ATTACHMENT 3 CALCULATION PTN-BFJR-06-001 PHASE 3 SDP FOR TURKEY POINT "B" AFW PUMP FAILURE

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CALCULATION COVER SHEET

Calculation No: <u>PTN-BFJR-06-001</u>

Title: PHASE 3 SDP FOR TURKEY POINT B AFW PUMP FAILURE

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PTN-BFJR-06-001 Rev 0 PTN AFWP B SDP Calc.doc

LIST OF EFFECTIVE PAGES

Calculation No: <u>PTN-BFJR-06-001</u>

REV. 0

Title: PHASE 3 SDP FOR TURKEY POINT B AFW PUMP FAILURE.

PAGE	SECTION	REV	PAGE	SECTION	REV	PAGE	SECTION	REV
1	COVER SHEET	0						
2	LIST OF EF PG	0						
3	TABLE OF CONTS	0						
4	1.0	0						
4	2.0	0	1					
4	3.0	0						
5	4.0	0						
7	5.0	0						
15	6.0	0						
15	7.0	0						1
18	Attachment 1	0		· ·.				
23	Attachment 2	<u> </u> 0					•	
25	Attachment 3	0						
28	Attachment 4	0						
29	Attachment 5	0						
30	Attachment 6	0						
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TABLE OF CONTENTS

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Calculation No:	PTN-BFJR-06-001	REV. <u>0</u>
SECTION		PAGE
1.0 PURPOSE/SCOPE		4
2.0 REFERENCES		4
3.0 METHODOLOGY		4
4.0 ASSUMPTIONS/BAS	SES	5
5.0 CALCULATION	· · · · · · · · · · · · · · · · · · ·	7
6.0 CALCULATIONAL F	ILES	15
	ITIVITY CASE, USING MSPI DATA, WITH	
	ITIVITY STUDY: BASE CASE, USING MSF	
ATTACHMEINT 3: CLAR	IFICATION OF LOSS OF DC 3A OPERAT	OR RECOVERY ACTION25
	MARY OF TURKEY POINT PLANT RESPO	
ATTACHMENT 5: SUMM	MARY OF NRC PHASE 3 SDP RESULTS	
ATTACHMENT 6: SPAR	-H PERFORMANCE SHAPING FACTORS	FOR EXECUTION

LIST OF TABLES

•••

	<u>IPAGE</u>
Table (1): AFW Pump B Surveillance Data.	5
Table (2): Top 10 cutsets from SPAR Model for LODC3A.	9
Table (3): List of Key HEPs and Performance shaping Factors.	10
Table (4): Top 10 cutsets from SPAR Model for LOCHS.	11
Table (5): Top 10 cutsets from SPAR Model for LOMFW.	13
Table (6): Best Estimate Delta CDF.	16
Table (7): Summary of Delta CDF Sensitivity Study.	16

1.0 PURPOSE/SCOPE

This calculation documents the methodology and input used to support a response to the NRC phase 3 SDP (Ref. 1) associated with B AFW pump failure identified in a test run on November 7, 2005. During IST testing 11/7/05, the B AFW pump P2B exhibited high vibration and temperatures at the inboard journal bearing location inspection point (Reference 4). The reading was documented as 0.8 in/sec. On 11/8/05 the AFW pump was disassembled for inspection. The initial inspection included disassembling the coupling and pump inboard bearing. The results of this inspection found signs of uneven tooth wear on the pump coupling and evidence of grease caking. Inspection of the inboard journal bearing found that the bearing was installed incorrectly. The bearing was installed 90 degrees from its correct orientation. This incorrect installation resulted in inadequate lubrication to the bearing and caused flaking of the sleeve bearing babbit.

2.0 REFERENCES

- 1. Turkey Point Nuclear Plant Integrated Inspection Report, 05000250/2005005 and 05000251/2005005 Preliminary White Finding, ; January 27, 2005.
- 2. NURG/CR-6883, The SPAR-H Human Reliability Analysis Method, 8/2005.
- 3. Emails from Glen Blinde 12/28/2005, Re: PTN AFW SDP issue success criteria need; 2/16/2006, Re: Questions on B5B & AFW MAAP runs.
- 4. CR 2005-30750 (High Vibrations on the P2B AFW Pump Extent of Condition).
- 5. NEI-99-02 Appendix F, "Methodologies for Computing The Unavailability Index, The Unreliability Index and Component Performance Limits", Revision 4.
- 6. PTN Change Form PTN-C-06-001, February, 2006.
- 7. PTN-BFJR-00-001, "PTN PSA Model Update," FPL-RRAG, Revision 5, 6/24/04.
- 8. SPAR Model for Turkey Point Units 3 and 4, August 2005, version 9/30/2005.

3.0 METHODOLOGY

Because the degradation of B AFW pump is time-dependent, its safety significance is assessed by including the following factors:

- 1. Based on the test data and operating experience of the B AFW pump, .the B AFW pump would run at least one hour on or before October 30, 2005. Afterwards, the performance of B AFW pump is not determined, and is conservatively assumed to fail within the first hour.
- 2. If B AFW pump runs for an hour and then fails, the decay heat is significantly lower, allowing more time for operators to take actions stipulated in the EOP.
- 3. The lower decay heat after one hour from hypothetical accidents also allows a less stringent success criterion for feed and bleed.
- 4. Credit for operator actions (e.g., certain offsite power recovery actions) not included in the original baseline PSA model, which were not important due to lower probability of the sequences, should be included for consistency.

5. Using a mission time of 24 hours for 3 AFW pumps and 2 standby steam generator feed pumps overestimates the probability of selected sequences.

The approach used in the Phase 3 SDP is to review the SPAR model (Reference 8), the Turkey Point PSA model (Reference 7), MSPI data base and insights obtained from the sensitivity studies to develop a scoping estimate of the risk impact.

4.0 ASSUMPTIONS/BASES

- 1. SPAR-H for Human Error Probability estimates are used for revising the HEPs for cases in which B AFW pump fails after 1 hour.
- 2. Run times for B AFW pump collected from AFW system engineer indicate that the AFW pump was capable of running for more than one hour (see run time for 10/10/05). The pump capability (residual runtime) given a demand would be increasingly longer looking back in time due to the progressively less wear when pump experienced fewer run hours. This is indicated in the table below per email from Joe Laduca 12/31/2005.

	Table (1): AFW Pump B Surveillance Data.							
Date	Surveillance Runs plus Rx Trips(hours)	Reason (Procedure or Trip)	Residual runtime					
\$/3/2003	0.7	4-OSP-075.9	54.83					
\$/6/2003	1.3	4-OSP-075.2	54.13					
£/6/2003	0.5	4-OSP-075.9	52.83					
£/7/2003	1.75	4-OSP-075.2	52.33					
£/8/2003	3.5	4-OSP-075.7	50.58					
£/9/2003	1.5	3-OSP-075.2	47.08					
9/10/2003	0.6	4-OSP-075.2	45.58					
9/12/2003	0.5	4-OSP-075.9	44.98					
10/13/2003	0.6	3-OSP-075.2	44.48					
11/4/2003	0.5	4-OSP-075.7	43.88					
11/10/2003	1.5	3-OSP-075.7	43.38					
12/8/2003	0.6	3-OSP-075.2	41.88					
12/9/2003	0.8	4-OSP-075.7	41.28					
1/5/2004	0.9	3-OSP-075.2	40.48					
1/5/2004	0.4	4-OSP-075.2	39.58					
1/30/2004	1	3-OSP-075.7	39.18					
2/2/2004	0.6	4-OSP-075.2	38.18					
3/2/2004	0.5	3-OSP-075.2	37.58					
3/4/2004	1.7	4-OSP-075.7	37.08					
3/:29/2004	1.1	4-OSP-075.2	35.38					
3/:29/2004	0.25	3-OSP-075.2	34.28					
4/.26/2004	1.1	3-OSP-075.7	34.03					
5/14/2004	2.75	Rxr Trip AFW Auto Initiation	32.93					

Date	Surveillance Runs plus Rx Trips(hours)	Reason (Procedure or Trip)	Residual runtime
5/24/2004	0.5	3-OSP-075.2	30.18
6/21/2004	0.5	3-OSP-075.2	29.68
6/21/2004	0.9	4-OSP-075.2	29.18
7/19/2004	1.7	3-OSP-075.7	28.28
7/20/2004	0.5	4-OSP-075.2	26.58
8/16/2004	0.4	3-OSP-075.2	26.08
9/13/2004	. 0.25	3-OSP-075.2	25.68
9/13/2004	0.5	4-OSP-075.2	25.43
10/11/2004	0.4	4-OSP-075.2	24.93
11/8/2004	0.9	4-OSP-075.2	24.53
11/12/2004	1.4	4-OSP-075.7	23.63
12/1/2004	1.2	3-OSP-75.7	22.23
12/6/2004	1	4-OSP-075.2	21.03
12/14/2004	1.8	Rxr Trip AFW Auto Initiation	20.03
12/25/2004	1.1	Rxr Trip AFW Auto Initiation	18.23
12/28/2004	0.9	Rxr Trip AFW Auto Initiation	17.13
1/10/2005	0.9	4-OSP-075.2	16.23
1/31/2005	1.33	4-OSP-075.7	15.33
2/24/2005	1.05	4-OSP-075.2	14.00
2/28/2005	0.43	4-OSP-075.2	12.95
2/28/2005	0.52	3-OSP-075.2	12.52
2/28/2005	0.5	3-OSP-075.9	12.00
3/22/2005	0.5	3-OSP-075.2	11.50
3/.22/2005	1.5	Rxr Trip AFW Auto Initiation	11.00
4/25/2005	0.4	3-OSP-075.2	9.50
5/6/2005	0.3	3-OSP-075.2	9.10
5/,23/2005	0.5 .	3-OSP-075.2	8.80
5/:27/2005	0.2	3-OSP-075.2	8.30
6/:25/2005	. 0.5	4-OSP-075.2	8.10
6/:25/2005	. 0.6	3-OSP-075.7	7.60
6/:27/2005	0.9	Rxr Trip AFW Auto Initiation	7.00
7/18/2005		4-OSP-075.7	6.1
7/:20/2005	0.5	3-OSP-075.2	5.1
8/15/2005	0.5	4-OSP-075.2	4.6
9/12/2005	0.3	4-OSP-075.2	4.1
10/10/2005	0.4	3-OSP-075.2	3.8
10/10/2005	2.1	4-OSP-075.7	3.4
10/31/2005	0.6	Rxr Trip AFW Auto Initiation	1.3
		November 7 ran 0.7 hours	

3. As a sensitivity study, the MSPI industry reliability data as a new generic prior and the SPAR model failure data were used for AFW pumps failure to start and run.

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5.0 CALCULATION

Based on the test data and operating experience of the B AFW pump, the B AFW pump would run at least one hour at normal failure rate (thus for the first hour given any hypothetical accidents, there is no Delta CDF increase) on or before October 31, 2005. Afterwards, the performance of B AFW pump is not determined, and is conservatively assumed to fail.

The risk impact of degraded B AFW pump is composed of two time windows, each with a different risk increase.

<u>Time Window 1:</u> Before October 30, 2005, B AFW pump is assumed to fail one hour or longer after automatic actuation

1. If B AFW pump runs for an hour and then fails, the decay heat is significantly lower, allowing more time for operators to take actions stipulated in the EOP.

A scoping MAAP run and an analysis based on decay heat equation indicated that at least an additional hour would be available for execution (Reference 7). The Human Error Probabilities, based on the SPAR-H, for the performance shaping factor "Available Time", are adjusted from "just enough" to "nominal" due to much longer time and potentially less stress. Thus HEPs (see Attachment 6, which is excerpted from Reference 2) would be reduced by a factor of 10 or more.

 The lower decay heat after one hour from hypothetical accidents also allows a less stringent success criterion for bleed and feed. Instead of 2 PORVs for bleed, either PORV opening is sufficient for the successful operation of bleed and feed. (see Attachment 4, which is excerpted from Reference 3, second and third cases)

This reduces the contribution of the dominant sequences LDC3A, by a factor of 10 or more.

The above factors are included in the Turkey Point SPAR model to estimate the delta CDF for the case where B AFW pump would fail after one hour of operation. Delta CDF is estimated to be approximately 3.2E-7 (a factor of 10 reduction from 3.2E-6/Yr).

<u>Time Window 2</u>: After October 31, 2005, B AFW pump is assumed to fail within one hour of automatic actuation.

A review of the cutsets for loss of DC bus, indicates that if AFW fails within the first hour, those cutsets involving the stopping of the C pump are not valid, as the condition for it being failed due to deadheading is eliminated by B pump failing. The CDF is conservatively assumed to be 1.6 E-6/Yr (3.2E-6/Yr, subtracted by 1.6E-6/Yr, a scoping elimination of the top cutest of loss of DC bus).

The core damage frequency increase due to the degraded B AFW pump over a year is estimated to be:

1.6E-6/Yr * 1/12 + 3.2E-7/Yr * 11/12 = 4.3E-7/Yr, which is less than 1.0E-6/Yr. The Delta CDF increase is considered not risk significant.

There is still some margin in the estimated safety significance from the threshold of 1.0E-6/Yr, even if it is conservatively assumed that risk impact of the B AFW pump due to external events is as high as that due to internal events.

Other mitigating factors that may reduce the risk impact include:

- Unit 3 and Unit 4 were shutdown to Mode 3 on October 24 because of grid instabilities due to Hurricane Wilma. Unit 3 was returned to full power operation on November 2. Unit 4 remained shutdown due to secondary chemistry problems. On October 31, the switchyard insulator salting caused loss of Unit 4 startup transformer and on November 1, the unit was placed in Mode 5. Following restoration of offsite power and resolution of chemistry problems, the unit was restarted on November 12 and returned to full power operation on November 14.
- 2. Using a mission time of 24 hours for 3 AFW pumps and 2 standby steam generator feed pumps overestimates the probability of selected sequences.
- Manual actions stipulated in the plant procedures to recover failure of AFW pumps were not credited in the original baseline PSA model should be included to be consistent with NRC's SPAR model
- 4. The delta CDF for the time windows where B AFW pump was degraded, but could have run for longer than one hour, is lower than that for which B AFW pump was assumed to run for just one hour.

SAPHIRE 7 and the latest Turkey Point model were used to understand the three dominant sequences contributing to the phase 3 SDP summarized in the NRC inspection report. The SPAR model was modified by incorporating the key modeling assumptions related to using SSGFW pump, with slightly higher delta CDF than that estimated in Reference 2 (see Attachment 5)

Mitigating factor 1: For the case of B AFW pump failing within the first hour, the operator action to stop the weaker pump is not applicable, as the B AFW pump would fail before the deadheading of the weaker pump becomes an issue.

For the case when B AFW pump fails after running for one hour or more, the probability of dominant cutsets can be reduced by a factor of 10 or more, because:

- 1. The success criterion for feed and bleed is relaxed from two PORVs to one PORV.
- Recovery action to locally use AFW train A given loss of DC bus A is proceduralized and credited in the Turkey Point PSA model, with failure probability of 0.11 including the harcware failure.

<u>A</u> 1			Table (2): Top 10 Cl	uisets from SPAP	R Model for LODC3A.	
Cut No.	% Total	% Cut Set	Prob./Frequency	Basic Event	Description	Event Prob.
1	93.79	93.79	1.750E-006	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
	· · ·			AFW-TDPC- WEAKER	AFW TDP-C WEAKER OF THE TWO TRAIN 2 PUMPS (PSA)	5.000E-001
				AFW-XHE-XM- TRIP1	OPERATOR FAILS TO TRIP AFW PUMP	1.400E-003
				MFW-XHE-XL- TRIP	OPERATOR FAILS TO RECOVER MFW	1.000E+000
2	95.67	1.88	3.500E-008	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
				AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-003
				MFW-XHE-XL- RESTORE	OPERATOR FAILS TO RESTORE MFW (LODC3A - PSA)	2.000E-003
3	97.01	1.34	2.500E-008	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
				AFW-TDP-TM-C	AFW TDP C UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.000E-003
				MFW-XHE-XL- RESTORE	OPERATOR FAILS TO RESTORE MFW (LODC3A - PSA)	2.000E-003
4	98.25	1.24	2.305E-008	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
				AFW-TDP-CF- FRBC	COMMON CAUSE FAILURE OF TDP B & C TO RUN	4.610E-003
				MFW-XHE-XL- RESTORE	OPERATOR FAILS TO RESTORE MFW (LODC3A - PSA)	2.000E-003
5	98.97	0.72	1.348E-008	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
				AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003
				MFW-XHE-XL- RESTORE	OPERATOR FAILS TO RESTORE MFW (LODC3A - PSA)	2.000E-003
6	99.13	0.16	2.951E-009	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
				AFW-TDP-FR-C	AFW TDP C FAILS TO RUN	5.366E-003
				AFW-XHE-XL- TDPA	OPERATOR FAILS TO MANUALLY ALIGN TDP-A GIVEN LOSS OF DC-3A (PSA)	1.100E-001
				MFW-XHE-XL- RESTORE	OPERATOR FAILS TO RESTORE MFW (LODC3A - PSA)	2.000E-003
7	99.26	0.13	2.500E-009	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003
			· ·	AFW-CKV-CC- 3012	FAILURE OF FLOW TO SG- 3B THROUGH CHECK VALVE 3-012	1.000E-004
			· ·	AFW-XHE-XM- FLOW2	OPERATOR FAILS TO INCREASE AFW TRAIN 2 FLOW GIVEN ONE DISCH PATH FAILED	1.000E-002

PTN-BFJR-06-001 Rev. 0 Page 10 of 30

	Table (2): Top 10 cutsets from SPAR Model for LODC3A.							
Cut No.	% Total	% Cut Set	Prob./Frequency	Basic Event	Description	Event Prob.		
				MFW-XHE-XL- TRIP	OPERATOR FAILS TO RECOVER MFW	1.000E+000		
8	99.39	0.13	2.500E-009	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003		
				AFW-CKV-CC- 3010	FAILURE OF FLOW TO SG- 3A THROUGH CHECK VALVE 3-010	1.000E-004		
				AFW-XHE-XM- FLOW2	OPERATOR FAILS TO INCREASE AFW TRAIN 2 FLOW GIVEN ONE DISCH PATH FAILED	1.000E-002		
				MFW-XHE-XL- TRIP	OPERATOR FAILS TO RECOVER MFW	- 1.000E+000		
9	99.52	0.13	2.500E-009	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003		
				AFW-CKV-CC- 3014	FAILURE OF FLOW TO SG- 3C THROUGH CHECK VALVE 3-014	1.000E-004		
				AFW-XHE-XM- FLOW2	OPERATOR FAILS TO INCREASE AFW TRAIN 2 FLOW GIVEN ONE DISCH PATH FAILED	1.000E-002		
				MFW-XHE-XL- TRIP	OPERATOR FAILS TO RECOVER MFW	1.000E+000		
10	99.63	0.11	2.134E-009	IE-LODC3A	LOSS OF DC BUS 3A	2.500E-003		
				AFW-TDP-TM- TRAIN2	AFW TRAIN 2 UNAVAILABLE DUE TO TEST AND MAINTENANCE (PSA)	3.880E-003		
				AFW-XHE-XL- TDPA	OPERATOR FAILS TO MANUALLY ALIGN TDP-A GIVEN LOSS OF DC-3A (PSA)	1.100E-001		
				MFW-XHE-XL- RESTORE	OPERATOR FAILS TO RESTORE MFW (LODC3A - PSA)	2.000E-003		

For the case when B AFW pump fails after running for one hour or more, the HEPs are reduced by a factor of 10 because available time is nominal (See Attachment 6, the basis of SPAR-H for execution).

	Table (3): List of Key HEPs and Performance shaping Factors.							
HRA Basic Event Name	Event Description/Shaping Factor	Distribution Type/PSF	Probability/ Percentage	Initial/Multiplier				
AFW-XHE-XM-THRTL	OPERATOR FAILS TO THROTTLE SG FCVs	Constrained Noninformative	1.0E-3					
	Action is modeled.			1.0E-3				
	Available Time	Nominal time	100%	1.00				
	Stress/Stressors	Nominal	100%	1.00				
	Complexity	Nominal	100%	1.00				
· · · ·	Experience/Training	Nominal	100%	1.00				
	Procedures	Nominal	100%	1.00				
	Egonomics/HMI	Nominal	100%	1.00				

HRA Basic Event	Event Description/Shaping Factor	Distribution Type/PSF	Probability/ Percentage	Initial/Multiplier
	. Fitness for Duty	Nominal	100%	1.00
•	Work Processes	Nominal	100%	1.00
·····	Dependency is not modeled.			
SFP-XHE-XM-SSGFP	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS	Constrained Noninformative		·
	Action is modeled.			1.0E-3
•	Available Time	Nominal time	100%	1.00
···	Stress/Stressors	Nominal	100%	1.00
	Complexity	Nominal	100%	1.00
	Experience/Training	Nominal	100%	1.00
	Procedures	Nominal	100%	1.00
	Egonomics/HMI	Nominal	100%	1.00
	Fitness for Duty	Nominal	100%	1.00
	Work Processes	Nominal	100%	1.00
	Dependency is not modeled.		1i	·
HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	Constrained Noninformative	2.0E-3	
······································	Action is modeled.			1.0E-3
	Available Time	Nominal time	100%	1.00
	Stress/Stressors	High	100%	2.00
·	Complexity	Nominal	100%	1.00
·····	Experience/Training	Nominal	100%	1.00
	Procedures	Nominal	100%	1.00
	Egonomics/HMI	Nominal	100%	1.00
	Fitness for Duty	Nominal	100%	1.00
	Work Processes	Nominal	100%	1.00

	Table (4): Top 10 cutsets from SPAR Model for LOCHS.									
Cut No.	% Total	% Cut Set	Prob <i>.</i> Frequency	Basic Event	Description	Event Prob.				
1	70.82	70.82	2.888E-007	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002				
				AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003				
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002				
			· .	SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002				
2	73.80	2.98	1.213E-008	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002				
			•	AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003				
				PPR-SRV-CC- 456	PORV 1 (PCV-456) FAILS TO OPEN ON DEMAND	5.000E-003				

PTN-BFJR-06-001 Rev. 0 Page 12 of 30

	Table (4): Top 10 cutsets from SPAR Model for LOCHS.							
Cut	% Totul	% Cut	Prob./	Basic Event	Description	Event Prob.		
No.	Total	Set	Frequency	SFP-XHE-XM-	OPERATOR FAILS TO START AND	1.000E-002		
				SSGFP	ALIGN STANDBY SG PUMP	1.0002.002		
	[·	[TRAINS			
3	76.78	2.98	1.213E-008	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002		
				AFW-TDP-CF-	COMMON CAUSE FAILURE OF	2.696E-003		
				FRALL	TURBINE DRIVEN PUMPS TO RUN	<u></u>		
		ł		PPR-SRV-CC- 455C	PORV 2 (PCV-455C) FAILS TO OPEN ON DEMAND	5.000E-003		
	<u> </u>			SFP-XHE-XM-	OPERATOR FAILS TO START AND	1,000E-002		
				SSGFP	ALIGN STANDBY SG PUMP			
					TRAINS			
4	78.07	1.29	5.248E-009	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002		
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003		
-				AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-003		
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE	2.000E-002		
			•		FEED AND BLEED COOLING			
				SFP-XHE-XM-	OPERATOR FAILS TO START AND	5.950E-002		
				SSGFP1	ALIGN STANDBY SG PUMP TRAINS (DE			
5	79.26	1.19	4.853E-009	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002		
				AFW-TDP-CF-	COMMON CAUSE FAILURE OF	2.696E-003		
				FRALL	TURBINE DRIVEN PUMPS TO RUN			
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE	2.000E-002		
					FEED AND BLEED COOLING			
				SFP-MOV-CC-	FAILURE OF SSGFP DISCHARGE	1.000E-003		
6	80.25	0.99	4.023E-009	3012 IE-LOCHS	PATH VALVE 3-012	9.000E-002		
	00.25	0.35	4.0232-009	AFW-TDP-FR-A	AFW TDP A FAILS TO RUN	5.366E-003		
				AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-003		
			·		OPERATOR FAILS TO INITIATE	2.000E-002		
		•		HPI-XHE-XM-FB	FEED AND BLEED COOLING	2.000E-002		
				SFP-XHE-XM-	OPERATOR FAILS TO START AND	5.950E-002		
			•	SSGFP1	ALIGN STANDBY SG PUMP			
					TRAINS (DE			
7	81.24	0.99	4.023E-009	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002		
				AFW-TDP-FR-C	AFW TDP C FAILS TO RUN	5.366E-003		
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003		
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE	2.000E-002		
				SFP-XHE-XM-	FEED AND BLEED COOLING OPERATOR FAILS TO START AND	5.950E-002		
				SSGFP1	ALIGN STANDBY SG PUMP	0.900E-002		
					TRAINS (DE			
8	82.16	. 0.92	3.749E-009	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002		
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003		
				AFW-TDP-TM-C	AFW TDP C UNAVAILABLE DUE	5.000E-003		
					TO TEST AND MAINTENANCE	·		
· 				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002		
				SFP-XHE-XM-	OPERATOR FAILS TO START AND	5.950E-002		
		•		SSGFP1	ALIGN STANDBY SG PUMP			
					TRAINS (DE			
9	83.08	0.92	3.749E-009	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002		

PTN-BFJR-06-001 Rev. 0 Page 13 of 30

		Т	able (4): To	p 10 cutsets from	m SPAR Model for LOCHS.		
Cut No.	% Total	% Cut Set					
			· · · · · · · · · · · · · · · · · · ·	AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-003	
			····	AFW-TDP-TM-A	AFW TDP A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.000E-003	
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002	
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002	
10	83.93	0.85	3.456E-009	IE-LOCHS	LOSS OF CONDENSER HEAT SINK	9.000E-002	
				AFW-TDP-CF- FRBC	COMMON CAUSE FAILURE OF TDP B & C TO RUN	4.610E-003	
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003	
		· .		HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002	
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002	

For the case when B AFW pump fails after running for one hour or more, the HEPs are reduced by a factor of 10 because available time is "nominal" instead of "just enough".

	Table (5): Top 10 cutsets from SPAR Model for LOMFW.											
Cut No.	% Totai	% Cut Set	Prob./ Frequency	Basic Event	Description	Event Prob.						
1	70.78	70.78	3.209E-007	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-001						
				AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003						
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002						
				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+000						
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002						
2	73.75	2.97	1.348E-008	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-001						
				AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003						
				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+000						
				PPR-SRV-CC- 456	PORV 1 (PCV-456) FAILS TO OPEN ON DEMAND	5.000E-003						
				SFP-XHE-XM- SSGFP	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS	1.000E-002						
3	76.72	2.97	1.348E-008	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-001						
				AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003						
Ĭ		-		MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+000						
				PPR-SRV-CC- 455C	PORV 2 (PCV-455C) FAILS TO OPEN ON DEMAND	5.000E-003						
				SFP-XHE-XM-	OPERATOR FAILS TO START AND	1.000E-002						

PTN-BFJR-06-001 Rev. 0 Page 14 of 30

Cut	%	% Cut	Prob./		SPAR Model for LOMFW.	
No.	Total	Set	Frequency	Basic Event	Description	Event Prob
				SSGFP	ALIGN STANDBY SG PUMP TRAINS	
4	78.01	1.29	5.831E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-00
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003
		<u>`</u>		AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-00
	· · ·	<u>-</u>	· · · · · · · ·	HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE	2.000E-00
					FEED AND BLEED COOLING	
·	· .	-	· · ·	MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+00
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND . ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002
5	79.20	1.19	5.392E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-00
	· .		· · · ·	AFW-TDP-CF- FRALL	COMMON CAUSE FAILURE OF TURBINE DRIVEN PUMPS TO RUN	2.696E-003
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002
				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+00
			•	SFP-MOV-CC- 3012	FAILURE OF SSGFP DISCHARGE PATH VALVE 3-012	1.000E-003
6	80.19	0.99	. 4.470E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-00
			• • •	AFW-TDP-FR-C	AFW TDP C FAILS TO RUN	5.366E-00
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003
			· · · · ·	HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002
			· ·	MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+00
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002
7	81.18	0.99	4.470E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-001
				AFW-TDP-FR-A	AFW TDP A FAILS TO RUN	5.366E-003
				AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-003
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002
•				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+00
	· .	· · · · · · · · · · · · · · · · · · ·		SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002
8	82.10	0.92	4.165E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-00
				AFW-TDP-FS-C	AFW TDP C FAILS TO START	7.000E-003
			•••••••	AFW-TDP-TM-A	AFW TDP A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.000E-003
		•. ••		HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002
				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+000
		•	·	SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002

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PTN-BFJR-06-001 Rev. 0 Page 15 of 30

		Т	able (5): Top	10 cutsets from	SPAR Model for LOMFW.	
Cut No.	% Total	% Cut Set	Prob./ Frequency	Basic Event	Description	Event Prob.
9	83.02	0.92	4.165E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-001
	<u> </u>			AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003
		· .		AFW-TDP-TM-C	AFW TDP C UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.000E-003
				HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002
				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+000
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002
10	83.87	0.85	3.840E-009	IE-LOMFW	LOSS OF MAIN FEEDWATER	1.000E-001
				AFW-TDP-CF- FRBC	COMMON CAUSE FAILURE OF TDP B & C TO RUN	4.610E-003
				AFW-TDP-FS-A	AFW TDP A FAILS TO START	7.000E-003
	· ·			HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.000E-002
				MFW-XHE-XL- MFWREC	OPERATOR FAILS TO RECOVER MFW	1.000E+000
				SFP-XHE-XM- SSGFP1	OPERATOR FAILS TO START AND ALIGN STANDBY SG PUMP TRAINS (DE	5.950E-002

Similarly, the probability of cutsets for other sequences are reduced by a factor of 10 due to the following mitigating factors:

- 1. Feed and bleed success criterion being relaxed to one of 2 PORVs,
- 2. Time to take actions is increased by at least an hour
- 3. Condensate system may be used for scenarios not involving power conversion systems

6.0 CALCULATIONAL FILES

The key assumptions and data used in the calculation are documented in the calculation. Additional files and information used for sensitivity studies are found in directory \\Ws084784\Max1\PTNAFW,

7.0 RESULTS

The CDF increase is estimated by combining the different CDF for the two different time windows, one for B AFW pump failing before one hour and the other B AFW pump failing after one hour. For the purpose of bounding evaluation, conservative values are used to simplify the calculation. A best-estimate based on the review of the NRC's phase 3 SDP and revised SPAR model yields the following:

Table (6): Best Estimate Delta CDF.											
Exposure Time	11 months	1 month	Delta CDF								
AFW Failure Time	after 1 hour	in the first hour	weighted by exposure time								
delta CDF	3.20E-07	1.60E-06	4.27E-07								

Additional sensitivity studies were performed by using the Turkey Point Rev 5B model with newer MSIPI industry average failure data (Reference 6) for MOVs, Motor Driven Pumps, Turbine Driven Pumps, AOVs, EDGs, etc. Attachments 1 and 2 provide a list of dominant cutsets involving the B AFW pump, for failure probability of running set to 1.0 and 1.6E-2 respectively.

Comparable results are obtained using a similar approach but using Turkey Point PSA model with a scoping assumption based on insights of many exploratory runs considering the following factors:

- 1. Top cutsets involving A & C AFW failing to runs, can be reduced by a factor of 2 to 4, simply by applying convolution.
- Top cutsets involving A& C AFW failing to start, can apply 0.5 or smaller for reasons similar to that of MSPI AFW FTS, PSL SPAR or even lower say a factor of 0.1 based on PSL Unit 2 C AFW pump case
- 3. Selected cutsets involving LOG I.E. do not have offsite power recovery
- 4. For AFW failing within the first hour, cutsets involving AHFAFWPTRP may be eliminated
- 5. Cutsets involving T3 and T1 may be mitigated by using condensate for secondary heat removal
- 6. Cutsets involving loss of 4 KV bus may be mitigated by condensate for secondary heat removal

A scoping estimate is performed assuming a factor of 2 reduction (based on judgment and the fact that SPAR model results indicate a factor of 5 reduction as indicated in Table 6) for the delta CDF associated with B AFW pump failing after one hour from that when AFW fails within the first hour. The delta CDF in the first hour for the second case in Table 7, PTN Model with MSPI data is obtained by using the cutest files indicated in Attachments 1 and 2, by setting AHFPAFWPTRP to false, as this operator action is not required if AFW is assumed to fail in less than one hour. The delta CDF for the case in which AFW fails after one hour is obtained by reducing by a factor of 2 that for the case in which AFW is assumed to fail in less than one hour.

The results are summarized below.

Table (7): Summary of Delta CDF Sensitivity Study.										
	Exposure Time	11 months	1 month	Delta CDF						

	AFW Failure Time	after 1 hour	in the first hour	weighted by exposure time
SPAR Model	delta CDF	3.20E-07	1.60E-06	4.27E-07
PTN Model with MSPI data	delta CDF	2.79E-07	5.58E-07	3.02E-07

The increase in the CDF associated with the degraded B AFW pump is estimated to be lower than 4.3E-7/Yr.

In summary, a phase 3 safety significance determination has been performed, based in part, on the following key assumptions:

- 1. The degradation of the B AFW pump is time-dependent, as the pump continued to deliver adequate flow at least for one hour until 10/30/2005. Between 10/30/2005 and the date of condition discovery (11/07/05), the ability to deliver flow for longer than an hour is not determined.
- 2. Based on the test operating data, the B AFW pump would run at least one hour on or before October 30, 2005 (eight days prior to discovery). After October 30, 2005, the B AFW pump is conservatively assumed to fail in the first hour.
- 3. If the E AFW pump runs for one hour prior to failure, the decay heat is significantly lower, which allows more time for operators to take actions stipulated in the EOP.
- 4. Manual actions stipulated in the plant procedures (e.g. EOP, ONOP and OP) to provide secondary heat removal after the failure of AFW pumps by use of Standby Steam Generator Feedwater pumps and bleed and feed are included in the model (e.g. reduces the need for two pressurizer power operated relief valves to one).

The safety significance determination has concluded that the core damage probability increase over a year is less than 1.0E-6.

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Attachment 1: Sensitivity Case, Using MSPI data, with AFW B failure to run set to 1.0

:\2006MSPI\CAFTA Files Rev C\Cuts\PTNR5C10AFWB.CUT					2/15/2008	9:20 PM		
ŧ	Cutset Prol	Event Prob C	Rate	U	Exposure	υ.	Event	Description
	7.95E-08	3.50E-03 9			3.50E-03			STEAM GENERATOR TUBE RUPTURE 3C GENERATOR
		1.00E+00 0			.5		AHFPAFV	
		1.60E-02 3 1.00E+00	6.73E-04	н	24 0.5	н	ATPF0AF FHFPAFV	
		1.00E+00 0			.5			TAILURE O RESET IS AND RESTART MEW FOLLOWING A REACTOR TRIP OR SI ACTUATION
		1.00E+00 0			.5		FHFPSSC	
		6.40E-04 0			6.4E-4		ZHF-C2-0	
OF FEED	WATER (FHF	PCD4-1*FHFPSSGF	W)					
		5.00E-01			0.5		ZZAFWPI	
2	7.63E-08	7.10E-02 0 1.27E-01 9			.071			UNIT 4 OUT OF SERVICE
2	7.63E-08	1.27E-01 9 1.00E+00 0			1.27E-01 .5		AHEPAEV	3 LOSS OF MAIN FEEDWATER-NOT RECOVERABLE PTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02 3	6.73E-04	н	.5 24	н	ATPFOAF	
		1.60E-02 3	6.73E-04		24	н	ATPFOAF	
		1.00E+00 0			.5	••	FHFPSSC	
		1.00E+00 0			.5		GHFPOP	
		1.00E+00 0			.5		GHFPS2F	
		7.50E-05 0			7.5E-05		ZHF-C2-0	OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOS
UNITRY	VST (GHFPS2)	RCRC*GHFPOPPSI) 5.00E-01			0.5		ZZAFWP	MPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
3	6.72E-08	1.00E+00 9	,		1.0			SPECIAL INTIATOR - LOSS OF 125VDC BUS 3A
•	0.726-00	1.00E+00 0			.5		AHEPAEV	
		1.60E-02 3	6.73E-04	н	24	н	ATPFOAF	
		8.76E-04 3	1.00E-07	н	1	Y	EBDF33D	
		1.00E+00 0			.5		FHFPT4C	
		1.40E-03 0			1.4E-03		ZHFPAFV	
		5.00E-01 1.10E-01 0			0.5 0.1097		ZZAFWP	
A	4.84E-08	5.30E-02 9			5.30E-02			AMAN OPERATORS FAIL TO MANUALLY ALIGN, START, AND RUN AFW TRAIN A GIVEN A LOSS OF DC BUS 3A LOSS OF GRID
•	4.042-00	1.00E+00 0			.5		AHEPAE	
		1.60E-02 3	6.73E-04	н	24	н	ATPFOAF	
		2.43E-02 3	1.03E-03	н	24			DIESEL GENERATOR 4A FAILS TO RUN
		1.00E+00 0			.5		FHFPSS	
		1.00E+00 0			.5		GHFPOP	
		1.00E+00 0 1.00E+00 0			.5 .5		GHFPS29	
		1.00E+00 0			.5		RHFPSR	
		7.50E-05 0			7.5E-05		ZHF-C2-C	
UNIT RV	VST (GHFPS2	RCRC*GHFPOPPSI)						
		5.00E-01			0.5		ZZAFWP	
~		1.00E+00			1.0			
5	3.97E-08	5.30E-02 9			5.30E-02		%ZZLOG AHFPAF\	
		1.00E+00 0 1.60E-02 3	6.73E-04	u	.5 24	н	ATPFOAF	
		1.00E+00 0	0.735-04	п	.5	п	EHFPCL	
		2.00E-02			1.999E-02		EMM4AC	
		1.00E+00 0			.5		FHFPSS	FW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.00E+00 0			.5		GHFPOP	
		1.00E+00 0			.5		GHFPS2	
		1.00E+00 0 1.00E+00 0			.5		IHFPPOR RHFPSR	
		7.50E-05 0			.5 7.5E-05		ZHF-C2-0	
UNIT RV	VST (GHEPS2	RCRC*GHFPOPPSN			1.52-05		200-024	
		5.00E-01			0.5		ZZAFWP	JMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
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PTN-BFJR-06-001 Rev. 0 Page 19 of 30

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		1.00E+00			1.0		ZZHVAC HVAC FLAG
6	3.97E-08	1.27E-01 9			1.27E-01		%ZZT3CU3 LOSS OF MAIN FEEDWATER-NOT RECOVERABLE
•	0.01000	1.00E+00 0			.5		AHEPAFWPTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
•		1.60E-02 3	6.73E-04	н	24	н	ATPF0AFWA AFW TURBINE-DRIVEN PUMP A FAILS TO RUN
		1.60E-02 3		н	24	н	ATPFOAFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00 0	0.102-04	••	.5	••	FHEPSSOFW FAILURE TO RECOVER SECON. HEAT SINK BY SSOFW
	•	1.00E+00 0			.5		GHEPBLEEEDL OPERATING CREW FAILS TO IMPLEMENT BLEED-AND-FEED - LMFW W/LOW SG LEVEL
		3.90E-05 0			4.0E-5		CHFC3-007 FAILURE TO TRIP ONE OF THE TWO TRAIN 2 AFW PUMPS, FAILURE TO RESTORE SECONDARY COOLING USING SSGFW
ACTED							LING (AHPARWPTRP-FHFPSSGF
	LOSS OF AFVY		CESET STAND I				
-		5.00E-01			0.5		ZZAFWPUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
.7	3.31E-08				5.30E-02		%ZZLOG LOSS OF GRID
		1.00E+00 0			.5		AHFPAFWPTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02 3	6.73E-04	н	24	н	ATPF0AFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00 0			.5		EHFPDOSTXT OPERATOR FAILS TO ATTEMPT DOST XTIE
		1.67E-02 3	2.10E-03	N	8	N	EMPA4P241A DIESEL OIL TRANSFER PUMP 4P241A FAILS TO START
		1.00E+00 0			.5		FHFPSSGFW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.00E+00 0			.5		GHFPOPPSI OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT
		1.00E+00 0	•		.5		GHFPS2RCRC OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA)
		1.00E+00 0			.5		IHFPPORTFN OPERATOR FAILS TO UTILIZE PORTABLE FANS
		1.00E+00 0			.5		RHFPSRHVAC OPERATOR FAILURE TO START SR HVAC
		7.50E-05 0			7.5E-05		ZHF-C2-020 OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
UNIT R	RWST (GHFPS2F	CRC*GHFPOPPSI)					
	•	5.00E-01			0.5		ZZAFWPUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
		1.00E+00			1.0		ZZHVAC HVAC FLAG
8	3.25E-08	1.27E-01 9			1.27E-01		%ZZT3CU3 LOSS OF MAIN FEEDWATER-NOT RECOVERABLE
-	•••••	1.00E+00 0			.5		AHEPAEWPTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
•		6.83E-03 0			6.825E-03		ATMOTRAIN1 AFW TRAIN 1 UNAVAILABLE DUE TO TEST OR MAINTENANCE
		1.60E-02 3	6.73E-04	н	24	н	ATPFOAFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00 0	0.102-04		.5	••	FHEPSIGEW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.00E+00 0			.5		GHFPOPPSI OPERATING CREW FAILS TO USE HHISI FROM OPPOSITE UNIT
		1.00E+00 0			.5		GHFPSTRCRC OPERATOR FAILS TO SUBJECTION OF CONTE OWN
		7.50E-05 0			.5 7.5E-05		
LINHT		RCRC*GHFPOPPSI)			1.55-05		ZHF-C2-020 OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
UNITE	(WSI (GREPSZI						
•	0.045.00	5.00E-01			0.5		ZZAFWPUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
9	3.24E-08	5.30E-02 9			5.30E-02		%ZZLOG LOSS OF GRID
		1.00E+00 0			.5		AHFPAFWPTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02 3	6.73E-04	н	24	н	ATPF0AFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.63E-02 0			1.630E-02		ETM4AEDGEDG 4A IN TEST OR MAINTENANCE
		1.00E+00 0			.5 .5		FHFPSSGFW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.00E+00 0			.5		GHFPOPPSI OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT
		1.00E+00 0			.5		GHFPS2RCRC OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA)
		1.00E+00 0			.5		IHFPPORTFN OPERATOR FAILS TO UTILIZE PORTABLE FANS
		1.00E+00 0			.5		RHFPSRHVAC OPERATOR FAILURE TO START SR HVAC
		7.50E-05 0			7.5E-05		ZHF-C2-020 OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
UNIT F	RWST (GHFPS2)	RCRC*GHFPOPPSI)					
	•	5.00E-01			0.5		ZZAFWPUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
		1.00E+00			1.0		ZZHVAC HVAC FLAG
10	3,19E-08	5.30E-02 9			5.30E-02		%ZZLOG LOSS OF GRID
		1.00E+00 0			.5		AHEPAFWPTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02 3	6.73E-04	н	24	н	ATPF0AFWA AFW TURBINE-DRIVEN PUMP A FAILS TO RUN
		1.60E-02 3	6.73E-04	н	24	н	ATPROAFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
•		1.002+00 0	0.702-04		5		FHFPSSGFW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.00E+00 0			.5 .5		GHEPOPPSI OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT
		1.00E+00 0					GHFPSPRCRC OPERATOR FAILS TO SUBCHTS IT NOW OPPOSITE UNIT
					.5		GREPSZICKC OPERATOR PALS TO SWITCHOVER TO HIGH TEAD COLD LEG RECIRC (SMALL LOCA)
		7.50E-05 0			7.5E-05		ZHF-C2-020 OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
	WVSI (GHEPS2)	RCRC*GHFPOPPSI)					
		5.00E-01			0.5		ZZAFWPUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
11	3.17E-08	1.10E-01 9			1.10E-01		%ZZT3AU3 LOSS OF MAIN FEEDWATER - RECOVERABLE
	•	1.00E+00 0			.5		AHFPAFWPTRP OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02 3	6.73E-04		24	н	ATPF0AFWA AFW TURBINE-DRIVEN PUMP A FAILS TO RUN
		1.60E-02 3	6.73E-04	н	24	н	ATPF0AFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00 0			.5		FHFPCD4-1 FAILURE TO RESET SI AND RESTART MFW FOLLOWING A REACTOR TRIP OR SI ACTUATION
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PTN-BFJR-06-001 Rev. 0 Page 20 of 30

		1.00E+00				.5		FHFPSSGFW	FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.00E+00 3.60E-05				.5 3.6E-05		GHFPBLFEEDL	OPERATING CREW FAILS TO IMPLEMENT BLEED-AND-FEED - LMFW WILOW SG LEVEL
FAILURE	ORESETS					J.0E-UJ	P*EHEPCD4	ZHF-C3-006 I-1*GHFPBLFEEDL)	FAILURE TO TRIP ONE OF THE TWO TRAIN 2 AFW PUMPS, FAILURE TO RESTORE MFW AFTER LOSS OF AFW, AND
		5.00E-01				0.5		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
12	3.15E-08	5.30E-02	9			5.30E-02		%ZZLOG LOSS OF G	
			0			.5		AHFPAFWPTRP	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
•			3	6.73E-04		24	H	ATPFOAFWB	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.59E-02 1.00E+00	3 0	2.00E-03	N	8 .5	N	ESVN43434A FHFPSSGFW	SOLENOID VALVE SV-4-3434A FAILS TO OPEN
		1.00E+00				.5		GHFPOPPSI	FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT
		1.00E+00	ŏ			.5		GHFPS2RCRC	OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA)
		1.00E+00	0			.5		IHFPPORTFN '	OPERATOR FAILS TO UTILIZE PORTABLE FANS
	••	1.00E+00	0			.5		RHFPSRHVAC	OPERATOR FAILURE TO START SR HVAC
		7.50E-05	0			7.5E-05		ZHF-C2-020	OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
UNIT RVS	ST (GHFPS2F	5.00E-01	09951)		•	0.5		ZZAFWPUMPC	
		1.00E+00				1.0		ZZHVAC HVAC FLA	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
13	3.02E-08	1.00E+00	9			1.00		%ZZIAU3 UNIT 3 LOS	
		1.00E+00	0			.5		AHFPAFWPTRP	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02	3	6.73E-04		24	н	ATPFOAFWA	AFW TURBINE-DRIVEN PUMP A FAILS TO RUN
		1.60E-02	3	6.73E-04	н	24	н	ATPFOAFWB	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00 1.00E+00	0			.5 · .5		FHFPT4CD4-1 GHFPOPPSI	FAILURE TO RECOVER MFW OPERATING FWBFCVs LOCALLY
		1.00E+00	ŏ			.5		GHFPS2RCRC	OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA)
		5.02E-02	3	5.88E-06	н	1	Y		R 319 FAILS TO DELIVER FLOW (1 YR EXPOSURE)
		7.50E-05	0			7.5E-05		ZHF-C2-020	OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
UNIT RWS	ST (GHFPS2F		POPPSI)						
14	2 085-08	5.00E-01 3.50E-03	9	·		0.5 3.50E-03			AFW PUMP C IS THE WEAKER OF THE 2 PUMPS INERATOR TUBE RUPTURE 3A GENERATOR
14	2.002-00	1.00E+00	ŏ.			.5 .5		AHFPAFWFLO	OPERATOR FAILS TO THROTTLE UP AFW FLOW
		1.00E+00	ō			.5		AHFPAFWPTRP	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02	3	6.73E-04	н	24	н	ATPFOAFWB	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00	0			.5			O RESET SI AND RESTART MFW FOLLOWING A REACTOR TRIP OR SI ACTUATION
	• •	1.00E+00 1.70E-05	0			.5 1 75 5		FHFPSSGFW ZHF-C2-026	FAILURE TO RECOVER SECON, HEAT SINK BY SSGFW
(AHFPAFV	VFLO • FHFF	PSSGFW	0			1.7E-5		200-02-020	FAILURE TO THROTTLE UP AFW FLOW AND FAILURE TO USE SSGFW AS A BACKUP SOURCE OF FEEDWATER
•		5.00E-01				0.5		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
15	2.98E-08	3.50E-03	9			3.50E-03			ENERATOR TUBE RUPTURE 3B GENERATOR
		1.00E+00	0			.5		AHFPAFWFLO	OPERATOR FAILS TO THROTTLE UP AFW FLOW
		1.00E+00 1.60E-02	0 3	6.73E-04	L)	.5 24	н	AHFPAFWPTRP ATPF0AFWB	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.00E+02	0	0.73E-04	п	24 .5	п		AFW TURBINE-DRIVEN PUMP B FAILS TO RUN 10 RESET SI AND RESTART MFW FOLLOWING A REACTOR TRIP OR SI ACTUATION
		1.00E+00	ŏ			.5		FHFPSSGFW	FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		1.70E-05	0			1.7E-5		ZHF-C2-026	FAILURE TO THROTTLE UP AFW FLOW AND FAILURE TO USE SSGFW AS A BACKUP SOURCE OF FEEDWATER
(AHFPAFV	NFLO * FHFF							7710100	
16	2.98E-08	5.00E-01 3.50E-03	9			0.5 3.50E-03		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS ENERATOR TUBE RUPTURE 3C GENERATOR
10	2.002-00	1.00E+00	õ			.50⊵-03		AHFPAFWFLO	OPERATOR FAILS TO THROTTLE UP AFW FLOW
		1.00E+00	ō			.5		AHFPAFWPTRP	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02	3	6.73E-04	н	24	н	ATPFOAFWB	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00	0			.5			TO RESET SI AND RESTART MFW FOLLOWING A REACTOR TRIP OR SI ACTUATION
		1.00E+00 1.70E-05	0			.5		FHFPSSGFW	FAILURE TO RECOVER SECON, HEAT SINK BY SSGFW
(AHEPAEV	VFLO * FHFF	PSSGFW	U			1.7E-5		ZHF-C2-026	FAILURE TO THROTTLE UP AFW FLOW AND FAILURE TO USE SSGFW AS A BACKUP SOURCE OF FEEDWATER
•		5.00E-01				0.5		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
17	2.58E-08	8.94E-01	9			8.94E-01		%ZZT1U3 REACTOR	TRIP
		1.60E-02	3	6.73E-04		24	H	ATPFOAFWA	AFW TURBINE-DRIVEN PUMP A FAILS TO RUN
		1.60E-02 1.80E-06	3 0	6.73E-04	н	24	н	ATPF0AFWB NRDFPHYSICAL	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED
		1.00E+00	v			1.80E-06 1.0		ZZATWS ATWS FLA	
18	2.58E-08	8.94E-01	9			8.94E-01		%ZZT1U3 REACTOR	TRIP

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PTN-BFJR-06-001 Rev. 0 Page 21 of 30

			3 3 0	6.73E-04 6.73E-04	н Н	24 24 1.80E-06 1.0	H H	ATPF0AFWB ATPF0AFWC NRDFPHYSICAL ZZATWS ATWS FLAC	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN AFW TURBINE-DRIVEN PUMP C FAILS TO RUN FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED 3
19	2.44E-08	1.27E-01 1.00E+00 5.13E-03 · 1.60E-02 1.00E+00			N H	1.27E-01 .5 1 24 .5 .5 .5 7.5E-05	N H	%ZZT3CU3 LOSS OF M AHFPAFWPTRP ATPA0AFWA ATPF0AFWB	AIN FEEDWATER-NOT RECOVERABLE OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS AFW TURBINE-DRIVEN PUMP A FAILS TO START AFW TURBINE-DRIVEN PUMP B FAILS TO RUN FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) OPERATOR CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
UNIT RWS	ST (GHFPS2F	CRC*GHFP							
20	2.23E-08	1.60E-02 1.12E-02 1.00E+00 1.00E+00 1.00E+00 1.00E+00 1.00E+00 1.00E+00	9 0 3 3 0 0 0 0 0 0	6.73E-04 1.13E-02	H Z	0.5 5.30E-02 .5 24 1 .5 .5 .5 .5 .5	H N	FHFPSSGFW GHFPOPPSI GHFPS2RCRC IHFPPORTFN RHFPSRHVAC	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS AFW TURBINE-DRIVEN PUMP B FAILS TO RUN INERATOR 4A FAILS TO START FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) OPERATOR FAILS TO UTILIZE PORTABLE FANS OPERATOR FAILURE TO START SR HVAC
UNIT RW	ST (GHFPS2F	7.50E-05 RCRC*GHFP	-			7.5E-05		ZHF-C2-020	OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
21	·	5.00E-01 1.00E+00 1.27E-01 1.57E-04	9 3 0	6.73E-04	н	0.5 1.0 1.27E-01 1.569E-04 24 .5 .5 1.1E-3	н	ZZAFWPUMPC ZZHVAC HVAC FLAG %ZZT3CU3 LOSS OF N AMMOCCTPAAC ATPF0AFWB FHFPSSGFW GHFPBLFEEDL ZHF-C2-028	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS G MAIN FEEDWATER-NOT RECOVERABLE CCF (23) OF TURBINE-DRIVEN PUMP A.C TO START AFW TURBINE-DRIVEN PUMP B FAILS TO RUN FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW OPERATING CREW FAILS TO IMPLEMENT BLEED-AND-FEED - LMFW W/LOW SG LEVEL OPERATING CREW FAILS TO IMPLEMENT BLEED-AND-FEED - LMFW W/LOW SG LEVEL OPERATING S FAIL TO RECOVER SEC COOLING USING SSGFW AND FAIL TO IMPLEMENT BLEED-AND-FEED COOLING
	FW*GHFPBL		v			1.12-0		2111-02-020	
22 UNIT RW	2.15E-08 ST (GHFPS2I		0 3 0 0 0 0	6.73E-04	н	1.00 .5 24 .5 .5 3.717E-01 3.086E-03 .5 7.5E-05	н	%ZZIA34 DUAL UNIT AHEPAFWPTRP ATPF0AFWB FHFPT4CD4-1 GHFP92RCRC HMM3M3321 HMMCCFALLR XHFPRCPTRP ZHF-C2-020	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS AFW TURBINE-DRIVEN PUMP B FAILS TO RUN FAILURE TO RECOVER MFW OPERATING FWBFCVS LOCALLY OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) LOCAL FAULTS IN HEADER M 332 (1 YR EXPOSURE) CCF TO RUN- 4/4 U3 & U4 IA COMPRESSORS (2 DAY EXPOSURE) OPERATING CREW FAILS TO TRIP RCPS GIVEN DUAL-UNIT TRIP OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
		5.00E-01 5.00E-01	0			0.5 0.5		ZZAFWPUMPC ZZIAU3 FLAG - 3CI	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS M RUNNING, 4CM IN STANDBY
23	2.15E-08	1.00E+00 1.00E+00 1.60E-02 1.00E+00 1.00E+00 3.72E-01 3.09E-03 1.00E+00 7.50E-05	9 0 3 0 0 0 0	6.73E-04	н	0.5 1.00 .5 24 .5 .5 3.717E-01 3.086E-03 .5 7.5E-05	н	AHFPAFWPTRP ATPF0AFWPTRP ATPF0AFWB FHFPT4CD4-1 GHFP0PPSI GHFP52RCRC HMM4M4321 HMMCCFALLR XHFPRCPTRP ZHF-C2-020	
UNITRW	ST (GHFPS2	RCRC*GHFF 5.00E-01	POPPSI)			0.5		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
24	2.15E-08	5.00E-01	0 9 0			0.5 5.30E-02 .5			M RÜNNING, 3CM IN STANDBY

PTN-BFJR-06-001 Rev. 0 Page 22 of 30

UNIT R	WST (GHFPS2)	1.60E-02 1.08E-02 1.00E+00 1.00E+00 1.00E+00 1.00E+00 1.00E+00 7.50E-05	2 0 0 0 0 0 0 0 0 0	6.73E-04 3.00E-05		24 1 .5 .5 .5 .5 .5 7.5E-05	н м	ATPF0AFWB EBSP46332A EHFPD0STXT FHFPSSGFW GHFPOPPSI GHFPS2RCRC IHFPPORTFN RHFPSRHVAC ZHF-C2-020	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN BASKET STRAINER BS-46332A PLUGS OPERATIOR FAILS TO ATTEMPT DOST XTIE FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) OPERATOR FAILS TO UTILIZE PORTABLE FANS OPERATOR FAILURE TO START SR HVAC OPERATING CREW FAILS TO IMPLEMENT HHSR FOR A SMALL LOCA AND FAILS TO IMPLEMENT HHSI FROM OPPOSITE
		5.00E-01	,			0.5		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS
		1.00E+00				1.0		ZZHVAC HVAC FLA	
25	1.80E-08	3.50E-03				3.50E-03			ENERATOR TUBE RUPTURE 3A GENERATOR
		1.00E+00				.5		AHFPAFWPTRP	OPERATORS FAIL TO SHUT DOWN 1 OF THE TRAIN 2 PUMPS
		1.60E-02		6.73E-04	н	24	H	ATPFOAFWA	AFW TURBINE-DRIVEN PUMP A FAILS TO RUN
		1.60E-02		6.73E-04	н	24	н	ATPFOAFWB	AFW TURBINE-DRIVEN PUMP B FAILS TO RUN
		1.00E+00	-			.5			TO RESET SI AND RESTART MFW FOLLOWING A REACTOR TRIP OR SI ACTUATION
		1.00E+00				.5		FHFPSSGFW	FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW
		6.40E-04				6.4E-4		ZHF-C2-004	FAILURE TO RESET SI AND RESTORE MFW AFTER LOSS OF AFW AND FAILURE TO USE SSGFW AS A BACKUP SOURCE
OF FEE	EDWATER (FHF		PSSGFW)						
		5.00E-01				0.5		ZZAFWPUMPC	AFW PUMP C IS THE WEAKER OF THE 2 PUMPS

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Report Summary: Filename: C:\2006MSPI\CAFTA Files Rev C\Cuts\PTNR5C10AFWB.CUT Print date: 2/15/2006 9:20 PM Not sorted Printed the first 25

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Attachment 2, Sensitivity Study: Base Case, Using MSPI data, Nominal AFW B failure to run

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PTNRSC10 = 3.87E-06 C.\2006MSPI\CAFTA Files Rev C\Cuts\PTNR5C10.CUT					2/15/2006 9	9:30 PM				
#	Cutset Prob	Event Prob	с	Rate	U	Exposure	U	Event	Description	
1	1.27E-09	3.50E-03 1.00E+00 1.60E-02 1.00E+00 1.00E+00 1.00E+00 6.40E-04	0 3	6.73E-04	н	3.50E-03 .5 24 0.5 .5 .5 6.4E-4	н	AHFPAFW ATPF0AFW FHFPAFW FHFPCD4- FHFPSSGF	FWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN WSTM OPERATING CREW FAILS TO SWITCH STEAM SUPPLY TO AFW TRAIN I GIVEN SGTR IN SG 3C 14-1 FAILURE TO RESET SI AND RESTART MFW FOLLOWING A REACTOR TRIP OR SI ACTUATION	
(FHFP	CD4-1*FHFPSSG	FW) 5.00E-01				0.5		ZZAFWPU	PUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS	
2	1.22E-09	7.10E-02 1.27E-01 1.00E+00 1.60E-02 1.60E-02 1.00E+00 1.00E+00 7.50E-05	0 9 0 3 3 0 0 0 0	6.73E-04 6.73E-04	Н Н	0.5 .071 1.27E-01 .5 24 24 .5 .5 .5 .5 7.5E-05	Н Н	ZZU400S %ZZT3CU AHFPAFW ATPF0AFV ATPF0AFV FHFPSSGF GHFP0PP3 GHFPS2R0	IS UNIT 4 OUT OF SERVICE U3 LOSS OF MAIN FEEDWATER-NOT RECOVERABLE WYPTRP OPERATORS FAIL TO SHUT DOWN I OF THE TRAIN 2 PUMPS FWA AFW TURBINE-DRIVEN PUMP A FAILS TO RUN FWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN GFW FAILURE TO RECOVER SECON, HEAT SINK BY SSGFW PSI OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT	
(GHFP	S2RCRC*GHFPC	OPPSI)	-							
3	1.08E-09	5.00E-01 1.00E+00 1.00E+00 1.60E-02 8.76E-04 1.00E+00 1.40E-03	9 0 3 3 0	6.73E-04 1.00E-07	H H	0.5 1.0 .5 24 1 .5 1.4E-03	H Y	ZZAFWPU %ZZDC3A AHFPAFW ATPF0AFV EBDF33D0 FHFPT4CI ZHFPAFW	3A SPECIAL INITIATOR - LOSS OF 125VDC BUS 3A FWPTRP OPERATORS FAIL TO SHUT DOWN I OF THE TRAIN 2 PUMPS FWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN D011 125V DC BUS 3A FAILURE CD4-1 FAILURE TO RECOVER MFW OPERATING FWBFCVs LOCALLY	
4	7.76E-10	5.00E-01 1.10E-01 5.30E-02 1.00E+00 1.60E-02	0 9 0 3	6.73E-04	н	0.5 0.1097 5.30E-02 .5 24	н	ZZAFWPU ZHFPTRN	PUMPC AFW PUMP C IS THE WEAKER OF THE 2 PUMPS NAMAN OPERATORS FAIL TO MANUALLY ALIGN, START, AND RUN AFW TRAIN A GIVEN A LOSS OF DC BUS 3A G LOSS OF GRID FWPTRP OPERATORS FAIL TO SHUT DOWN I OF THE TRAIN 2 PUMPS	
		2.43E-02 1.00E+00 1.00E+00 1.00E+00 1.00E+00 1.00E+00 7.50E-05	3 0 0 0 0 0 0	1.03E-03	H	24 .5 .5 .5 .5 .5 7,5E-05		EDGF44A FHFPSSGI GHFPOPP GHFPS2R IHFPPORT RHFPSRH	A DIESEL GENERATOR 4A FAILS TO RUN GFW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW PPSI OPERATING CREW FAILS TO USE HHSI FROM OPPOSITE UNIT RCRC OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) RTFN OPERATOR FAILS TO UTILIZE PORTABLE FANS	
(GHFF	S2RCRC*GHFP	5.00E-01				0.5		ZZAFWPU		
5	6.37E-10	1.00E+00 5.30E-02 1.00E+00 1.00E+00 2.00E+00 1.00E+00 1.00E+00 1.00E+00 1.00E+00 1.00E+00 7.50E-05	9 0 3 0 0 0 0 0 0 0	6.73E-04	н	1.0 5.30E-02 .5 24 .5 1.999E-02 .5 .5 .5 .5 .5 .5 7.5E-05	н	%ZZLOG AHFPAFV ATPF0AF EHFPCLR EMM4ACI FHFPSSGI GHFPSPR GHFPS2R IHFPPORT RHFPSRH	LFWB AFW TURBINE-DRIVEN PUMP B FAILS TO RUN LR4KVS OPERATOR FAILS TO MANUALLY OPEN BREAKER TO ALLOW BUS TO LOAD - SOFT BREAKER FAIL CLR 4160V BUS 4A BREAKERS FAIL TO OPEN - SOFT FAILURES GFW FAILURE TO RECOVER SECON. HEAT SINK BY SSGFW PPSI OPERATING CREW FAILS TO USE HHISI FROM OPPOSITE UNIT RCRC OPERATOR FAILS TO USE HHISI FROM OPPOSITE UNIT OPERATOR FAILS TO USTICHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) RTFN OPERATOR FAILS TO UTILZE PORTABLE FANS	
(GHFI	S2RCRC*GHFP	OPPSI) 5.00E-01				0.5		ZZAFWPU		

PTN-BFJR-06-001 Rev. 0 Page 24 of 30

6 6.35E-10 1.27E-01										
1.001-00 0 -5 AIPPAPYMEN OPEXATOR SECURIC SUBJECT ON ICH THE TAME I POWER 1.001-00 1.001-00 -5 AIPPAPYMEN OPEXATOR SECURIC SUBJECT ON ICH THE TAME I POWER 1.001-00 -5 -5 AIPPAPYMEN OPEXATOR SECURIC SUBJECT ON ICH THE TAME I POWER 1.001-00 -5 -5 -5 OPEXATOR SECURIC SUBJECT ON ICH THE TAME I POWER SUBJECT ON ICH THE POWER SUBJECT ON ICH THE TAME I POWER SUBJECT ON ICH THE POWER POWER SUBJECT ON ICH THE POWER POWER POWER SUBJECT ON ICH THE POWER		()(7 10	1.00E+00	•			1.0			
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6 82F-03 0 6 825F-03 ATM OR ANY TRAIN I LAWAULABLE DUE TO TEST OR MAINTENANCE 1.00F+04 0 5 FHF PS26FW PAILURE TO RECOVER SECON. HEAT SINK BY SGFW 1.00F+05 0 -5 GHF POPESIGE ATM OR ANY TRAIN I LAWAULABLE DUE TO TEST OR MAINTENANCE 1.00F+06 0 -5 GHF POPESIGE ATM OR ANY TRAINS I LAWAULABLE DUE TO TEST OR MAINTENANCE (GHFPS2R-CR-OHFPOPESIGE -5 GHF POPESIGE 2HF-C2-420 OPERATING CERE VERMIST TO SUMT HOWE RTO HIGH HEAD COLD LEG RECIRC (SMALL LOCA) 9 5.19E-10 5.09E-01 -5 ZAFWPUMP C IS THE VALKER OF THE 2 PUMPS 9 5.19E-10 5.09E-02 -5 SIGE-02 2LAFWPUMP C OPERATOR FAILS TO SIMT DOWN 10 FTHE TAIN 2 PUMPS 1.60E-60 0 -5 SIGE-02 ETMAEDDE OF PUMP PUMP BAILS TO NUT THE TAIN 2 PUMPS 1.60E-60 0 -5 AHFPATYTPP OPERATOR FAILS TO SIMT DOWN 10 FTHE TAIN 2 PUMPS 160E+00 1630E-02 ETMAEDDE OPERATOR FAILS TO SIMT DOWN 10 FTHE TAIN 2 PUMPS 1.00E+00 0 -5 SIMPAEDWERDENT HIST FOR OPERATOR FAILS TO SIMT DOWN 10 FTHE TAIN 2 PUMPS 160E+00 5 SIMPAEDWERDENT HIST FOR OPERATOR FAILS TO SIMT DOWN 10 FTHE TAIN 2 PUMPS 1.00E+00 <t< td=""><td>8</td><td>5.21E-10</td><td>1.27E-01</td><td>9</td><td></td><td></td><td>1.27E-01</td><td></td><td>%ZZT3CU3 LOS</td><td>OF MAIN FEEDWATER-NOT RECOVERABLE</td></t<>	8	5.21E-10	1.27E-01	9			1.27E-01		%ZZT3CU3 LOS	OF MAIN FEEDWATER-NOT RECOVERABLE
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Report Summary: Filename: C. 2006MSPICAFTA Files Rev C\Cuts\PTNR5C10.CUT Print date: 2/15/2006 9:30 PM Not sorted, Printed the first 10

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PTN-BFJR-06-001 Rev. 0 Page 25 of 30

Attachment 3: Clarification of Loss of DC 3A Operator Recovery Action

----- Forwarded by Ching Gucy/Juno/Nuclear/FplNuc on 02/17/2006 07:53 AM -----

See resp	onse in blue.	cc:Brien Vincent/Juno/Nuclear/Fp!Nuc@Fp!Nuc, Glen Blinde/Ptn/Nuclear/Fp!Nuc@Fp!Nuc, Mahmou Heiba/Juno/Nuclear/Fp!Nuc@Fp!Nuc Subject:Re: AHFPTRNAMAN
Mark		

Ching Guey

02/17/2006 07:31 AM

To: Mark Averett/Juno/Nuclear/FplNuc@FplNuc cc:Brien Vincent/Juno/Nuclear/FplNuc@FplNuc, Mahmoud Heiba/Juno/Nuclear/FplNuc, Glen Blinde/Ptn/Nuclear/FplNuc@FplNuc Subject:Re: AHFPTRNAMAN

Does this imply that the Birnbaum importance of the hardware (A AFW pump, and train 1 steam admission valve, mainly) involved may need to be added (or allocated based on its contribution to 0.1083, which may be reduced if the MSPI data is used, I presume that FTR of 0.096 for Train A AFW pump may dominate)? Yes, it does. Replacing ZHFPTRNAMAN with ATPF0AFWA in the cutsets would approximate the increase in Birnbaum due to the hardware portion of the AHFPTRNAMAN recovery.

This may not be an important issue, until DC bus 3A becomes dominant sequence of concern.

Also, Glen's email earlier may change the HEP somewhat? No. Glen's email simply confirms that the AHFPTRNAMAN recovery is possible.

Ching

PTN-BFJR-06-001 Rev. 0 Page 26 of 30

Mark Averett

To: ching guey@fpl.com 02/17/2006 07:10 AM cc: Brien Vincent/Juno/Nuclear/FpINuc@FpINuc, Mahmoud Heiba/Juno/Nuclear/FpINuc@FpINuc, glen_blinde@fpl.com Subject: AHFPTRNAMAN

Ching,

I found the reference for the 0.11 probability for the recovery event AHFPTRNAMAN in the Rev. 4 update calculation.

PTN-03-068 Recovery for %ZZDC3A/B Sequences

Description Actual Changes

During the cutset review with the Licensed Operator Instructors, it was pointed out that it did not appear that the dependency of SSGFW on the feedwater bypass valves (FCV-3-479, 489, and 499) was

that the loss of DC Bus 3A (power for these valves) was not resulting in a failure of SSGFW. This was corrected via change PTN-03-066. This change brought a lot of loss of DC Bus 3A cutsets to the out that Train 1 of AFW which is lost due to the loss of DC Bus 3A due to steam admission valve not opening and the FCVs not opening could be recovered by manually opening these valves and manually controlling the FCVs using local indication. **CLEAR RECOVERY FLAGS** **RECOVERY** ZHFPTRNAMAN 0.1097 %ZZDC3A ATPF0AFWB ATPF0AFWC

This recovery action was modeled in the HRA Toolbox as event AHFPTRNAMAN. The hardware portion of this recovery was determined by quantifying the gate A0003, giving a failure probability of 0.1083, dwarfing the the human error part of the adequately modeled. This was discovered by noting recovery of 1.4E-3.

This recovery cannot easily be placed into the fault tree itself as it is very cutset-specific. Therefore, the recovery was applied using the recovery rule file to apply it to the individual cutsets. top. The Licensed Operator Instructors also pointed The probability of the recovery was set to the sum of the hardware and human error probabilities, or 0.1097.

The addition to the recovery rule file is shown below:

PTN-BFJR-06-001 Rev. 0 Page 27 of 30

%77DC3A ATPA0AFWB ATPF0AFWC %ZZDC3A ATPFOAFWB ATPAOAFWC %ZZDC3A ATM0TRAIN2 %77DC3A AHFAOPUMPB ATPFOAFWC %ZZDC3A AHFA0PUMPC ATPF0AFWB %ZZDC3A AHFA0PUMPB ATPA0AFWC %ZZDC3A AHFA0PUMPC ATPA0AFWB %ZZDC3A AHEPAEWPTRP ATPE0AEWB ZZAEWPUMPC %ZZDC3A AHFPAFWPTRP ATPF0AFWC ZZAFWPUMPB %77DC3A AHEPAEWPTRP ATPA0AEWB ZZAEWPUMPC %ZZDC3A AHFPAFWPTRP ATPA0AFWC ZZAFWPUMPB %ZZDC3A AROP0-3418 ATPF0AFWC %ZZDC3A ATPF0AFWB AROP0-3419 %ZZDC3A AROP0-3418 ATPA0AFWC %ZZDC3A ATPA0AFWB AROP0-3419 %ZZDC3A AMM0CCFAVBD %ZZDC3A AMM0CCFAVBF %ZZDC3A AMM0CCFAVDF %ZZDC3A AMM3SSHV2 ZZU400S %ZZDC3A ACVN0PD243 ATPF0AFWC %ZZDC3A ACVN0PD243 ATPF0AFWC %ZZDC3A ACVN0S003B ATPF0AFWC %ZZDC3A ACVN0S003C ATPF0AFWB %ZZDC3A ACVN0PD243 ATPA0AFWC %ZZDC3A ACVN0PD243 ATPA0AFWC %ZZDC3A ACVN0S003B ATPA0AFWC %ZZDC3A ACVN0S003C ATPA0AFWB

Added ZHFPTRNAMAN to gate ZREC6 for placeholding.

Mark

Attachment 4: Summary of Turkey Point Plant Response to Loss of AFW 1 Hour after a Loss of Feedwater

MAAP File Name	Event Description	Results
PTN_AFW1HR_LSGWR_2HHSI_2PORV_SGL60	Loss of feedwater	S/G dryout - none
86400 sec run	Loss of AFW @ 1hr	Core uncovery - none
	SSGFW available	Fuel damage - none
		Bleed & feed - none
		CL recirc - none
PTN_LOHS1HR_1HHSI_1PORV_SGL60_HRA	Loss of feedwater	S/G dryout - none
43200 sec run	Loss of AFW/SSGFW @ 1hr	Core uncovery - none
	Bleed & feed initiated (1	Fuel damage - none
	HHSIP - 1 PORV) to avoid	Bleed & feed - 22596 sec
	core uncovery	CL recirc - > 43200 sec
PTN_LOHS1HR_2HHSI_1PORV_SGL60_HRA	Loss of feedwater	S/G dryout - none
43200 sec run	Loss of AFW/SSGFW @ 1hr	Core uncovery - none
	Bleed & feed initiated (2	Fuel damage - none
	HHSIP - 1 PORV) to avoid	Bleed & feed - 23166 sec
	core uncovery	CL recirc - > 43200 sec
PTN_LOHS1HR_2HHSI_2PORV_SGL60_HRA	Loss of feedwater	S/G dryout - none
43200 sec run	Loss of AFW/SSGFW @ 1hr	Core uncovery - none
	Bleed & feed initiated (2	Fuel damage - none
	HHSIP - 2 PORV) to avoid	Bleed & feed - 23746 sec
	core uncovery	CL recirc - 33132 sec
PTN_LOHS1HR_2HHSI_2PORV_SGL60_NOCD	Loss of feedwater	S/G dryout - 26834 sec
36000 sec run	Loss of AFW/SSGFW @ 1hr	Core uncovery - 28406 sec
	Bleed & feed initiated (2	Fuel damage - none
>	HHSIP - 2 PORV) to avoid	Bleed & feed - 27646 sec
	core damage	CL recirc - 35861 sec
PTN_LOHS1HR_NOF&B_NOCHG	Loss of feedwater	S/G dryout - 25787 sec
36000 sec run	Loss of AFW/SSGFW @ 1hr	Core uncovery - 28221 sec
50000 See Tuli	No bleed & feed initiated	Fuel damage - 30657 sec
	No charging	Bleed & feed - n/a
		CL recirc - n/a
PTN_LOHS1HR_NOF&B_NOCHG_AFWREST_HRA	Loss of feedwater	S/G dryout - 25787 sec
43200 sec run	Loss of AFW/SSGFW @ 1hr	Core uncovery - 28221 sec
15200 500 1411	No bleed & feed initiated	Fuel damage - none
	No charging	Bleed & feed - n/a
	AFW restored to avoid core	CL recirc - n/a
	damage	AFW restored - 28746 sec
PTN_LOOP_LOHS1HR_NOF&B_NOCHG	LOOP/Loss of feedwater	S/G dryout - 23810 sec
30000 sec	Loss of AFW/SSGFW @ 1hr	Core uncovery - 26186 sec
	No bleed & feed initiated	Fuel damage - 28580 sec
· ·	No charging	Bleed & feed - n/a
		CL recirc - n/a
PTN_2IN_S1LOCA_LOHS1HR_NOCHG	2" S1LOCA	S/G dryout - none
86400 sec	Loss of AFW/SSGFW @ 1hr	Core uncovery - none
	Minimum SI @ 77 sec	Fuel damage - none
	No charging	Bleed & feed - none
		CL recirc - 78507 sec
PTN_LOOP_AFW1HR_LSGWR_2HHSI_2PORV_SGL60	Loss of feedwater	S/G dryout - none
86400 sec run	Loss of AFW @ 1hr	Core uncovery - none
	SSGFW available	Fuel damage - none
		Bleed & feed - none
	•	CL recirc - none

Attachment 5: Summary of NRC Phase 3 SDP Results

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Sequence Base Vs. Current Report by Diff. Min cut (b-c)

Project : TKPT_3 Analysis: RANDOM

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Units: Per Year

Event tree	Sequence	Curr Freq Por Year	Base Freq Per Year	Difference	Retio	Curr Cnt	Base Cnt	Differo	End
LOCHS	02-07-07	0.000E+00	1 0.000E+00	0.000E+00	0.000E+00	0	0	0	CD
LOCCW	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	0	CD
LOCCW	17	3.738E-12	3.738E-12	0.000E+00	1.000E+00	3	3	10	CD
LOCCW	15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	1	1-1	CD
LOCCW	13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	11	1.1	CO
LOCCW	26-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	0	CD
LOCHS	02-02-05	1.462E-11	1.462E-11	0.000E+00	1.000E+00	5	5	0	CD
LOCCW	26-10	3.331E-11	3.331E-11	0.000E+00	1.000E+00	3	13	0	CD
LOCCW	26-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	0	CO
LOCHS	02-06-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.	10	0	CD
LOCHS	02-08-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	<u>ö</u>	CD
LOCCW	26-12	2.331E-11	2.331E-11	0.000E+00	1.000E+00	3	3	10	co
LOCHS	02-06-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	0	CO
LOCCW	26-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	0	CO
LOCHS	02-07-03	0.000E+00	0.000E+00	0.000E+00	0,000E+00	0	10	10	CD
LOCHS	02-07-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	10	0	CD
LOCHS	02-04-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0	0	0.	CO
LOOP	18-43-3	1.667E-11	1.136E-11	5.310E-12	1.467E+00	3	5	-2	CD
LDC3A	15-11	7.286E-12	2.311E-13	7.055E-12	3.153E+01	3	14	-11	CD
LOCHS	13	1.096E-11	0.000E+00	1.096E-11	0.000E+00	3	0	3	CD
LOMFW	13	1.217E-11	0.000E+00	1.217E-11	0.000E+00	3	0	3	CD
LOOP	18	1.403E-11	0.000E+00	1.403E-11	0.000E+00	6	10	10	CD
MLOCA	12	9.331E-11	2.383E-11	6.948E-11	3.918E+00	23	9	14	CD
LOCCW	26-11	9.3126-11	2.313E-11	6.999E-11	4.026E+00	30	12	18	CD
LOICW	26-11	9.312E-11	2.3136-11	6.999E-11	4.025E+00	30	12	18	CD
SLOCA	19-11	9.312E-11	2.313E-11	6.999E-11	4.026E+00	30	12	18	CD
LOOP	18-45	3.152E-10	2.055E-10	1.097E-10	1.534E+00	17 .	38	-21	CD
LOOP	14	1.925E-10	3.306E-12	1.8925-10	5.823E+01	28	2	26	CD
LACSA	14	4.494E-10	5.052E-12	4.444E-10	8.896E+01	44	44	0	CD
LOIAS	19-11	1.939E-09	4.757E-10	1.463E-09	4.078E+00	48	17	31	CO
SLOCA	18	1.685E-09	3.892E-11	1.646E-09	4.329E+01	33	13	20	CD
LOOP	19-11	2.470E-09	6.425E-10	1.828E-09	3.844E+00	15	30	•15	CO
TRANS	14	2.607E-09	1.764E-10	2.431E-09	1.478E+01	109	179	•70	CD
LACSB	14	3.092E-09	8.120E-11	3.011E-09	3.808E+01	27	109	-82	CD
LAC3B	15-11	4.873E-09	1.227E-09	3.646E-09	3.972E+00	63	50	13	CD
LAC3A	-15-11	4.873E-09	1.227E-09	3.646E-09	3.972E+00	63	50	13	CD
SGTA	30	5.580E-09	1.261E-10	5,452E-09	4.356E+01	255 .	49	206	CD
SOTA	32-11	9.932F-09	3.306E-10	9.601E-09	3.004E+01	50	18	32	CD
LOCHS	15-11	2.195E-08	5.710E-09	1.624E-08	.3.844E+00	72	104	32	CD
OMEW	15-11	2.439E-08	6.344E-09	1.805E-08	3.845E+00	73	104	-31	CD
OIAS	18	4.2685-08	1.328E-09	4.136E-08	3.214E+01	173	86.	87	CD
TRANS	15-11	1.708E-07	4.449E-08	1.263E-07.	3.839E+00	95	135	-40	CD
SGTA	81	1.598E-07	6.430E-09	1.544E-07	2.943E+01	434	163	271	CD
OOP	17	1.968E-07	1.693E-08	1.799E-07	1.162E+01	471	299	172	CO
OCHS	14	3.870E-07	1.100E-08	3.760E-07	3.518E+01	341	214	127	CD
OMFW	14	4.300E-07	1.225E-08	4.178E-07	3,510E+01	353	293	60	CO
DC3A	14	1.867E-06	2.123E-08	1.846E-06	8.794E+01	59	212	+153	CO
	TOTALS =	5.655E-06	2.473E-06	24 8 8 9 9	2.287E+00	5390	5010	380	+

2005/12/21

Page 22 Model Rev. 3.31 2005/10/28 13:55:45

Attachment 6: SPAR-H Performance Shaping Factors for Execution

.

Plant:_____Initiating Event:_____Basic Event :______Event Coder:_____

Basic Event Context:____

Basic Event Description:

Part IL EVALUATE EACH PSF FOR ACTION

A. Evaluate PSFs for the Action Portion of the Task, If Any.

PSiFs	PSF Levels	Multiplier for Action	Please note specific reasons for PSF level selection in this column.
Amihble	Instagaste time	P(failure) ~ 1.0	
Tanc	Time available is - the time required	19	
	Nominul time] [
	Time available & for the time required	n 1] [
	Time available is > 50x the time required	0.01	
L	Insufficient Information		
Shaw	Extreme	5	
Strasors	High	2]]
	Nominal	_]t] [
	Insufficient Information		
Complexity	Highly complex	15 [
	Moderately complex		
	Naminal]]
	Insufficient Information		
Ext trients/	LOW	3	
Tmining	Nominal		Ĩ
-	High) 🕽
	Line Milliclent Lafornianion	"li" [
Pro reduces	Nat avgilable	. 59	
	Dissemplere	20	
	Available, but poor] S 🗆 🗆	
	Municul		
	Insufficient Information	1	
Eigenminics	MissingAdistuding	30	
HMI	Poor	10	
	Nominal		
	Cloud	0.5	
	Insufficient Information	1	
Fines for	Uafit	P(fulture) = 1.0	
Duty	Degraded Filmas		Ë.
	Nominal		
	Inufficient Information		
Work	Poar	15	
Prot enter	Neminal		
	Good	0.5	
	Insufficient Information		

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[END]

PTN-BFJR-06-001 Rev 0 PTN AFWP B SDP CalcFinal.doc

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