

LER 313/83-015

Event Description: Transient with One HPI Injection Valve Failed Closed

Date of Event: June 16, 1983

Plant: ANO 1

Summary

On June 16, 1983 while in hot shutdown following a main turbine generator exciter failure reactor trip, high- pressure injection (HPI) system control valve CV-1219 failed to open on demand from the control room. The valve was being opened to allow additional makeup flow following the reactor trip. Redundant HPI valves CV-1220, CV-1227 and CV-1228 were available and operable. A redundant valve was immediately used and CV-1219 was opened manually. The root cause could not be determined, and subsequent valve testing could not duplicate the failure. Contacts on the torque switch were found to be slightly corroded, but investigation of the circuit revealed that this should not have prevented CV-1219 from opening. The HPI system at ANO 1 has three pumps. Two pumps provide coolant to the reactor coolant cold legs through four injection lines. The third pump can be used in the event that one of the normally used pumps is unavailable. When valve CV-1219 failed to open, only one injection line was inoperable. All pumps were still operable and three injection lines remained.

This event was modeled as a transient with one HPI injection valve inoperable. The HPI model consists of three trains that are assumed to be dominated by pump failures. Thus, the HPI model does not directly address the failure of the injection valves. To address the failure of one of the four injection valves, the branch probability for HPI was modified by adding the probability of failure of the three remaining injection valves given one injection valve failed, i.e.,

$$p(HPI)_{new} = p(HPI)_{old} + p(\text{second injection valve fails} / \text{one injection valve failed}) \\ + p(\text{third injection valve fails} / \text{two injection valves failed}) \\ + p(\text{fourth injection valve fails} / \text{three injection valves failed})$$

The conditional failure probabilities for the injection valves are shown in the following table. Since feed and bleed (FEED.BLEED) utilizes the HPJ pumps and injection valves, the FEED.BLEED branch probability was modified in the same manner as the HPI branch probability. The estimated conditional core damage probability for this event is 2.9×10^{-6} . The dominant sequence was an anticipated transient without scram (ATWS) sequence which involved the failure to trip and the failure of auxiliary feedwater (AFW) given ATWS. The second highest contributing sequence involved a successful reactor trip, failure of the auxiliary feedwater system, failure of main feedwater, and failure of feed and bleed.

Conditional Failure Probabilities for HPI Injection Valves

Event	Failure Probability
Second injection valve fails given the first injection valve failed	0.1
Third injection valve fails given two injection valves failed	0.3
Fourth injection valve fails given three injection valves failed	0.5