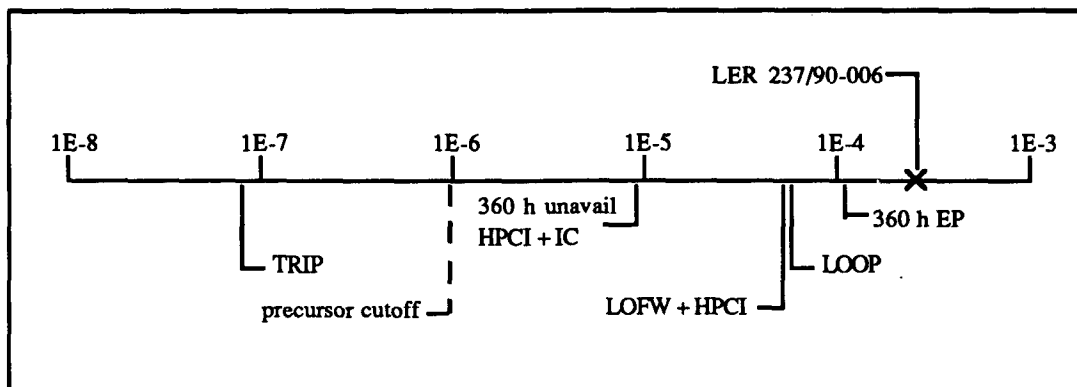


ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No.: 237/90-006
 Event Description: Stuck open safety relief valve followed by a manual scram
 Date of Event: August 2, 1990
 Plant: Dresden 2

Summary

Dresden had its Target Rock main steam combination safety relief valve (SRV) spuriously lift and stick open for 2.8 h on August 2, 1990. The valve lift was apparently caused by steam cuts on the first stage pilot valve disc. The unit was manually scrambled from 87% power. The conditional core damage probability estimated for this event is 2.6×10^{-4} . The relative significance of this event compared to other postulated events at Dresden 2 is shown below.



Event Description

During a Load Dispatcher requested power reduction from 90% power on August 2, 1990, the operators at Dresden received indication (acoustic monitor alarm, elevated tailpipe temperature, and a 600,000 lbm/h decrease in main steam flow indication) that the Target Rock SRV had spuriously opened. The operators were unable to close the valve and within 5 min they had started two containment cooling service water (CCSW) pumps and one low-pressure coolant injection (LPCI) pump to try and control the increasing suppression chamber temperature. However, the suppression chamber water temperature continued to rise, so they started the other two CCSW pumps and one additional LPCI pump. About 2 min later the operators manually scrambled the reactor from 87% power. They started the last two LPCI pumps about 3 min after that to

maximize suppression chamber cooling, and the main turbine main steam bypass valves were opened to limit the heat load on the suppression chamber.

Approximately 2.8 h after it opened the SRV was determined to be closed. The reactor was placed in cold shutdown about 5 h after the event began. The apparent cause of the failure of the Target Rock SRV was a severely steam cut pilot valve disc. Excessive steam leakage through the pilot sensing port and past the pilot valve via the severe steam cuts allowed pressure to be transferred to the second stage piston. The second stage piston was forced down, moving the second stage disc away from its seat. This permitted pressure from the top of the main valve piston to be vented via the second stage disc and out the main valve piston vent. This created a differential pressure across the main valve piston. Reactor pressure then lifted the main valve piston and the main valve disc, thus opening the valve. When reactor pressure reached approximately 100 psig, the main valve preload spring force overcame the reactor pressure force, and the main valve disc subsequently closed. The root cause for the steam cuts on the pilot disc is believed by the utility to be an inherent design deficiency.

The Target Rock SRV indicator on the front panel showed a closed position due to the position indicators receiving their signals from the pressure switches on the drywell pneumatic air line between the solenoid and the SRV. Indication of the open SRV was provided by its acoustic monitor and tailpipe temperature indication, and by a change in main steam flow indication.

When the SRV was inspected in the drywell, an electrical junction box in the vicinity of the valve was found detached from its mounting, and a pressure switch nearby had separated from its conduit. However, both remained functional.

Additional Event-Related Information

Dresden 2 has four electromatic main steam relief valves, eight spring-loaded main steam safety valves, and one Target Rock SRV. The relief valves and the Target Rock SRV relieve to the torus below the surface of the water, and the safety valves relieve to the drywell atmosphere.

The Target Rock SRV operates through self-actuation (safety mode) at 1135 psig reactor pressure, or through remote actuation of a solenoid valve that admits a pneumatic supply to an air operator. This remote actuation may occur from the following sources:

1. Remote manual switch in the control room.
2. High reactor pressure (1115 psig) from a pressure controller.
3. Initiation of automatic depressurization system (ADS) logic.

One other event (LER 237/76-034) like this occurred at Dresden 2 in 1976. The Target Rock SRV was opened during automatic blowdown surveillance testing and it remained open for approximately 3.8 h.

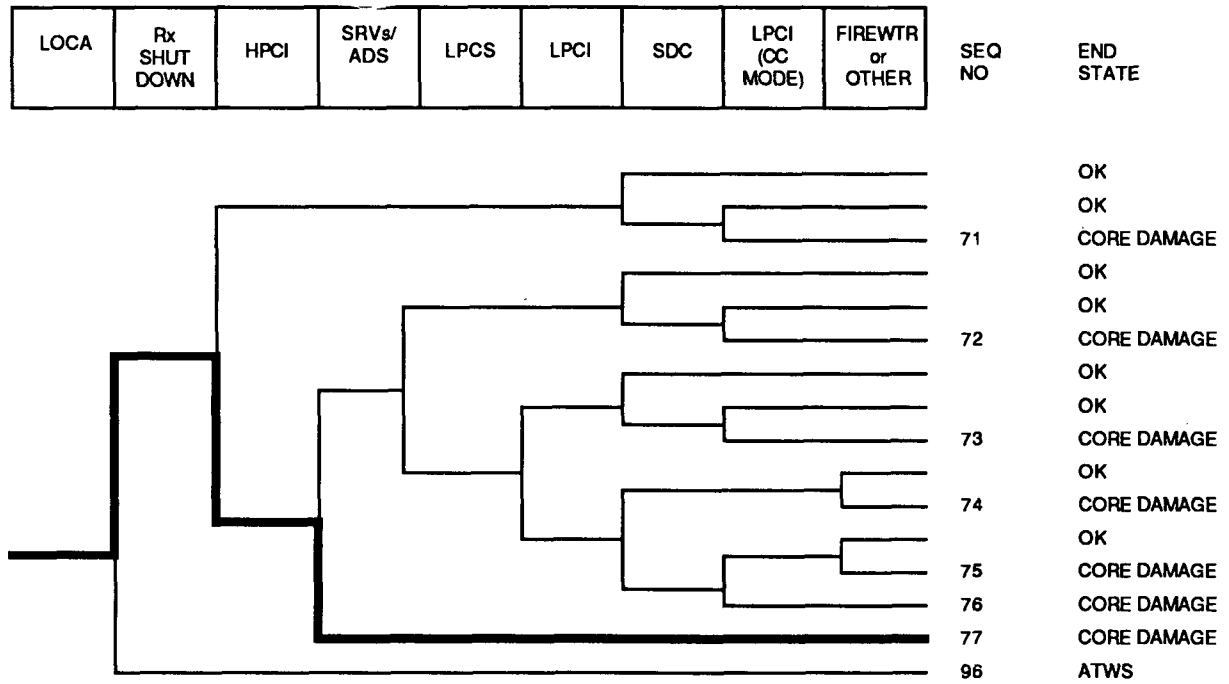
ASP Modeling Assumptions and Approach

This event has been modeled as a loss-of-coolant accident (LOCA) due to a stuck open relief valve.

Analysis Results

The conditional probability of severe core damage for this event is 2.6×10^{-4} . The dominant sequence associated with the event is highlighted on the following event tree. This sequence involves a LOCA with subsequent HPCI and ADS failure.

The LER for this report includes a detailed description of the operation of the Target Rock valve.



Dominant core damage sequence for LER 237/90-006

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 237/90-006
 Event Description: Stuck open relief valve followed by manual scram
 Event Date: 08/02/90
 Plant: Dresden 2

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOCA	1.0E+00
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SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
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CD

LOCA	2.6E-04
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Total	2.6E-04
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ATWS

LOCA	3.0E-05
------	---------

Total	3.0E-05
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SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
77 LOCA -rx.shutdown hpci srv.ads	CD	2.6E-04	5.0E-01
96 LOCA rx.shutdown	ATWS	3.0E-05	1.0E+00

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
77 LOCA -rx.shutdown hpci srv.ads	CD	2.6E-04	5.0E-01
96 LOCA rx.shutdown	ATWS	3.0E-05	1.0E+00

** non-recovery credit for edited case

SEQUENCE MODEL: c:\asp\1989\bwrseal.cmp

BRANCH MODEL: c:\asp\1989\dresden.sll

PROBABILITY FILE: c:\asp\1989\bwr_csll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	3.4E-04	1.0E+00	
loop	1.6E-05	3.6E-01	
LOCA	3.3E-06 > 3.3E-06	5.0E-01 > 1.0E+00	

Event Identifier: 237/90-006

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Branch Model:  INITOR
Initiator Freq:  3.3E-06
rx.shutdown      3.0E-05      1.0E+00
rx.shutdown/ep   3.5E-04      1.0E+00
pcs/trans        1.7E-01      1.0E+00
srv.chall/trans.-scram  1.0E+00      1.0E+00
srv.chall/loop.-scram  1.0E+00      1.0E+00
srv.close        1.6E-02      1.0E+00
emerg.power      2.9E-03      8.0E-01
ep.rec           6.6E-02      1.0E+00
fw/pcs.trans     2.9E-01      3.4E-01
hpci             2.9E-02      7.0E-01
isol.cond        2.0E-02      1.0E+00
crd              1.0E-02      1.0E+00      1.0E-02
srv.ads          3.7E-03      7.1E-01      1.0E-02
lpcs            2.0E-03      3.4E-01
lpci            1.0E-03      7.1E-01
sdc             2.9E-03      3.4E-01      1.0E-03
lpci(cc)         1.0E-03      3.4E-01
lpci(cc)/lpci    1.0E+00      1.0E+00
lpci(cc)/-lpci   0.0E+00      1.0E+00
firewater        1.0E+00      1.0E+00      2.0E-03

* branch model file
** forced

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Minarick
08-06-1991
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