ACT time line additions .mLm

From: David Loveless
To: Gody, Tony
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Subject: ACT: time line additions

The last one is already on there, but the words, "from offsite power" should be added.

David

B/34

prelim LOOP risk for AIT. WYE

The Nuclear Regulatory Commission's Management Directive 8.3, "Incident Investigation Program," documents the NRC's formal process conducted for the purpose of accident prevention. This directive documents a risk-informed approach to determining when the agency will commit additional resources for further investigation of an event. The risk metric used for this decision is the conditional core probability. Because there is a lack of complete information at the time of initial decision-making, a preliminary evaluation is performed.

A loss of offsite power is a significant event at any nuclear facility, and more so for a Combustion Engineering plant without primary system power-operated relief valves, because of the inability to perform a reactor coolant system feed and bleed evolution. To evaluate this event, the analyst used the Standardized Plant Analysis Risk Model for Palo Verde (SPAR), Revision 3 model, and modified appropriate basic events to include updated loss of offsite power curves published in NUREG CR-5496. The analyst evaluated the risk associated with the Unit 2 reactor because it represented the dominant risk of the event.

For the preliminary analysis, the analyst established that a loss of offsite power had occurred and that the event may have been recovered at a rate equivalent to the industry average. Both Emergency Diesel Generator A and Charging Pump E were determined to have failed and assumed to be unrecoverable. Additionally, the analyst ignored all sequences that included a failure of operators to trip reactor coolant pumps, because all pumps trip automatically on a loss of offsite power. The conditional core damage probability was estimated to be 6.5×10^{-4} indicating that the event was of substantial risk significance and warranted an augmented inspection team.

Risk Significance of the Event

The initial risk assessment for Unit 2 resulted in a conditional core damage probability (CCDP) of 6.5×10^{-4}. The initial CCDP for Units 1 and 3 was estimated as 3.2×10^{-4} per unit. Subsequently, the team, assisted by Office of Nuclear Regulatory Research personnel, completed a detailed risk assessment for the event. This analysis used the Standardized Plant Analysis Risk (SPAR) Model for Palo Verde 1, 2, & 3, Revision 3.03, to estimate the risk. The analyst assumed that 95 percent of loss of offsite power events, similar to the June 14th event, would be recovered within 2-1/2 hours. The resulting CCDPs were 4×10^{-5}, 7×10^{-4}, and 4×10^{-5} for Units 1, 2, and 3, respectively.

The team gathered information concerning the failed emergency diesel generator and charging pump in Unit 2. Other equipment problems including turbine-driven auxiliary feedwater pump drains, power-operated relief valves problems, and 13.8 kV breaker issues were assessed. In addition, the team evaluated the ability of the licensee to recovery offsite power, the probability that power could be provided to the vital buses from the gas turbine generators had it been needed, and the capability of vital and nonvital batteries to continue to provide control power, had a station blackout occurred.

The team made the following assumptions critical to the analysis:

- The Unit 2 Emergency Diesel Generator A failed and could not have been recovered prior to postulated core damage.

- A Unit 2 licensed operator misaligned the suction path to Charging Pump E causing the pump to trip on low suction pressure. The pump could not have been recovered prior to postulated core damage because the pump was air bound.

- The required mission times, during this specific event, for the emergency diesel generators and the turbine-driven auxiliary feedwater pump were 2.5 hours.

- Recovery of ac power to the first vital bus, via the gas turbine generators or offsite power, was possible within one hour following a postulated station blackout. This assumption was derived from the following facts and their associated timeframes:

  - the east switchyard bus was energized from offsite power (32 minutes);
  - the gas turbine generators were started and loaded (29 minutes);
  - licensed operators determined the grid to be stable (49 minutes); and
  - power can be aligned from east bus to a vital 4160 volt bus (≈30 minutes).

- The probability that operators failed to restore offsite power within 1 hour was 4×10^{-2} as determined using the SPAR-H method. The nominal action failure rate of 0.001 was modified because the available time was barely adequate to accomplish the breaker alignments necessary, the operator stress level would have been high, and the actions required were of moderate complexity.

- The probability that operators failed to restore offsite power prior to the core becoming uncovered during a reactor coolant pump seal LOCA was estimated as 4×10^{-3}. The same performance shaping factors were used as for the 1-hour recovery with the exception of the time available. The team determined that the time available was

nominal, because there would be some extra time, above what is minimally required, to execute the recovery action.

- The failure probability for recovery of offsite power prior to battery depletion during a station blackout was estimated as 4×10^{-3}. The same performance shaping factors were used as for the seal LOCA recovery.

- The team concluded that the failures of 13.8 kV feeder breakers in Units 1 and 3 would have increased the complexity in recovering offsite power for these units. However, the potential contribution of common cause failure probabilities would not greatly impact the nonrecovery probabilities described previously for Unit 2.

- The Palo Verde gas turbine generators used for station blackout could be started and loaded within one hour of blackout initiation. One gas turbine generator can provide power to switchyard components and supply one Unit 1 vital 4160 volt bus. Both generators can provide one vital bus on Units 1 and 2 or Units 1 and 3, but not Units 2 and 3.

To account for the offsite power circumstances on June 14, 2004, the team modified the SPAR to replace industry average loss of offsite power nonrecovery probabilities with ones derived from actual grid conditions and estimated probabilities of human actions failing. Additionally, modeling of the Palo Verde gas turbine generators was improved to better represent their contribution in providing power to vital buses if needed. The team determined that this modified SPAR was an appropriate tool to assess the risk of this event.

The team set the likelihood of a loss of offsite power to 1.0, and the likelihood of all other initiating events were set to the house event FALSE, indicating the assumption that it is unlikely that two initiating events would occur at the same time. The failure to start and failure to run basic events for both Emergency Diesel Generator A and Charging Pump E were set to the house event TRUE, permitting calculation of the probability that similar components would fail from common cause. The SPAR model was quantified following the modifications, and the mean of the best estimate CCDPs were obtained through Monte Carlo simulation of the event.

0803 Gas Turbine Generator 1 energizing NAN S07

0830 Operators determined that switchyard parameters are stable (perturbations had been noted previously)

0927 Unit 2 PBA S03, vital 4160 volt bus, energized from offsite power