

## PRECURSOR DESCRIPTION AND DATA

NSIC Accession Number: 158233

Date: June 25, 1980

Title: Loss of Reactor Coolant Pumps and Top Head Bubble Incident at St. Lucie 1

### The failure sequence was:

1. With the reactor at 100% power, moisture in the vicinity of the solenoid for valve HCV-14-6 resulted in a short circuit across the solenoid valve terminal board. This caused one of the two in-series containment isolation valves in the component cooling water (CCW) common return line from all reactor coolant pumps (RCPs) to fail closed. This resulted in unavailability of component cooling water to all RCPs.
2. The operators manually tripped the plant and RCPs seven minutes later.
3. Natural circulation flow using the steam generators (SGs) was initiated and plant cooldown was began.
4. The CCW flow was restored by jumping the failed valve at 1-1/2 hours after its failure but plant cooldown was continued.
5. The cooldown rate did not exceed Tech. Spec. limits, but unknown to the operator, the top head was not cooling down as fast as the primary loops.
6. While reducing pressurizer pressure (using auxiliary spray from the charging system) to initiate the shutdown cooling system (SCS), the top head water flashed to steam and formed a large steam bubble. The bubble was not initially detected by the operators.
7. Pressure and level oscillations occurred in the reactor coolant system (RCS) as a result of the steam bubble. Pressurizer level fluctuations continued for approximately 6 h. Each time charging was shifted to the cold leg, the steam bubble slowly condensed and shrank.
8. The plant finally cooled down to the SCS entry condition and entered SCS at 235 psi. At this time the SCS relief valves opened, slowly discharging RCS water to the refueling water tank, a result of a partially opened valve in the recirculation line from LPSI pump 1B. (The LPSI pumps double as SCS pumps). The second LPSI was subsequently initiated and operated in the injection mode to restore RCS pressure until the shutdown cooling loops were isolated from the RWST (approximately 1-1/2 h).
9. Conduction cooling of the top head eventually collapsed the bubble.

### Corrective action:

1. The solenoid and terminal block were replaced.
2. The RCP seals required replacement.
3. The blowdown line which was the source of steam that caused the short was modified by replacing flanged (leaking) joints with welded joints.

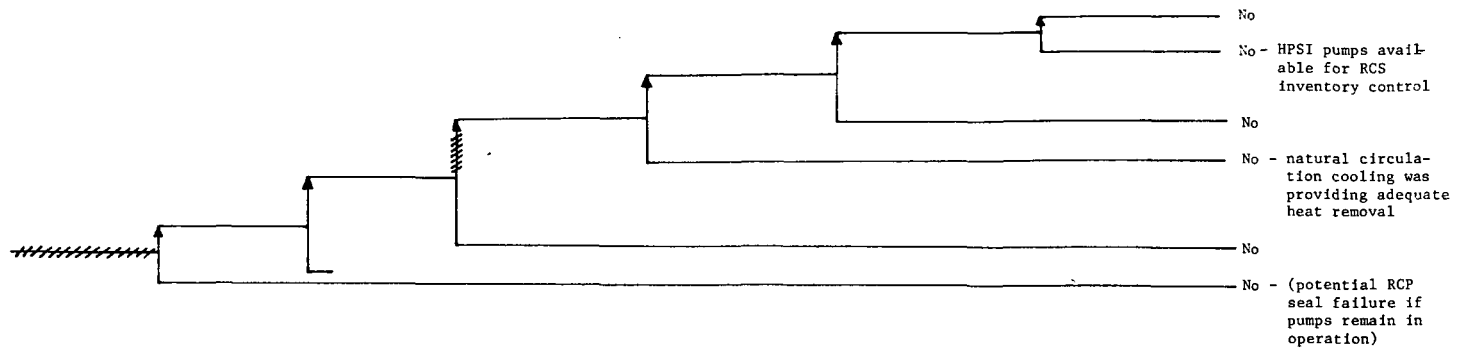
4. A backup nitrogen supply was provided to the RCP CCW isolation valves.
5. A manual jacking device was made more accessible.

Design purpose of failed system or component:

1. The CCW RCP discharge line is common to all RCPs and is part of the RCP seal cooling system.
2. The LPSI recirculation line is used to prevent deadheading of the pump.

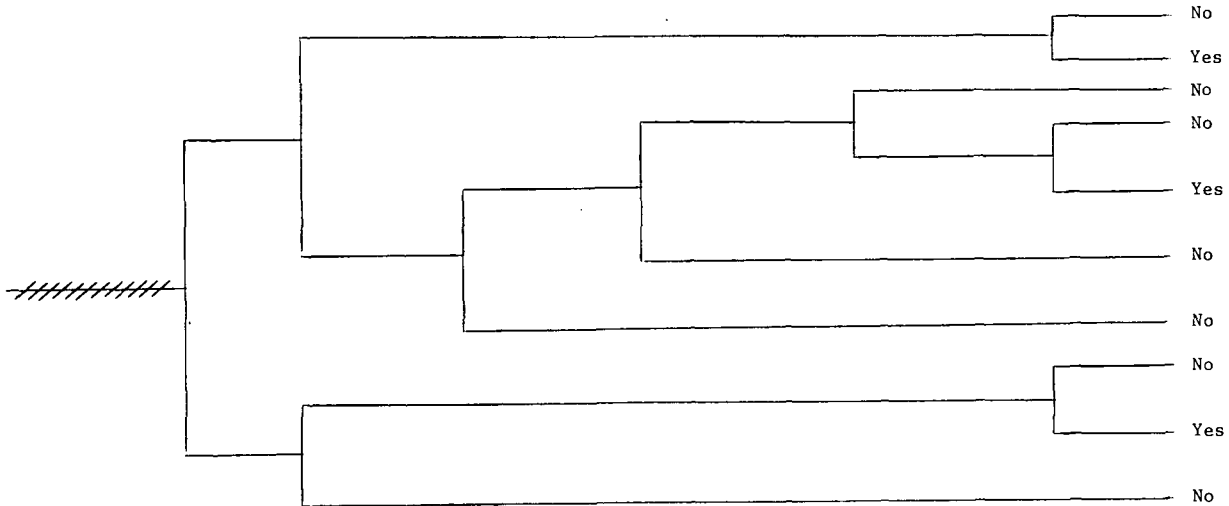
Reactor at power and RCP CCW return valve fails shut due to shorted solenoid	Manual Reactor/RCP trip	Natural circulation cooldown initiated	Due to slower top head cooling than RCS, steam bubble forms in top head when auxiliary spray was used to reduce pressurizer level (Anomalous pressurizer response noted)	RCS cooldown depressurization to SCS entry point effected and SCS initiated	Leakage from shutdown cooling loops to RWST occurs due to partially open recirculation valve	Second LPSI pump used to re-establish RCS inventory
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Potential Severe Core Damage



NSIC 158233 - Actual Occurrence for Loss of Reactor Coolant Pumps and Top Head Bubble Incident at St. Lucie 1

Reactor at power and RCP CCW return valve fails shut due to shorted solenoid	Manual reactor/RCP trip	RCP seal failure due to loss of CCW	Due to slower top head cool-down than RCS, steam bubble forms in top head	Steam bubble prevents natural circulation	Lack of natural circulation detected by operator and RCP started for core cooling	High pressure injection	Potential Severe Core Damage	Sequence No.
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NSIC 158233 - Sequence of Interest for Loss of Reactor Coolant Pumps and Top Head Bubble Incident at St. Lucie 1

CATEGORIZATION OF ACCIDENT SEQUENCE PRECURSORS

NSIC ACCESSION NUMBER: 158233

LER NO.: 80-029

DATE OF LER: June 25, 1980

DATE OF EVENT: June 11, 1980

SYSTEM INVOLVED: Component cooling water, reactor coolant

COMPONENT INVOLVED: Solenoid valve

CAUSE: Short circuit resulted in a failed-closed solenoid valve

SEQUENCE OF INTEREST: Loss of RCP seal cooling

ACTUAL OCCURRENCE: Loss of RCP seal cooling

REACTOR NAME: St. Lucie 1

DOCKET NUMBER: 50-335

REACTOR TYPE: PWR

DESIGN ELECTRICAL RATING: 802 MWe

REACTOR AGE: 4.1 years

VENDOR: Combustion Engineering

ARCHITECT-ENGINEERS: Ebasco

OPERATORS: Florida Power and Light

LOCATION: 12 miles SE of Ft. Pierce, Florida

DURATION: N/A

PLANT OPERATING CONDITION: Full power

TYPE OF FAILURE: Inadequate performance;  
failed to start

DISCOVERY METHOD: Operational event

COMMENT: