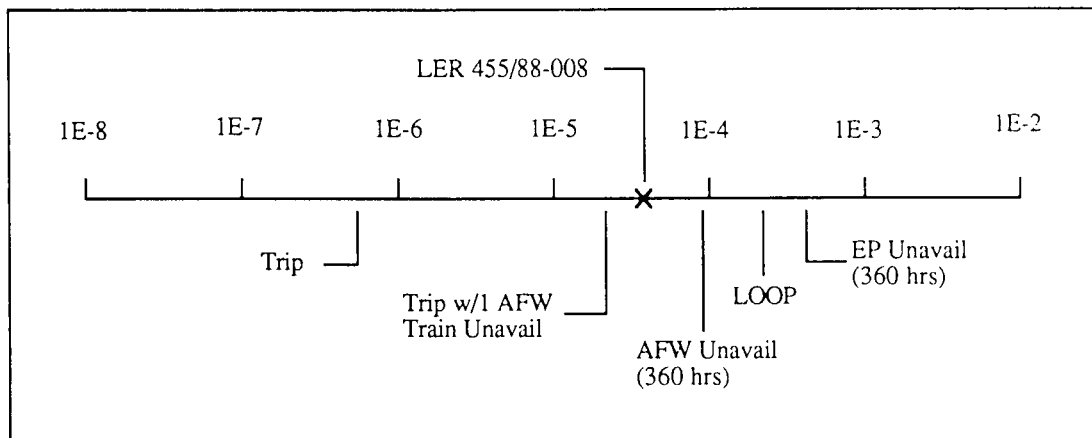


Accident Sequence Precursor Program Event Analysis

LER No: 455/88-008
 Event Description: Loss of feedwater and one train of auxiliary feedwater tripped
 Date of Event: July 14, 1988
 Plant: Byron Unit 2

Summary

An operator inadvertently caused a loss of feedwater while operating at 95% power. During the recovery from the reactor trip, one train of auxiliary feedwater tripped and was restored approximately 4 min later. The core damage probability estimated for the event is 4.0×10^{-5} . The relative significance of this event compared with other potential events at Byron 2 is shown below.



Event Description

The feeder breaker from the unit auxiliary transformer to nonsafety-related bus 243 had been operating at elevated temperatures, and it was decided to rack the breaker out for a visual inspection. Therefore, the feeder breaker from the system auxiliary transformer was closed and the feeder breaker from the unit auxiliary transformer was opened. While attempting to place the opened feeder breaker in "pull-to-lock," the operator inadvertently operated the handswitch for the feeder breaker from the system auxiliary transformer, which de-energized bus 243. This resulted in loss of several secondary-side pumps, including the 2B and 2C main feedwater pumps. Steam generator levels decreased rapidly, and an automatic reactor trip occurred. A main feedwater isolation occurred

as expected shortly after the trip and auxiliary feedwater pumps 2A and 2B started automatically at 0114; however, the 2B AFW pump tripped on a false overspeed signal caused by a loose terminal grounding connection. The 2B AFW pump was reset and was automatically started at 0118 and operated normally for the duration of the event.

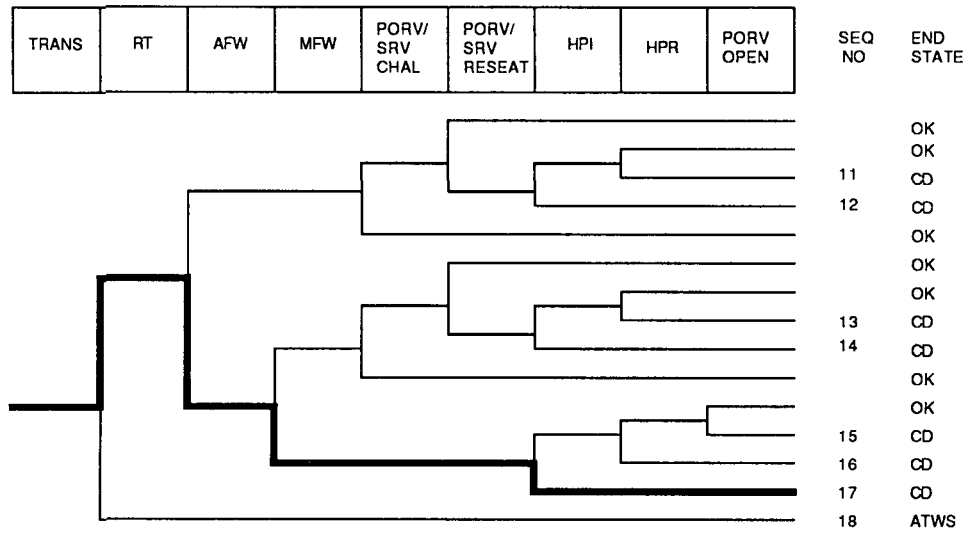
The abnormally high temperature of the feeder breaker for bus 243 was caused by failure of a heater control circuit used to keep breaker cubicles warm during cold weather.

ASP Modeling Assumptions and Approach

The event was modeled as a loss of feedwater and one train of auxiliary feedwater unavailable.

Analysis Results

The conditional probability of severe core damage estimated for this event is 4.0×10^{-5} . The dominant sequences to core damage involve failure of auxiliary feedwater ($p = 5.2 \times 10^{-3}$), failure to recover main feedwater ($p = 0.34$), and failure of feed and bleed capability ($p = 0.02$, including operator failure). The dominant sequence for this event is highlighted on the following event tree.



Dominant Core Damage Sequence for LER 455/88-008

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 455/88-008
 Event Description: Loss of feedwater and one train of AFW tripped
 Event Date: 07/14/88
 Plant: Byron 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	4.0E-05
Total	4.0E-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	1.9E-05	7.4E-02
15 trans -rt AFW MFW -hpi(f/b) -hpr/-hpi porv.open	CD	1.8E-05	8.8E-02
16 trans -rt AFW MFW -hpi(f/b) hpr/-hpi	CD	2.0E-06	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	1.8E-05	8.8E-02
16 trans -rt AFW MFW -hpi(f/b) hpr/-hpi	CD	2.0E-06	8.8E-02
17 trans -rt AFW MFW hpi(f/b)	CD	1.9E-05	7.4E-02
18 trans rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE MODEL: a:\sealmod\pwrseal.cmp
 BRANCH MODEL: a:\sealmod\byron.sll
 PROBABILITY FILE: a:\sealmod\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	5.3E-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	1.3E-03 > 2.0E-02	2.6E-01	
Branch Model: 1.OF.2+ser			
Train 1 Cond Prob:	2.0E-02		

Event Identifier: 455/88-008

Train 2 Cond Prob:	5.0E-02 > Failed		
Serial Component Prob:	2.8E-04		
AFW/EMERG.POWER	5.0E-02 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	5.0E-02 > Failed		
MFW	1.0E+00 > 1.0E+00	7.0E-02 > 3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	1.0E+00 > Failed		
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)	5.8E-01	1.0E+00	
ep.rec	1.8E-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
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