

B.32-1

B.32 LER Nos. 327/83-183 and -186

Event Description: Unavailability of One Emergency Diesel Generator and the Turbine-Driven Auxiliary Feedwater Pump

Date of Event: December 2, 1983

Plant: Sequoyah 1

B.32.1 Summary

Emergency diesel generator (EDG) 1A-A tripped due to high crankcase pressure during surveillance testing. The diesel suffered extensive damage which was determined to be due to incorrect assembly. Ten days earlier, stroke testing of the turbine-driven auxiliary feedwater (TDAFW) pump revealed that the steam supply valve was inoperable because of a failed Limatorque operator-gear limit switch. The estimated increase in core damage probability, or importance, over the duration of the event is 3.1×10^{-5} . The base-case core damage probability (CDP) over the duration of the event is 1.6×10^{-6} , resulting in an estimated conditional core damage probability (CCDP) of 3.3×10^{-5} .

B.32.2 Event Description

During performance of surveillance testing of emergency diesel generator 1A-A on December 12, 1983, it tripped due to high crankcase pressure. Unit 1 was operating at 100% power at the time of the event. Investigation of the failure revealed significant damage to the diesel, which resulted from improper torquing of the wrist pin bolts on one cylinder. The EDG was repaired and returned to service on December 12, 1983. This event was reported under LER 327/83-186. On December 2, 1983, with Unit 1 at 0% power, stroke testing of the turbine-driven auxiliary feedwater pump revealed that the steam supply valve was inoperable. The cause was a failed limitorque operator-gear limit switch. The switch was replaced and the valve was verified operable on December 12, 1983. This event was reported under LER 327/83-183.

B.32.3 Additional Event-Related Information

LER 327/83-183 states that the steam supply valve could have been in a failed condition during power operation. EDG 1A-A is one of two diesel generators that provide emergency power to Unit 1.

B.32.4 Modelling Assumptions

These events are modeled as a combined unavailability of one EDG and the TDAFW pump. Since steam supply valve 1-FCV-1-18 was found to be failed on December 2, 1983, it was assumed that it was failed on November 17, 1983, 15 days after the last pump test one month earlier. On December 12, 1983, EDG 1A-A was found to be failed. Given the fact that the failure was due to incorrect assembly, it was assumed that it would have been unavailable since the last test one month earlier on November 11, 1983. Therefore, both

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systems would have been unavailable from November 17, 1983 until December 12, 1983 when the EDG was the first of the two systems to be returned to service. This unavailability period of 25 days (600 hours) was reduced to 168 hours to reflect the fact that the unit tripped on November 24, 1983. With EDG 1A-A inoperable, train 2 of the emergency power system model was failed to reflect the assumption that EDG 1B-B would not be likely to fail due to the same cause since, according to LER 327/83-186, a similar failure had not occurred in a factory-assembled unit since 1979. In the AFW model, train 3, which represents the TDP, was failed. The single train in the AFW/EP model represents the TDP, so it was also failed. Trains 1 and 2 represent the two motor-driven pumps (MDPs). Since one MDP would be unavailable due to the failure of EDG 1A-A, train 2 was set to unavailable, making train 1 only susceptible to independent (random) failures. Similarly, the high-pressure injection (HPI) and high-pressure recirculation (HPR) system models were modified by setting train 2 to unavailable due to the loss of EDG 1A-A. Since train 3 of the HPI model represents the two charging pumps, which have a 2 of 2 success criteria, the failure probability was also set to unavailable. Feed-and-bleed operations use the HPI system. Therefore, the modifications made to the HPI model were also made to the FEED.BLEED model. A loss of offsite power (LOOP) was used as the potential initiator for the unavailability analysis.

B.32.5 Analysis Results

The estimated increase in core damage probability over the duration of the event is 3.1×10^{-5} . The base-case CDP (not shown in calculation) is 1.6×10^{-6} , resulting in an estimated CCDP of 3.3×10^{-5} . The dominant core damage sequence, shown in Figure B.32.1, involves a postulated LOOP, failure of emergency power, and loss of AFW.

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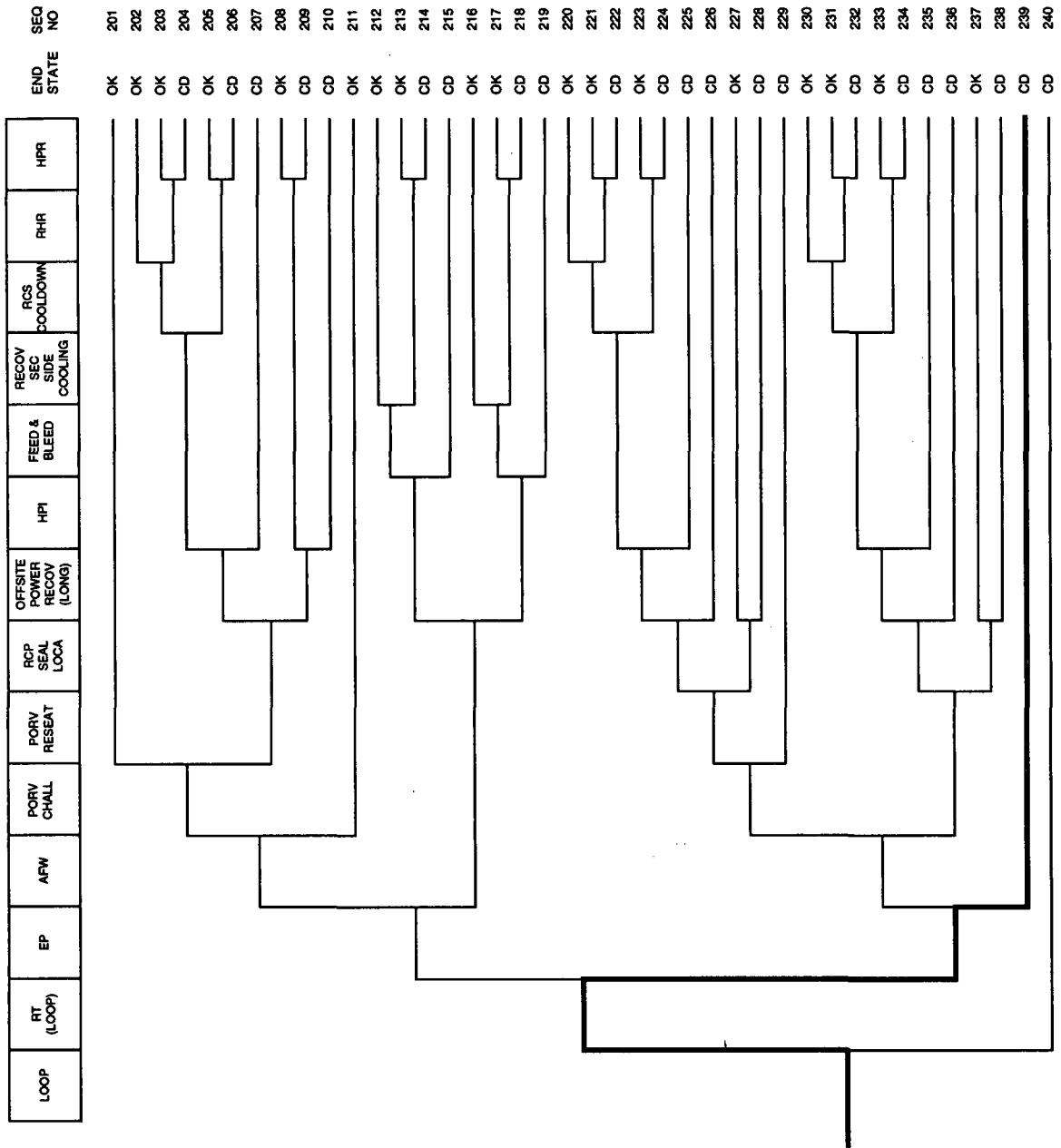


Figure B.32.1 Dominant core damage sequence for LER Nos. 327/83-183 and -186

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 327/83-183 and -186
 Event Description: EDG trips during test, valve on TDAFW pump fails test
 Event Date: December 2, 1983
 Plant: Sequoyah 1

UNAVAILABILITY DURATION= 168
 NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP 1.5E-03

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
LOOP	3.1E-05
Total	3.1E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
239 loop -rt(loop) EP AFW/EP	CD	2.2E-05	1.6E-01
226 loop -rt(loop) EP -AFW/EP porv.chall/sbo -porv.reseat/ep seal .loca offsite.pwr.rec/seal.loca	CD	5.9E-06	3.1E-01
228 loop -rt(loop) EP -AFW/EP porv.chall/sbo -porv.reseat/ep -seal .loca offsite.pwr.rec/-seal.loca	CD	2.0E-06	3.1E-01
229 loop -rt(loop) EP -AFW/EP porv.chall/sbo porv.reseat/ep	CD	7.8E-07	3.1E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
226 loop -rt(loop) EP -AFW/EP porv.chall/sbo -porv.reseat/ep seal .loca offsite.pwr.rec/seal.loca	CD	5.9E-06	3.1E-01
228 loop -rt(loop) EP -AFW/EP porv.chall/sbo -porv.reseat/ep -seal .loca offsite.pwr.rec/-seal.loca	CD	2.0E-06	3.1E-01
229 loop -rt(loop) EP -AFW/EP porv.chall/sbo porv.reseat/ep	CD	7.8E-07	3.1E-01
239 loop -rt(loop) EP AFW/EP	CD	2.2E-05	1.6E-01

** 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.

SEQUENCE MODEL: c:\asp\1982-83\pwr8283.cmp
 BRANCH MODEL: c:\asp\1982-83\sequoy1.82
 PROBABILITY FILE: c:\asp\1982-83\pwr8283.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

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Branch	System	Non-Recov	Opr Fail
trans	1.6E-03	1.0E+00	
loop	1.6E-05	5.3E-01	
loca	2.4E-06	5.4E-01	
sgtr	1.6E-06	1.0E+00	
rt	2.8E-04	1.0E-01	
rt(loop)	0.0E+00	1.0E+00	
AFW	3.8E-04 > 2.0E-02	4.5E-01	
Branch Model: 1.0F.3+ser			
Train 1 Cond Prob:	2.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Train 3 Cond Prob:	5.0E-02 > Failed		
Serial Component Prob:	2.8E-04		
afw/atws	4.3E-03	1.0E+00	
AFW/EP	5.0E-02 > 1.0E+00	3.4E-01	
Branch Model: 1.0F.1			
Train 1 Cond Prob:	5.0E-02 > Failed		
mfw	2.0E-01	3.4E-01	1.0E-03
porv.chall	4.0E-02	1.0E+00	
porv.chall/afw	1.0E+00	1.0E+00	
porv.chall/loop	1.0E-01	1.0E+00	
porv.chall/sbo	1.0E+00	1.0E+00	
PORV.RESEAT	2.0E-02 > 2.0E-02	1.1E-02 > 5.0E-01	
Branch Model: 1.0F.1			
Train 1 Cond Prob:	2.0E-02		
porv.reseat/ep	2.0E-02	1.0E+00	
srv.reseat(atws)	1.0E-01	1.0E+00	
HPI	1.0E-05 > 1.0E-02	8.9E-01	
Branch Model: 1.0F.3			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Train 3 Cond Prob:	1.0E-02 > Unavailable		
FEED.BLEED	2.0E-02 > 3.0E-02	1.0E+00	1.0E-02
Branch Model: 1.0F.3+ser+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Train 3 Cond Prob:	1.0E-02 > Unavailable		
Serial Component Prob:	2.0E-02		
emrg.boration	0.0E+00	1.0E+00	1.0E-02
recov.sec.cool	2.0E-01	1.0E+00	
recov.sec.cool/offsite.pwr	3.4E-01	1.0E+00	
rsc.cooldown	3.0E-03	1.0E+00	1.0E-03
RHR	2.2E-02 > 1.0E+00	5.7E-02	1.0E-03
Branch Model: 1.0F.2+ser+opr			
Train 1 Cond Prob:	2.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Serial Component Prob:	2.0E-02 > 1.0E+00		
RHR.AND.HPR	1.0E-03 > 1.0E-02	1.0E+00	1.0E-03
Branch Model: 1.0F.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
HPR	4.0E-03 > 4.0E-02	1.0E+00	1.0E-03
Branch Model: 1.0F.2+opr			
Train 1 Cond Prob:	4.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
EP	2.9E-03 > 5.0E-02	8.9E-01	
Branch Model: 1.0F.2			
Train 1 Cond Prob:	5.0E-02		
Train 2 Cond Prob:	5.7E-02 > Failed		

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seal.loca	2.7E-01	1.0E+00	
offsite.pwr.rec/-ep.and.-afw	2.2E-01	1.0E+00	
offsite.pwr.rec/-ep.and.afw	6.7E-02	1.0E+00	
offsite.pwr.rec/seal.loca	5.7E-01	1.0E+00	
offsite.pwr.rec/-seal.loca	7.0E-02	1.0E+00	
sg.iso.and.rcs.cooldown	1.0E-02	1.0E-01	
rsc.cool.below.rhr	3.0E-03	1.0E+00	3.0E-03
prim.press.limited	8.8E-03	1.0E+00	

* branch model file
** forced