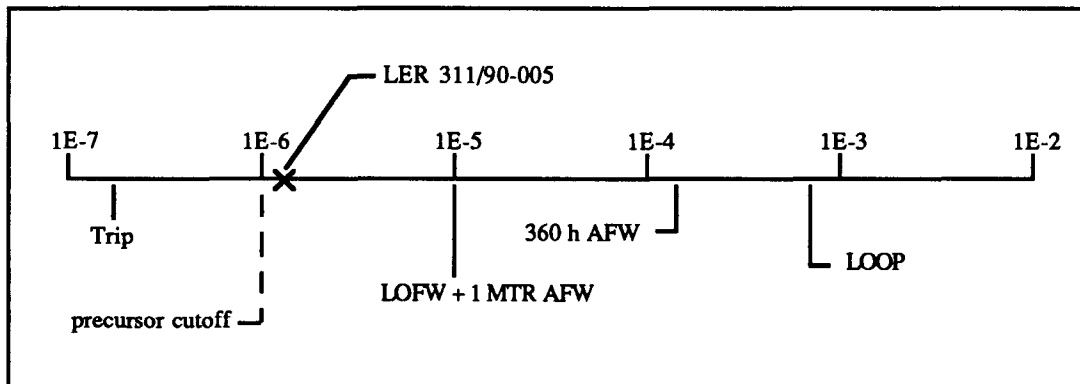


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No.: 311/90-005
 Event Description: HPI inoperable due to leaking weld
 Date of Event: January 17, 1990
 Plant: Salem 2

Summary

The high-pressure injection (HPI) flow path to the reactor coolant system (RCS) was isolated to stop leakage of borated water from the discharge side of the boron injection tank (BIT). The conditional core damage probability estimated for this event is 1.3×10^{-6} . The relative significance of this event compared to other postulated events at Salem 2 is shown below.



Event Description

Salem 2 was operating at 100% of rated power on January 16, 1990, when a boron leak was discovered on the discharge side of the BIT. The leak was located on a portion of the old recirculation line from the BIT to the boric acid storage tank, which had been removed and capped by a design change in 1988. The BIT inlet isolation motor-operated valves had to be closed to isolate the leak. This action not only isolated the leak, but also eliminated the cold leg injection flow path for the charging pumps; thus HPI was inoperable. The unit was shut down in accordance with Technical Specifications, and the leaking pipe was removed and replaced.

The leak was isolated at 2300 h on January 16, 1990. The plant was in Mode 4 at 1300 h on January 17, 1990, and in Mode 5 (cold shutdown) at 0808 h the next day.

A failure analysis performed on the damaged section of pipe determined that the crack that caused the leak was probably initiated at a weld defect during the installation of the pipe cap in November 1988. Crack propagation is attributed to "high frequency, low amplitude cyclic loading, which is characteristic of the positive displacement pump discharge..."

Additional Event-Related Information

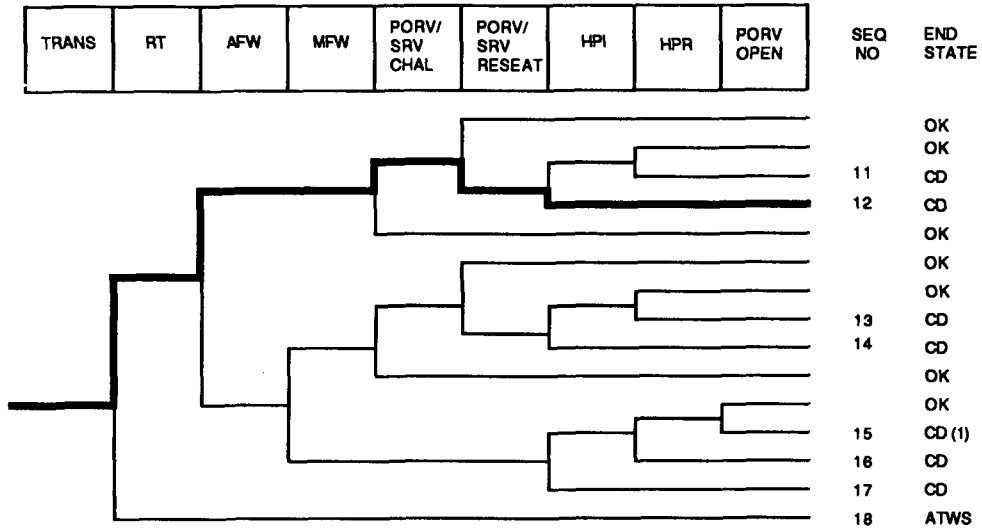
The emergency core cooling system (ECCS) delivers water to the RCS in the event of a loss-of-coolant accident (LOCA). Two centrifugal charging pumps are required for the high-pressure injection phase of the ECCS following a design basis LOCA. These pumps then deliver borated water at RCS pressure from the refueling water storage tank (RWST) through the BIT to the four RCS cold legs. Conversely, the safety injection pumps take a suction on the RWST and deliver borated water at approximately 1520 psig through the accumulator discharge lines to the four RCS cold legs.

ASP Modeling Assumptions and Approach

This event has been modeled as an unavailability of HPI and bleed and feed following a postulated trip during plant shutdown. The likelihood of trip during the shutdown was assumed to be 0.1. The potential for catastrophic failure of the weld prior to discovery has not been addressed in the analysis.

Analysis Results

The conditional probability of severe core damage estimated for this event is 1.3×10^{-6} . The dominant sequence, highlighted on the following event tree, involves a transient-induced LOCA with failure of HPI.



(1) OK for Class D

Dominant core damage sequence for LER 311/90-005

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 311/90-005
 Event Description: HPI inoperable due to leaking weld
 Event Date: 01/17/90
 Plant: Salem 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS 1.0E-01

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
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CD

TRANS	1.3E-06
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Total	1.3E-06
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ATWS

TRANS	3.4E-06
-------	---------

Total	3.4E-06
-------	---------

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
12 TRANS -rt -afw porv.or.srv.chall porv.or.srv.reseat HPI	CD	7.4E-07	9.2E-04
17 TRANS -rt afw mfw HPI(F/B)	CD	5.9E-07	1.5E-03
18 TRANS rt	ATWS	3.4E-06	1.2E-02

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
12 TRANS -rt -afw porv.or.srv.chall porv.or.srv.reseat HPI	CD	7.4E-07	9.2E-04
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18 TRANS rt	ATWS	3.4E-06	1.2E-02

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\pwrseal.cmp
 BRANCH MODEL: c:\asp\1989\salem2.s11
 PROBABILITY FILE: c:\asp\1989\pwr_ball.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
TRANS	9.0E-04 > 9.0E-04	1.0E+00 > 1.0E-01	

Event Identifier: 311/90-005

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Branch Model:  INITOR
Initiator Freq:      9.0E-04
loop                 1.6E-05      5.3E-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          7.5E-03      8.0E-01
afw                   3.8E-04      2.6E-01
afw/emerg.power      5.0E-02      3.4E-01
mfw                   1.0E+00      7.0E-02
porv.or.srv.chall    4.0E-02      1.0E+00
porv.or.srv.reseat   2.0E-02      1.1E-02
porv.or.srv.reseat/emerg.power  2.0E-02      1.0E+00
seal.loca            2.7E-01      1.0E+00
ep.rec(sl)           5.7E-01      1.0E+00
ep.rec               7.0E-02      1.0E+00
HPI                  1.0E-03 > 1.0E+00  8.4E-01
    Branch Model:  1.OF.2
    Train 1  Cond Prob:      1.0E-02 > Failed
    Train 2  Cond Prob:      1.0E-01 > Failed
HPI(F/B)              1.0E-03 > 1.0E+00  8.4E-01      1.0E-02
    Branch Model:  1.OF.2+opr
    Train 1  Cond Prob:      1.0E-02 > Failed
    Train 2  Cond Prob:      1.0E-01 > Failed
hpr/-hpi              1.5E-04      1.0E+00      1.0E-03
porv.open             1.0E-02      1.0E+00      4.0E-04

* branch model file
** forced

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Minarick
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