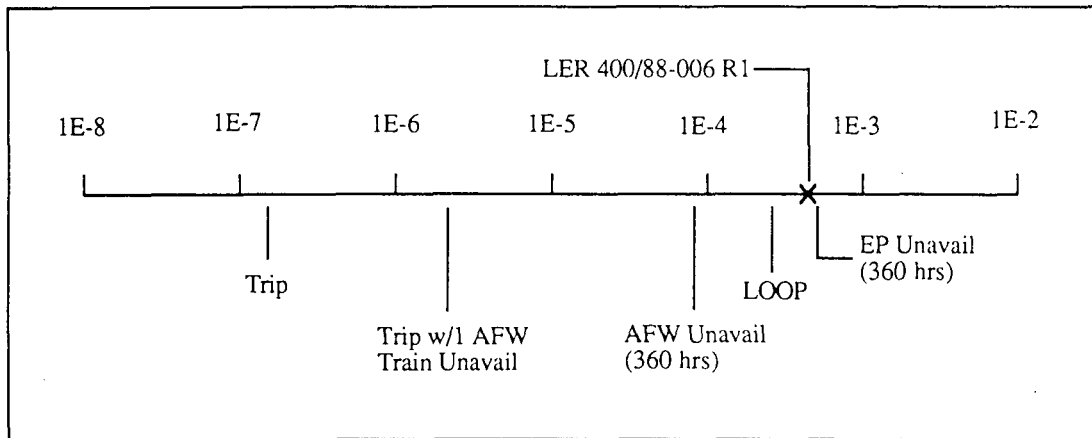


Accident Sequence Precursor Program Event Analysis

LER No: 400/88-006 R1
 Event Description: SWS pump seal water unavailable
 Date of Event: February 8, 1988
 Plant: Shearon Harris Unit 1

Summary

During surveillance testing of the emergency service water system, the nonsafety-related portion of the ESW pump seal water supply system failed to isolate as required due to an accumulation in two valves of debris from the raw lake water supply. The significance of the event is estimated to be 4.8×10^{-4} (this value may be conservative). The relative significance of this event compared with other potential events at Harris is shown below.



Event Description

During surveillance testing of the emergency service water system, the nonsafety-related portion of the ESW pump seal water supply system failed to isolate as required when valves 1SW-1335 and 1SW-1336 failed to close on demand due to accumulated debris from the ESW raw lake water supply. Additionally, check valve 1SW-1336 failed to properly seat. Upon confirming valve failure, both ESW trains were declared inoperable. Manual valves 1SW-1332 and 1SW-1324 were then closed, which restored operability of train A emergency service water, since the train was now isolated from the nonsafety-related piping.

Four days later, a concern was raised that the seal water piping configuration may be vulnerable to single passive failures that could

render both emergency service water trains inoperable. This problem was temporarily resolved by isolating the two ESW trains by a locked closed valve pending design changes to the system. Additional corrective action was taken to clean the debris from the valves.

Event-Related Plant Design Information

The ESW pumps are normally not in service; however, they will start on SIAS, LOOP, or low SWS header pressure. When ESW is not in use, one of the ESW pump seal/bearing water booster pumps (nonsafety) draws raw lake water from the ESW header and supplies clean water via a cyclone separator to the ESP pump seals and bearings. The separator is used to prevent debris accumulation between the bearing and shaft seals. The failure of the subject valves to close prevents the isolation of the nonsafety seal water booster pump and both trains of the safety-related ESW pump seal water supplies. Valves 1SW-1332 and 1SW-1324 were manually closed to provide isolation and restore ESW train "A" to operability. Since valve 1SW-1338 could not close, ESW train "B" was considered inoperable, although the valve could be manually closed if required.

Normally when ESW starts, the booster pumps trip off and the valves close to isolate the nonsafety portions of the system. Qualified ESW water is then provided by the safety-related ESW screen wash pumps, which tie into the seal water supply header downstream from the isolation valves.

ASP Modeling Assumptions and Approach

The event has been modeled as a potential ESW unavailability for one-half of a test period (360 h). This results in unavailability of emergency power, high-pressure injection, feed and bleed, and high-pressure recirculation. A value of 0.34 has been assigned to the likelihood of not recovering ESW prior to equipment damage.

Because the impact of the existing ESW seal diversion and debris on the systems cannot be fully ascertained from the LER, this assessment may be conservative.

Analysis Results

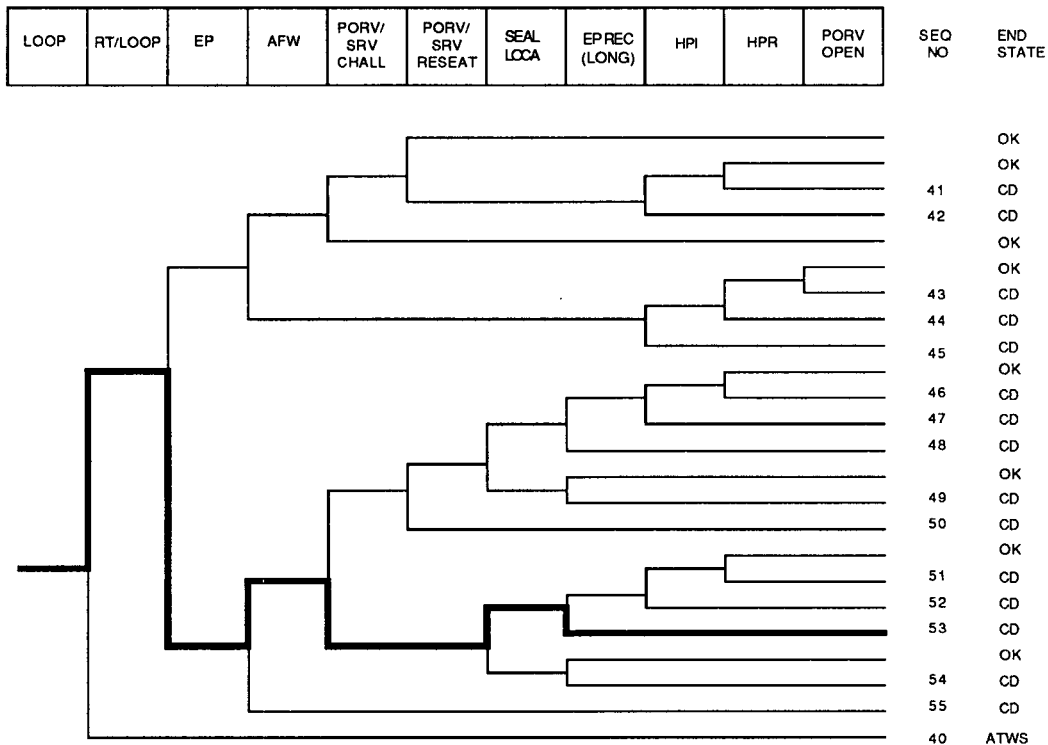
The significance of the event is estimated to be 4.8×10^{-4} , a significant event from an ASP standpoint. Dominant sequences involve:

- (1) a postulated LOOP during the vulnerability period ($p = 3.1 \times 10^{-3}$), failure to recover ESW and therefore emergency power ($p = 0.34$), a

subsequent RCP seal LOCA ($p = 0.27$), and failure to recover AC power prior to core uncover ($p = 0.57$); and

- (2) a postulated small-break LOCA ($p = 3.7 \times 10^{-4}$), with failure to recover ESW and subsequent HPI failure ($p = 0.34$).

Sequence (1) is highlighted on the following event tree.



Dominant Core Damage Sequence for LER 400/88-006 R1

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 400/88-006
 Event Description: SWS pump seal water is unavailable
 Event Date: 02/08/88
 Plant: Harris 1

UNAVAILABILITY, DURATION= 360

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

TRANS	2.0E-01
LOOP	3.1E-03
LOCA	3.7E-04

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
TRANS	2.8E-06
LOOP	1.0E-03
LOCA	3.7E-04
Total	1.4E-03
ATWS	
TRANS	0.0E+00
LOOP	0.0E+00
LOCA	0.0E+00
Total	0.0E+00

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

Sequence	End State	Prob	N Rec**
53 loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.loca ep.rec(s1)	CD	4.5E-04	5.2E-01
72 loca -rt -afw HPI	CD	3.7E-04	4.3E-01
52 loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.loca -ep.rec(s1) HPI	CD	3.4E-04	5.2E-01
54 loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall - seal.loca ep.rec	CD	1.5E-04	5.2E-01
55 loop -rt/loop EMERG.POWER afw/emerg.power	CD	5.3E-05	1.8E-01
48 loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.loca ep.rec(s1)	CD	1.8E-05	5.2E-01
47 loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.loca -ep.rec(s1) HPI	CD	1.4E-05	5.2E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

Sequence	End State	Prob	N Rec**
47 loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.loca -ep.rec(s1) HPI	CD	1.4E-05	5.2E-01
48 loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.loca ep.rec(s1)	CD	1.8E-05	5.2E-01
52 loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.loca -ep.rec(s1) HPI	CD	3.4E-04	5.2E-01
53 loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.loca ep.rec(s1)	CD	4.5E-04	5.2E-01
54 loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall - seal.loca ep.rec	CD	1.5E-04	5.2E-01
55 loop -rt/loop EMERG.POWER afw/emerg.power	CD	5.3E-05	1.8E-01
72 loca -rt -afw HPI	CD	3.7E-04	4.3E-01

Event Identifier: 400/88-006

** 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\sealmod\pwrbsseal.cmp
 BRANCH MODEL: c:\asp\sealmod\harris.sll
 PROBABILITY FILE: c:\asp\sealmod\pwr_bsll.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	5.5E-04	1.0E+00	
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	2.9E-03 > 1.0E+00	8.0E-01 > 1.0E+00	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	5.0E-02 > Unavailable		
Train 2 Cond Prob:	5.7E-02 > Unavailable		
afw	3.8E-04	2.6E-01	
afw/emerg.power	5.0E-02	3.4E-01	
mfw	1.0E+00	7.0E-02	1.0E-03
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	3.0E-04 > 1.0E+00	8.4E-01 > 1.0E+00	
Branch Model: 1.OF.3			
Train 1 Cond Prob:	1.0E-02 > Unavailable		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Train 3 Cond Prob:	3.0E-01 > Unavailable		
HPI(F/B)	3.0E-04 > 1.0E+00	8.4E-01 > 1.0E+00	1.0E-02
Branch Model: 1.OF.3+opr			
Train 1 Cond Prob:	1.0E-02 > Unavailable		
Train 2 Cond Prob:	1.0E-01 > Unavailable		
Train 3 Cond Prob:	3.0E-01 > Unavailable		
HPR/-HPI	1.5E-04 > 1.0E+00	1.0E+00	1.0E-03
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02 > Unavailable		
Train 2 Cond Prob:	1.5E-02 > Unavailable		
porv.open	1.0E-02	1.0E+00	4.0E-04

* branch model file
 ** forced

Minarick
 11-13-1989
 14:25:45

Event Identifier: 400/88-006