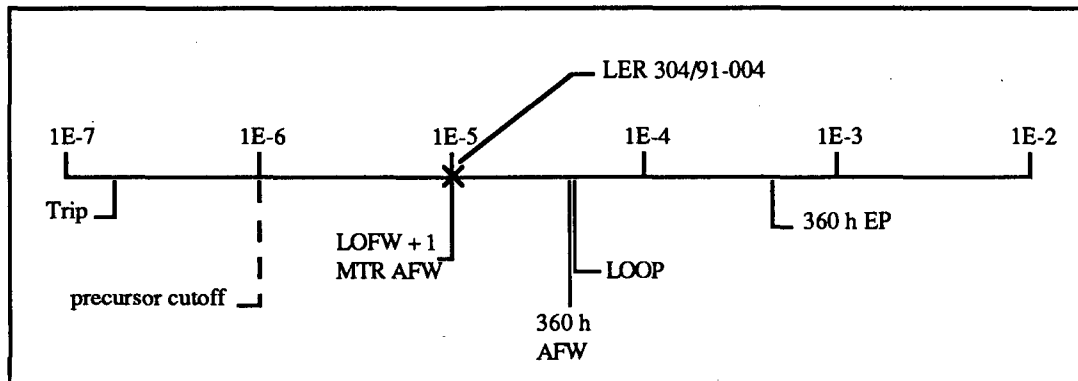


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No.: 304/91-004
 Event Description: Main feedwater pump trip with one AFW pump failed
 Date of Event: June 11, 1991
 Plant: Zion 2

Summary

Failure of a capacitor in the steam generator (SG) level controller power supply caused an SG overfeed during a startup. As a result of the high SG level, a main feedwater (MFW) pump trip and reactor trip occurred. During the startup, one of the auxiliary feedwater (AFW) pumps had failed to start. The conditional core damage probability estimated for this event is 1.0×10^{-5} . The relative significance of this event compared to other postulated events at Zion 2 is shown below.



Event Description

During a Zion 2 startup on June 11, 1991, the AFW pumps were being used to feed the SGs. MFW pump 2C had been started and was being aligned to feed the SGs. The bypass feedwater regulating valves (FRVs) were placed in automatic to control the SG level. Failure of a capacitor in the SG level controller power supply circuitry resulted in overfeed of the SGs. MFW pump 2C tripped on a high SG level signal resulting in a turbine and reactor trip. During the startup attempt, one of the AFW pumps had failed to start (reason unspecified). Prior experience with leakage from the FRVs led operators to conclude that the overfeed event had resulted from valve leakage, thereby confounding accurate diagnosis of the event. Several attempts at startup were made over two shifts, and each resulted in a high SG level trip, before the problem was correctly diagnosed.

Additional Event-Related Information

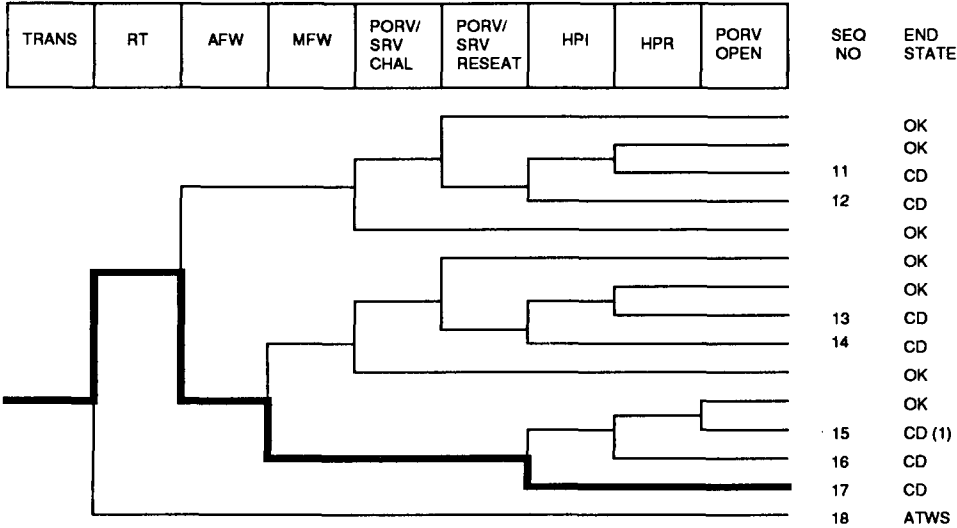
Zion 2 has two motor-driven AFW pumps and one turbine-driven AFW pump. The AFW success criterion for decay heat removal is one pump out of three.

ASP Modeling Assumptions and Approach

The event has been modeled as a potentially recoverable loss of feedwater with one motor-driven AFW pump unavailable. The event was analyzed assuming it had occurred at power, although it actually occurred during startup, when decay heat loads were less.

Analysis Results

The conditional core damage probability for this event is conservatively estimated at 1.0×10^{-5} . The estimate is conservative because of the analysis assumption that the event occurred at power, when it actually occurred during startup. The dominant core damage sequence, highlighted on the following event tree, involves a reactor trip with unavailable secondary-side cooling and failure of bleed and feed.



(1) OK for Class D

Dominant core damage sequence for LER 304/91-004

B-267

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 304/91-004
 Event Description: MFW pump trip and reactor trip with one AFW pump failed
 Event Date: 06/11/91
 Plant: Zion 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS	1.0E+00
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SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	1.0E-05
Total	1.0E-05
ATWS	
TRANS	3.4E-05
Total	3.4E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
17 trans -rt AFW MFW hpi(f/b)	CD	5.1E-06	7.4E-02
15 trans -rt AFW MFW -hpi(f/b) -hpr/-hpi porv.open	CD	4.8E-06	8.8E-02
16 trans -rt AFW MFW -hpi(f/b) hpr/-hpi	CD	5.3E-07	8.8E-02
18 trans rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
15 trans -rt AFW MFW -hpi(f/b) -hpr/-hpi porv.open	CD	4.8E-06	8.8E-02
16 trans -rt AFW MFW -hpi(f/b) hpr/-hpi	CD	5.3E-07	8.8E-02
17 trans -rt AFW MFW hpi(f/b)	CD	5.1E-06	7.4E-02
18 trans rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\pwrbaseal.cmp
 BRANCH MODEL: c:\asp\1989\zion.sll
 PROBABILITY FILE: c:\asp\1989\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
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Event Identifier: 304/91-004

trans	1.5E-04	1.0E+00	
loop	1.6E-05	5.3E-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	5.4E-04	8.0E-01	
AFW	3.8E-04 > 5.3E-03	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		
Serial Component Prob:	2.8E-04		
afw/emerg.power	5.0E-02	3.4E-01	
MFW	2.0E-01 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	2.0E-01 > Unavailable		
porv.or.srv.chall	4.0E-02	1.0E+00	
porv.or.srv.reseat	2.0E-02	1.1E-02	
porv.or.srv.reseat/emerg.power	2.0E-02	1.0E+00	
seal.loca	2.7E-01	1.0E+00	
ep.rec(sl)	5.7E-01	1.0E+00	
ep.rec	3.1E-02	1.0E+00	
hpi	1.0E-03	8.4E-01	
hpi(f/b)	1.0E-03	8.4E-01	1.0E-02
hpr/-hpi	1.5E-04	1.0E+00	1.0E-03
porv.open	1.0E-02	1.0E+00	4.0E-04
* branch model file			
** forced			

Minarick
05-26-1992
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Event Identifier: 304/91-004