

B.52-1

B.52 LER No. 387/83-120

Event Description: RCIC System Unavailable Owing to Governor Valve Problem

Date of Event: August 28, 1983

Plant: Susquehanna 1

B.52.1 Summary

During a post-scrum vessel level fluctuation on August 28, 1983, the reactor core isolation cooling (RCIC) system initiated and then tripped on turbine overspeed 3 seconds later. The conditional core damage probability estimated for the event is 1.2×10^{-5} .

B.52.2 Event Description

During a post-scrum vessel level fluctuation on August 28, 1983, the RCIC system initiated and then tripped on turbine overspeed 3 seconds later. Operations personnel established manual control of RCIC and adjusted turbine speed to maintain proper vessel level. Investigations revealed the overspeed trip was caused by slow response of the governor valve during system start. The governor valve linkage travel was reduced by one-quarter inch and the system successfully retested.

The scram occurred when a main turbine stop valve opened, causing a main steam isolation valve (MSIV) isolation to occur. A scram followed owing to the MSIVs being less than 94% open. Spurious actuation of main steam line pressure switches is considered to be the cause of the scram.

B.52.3 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.52.4 Modeling Assumptions

Given that a plant trip occurred, this event was modeled as a transient initiator. The main steam isolation valves were closed as a result of the MSIV isolation. This will 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 is assumed that the use of the MSIV bypass valves to supply steam for the FW pumps is not appropriate. RCIC was assumed failed owing to the governor valve problem. Short-term recovery of PCS or FW was not considered, since the MSIVs had closed. Recovery of RCIC was considered

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since manual control of RCIC was established 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 system (RHR) nonrecovery probability of 0.016 results in a combined nonrecovery probability for RHR and PCS of $2.7E-4$.

B.52.5 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.52.1, 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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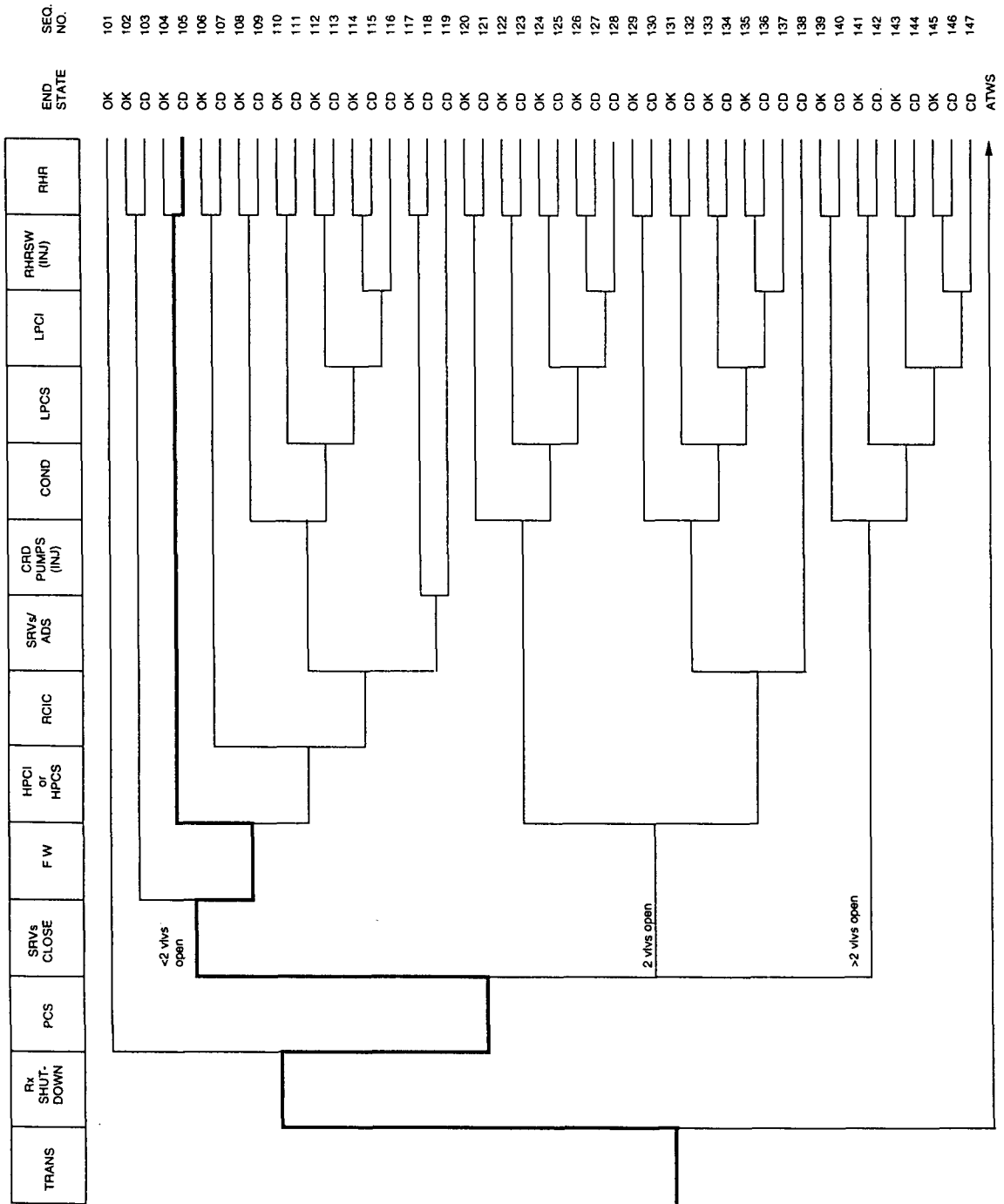


Figure B.52.1 Dominant core damage sequence for LER 387/83-120

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 387/83-120
 Event Description: Scram, MSIV isolation and RCIC failure
 Event Date: August 28, 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 | 1.2E-05 |
| Total | 1.2E-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 |
| 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 |
| 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
 PROBABILITY FILE: c:\asp\1982-83\bwr8283.pro

No Recovery Limit

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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 > 5.2E-02 | |
| 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 | |
| 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

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