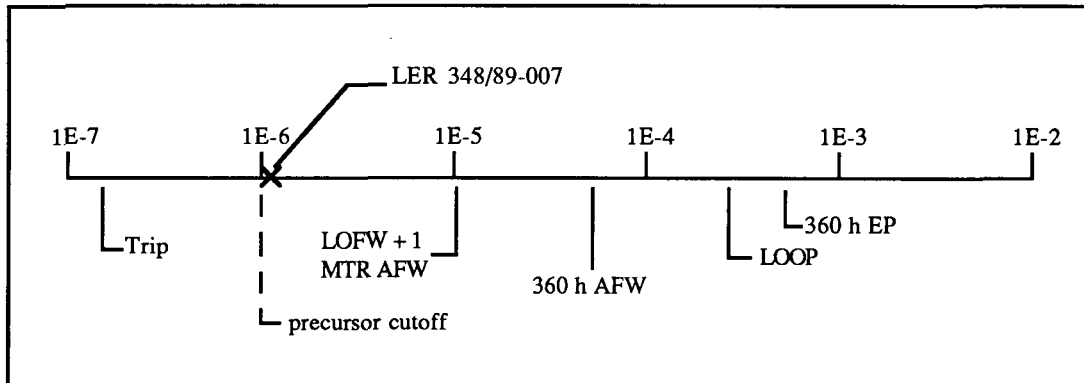


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 348/89-007
 Event Description: Motor-driven AFW pumps fail to start under manual control
 Date: November 12, 1989
 Plant: Farley 1

Summary

Operators experienced difficulties in manually restarting the motor-driven auxiliary feedwater (AFW) pumps during recovery from a trip and safety injection. During investigation of these difficulties it was discovered that, because of a wiring error, the motor-driven AFW pumps would not restart once they had automatically initiated and then been secured unless the auto-initiation signal was cleared. The conditional core damage probability estimated for this event is 1.1×10^{-6} . The relative significance of this event compared with other postulated events at Farley is shown below.



Event Description

The motor-driven AFW pumps initially functioned as designed following a trip and safety injection at Farley 1. Some time after the trip, they were secured by the operator so that steam generator blowdown could be established. Subsequent efforts to manually restart the motor-driven AFW pumps were initially unsuccessful. After about 10 min of investigation, it was discovered that placing the motor-driven AFW pump autostart defeat switches in "defeat" would permit restart of the motor-driven AFW pumps. They were then operated as needed.

The pumps' failure to start was caused by a wiring error. A designer had assumed that

switchgear wiring for Unit 1 was identical to Unit 2 and developed a design change for Unit 1 on that basis.

During the utility's analysis of the event, it was initially believed that the problem was restricted to a wiring error associated with the "autodefeat" switches. It was subsequently discovered that, once the pumps had automatically initiated and been secured, they could not be manually restarted until the autostart signal was removed.

Additional Event-Related Information

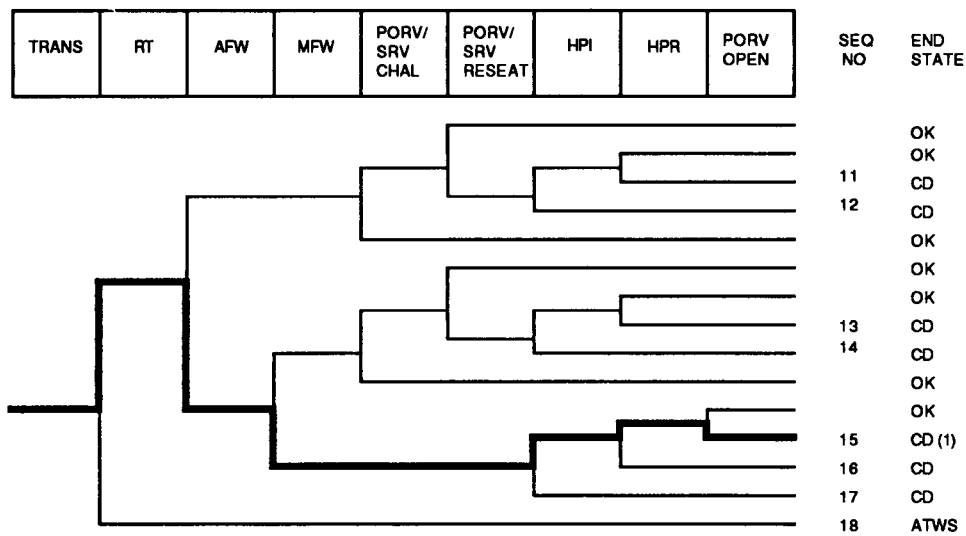
The motor-driven AFW pumps at Farley 1 receive automatic start signals when both steam generator feedpumps are tripped. These autostart signals may be blocked by means of "autodefeat" switches. Since these switches were apparently providing the automatic start signals to the motor-driven AFW pumps during the event, placing them in "defeat" removed the signals from the pumps. It was then possible for the operator to manually start the motor-driven AFW pumps. Had the autostart signal been applied from some other source, it would have been necessary to remove that signal to restart the pumps.

ASP Modeling Assumptions and Approach

The event has been modeled as a reactor trip with main feedwater isolation and degraded AFW. The probability of failure for the degraded AFW system was estimated by assuming the turbine-driven pump was not impacted by the event (failure probability = 0.05), and that 10% of the time the AFW pumps will be tripped and restarted following a trip. If they are tripped, the probability of successful restart was assumed to be 0.12 (non-proceduralized in-control room action). This results in an increase in AFW system probability of $p(\text{turbine-driven pump}) \times p(\text{AFW pumps tripped during trip recovery}) \times p(\text{operator fails to restart motor-driven pumps}) = 0.05 \times 0.1 \times 0.12 = 6.0 \times 10^{-4}$.

Analysis Results

The core damage probability estimated for the event is 1.1×10^{-6} . The dominant sequence associated with the event (highlighted on the following event tree), involves failure of AFW, failure to recover main feedwater, and failure of feed and bleed.



(1) OK for Class D

Dominant core damage sequence for LER 348/89-007

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 348/89-007
 Event Description: Motor-driven AFW pumps fail to restart following trip
 Event Date: 11/12/89
 Plant: Farley 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	1.1E-06
Total	1.1E-06
ATWS	
TRANS	3.4E-05
Total	3.4E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
15 trans -rt AFW mfw -hpi(f/b) -hpr/-hpi porv.open	CD	5.1E-07	9.1E-03
17 trans -rt AFW mfw hpi(f/b)	CD	5.1E-07	7.6E-03
16 trans -rt AFW mfw -hpi(f/b) hpr/-hpi	CD	5.7E-08	9.1E-03
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	5.1E-07	9.1E-03
16 trans -rt AFW mfw -hpi(f/b) hpr/-hpi	CD	5.7E-08	9.1E-03
17 trans -rt AFW mfw hpi(f/b)	CD	5.1E-07	7.6E-03
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\farley1.sll
 PROBABILITY FILE: c:\asp\1989\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	2.5E-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	2.9E-03	8.0E-01	
AFW	3.8E-04 > 5.4E-03 **	2.6E-01, > 1.3E-01	
Branch Model:	1.OP.3+ser		
Train 1 Cond Prob:	2.0E-02		

Event Identifier: 348/89-007

B-274

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	1.0E+00	7.0E-02	1.0E-03
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	7.0E-02	1.0E+00	
hpi	3.0E-04	8.4E-01	
hpi(f/b)	3.0E-04	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

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