PRECURSOR DESCRIPTION SHEET

LER No.: 458/86-002
Event Description: Hand-held radio causes LOOP
Date of Event: January 1, 1986
Plant: River Bend 1

EVENT DESCRIPTION

Sequence

At 0941 h with the unit in hot shutdown and cooling down from a reactor trip that had occurred ~6 h earlier (see LER 458/86-001) preferred station transformers A and C tripped. Recirculation pump A tripped, the operating condensate pump tripped, and the reactor water cleanup system isolated. RPS bus A deenergized, initiating a half scram and partial isolation of the nuclear steam supply shutoff system. The partial NSSSS isolation caused an instrument air isolation to the reactor building, which caused the scram valves to leak, thereby causing the scram discharge volume to fill. This filling subsequently resulted in an RPS actuation on high scram-discharge-volume level at 0957 h. Upon the preferred station transformer trips, division I and III DGs started, division I emergency ventilation systems autostarted, and standby service-water pumps A, B, C, and D load sequenced. Normal service-water pump B and circulating-water pump B were still running but without any bearing cooling water because bearing-cooling-water pump A had lost power. At 1001 h the MSIV automatically isolated due to decreasing condenser vacuum.

At 1003 h operators were dispatched, and they attempted to recover deenergized load centers. At 1031 h, RPS bus A was reset. Later, an electrical panel was discovered deenergized because of a blown fuse in a transformer. This loss had caused several control building HVAC and fuel building HVAC dampers to close, which then caused the division I control building chiller to trip. Subsequent attempts to restore operation of chillers B and D were also unsuccessful. The partial NSSSS isolation remained sealed in because of the deenergized electrical panel.

The RPS actuation was reset at 1042 h. At 1044 h, ~1 h after the initiating event, preferred station transformers B and D tripped. The station was now in a complete LOOP. The division II DG started and sequenced properly. An unusual event was immediately declared, and abnormal operating procedures were initiated. Reactor water level was +80 in. on the shutdown range, and pressure was at 240 psig.

At 1114 h the half RPS actuation was reset, and power to RPS bus B was restored. At 1124 h the preferred station transformers were energized, but the supply breakers to the plant could not be closed. It was determined that breaker closure was locked out by the tone-relaying transfer trip (fiber-optic) system, which could not be reset. At 1130 h this backup system was disabled and the breakers were closed. All in-house loads were restored, and the unusual event ended after 1 h and 10 min.

An investigation of the protective relaying revealed that no protective relaying targets had been initiated. Further, the trip signals sent to the lockout relays could only have been initiated by a spurious signal in the backup pilot wire or tone-relaying transfer trip circuits. Functional and diagnostic testing of both the pilot wire and tone-relaying circuits showed that both systems were operating as designed at the time of testing. Two items were noted: (1) spurious trips could be generated on the tone-relaying system with hand-held radios in close proximity (within approximately a 10- to 12-ft radius) of the transmitters/receivers and (2) some of the tone-relaying keying and rack power were supplied from two separate battery sources. Although no spurious trips could be simulated by testing, this type of connection could result in transients within the tone-relaying equipment. It was decided to correct the wiring in the field such that keying power and rack power were supplied by the same battery source.

Two types of hand-held radios were tested. They are commonly used on site by security and operations personnel. Both of these radios were keyed to transmit inside the control building of the Fancy Point switchyard, and both caused spurious trips on the tone-relaying system. Careful consideration led to the conclusion that it was highly probable that the LOOP was caused by radio frequency interference.

Also investigated was the difficulty in resetting the lockout relays. Because of the complexity of the tone-relaying and pilot-wire-tripping circuitry, the resetting of the lockout relays must be performed in the proper sequence. Operations procedures were determined to have addressed the required sequence.

Corrective Action

As a result of this event, several corrective actions have been completed or are in progress. These corrective actions in part include

1. installation of shielding on the tone-relaying equipment in the Fancy Point switchyard,
2. rewiring the tone equipment such that both channels are required for tripping,

3. changing dc power supplies to tone-relaying equipment such that the keying and rack power are both supplied from the same dc source,
4. installation of sequence of event recorders in the switchyard and at the generator/transformers protective relaying panel,
5. installation of additional drainage reactors at the plant end of the pilot wire shielding, and
6. installation of supervisory control and data acquisition (SCADA) system alarms to provide annunciation in the main control room and at the Government Street transmission and distribution control center for loss of channel signals on tone-relaying equipment.

Plant/Event Data

Systems Involved:
Power system (ac), pilot-wire relay system, tone-relaying transfer trip system, plant communications system

Components and Failure Modes Involved:
Hand-held radios — gave false signals to tone-relaying transfer trip system
Power relay (ac) — transferred open
Main feedwater — failed in operation

Component Unavailability Duration: NA
Plant Operating Mode: 3 (0% power)
Discovery Method: Operational event
Reactor Age: 0.2 year
Plant Type: BWR

Comments

None

MODELING CONSIDERATIONS AND DECISIONS

Initiators Modeled and Initiator Nonrecovery Estimate

LOOP	1.0	Nonrecovery

Branches Impacted and Branch Nonrecovery Estimate

None

Plant Models Utilized

BWR plant Class C

Event Identifier: 458/86-002

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

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Event Description: Hand Held Radio Causes LOOP
Event Date: 1/1/86
Plant: River Bend 1

INITIATING EVENT

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP	1.0E+00

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CV	
LOOP	9.0E-08
Total	9.0E-08
CD	
LOOP	7.0E-05
Total	7.0E-05
ATWS	
LOOP	1.9E-05
Total	1.9E-05

DOMINANT SEQUENCES

End State: CV Conditional Probability: 8.9E-08

226 LOOP -EMERG.POWER SCRAM -SLC.OR.RODS HPCI RCIC/TRANS.OR.LOOP -SRV.ADS -LPCS -RHR(SDC)

End State: CD Conditional Probability: 4.5E-05

201 LOOP -EMERG.POWER -SCRAM SRV.CHALL/LOOP.-SCRAM -SRV.CLOSE -HPCI RHR(SDC) RHR(SPCOOL)/-
LPCI.RHR(SDC) C.I.AND.V/RHR(SDC).RHR(SPCOOL)

End State: ATWS Conditional Probability: 1.7E-05

Event Identifier: 458/86-002

240 LOOP -EMERG.POWER SCRAM SLC.OR.RODS

SEQUENCE CONDITIONAL PROBABILITIES

	Sequence	End State	Prob	N Rec**
201	LOOP -EMERG.POWER -SCRAM SRV.CHALL/LOOP.-SCRAM -SRV.CLOSE -HP CI RHR(SDC) RHR(SPCOOL)/-LPCI.RHR(SDC) C.I.AND.V/RHR(SDC).RHR(SPCOOL)	CD	4.5E-05 *	1.1E-01
209	LOOP -EMERG.POWER -SCRAM SRV.CHALL/LOOP.-SCRAM SRV.CLOSE -HP CI RHR(SDC) RHR(SPCOOL)/-LPCI.RHR(SDC) C.I.AND.V/RHR(SDC).RHR(SPCOOL)	CD	2.8E-06	1.1E-01
215	LOOP -EMERG.POWER -SCRAM SRV.CHALL/LOOP.-SCRAM SRV.CLOSE HP CI RCIC/LOCA SRV.ADS	CD	1.7E-05	2.4E-01
226	LOOP -EMERG.POWER SCRAM -SLC.OR.RODS HPCI RCIC/TRANS.OR.LOOP -SRV.ADS -LPCS -RHR(SDC)	CV	8.9E-08 *	2.4E-01
240	LOOP -EMERG.POWER SCRAM SLC.OR.RODS	ATWS	1.7E-05 *	1.0E+00
243	LOOP EMERG.POWER -SCRAM SRV.CHALL/LOOP.-SCRAM -SRV.CLOSE HP CI RCIC/TRANS.OR.LOOP	CD	1.6E-06	1.9E-01
246	LOOP EMERG.POWER -SCRAM SRV.CHALL/LOOP.-SCRAM SRV.CLOSE HP CI RCIC/LOCA	CD	2.4E-06	2.7E-01
250	LOOP EMERG.POWER SCRAM	ATWS	2.1E-06	8.0E-01

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

SEQUENCE MODEL: c:\asp\newmodel\bwrctree.cmp
BRANCH MODEL: c:\asp\newmodel\riverbnd.txt
PROBABILITY FILE: c:\asp\newmodel\bwr_c.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
TRANS	8.6E-04	1.0E+00	
LOOP	1.7E-05 > 1.7E-05	3.2E-01 > 1.0E+00	
Branch Model: INITOR			
Initiator Freq:	1.7E-05		
LOCA	3.3E-06	5.0E-01	
SCRAM	3.5E-04	1.0E+00	
SLC.OR.RODS	1.0E-02	1.0E+00	4.0E-02
PCS/TRANS	1.7E-01	1.0E+00	
PCS/LOCA	1.0E+00	1.0E+00	
SRV.CHALL/TRANS.-SCRAM	1.0E+00	1.0E+00	
SRV.CHALL/TRANS.SCRAM	1.0E+00	1.0E+00	
SRV.CHALL/LOOP.-SCRAM	1.0E+00	1.0E+00	

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SRV.CHALL/LOOP.SCRAM	1.0E+00	1.0E+00	
SRV.CLOSE	5.9E-02	1.0E+00	
EMERG.POWER	7.5E-03	8.0E-01	
FW/PCS.TRANS	4.6E-01	3.4E-01	
FW/PCS.LOCA	1.0E+00	3.4E-01	
HPCI	2.0E-02	3.4E-01	
RCIC/TRANS.OR.LOOP	6.0E-02	7.0E-01	
RCIC/LOCA	1.0E+00	1.0E+00	
CRD	1.0E-02	1.0E+00	4.0E-02
SRV.ADS	3.7E-03	7.1E-01	4.0E-02
COND/FW.PCS	1.0E+00	3.4E-01	
LPCS	2.0E-02	3.4E-01	
LPCI(RHR)/LPCS	6.0E-04	7.1E-01	
RHRSW/LPCS.LPCI.TRANS	1.0E+00	1.0E+00	
RHRSW/LPCS.LPCI.LOOP	1.0E+00	1.0E+00	
RHRSW/LPCS.LPCI.LOCA	1.0E+00	1.0E+00	
RHR(SDC)	2.1E-02	3.4E-01	
RHR(SDC)/-LPCI	2.0E-02	3.4E-01	
RHR(SDC)/LPCI	1.0E+00	1.0E+00	
RHR(SPCOOL)/-LPCI.RHR(SDC)	2.0E-02	1.0E+00	
RHR(SPCOOL)/LPCI.RHR(SDC)	5.2E-01	1.0E+00	
C.I.AND.V/RHR(SDC).RHR(SPCOOL)	1.0E+00	3.4E-01	

* branch model file
** forced

Minarick
02-24-1988
12:17:28

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