

PRECURSOR DESCRIPTION AND ANALYSIS

LER No.: 344/85-009
Event Description: AFW Pumps Fail on Demand Following Trip
Date of Event: July 20, 1985
Plant: Trojan

EVENT DESCRIPTION

Sequence

At 0707 h a short in a cooling fan caused a trip of the main cooling unit for the unit auxiliary transformer and overheating of the transformer. The entire transformer cooling system tripped rather than only the one affected fan. The control room alarm failed. The operators failed to notice another temperature indication. This resulted in a turbine trip and a subsequent reactor trip. AFW was demanded as plant conditions initiated MFW isolation. Both AFW pumps started, but the diesel AFW pump tripped on low suction pressure. The operator restarted the pump after blocking the trip, but then the turbine AFW pump tripped (3 to 5 min later), also on low suction pressure. The operator throttled down the AFW pump discharge valves and restarted the turbine pump satisfactorily.

Six hours after the reactor trip during restart, a condenser/circulating water leak was discovered but thought to be minor by the operators. The plant was restarted but then later shut down when the severity of the leak was discovered.

Corrective Action

The transformer cooling fan was repaired, and the AFW pump suction trip design problem was resolved.

Plant/Event Data:

Systems Involved:

AFW, transformer (cooling system), MFW

Components and Failure Modes Involved:

AFW pumps — failed on demand (sequentially)

Main condenser tube leak — discovered during restart operation

Component Unavailability Duration: NA

Plant Operating Mode: 1 (100% power)

Discovery Method: During operation

Reactor Age: 9.59 years

Plant Type: PWR

Event Identifier: 344/85-009

Comments

The AFW pumps also tripped repeatedly during subsequent testing and investigation of the problem

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

Transient	1.0	Nonrecoverable
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Branches Impacted and Branch Nonrecovery Estimate

AFW	0.04	Readily recoverable
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MFW	Base case	Note that MFW is modeled as unavailable because of automatic isolation following transients involving each trip
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Plant Models Utilized

PWR plant Class C

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CONDITIONAL CORE DAMAGE CALCULATIONS

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INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.000E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CV	
TRANS	7.786E-04
Total	7.786E-04
CD	
TRANS	4.445E-04
Total	4.445E-04
ATWS	
TRANS	3.000E-05
Total	3.000E-05

DOMINANT SEQUENCES

End State: CV	Conditional Probability:	3.504E-04
125 TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS -COND/MFW		
End State: CD	Conditional Probability:	1.805E-04
126 TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS COND/MFW		
End State: ATWS	Conditional Probability:	3.000E-05
128 TRANS RT		

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SEQUENCE CONDITIONAL PROBABILITIES

	Sequence	End State	Seq. Prob	Non-Recov**
119	TRANS -RT AFW MFW -HPI(F/B) -HPR/-HPI PORV.OPEN -SS.DEPRESS -COND/MFW	CV	7.957E-05	8.264E-03
120	TRANS -RT AFW MFW -HPI(F/B) -HPR/-HPI PORV.OPEN -SS.DEPRESS COND/MFW	CD	4.099E-05	4.257E-03
122	TRANS -RT AFW MFW -HPI(F/B) HPR/-HPI -SS.DEPRESS -COND/MFW	CV	3.455E-04	5.107E-04
123	TRANS -RT AFW MFW -HPI(F/B) HPR/-HPI -SS.DEPRESS COND/MFW	CD	1.780E-04	2.631E-04
124	TRANS -RT AFW MFW -HPI(F/B) HPR/-HPI SS.DEPRESS	CD	1.955E-05	7.738E-04
125	TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS -COND/MFW	CV	3.504E-04 *	4.098E-04
126	TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS COND/MFW	CD	1.805E-04 *	2.111E-04
127	TRANS -RT AFW MFW HPI(F/B) SS.DEPRESS	CD	1.983E-05	6.210E-04
128	TRANS RT	ATWS	3.000E-05 *	1.200E-01

* dominant sequence for end state
 ** non-recovery credit for edited case

Note:

Conditional probability values are differential values which reflect the added risk due to observed failures. Parenthetical values indicate a reduction in risk compared to a similar period without the existing failures.

MODEL: b:pwrmtree.cmp
 DATA: b:trojprob.cmp

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
TRANS	1.030E-03	1.000E+00	
LOOP	2.280E-05	3.400E-01	
LOCA	4.170E-06	3.400E-01	
RT	2.500E-04	1.200E-01	
RT/LOOP	0.000E+00	1.000E+00	
EMERG.POWER	2.850E-03	5.100E-01	
AFW	2.500E-03 > 1.000E+00	3.400E-01 > 4.000E-02	
Branch Model: 1.0F.2			
Train 1 Cond Prob:	5.000E-02 > Failed		
Train 2 Cond Prob:	5.000E-02 > Failed		
AFW/EMERG.POWER	5.000E-02 > 1.000E+00	3.400E-01 > 1.200E-01	
Branch Model: 1.0F.1			
Train 1 Cond Prob:	5.000E-02 > Failed		
MFW	1.000E+00	3.400E-01	
PORV.OR.SRV.CHALL	4.000E-02	1.000E+00	
PORV.OR.SRV.RESEAT	2.000E-02	5.000E-02	

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PORV. DR. SRV. RESEAT/EMERG. POWER	2.000E-02	5.000E-02	
SS. RELEAS. TERM	1.500E-02	3.400E-01	
SS. RELEAS. TERM/-MFW	1.500E-02	3.400E-01	
HPI	1.000E-03	5.200E-01	
HPI (F/B)	1.000E-03	5.200E-01	4.000E-02
HPR/-HPI	3.000E-03	5.600E-01	4.000E-02
PORV. OPEN	1.000E-02	1.000E+00	
SS. DEPRESS	3.600E-02	1.000E+00	
COND/MFW	1.000E+00	3.400E-01	
LPI/HPI	1.000E-03	3.400E-01	
LPR/-HPI.HPR	6.700E-01	1.000E+00	
LPR/HPI	1.000E-03	1.000E+00	

*** forced

Austin
08-13-1986
05:10:45

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