

## PRECURSOR DESCRIPTION SHEET

LER No.: 247/86-035  
Event Description: Trip, LOFW, and two AFW train failures occur  
Date of Event: October 20, 1986  
Plant: Indian Point 2

### EVENT DESCRIPTION

#### Sequence

At 0936 h the Unit 2 reactor tripped from 100% power when reactor trip breaker B unexpectedly opened because of loose wires in the relay racks. Breakers RT3 and 4 were deenergized. One of the reactor protection relays had also been deenergized while a monthly SI surveillance test was being performed in a nearby equipment rack.

Following the trip, SG levels dropped rapidly as expected. Both motor-driven auxiliary feed pumps started on low-low SG level. While following the emergency recovery procedure, a control room operator discovered that auxiliary feed pump 21 had tripped when its breaker tripped for an unknown reason. The pump was then successfully restarted from the control room. AFW was used to maintain the SG water levels.

The steam-driven auxiliary-feed-pump steam relief valve had also popped open following the plant trip when its steam-pressure control valve opened because its set point was out of calibration on the low side. The steam-pressure control valve received an automatic open signal on low-low steam generator level in two of the four SGs, admitting steam up to the turbine governor valve. The auxiliary-feed-pump speed changer setting was at minimum as designed, but response by the pressure control valve was too slow, which caused the relief valve to lift.

#### Corrective Action

Repairs were made.

#### Plant/Event Data

Systems Involved:  
AFW, MFW

Components and Failure Modes Involved:  
Two trains of AFW failed in operation

Event Identifier: 247/86-035

Component Unavailability Duration: NA  
 Plant Operating Mode: 1 (100% power)  
 Discovery Method: Operational event  
 Reactor Age: 13.4 years  
 Plant Type: PWR

Comments

The FSAR states that upon SI actual signal, the MFW system will isolate. An SI actual signal actuation is not reported to have occurred. Upon RPS actuation, the MFW regulating valves should fully open, yet the LER states that the AFW pumps started as a result of low SG level and were used to maintain SG level. Therefore, MFW is assumed to have tripped, even though the LER does not appear to say so.

The event was modeled assuming that the turbine-driven AFW pump was made unavailable when its steam side relief valve opened during pump start. This, in combination with the also unavailable motor-driven train produced the calculated core damage probability estimate. It is possible that the turbine-driven AFW pump was available for steam generator cooling; if this was the case, the core damage probability estimate would be lower by a factor of ~10. However, the LER does state that steam generator inventory was maintained by one of the motor-driven AFW pumps and does not clarify that the turbine-driven pump would have been available if required.

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

Transient	Base case nonrecovery
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Branches Impacted and Branch Nonrecovery Estimate

AFW	Base case	Two of three trains failed on demand; one train was nonrecoverable
MFW	Base case	Assumed failed in operation

Plant Models Utilized

PWR plant Class F

Event Identifier: 247/86-035

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 247/86-035  
 Event Description: Trip, LOFW, and Two AFW Train Failures  
 Event Date: 10/20/86  
 Plant: Indian Point 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CV	
TRANS	5.1E-04
Total	5.1E-04
CD	
TRANS	2.9E-04
Total	2.9E-04
ATWS	
TRANS	3.4E-05
Total	3.4E-05

DOMINANT SEQUENCES

End State: CV Conditional Probability: 2.3E-04  
 125 TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS -COND/MFW  
 End State: CD Conditional Probability: 1.2E-04  
 126 TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS COND/MFW  
 End State: ATWS Conditional Probability: 3.4E-05

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128 TRANS RT

SEQUENCE CONDITIONAL PROBABILITIES

	Sequence	End State	Prob	N Rec**
119	TRANS -RT AFW MFW -HPI(F/B) -HPR/-HPI PORV.OPEN -SS.DEPRESS -COND/MFW	CV	5.2E-05	5.8E-02
120	TRANS -RT AFW MFW -HPI(F/B) -HPR/-HPI PORV.OPEN -SS.DEPRESS COND/MFW	CD	2.7E-05	3.0E-02
122	TRANS -RT AFW MFW -HPI(F/B) HPR/-HPI -SS.DEPRESS -COND/MFW	CV	2.2E-04	5.8E-02
123	TRANS -RT AFW MFW -HPI(F/B) HPR/-HPI -SS.DEPRESS COND/MFW	CD	1.1E-04	3.0E-02
124	TRANS -RT AFW MFW -HPI(F/B) HPR/-HPI SS.DEPRESS	CD	1.2E-05	8.8E-02
125	TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS -COND/MFW	CV	2.3E-04 *	4.9E-02
126	TRANS -RT AFW MFW HPI(F/B) -SS.DEPRESS COND/MFW	CD	1.2E-04 *	2.5E-02
127	TRANS -RT AFW MFW HPI(F/B) SS.DEPRESS	CD	1.3E-05	7.4E-02
128	TRANS RT	ATWS	3.4E-05 *	1.2E-01

\* dominant sequence for end state

\*\* non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\newmodel\pwrmtree.cmp  
 BRANCH MODEL: c:\asp\newmodel\indpoint.txt  
 PROBABILITY FILE: c:\asp\newmodel\pwr\_b.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
TRANS	4.8E-04	1.0E+00	
LOOP	4.6E-06	3.9E-01	
LOCA	2.4E-06	4.3E-01	
RT	2.8E-04	1.2E-01	
RT/LOOP	0.0E+00	1.0E+00	
EMERG.POWER	2.9E-03	8.0E-01	
AFW	3.8E-04 > 1.0E-01	2.6E-01	
Branch Model: 1.OF.3+ser			
Train 1 Cond Prob:	2.0E-02 > Failed		
Train 2 Cond Prob:	1.0E-01		
Train 3 Cond Prob:	5.0E-02 > Failed		
Serial Component Prob:	2.8E-04		
AFW/EMERG.POWER	5.0E-02 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	5.0E-02 > Failed		
MFW	2.0E-01 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	2.0E-01 > Failed		

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PORV.DR.SRV.CHALL	4.0E-02	1.0E+00	
PORV.DR.SRV.RESEAT	2.0E-02	5.0E-02	
PORV.DR.SRV.RESEAT/EMERG.POWER	2.0E-02	1.0E+00	
SS.RELEAS.TERM	1.5E-02	3.4E-01	
SS.RELEAS.TERM/-MFW	1.5E-02	3.4E-01	
HPI	1.5E-03	8.4E-01	
HPI(F/B)	1.5E-03	8.4E-01	4.0E-02
HPR/-HPI	1.5E-04	1.0E+00	4.0E-02
PORV.OPEN	1.0E-02	1.0E+00	
SS.DEPRESS	3.6E-02	1.0E+00	
COND/MFW	1.0E+00	3.4E-01	
LPI/HPI	1.5E-04	3.4E-01	
LPR/-HPI.HPR	6.7E-01	1.0E+00	
LPR/HPI	1.5E-04	1.0E+00	

\* branch model file  
\*\* forced

Austin  
09-11-1987  
14:20:03