PRECURSOR DESCRIPTION SHEET

LER No.: 286/84-015
Event Description: LOOP with Both a DG Failure and an Unavailability
Date of Event: November 16, 1984
Plant: Indian Point 3

EVENT DESCRIPTION

Sequence

On November 16, 1984, the reactor was at cold shutdown for a scheduled maintenance and inspection outage. RCS temperature was ~115°F with RHR pump 32 providing core cooling. All plant electrical loads were being supplied from offsite 13.8-kV sources through the station auxiliary transformer (ST); 6.9-kV buses 5 and 6 were energized from the station auxiliary transformer via breakers ST-5 and ST-6. All other inservice 6.9-kV buses were energized via tie breakers to buses 5 and 6. EDG 31 was out of service for scheduled maintenance. SWPs 31 through 36 were out of service to provide protection for divers cleaning the suction to the pumps on the intake structure. SWPs 38 and 39 and CCW pumps 31 and 32 were operating.

At 1242 h on November 16, breakers ST-5 and ST-6 were tripped open via fault detection circuitry. A phase-to-phase fault had occurred as a piece of metal was blown onto the 138-kV primary-side A and B phase station auxiliary transformer buswork from an adjacent building roof. As breakers ST-5 and ST-6 opened, normal offsite power to the plant was lost. DGs 32 and 33 started automatically due to the undervoltage condition on their respective 480-V buses (6A and 5A) and achieved normal operating voltage. DG 33 successfully reenergized bus 5A, automatically starting CCW pump 31. The output breaker, 52-EG2, for DG 32 did not close, leaving bus 6A deenergized.

The control room operators closed breakers GT-35 and GT-36 at 1256 h to reenergize 6.9-kV buses 5 and 6 from the 13.8-kV offsite sources. Four-hundred-eighty-volt buses 2A and 3A were then manually energized via normal supply and tie breakers. RHR pump 31 was started manually to reestablish core cooling. Attempts to energize 480-V bus 6A by closing the station service transformer (SST) supply breaker SST-6 were unsuccessful due to an apparent loss of dc control power to the breaker. The operators then attempted to energize bus 6A from bus 3A by closing tie breaker 3AT6A. This breaker also failed to close. SW pump 38 was started manually to supply essential header cooling water. Both

operating DGs were secured because offsite power had been successfully restored. After replacing failed control fuses, breaker SST-6 was closed, reenergizing 480-V bus 6A. All equipment was then returned to original status with the exception that outside power was being supplied by the 13.8-kV source instead of the normal 138-kV source. RCS temperature increased ~3°F during the time RHR was interrupted.

The total time that power was unavailable to the RHR system was 14 min. Because the reactor had been in the cold shutdown condition for over a month and Tavg was significantly below the 200°F limit for cold shutdown at the time of the event, the plant operators voluntarily chose to proceed cautiously and deliberately in restoring power. This was in light of the amount of equipment out of service at the time.

Corrective Action

Investigation into the series of breaker failures associated with bus 6A has yielded the following results: (1) Breaker 52-EG2, the output breaker for DG 32, operated in accordance with design even though it did not close. Logic circuitry for the plant's electrical distribution system prevents any 480-V vital bus from being tied to two separate power supplies simultaneously. The bus 6A normal feed breaker, 52/6A, failed to open when offsite power was lost due to failed control power fuses. The logic circuitry therefore prevented breaker 52-EG2 from closing because two supply breakers to bus 6A would have been closed. (2) Breaker SST-6, the SST supply breaker for bus 6A, opened as required on the LOOP. The control power fuses for this breaker are believed to have failed the previous time that the breaker was closed. The operators were unable to close SST-6 until the fuses were replaced. (3) No cause for the failure of breaker 3A-6A was determined. The breaker worked properly the following day during testing.

On November 17, 1984, the events of the previous day were simulated to check the operation of all undervoltage associated equipment. As previously mentioned, new power supply fuses had been installed in breakers SST-6 and 52/6A. All equipment operated correctly. The roof from which the metal had fallen was inspected, and all remaining loose material was removed.

Plant/Event Data

Systems Involved:
Emergency power

Components and Failure Modes Involved:
One DG — unavailable due to routine maintenance

One DG breaker — could not close on demand (logic failure)

Event Identifier: 286/84-015

Component Unavailability Duration: 1 d (assumed)
Plant Operating Mode: 5 (0% power)
Discovery Method: Operational event
Reactor Age: 8.6 years
Plant Type: PWR

Comments

A bounding estimate was developed for this event. It assumes that the LOOP occurred while at power and that one DG was undergoing maintenance.

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

LOOP	Base case	

Branches Impacted and Branch Nonrecovery Estimate

Emergency power	Base case	Degraded, two of three DGs unavailable
AFW	Base case	Degraded, one train unavailable
HPI	Base case	Degraded, one train unavailable
HPR	Base case	Degraded, one train unavailable
LPI	Base case	Degraded, one train unavailable
LPR	Base case	Degraded, one train unavailable

Plant Models Utilized

PWR plant Class B

Event Identifier: 286/84-015

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 286/84-015
Event Description: LOOP with both a DG Failure and an Unavailability
Event Date: 11/16/84
Plant: Indian Point 3

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP	3.4E-01

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CV	
LOOP	5.0E-05
Total	5.0E-05
CD	
LOOP	1.9E-04
Total	1.9E-04
ATWS	
LOOP	0.0E+00
Total	0.0E+00

DOMINANT SEQUENCES

End State: CV Conditional Probability: 4.8E-05

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

End State: CD Conditional Probability: 1.7E-04

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

SEQUENCE CONDITIONAL PROBABILITIES

Event Identifier: 286/84-015

	Sequence	End State	Prob	N Rec**
213	LOOP -RT/LOOP -EMERG.POWER AFW -HPI(F/B) HPR/-HPI	CD	9.2E-06	5.1E-02
214	LOOP -RT/LOOP -EMERG.POWER AFW HPI(F/B)	CD	7.0E-06	4.7E-02
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-06	5.8E-02
217	LOOP -RT/LOOP EMERG.POWER -AFW/EMERG.POWER -PORV.OR.SRV.CHALL SS.RELEAS.TERM	CV	4.8E-05 *	5.8E-02
218	LOOP -RT/LOOP EMERG.POWER AFW/EMERG.POWER	CD	1.7E-04 *	5.9E-02

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

MODEL: b:\pwrbtree.cmp
DATA: b:\IPPROB.CMP

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
TRANS	1.0E-03	1.0E+00	
LOOP	2.3E-05	3.4E-01	
LOCA	4.2E-06	3.4E-01	
RT	2.5E-04	1.2E-01	
RT/LOOP	0.0E+00	1.0E+00	
EMERG.POWER	2.9E-03 > 5.7E-02	5.1E-01	
Branch Model: 1.OF.3			
Train 1 Cond Prob:	5.0E-02 > Failed		
Train 2 Cond Prob:	5.7E-02		
Train 3 Cond Prob:	1.9E-01 > Unavailable		
AFW	1.0E-03 > 1.9E-03	2.7E-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:	9.2E-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	2.0E-02	5.0E-02	
PORV.OR.SRV.RESEAT/EMERG.POWER	2.0E-02	5.0E-02	
SS.RELEAS.TERM	1.5E-02	3.4E-01	
SS.RELEAS.TERM/-MFW	1.5E-02	3.4E-01	
HPI	1.5E-03 > 2.2E-03	5.2E-01	
Branch Model: 1.OF.3+ser			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01		

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Train 3 Cond Prob:	3.0E-01 > Unavailable			
Serial Component Prob:	1.2E-03			
HPI(F/B)	1.5E-03 > 2.2E-03		5.2E-01	4.0E-02
Branch Model: 1.OF.3+ser+opr				
Train 1 Cond Prob:	1.0E-02			
Train 2 Cond Prob:	1.0E-01			
Train 3 Cond Prob:	3.0E-01 > Unavailable			
Serial Component Prob:	1.2E-03			
HPR/-HPI	3.0E-03 > 3.0E-02		5.6E-01	4.0E-02
Branch Model: 1.OF.2+opr				
Train 1 Cond Prob:	3.0E-02			
Train 2 Cond Prob:	1.0E-01 > Unavailable			
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	1.0E-03 > 1.0E-02		3.4E-01	
Branch Model: 1.OF.2				
Train 1 Cond Prob:	1.0E-02			
Train 2 Cond Prob:	1.0E-01 > Unavailable			
LPR/-HPI.HPR	6.7E-01		1.0E+00	
LPR/HPI	1.0E-03 > 1.0E-02		1.0E+00	
Branch Model: 1.OF.2				
Train 1 Cond Prob:	1.0E-02			
Train 2 Cond Prob:	1.0E-01 > Unavailable			

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Event Identifier: 286/84-015