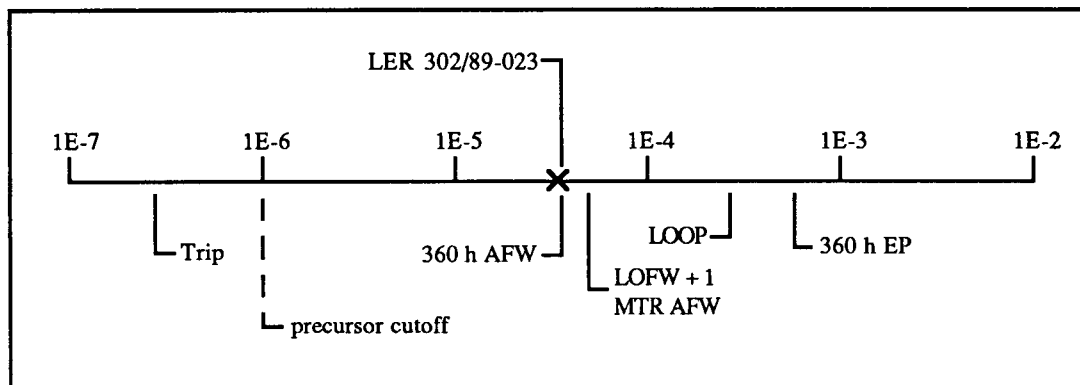


## ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 302/89-023  
 Event Description: Loss of offsite power with degraded emergency feedwater  
 Date of Event: June 16, 1989  
 Plant: Crystal River 3

### Summary

A loss of offsite power (LOOP) was initiated at Crystal River 3 with the plant at 12% power when a technician bumped a test trip button. Automatic transfer to another source did not occur because a relay failed and indicated that a breaker was closed when it was not. The emergency diesel generators (EDGs) automatically started and reenergized their respective engineered safeguards (ES) buses. Also, the motor-driven emergency feedwater pump failed to automatically start because of two faulted relays and was manually started. The conditional core damage probability estimated for this event is  $3.5 \times 10^{-5}$ . The relative significance of this event compared with other postulated events at Crystal River 3 is shown below.



### Event Description

On June 16, 1989, Crystal River 3 was operating at 12% of rated power with the main generator latched and rolling. An electrical technician accidentally bumped the test trip button in the Brookridge (230-kV) line metering cabinet, opening switchyard breakers 1690 and 1691. This alone should have only de-energized the Brookridge line. However, a fault detector relay in breaker 1691 failed, causing a false breaker-closed indication. The fault detection scheme opened breaker 1692 to clear the indicated fault. As a result, power to the startup transformer was lost. EDGs 3A and 3B automatically started and reenergized their

respective 4160-V ES buses. All operating reactor coolant pumps and both operating main feedwater pumps tripped because of the loss of power on the startup transformer. This caused an automatic initiation of the emergency feedwater (EFW) system. The turbine-driven EFW pump started. However, the motor-driven EFW pump had to be started manually. This was caused by the failure of two series relays. The startup transformer was returned to service approximately 1 h after the event began.

### **Additional Event-Related Information**

Crystal River 3's normal offsite source of power to the ES buses 3A and 3B is from the 230-kV switchyard (five possible sources) stepped down through the Unit 3 startup transformer. Alternate offsite power to the ES buses is from the Unit 3 auxiliary transformer supplied by the main generator. Backup offsite power to the ES buses is from the Units 1 and 2 startup transformer. EDGs 3A and 3B supply emergency power to the ES buses in the event that all other sources of power are lost. In this event, the plant was in power operation, but the main generator was separated from the grid even though it was latched and rolling. Thus, the alternate source of power to the ES buses was unavailable.

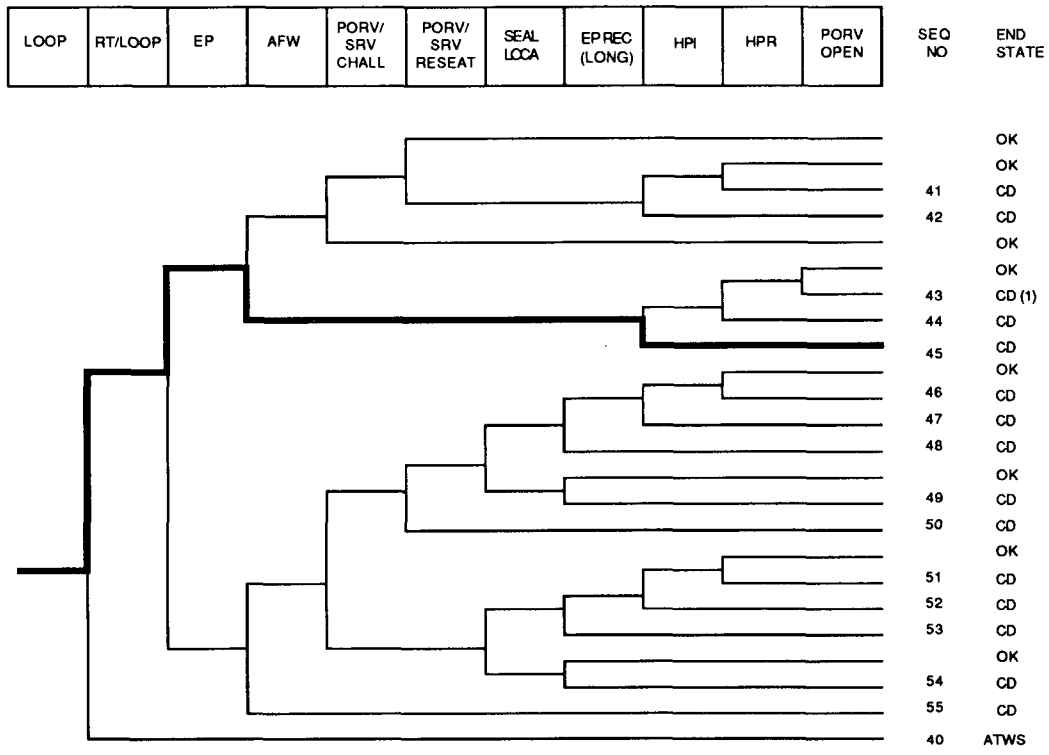
The EFW system consists of two 100% capacity trains, one with a motor-driven pump and the other with a turbine-driven pump. The motor-driven pump receives power from 3A ES bus.

### **ASP Modeling Assumptions and Approach**

This event has been modeled as a plant-centered loss of offsite power with one train of EFW initially unavailable. No change in the EFW system nonrecovery estimate was assumed in the analysis.

### **Analysis Results**

The conditional probability of severe core damage for this event is  $3.5 \times 10^{-5}$ . The dominant core damage sequence involves successful emergency power following the LOOP, with subsequent failure of AFW and feed and bleed. This sequence is highlighted on the following event tree. If the failure of the motor-driven EFW pump is not addressed in the analysis (since it was manually started shortly after the LOOP), the core damage probability estimate is reduced to  $1.3 \times 10^{-5}$ . In this case, the dominant sequence involves failure of emergency power and failure of the turbine-driven AFW train.



(1) OK for Class D

Dominant core damage sequence for LER 302/89-023

# B-73

## CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 302/89-023  
 Event Description: LOOP with degraded emergency feedwater  
 Event Date: 06/16/89  
 Plant: Crystal River 3

### INITIATING EVENT

#### NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP 1.5E-01

#### SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
LOOP	3.5E-05
Total	3.5E-05
ATWS	
LOOP	0.0E+00
Total	0.0E+00

#### SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
45 LOOP -rt/loop -emerg.power AFW hpi(f/b)	CD	2.0E-05	3.3E-02
55 LOOP -rt/loop emerg.power afw/emerg.power	CD	5.8E-06	4.1E-02
54 LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall - SEAL.LOCA EP.REC	CD	4.9E-06	1.2E-01
44 LOOP -rt/loop -emerg.power AFW -hpi(f/b) hpr/-hpi	CD	2.2E-06	3.9E-02
53 LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall SEAL.LOCA EP.REC(SL)	CD	1.3E-06	1.2E-01

\*\* non-recovery credit for edited case

#### SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
44 LOOP -rt/loop -emerg.power AFW -hpi(f/b) hpr/-hpi	CD	2.2E-06	3.9E-02
45 LOOP -rt/loop -emerg.power AFW hpi(f/b)	CD	2.0E-05	3.3E-02
53 LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall SEAL.LOCA EP.REC(SL)	CD	1.3E-06	1.2E-01
54 LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall - SEAL.LOCA EP.REC	CD	4.9E-06	1.2E-01
55 LOOP -rt/loop emerg.power afw/emerg.power	CD	5.8E-06	4.1E-02

\*\* non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\pwrseal.cmp  
 BRANCH MODEL: c:\asp\1989\crystal3.sll  
 PROBABILITY FILE: c:\asp\1989\pwr\_bsll.pro

No Recovery Limit

#### BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	3.9E-04	1.0E+00	
LOOP	1.8E-05 > 1.8E-05	3.3E-01 > 1.5E-01	
Branch Model: INITOR			

Event Identifier: 302/89-023

# B-74

Initiator Freq:	1.8E-05		
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 > 5.0E-02	2.6E-01	
Branch Model: 1.OF.2+ser			
Train 1 Cond Prob:	2.0E-02 > Failed		
Train 2 Cond Prob:	5.0E-02		
Serial Component Prob:	2.8E-04		
afw/emerg.power	5.0E-02	3.4E-01	
mfw	2.0E-01	3.4E-01	
porv.or.srv.chall	8.0E-02	1.0E+00	
porv.or.srv.reseat	1.0E-02	1.1E-02	
porv.or.srv.reseat/emerg.power	1.0E-02	1.0E+00	
SEAL,LOCA	6.0E-02 > 1.5E-02	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	6.0E-02 > 1.5E-02		
EP.REC(SL)	7.6E-01 > 2.8E-01	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	7.6E-01 > 2.8E-01		
EP.REC	3.1E-01 > 1.6E-02	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	3.1E-01 > 1.6E-02		
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
* branch model file			
** forced			

Minarick  
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