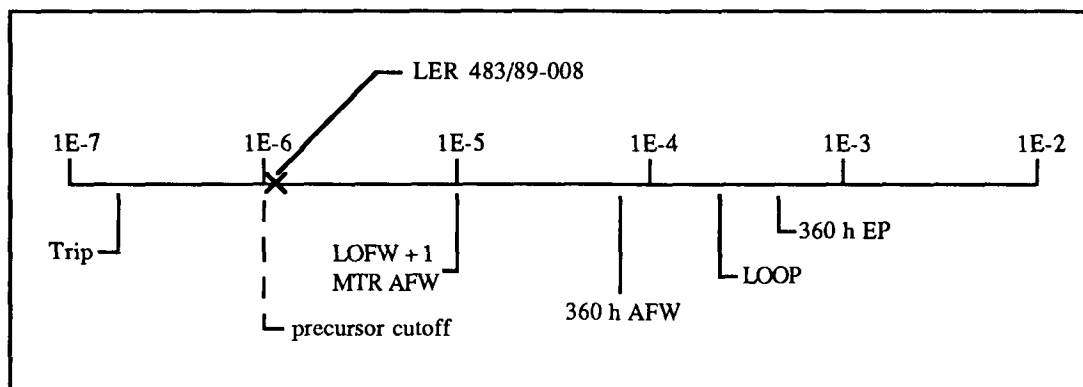


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 483/89-008
 Event Description: Reactor trip, one EDG out of service, and loss of ESF bus
 Date of Event: June 23, 1989
 Plant: Callaway 1

Summary

A reactor shutdown was initiated from 100% power when a control rod bank failed to move and was declared inoperable at Callaway. When the turbine was tripped at 3% power, a relay in the generator protective circuitry incorrectly stripped all power from a 4.16-kV engineered safety features (ESF) bus. The emergency diesel generator (EDG) that supplied backup power to the bus was out of service for maintenance, and the bus was without power for approximately 1 h and 43 min. The loss of power to the bus initiated the auxiliary feedwater (AFW) system turbine-driven pump, which supplied water to the steam generators. The conditional core damage probability estimated for this event is 1.2×10^{-6} . The relative significance of this event compared with other postulated events at Callaway is shown below.



Event Description

On June 23, 1989, Callaway was operating at 100% of rated power when control rod bank "B" failed to move during a monthly plant Technical Specifications surveillance. The operators began an orderly shutdown of the plant in accordance with Tech Specs. At 3% power the main turbine was tripped off. However, a generator output breaker protective relay incorrectly sensed that a flashover had occurred and cleared bus "B" in the 345-kV switchyard; this, in turn, cleared NB01, an ESF 4.16-kV bus supplied from

the switchyard. Usually, NB01 receives power from “A” EDG when normal power is lost; however, in this instance the “A” EDG was out of service for maintenance, so when the relay cleared the switchyard, a loss of power occurred on the bus. The loss of power to the ESF bus automatically initiated the turbine-driven AFW pump. Normal power to bus NB01 was restored ~1.7 h after the trip.

Additional Event-Related Information

Callaway’s safety-related onsite power system is normally supplied from offsite sources through two independent supply paths:

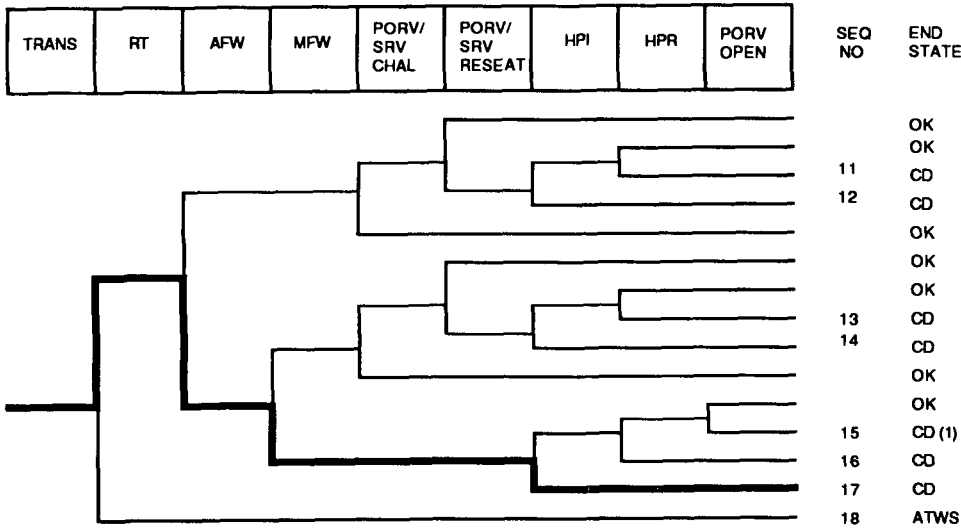
- one preferred circuit from the switchyard to the startup transformer, which feeds 13.8-kV buses PA01 and PA02, and 13.8-kV/4.16-kV ESF transformer XNB02 (this circuit can be powered from the main generator via the unit auxiliary transformer).
- the second preferred circuit, which feeds 13.8-kV/4.16-kV ESF transformer XNB01 (this bus is powered from the switchyard).

ASP Modeling Assumptions and Approach

This event has been modeled as a reactor trip with one of the two ESF buses unavailable.

Analysis Results

The conditional probability of severe core damage for this event is 1.2×10^{-6} . The dominant sequences associated with the event involve failure of secondary-side cooling and failure of feed and bleed. The dominant sequence for the event is highlighted on the following event tree.



(1) OK for Class D

Dominant core damage sequence for LER 483/89-008

B-412

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 483/89-008
 Event Description: Reactor trip with unavailable ESF bus
 Event Date: 06/23/89
 Plant: Callaway 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	1.2E-06
Total	1.2E-06
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	4.3E-07	1.5E-02
16 trans -rt AFW mfw -HPI(F/B) HPR/-HPI	CD	2.5E-07	1.8E-02
15 trans -rt AFW mfw -HPI(F/B) -HPR/-HPI porv.open	CD	2.4E-07	1.8E-02
11 trans -rt -AFW porv.or.srv.chall porv.or.srv.reseat -HPI HPR/-HPI	CD	1.4E-07	1.1E-02
12 trans -rt -AFW porv.or.srv.chall porv.or.srv.reseat HPI	CD	1.1E-07	9.2E-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**
11 trans -rt -AFW porv.or.srv.chall porv.or.srv.reseat -HPI HPR/-HPI	CD	1.4E-07	1.1E-02
12 trans -rt -AFW porv.or.srv.chall porv.or.srv.reseat HPI	CD	1.1E-07	9.2E-03
15 trans -rt AFW mfw -HPI(F/B) -HPR/-HPI porv.open	CD	2.4E-07	1.8E-02
16 trans -rt AFW mfw -HPI(F/B) HPR/-HPI	CD	2.5E-07	1.8E-02
17 trans -rt AFW mfw HPI(F/B)	CD	4.3E-07	1.5E-02
18 trans rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\pwrbscal.cmp
 BRANCH MODEL: c:\asp\1989\callwy.sll
 PROBABILITY FILE: c:\asp\1989\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	3.5E-04	1.0E+00	
loop	1.6E-05	5.3E-01	
loca	2.4E-06	4.3E-01	

Event Identifier: 483/89-008

B-413

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 > 1.3E-03	2.6E-01	
Branch Model: 1.OF.3+ser			
Train 1 Cond Prob:	2.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
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	
porv.or.srv.chall	4.0E-02	1.0E+00	
porv.or.srv.reseat	3.0E-02	1.1E-02	
porv.or.srv.reseat/emerg.power	3.0E-02	1.0E+00	
seal.loca	2.7E-01	1.0E+00	
ep.rec(sl)	5.8E-01	1.0E+00	
ep.rec	2.5E-02	1.0E+00	
HPI	1.0E-03 > 1.0E-02	8.4E-01	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
HPI(F/B)	1.0E-03 > 1.0E-02	8.4E-01	1.0E-02
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
HPR/-HPI	1.5E-04 > 1.0E-02	1.0E+00	1.0E-03
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.5E-02 > Unavailable		
porv.open	1.0E-02	1.0E+00	4.0E-04
* branch model file			
** forced			

Minarick
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