simply shorts as a result of the postulated HELB. Therefore, the probability of failure to recover the affected switchgear train during a 24-hour mission time is determined to be 1.0.

Criticality factor (fraction of time the plant is at power) for Oconee Units 1, 2, and 3: Based on Table H-3 of NUREG/CR-5750 (Ref. 32), the average criticality factors for Oconee Units 1, 2, and 3 for the time period 1987-1995 are 0.87, 0.88, and 0.84, respectively.

Probability of failing to recover seal cooling capability within 10 minutes (event tree top event "RCM10M"): Failure of the switchgear trains would fail RCP seal cooling. If RCP seal cooling could not be established using the safe shutdown facility (SSF) within about 10 minutes, there is some likelihood of RCP seal failure (NUREG/CR-5167, Ref. 35). The probability of failing to recover seal cooling within 10 minutes is approximately 0.44. This probability is dominated by the probability of operator error to establish SSF RCM (0.25) and probability of failure of SSF support systems (0.16). The bases for these probabilities are provided in Section 7 to Attachment 1.

Probability of failing to recover seal cooling capability within 2 hours (event tree top event "RCM2HR"): This event tree top event is used for Oconee Unit 1 only. If RCP seal cooling could not be established using the safe shutdown facility (SSF) within about 2 hours, for seal assemblies whose O-rings are not qualified, there is an additional likelihood of RCP seal failure due to O-ring failure (NUREG/CR-5167, Ref. 35). The probability of failing to recover seal cooling within 2 hours is approximately 0.24. This probability is dominated by the probability failure of SSF support systems (0.16). The bases for this probability is provided in Section 7 to Attachment 1.

Probability of RCP seal failure if seal cooling is not recovered for 10 minutes (event tree top event "RCPSEAL"): NUREG/CR-5167 (Ref. 35) provides failure probabilities for Westinghouse RCP seal assemblies. If seal cooling is not recovered for 10 minutes, the Rhodes model uses a total RCP seal failure probability (in the absence of seal cooling) of 0.22 for Westinghouse RCP seal assemblies that use improved O-ring material. Oconee Units 2 and 3 have RCP seal assemblies manufactured by Bingham.

[5] S. Weerakkody (U.S. NRC), Private communiations with W. Raughly (U.S. NRC).

ATTACHMENT 4

(EARTHQUAKE)

Cutset Number	Cutset Freq.	Accident Sequences				
95	5.60E-07	CJOCDAMSIS	NACSFDGDGR	T0SMALLDEX		
96	5.24E-07	CONDENSSIS	NACSFDGDGR	T0SMALLDEX		
94	3.14E-07	CINTAKESIS	NACSFDGDGR	T0SMALLDEX		
92	2.33E-07	C003B1TSIS	NACSFDGDGR	T0SMALLDEX		
97	1.69E-07	CTURSRGSIS	NACSFDGDGR	T0SMALLDEX		
93	2.57E-08	CBURPIPSIS	NACSFDGDGR	T0SMALLDEX		
255	3.42E-07	CAUXSRGSIS	CCSTSUPSIS	NACSFDGDGR	T0SMALLDEX	
256	1.29E-07	CAUXSRGSIS	COMPCLRSIS	NACSFDGDGR	T0SMALLDEX	
251	1.18E-07	C00BWSTSIS	CCSTSUPSIS	NACSFDGDGR	T0SMALLDEX	C00RBCUSIS
253	6.11E-08	C00BWSTSIS	COMPCLRSIS	NACSFDGDGR	T0SMALLDEX	C00RBCUSIS
242	3.92E-08	CAUXSRGSIS	CCCOPN1DHE	NACSFDGDGR	T0SMALLDEX	
252	1.48E-08	C00BWSTSIS	CCSTSUPSIS	NACSFDGDGR	T0SMALLDEX	-C00RBCUSIS
254	2.33E-09	C00BWSTSIS	COMPCLRSIS	NACSFDGDGR	T0SMALLDEX	-C00RBCUSIS
893	3.83E-07	CKEOBATSIS	CLEEFEDSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
892	3.09E-07	CK600MCSIS	CLEEFEDSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
895	2.79E-07	CKEOWCBSIS	CLEEFEDSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
883	2.12E-07	C000CT5SIS	CKEOBATSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
882	1.87E-07	C000CT5SIS	CK600MCSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
885	1.76E-07	C000CT5SIS	CKEOWCBSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
896	1.73E-07	CKEOWEESIS	CLEEFEDSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
870	1.33E-07	C000CT3SIS	CK600MCSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
871	1.47E-07	C000CT3SIS	CKEOBATSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
873	1.26E-07	C000CT3SIS	CKEOWCBSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
894	1.26E-07	CKEOSRGSIS	CLEEFEDSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
865	1.02E-07	C000CT3SIS	C000CT5SIS	CK600MCSIS	NACSFDGDGR	T0SMALLDEX
866	1.10E-07	C000CT3SIS	C000CT5SIS	CKEOBATSIS	NACSFDGDGR	T0SMALLDEX
868	9.84E-08	C000CT3SIS	C000CT5SIS	CKEOWCBSIS	NACSFDGDGR	T0SMALLDEX
884	9.69E-08	C000CT5SIS	CKEOSRGSIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
886	1.11E-07	C000CT5SIS	CKEOWEESIS	COFSITESIS	NACSFDGDGR	T0SMALLDEX
887	9.17E-08	C0230KVSIS	CK600MCSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
888	1.02E-07	C0230KVSIS	CKEOBATSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
867	6.49E-08	C000CT3SIS	C000CT5SIS	CKEOSRGSIS	NACSFDGDGR	T0SMALLDEX
869	6.59E-08	C000CT3SIS	C000CT5SIS	CKEOWEESIS	NACSFDGDGR	T0SMALLDEX
872	7.60E-08	C000CT3SIS	CKEOSRGSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
874	8.18E-08	C000CT3SIS	CKEOWEESIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
877	7.00E-08	C000CT5SIS	C0230KVSIS	CK600MCSIS	NACSFDGDGR	T0SMALLDEX
878	7.53E-08	C000CT5SIS	C0230KVSIS	CKEOBATSIS	NACSFDGDGR	T0SMALLDEX
880	6.75E-08	C000CT5SIS	C0230KVSIS	CKEOWCBSIS	NACSFDGDGR	T0SMALLDEX
890	8.72E-08	C0230KVSIS	CKEOWCBSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
891	5.67E-08	C0230KVSIS	CKEOWEESIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
863	2.46E-08	C000CT3SIS	C000CT4SIS	C000CT5SIS	NACSFDGDGR	T0SMALLDEX
864	2.68E-08	C000CT3SIS	C000CT4SIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
876	1.88E-08	C000CT4SIS	C0230KVSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
879	4.49E-08	C000CT5SIS	C0230KVSIS	CKEOSRGSIS	NACSFDGDGR	T0SMALLDEX
881	4.55E-08	C000CT5SIS	C0230KVSIS	CKEOWEESIS	NACSFDGDGR	T0SMALLDEX
889	5.24E-08	C0230KVSIS	CKEOSRGSIS	CLEEFEDSIS	NACSFDGDGR	T0SMALLDEX
800	6.73E-09	C000CT3SIS	C00BWSTSIS	CCCOPN1DHE	NACSFDGDGR	T0SMALLDEX
801	4.67E-09	C00BWSTSIS	C0230KVSIS	CCCOPN1DHE	NACSFDGDGR	T0SMALLDEX
802	1.22E-08	C00BWSTSIS	CCCOPN1DHE	COFSITESIS	NACSFDGDGR	T0SMALLDEX
875	1.74E-08	C000CT4SIS	C000CT5SIS	C0230KVSIS	NACSFDGDGR	T0SMALLDEX
	6.39E-06					

TABLE C-2

COMPONENT FRAGILITIES USED IN THE OCONEE SEISMIC ANALYSIS

Basic Event Name	Description	Median Fragility, Â(g)	β_r	β_u
C000CT3SIS	Seismically-Induced Failure Of Startup Transformer CT3	0.58	0.26	0.21
C000CT4SIS	Seismically-Induced Failure Of Transformer CT4	0.88	0.26	0.21
C000CT5SIS	Seismically-Induced Failure Of Transformer CT5	0.49	0.26	0.21
C000ICSSIS	Seismically-Induced Failure of the Integrated Control System Cabinets	0.35	0.24	0.18
C003B1TSIS	Seismically-Induced Failure of 4 kV Switchgear B1T, B2T, 3B1T & 3B2T	0.55	0.24	0.18
C00BWSTSIS	Seismically-Induced Failure Of The BWST	0.71	0.25	0.31
C00RBCUSIS	Seismically-Induced Failure of The Reactor Building Cooling Units	0.33	0.24	0.18
C0230KVSIS	Seismically-Induced Failure of Keowee Overhead Path	0.72	0.26	0.38
C03ATC4SIS	Seismic Failure of Area Termination Cabinet 3AT4 (Fails 3MS-94)	0.46	0.24	0.18
CABMFRMSIS	Seismically-Induced Failure Of Aux. Building Moment Frames	1.29	0.25	0.28
CAUXSRGSIS	Auxiliary Building Components Surrogate	0.48	0.24	0.18
CBURPIPSIS	Seismically-Induced Failure Of Buried Piping	1.40	0.20	0.57
CCSTSUPSIS	Seismically-Induced Failure Of Component Cooling Surge Tank Supports	0.24	0.24	0.18
CESFTCBSIS	Seismic Failure of ESFAS Termination Cabinets	0.35	0.24	0.18
CHTOVERSIS	Surrogate For Relay Chatter Failing Overhead Power Path	0.56	0.21	0.36
CINTAKESIS	Seismically-Induced Failure Of Intake Canal East Dike	0.58	0.32	0.34
CJOCDAMSIS	Seismically-Induced Failure Of Jocassee Dam Floods Site	0.49	0.40	0.32
CK600MCSIS	Seismic Failure of Keowee 600V ac MCCs 1XA and 2XA	0.41	0.24	0.18
CKEOBATSIS	Seismically-Induced Failure of Keowee Batteries	0.36	0.24	0.18
CKEOSRGSIS	Keowee Components Surrogate	0.60	0.24	0.18
CKEOWCBSIS	Seismic Failure of Keowee Control Boards	0.43	0.24	0.18
CKEOWEESIS	Seismically-Induced Failure Of Keowee Dam	0.58	0.32	0.34
CLEEFEDSIS	Seismically-Induced Failure Of 100 kV Lee Feeder	0.30	0.25	0.50
CLETDWNSIS	Seismically-Induced Failure Of The Letdown Coolers	1.10	0.24	0.18
CMSNWLLSIS	Seismically-Induced Failure of Masonry Block Walls	1.34	0.17	0.52
COFSITESIS	Seismically-Induced Failure Of Offsite Power Line Insulators	0.30	0.25	0.50
COMPCLRSIS	Seismically-Induced Failure Of Component Coolers	0.57	0.24	0.18

TABLE C-2

COMPONENT FRAGILITIES USED IN THE OCONEE SEISMIC ANALYSIS

Basic Event Name	Description	Median Fragility, Â(g)	β_r	β_u
CONDCLRSIS	Seismic Failure of Condensate Coolers	0.29	0.24	0.18
CONDENSSIS	Seismically-Induced Failure Of The Condenser / Hotwell	0.46	0.25	0.31
CPIPSUPSIS	Seismically-Induced Failure Of Plant Piping Supports	1.77	0.46	0.43
CPOLDTKSIS	Seismic Failure of Polishing Demineralizer Tanks	0.38	0.24	0.18
CRCSPIPSIS	Seismically-Induced Failure Of A Large RCS Pipe	1.27	0.34	0.43
CRVINTRSIS	Seismically-Induced Failure Of The Reactor Vessel Internals	0.95	0.31	0.37
CRVSKRTSIS	Seismically-Induced Failure Of The Reactor Vessel Skirt	1.30	0.24	0.29
CSSFSRGSIS	SSF Components Surrogate	0.60	0.24	0.18
CSSFTRNSIS	Seismically-Induced Failure Of SSF 600/208 V ac Transformers	0.73	0.18	0.44
CTURSRGSIS	Turbine Building Components Surrogate	0.60	0.24	0.18
CVDC3DPSIS	Seismic Failure of 125/250 V dc Distribution Center 3DP	0.53	0.24	0.18

Comparison of licensee's Earthquake (EPRI) frequency & NUREG-1488 (LLL) show minimal deviation. Therefore, use of licensee curve acceptable.

WRogers

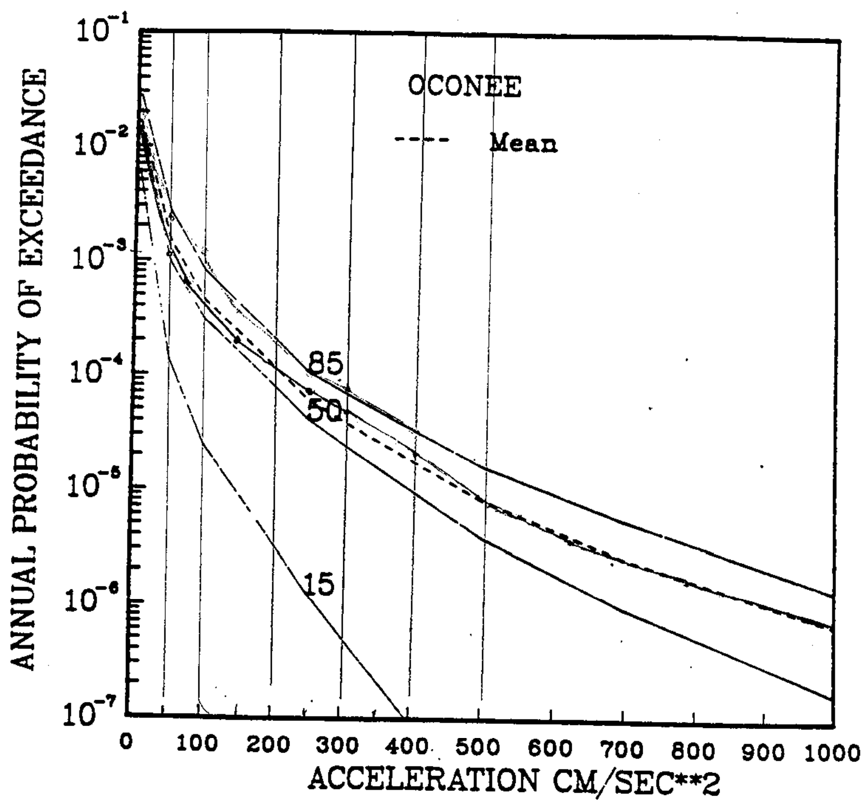

Figure 3.2-1 15th, 50th, 85th Fractiles and Mean Annual Probability of Exceedance of Peak Ground Acceleration

ATTACHMENT 5

(TORNADO)

Top 20 Tornado Cut Sets with SSF in Maintenance (Subsumed)

CS #	Probability	Event Name	Description
1	1.04E-05	FXTORNBH	U1 Tornado Damage To 4160V Buslines at Blockhouse (3 Units)
		NSSFSYSTRM	SSF Is In Maintenance
2	8.04E-06	F4TORNAD	Annual Frequency Of An F4 Intensity Tornado Striking Oconee Unit 3
		BACKHF4DEX	F4 Tornado Hits Keowee Hydro Station And Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
3	7.17E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		-BACKHF3DEX	F3 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
		BACF3TCDEX	F3 Tornado Damage To Unit 1 MFBs or Swgr 1TC
4	6.99E-06	F4TORNAD	Annual Frequency Of An F4 Intensity Tornado Striking Oconee Unit 3
		BACF4TCDEX	F4 Tornado Damage To Unit 1 MFBs or Swgr 1TC
		-BACKHF4DEX	F4 Tornado Hits Keowee Hydro Station And Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
5	6.39E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BACKHF3DEX	F3 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
6	4.33E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BF3BWSTDEX	F3 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)
		BF3BHBWDEX	Loss of Unit 1 Blockhouse MFBs given F3 Tornado Fails BWST
		-BACKHF3DEX	F3 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
7	3.33E-06	F2TORNAD	Annual Frequency Of An F2 Intensity Tornado Striking Oconee Unit 3
		BACKHF2DEX	F2 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
8	3.31E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BTOF3F3DEX	F-3 Tornado Causes F-3 Damage to the Oconee Powerhouse
		-BACKHF3DEX	F3 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		BEF0ASWDHE	Operators Fail to Depressurize SGs and Align ASW (Tornado) Pump
		NSSFSYSTRM	SSF Is In Maintenance
9	3.18E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BF3BWSTDEX	F3 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)
		-BACKHF3DEX	F3 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		BEF0ASWDHE	Operators Fail to Depressurize SGs and Align ASW (Tornado) Pump
		NSSFSYSTRM	SSF Is In Maintenance
10	3.17E-06	F2TORNAD	Annual Frequency Of An F2 Intensity Tornado Striking Oconee Unit 3
		-BACKHF2DEX	F2 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
		BACF2TCDEX	F2 Tornado Damage To Unit 1 MFBs or Swgr 1TC
11	2.46E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BTOF3F3DEX	F-3 Tornado Causes F-3 Damage to the Oconee Powerhouse
		BRCPORVPRC	Pilot-Operated Relief Valve 3RC-66 Fails To Close On Demand (steam relief)
		NSSFSYSTRM	SSF Is In Maintenance
12	2.42E-06	F4TORNAD	Annual Frequency Of An F4 Intensity Tornado Striking Oconee Unit 3
		BTOF4F3DEX	F-4 Tornado Causes F-3 Damage to the Oconee Powerhouse
		-BACKHF4DEX	F4 Tornado Hits Keowee Hydro Station And Fails Emergency Power To CT4
		BEF0ASWDHE	Operators Fail to Depressurize SGs and Align ASW (Tornado) Pump
		NSSFSYSTRM	SSF Is In Maintenance
13	2.36E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BF3BWSTDEX	F3 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)

		BRCPORVPRC	Pilot-Operated Relief Valve 3RC-66 Fails To Close On Demand (steam relief)
		NSSFSYSTRM	SSF Is In Maintenance
14	2.15E-06	F2TORNAD	Annual Frequency Of An F2 Intensity Tornado Striking Oconee Unit 3
		BF2BWSTDEX	F2 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)
		BF2BHBWDEX	Loss of Unit 1 Blockhouse MFBs given F2 Tornado Fails BWST
		-BACKHF2DEX	F2 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		NSSFSYSTRM	SSF Is In Maintenance
15	1.97E-06	F2TORNAD	Annual Frequency Of An F2 Intensity Tornado Striking Oconee Unit 3
		BF2BWSTDEX	F2 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)
		-BACKHF2DEX	F2 Tornado Hits Keowee Hydro Station and Fails Emergency Power To CT4
		BEF0ASWDHE	Operators Fail to Depressurize SGs and Align ASW (Tornado) Pump
		NSSFSYSTRM	SSF Is In Maintenance
16	1.96E-06	F4TORNAD	Annual Frequency Of An F4 Intensity Tornado Striking Oconee Unit 3
		BTOF4F3DEX	F-4 Tornado Causes F-3 Damage to the Oconee Powerhouse
		BRCPORVPRC	Pilot-Operated Relief Valve 3RC-66 Fails To Close On Demand (steam relief)
		NSSFSYSTRM	SSF Is In Maintenance
17	1.91E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BTOF3F3DEX	F-3 Tornado Causes F-3 Damage to the Oconee Powerhouse
		BEF2USTDEX	Tornado Damage to Multiple Units' UST or EFW Systems (Screening)
		BEFASW3DEX	Unit 3 ASW Alignment Failure due U1/U2 Event (Staffing)
		NSSFSYSTRM	SSF Is In Maintenance
18	1.91E-06	F4TORNAD	Annual Frequency Of An F4 Intensity Tornado Striking Oconee Unit 3
		BF4WALLDEX	Cond. Prob. of West Pen Room Failure (F4+ Damage on TB)
		BF4BWSTDEX	F4 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)
19	1.83E-06	F3TORNAD	Annual Frequency Of An F3 Intensity Tornado Striking Oconee Unit 3
		BF3BWSTDEX	F3 Tornado Missiles Cause Failure of BWST (& Damage To Turb Bldg)
		BEF2USTDEX	Tornado Damage to Multiple Units' UST or EFW Systems (Screening)
		BEFASW3DEX	Unit 3 ASW Alignment Failure due U1/U2 Event (Staffing)
		NSSFSYSTRM	SSF Is In Maintenance
20	1.52E-06	F4TORNAD	Annual Frequency Of An F4 Intensity Tornado Striking Oconee Unit 3
		BTOF4F3DEX	F-4 Tornado Causes F-3 Damage to the Oconee Powerhouse
		BEF2USTDEX	Tornado Damage to Multiple Units' UST or EFW Systems (Screening)
		BEFASW3DEX	Unit 3 ASW Alignment Failure due U1/U2 Event (Staffing)
		NSSFSYSTRM	SSF Is In Maintenance

7.68E-05	THIS CDF IS SLIGHTLY CONSERVATIVE & THE TRUE SOLUTION IS APPROXIMATELY 7E-5 MODIFYING FOR THE PERFORMANCE DEFICIENCY 7E-5 * 6.5E-1 * 1.5E-2 = 6.82E-7

Event Prob
1.04E-05
1.00E+00
3.59E-05
2.24E-01
1.00E+00
4.12E-05
1.55E-01
1.00E+00
2.06E-01
3.59E-05
2.51E-01
2.24E-01
1.00E+00
4.12E-05
1.55E-01
1.00E+00
4.12E-05
1.66E-01
7.50E-01
1.55E-01
1.00E+00
5.37E-05
6.20E-02
1.00E+00
4.12E-05
1.73E-01
1.55E-01
5.50E-01
1.00E+00
4.12E-05
1.66E-01
1.55E-01
5.50E-01
1.00E+00
5.37E-05
6.20E-02
1.00E+00
6.30E-02
4.12E-05
1.73E-01
3.45E-01
1.00E+00
3.59E-05
1.58E-01
2.24E-01
5.50E-01
1.00E+00
4.12E-05
1.66E-01

3.45E-01
1.00E+00
5.37E-05
7.10E-02
6.00E-01
6.20E-02
1.00E+00
5.37E-05
7.10E-02
6.20E-02
5.50E-01
1.00E+00
3.59E-05
1.58E-01
3.45E-01
1.00E+00
4.12E-05
1.73E-01
4.00E-01
6.70E-01
1.00E+00
3.59E-05
1.68E-01
3.16E-01
4.12E-05
1.66E-01
4.00E-01
6.70E-01
1.00E+00
3.59E-05
1.58E-01
4.00E-01
6.70E-01
1.00E+00

ATTACHMENT 6

(FIRE INITIATING EVENT)

Initiating Event Development for Full Compartment Fires that Result in SSF Operation

The fire ignition frequency estimates for the specific fire areas were calculated as follows:

(a) Cable Shaft - Based on a revised analysis of the fire ignition frequency for a large fire in the cable shaft (page 13, Responses to NRC RAI for the Oconee IPEEE, March 1999), the fire ignition frequency estimate is (9.6E-3/year)x(0.0131) = 1.3E-4/year. This estimate was calculated using the estimated fire frequency of 9.6E-3/year for a large fire in 1/3 of the auxiliary building (AEOD Report 97-03, J. Houghton) and the probability value of 0.0131 for the combined credit of fire growth, and failure of detection and suppression.

Based on licensee-provided information (March 3, 2003 e-mail to W. Rogers), the results of more detailed Fire Ignition Frequency calculations showed the fire frequency estimates with credit for manual suppression (the Cable Shaft has installed smoke ionization detectors for fire detection and a water sprinkler system of 0.1 spatial density of sprinklers that is manually activated by fire brigade responders to control the spread of fire within the area) and severity of fire in the cable shaft to be as follows:

Cable Shaft 796 foot level (near Cable Room) = 3.8E-5/year
Cable Shaft 809 foot level (near Equipment Room) = 4.0E-5/year

(b) Cable Spreading Room - The fire ignition frequency estimate for a severe fire in the cable spreading room is calculated by summing the ignition frequencies for fixed and transient ignition sources. The fixed ignition sources are low voltage termination electrical cabinets in the Cable Spreading Room. Using the generic fire frequency estimate of 3.2E-3/year for electrical cabinets in the Cable Spreading Room (page 10.3-4, EPRI FIVE) and a severity factor of 0.12 (page D-7, EPRI Fire PRA Implementation Guide), the fire ignition frequency for fixed ignition sources prior to manual suppression is estimated to be 3.8E-4/year. The Cable Spreading Room has installed smoke ionization detectors for fire detection and a water sprinkler system of 0.1 spatial density of sprinklers that is manually activated by fire brigade responders to control the spread of fire within each area. Assuming that the failure probability of manual suppression is 0.1, the fire ignition frequency estimate for fixed sources is 3.8E-5/year. Although an "equivalent" fire modeling analysis (McGuire NEI-00-01 Pilot Project) shows that the likelihood of cabinet-to-cabinet fire propagation may be low, it is assumed that there is a 10 percent fire propagation rate from one cabinet to another. Therefore, the fire ignition frequency for fixed ignition sources in the Cable Spreading Room is estimated to be (0.1) x (3.8E-5/year) = 3.8E-6/year.

The transient ignition sources include general transient fires, cable fires caused by welding, and transient fires caused by welding and cutting. Based on licensee-supplied information, the fire frequency estimates were 6.4E-05/year for general transient fires, 6.3E-5/year for cable fires caused by welding, and 3.8E-4/year for transient fires caused by welding and cutting. Using the manual suppression curves in Figures K-3 and K-4, Appendix K of EPRI Fire PRA Implementation Guide and a conservative 10-minute damage time, it was determined that the failure probabilities of manually suppressing transient fires and fires caused by welding within 10 minutes, are 0.44 and 0.08 respectively. The 10-minute damage time is considered conservative because cable fire

testing on armored cables at a heat load of 350kW showed the time to fire damage on the cables at greater than 30 minutes. Therefore, the total fire ignition frequency estimate for transient ignition sources is (6.4E-5/year * 0.44) + (6.3E-5/year * 0.08) + (3.8E-4/year * 0.08) = 6.4E-5/year.

The total fire ignition frequency estimate for the Cable Spreading Room is (3.8E-6/year + 6.4E-5) = 6.8E-5/year.

(c) Electrical Equipment Room - The Electrical Equipment Room contains the control cables in bundles in the Cable Shaft. Based on licensee-provided information (March 3, 2003 e-mail to W. Rogers), the results of more detailed Fire Ignition Frequency calculations showed the fire frequency estimate with credit for manual suppression and severity of fire in the Electrical Equipment Room to be 1.0E-4/year. The Electrical Equipment Room has installed smoke ionization detectors for fire detection and a water sprinkler system of 0.1 spatial density of sprinklers that is manually activated by fire brigade responders to control the spread of fire within each area.

The total fire ignition frequency estimate for all of the above stated fire areas, **except for the Main Control Room,** affecting the armored LP-19 or LP-20 cables, with credit for fire growth and failure of detection and suppression, is calculated to be (3.8E-5/year + 4.0E-5/year + 6.8E-5/year + 1.0E-4/year) = 2.5E-4/year.

(d) Main Control Room - Unit 1 / 2: This is a common Main Control Room (MCR) with 89 electrical cabinets estimated in the area. The generic fire ignition frequency estimate for Control Rooms is 9.5E-3/year (Table 4-2, EPRI TR-105928). There are no fire walls between the MCR boards. Based on Sandia electrical cabinet fire tests, it is assumed that it takes at least 15 minutes for fire propagation to adjacent cabinets before the smoke build-up requires MCR evacuation (See Appendix H-1 of EPRI TR-105928 for guidance on fire spread between electrical cabinets).

Using the Control Room Fire manual suppression curve in Appendix M of EPRI Fire PRA Implementation Guide and a 15-minute time available for suppression prior to smoke build-up requiring control room evacuation, it was determined that the failure probability of manually suppressing a fire in the MCR within 15 minutes is 3.4E-3. Therefore, the fire ignition frequency estimate for fire affecting the common Unit 1 /2 MCR with credit for manual suppression is (2 * 9.5E-3/year) x (3.4E-3) = 6.46E-5/year.

Unit 3: This is a separate control room and full compartment fire frequency is (9.5E-3/year) x (3.4E-3) = 3.23E-5

(e) Turbine Building - The licensee's IPEEE was used directly. A synopsis of the IPEEE analysis is provided below:

> For an all-consuming fire of the turbine building, the credible ignition source was determined to be the turbine's oil system. With zero fires causing loss of the turbine building reported the ignition frequency was derived by::
>
> $\Phi(A) = \chi^2 50^{(2n+1)/2T} = 1.7E\text{-}4/yr$
>
> $\Phi(A)$ is the frequency

$\chi^2 50$ is the variate at the 50% cumulative level or 0.455 fo the Chi-Squared distribution

T is the number of years of experience of 1303.6 unit years between 1980 & 1993

N is the number of events or 0 in the 1980 to 1993 time

An automatic suppression system was credited with a failure probability of 0.1. Therefore, the initiating event frequency requiring SSF use was 1.7E-4 * 0.1 = 1.7E-5.