PRECURSOR DESCRIPTION SHEET

LER No.: 261/86-005
Event Description: Bus failure causes a trip followed by a LOOP with a DG unavailability
Date of Event: January 28, 1986
Plant: Robinson 2

EVENT DESCRIPTION

Sequence

The plant was operating at ~80% power. EDG B had just been taken out of service to install a solid state overcurrent trip device on its output breaker. This breaker upgrade was being performed on all Westinghouse type DB safety-related breakers and had been completed on EDG A the week before. At 0917 h, the EDG B output breaker had just been "racked out" when emergency bus E-2 was lost as a result of a blown fuse. This also resulted in the loss of instrument bus 4 (IB-4), which is supplied by motor control center MCC-6. Nuclear instrumentation system power range channel N-44 (fed from IB-4) was lost, which initiated a turbine runback. The automatic-rod-control and steam-dump-control systems would not function properly. As a result, a reactor trip was received on "Hi Pressurizer Pressure" ~21 s after bus E-2 was lost.

One minute after the reactor trip, the main generator oil circuit breakers opened, and the plant auxiliaries (those powered by the auxiliary transformer during operation) shifted to the startup transformer as part of the normal turbine generator lockout feature. Approximately 1 s later, a west bus lockout occurred in the 115-kV switchyard; this deenergized the Unit 2 startup transformer, resulting in a loss of offsite ac power. EDG A started automatically and loaded emergency bus E-1. Approximately 67 s after the west bus lockout was received, an SI and MSIV signal were received. These were caused by high steam-line flow coincident with low Tave. The low Tave signal was caused by the plant cooldown as a result of the reactor trip. The high steam-line flow signal was present due to loss of bus IB-4. During the attempt to restore bus E-2, an operator accidentally disabled HPI train B.

At 1027 h power was restored to bus E-2 by manually starting and loading the B EDG.

At 1115 h after investigation, offsite ac power was restored to the plant's nonvital electrical distribution system.

At 1228 h, a second SI signal was received. It was caused by steam-line high differential pressure, which resulted when frozen sensing lines caused "C" SG's PORV to stick open. The "C" PORV was closed by isolating the air supply to the PORV.

Corrective Action

The investigations concluded that two major events (loss of emergency bus E-2 and the loss of offsite ac power) were separate and independent from one another. An extensive investigation of the EDG B output breaker, bus E-2 control cabinet, associated circuits, and wiring was performed. No unusual conditions were found that would have caused the blown fuse. Later, while in the process of energizing E-2 via E-1 (cross tie E-1 and E-2), degraded voltage relay actuation caused the E-2 normal supply breaker to trip open.

Plant/Event Data

Systems Involved: AFW, emergency power, HPI/recirculation, and LPI/recirculation

Components and Failure Modes Involved:
Diesel generator — unavailable due to maintenance

Component Unavailability Duration: NA
Plant Operating Mode: 1 (80% power)
Discovery Method: Operational event
Reactor Age: 15.4 years
Plant Type: PWR

Comments

None

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

LOOP	Base case	Normal recovery assumed

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Branches Impacted and Branch Nonrecovery Estimate

EPS	Base case	DG B out of service for repairs
HPI/HPR	Base case	Train B disabled by error
PI/LPR	Base case	Train B unavailable because DG B was unavailable
AFW	Base case	Motor train B unavailable because DG B was unavailable
SS release terminated	Base case	"C" PORV required local action to isolate the valve

Plant Models Utilized

PWR plant Class B

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

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Event Date: 1/28/86
Plant: Robinson 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP	3.9E-01

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CV	
LOOP	5.3E-03
Total	5.3E-03
CD	
LOOP	3.0E-04
Total	3.0E-04
ATWS	
LOOP	0.0E+00
Total	0.0E+00

DOMINANT SEQUENCES

End State: CV Conditional Probability: 5.0E-03

217 LOOP -RT/LOOP EMERG.POWER -AFW/EMERG.POWER -PORV.OR.SRV.CHALL SS.RELEAS.TERM

End State: CD Conditional Probability: 2.7E-04

218 LOOP -RT/LOOP EMERG.POWER AFW/EMERG.POWER

SEQUENCE CONDITIONAL PROBABILITIES

Event Identifier: 261/86-005

	Sequence	End State	Prob	N Rec**
215	LOOP -RT/LOOP EMERG.POWER -AFW/EMERG.POWER PORV.OR.SRV.CHALL -PORV.OR.SRV.RESEAT/EMERG.POWER SS.RELEAS.TERM	CV	2.0E-04	1.0E-01
216	LOOP -RT/LOOP EMERG.POWER -AFW/EMERG.POWER PORV.OR.SRV.CHALL PORV.OR.SRV.RESEAT/EMERG.POWER	CD	1.8E-05	3.1E-01
217	LOOP -RT/LOOP EMERG.POWER -AFW/EMERG.POWER -PORV.OR.SRV.CHALL SS.RELEAS.TERM	CV	5.0E-03 *	1.0E-01
218	LOOP -RT/LOOP EMERG.POWER AFW/EMERG.POWER	CD	2.7E-04 *	1.1E-01

* dominant sequence for end state
** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\newmodel\pwrbtree.cmp
BRANCH MODEL: c:\asp\newmodel\robinson.txt
PROBABILITY FILE: c:\asp\newmodel\pwr_b.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Dpr Fail
TRANS	4.8E-04	1.0E+00	
LOOP	4.6E-06	3.9E-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 > 5.0E-02	8.0E-01	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	5.0E-02		
Train 2 Cond Prob:	5.7E-02 > Unavailable		
AFW	3.8E-04 > 1.3E-03	2.6E-01	
Branch Model: 1.OF.3+ser			
Train 1 Cond Prob:	2.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Train 3 Cond Prob:	5.0E-02		
Serial Component Prob:	2.8E-04		
AFW/EMERG.POWER	5.0E-02	3.4E-01	
MFW	2.0E-01	3.4E-01	
PORV.OR.SRV.CHALL	4.0E-02	1.0E+00	
PORV.OR.SRV.RESEAT	3.0E-02	5.0E-02	
PORV.OR.SRV.RESEAT/EMERG.POWER	3.0E-02	1.0E+00	
SS.RELEAS.TERM	1.5E-02 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	1.5E-02 > Failed		
SS.RELEAS.TERM/-MFW	1.5E-02 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	1.5E-02 > Failed		

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HPI	1.0E-03 > 1.0E-02	8.4E-01	
Branch Model: 1.0F.2			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
HPI(F/B)	1.0E-03 > 1.0E-02	8.4E-01	4.0E-02
Branch Model: 1.0F.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
HPR/-HPI	1.5E-04	1.0E+00	4.0E-02
PORV.OPEN	1.0E-02	1.0E+00	
SS.DEPRESS	3.6E-02	1.0E+00	
COND/MFW	1.0E+00	3.4E-01	
LPI/HPI	1.5E-04 > 1.0E-02	3.4E-01	
Branch Model: 1.0F.2			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.5E-02 > Unavailable		
LPR/-HPI.HPR	6.7E-01	1.0E+00	
LPR/HPI	1.5E-04 > 1.0E-02	1.0E+00	
Branch Model: 1.0F.2			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.5E-02 > Unavailable		

* branch model file
** forced

Austin
09-11-1987
11:23:11

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