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Your Turn

On August 23, 2000, while raising the turbine-driven Auxiliary Feedwater (TDAFW) pump speed from approximately 1400 rpm to its rated speed of 4400 rpm, the control room operator noted that the turbine speed would at times not respond to the motion of the speed control switch and at other times raise in spurts. Also during the start, a senior reactor operator in the pump room noted that at times the speed control servo motor was turning without any corresponding motion of the turbine governor steam valve. These observations were documented in CR-08-23. Engineering personnel and the Shift Manager evaluated the condition and concluded that the observed governor valve response was consistent with the expected response in that, at certain points, substantial motion of the speed control servo motor is necessary to cause a perceptible change in governor steam valve position. The corrective action assignment for CR-08-23 was to have the system engineer observe the next periods of pump operation.

The next operation of the TDAFW pump was a regularly scheduled surveillance test performed on November 20, 2000. During the test, the turbine was started and warmed up at its minimum operating speed of approximately 1400 rpm. Following the warmup, control room operators were unable to increase turbine speed above its starting speed through operation of the TDAFW pump speed control switch. The discharge pressure of the pump at that speed was 200 psig, which was insufficient pressure for the pump to provide feedwater to the steam generators. The licensee declared the pump inoperable and documented the surveillance test failure in CR-11-20.

The TDAFW pump speed control switch in the control room operates a speed control servo motor mounted on the turbine governor. The servo motor is connected through reduction gears and a mechanical coupling to the manual speed control knob on the governor, which positions the governor steam valve. The manual speed control knob is held on the governor shaft by a self-locking nut and Belleville washers. The knob is keyed to the shaft through an outward bend in the clutch spring that engages a groove on the inner surface of the knob.

Following the surveillance test failure, the licensee disassembled the speed control servo motor and the associated coupling. The mechanic performing the disassembly found the self-locking nut loose and the outward bend in the clutch spring sheared off. Because of the lack of engagement between the manual speed control knob and the governor shaft, the servo motor could not turn the governor shaft. The inspector concluded that this failure mechanism would not readily allow recovery of the pump by local manipulation of the speed control knob.

Note: It is difficult to prove that the pump was inoperable on 8/23/2000. The time difference between 8/23/2000 (assuming operability on 8/23) and 11/20/2000 is 88 days. Using the $t/2$ rule, the exposure time is 44 days, and you should use this number in your calculations.

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