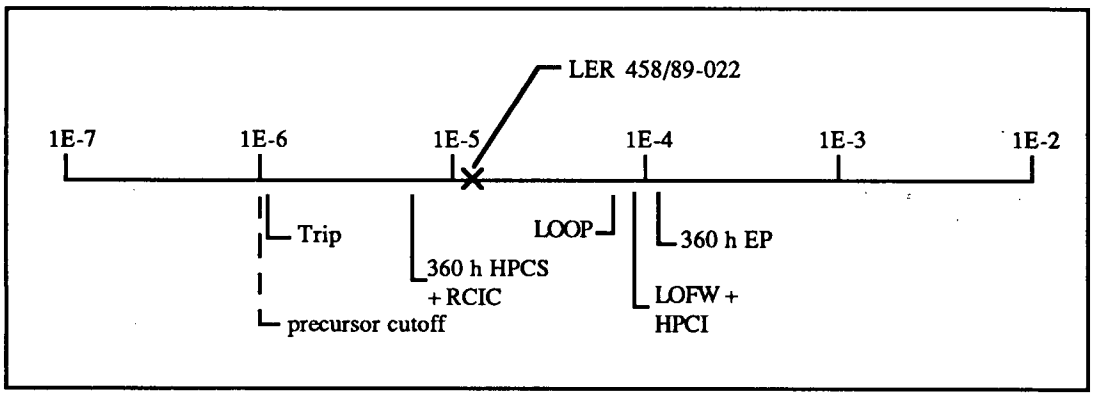
ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No: 458/89-022
Event Description: IA solenoid valves backward, impacting long-term ADS operability
Date: May 2, 1989
Plant: River Bend 1

Summary

During a refueling outage, it was discovered that solenoid isolation valves were installed backward on the outlets of air dryers supplying control air to the safety/relief valves (SRVs). Thus installed, they could not properly isolate the safety-related air system from nonsafety-related systems. This could impact long-term ADS operability. The conditional probability of core damage estimated for the event is 1.3×10^{-5}. The relative significance of this event compared with other postualted events at River Bend is shown below.



Event Description

During a test procedure, it was noted that a safety/relief valve air dryer (1SVV*DRY1A) was not properly isolated when its isolation valves were closed. No differential pressure was observed across its outlet isolation valve when the dryer casing was vented. It was discovered that the valve (solenoid valve 1SVV*SOV21A) was installed backward. In this configuration it could not prevent backflow toward the dryer (air pressure tended to lift the valve disk off the seat). The same situation was also identified with redundant dryer 1SVV*DRY1B and its isolation, 1SVV*SOV21B. Valves 1SVV*SOV21A and B were reoriented in the correct direction and were verified to work properly.

The utility noted that while short-term ADV operability was provided by the accumulators associated with the SRVs, long-term operability could be impacted.

Additional Event-Related Information

Normal control air supply to the SRV accumulators is from nonsafety-related compressors C4A and C4B. The River Bend USAR indicates that these compressors are not among the loads that can be powered from emergency power supplies, and it is anticipated that they would not be available during a seismic event or on a loss of offsite power. In these events, the nonsafety-related dryers (DRY1A and DRY1B) are isolated and bypassed. Compressed air from the safety-related penetration valve leakage control system (PVLCS) can be routed through the bypass to supply SRV accumulators and suppression pool level instrumentation.

In the event of failure of the air dryer or associated piping, the safety-related air system would not have been isolated from the nonsafety-related system. Until this condition was corrected, it would not have been possible to replenish the SRV accumulators or compensate for backleakage through the accumulator check valves. The accumulator air supplies are sufficient to permit four or five operations of each SRV when the drywell is at normal atmospheric pressure, provided check valve leakage is within design.

It was also noted during analysis that there is a line connecting the air dryer and the instrument air system. This line is depicted in the USAR as having only a normally open, manually operated valve (SVV-V120 / SVV-V127) between a main instrument air header and the air dryer. This implies that the air supply to the SRV accumulators could also have been impaired by a loss of instrument air, given the incorrect orientation of the SOVs. In addition, this could have provided an unanticipated load on the PVLCS.

ASP Modeling Assumptions and Approach

In an attempt to bound the significance of this event, the potential for long-term inoperability of ADS following unavailability of the instrument air system was addressed through consideration of the dominant LOOP sequence, that involves ADS. A LOOP was picked because it would result in inoperability of the instrument air compressors, since they are powered from buses that are not loaded on the diesel generators. The dominant LOOP sequence involving ADS is failure of an SRV (opened for pressure control) to close, with failure of HPCS and failure to depressurize using ADS.

Based on the utility comment that only long-term ADS operability would be impacted by

the event, it was assumed that the ADS would fail after 2 h, unless offsite power was recovered by that time.

For the above sequence and a 1-year exposure time, the following sequence probability is estimated:

p(LOOP in 1-year period) × p(SRV sticks open) × p(HPCS or HPCS diesel fails) × p(offsite power not recovered within 2 h) = (0.1) × (0.053) × (0.02) × (0.12) = 1.3×10^{-5}.

Analysis Results

The conditional core damage probability estimated for the event is 1.3×10^{-5}. This is considered a bounding analysis and involves substantial uncertainty. The dominant core damage sequence involves a postulated LOOP that is not recovered within 2 h (which renders ADS unavailable) with failure of an SRV to close and failure of high-pressure core spray.