

PRECURSOR DESCRIPTION SHEET

LER No.: 259/84-032
Event Description: Inadvertent Overpressurization and Leakage from LPCS
Date of Event: August 14, 1984
Plant: Browns Ferry 1

EVENT DESCRIPTION

Sequence

While at full power, the LPCS's normally closed, motor-operated isolation valve was undergoing a surveillance test. The normal interlock preventing opening the valves simultaneously at power was bypassed. By error, 8 months previously, the testable isolation check valve's air operator had been installed backwards, thereby causing the valve to actually be open while the indicator showed closed. By a second operator error, the power to the closed motor-operated valve was not locked out during the surveillance test. The normally open motor-operated isolation valve remained open. While applying the open signal in the test, the operator caused the normally closed motor isolation valve to cycle open. The LPCS overpressurized, and the line RV discharged steam and water into the pump room. The overpressure alarm failed to sound, and the operator did not observe the change in system pressure. The pipe heated to 400°F. The seal there leaked due to backflow from the common drain that serves the seal leak line, and the clean radwaste line for the A train pump ruptured. The event lasted 13 min before the line was isolated. The workers responding to the event had their clothing contaminated by the leaking water.

Corrective Action

CS loop I was isolated and tagged, which placed the unit in a 7-d limiting condition of operation. Meanwhile, the plant manager ordered an investigation of the event. Site engineering and maintenance staffs inspected all affected components and found no damage. The extent of the pipe heating was determined by examination of paint damage on the piping. The maximum temperature experienced was estimated to be <400°F. Paint damage extended from the injection valves down to the system RV. Tennessee Valley Authority's Office of Engineering Design analyzed the system piping and supports for the transient and found that integrity for continued use was ensured. The pump A seal was removed, and no damage was observed. Also, there was no evidence that hot water entered the pump area piping, which indicates that the pump discharge check valve was holding.

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Plant/Event Data

Systems Involved:

LPCS

Components and Failure Modes Involved:

LPCS isolation valves — inadvertently open

Component Unavailability Duration: 8 months

Plant Operating Mode: 1 (100% full power)

Discovery Method: During testing

Reactor Age: 11 years

Plant Type: BWR

Comments

Development of probability estimates related to this and other overpressurization events is addressed in An Evaluation of BWR Over-Pressure Incidents in Low Pressure Systems, J. D. Harris and J. W. Minarick, May 1985 (internal accident sequence precursor report). Based on the impact of the event on Browns Ferry Unit 1 (one train of LPCI and one train of LPCS impacted), the following modifications to probability values used in that document are required to estimate the conditional probability for the event:

$$p(\text{core damage/pipe rupture and RCS depressurization}) = 2E-2$$

$$p(\text{core damage/small-break LOCA}) = 1.1E-4$$

In addition, the probability of pipe rupture given overpressurization has been assumed to be $1E-1$ (see the above document). These estimates result in an event tree/probability model for core damage associated with the events shown in the figure below. The attached calculations address sequences 15 and 17. The overall core damage likelihood is estimated using the model in the figure to be $6E-6$. See also Abnormal Occurrence Reports to Congress, NUREG-00990, 7(3) for additional information on this event.

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

LOCA	0.12	Recoverable locally at valves
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Branches Impacted and Branch Nonrecovery Estimate

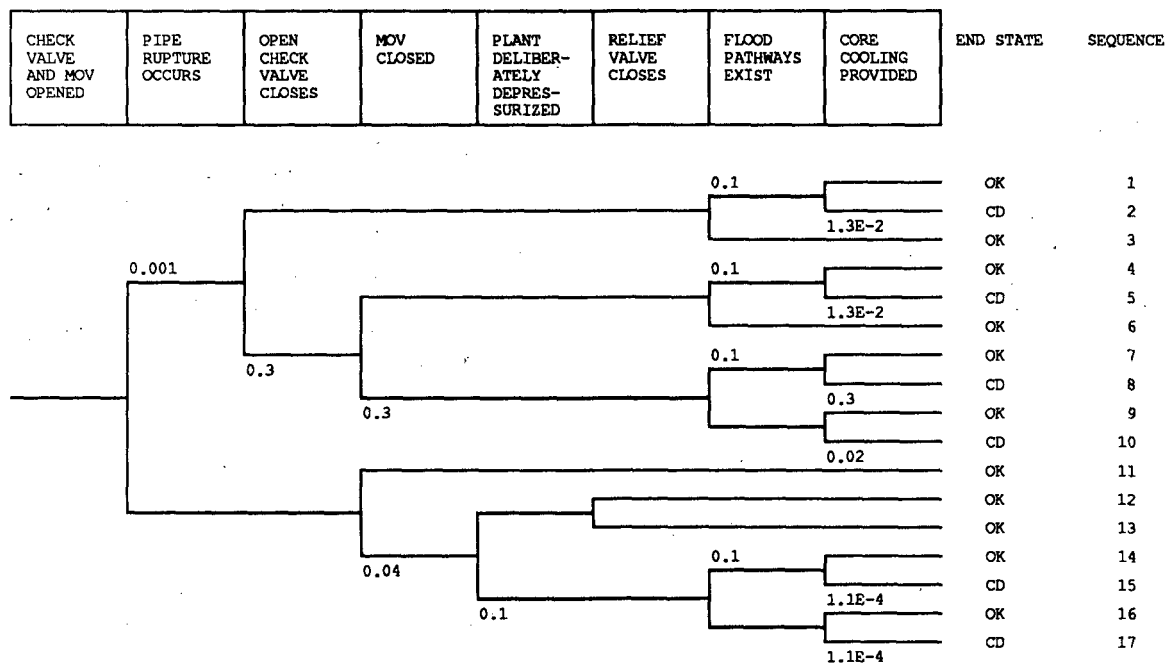
LPCS	Base case
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LPCI/RHR	Base case
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Plant Models Utilized

BWR plant Class C



P(CORE DAMAGE) = 6E-6

Core damage model for LER 259/84-032.

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

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 Event Date: 8/14/84
 Plant: Browns Ferry 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOCA	1.2E-01
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SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CV	
LOCA	8.6E-07
Total	8.6E-07
CD	
LOCA	1.1E-04
Total	1.1E-04
ATWS	
LOCA	2.4E-06
Total	2.4E-06

DOMINANT SEQUENCES

End State: CV	Conditional Probability: 5.7E-07
314 LOCA SCRAM -SLC.OR.RODS PCS/LOCA FW/PCS.LOCA HPCI -SRV.ADS -COND/FW.PCS -RHR(SDC)	
End State: CD	Conditional Probability: 1.1E-04
310 LOCA -SCRAM PCS/LOCA FW/PCS.LOCA HPCI RCIC/LOCA SRV.ADS	
End State: ATWS	Conditional Probability: 2.4E-06

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332 LOCA SCRAM SLC.OR.RODS

SEQUENCE CONDITIONAL PROBABILITIES

	Sequence	End State	Prob	N Rec**
302	LOCA -SCRAM PCS/LOCA -FW/PCS.LOCA RHR(SDC) RHR(SPCOOL)/-LPC I.RHR(SDC) C.I.AND.V/RHR(SDC).RHR(SPCOOL)	CD	3.7E-06	9.2E-03
310	LOCA -SCRAM PCS/LOCA FW/PCS.LOCA HPCI RCIC/LOCA SRV.ADS	CD	1.1E-04 *	2.3E-02
314	LOCA SCRAM -SLC.OR.RODS PCS/LOCA FW/PCS.LOCA HPCI -SRV.ADS -COND/FW.PCS -RHR(SDC)	CV	5.7E-07 *	1.5E-02
318	LOCA SCRAM -SLC.OR.RODS PCS/LOCA FW/PCS.LOCA HPCI -SRV.ADS COND/FW.PCS -LPCS -RHR(SDC)	CV	2.9E-07	7.8E-03
332	LOCA SCRAM SLC.OR.RODS	ATWS	2.4E-06 *	1.2E-01

* dominant sequence for end state

** non-recovery credit for edited case

MODEL: b:\bwrctree.cmp

DATA: b:\bfprob.cmp

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
TRANS	1.1E-03	1.0E+00	
LOOP	1.3E-05	3.4E-01	
LOCA	3.3E-06 > 3.3E-06	3.4E-01 > 1.2E-01	
Branch Model: INITOR			
Initiator Freq:			
SCRAM	4.1E-04	1.0E+00	
SLC.OR.RODS	1.0E-02	1.0E+00	4.0E-02
PCS/TRANS	1.7E-01	1.0E+00	
PCS/LOCA	1.0E+00	1.0E+00	
SRV.CHALL/TRANS.-SCRAM	1.0E+00	1.0E+00	
SRV.CHALL/TRANS.SCRAM	1.0E+00	1.0E+00	
SRV.CHALL/LOOP.-SCRAM	1.0E+00	1.0E+00	
SRV.CHALL/LOOP.SCRAM	1.0E+00	1.0E+00	
SRV.CLOSE	3.6E-02	1.0E+00	
EMERG.POWER	5.4E-04	5.1E-01	
FW/PCS.TRANS	4.6E-01	3.4E-01	
FW/PCS.LOCA	1.0E+00	3.4E-01	
HPCI	1.0E-01	5.7E-01	
RCIC/TRANS.OR.LOOP	6.7E-02	5.7E-01	
RCIC/LOCA	1.0E+00	1.0E+00	
CRD	1.0E-02	1.0E+00	4.0E-02
SRV.ADS	6.7E-03	1.0E+00	4.0E-02

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COND/FW.PCS	1.0E+00	3.4E-01	
LPCS	3.0E-03 > 3.0E-02	3.4E-01	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	3.0E-02		
Train 2 Cond Prob:	1.0E-01 > Failed		
LPCI(RHR)/LPCS	4.0E-04 > 4.0E-03	3.4E-01	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	4.0E-03		
Train 2 Cond Prob:	1.0E-01 > Failed		
RHRSW/LPCS.LPCI.TRANS	5.0E-01	1.0E+00	4.0E-02
RHRSW/LPCS.LPCI.LOOP	5.0E-01	1.0E+00	4.0E-02
RHRSW/LPCS.LPCI.LOCA	5.0E-01	1.0E+00	4.0E-02
RHR(SDC)	2.0E-02	3.4E-01	
RHR(SDC)/-LPCI	2.0E-02	3.4E-01	
RHR(SDC)/LPCI	1.0E+00	1.0E+00	
RHR(SPCOOL)/-LPCI.RHR(SDC)	2.0E-02	1.0E+00	
RHR(SPCOOL)/LPCI.RHR(SDC)	5.2E-01	1.0E+00	
C.I.AND.V/RHR(SDC).RHR(SPCOOL)	1.0E+00	3.4E-01	

*** forced

Minarick
04-11-1987
13:56:22

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