## Accident Sequence Precursor Program Event Analysis

LER No: 456/88-022
Event Description: Loss of offsite power for approximately 2 h
Date of Event: October 16, 1988
Plant: Braidwood 1

Summary

A 2-h loss of offsite power occurred at Braidwood 1. Emergency power was provided as designed, and all other plant responses were as expected. The core damage probability associated with the event is estimated to be 1.8×10^{-4}. The relative significance of this event compared with other potential events at Braidwood 1 is shown below.
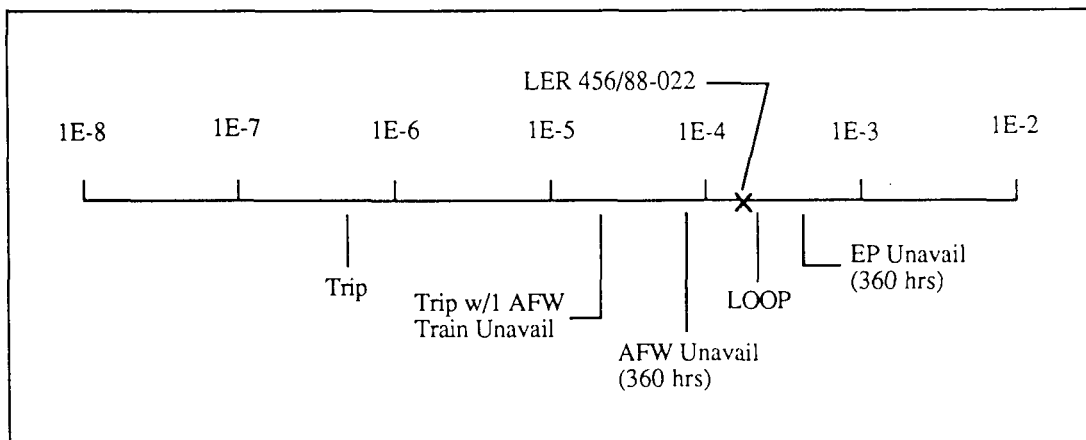
Event Description

The failure of the phase "A" potential transformer for 138-kV line 8604 at Davis Creek caused a current surge that resulted in an attempt to transfer to 138-kV line 2002. However, a breaker took longer to open than designed, which resulted in actuation of a pole disagreement relay, and the transfer was not completed. RCP 1C supply breaker tripped on instantaneous overcurrent, causing a reactor trip. This resulted in a loss of offsite power at Braidwood 1. Offsite power for unit 1 was lost for ~2 h. The emergency diesel generators started and loaded as designed. Unit 2 was powered by offsite power throughout this event.

The cause of the loss of line 2002 was due to a failure of the phase "A" potential transformer for 138-kV line 8604 at Davis Creek. This resulted in a current surge on the low side of transformer 83, which

caused its sudden pressure relay to actuate. This caused a transfer trip signal to be sent to the 345-kV breakers associated with line 2002 at both Braidwood Station and Davis Creek.

The cause of this loss of power to the station auxiliary transformers was improper time between opening for the different phase poles for 345-kV OCBs 4-7 and 7-8, which resulted in a pole disagreement actuation. This caused the local breaker backup system to open 345-kV ACB 3-4, which resulted in removing 345-kV power from the high side of station auxiliary transformers 142-1 and 142-2.

The cause of the reactor trip was the result of the 1C RCP supply breaker on 6.9-kV bus 158 tripping on instantaneous overcurrent. This was caused by a piece of cardboard inserted in the 1C RCP breaker instantaneous overcurrent relay, bypassing the 5-6 cycle time delay. It was suspected that the cardboard was inserted during the last maintenance on the relay as a relay block. This was considered by the utility to be a programmatic deficiency in that no mechanism existed to ensure that relay blocks were removed following maintenance activities. (Additional administrative controls on the use of relay blocks were subsequently issued.)

ASP Modeling Assumptions and Approach

The event has been modeled as a plant-centered loss of offsite power.

Analysis Results

The conditional probability of severe core damage estimated for this event is 1.8×10^{-4}. This event is considered significant from an ASP standpoint.

The dominant sequence (highlighted on the following event tree) involves a failure of emergency power ($p = 2.3 \times 10^{-3}$) following the LOOP (a station blackout), a subsequent seal failure ($p = 0.23$), and failure to recover AC power prior to core uncovery ($p = 0.48$).

LOOP	RT/LOOP	EP	AFW	PORV/ SRV CHALL	PORV/ SRV RESEAT	SEAL LOCA	EP REC (LONG)	HPI	HPR	PORV OPEN	SEQ NO	END STATE
												OK
												OK
											41	CD
											42	CD
												OK
												OK
											43	CD
											44	CD
											45	CD
												OK
											46	CD
											47	CD
											48	CD
												OK
											49	CD
											50	CD
												OK
											51	CD
											52	CD
											53	CD
												OK
											54	CD
											55	CD
											40	ATWS
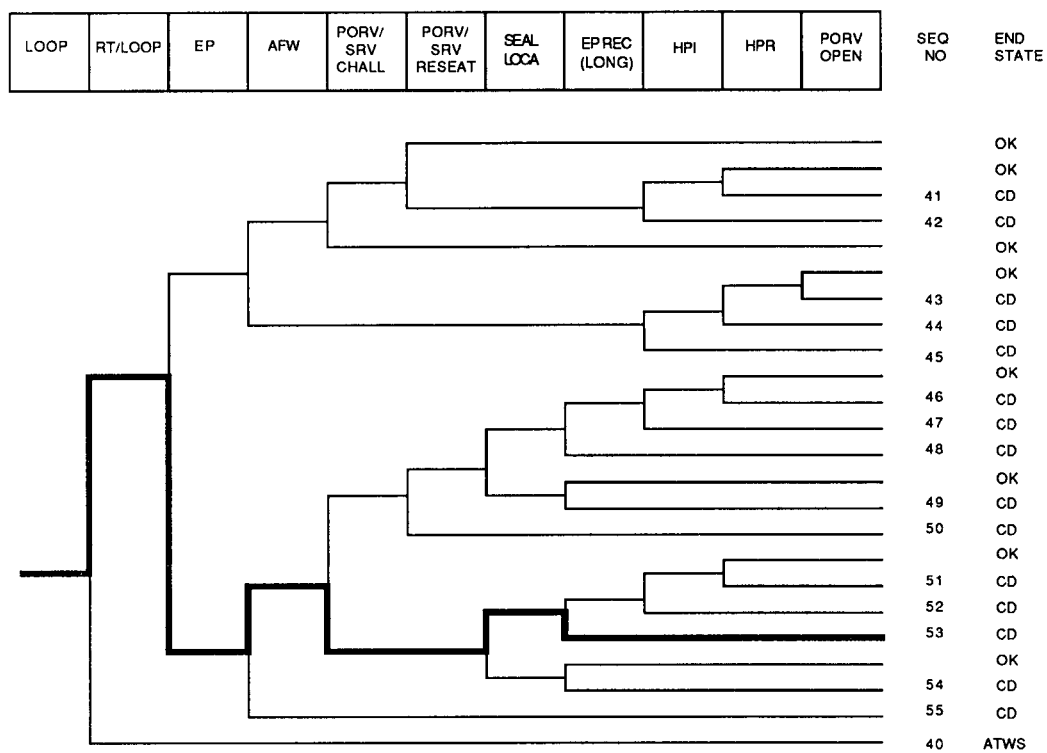
Dominant Core Damage Sequence for LER 456/88-022

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 456/88-022
Event Description: Loss of offsite power for approximately two hours.
Event Date: 10/16/88
Plant: Braidwood 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP   5.0E-01

SEQUENCE CONDITIONAL PROBABILITY SUMS

    End State/Initiator   Probability

CD

    LOOP   1.8E-04

    Total   1.8E-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	1.2E-04	4.0E-01
54	LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall - SEAL.LOCA EP.REC	CD	3.6E-05	4.0E-01
55	LOOP -rt/loop emerg.power afw/emerg.power	CD	1.9E-05	1.4E-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	4.8E-06	4.0E-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	4.8E-06	4.0E-01
53	LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall SEAL.LOCA EP.REC(SL)	CD	1.2E-04	4.0E-01
54	LOOP -rt/loop emerg.power -afw/emerg.power -porv.or.srv.chall - SEAL.LOCA EP.REC	CD	3.6E-05	4.0E-01
55	LOOP -rt/loop emerg.power afw/emerg.power	CD	1.9E-05	1.4E-01

** non-recovery credit for edited case

SEQUENCE MODEL: a:\sealmod\pwrbseal.cmp
BRANCH MODEL: a:\sealmod\braid.sll
PROBABILITY FILE: a:\sealmod\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	4.3E-04	1.0E+00	
LOOP	1.6E-05 > 1.6E-05	5.3E-01 > 5.0E-01	
Branch Model: INITOR			

Event Identifier: 456/88-022

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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                              1.3E-03            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               2.0E-02            1.1E-02
porv.or.srv.reseat/emerg.power   2.0E-02            1.0E+00
SEAL.LOCA                        2.7E-01 > 2.3E-01  1.0E+00
    Branch Model:  1.OF.1
    Train 1  Cond Prob:          2.7E-01 > 2.3E-01
EP.REC(SL)                       5.8E-01 > 4.8E-01  1.0E+00
    Branch Model:  1.OF.1
    Train 1  Cond Prob:          5.8E-01 > 4.8E-01
EP.REC                           1.8E-02 > 4.3E-02  1.0E+00
    Branch Model:  1.OF.1
    Train 1  Cond Prob:          1.8E-02 > 4.3E-02
hpi                              1.0E-03            8.4E-01
hpi(f/b)                         1.0E-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


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