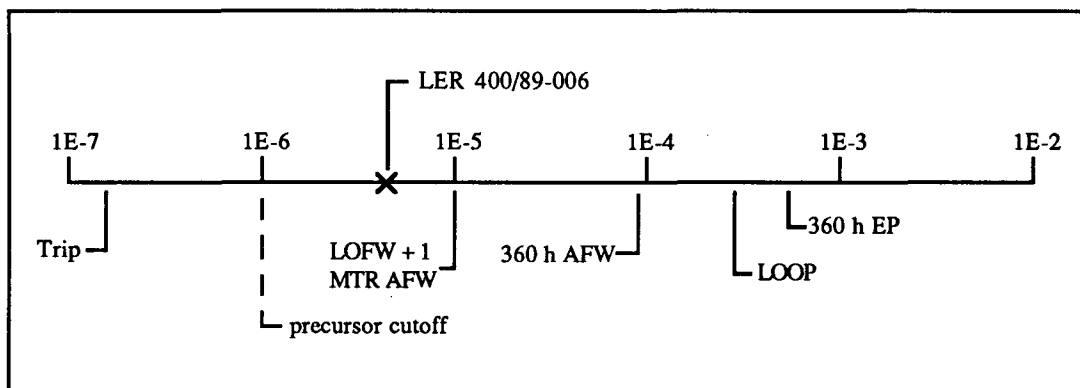


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 400/89-006
 Event Description: Reactor trip with one AFW pump out of service
 Date of Event: March 14, 1989
 Plant: Shearon Harris

Summary

Shearon Harris was operating at 100% of rated power when the "B" main feedwater pump (MFP) tripped off because of an inadvertent fire protection spray actuation. An automatic turbine runback reduced the turbine load to 60%; however, with all control systems in automatic, the plant was unable to maintain level in the steam generators with the remaining MFP. An SG low-low level tripped the reactor approximately 71 s after the "B" MFP tripped. The two motor-driven auxiliary feedwater (AFW) system pumps started automatically and began supplying water to the SG, but the turbine-driven AFW pump was out of service for maintenance. The conditional core damage probability estimated for this event is 4.4×10^{-6} . The relative significance of this event compared with other postulated events at Shearon Harris is shown below.



Event Description

On March 14, 1989, Shearon Harris was operating at 100% of rated power when a technician opened an upstream manual isolation valve in the supply line to a fire protection sprinkler deluge valve. Following maintenance on the system, the solenoid-operated deluge valve had not reseated, and fire protection personnel, thinking that the sprinkler head downstream of the deluge valve was closed, cracked open the isolation

valve; some water sprayed from the sprinkler head onto the "B" MFP junction box. This was unexpected; however, the junction boxes were rain- and drip-proof. A short time later a short circuit due to water accumulation blew the "B" MFP junction box apart, and the pump tripped. The plant automatically responded by reducing the turbine load to 60%, dumping steam, inserting control rods, and trying to control water level in the SGs. SG low-low level during the subsequent transient initiated auxiliary feedwater, which started both motor-driven AFW pumps, and they began supplying water to the SGs. The turbine-driven AFW pump was out of service for maintenance. The remaining MFW pump tripped on low flow 26 s after the SG low-low level signal.

Additional Event-Related Information

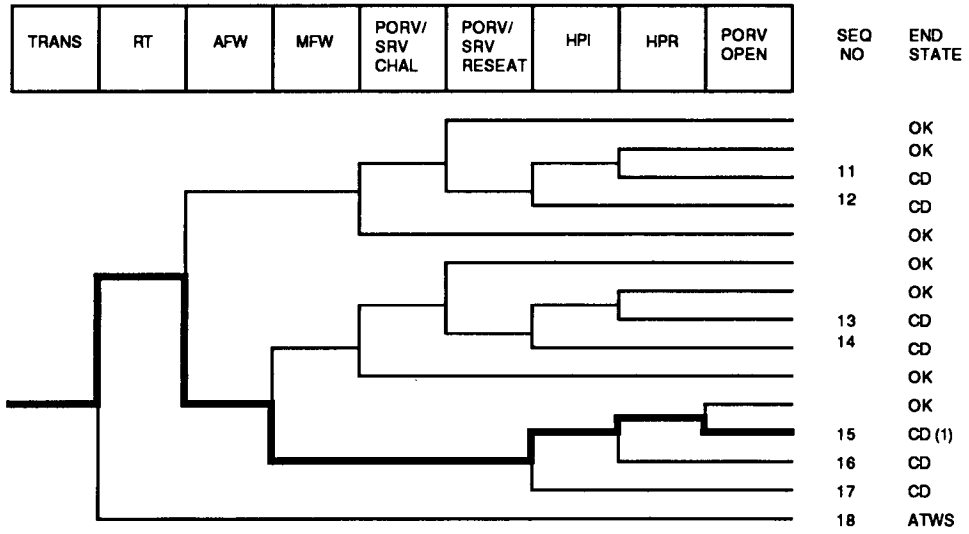
Shearon Harris' AFW system consists of two motor-driven pumps and one turbine-driven pump. All three pumps share a common suction from the condensate storage tank (CST). AFW supplies the three SGs through separate lines (one for each SG); however, any of the AFW pumps can supply the SGs.

ASP Modeling Assumptions and Approach

This event has been modeled as a reactor scram and locally recoverable loss of main feedwater, with the turbine-driven AFW pump unavailable.

Analysis Results

The conditional probability of severe core damage for this event is 4.4×10^{-6} . The dominant sequence associated with the event (highlighted on the following event tree) involves failure of secondary-side cooling and failure to initiate feed and bleed. Note that two other events at this plant involved a turbine trip with one train of AFW unavailable (see LERs 400/89-001 and -017).



(1) OK for Class D

Dominant core damage sequence for LER 400/89-006

B-369

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 400/89-006
 Event Description: Reactor trip with one AFW pump out of service
 Event Date: 03/14/89
 Plant: Harris 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	4.4E-06
Total	4.4E-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	2.1E-06	8.8E-02
17 trans -rt AFW MFW hpi(f/b)	CD	2.1E-06	7.4E-02
16 trans -rt AFW MFW -hpi(f/b) hpr/-hpi	CD	2.3E-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	2.1E-06	8.8E-02
16 trans -rt AFW MFW -hpi(f/b) hpr/-hpi	CD	2.3E-07	8.8E-02
17 trans -rt AFW MFW hpi(f/b)	CD	2.1E-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\pwrseal.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	

Event Identifier: 400/89-006

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Train 2 Cond Prob: 1.0E-01
Train 3 Cond Prob: 5.0E-02 > Unavailable
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 > 3.4E-01 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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Minarick
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