PRECURSOR DESCRIPTION SHEET

LER No.: 370/87-016, -017
Event Description: Trip with service water train and PORVs unavailable
Date of Event: 9/6/87
Plant: McGuire 2

EVENT DESCRIPTION

Sequence

On September 5, service water train 2A was taken out of service for cleaning after a test when it failed to provide adequate circulation to the train 2A component cooling heat exchanger, containment spray heat exchanger, and residual heat removal pump air-handling unit. Further, static invertor KXB was de-energized for periodic maintenance scheduled for September 7. Alternate feed to bus KXB was provided via bus SMXT. On September 6 at 1035, operations personnel started Compressor A to verify operation after maintenance work on the unit. Insulating tape on a connecting lug to a motor lead had worn through and allowed the lug to ground against the metal frame of the motor. This short caused the 600-V motor feeder breaker and the 600-V feeder breaker for the 600-V motor control center SMXT to trip. Trip of SMXT caused KXB to de-energize. When KXB de-energized, it de-energized a relay sending a signal to the turbine control system that the main turbine generator output breakers had de-energized. This signal caused the main turbine throttle, governor, and intercept valves to close. Loss of the turbine caused a pressure spike in the main steam and reactor coolant systems, and a high pressurizer pressure signal caused a reactor trip.

After trip, the pressurizer power-operated relief valves failed to open when the pressure exceeded the high-pressure set point. This occurred since source power to the PORVs was lost with failure of KXB. Loss of KXB also caused eight atmospheric dump valves and nine steam-dump-to-condenser valves to fail closed during the transient. All steam generator PORVs opened and closed late. One main steam line code safety valve failed to indicate that it had been opened, and another failed to open due to a misadjusted pressure set point. The 8-in. moisture separator reheater valves failed to close both automatically and on reset (due to KXB), which caused uncontrolled cooldown and a low reactor coolant T_{avg} signal that initiated main feedwater isolation. Operators isolated main steam from second-stage reheater, shut down the main feedwater pumps, and controlled cooldown by manually starting AFW pumps A and B. The AFW pumps had to be manually started due to the loss of KXB (it is assumed that manual start was required upon main feed pump trip, but that auto-start was still available in low SG level). After recovery from the trip, the unit was placed in hot standby (Mode 3). The trip required that the solid state protection system train 2B be tested prior to returning the reactor to power. This would render both service water trains inoperable from a Technical Specifications standpoint. Operations supervision permitted the test to be performed, understanding that the plant would be in hot standby at the time.

Event Identifier: 370/87-016,-017

Corrective Action

Plant/Event Data
Systems Involved:
Reactor pressure relief
Secondary pressure control
Component cooling water
Containment spray system
Residual heat removal system (low-pressure recirculation)
Service water system

Components and Failure Modes Involved:
Pressurizer PORVs – unavailable due to loss of bus KXB
Moisture separator reheater valves – open due to loss of bus KXB
Main steam line code safety valve – fails to open
Eight atmospheric dump valves – failed closed due to loss of bus KXB
Nine steam dump to condenser valves – failed closed due to loss of bus KXB

Component Unavailability Duration: N/A
Plant Operating Mode: 1(100% power)
Discovery Method: Operational event
Reactor Age: 4.3 y
Plant Type: PWR

Comments
None.

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

Transient	1.0	No recovery assumed possible

Branches Impacted and Branch Nonrecovery Estimate

PORV.OPEN	1.0	No recovery assumed possible
SS.DEPRESS	1.0	No recovery assumed possible
HPI	Base case	One train unavailable
Feed & Bleed	Base case	One train unavailable*
HPR	Base case	One train unavailable
LPI	Base case	One train unavailable
LPR	Base case	One train unavailable

*Failure of the PORVs to open faults feed and bleed.

Plant Models Utilized
PWR plant Class B

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 370/87-016
Event Description: Trip with service water train and PORVs unavailable
Event Date: 09/06/87
Plant: McGuire 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS	1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	7.0E-06
Total	7.0E-06
CV	
TRANS	4.3E-05
Total	4.3E-05
ATWS	
TRANS	3.4E-05
Total	3.4E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
121	trans -rt afw mfw -HPI(F/B) -HPR/-HPI PORV.OPEN SS.DEPRESS	CD	6.5E-06	8.8E-02
109	trans -rt -afw -porv.or.srv.chall ss.releas.term HPI	CV	4.1E-05	2.9E-01
101	trans -rt -afw porv.or.srv.chall -porv.or.srv.reseat ss.releas .term HPI	CV	1.7E-06	2.9E-01
128	trans rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
101	trans -rt -afw porv.or.srv.chall -porv.or.srv.reseat ss.releas .term HPI	CV	1.7E-06	2.9E-01
109	trans -rt -afw -porv.or.srv.chall ss.releas.term HPI	CV	4.1E-05	2.9E-01
121	trans -rt afw mfw -HPI(F/B) -HPR/-HPI PORV.OPEN SS.DEPRESS	CD	6.5E-06	8.8E-02
128	trans rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\newmodel\pwr_bnew.cmp
BRANCH MODEL: c:\asp\newmodel\mcguire.new
PROBABILITY FILE: c:\asp\newmodel\pwr_bnew.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr 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	8.0E-01	
ep.rec	1.0E+00	1.7E-01	
afw	3.8E-04	2.6E-01	
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	1.1E-02	
porv.or.srv.reseat/emerg.power	3.0E-02	1.0E+00	
ss.releas.term	1.5E-02	3.4E-01	
HPI	1.0E-03 > 1.0E-02	8.4E-01	
Branch Model: 1.OF.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	1.0E-02
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
HPR/-HPI	1.5E-04 > 1.0E-02	1.0E+00	1.0E-03
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.5E-02 > Unavailable		
PORV.OPEN	1.0E-02 > 1.0E+00	1.0E+00	4.0E-04
Branch Model: 1.OF.1+opr			
Train 1 Cond Prob:	1.0E-02 > Unavailable		
SS.DEPRESS	3.6E-02 > 1.0E+00	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	3.6E-02 > Unavailable		
cond/mfw	1.0E+00	3.4E-01	1.0E-02
LPI/HPI	1.5E-04 > 1.0E-02	3.4E-01	
Branch Model: 1.OF.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.OF.2			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.5E-02 > Unavailable		

* branch model file
** forced

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