

B.50-1

B.50 LER No. 387/83-051

Event Description: RCIC System Unavailable Owing to Governor Valve Problem

Date of Event: March 22, 1983

Plant: Susquehanna 1

B.50.1 Summary

On March 22, 1983, in response to a low reactor pressure vessel (RPV) water level signal following a scram, the reactor core isolation cooling (RCIC) system initiated and then tripped on turbine overspeed. The conditional core damage probability estimated for the event is 1.2×10^{-5} .

B.50.2 Event Description

On March 22, 1983, in response to a low RPV water level signal following a scram, the RCIC system initiated and then tripped on turbine overspeed. Operations personnel manually started the RCIC immediately after the overspeed trip; the high-pressure injection system started; and vessel level was recovered and maintained. Investigations revealed the overspeed trip was caused by the slow response of the governor valve during system start. The slow response was caused by dirt deposited in the opening of the pilot valve. This was corrected on May 17, 1984 by installing a new upgraded governor in which the pilot valve opening was enlarged.

The scram was caused by an operator error that allowed air to be injected into the reactor vessel via the condensate demineralizers, resulting in high main steam radiation signals.

B.50.3 Additional Event-Related Information

The RCIC system consists of a single turbine-driven pump that can provide primary coolant makeup at a maximum rate of 600 gpm. The RCIC pump is provided with two suction sources. The primary source is the condensate storage tank (CST), with the suppression pool providing the secondary source. The system is designed to swap suction from the CST to the suppression pool on low CST level.

B.50.4 Modeling Assumptions

Given that a plant trip occurred, this event was modeled as a transient initiator. The main steam isolation valves (MSIVs) were assumed to have closed as a result of the high main steam radiation signals. This would result in unavailability of the power conversion system (PCS) and the feedwater (FW) system, since Susquehanna uses turbine-driven FW pumps. In addition, Susquehanna's individual plant examination (IPE) submittal states that flow through the MSIVs is needed for the turbine-driven FW pumps; thus, it was assumed that the use of the MSIV bypass valves to supply steam for the FW pumps was not appropriate. RCIC was assumed failed, owing to the governor valve problem. Short-term recovery of PCS or FW was not considered,

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since the MSIVs had closed. Recovery of RCIC was considered since the control room operator manually started RCIC immediately after the overspeed trip. This action was assumed to take place in the control room with a failure probability of 0.01. Thus, the probability of nonrecovery of RCIC was set to 0.052 [$p(\text{nrec}) = 0.01 + 0.06 * 0.7$] to account for the fact that RCIC might also fail from other causes. The nonrecovery probability for PCS was revised to 0.017 to reflect the MSIV closure (see Appendix A). Combining this value with the estimated long-term residual heat removal (RHR) nonrecovery probability of 0.016 results in a combined nonrecovery probability for RHR and PCS of $2.7E-4$.

B.50.5 Analysis Results

The estimated conditional core damage probability for the event is 1.2×10^{-5} . The dominant sequence, highlighted on the event tree in Figure B.50.1, involved a transient initiator followed by successful reactor shutdown, failure of the power conversion system, failure of the feedwater system and failure of the residual heat removal system.

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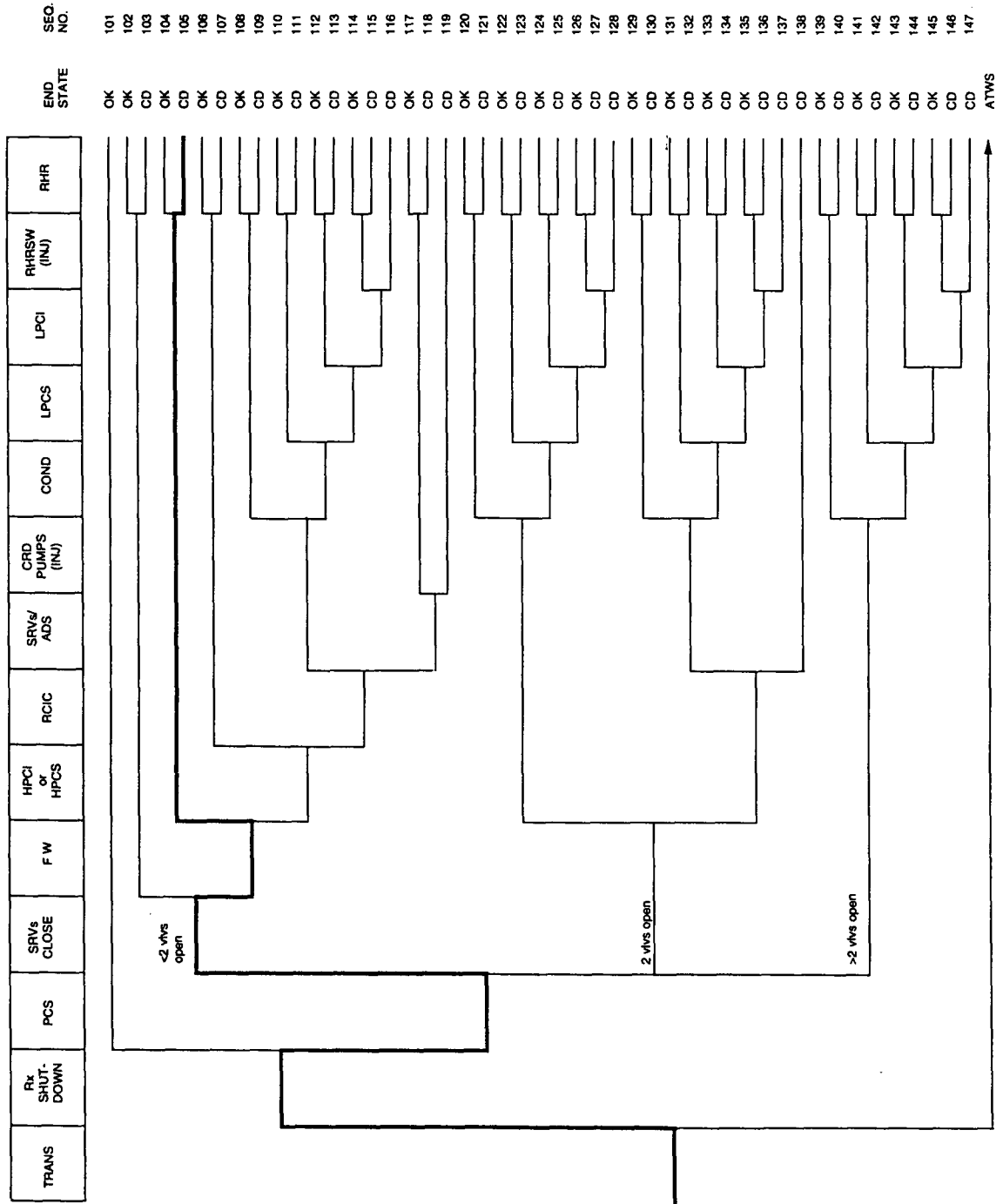


Figure B.50.1 Dominant core damage sequence for LER 387/83-051

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 387/83-103
Event Description: Scram, MSIV isolation and RCIC failure
Event Date: July 7, 1983
Plant: Susquehanna 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	1.4E-05
Total	1.4E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
103 trans -rx.shutdown PCS srv.ftc.<2 -MFW RHR.AND.PCS.NREC	CD	6.6E-06	1.8E-04
105 trans -rx.shutdown PCS srv.ftc.<2 MFW -hpci RHR.AND.PCS.NREC	CD	3.3E-06	9.1E-05
119 trans -rx.shutdown PCS srv.ftc.<2 MFW hpci RCIC srv.ads c rd(inj)	CD	1.7E-06	1.7E-01
414 trans rx.shutdown rpt	CD	6.7E-07	1.0E-01
413 trans rx.shutdown -rpt slcs	CD	4.1E-07	1.0E-01
412 trans rx.shutdown -rpt -slcs PCS ads.inhibit	CD	3.4E-07	1.0E-01
138 trans -rx.shutdown PCS srv.ftc.2 hpci srv.ads	CD	3.3E-07	4.9E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
103 trans -rx.shutdown PCS srv.ftc.<2 -MFW RHR.AND.PCS.NREC	CD	6.6E-06	1.8E-04
105 trans -rx.shutdown PCS srv.ftc.<2 MFW -hpci RHR.AND.PCS.NREC	CD	3.3E-06	9.1E-05
119 trans -rx.shutdown PCS srv.ftc.<2 MFW hpci RCIC srv.ads c rd(inj)	CD	1.7E-06	1.7E-01
138 trans -rx.shutdown PCS srv.ftc.2 hpci srv.ads	CD	3.3E-07	4.9E-01
412 trans rx.shutdown -rpt -slcs PCS ads.inhibit	CD	3.4E-07	1.0E-01
413 trans rx.shutdown -rpt slcs	CD	4.1E-07	1.0E-01
414 trans rx.shutdown rpt	CD	6.7E-07	1.0E-01

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1982-83\bwrc8283.cmp
BRANCH MODEL: c:\asp\1982-83\susque.82

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PROBABILITY FILE: c:\asp\1982-83\bwr8283.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	1.5E-03	1.0E+00	
loop	1.6E-05	2.4E-01	
loca	3.3E-06	6.7E-01	
rx.shutdown	3.5E-04	1.0E-01	
PCS	1.7E-01 > 1.0E+00	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	1.7E-01 > 1.0E+00		
srv.ftc.<2	1.0E+00	1.0E+00	
srv.ftc.2	1.3E-03	1.0E+00	
srv.ftc.>2	2.2E-04	1.0E+00	
MFW	4.6E-01 > 1.0E+00	3.4E-01	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	4.6E-01 > 1.0E+00		
hpci	2.9E-02	7.0E-01	
RCIC	6.0E-02 > 1.0E+00	7.0E-01 > 1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	6.0E-02 > 1.0E+00		
srv.ads	3.7E-03	7.0E-01	1.0E-02
crd(inj)	1.0E-02	1.0E+00	1.0E-02
cond	1.0E+00	3.4E-01	1.0E-03
lpcs	1.7E-03	1.0E+00	
lpci	1.1E-03	1.0E+00	
rhrsw(inj)	2.0E-02	1.0E+00	1.0E-02
rhr	1.5E-04	1.6E-02	1.0E-05
RHR.AND.PCS.NREC	1.5E-04 > 1.5E-04	8.3E-03 > 2.7E-04	1.0E-05
Branch Model: 1.OF.4+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01		
Train 3 Cond Prob:	3.0E-01		
Train 4 Cond Prob:	5.0E-01		
rhr/-lpci	0.0E+00	1.0E+00	1.0E-05
rhr/lpci	1.0E+00	1.0E+00	1.0E-05
rhr(spcool)	2.1E-03	1.0E+00	1.0E-03
rhr(spcool)/-lpci	2.0E-03	1.0E+00	1.0E-03
ep	1.4E-03	8.7E-01	
ep.rec	2.1E-01	1.0E+00	
rpt	1.9E-02	1.0E+00	
sics	2.0E-03	1.0E+00	1.0E-02
ads.inhibit	0.0E+00	1.0E+00	1.0E-02
man.depress	3.7E-03	1.0E+00	1.0E-02

* branch model file

** forced

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