B.17 LER Number 301/92-003

Event Description: Plugged Safety Injection Pump Suction

Date of Event: September 18, 1992

Plant: Point Beach 2

B.17.1 Summary

Point Beach 2 was at 100% power on September 18, 1992 while performing the A train containment spray (CS) pump quarterly test. When the pump failed to pass the test, it was disassembled. A foam rubber plug, which had been installed in the RHR system 10 months earlier, was found in the suction line of the CS pump. This plug rendered the A train SI and RHR pumps inoperable for the 10 months it was installed. The conditional probability of subsequent core damage estimated for this event is 9.9×10^{-6}. The relative significance of the event compared to other postulated events at Point Beach 2 is shown in Fig. B.32.

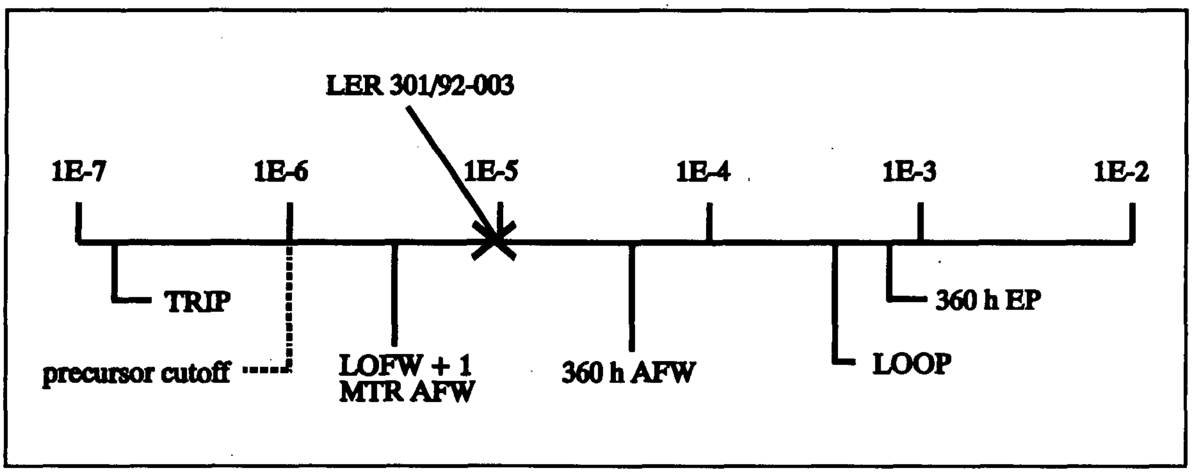

Fig. B.32. Relative significance of LER 301/92-003 compared with other potential events at Point Beach 2.

B.17.2 Event Description

On September 17, 1992, the CS system "Leakage Reductions and Preventive Maintenance Program Test" was conducted. This test requires each CS pump to be operated with its suction aligned to the discharge of its corresponding RHR pump. The RHR pump is operated with its suction aligned to the refueling water storage tank (RWST). After the test was completed, a significant difference was noted between the discharge pressures of the train A and train B CS pumps.

The following day, September 18, 1992, the quarterly test of the CS pumps was performed. This test, which consists of operating each CS pump with its suction aligned to the RWST and its discharge recirculating back to the RWST, was conducted while the plant was at 100% power. When the train A CS pump was started, an operator stationed at the pump noted that the pump suction pressure was oscillating. The pump was stopped and vented and then restarted. The pump discharge pressure was reading zero after the restart, so the pump was again stopped and vented. When the pump was started for a third time, the operator noted abnormal noises emanating from the pump. The train A CS pump was then secured. Upon disassembly of the pump, a foam rubber plug was found blocking the pump suction. The plug was removed, and the pump was reassembled. The pump subsequently tested satisfactorily.

The utility chartered an incident investigation team to attempt to determine the source of the foam rubber plug. Although the team could not conclusively ascertain the origin of the foam rubber plug, they determined that it was probably installed 10 months earlier as a temporary cleanliness barrier during modifications to the RHR system performed during the fall 1991 refueling outage. They also concluded that the most likely original location for the plug was in the portion of the common line between the train A RHR pump discharge to the train A CS pump and train A SI pump suction. In this location, the plug would not have affected any of the pumps in the initial injection mode but could have prevented both the A CS and the A SI pumps from operating in the long-term recirculation mode.

B.17.3 Additional Event-Related Information

The CS system provides a water spray to the containment atmosphere following a design basis accident. The system consists of two pumps which discharge to spray headers inside the containment building. The SI system provides high pressure, borated water to the reactor coolant system. Following initiation, the SI system's two pumps take suction from a concentrated boric acid storage tank (BAST). Following the depletion of the BAST, the system suction is automatically realigned to the refueling water storage tank (RWST). The residual heat removal (RHR) system functions as the low pressure safety injection system. Following actuation, it too takes suction from the RWST.

Following depletion of the RWST, these three systems are manually realigned. The RHR system is realigned to take suction from the containment sump, and discharge to the suction of the CS and SI pumps. The CS and SI systems are realigned to take suction from the RHR pump discharge (the CS system may not be required in the recirculation phase). Plant design prevents the CS and SI systems from taking suction directly from the containment sump. Therefore, plugging of the RHR discharge line could prevent the operation of the associated CS and SI pumps when the recirculation phase is initiated.

B.17.4 Modeling Assumptions

This event was analyzed because one train of both CS and SI were unavailable for operation in the recirculation mode for the 10 months of plant operation while the foam rubber plug was in the piping. The CS pump is not modeled in the current ASP model for Point Beach 2. Therefore, the impact of the foam rubber plug on the availability of the train A CS pump does not affect the estimation of the

conditional core damage probability for this event, and only the availability of the train A SI pump is addressed by the current model.

The foam rubber plug was found to be blocking the impeller suction of the train A CS pump. The plug had evidently migrated there when the CS pump was run with its suction aligned to the RHR pump discharge on September 17, 1992. Prior to that time the plug was presumably in the common line between the train A RHR pump discharge to both the A CS and the A SI pumps. If the plug had remained in that location, it would have prevented both the A CS pump and the A SI pump from operating in the recirculation mode. If not, the SI pump would have been started in the recirculation mode before the CS pump during an actual event. Therefore, the plug would have migrated to the suction of the SI pump and caused it to fail. Therefore it was assumed that the presence of the foam rubber plug in the A RHR pump discharge to the A CS and A SI pump suctions was equivalent to an unavailability of the A SI pump in the recirculation mode. This was modeled as the unavailability of one train of high-pressure recirculation (HPR) for 10 months.

The use of RHR as an alternate to HPR when HPI is successful and secondary feed is available was included in the modeling for this event. To do this, HPR failure was set to 1.0 in the model and the output of the computer model was mutiplied by the results of the event tree in Fig. B.33 for sequences where HPR failed, and AFW or MFW were successful (sequences 71 and 73). The model was also modified to include LPI as an alternative to a failed HPI system when secondary feed is available. In this case, HPI failure was multiplied by the results of the event tree shown in Fig. B.34 for sequences where AFW or MFW were sucessful (sequences 71-74). This modification does not have a significant effect on the results. The probabilities for the additional events are shown in Table B.9.

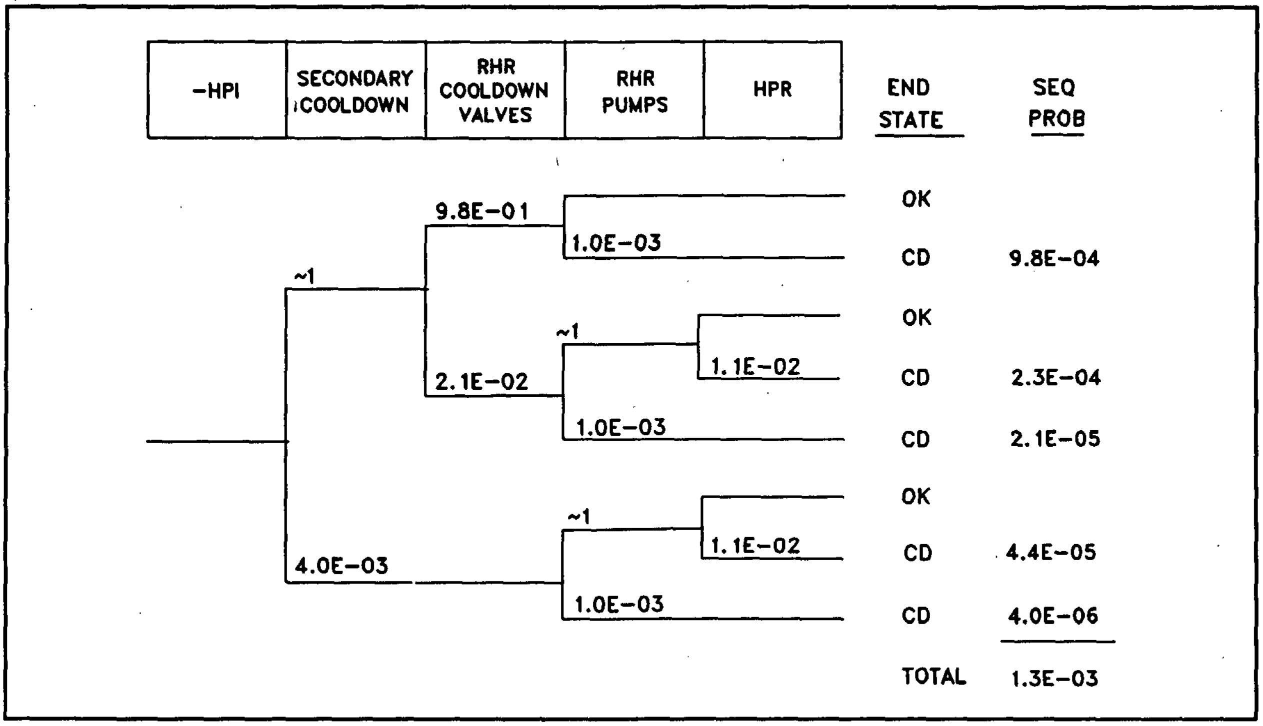

Fig. B.33. Modification to HPR event when HPI is successful and AFW or MFW is successful.

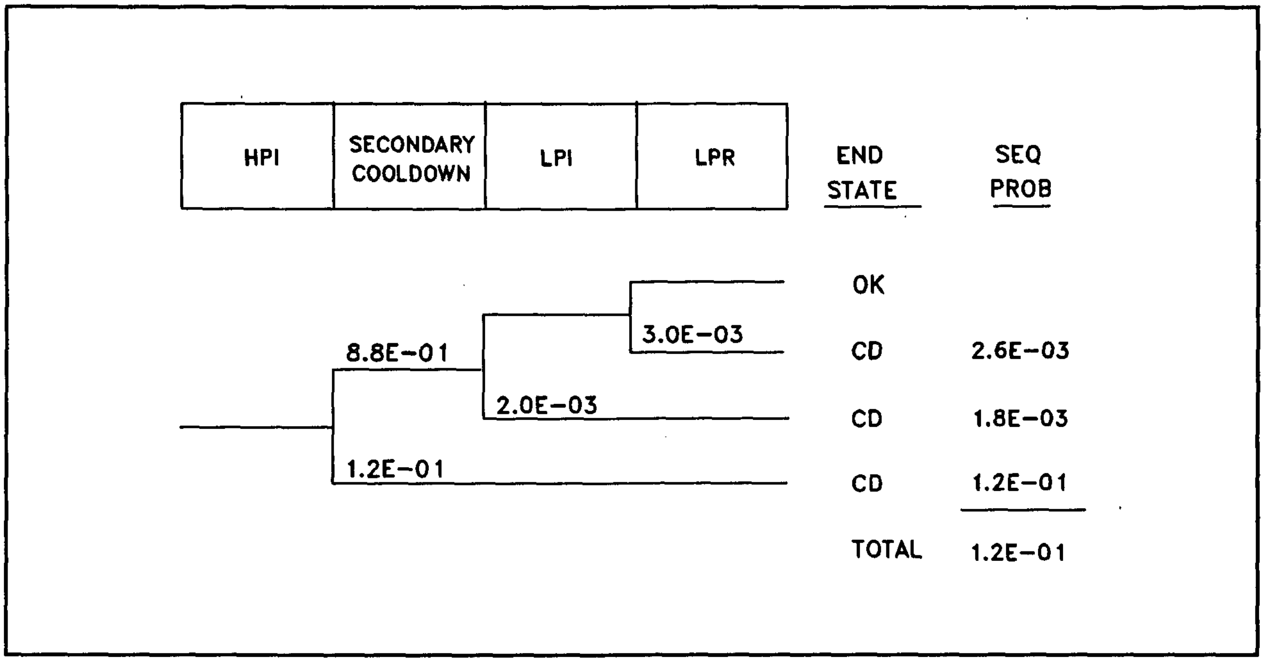

Fig. B.34. Modification to HPR event when HPI fails and AFW or MFW is successful.

Table B.9. Probability values used for modification of high-pressure recirculation event for 301/92-003.

Event	Model Probability	×	Non Recovery	+	Operator Action	=	Branch Probability
Secondary cooldown							
Following HPI Success	3.0E-03*		1.0		1.0E-03		4.0E-03
Following HPI Failure	3.0E-03*		1.0		1.2E-01		1.2E-01
RHR Cooldown Valves = VLV1+VLV2 + (VLV3×VLV4× VLV56×VLV6) = 0.01+0.01+ (0.01×0.015×0.3×0.5) = 0.02	2.0E-02		1.0		1.0E-03		2.1E-02
RHR Pumps	1.0E-03		1.0				1.0E-03
HPR = (VLV1+PMP1) × (VLV2+PMP2) = (0.01+0) × (0.015+1) = 0.01	1.0E-02		1.0		1.0E-03		1.1E-02
LPI = (PMPA + VLVA) + (PMPB + VLVB) = (0.01 + 0.01) × 0.1 = 0.002	2.0E-03		1.0				2.0E-03
LPR = (SUMPVLVA + RWSTVLVA) + (SUMPVLVB + RWSTVLVB) = (0.01 + 0.01) × 0.1 = 0.002	2.0E-03		1.0		1.0E-03		3.0E-03

*See NRR Daily Events Evaluation Manual, 1-275-03-336-01, January 31, 1992 (Preliminary).

B.17.5 Analysis Results

The estimated conditional core damage probability associated with this event is 9.9×10^{-6}. The dominant core-damage sequence, highlighted on the event tree in Fig. B.35, involves a postulated loss-of-coolant accident (LOCA) with successful auxiliary feedwater and high-pressure injection and failure of high-pressure recirculation.

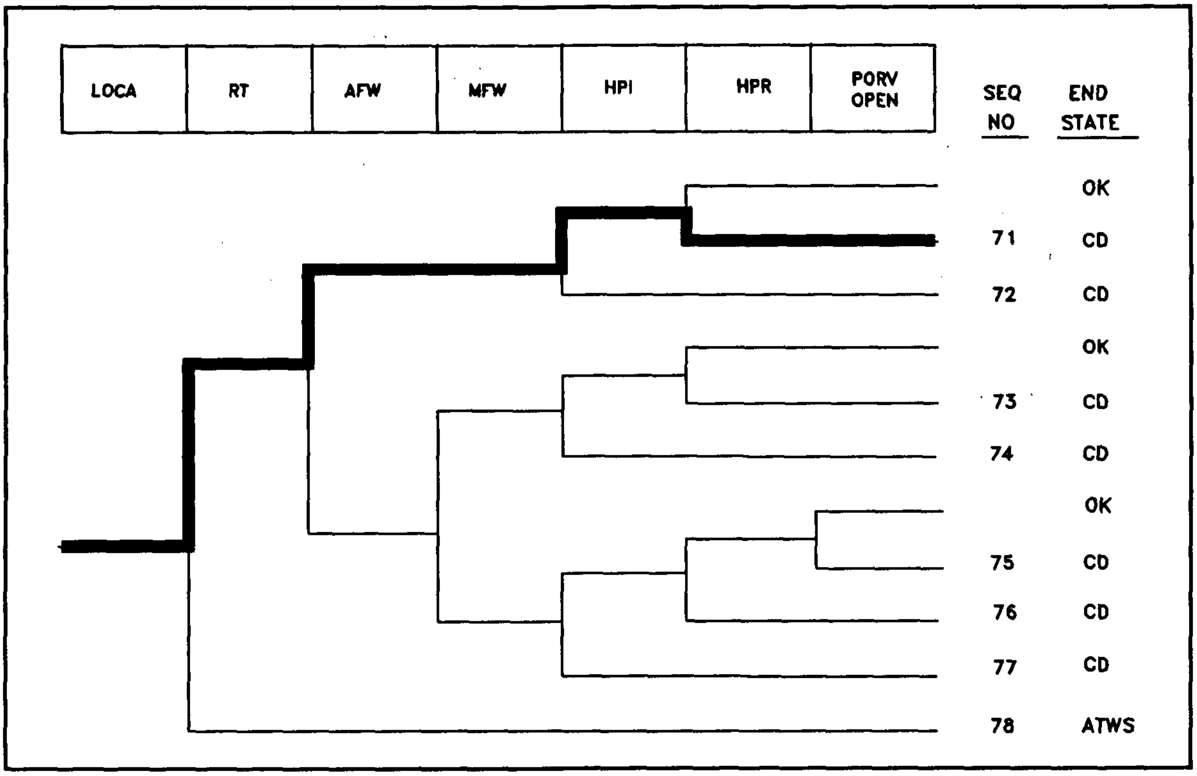

Fig. B.35. Dominant core damage sequence for LER 301/92-003.

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 301/92-010
Event Description: Foam Rubber Plug in RHR discharge line
Event Date: 09/18/92
Plant: Point Beach 2

UNAVAILABILITY, DURATION= 7488

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOCA	7.7E-03

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability (w/o modifications)	Probability (w/modifications)
CD		
LOCA	7.6E-03	9.9E-06[†]
Total	7.6E-03	9.9E-06
ATWS		
LOCA	0.0E+00	
Total	0.0E+00	

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
71	loca -rt -afw -HPI HPR/-HPI	CD	7.6E-03	4.3E-01

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
71	loca -rt -afw -HPI HPR/-HPI	CD	7.6E-03	4.3E-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.

Event Identifier: 301/92-010

SEQUENCE MODEL: s:\asp\prog\models\pwrbseal.cmp
BRANCH MODEL: s:\asp\prog\models\ptbeach2.sl2
PROBABILITY FILE: s:\asp\prog\models\pwr_prob.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	2.0E-04	1.0E+00	
loop	1.6E-05	3.6E-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	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	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	0.0E+00	1.0E+00	
ep.rec(sl)	0.0E+00	1.0E+00	
ep.rec	4.5E-01	1.0E+00	
HPI	1.0E-03 > 1.0E-04[2]**	8.4E-01 > 1.0E+00	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.0E-01		
hpi(f/b)	1.0E-03	8.4E-01	1.0E-02
HPR/-HPI	1.5E-04 > 1.0E+00 **	1.0E+00	1.0E-03 > 1.0E+00
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02		
Train 2 Cond Prob:	1.5E-02 > Failed		
porv.open	2.0E-02	1.0E+00	4.0E-04

* branch model file
** forced

Notes:

1 Includes use of RHR cooldown (see -HPI event tree). Probability = 7.6E-03 × 1.3E-03 = 9.9E-06.
2 Includes use of LPI and LPR for failed HPR (see HPI event tree). Probability = 1.0E-03 × 8.4E-01 × 1.2E-01 = 1.0E-04.

Event Identifier: 301/92-010