# ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 400/89-001 R2
Event Description: Reactor trip and loss of one train of auxiliary feedwater
Date of Event: January 16, 1989
Plant: Shearon Harris

Summary

A turbine trip on low main condenser vacuum was initiated at Shearon Harris when a technician inadvertently opened a valve that vented the main condenser to atmosphere. The reactor tripped immediately following the turbine trip, and a steam generator (SG) low-low level during the subsequent transient initiated the auxiliary feedwater (AFW) system. The turbine-driven AFW pump tripped off 15 s after it had started. The conditional core damage probability estimated for this event is 1.3×10^{-5}. The relative significance of this event compared with other postulated events at Shearon Harris is shown below.
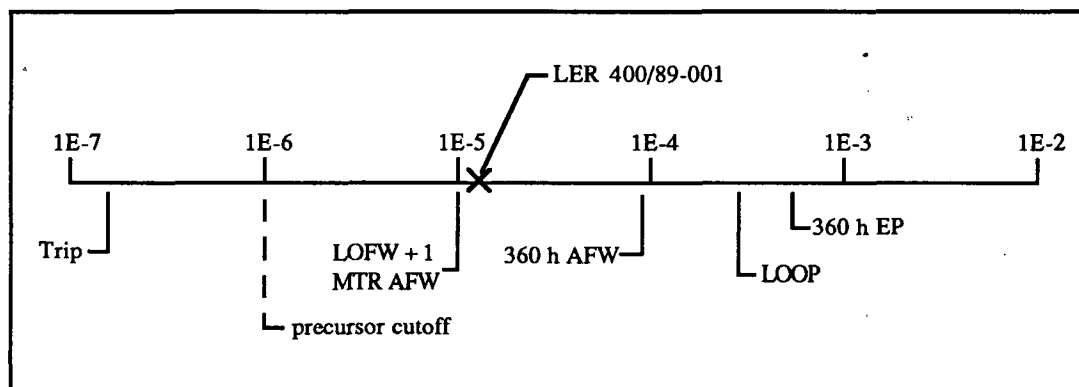
Event Description

On January 16, 1989, Shearon Harris was operating at 100% of rated power when a technician opened an auxiliary steam condensate tank vent valve and established a vent path for the main condenser to the atmosphere. This manually operated valve had been closed to isolate a motor-operated valve (MOV) that had been worked on, and the technician was restoring the system lineup. However, the MOV was not fully closed, and, as a result, vacuum started decreasing in the main condenser when he opened the manual valve. The operators tried, without success, to stop the loss of vacuum by

reducing the turbine load, and approximately 8 min later, the turbine tripped on low vacuum. The reactor tripped immediately thereafter because of the turbine trip. An SG low-low level during the subsequent transient initiated AFW, and all three AFW pumps started. The turbine-driven AFW pump tripped off 15 s after it had started. This was initially believed to be caused by excessive moisture in the steam supply lines, but it was later concluded that the pump trip was caused by an overspeed signal from the turbine tachometer (see LER 400/89-017). The motor-driven AFW pumps were unaffected and continued supplying water to the steam generators.

Additional Event-Related Information

Shearon Harris' AFW system consists of two motor-driven pumps and one turbine-driven pump. All three pumps share a common suction from the condensate storage tank (CST). AFW supplies the three SGs through separate lines (one for each SG), and any of the AFW pumps can supply the SGs.

ASP Modeling Assumptions and Approach

This event has been modeled as a loss of feedwater (due to the unavailability of the main condenser) with a failed turbine-driven AFW pump.

Analysis Results

The conditional probability of severe core damage for this event is 1.3×10^{-5}. The dominant sequences for this event involve unavailability of secondary-side cooling and failure to initiate feed and bleed. The dominant sequence is highlighted on the following event tree.

Note that two other events occurred at this plant that involved a trip with one AFW pump unavailable (see LERs 400/89- 006 and -017).

TRANS	RT	AFW	MFW	PORV/ SRV CHAL	PORV/ SRV RESEAT	HPI	HPR	PORV OPEN	SEQ NO	END STATE

										OK
										OK
									11	CD
									12	CD
										OK
										OK
										OK
									13	CD
									14	CD
										OK
										OK
									15	CD (1)
									16	CD
									17	CD
									18	ATWS
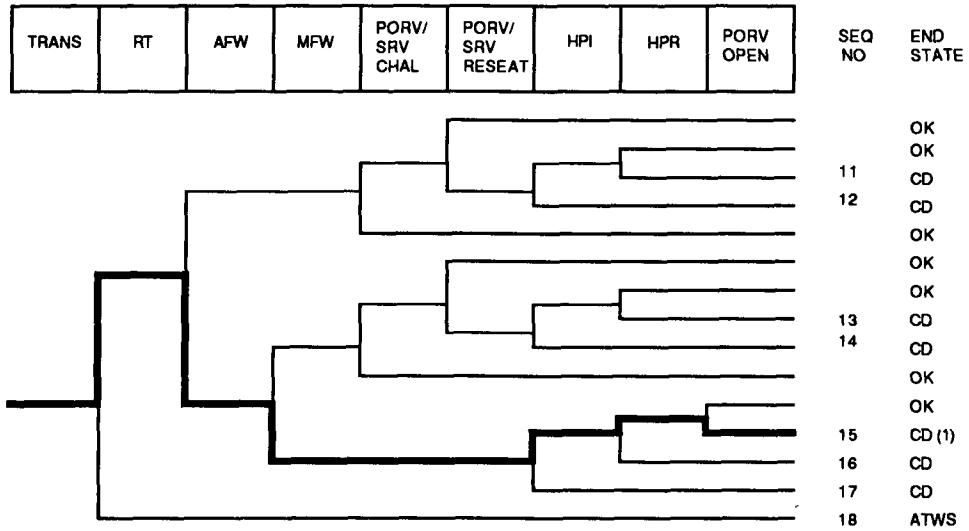
(1) OK for Class D

Dominant core damage sequence for LER 400/89-001

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 400/89-001
Event Description: Reactor trip and failure of turbine-driven AFW pump to run
Event Date: 01/16/89
Plant: Harris 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS   1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

    End State/Initiator   Probability

CD

    TRANS   1.3E-05

    Total   1.3E-05

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	6.1E-06	2.6E-01
17	trans -rt AFW MFW hpi(f/b)	CD	6.1E-06	2.2E-01
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	6.1E-06	2.6E-01
17	trans -rt AFW MFW hpi(f/b)	CD	6.1E-06	2.2E-01
18	trans rt	·ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\pwrbseal.cmp
BRANCH MODEL: c:\asp\1989\harris.sll
PROBABILITY FILE: . c:\asp\1989\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	5.5E-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 > 2.3E-03	2.6E-01	
Branch Model: 1.OF.3+ser			
Train 1 Cond Prob:	2.0E-02		
Train 2 Cond Prob:	1.0E-01		
Train 3 Cond Prob:	5.0E-02 > Failed		

Event Identifier: 400/89-001

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        Serial Component Prob:      2.8E-04
afw/emerg.power                     5.0E-02                    3.4E-01
MFW                                 1.0E+00 > 1.0E+00          7.0E-02 > 1.0E+00        1.0E-03
        Branch Model:  1.OF.1+opr
        Train 1  Cond Prob:         1.0E+00
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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