B.31 LER No. 327/83-063

Event Description: Failure of Power Operated Relief Valve

Date of Event: April 21, 1983 through September 12, 1983

Plant: Sequoyah 1

B.31.1   Summary

On April 21, 1983, one of two power operated relief valves (PORVs) failed to open when operators attempted to reseat it, apparently because of a failed solenoid. The same PORV was found to be leaking through following valve maintenance on September 12, 1983. Failure of the PORV resulted in unavailability of feed and bleed. The increase in core damage probability (CDP) over the duration of the event, or importance, is 1.9×10^{-5}. The base-case CDP over the duration of the event is 6.0×10 , resulting in an estimated conditiional core probability of 7.9×10^{-5}.

B.31.2   Event Description

On April 21, 1983, with the unit at power, one of two PORVs failed to open when operators attempted to reseat it. The associated block valve was closed and power removed. Following maintenance during an outage on September 12, 1983, with the unit in Mode 3, the same PORV was found to be leaking through. The block valve was again closed and power removed. The most probable cause for the first event was determined to be a failed solenoid coil. The second event was attributed to the valve not fully closing. No root cause for this condition was provided. To correct the problem, it was decided to replace the PORV during the next refueling outage.

B.31.3   Additional Event-Related Information

None.

B.31.4   Modeling Assumptions

The NUREG-1150 analysis of Sequoyah 1 (NUREG/CR-4550, Vol. 5, Rev.1, Part 1) indicates that both PORVs are required for successful feed and bleed. Since one PORV was presumably unavailable, the feed and bleed branch was modelled by setting the failure probability of the serial component, i.e. the PORVs, to 1. The probabilities for failure of the PORVs to reseat once challenged (branch models PORV.RESEAT and PORV.RESEAT/EP) were also revised to reflect this. The Sequoyah final safety analysis report (FSAR) specifies a maximum time between PORV tests of 18 months or between each refueling shutdown, whichever occurs sooner. The date of the last refueling outage prior to the April 23, 1983 valve failure was not provided. In the absence of this information, the time the PORV was estimated to be unavailable was assumed to be half the maximum time between required PORV tests, i.e., nine months or 6570 hours. Since this is greater than

one year of reactor operation, the unavailability time was taken to be 6,132 hours (one reactor year, assuming the unit was critical 70% of the time). Transient (TRANS), loss-of-offsite power (LOOP), loss-of-coolant accident (LOCA), and steam generator tube rupture (SGTR) were used as potential initiators in the unavailability analysis.

B.31.5   Analysis Results

The increase in CDP, or importance, estimated for the event is 1.9×10^{-5}. Adding this value to the nominal CDP in the unavailability period, 6.0×10^{-5} (not shown on calculation sheet), results in an estimated conditional core damage probability of 7.9×10^{-5} The dominant sequence, highlighted on the event tree shown in Figure B.31.1, involves a postulated transient, failure of auxiliary feedwater and main feedwater, and failure of feed and bleed.
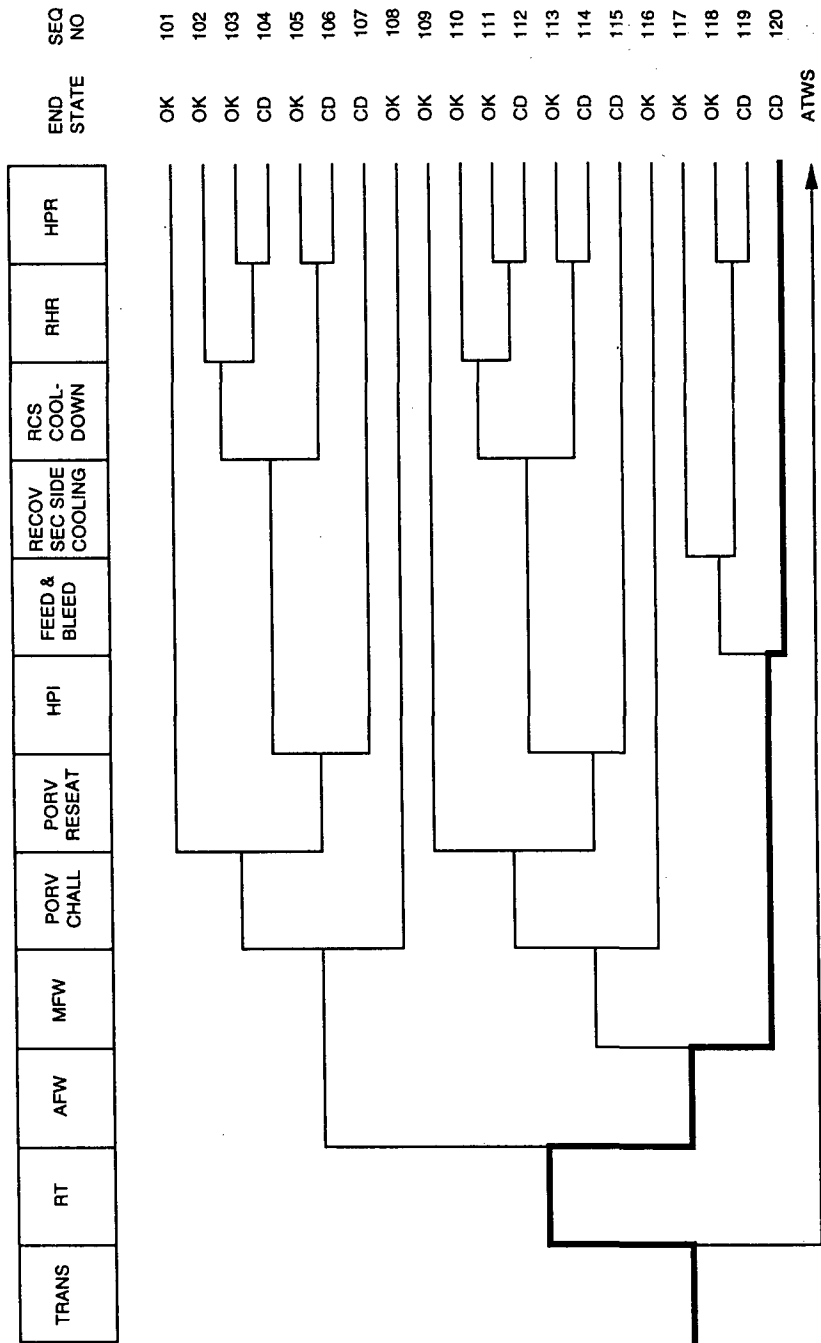
Figure B.31.1 Dominant core damage sequence for LER 327/83-063

LER No. 327/83-063

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 327/83-063
Event Description: PORV fails to open during attempt to reseat
Event Date: 9/12/83
Plant: Sequoyah 1

UNAVAILABILITY. DURATION= 6132

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS   9.6E+00
LOOP   5.3E-02
LOCA   7.9E-03
SGTR   1.0E-02

SEQUENCE CONDITIONAL PROBABILITY SUMS

    End State/Initiator   Probability

CD

    TRANS   1.1E-05
    LOOP   7.3E-06
    LOCA   9.0E-08
    SGTR   0.0E+00

    Total   1.9E-05

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
120	trans -rt afw mfw FEED.BLEED	CD	1.1E-05	1.5E-01
215	loop -rt(loop) -ep afw -offsite.pwr.rec/-ep.and.afw FEED.BLEED	CD	7.8E-06	2.4E-01
219	loop -rt(loop) -ep afw offsite.pwr.rec/-ep.and.afw FEED.BLEED	CD	5.6E-07	2.4E-01
229	loop -rt(loop) ep -afw/ep porv.chall/sbo PORV.RESEAT/EP	CD	(1.3E-06)	4.7E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
120	trans -rt afw mfw FEED.BLEED	CD	1.1E-05	1.5E-01
215	loop -rt(loop) -ep afw -offsite.pwr.rec/-ep.and.afw FEED.BLEED	CD	7.8E-06	2.4E-01
219	loop -rt(loop) -ep afw offsite.pwr.rec/-ep.and.afw FEED.BLEED	CD	5.6E-07	2.4E-01
229	loop -rt(loop) ep -afw/ep porv.chall/sbo PORV.RESEAT/EP	CD	(1.3E-06)	4.7E-01

** non-recovery credit for edited case

Note: For unavailabilities, conditional probability values are differential values which reflect the
added risk due to failures associated with an event. Parenthetical values indicate a reduction in
risk compared to a similar period without the existing failures.

SEQUENCE MODEL: c:\asp\1982-83\pwrb8283.cmp
BRANCH MODEL: c:\asp\1982-83\sequoy1.82
PROBABILITY FILE: c:\asp\1982-83\pwr8283.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	1.6E-03	1.0E+00	
loop	1.6E-05	5.3E-01	
loca	2.4E-06	5.4E-01	
sgtr	1.6E-06	1.0E+00	
rt	2.8E-04	1.0E-01	
rt(loop)	0.0E+00	1.0E+00	
afw	3.8E-04	4.5E-01	
afw/atws	4.3E-03	1.0E+00	
afw/ep	5.0E-02	3.4E-01	
mfw	2.0E-01	3.4E-01	1.0E-03
porv.chall	4.0E-02	1.0E+00	
porv.chall/afw	1.0E+00	1.0E+00	
porv.chall/loop	1.0E-01	1.0E+00	
porv.chall/sbo	1.0E+00	1.0E+00	
PORV.RESEAT	2.0E-02 > 1.0E-02	1.1E-02	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	2.0E-02 > 1.0E-02		
PORV.RESEAT/EP	2.0E-02 > 1.0E-02	1.0E+00	
Branch Model: 1.OF.1			
Train 1 Cond Prob:	2.0E-02 > 1.0E-02		
srv.reseat(atws)	1.0E-01	1.0E+00	
hpi	1.0E-05	8.9E-01	
FEED.BLEED	2.0E-02 > 1.0E+00	1.0E+00	1.0E-02
Branch Model: 1.OF.3+ser+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01		
Train 3 Cond Prob:	1.0E-02		
Serial Component Prob:	2.0E-02 > 1.0E+00		
emrg.boration	0.0E+00	1.0E+00	1.0E-02
recov.sec.cool	2.0E-01	1.0E+00	
recov.sec.cool/offsite.pwr	3.4E-01	1.0E+00	
rcs.cooldown	3.0E-03	1.0E+00	1.0E-03
rhr	2.2E-02	5.7E-02	1.0E-03
rhr.and.hpr	1.0E-03	1.0E+00	1.0E-03
hpr	4.0E-03	1.0E+00	1.0E-03
ep	2.9E-03	8.9E-01	
seal.loca	2.7E-01	1.0E+00	
offsite.pwr.rec/-ep.and.-afw	2.2E-01	1.0E+00	
offsite.pwr.rec/-ep.and.afw	6.7E-02	1.0E+00	
offsite.pwr.rec/seal.loca	5.7E-01	1.0E+00	
offsite.pwr.rec/-seal.loca	7.0E-02	1.0E+00	
sg.iso.and.rcs.cooldown	1.0E-02	1.0E-01	
rcs.cool.below.rhr	3.0E-03	1.0E+00	3.0E-03
prim.press.limited	8.8E-03	1.0E+00	

* branch model file
** forced