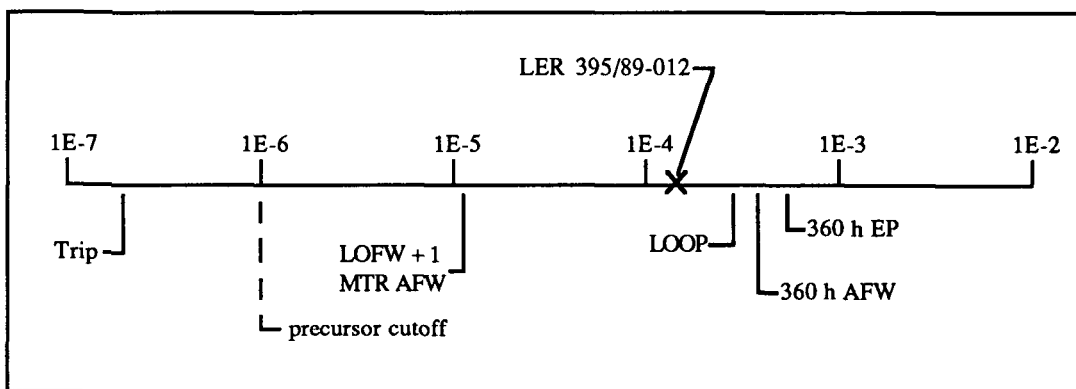


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 395/89-012
 Event Description: Reactor trip causes trip of 3 other stations and an effective loss of offsite power
 Date of Event: July 11, 1989
 Plant: Summer 1

Summary

A loss of offsite power (LOOP) was initiated at Summer following a reactor trip that was caused by a main turbine trip from 100% power. The LOOP occurred when Summer tripped and caused three other generating stations to trip also. The loss of the four generating stations degraded the vital bus voltage to the point that the diesel generators started and sequenced on vital loads. The conditional core damage probability estimated for this event is 1.5×10^{-4} . The relative significance of this event compared with other postulated events at Summer is shown below.



Event Description

On July 11, 1989, Summer was operating at 100% of rated power. An electrical technician accidentally shorted the leads on a temperature converter in the "Generator Stator Cooling Water" cabinet. This blew an AC power fuse that, in turn, caused a loss of indication. Normally, if left unattended, this would run back the main generator to about 25% load; however, a turbine runback relay failed, and the generator remained above 80% load with a loss of stator water cooling indicated. Several minutes later the turbine automatically tripped. This initiated a reactor trip since power was greater than 50%. When Summer tripped, it had an unusually high reactive load. This, plus the high grid

load and extremely sensitive settings on other plants' generator backup relays, caused three other generating stations to trip off also. This large perturbation on the grid caused a degraded grid voltage condition that lasted long enough to automatically start the diesel generators, shed ESF bus loads, and sequence on vital loads to the ESF buses supplied by the EDG. The diesel generators powered the ESF buses for 1 h and 35 min. At that time, normal power to the ESF buses was restored.

Additional Event-Related Information

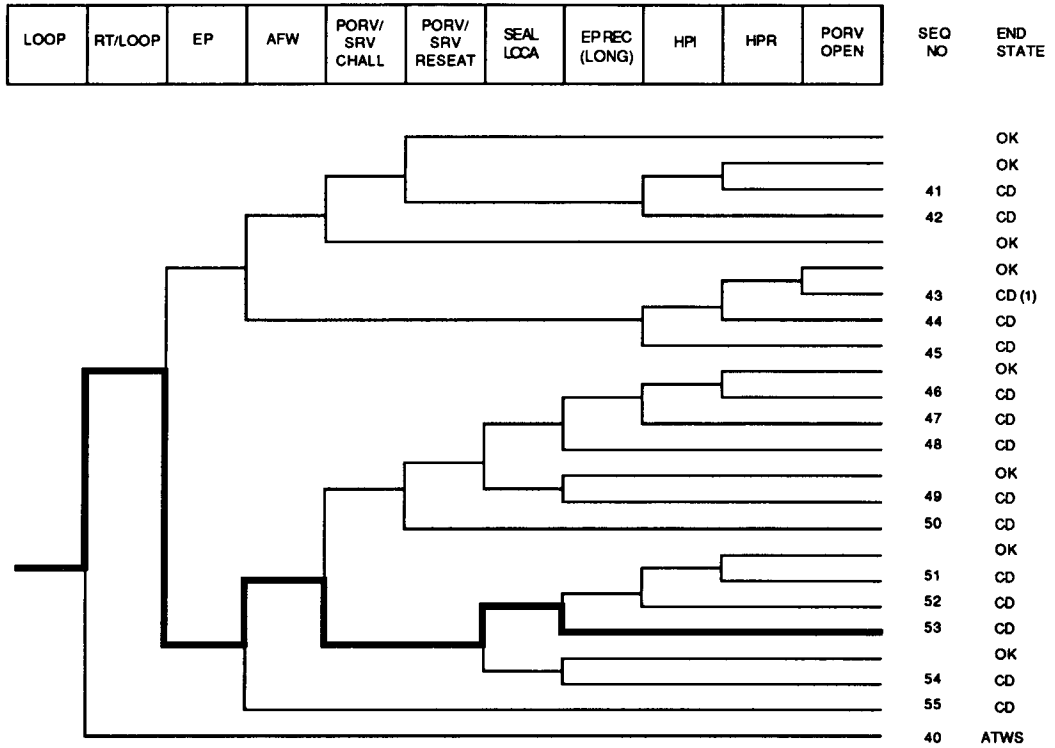
Summer's normal offsite source of power to the ESF 7200-V Bus A is from the Unit ESF transformers (two in parallel) supplied by the 115-kV switchyard. Alternate offsite power to this bus is from the 230-kV switchyard, stepped down through the emergency auxiliary transformer (EAT). In the event that all other sources of power are lost, emergency power to the bus is from EDG A. Summer's normal offsite source of power to the ESF 7200-V bus B is from the 230-kV switchyard, stepped down through the EAT. Alternate offsite power to this bus is from the Unit ESF transformers supplied by the 115-kV switchyard. In the event that all other sources of power are lost, emergency power to the bus is from EDG B. Note that the ESF buses A and B are supplied from offsite and never from the main generator. In this event, when the plant tripped and the other stations were lost, normal and alternate power supply to the buses was lost; however, the grid was still supplying power to the buses but at a reduced voltage. The diesel generators have an autostart signal when a reduced bus voltage is sensed for a fixed period of time; thus, when the timer ran out, as in this case, the diesels started and assumed their respective loads.

ASP Modeling Assumptions and Approach

This event has been modeled as a grid-related loss of offsite power.

Analysis Results

The conditional probability of severe core damage estimated for this event is 1.5×10^{-4} . The dominant sequence associated with the event involves station blackout: failure to recover offsite power in the short term ($p = 0.48$), failure of emergency power ($p = 2.3 \times 10^{-3}$), a subsequent RCP seal LOCA ($p = 0.21$) prior to restoration of AC power, and failure to recover AC power ($p = 0.45$) prior to core uncover due to the seal LOCA. This sequence is highlighted on the following event tree.



(1) OK for Class D

Dominant core damage sequence for LER 395/89-012

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 395/89-012
 Event Description: Reactor trip causes effective loss of offsite power
 Event Date: 07/11/89
 Plant: Summer 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP 4.8E-01

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
LOOP	1.5E-04
Total	1.5E-04
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.LOCA EP.REC(SL)	CD	9.8E-05	3.8E-01
54	LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall - SEAL.LOCA EP.REC	CD	2.7E-05	3.8E-01
55	LOOP -rt/loop emerg.power afw/emerg.power	CD	1.9E-05	1.3E-01
48	LOOP -rt/loop emerg.power -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power SEAL.LOCA EP.REC(SL)	CD	3.9E-06	3.8E-01

** 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.LOCA EP.REC(SL)	CD	3.9E-06	3.8E-01
53	LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall SEAL.LOCA EP.REC(SL)	CD	9.8E-05	3.8E-01
54	LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall - SEAL.LOCA EP.REC	CD	2.7E-05	3.8E-01
55	LOOP -rt/loop emerg.power afw/emerg.power	CD	1.9E-05	1.3E-01

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\pwrseal.cmp
 BRANCH MODEL: c:\asp\1989\summer.sll
 PROBABILITY FILE: c:\asp\1989\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	5.9E-04	1.0E+00	
LOOP	1.6E-05 > 1.6E-05	5.3E-01 > 4.8E-01	
Branch Model: INITOR			

Event Identifier: 395/89-012

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Initiator Freq:	1.6E-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	3.8E-04	2.6E-01	
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 > 2.1E-01	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	2.7E-01 > 2.1E-01		
EP.REC(SL)	5.7E-01 > 4.5E-01	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	5.7E-01 > 4.5E-01		
EP.REC	7.0E-02 > 3.3E-02	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	7.0E-02 > 3.3E-02		
hpi	1.5E-03	8.4E-01	
hpi(f/b)	1.5E-03	8.4E-01	1.0E-02
hpr/-hpi	1.5E-04	1.0E+00	1.0E-03
porv.open	1.0E-02	1.0E+00	4.0E-04
* branch model file			
** forced			

Minarick
06-13-1990
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