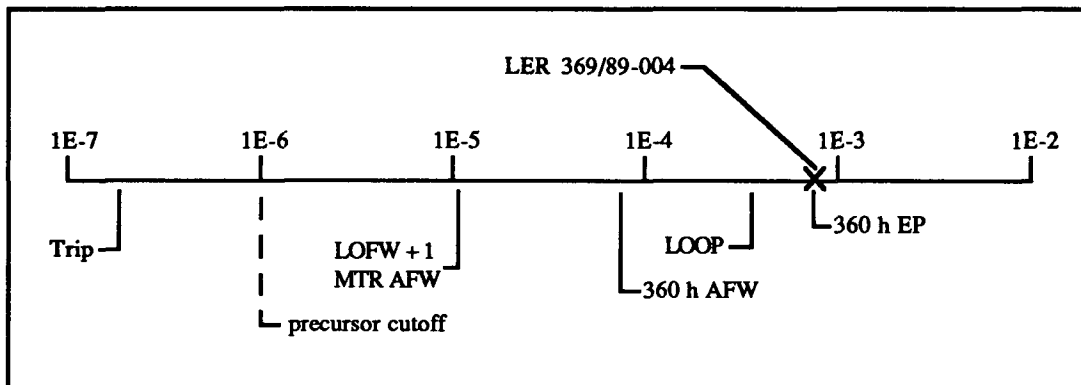


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 369/89-004
 Event Description: Steam generator tube rupture
 Date of Event: March 7, 1989
 Plant: McGuire Unit 1

Summary

A steam generator tube rupture with a flow rate of ~540 gpm occurred at McGuire 1. The charging pump suctions were aligned to the RWST, the affected steam generator was isolated, and the reactor coolant system was depressurized below the steam generator relief valve set point, terminating flow through the break. The conditional core damage probability estimated for the event is 7.7×10^{-4} . The relative significance of this event compared with other postulated events at McGuire is shown below.



Event Description

McGuire Unit 1 was operating at 100% power. Reactor coolant system leakage calculated on March 6, 1989, resulted in 0.377 gpm identified leakage and 0.199 gpm unidentified leakage. A primary to secondary leak on the "B" steam generator (SG) had been detected in January 1989 and was being monitored. The leak was approximately 10-15 gal/d. On March 7, 1989, at 2338, the "B" steam line radiation monitor alarmed and would not reset. The "B" SG feedwater flow decreased while the narrow range level indication remained relatively constant. In addition, pressurizer level was decreasing. The operators recognized this incident as a steam generator tube break. Power reductions were immediately started; the reactor was manually tripped at 2346. It was later estimated that flow through the tube rupture averaged approximately 540 gpm.

The operators swapped the suctions of the charging pumps to the RWST, isolated the "B" SG, and initiated RCS cooldown and depressurization. By 0025 on March 8, 1989, the pressure in the "B" SG and the RCS were equalized. This terminated reactor coolant flow out the break.

At 1015, cooldown of the "B" SG was initiated. Hot shutdown was entered at 1025. Both trains of RHR were operating by 1640, and cold shutdown was entered at 1744.

Based on a visual inspection after the event, the tube rupture was caused by a 3.48 in. by 0.2 in. (maximum) axial break in tube 18-25. At the time the LER was written, the cause of the break was believed to be corrosion-assisted cracking.

Activation of the Technical Support Center (TSC) to assist in recovery from the tube rupture was delayed because of freezing rain and ice buildup on the roads. In addition, the utility stated that discussions with NRC personnel at critical times interfered with the TSC emergency coordinator's management of the recovery.

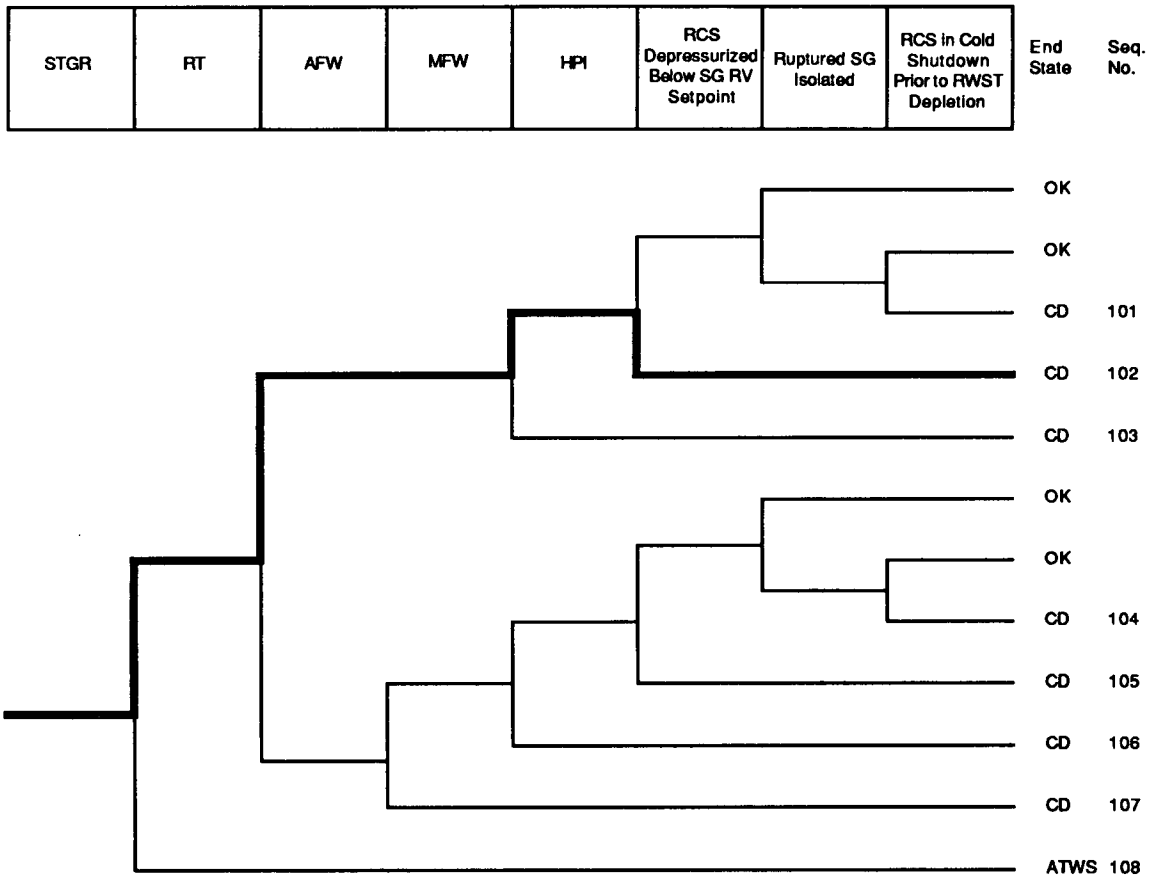
An unplanned radioactive release occurred as a result of the steam generator tube rupture. The release resulted from a steam release from the "A," "C," and "D" steam generator power-operated relief valves and from the condensate steam air ejector discharge to the unit vent. The total unplanned release averaged over the 2-h period from 2340 on March 7, 1989, to 0140 on March 8, 1989, was 12.72 Ci (^{133}Xe equivalent) and 5.24×10^{-4} Ci (^{131}I equivalent).

ASP Modeling Assumptions and Approach

The event has been modeled as a steam generator tube rupture. Information concerning the model used for the analysis is included with the documentation for LER 338/89-005.

Analysis Results

The core damage probability for this event is estimated to be 7.7×10^{-4} . Two sequences dominate this risk estimate: (1) successful AFW and HPI following the tube rupture with operator failure to depressurize the RCS below the SG relief valve setpoint, and (2) failure of HPI. The dominant sequence for this event is highlighted on the following event tree.



Dominant core damage sequence for LER 369/89-004

B-310

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 369/89-004
 Event Description: Steam generator tube rupture
 Event Date: 03/07/89
 Plant: PWR SGTR

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

SGTR 1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
SGTR	7.7E-04
Total	7.7E-04
ATWS	
SGTR	3.4E-05
Total	3.4E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
102	sgtr -rt -afw -hpi rcs.depr<sg.rv.setpoint	CD	4.1E-04	1.0E+00
103	sgtr -rt -afw hpi	CD	2.5E-04	8.4E-01
101	sgtr -rt -afw -hpi -rcs.depr<sg.rv.setpoint ruptured.sg.isol r cs.cold.prior.to.rwst.depl	CD	1.0E-04	1.0E+00
108	sgtr rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
101	sgtr -rt -afw -hpi -rcs.depr<sg.rv.setpoint ruptured.sg.isol r cs.cold.prior.to.rwst.depl	CD	1.0E-04	1.0E+00
102	sgtr -rt -afw -hpi rcs.depr<sg.rv.setpoint	CD	4.1E-04	1.0E+00
103	sgtr -rt -afw hpi	CD	2.5E-04	8.4E-01
108	sgtr rt	ATWS	3.4E-05	1.2E-01

** non-recovery credit for edited case

SEQUENCE MODEL: a:\1989\PWRSGTR.CMP
 BRANCH MODEL: a:\1989\PWRSGTR.NEW
 PROBABILITY FILE: a:\1989\PWR_BSL1.PRO

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
sgtr	5.0E-03	1.0E+00	
rt	2.8E-04	1.2E-01	
afw	3.8E-04	2.6E-01	
mfw	2.0E-01	3.4E-01	
hpi	3.0E-04	8.4E-01	
ruptured.sg.isol	1.0E-02	1.0E+00	
rcs.depr<sg.rv.setpoint	1.0E-05	1.0E+00	4.0E-04

Event Identifier: 369/89-004

B-311

rce,cold,prior.to.rwst.depl	1.0E-02	1.0E+00	4.0E-04
* branch model file			
** forced			

Minarick
06-17-1990
14:28:55