PRECURSOR DESCRIPTION SHEET

LER No.: 414/86-028
Event Description: SG PORVs open inadvertently in test, and trip with other failures occurs
Date of Event: June 27, 1986
Plant: Catawba 2

EVENT DESCRIPTION

Sequence

During a loss of control room function test from 24% power, an unexpected plant transient, SG depressurization, and reactor trip occurred as a result of test procedure errors. The procedure provides reactor guidelines to demonstrate, principally

1. that the plant can be brought to hot standby-conditions from a moderate power level (10—25%) using only the auxiliary shutdown panel controls,
2. that the plant can be maintained at hot standby conditions for 30 min from the auxiliary shutdown panels, and
3. that the RCS can be cooled down at least 50°F from a steady state hot standby condition while being operated from the auxiliary shutdown panel controls.

In accordance with the test procedure, the reactor was manually tripped at the reactor trip switchgear at 0942 h. MFW isolation and the autostart of both motor-driven AFW pumps occurred 12 s later. Low-low levels subsequently occurred in all four SGs. The AFW pump turbine automatically started on low-low level in two out of four SGs. MFW pump 2-B later tripped at 0942:42 h on low suction flow.

Unit control was transferred from the control room to the auxiliary shutdown panel at 0942:49 h. The letdown pressure control valve, 2NV-148A, unexpectedly failed open when the transfer occurred. Letdown flow indication began to oscillate rapidly. Charging flow spiked to a maximum of 178 gal/min at approximately 0946:30 h. Letdown was manually isolated after pressurizer level dropped to <20%. Letdown flow dropped to ~15 gal/min by 0947:30 h.

At 0946:59 h, the SG PORV breakers at the AFW turbine control panel were closed in accordance with the procedure. When the breakers were energized, SG A, B, C, and D PORVs opened to 75%. This was a result of the SG PORV manual loaders being initially set to what was thought to be the 1125 psig opening set point. A design change had modified the SG PORV controls, but the modification had not been adequately understood.

The SG PORV opening caused a rapid depressurization of the secondary side with an accompanying cooldown of the primary side. Personnel observed the decreasing steam pressure and attempted to increase the set point for SG PORV opening, but they actually opened the PORVs further. Personnel in the control room observed the actual SG PORV positions go Open, but did not immediately communicate this to personnel at the auxiliary shutdown panel because of the nature of the test. SG levels responded to the SG PORV openings by first swelling and then dropping rapidly off the narrow range scale. The auxiliary shutdown panel operators were observing wide range indication. The AFW turbine had been secured at 0945:45 h. For ~4.5 min the SGs were blowing down through the SG PORVs, with AFW flow being provided to SG D.

Pressurizer pressure dropped off scale (<1700 psig) ~2 min after the SG PORVs opened. SI condition on low pressurizer pressure (1845 psig) occurred at 0949:46 h. SI condition on low steam-line pressure loop D (725 psig) occurred at 0950:08 h. However, SI was partially blocked at that time because control had been transferred to the auxiliary shutdown panel operators. Several containment isolation valves closed automatically, and charging suction was automatically aligned to the refueling water storage tank when the SI conditions were satisfied.

As pressurizer level continued to decrease, personnel at the auxiliary shutdown panel manually started centrifugal charging pump 2-B. However, because of valve controller labeling problems, operators as the auxiliary shutdown panel reduced charging flow rather than increasing it while adjusting the manual loader for 2NV-294, charging pumps flow control valve.

At approximately 0953:30 h, the decision was made to terminate the test and return control to the control room. At 0953:14 h, the senior reactor operator directed personnel to swap control back to the control room. When this was done, SI was immediately actuated due to the unblocking of the still-present actuation signal. Both DGs actuated on LOCA condition. The SG PORVs reclosed on transfer of controls. The SI signal started the RHR pumps, SI pumps, and the AFW turbine pump and opened volume-control-pump discharge to cold-leg isolation valves 2NI-9A and 2NI-10B and associated AFW valves. Valve 2NV-148A reclosed following the transfer.

Both DG load sequencers completed accelerated sequencing within ~21 s. SI flow restored pressurizer level to 33% and pressure to 1250 psig within ~5.5 min.

At 0958 h, SI was reset, the cold-leg-injection isolation valves were closed, and the SI system and RHR pumps were secured. The SI had further reduced steam-line pressure to ~480 psig and primary coolant temperature to ~468°F. The AFW was secured at 1000 h.

Corrective Action

A review of all design changes and construction department shutdown requests implemented after hot functional testing and before fuel load was performed prior to the unit reentering Mode 2, startup.

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A review of both units' auxiliary shutdown panels and AFW pump turbine control panels was performed, and numerous unit differences and labeling problems were identified. Labeling problems were corrected. Revisions were made to operating and abnormal procedures. Also added were instructions to manually initiate SI, containment spray, and annulus ventilation if required following a loss of control room incident.

Plant/Event Data

Systems Involved:
SG atmospheric dump system

Components and Failure Modes Involved:
PORVs — failed open in test

Component Unavailability Duration: NA
Plant Operating Mode: 1 (24% power)
Discovery Method: Testing
Reactor Age: 0.1 year
Plant Type: PWR

Comments

None

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

SLB	0.12	No recovery assumed possible because of the test criteria; leak isolable from the control room when the test was terminated

Branches Impacted and Branch Nonrecovery Estimate

SS release terminated	1.0	Recoverable from control room but recovery was delayed due to numerous procedure and operator errors
HPI	1.0	Valve labeling errors resulted in the inability to provide sufficient HPI flow during the test

Plant Models Utilized

PWR plant Class F

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CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 414/86-028
Event Description: SG PORVs Open with Plant Trip and Other Failures at Catawba
Event Date: 6/27/86

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

SLB 1.2E-01

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
SLB	1.1E-04
Total	1.1E-04
ATWS	
SLB	3.6E-06
Total	3.6E-06

DOMINANT SEQUENCES

End State: CD Conditional Probability: 7.7E-05

107 SLB -RT REQ.SG.ISO -AFW HPI

End State: ATWS Conditional Probability: 3.6E-06

112 SLB RT

SEQUENCE CONDITIONAL PROBABILITIES

Sequence	End State	Prob	N Rec**
104 SLB -RT -REQ.SG.ISO AFW HPI(F/B)	CD	3.3E-05	3.2E-02
107 SLB -RT REQ.SG.ISO -AFW HPI	CD	7.7E-05 *	1.2E-01
112 SLB RT	ATWS	3.6E-06 *	1.4E-02

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* dominant sequence for end state
** non-recovery credit for edited case

MODEL: c:\asp\newmodel\pwrbmslb.txt
DATA:

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
SLB	1.1E-07 > 1.1E-07	1.0E+00 > 1.2E-01	
Branch Model: INITOR			
Initiator Freq:	1.1E-07		
RT	2.5E-04	1.2E-01	
REQ.SG.ISO	6.4E-04	1.0E+00	
AFW	1.0E-03	2.7E-01	
HPI	1.0E-03 > 1.0E+00	5.2E-01 > 1.0E+00	
Branch Model: 1.OF.2			
Train 1 Cond Prob:	1.0E-02 > Failed		
Train 2 Cond Prob:	1.0E-01 > Failed		
HPI(F/B)	1.0E-03 > 1.0E+00	5.2E-01 > 1.0E+00	4.0E-02
Branch Model: 1.OF.2+opr			
Train 1 Cond Prob:	1.0E-02 > Failed		
Train 2 Cond Prob:	1.0E-01 > Failed		
HPR/-HPI	3.0E-03	5.6E-01	4.0E-02
PORV.OPEN	1.0E-02	1.0E+00	
REQ.BA.ADDITION	8.3E-04	1.0E+00	
PORV.OPEN.DUE.TO.HPI	8.0E-01	1.0E+00	
PORV.CLOSURE	6.0E-03	1.0E+00	

*** forced

Austin
09-11-1987
13:53:04

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