B.13 LER No. 281/83-055

Event Description: Trip with AFW Pump Inoperable

Date of Event: November 18, 1983

Plant: Surry 2

B.13.1 Summary

Auxiliary feedwater (AFW) pump B was found failed due to steam binding on November 18, 1983. On November 20, 1982, it was found failed due to a failed lube oil cooler. Surry 2 experienced a trip on November 16. The conditional core damage probability estimated for this event is 3.5×10^{-5}.

B.13.2 Event Description

Surry unit 2 was operating at full power on November 18, 1983, when the B motor-driven AFW pump failed to provide flow when started. An investigation determined that a leaking check valve was allowing backflow into the pump, which became steam bound. A similar problem was experienced by the pump on December 6, 1983. The turbine-driven AFW pump at Surry experienced a steam-binding problem on November 20; however, the relevant licensee event report indicates that the pump had been operable previously. In addition, AFW pump B was found to have a failed lube oil cooler during maintenance efforts on November 20. There was a reactor trip reported on November 16, 1983.

B.13.3 Additional Event-Related Information

None.

B.13.4 Modeling Assumptions

As the problems with motor-driven auxiliary feedwater pump (MDAFWP) B reported on November 18 and 20 were believed to have been latent during the trip on November 16, this event was modeled as a trip with that AFW pump inoperable. It was assumed that failure of the other AFW pumps from the same cause was possible. Although the specific failure discovered was not reported to be present in redundant systems, the potential for common cause failure was believed to exist. Therefore, the conditional probability of a common cause failure was included in the analysis for those components that failed as part of the event. This was implemented in the model by setting the serial component failure probability equal to the conditional probability that the remaining pumps would fail, given failure of pump B (0.1 x 0.3). Since failure of either remaining pump would have rendered AFW inoperable for ATWS mitigation, the failure probability of AFW during ATWS was calculated as $0.1 + 0.1 = 0.2$.

B.13.5 Analysis Results

The conditional core damage probability estimated for this event is 3.5×10^{-5}. The dominant sequence for this event, highlighted on the event tree in Figure B.13.1, involves a transient with reactor trip success, failure of main and auxiliary feedwater, and failure of feed-and-bleed cooling.

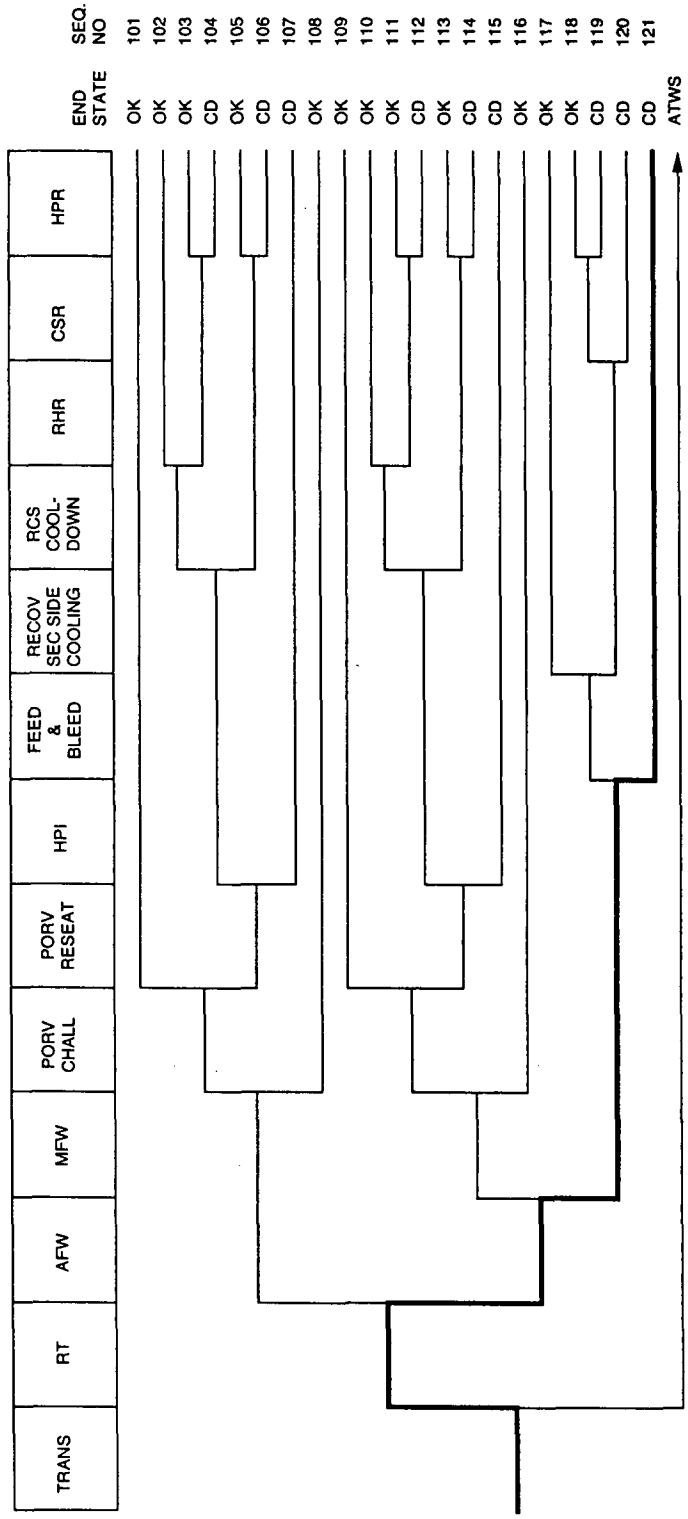

Figure B.13.1 Dominant core damage sequence for LER 281/83-055

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 281/83-055
Event Description: Trip with AFW pump inop
Event Date: November 18, 1983
Plant: Surry 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS	1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	3.5E-05
Total	3.5E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
121	trans -rt AFW mfw feed.bleed	CD	2.7E-05	1.5E-01
508	trans rt -prim.press.limited AFW/ATWS	CD	5.6E-06	1.0E-01
119	trans -rt AFW mfw -feed.bleed recov.sec.cool -csr hpr	CD	8.8E-07	1.5E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
119	trans -rt AFW mfw -feed.bleed recov.sec.cool -csr hpr	CD	8.8E-07	1.5E-01
121	trans -rt AFW mfw feed.bleed	CD	2.7E-05	1.5E-01
508	trans rt -prim.press.limited AFW/ATWS	CD	5.6E-06	1.0E-01

** non-recovery credit for edited case

SEQUENCE MODEL: d:\asp\models\pwra8283.cmp
BRANCH MODEL: d:\asp\models\surry2.82
PROBABILITY FILE: d:\asp\models\pwr8283.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	1.9E-03	1.0E+00	
loop	1.6E-05	5.3E-01	
loca	2.4E-06	5.4E-01	

sgtr	1.6E-06	1.0E+00	
rt	2.8E-04	1.0E-01	
rt(loop)	0.0E+00	1.0E+00	
AFW	3.8E-04 > 3.1E-02	4.5E-01	
Branch Model: 1.OF.3+ser			
Event Identifier: 281/83-055			
Train 1 Cond Prob:	2.0E-02		
Train 2 Cond Prob:	1.0E-01 > 1.0E+00		
Train 3 Cond Prob:	5.0E-02		
Serial Component Prob:	2.8E-04 > 3.0E-02		
AFW/ATWS	4.3E-03 > 2.0E-01	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	4.3E-03 > 2.0E-01		
afw/ep	5.0E-02	3.4E-01	
mfw	1.9E-01	3.4E-01	1.0E-03
porv.chall	4.0E-02	1.0E+00	
porv.chall/afw	1.0E+00	1.0E+00	
porv.chall/loop	1.0E-01	1.0E+00	
porv.chall/sbo	1.0E+00	1.0E+00	
porv.reseat	2.0E-02	1.1E-02	
porv.reseat/ep	2.0E-02	1.0E+00	
srv.reseat(atws)	1.0E-01	1.0E+00	
hpi	1.5E-03	8.9E-01	
feed.bleed	2.0E-02	1.0E+00	1.0E-02
emrg.boration	0.0E+00	1.0E+00	1.0E-02
recov.sec.cool	2.0E-01	1.0E+00	
recov.sec.cool/offsite.pwr	3.4E-01	1.0E+00	
rcs.cooldown	3.0E-03	1.0E+00	1.0E-03
rhr	2.2E-02	7.0E-02	1.0E-03
csr	7.5E-04	1.0E+00	
hpr	4.0E-03	1.0E+00	1.0E-03
ep	2.9E-03	8.9E-01	
seal.loca	2.7E-01	1.0E+00	
offsite.pwr.rec/-ep.and.-afw	2.2E-01	1.0E+00	
offsite.pwr.rec/-ep.and.afw	6.7E-02	1.0E+00	
offsite.pwr.rec/seal.loca	5.7E-01	1.0E+00	
offsite.pwr.rec/-seal.loca	7.0E-02	1.0E+00	
sg.iso.and.rcs.cooldown	1.0E-02	1.0E-01	
rcs.cool.below.rhr	3.0E-03	1.0E+00	3.0E-03
prim.press.limited	8.8E-03	1.0E+00	

* branch model file
** forced