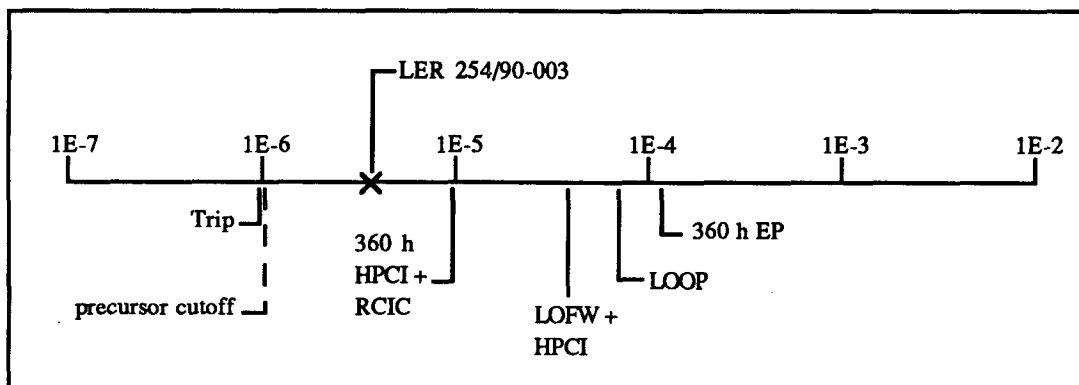


## ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No.: 254/90-003  
 Event Description: Two EDGs out of service  
 Date of Event: February 13, 1990  
 Plant: Quad Cities 1

### Summary

Both Quad Cities 1 emergency diesel generators (EDGs) were inoperable for approximately 25 h while the plant was operating at 99% power on February 13, 1990. The "swing" EDG, #1/2, was out of service for scheduled maintenance, and the other EDG, #1, failed its second daily Technical Specification required operability test. The conditional core damage probability estimated for this event is  $3.7 \times 10^{-6}$ . The relative significance of this event compared to other postulated events at Quad Cities 1 is shown below.



### Event Description

On February 12, 1990, EDG #1/2 was taken out of service for scheduled maintenance while the plant was at nearly 100% power. When an EDG is repaired with the plant at power, Technical Specifications require the other source of emergency power for the plant, in this case EDG #1, to be demonstrated operable every day. The first demonstration at 2145 h on February 12, 1990, was successful; however, during the second test at 1945 h on the following day, EDG #1 tripped on overspeed. A second demonstration was attempted about 45 min later, but the EDG tripped again on overspeed. The operator then went to "lower" on the governor adjustment switch, and a third demonstration was tried. This time the EDG started and was subsequently run for

2 h, at which time the EDG control switch was placed in automatic. EDG #1 was then declared operable. There were no component failures nor was any other safety system unavailable during this time. The elapsed time from the first overspeed trip until the EDG control switch was placed in automatic was 3.2 h. Note that this time includes a 2-h demonstration run.

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

Quad Cities 1 has two EDGs available for emergency loads. EDG #1 is used only by Unit 1; however, EDG #1/2 is designated a “swing” emergency power source and is capable of supplying emergency loads for either Unit 1 or Unit 2. Quad Cities 1 has two systems of 4.16-kV auxiliary buses consisting of three buses each. EDG #1 supplies emergency power for one bus in one system while EDG #1/2 supplies emergency power for one bus in the other system. Additionally, EDG #1/2 can supply emergency power to another bus in a similar system for Quad Cities 2.

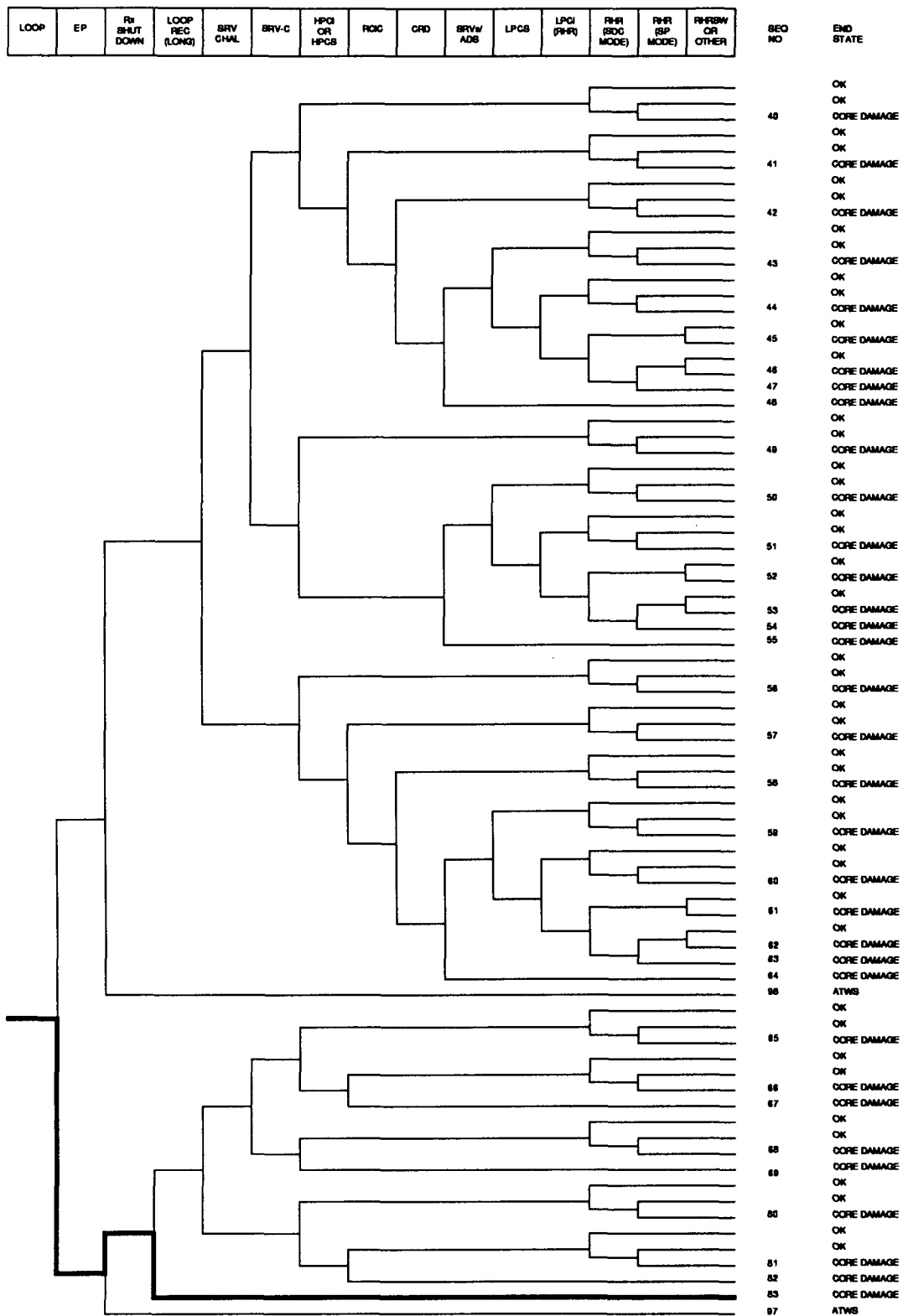
Quad Cities 1 has two independent sources of offsite power. Normally, five separate sources of 345-kV power feed the reserve auxiliary transformer (RAT-12) via a ring bus in the switchyard, which in turn feeds 4.16-kV buses 12 and 14. Bus 14 supplies 4.16-kV vital bus 14-1. Alternatively, five sources of 345-kV power supply the 4.16-kV Unit 2 vital bus 24-1 via the Unit 2 RAT-22, which in turn is cross-tied with bus 14-1. The emergency supply for bus 14-1 is EDG #1. The other Quad Cities 1 vital 4.16-kV bus, 13-1, is supplied by bus 13, which along with bus 11, is supplied by the Quad Cities 1 main generator via the unit auxiliary transformer (UAT-11). The common Unit 1 and Unit 2 EDG (EDG #1/2 or swing EDG) provides emergency backup power to bus 13-1. With this arrangement, the auxiliary power for Unit 1 is supplied by UAT-11 and RAT-12 with the loads equally divided between them.

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

This event has been modeled with both the EDGs unavailable for 25.2 h and with a nonrecovery probability of 0.34. This 25.2-h period includes 22 h from the end of the first (successful) demonstration run until the attempted second run on the next day, plus 3.2 h for adjustments and a 2-h demonstration run. This time period assumes the overspeed trip switch adjustment failed during the previous successful test. If, instead, it failed over time (a standby stress-related failure), the exposure time associated with the event would be 14.2 h, and the overall event significance would be approximately 60% of that calculated herein. Had a loss of offsite power (LOOP) occurred during the demonstration run prior to returning the EDG to service, it is also possible that the EDG could have powered required loads through manual operator action.

**Analysis Results**

The conditional probability of severe core damage for this event is  $3.7 \times 10^{-6}$ . The dominant sequence associated with the event (highlighted on the following event tree), involves a postulated loss of offsite power with failure to recover emergency power and failure to recover offsite power prior to battery depletion.



Dominant Core Damage Sequences for LER 254/90-003

## CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 254/90-003  
 Event Description: Two EDGs out of service  
 Event Date: 02/13/90  
 Plant: Quad Cities 1

UNAVAILABILITY, DURATION= 25.2

## NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP 2.2E-04

## SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
LOOP	3.7E-06
Total	3.7E-06
ATWS	
LOOP	0.0E+00
Total	0.0E+00

## SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
83 loop EMERG.POWER -rx.shutdown/ep ep.rec	CD	3.6E-06	1.8E-01
97 loop EMERG.POWER rx.shutdown	ATWS	2.2E-09	1.8E-01
98 loop -EMERG.POWER rx.shutdown	ATWS	( 2.2E-09 )	3.5E-01

\*\* non-recovery credit for edited case

## SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
98 loop -EMERG.POWER rx.shutdown	ATWS	( 2.2E-09 )	3.5E-01
83 loop EMERG.POWER -rx.shutdown/ep ep.rec	CD	3.6E-06	1.8E-01
97 loop EMERG.POWER rx.shutdown	ATWS	2.2E-09	1.8E-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\1989\bwr\_cseal.cmp  
 BRANCH MODEL: c:\asp\1989\quadcit1.sll  
 PROBABILITY FILE: c:\asp\1989\bwr\_csll.pro

No Recovery Limit

## BRANCH FREQUENCIES/PROBABILITIES

Event Identifier: 254/90-003

# B-148

Branch	System	Non-Recov	Opr Fail
trans	1.4E-04	1.0E+00	
loop	1.6E-05	5.3E-01	
loca	3.3E-06	5.0E-01	
rx.shutdown	3.0E-05	1.0E+00	
rx.shutdown/ep	3.5E-04	1.0E+00	
pcs/trans	1.7E-01	1.0E+00	
srv.chall/trans.-scram	1.0E+00	1.0E+00	
srv.chall/loop.-scram	1.0E+00	1.0E+00	
srv.close	1.0E-02	1.0E+00	
EMERG.POWER	2.9E-03 > 1.0E+00	8.0E-01 > 3.4E-01	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	5.0E-02 > Unavailable		
Train 2 Cond Prob:	5.7E-02 > Failed		
ep.rec	4.9E-02	1.0E+00	
fw/pcs.trans	2.9E-01	3.4E-01	
fw/pcs.loca	4.0E-02	3.4E-01	
hpci	2.9E-02	7.0E-01	
rcic	6.0E-02	7.0E-01	
crd	1.0E-02	1.0E+00	1.0E-02
srv.ads	3.7E-03	7.1E-01	1.0E-02
lpcs	3.0E-03	3.4E-01	
lpci(rhr)/lpcs	1.0E-03	7.1E-01	
rhr(sdc)	2.1E-02	3.4E-01	1.0E-03
rhr(sdc)/-lpci	2.0E-02	3.4E-01	1.0E-03
rhr(sdc)/lpci	1.0E+00	1.0E+00	1.0E-03
rhr(spcool)/rhr(sdc)	2.0E-03	3.4E-01	
rhr(spcool)/-lpci.rhr(sdc)	2.0E-03	3.4E-01	
rhr(spcool)/lpci.rhr(sdc)	9.3E-02	1.0E+00	
rhrsw	2.0E-02	3.4E-01	2.0E-03
* branch model file			
** forced			

Minarick  
08-06-1991  
17:31:26