B.15 LER No. 293/82-024 and -023

Event Description: Scram and HPCI Failure

Date of Event: August 13, 1982

Plant: Pilgrim

B.15.1 Summary

During recovery from a scram on August 13, 1982 (LER 293/82-023), the high-pressure coolant injection (HPCI) system tripped after 5 minutes owing to high reactor water level. After restarting the HPCI pump, attempts to bring it past idle speed were unsuccessful. The estimated conditional core damage probability for the event is 2.9×10^{-5}.

B.15.2 Event Description

On August 13, 1982, a scram occurred when a removable hand rail fell against main steam hi-flow instrumentation and generated a containment isolation signal (LER 293/82-023). During recovery from the scram, the HPCI system tripped after 5 minutes, owing to high reactor water level. After restarting the HPCI pump, attempts to bring it past idle speed were unsuccessful. Eleven manual safety relief valve (SRV) actuations were required to control pressure. Investigation of the HPCI system revealed that the HPCI gland seal condenser gasket had failed, causing wetting of the HPCI control circuitry. The control circuits were dried and calibrated, and gasket repair was accomplished.

B.15.3 Additional Event-Related Information

The HPCI system consists of a single turbine-driven pump that can provide primary coolant makeup at a rate of 4250 gpm. The HPCI pump is provided with two suction sources. The primary source is the condensate storage tank (CST), with the suppression pool providing the secondary source. These are interlocked to ensure that only one source is aligned at a time. The system is designed to swap from the CST to the suppression pool on low CST or high suppression pool level.

B.15.4 Modeling Assumptions

This event was modeled as a transient initiator with the power conversion system (PCS) unavailable and HPCI failed due to control circuit wetting and not recoverable. The PCS system was assumed unavailable because a containment isolation signal was generated when the hand rail fell against the main steam hi-flow instrumentation; this signal is expected to have closed the main isolation valves (MSIVs).

The main feedwater system is motor driven at Pilgrim, and was assumed to be available following closure of the MSIVs.

The nonrecovery probability for sequences involving residual heat removal (RHR) or PCS recovery was revised to reflect the MSIV isolation (see Appendix A).

B.15.5 Analysis Results

The estimated conditional core damage probability for the event is 2.9×10^{-5}. The dominant sequence, highlighted on the event tree in Figure B.15.1, involves a transient initiator followed by successful reactor shutdown, failure of the power conversion system, failure of two SRVs to close, HPCI unavailability and automatic depressurization system (ADS) failure.

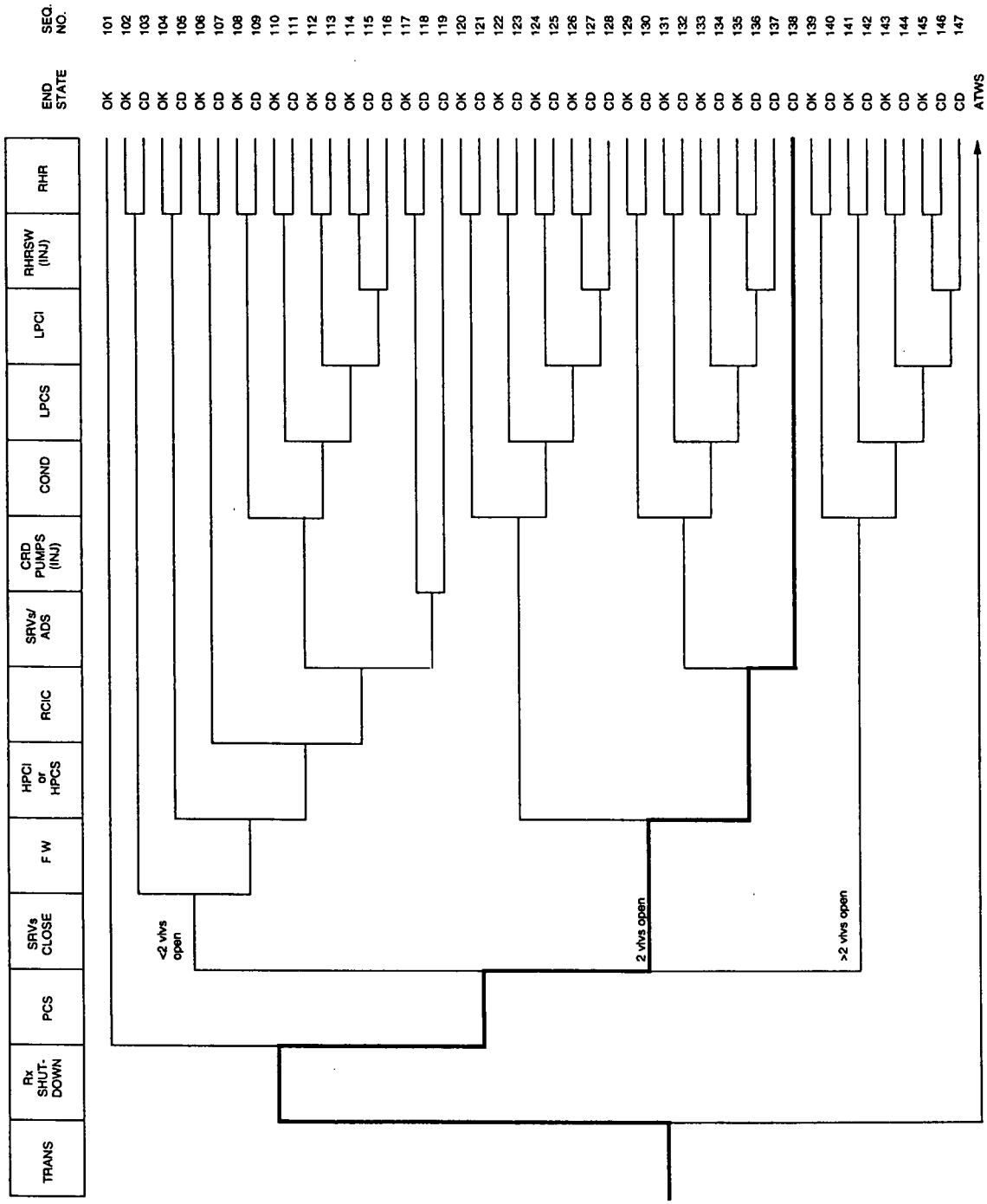

Figure B.15.1 Dominant core damage sequence for LER 293/82-024 and -023

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 293/82-024
Event Description: Scram and HPCI failure
Event Date: August 13. 1982
Plant: Pilgrim

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS	1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	2.9E-05
Total	2.9E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
138	trans -rx.shutdown PCS srv.ftc.2 HPCI srv.ads	CD	1.6E-05	7.0E-01
103	trans -rx.shutdown PCS srv.ftc.<2 -mfw RHR.AND.PCS.NREC	CD	9.0E-06	2.5E-04
119	trans -rx.shutdown PCS srv.ftc.<2 mfw HPCI rcic srv.ads c rd(inj)	CD	1.0E-06	1.7E-01
107	trans -rx.shutdown PCS srv.ftc.<2 mfw HPCI -rcic RHR.AND.PCS.NREC	CD	9.5E-07	9.1E-05
414	trans rx.shutdown rpt	CD	6.7E-07	1.0E-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	9.0E-06	2.5E-04
107	trans -rx.shutdown PCS srv.ftc.<2 mfw HPCI -rcic RHR.AND.PCS.NREC	CD	9.5E-07	9.1E-05
119	trans -rx.shutdown PCS srv.ftc.<2 mfw HPCI rcic srv.ads c rd(inj)	CD	1.0E-06	1.7E-01
138	trans -rx.shutdown PCS srv.ftc.2 HPCI srv.ads	CD	1.6E-05	7.0E-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\pilgrim.82
PROBABILITY FILE: c:\asp\1982-83\bwr8283.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	1.2E-03	1.0E+00	
loop	2.0E-05	4.3E-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	2.9E-01	3.4E-01	
HPCI	2.9E-02 > 1.0E+00	7.0E-01 > 1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	2.9E-02 > 1.0E+00		
rcic	6.0E-02	7.0E-01	
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	2.0E-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	2.9E-03	8.7E-01	
ep.rec	3.1E-02	1.0E+00	
rpt	1.9E-02	1.0E+00	
slcs	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