



THE BRUNSWICK UNIT 1 EVENT

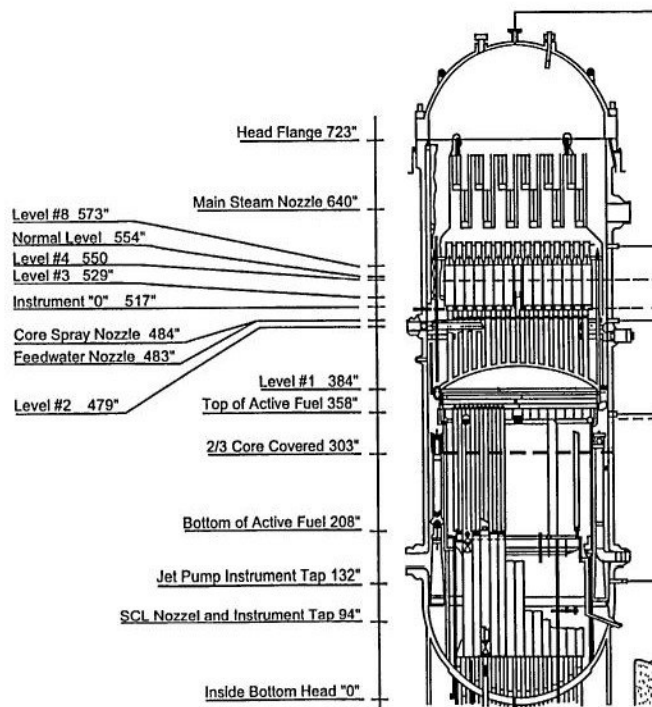
Nuclear Regulatory Commission (NRC) Daily Event Report No. 41837 summarized information the agency received from Progress Energy about an unplanned reactor scram of Unit 1 at their Brunswick Steam Electric Plant in North Carolina on July 13, 2005. Progress Energy informed the NRC that Unit 1 automatically scrammed from 100 percent power. Progress Energy updated their report on July 14th to inform the NRC that the scram was caused by a short on one of the main generator control switches. This Issue Brief focuses on something that did not happen during this event – operation of the Reactor Core Isolation Cooling (RCIC) system.

In their initial report, Progress Energy told the NRC that Unit 1’s “response to the reactor shutdown resulted in a reactor coolant level transient that caused a Low Level 2 signal,” that “the HPCI system started,” and that “Proper operation of the RCIC system has not been conclusively determined.”

“Low Level 2” refers to a water level setpoint within the reactor vessel. As shown in the representative schematic of boiling water level instrumentation, Low Level 2 still provides about ten feet of water above the top of the nuclear fuel in the reactor core.

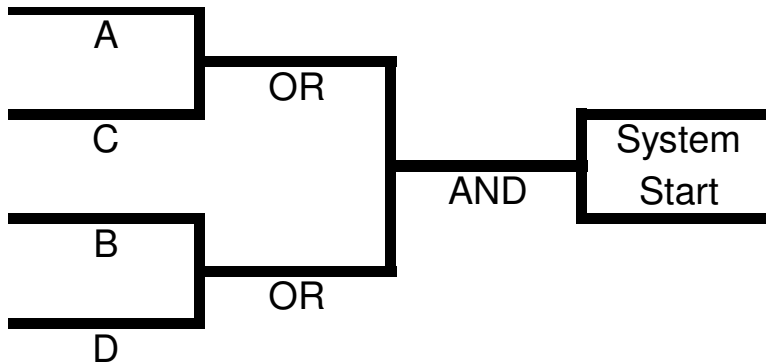
“HPCI” refers to the High Pressure Coolant Injection System while “RCIC” refers to the Reactor Core Isolation Cooling System. HPCI is one of the emergency core cooling systems (ECCS) that function to mitigate plant accidents. RCIC is not one of the ECCS, but it is credited as a mitigative measure in event of a station blackout (loss of electrical grid and failure of the onsite emergency diesel generators) because it needs no electricity for its pump (steam-driven turbine instead) and uses DC-power from batteries for its valves and controls. HPCI provides nearly 5,000 gallons per minute of makeup water to the reactor vessel. RCIC provides a more modest

600 gallons per minute. A key reason for the difference is that HPCI needs to provide sufficient water to cool the reactor and also compensate for water being lost through a broken pipe. RCIC, on the other hand, needs to only supply enough water to cool the reactor. Both HPCI and RCIC normally take their water from the Condensate Storage Tank, a 100,000-plus-gallon tank located out back behind the reactor building, although they can also take water from the torus, a large pool of water located in the basement of the reactor building.



At 5:41pm on July 14th, Progress Energy updated its report to the NRC about the event. They stated, “it was determined that the RCIC system performed appropriately (i.e., was not required to start) in response to the reactor coolant level transient. Reactor coolant level decreased to near, but did not exceed, the RCIC System actuation instrumentation setpoint.”

Progress Energy submitted Revision 31 to the Technical Specification Bases for Brunswick Unit 1 on October 23, 2003. Bases Section 3.3.5.1 stated, “The HPCI System may be initiated by either automatic or manual means. Automatic initiation occurs for conditions of Reactor Vessel Water Level – Low Level 2 or Drywell Pressure – High. Each of these variables is monitored by four redundant transmitters, which are, in turn, connected to four trip units. The outputs of the trip units are connected to relays whose contacts are arranged in a one-out-of-two taken twice logic for each function.” Bases Section 3.3.5.2 stated, “The RCIC System may be initiated by either automatic or manual means. Automatic initiation occurs for conditions of Reactor Vessel Water Level – Low Level 2. The variable is monitored by four transmitters that are connected to four trip units. The outputs of the trip units are connected to relays whose contacts are arranged in a one-out-of-two taken twice logic arrangement.”



“One-out-of-two taken twice logic” is represented by the graphic. Four transmitters (A, B, C, D) are arranged such that it takes either A or C together with either B or D to cause a signal to start the system. This arrangement prevents spurious failure of any one transmitter from causing the system to start when unneeded. It also permits the system to be tested during reactor operation since the

transmitters can be individually checked for proper calibration and functioning without either causing an unnecessary start of the system or preventing a start should that need arise.

In Brunswick’s design, both the HPCI and RCIC systems are supposed to automatically start when the water level inside the reactor vessel drops below the Low Level 2 setpoint. In their July 13th report to the NRC, Progress Energy stated that the “*reactor coolant level transient that caused a Low Level 2 signal*” and that the HPCI system automatically initiated. In their July 14th update to the NRC, Progress Energy reported that the RCIC system “*was not required to start.*”

The Low Level 2 signal caused the HPCI system to automatically start, but it did not cause the RCIC system to do so. About the only way for this outcome to occur without either a failure by HPCI (e.g., premature start) or a failure by RCIC (overdue start) would be if the water level dropped into the calibration zone for the HPCI and RCIC level transmitters. If the HPCI level transmitters were properly calibrated but at the high end of the allowable band and the RCIC level transmitters were properly calibrated but at the low end of the allowable band, then the water level might have dropped low enough to trip the HPCI transmitters but not quite low enough to trip the RCIC transmitters. The tolerance band for such level transmitters is typically on the order of a quarter inch or less.

Progress Energy’s July 14th update to the NRC indicated “*Further testing of RCIC System Low Reactor Level actuation instrumentation will be performed to further verify satisfactory RCIC System performance during the event.*”

Given the importance of the RCIC system to reactor safety, UCS hopes the NRC aggressively monitors this testing and documents what it looked at and what it found in an upcoming inspection report.

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