

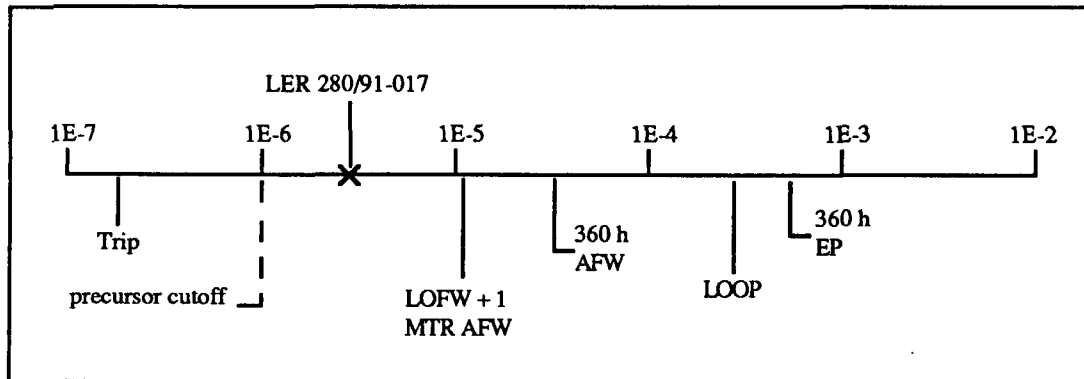
ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 280/91-017
 Event Description: Both emergency diesel generators for Unit 2 inoperable for 13 h
 Date of Event: July 15, 1991
 Plant: Surry 2

Summary

Both emergency diesel generators (EDGs) were inadvertently out of service at Surry 2 for 13 h. EDG 3, the dual-unit swing diesel, had been unavailable since May 7, 1991, because of inadequate post-maintenance testing. EDG 2 was removed from service for 13 h on July 15, 1991.

The conditional probability of core damage estimated for this event is 2.9×10^{-6} . The relative significance of the event compared to other postulated events at Surry 2 is shown below.



Event Description

On August 9, 1991, with Unit 1 and Unit 2 at 100% power, it was discovered that EDG 3 had been inoperable since May 9, 1991. The discovery was made while investigating the cause for EDG 3 failing to achieve rated speed during a Unit 2 engineered safeguards features actuation on August 2, 1991. This safety injection/reactor trip occurred as a result of vital bus power oscillations on one channel and a failed steam generator (SG) pressure transmitter on another channel. During this event, EDG 3 achieved a speed of approximately 835 rpm, which is below the 870 rpm permissive needed to allow the output breaker to close. Therefore, operator action would have been required to bring EDG 3 up to speed should it have been necessary for the EDG to supply power to its emergency bus.

The failure of EDG 3 was due to previous maintenance that began on May 7, 1991, during which a

replacement governor was installed. Adjustments were made to the governor to correct observed problems, but these adjustments rendered EDG 3 incapable of achieving rated speed when called upon to respond to a fast start signal. The required post-maintenance testing had not been performed on May 9, 1991, to verify proper response of EDG 3 to a fast start. Such testing would have detected the failure.

EDG 2 was inoperable (reason unknown) for approximately 13 h on July 15, 1991. Therefore, no EDGs were available for Unit 2 for 13 h on July 15, 1991. Since it was not known that EDG 3 was inoperable from May 9, 1991, EDGs 1 and 2 (the dedicated diesels for Units 1 and 2, respectively) were not tested daily, nor were the units placed in cold shutdown within the Technical Specification-required 7-d period.

Additional Event-Related Information

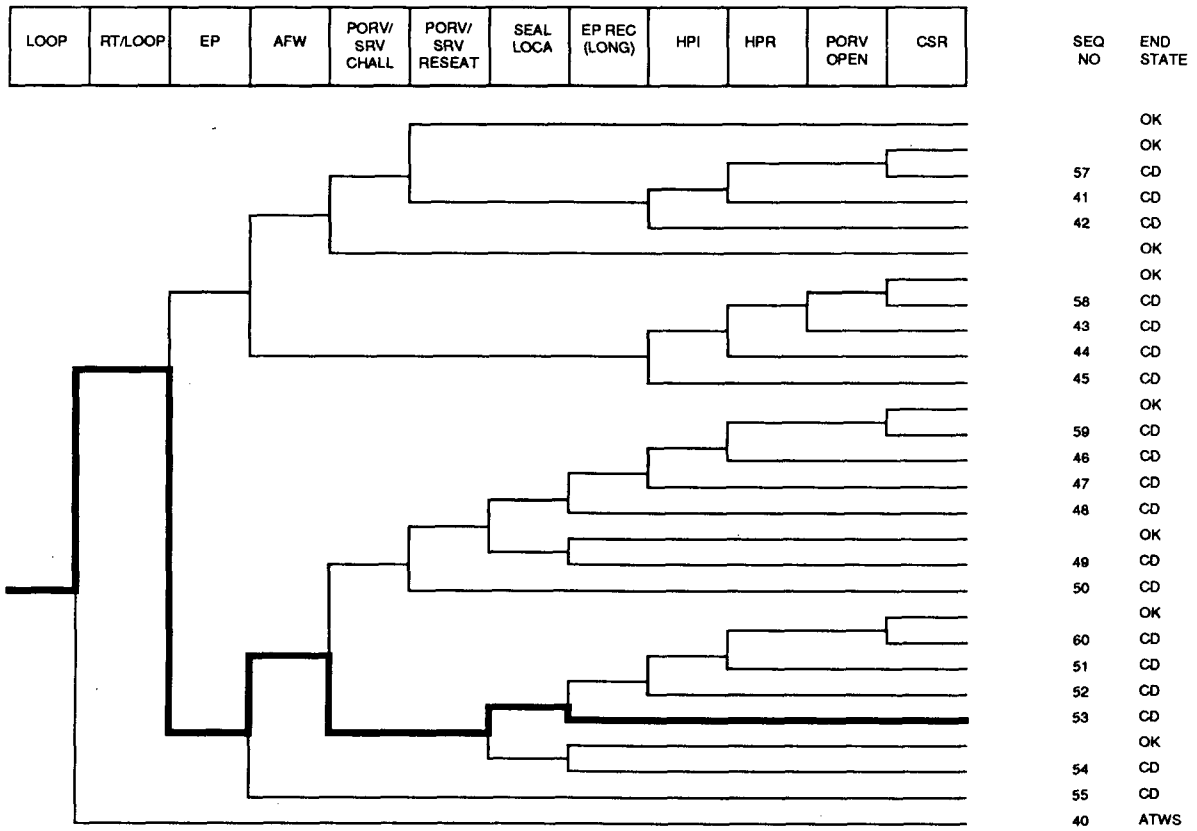
The emergency power system for Surry consists of three EDGs for the two units. EDG 1 is dedicated to Unit 1, EDG 2 is dedicated to Unit 2, and EDG 3 is a "swing" diesel that serves as a backup for either Unit 1 or Unit 2. Each EDG has 100% capacity and is connected to independent 4.16-kV emergency buses. Each unit has two emergency buses, "H" and "J", and the "H" bus for each unit is connected to its exclusive EDG. The "J" bus of the affected unit would be supplied by EDG 3.

ASP Modeling Assumptions and Approach

The event has been modeled as a potentially recoverable unavailability of emergency power for 13 h. A nonrecovery probability of 0.12 was utilized. This reflects the potential for recovery from the control room under burdened conditions following a blackout (LER 280/91-018 reports a similar incorrectly set governor for Unit 2, which was adjusted from the control room).

Analysis Results

The conditional probability of subsequent core damage estimated for this event is 2.9×10^{-6} . The dominant core damage sequence, highlighted on the following event tree, involves a postulated loss of offsite power (LOOP) with failure of emergency power, successful auxiliary feedwater (AFW) initiation, a reactor coolant pump seal loss-of-coolant accident (LOCA), and failure to recover AC power before core uncover.



Dominant core damage sequence for LER 280/91-017

B-150

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 280/91-017
 Event Description: Both EDGs for Unit 2 inoperable for 13 h
 Event Date: 05/09/91
 Plant: Surry 2

UNAVAILABILITY, DURATION= 13

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP 1.1E-04

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
LOOP	2.9E-06
Total	2.9E-06
ATWS	
LOOP	0.0E+00
Total	0.0E+00

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
53	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.locs ep.rec(sl)	CD	1.9E-06	6.3E-02
54	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall - seal.locs ep.rec	CD	6.4E-07	6.3E-02
55	loop -rt/loop EMERG.POWER afw/emerg.power	CD	2.2E-07	2.2E-02
48	loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.locs ep.rec(sl)	CD	7.8E-08	6.3E-02

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
48	loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.locs ep.rec(sl)	CD	7.8E-08	6.3E-02
53	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.locs ep.rec(sl)	CD	1.9E-06	6.3E-02
54	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall - seal.locs ep.rec	CD	6.4E-07	6.3E-02
55	loop -rt/loop EMERG.POWER afw/emerg.power	CD	2.2E-07	2.2E-02

** non-recovery credit for edited case

Note: For unavailabilities, conditional probability values are differential values which reflect the added risk due to failures associated with an event. Parenthetical values indicate a reduction in risk compared to a similar period without the existing failures.

Event Identifier: 280/91-017

SEQUENCE MODEL: c:\asp\1989\pwrseal.cmp
 BRANCH MODEL: c:\asp\1989\surry2.sl1
 PROBABILITY FILE: c:\asp\1989\pwr_bs11.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	8.6E-05	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 > 1.0E+00	8.0E-01 > 1.2E-01	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	5.0E-02 > Failed		
Train 2 Cond Prob:	5.7E-02 > Unavailable		
afw	3.8E-04	2.6E-01	
afw/emerg.power	5.0E-02	3.4E-01	
mfw	1.9E-01	3.4E-01	
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	1.5E-03	8.4E-01	
hpi(f/b)	1.5E-03	8.4E-01	1.0E-02
porv.open	1.0E-02	1.0E+00	4.0E-04
hpr/-hpi	1.5E-04	1.0E+00	1.0E-03
csr	9.3E-05	1.0E+00	
* branch model file			
** forced			

Minarick
 06-08-1992
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Event Identifier: 280/91-017