

## COMPONENT DESIGN BASES INSPECTION FINDINGS

### (1) Potential Air Entrainment and Vortexing of Safety-Related Fluid Systems

The design of the auxiliary feedwater (AFW) pump discharge pressure switches, which were intended to prevent potential air ingestion of all three pumps, was inadequate. This design (added by modification) was not adequate to protect the pumps under all conditions. The design was modified after the inspection. (Kewaunee IR 2005002)

The condensate storage tank (CST) level setpoint analysis did not include allowances for emergency operating procedure manual actions. (Kewaunee IR 2005002)

Licensee corrective actions were inadequate after determining that the refueling water storage tank (RWST) calculation failed to account for vortexing at the tank suction piping. The licensee inappropriately applied instrument uncertainty margin to the vortex allowance. (Callaway IR 2006009)

Licensee corrective actions were inadequate in that they did not address the potential impact of the air entrainment on the swap-over instrumentation for the assured water supply located in the suction line upstream of the AFW pumps. (Catawba IR 2007006)

Surveillance testing drained water from the containment sump suction piping for the containment spray system with no provisions to ensure the system was refilled. Air was found in the system after the inspectors questioned the condition. Vortexing could occur in the system chemical addition tank. (Comanche Peak IR 2006009)

The calculation of the low level CST setpoints did not include an analysis of the time required for the high pressure coolant injection (HPCI) system suction to transfer. This reduced the available margin to prevent vortexing. (Duane Arnold IR 2006007)

Licensee corrective actions were inadequate in that they failed to identify air trapped in the safety injection system suction lines. The licensee's evaluation erroneously determined that the plant was not vulnerable to the condition previously identified in industry experience. (San Onofre IR 2006009)

The licensee failed to incorporate the results of design calculations into appropriate emergency operating procedures with respect to the minimum RWST level and the transfer of the safety injection and residual heat removal (RHR) pumps. The procedures would have allowed the operators to transfer the pumps at a tank level that could allow air entrainment. (Kewaunee IR 2007006)

The licensee failed to incorporate instrument uncertainty in the reactor coolant system level standpipe setpoint, resulting in inadequate vortex margin for the RHR pumps during mid-loop operations. (Shearon Harris IR 2006007)

The licensee used a non-conservative method to calculate the required RWST level to prevent vortexing and a non-conservative RWST level for determining the net positive suction head for the safety injection pumps. (Indian Point 2 IR 2007007)

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The emergency operating procedure setpoint for transferring from the borated water storage tank did not include adequate margin to prevent vortex formation in this tank for all conditions. (Oconee IR 2006006)

The high pressure safety injection pump vortex limit calculation contained inaccuracies. This resulted in a non-conservative air entrainment value for the pumps when taking suction from the safety injection and refueling water tank. (Palisades IR 2006009)

A non-conservative method was used to calculate the required CST level to prevent vortexing in the HPCI pump suction. (Pilgrim IR 2006006)

Calculations showing that vortexing would not occur in the CST was not bounding for the station blackout scenario, which was the basis for the CST volume stated in the technical specifications. (Point Beach IR 2006006)

An inappropriate methodology was used to calculate the onset of vortexing at the intake of the HPCI and reactor core isolation cooling (RCIC) pump suction lines from the contaminated condensate storage tank. The licensee failed to fully account for the impact of instrument uncertainty on the setpoint. (Quad Cities IR 2006003)

The basis for the AFW pump low suction pressure trip was not available and the setpoint appeared to be inadequate to protect the pumps from air entrainment in the event of CST damage from extreme weather. The licensee verified operability based on crediting operator actions. (Salem IR 2006006)

The instrument uncertainty calculation for the RWST level instruments took credit for instrument temperature compensation; however, the instruments were not temperature compensated. Additional inaccuracies associated with the bulk temperature mismatch and air pressure differences resulted in a non-conservative RWST level error. (Seabrook 2007006)

## (2) Emergency Diesel Generators

The licensee failed to verify that the emergency diesel generator (EDG) fuel oil testing results were within specified limits. As a result of this failure, out-of-specification fuel oil was transferred to the train 'A' storage tank. (Callaway IR 2006009)

The licensee failed to properly calculate the tube plugging limit for the EDG heat exchangers. The analyses were non-conservative. (Callaway IR 2006009)

One of the EDGs could exceed its capacity rating if operated at the maximum frequency allowed by technical specifications. (D.C. Cook IR 2007002)

The acceptance criteria for the high head safety injection pumps did not account for the minimum EDG frequency. As a result, the acceptance criteria were non-conservative with respect to the safety analyses. (McGuire IR 2006007)

EDG load analyses did not account for the effects of frequency variations. The licensee determined that the diesel generator would still be within its load ratings. (Palisades IR 2006009)

EDG loading calculations failed to account for some electrical loads as well as the effect of operating at frequencies of greater than 60 hertz. The licensee determined that the diesel generators would still be within their load ratings. (Point Beach IR 2006006)

The EDG ground fault alarm response procedure was inadequate. It directed operators to check for grounds within the generator itself, but did not specify actions to address potential grounds in other locations. (San Onofre IR 2006009)

The licensee failed to identify that a ground fault on a non-safety-related uninterruptible power supply could cause an EDG to trip during a seismic event. The licensee had identified a similar concern for a fire event. (San Onofre IR 2006009)

EDG loading calculations failed to account for the effect of operating at frequencies of greater than 60 hertz. (Three Mile Island IR 2007006)

There was no procedure that would provide tornado depressurization protection of the EDG building. (Watts Bar IR 2007006)

EDG loading analyses failed to account for some electrical loads. (Kewaunee IR 2007006)

Several incorrect design parameters were used as inputs to EDG design calculations. (Quad Cities IR 2006003)

EDG loading calculations used a non-conservative assumption for fan motor brake horsepower. (St. Lucie IR 2007006)

EDG loading calculations failed to account for the effect of operating at frequencies of greater than 60 hertz. (Wolf Creek IR 2007006)

The licensee failed to verify that eight components involved in the transfer of fuel to the EDGs were rated for the temperature in which they had to operate. (Palisades IR 2006009)

The licensee did not ensure that design inputs in the EDG load analysis were conservative. As a result, capacity testing for EDG 32 was not sufficient to envelope the design basis load requirement at the maximum frequency limit allowed by technical specifications. (Indian Point 3 IR 2007006)

### (3) Testing

The licensee inappropriately took credit for post-maintenance valve testing as inservice testing. This was not a valid inservice test because it was not representative of baseline valve performance. (Comanche Peak IR 2006009)

The licensee failed to demonstrate how instrument uncertainties were correctly translated into technical specification values or acceptance criteria of surveillance tests. (Grand Gulf IR 2006008)

The licensee failed to ensure that adequate test equipment and suitable environmental conditions were used for testing safety-related room cooler performance. (Hatch IR 2006007)

The licensee failed to perform station battery capacity testing in accordance with the appropriate Institute of Electrical and Electronics Engineers standard. The test was terminated before reaching minimum voltage as specified by the standard. (Indian Point 2 IR 2007007)

The licensee failed to correctly account for calculated pressure locking effects in motor-operated valve testing procedures. (Palisades IR 2006009)

HPCI and RCIC pump performance test acceptance criteria did not bound the applicable design values. Licensee verified pump operability based on actual performance test results. (Peach Bottom IR 2006009)

The licensee failed to verify that the actual fouling factor of the containment fan cooler was consistent with the value assumed by the analyses, which took credit for a minimum value to prevent boiling of service water under accident conditions. (Point Beach IR 2006006)

HPCI pump performance test acceptance criteria did not bound the applicable design values. The licensee verified pump operability based on actual performance test results. (Quad Cities IR 2006003)

The licensee failed to incorporate the 125 volts direct current (Vdc) minimum voltage requirement into the battery terminal voltage service test procedure acceptance criteria. (Dresden IR 2007006, Kewaunee IR 2007006)

The licensee failed to ensure that the turbine driven emergency feedwater (EFW) pump steam admission valve inservice tests had stroke time acceptance criteria that incorporated design basis requirements. The licensee restored the valve to its design basis stroke time range. (Seabrook IR 2007006)

The licensee did not incorporate the requirements and acceptance limits contained in applicable design documents into the EDG battery service test procedures. (Oyster Creek IR 2007006)

The licensee failed to establish a test program for molded case circuit breakers. (Duane Arnold IR 2006007, Vogtle IR 2007006)

The licensee failed to update their molded case circuit breaker test program to conform with current industry standards. (Palisades IR 2006009)

The licensee failed to take corrective action when molded case circuit breakers exceeded their test acceptance criteria. (Kewaunee IR 2007006)

The licensee had not verified the adequacy of design for the turbine driven AFW pump. Specifically, the pump hydraulic analysis was non-conservative, but was used to verify adequacy of surveillance test acceptance criteria for pump minimum discharge pressure. (Indian Point 3 IR 2007006)

#### (4) Cooling Water Systems

Licensee corrective actions have not adequately resolved a potential design vulnerability for the EFW flow control valves to become plugged by tubercles and other debris from service water, which could result in a common mode failure of the EFW system. The licensee implemented compensatory actions during the inspection. (Virgil C. Summer IR 2004009)

Flow balance procedures did not provide adequate flow to the essential service water cooling tower to bound the value assumed in the cooling tower design calculation. (Callaway IR 2006009)

The licensee failed to implement a testing program to demonstrate the ability of the standby service water-cooled heat exchangers to perform their design functions under all conditions. (Grand Gulf IR 2006008)

Service water system abnormal operating procedures would allow the system to remain operable for up to 12 hours while the system strainer differential pressure exceeds the maximum value assumed in the system design calculation. Operation in this condition would not ensure adequate flow to safety-related components. (Hope Creek IR 2006015)

The licensee failed to evaluate the potential failure of the non-safety-related valve positioner in the safety-related nuclear service water valves and the impact of that failure on the capability of valves to perform their design function following a seismic event. (McGuire IR 2007007)

EDG cooling water system design calculation did not account for flow resistance due to clogging of the strainers or degradation of the common return piping from the diesel coolers. (Nine Mile Point IR 2006008)

Procedures were inadequate for responding to a loss of component cooling water. The licensee relied on alarm response procedures to perform time critical actions during this event. (Salem IR 2006006)

The licensee failed to adequately evaluate the potential effects on system performance of a 700 gallon per minute component cooling water flow diversion that existed due to leakage through a closed system valve. (Salem IR 2006006)

Procedures were inadequate to address degraded service water flow conditions. The procedures allowed a clogged system strainer to be bypassed without an evaluation of the potential impact on downstream equipment. (Vermont Yankee IR 2006007)

The service water system flow calculation was non-conservative in that it did not appropriately account for service water strainer plugging. (Kewaunee IR 2007006)

The licensee failed to address maximum component cooling water piping temperatures in their pump room heat up calculation, providing non-conservative results, which were used in an operability evaluation. (Kewaunee IR 2007006)

The modification that removed four fans from safeguards greenhouse ventilation system was inadequate in that it failed to adequately verify adequacy of remaining fans to cool safety-related cooling water pumps. (Prairie Island IR 2007007)

#### (5) Station Blackout

The licensee was not in compliance with 10 CFR Part 50.63, "Loss of All Alternating Current Power," because they had not completed a coping analysis and had not demonstrated by test the time required to make the alternate alternating current source available for an electrical grid collapse resulting in a station blackout. (Vermont Yankee IR 2004008)

The licensee failed to maintain adequate procedures to establish alternate room cooling within time criteria established by station blackout analysis. (Duane Arnold IR 2006007)

The licensee failed to take effective corrective action to address a significant decline in gas turbine reliability. (Indian Point 2 IR 2007007)

The licensee failed to complete a 10 CFR 50.59 evaluation for operating procedure change that substituted remote manual operator action for automatic actions during a station blackout event. The procedure change directed the operators to bypass the automatic HPCI controls. (Monticello IR 2006009)

The licensee had not analyzed the heat up of the turbine driven AFW pump room that would occur during the four-hour station blackout coping duration. (Point Beach IR 2006006)

The licensee had no analysis that verified the capability of AFW equipment to operate under the calculated temperature conditions during a station blackout event. (Salem IR 2006006)

#### (6) Motor-Operated Valves

The licensee failed to consider the most limiting differential pressure across the containment sump isolation motor-operated valves (MOVs) under post-accident conditions. (McGuire IR 2006007)

The licensee failed to correctly analyze the most limiting condition across the RHR system containment suction MOVs during a small-break loss-of-coolant accident (LOCA). (Virgil C. Summer IR 2006008)

The licensee failed to consider the most limiting differential pressure across the containment sump isolation MOVs under post-accident (small-break LOCA) conditions. (Vogtle IR 2007006)

The licensee used non-conservative lock rotor and bus voltages in MOV voltage calculations. (Prairie Island IR 2007007)

The licensee failed to maintain the required remote manual closure capability for a containment isolation valve. (Duane Arnold IR 2006007)

The maximum expected differential pressure established as a design input in the containment sump suction valve thrust margin evaluation had not been verified to be a conservative value during the recirculation phase of operation for a small-break LOCA. The licensee revised the emergency operating procedures to ensure that potential pressurization of the RHR system is monitored and depressurization performed prior to initial opening of the containment sump suction valves. (Ginna IR 2007006)

The licensee did not use an adequate methodology to determine if the RHR pump discharge header isolation valve was susceptible to the pressure locking phenomenon. Additionally, the operation of the isolation valve seal water system was not included in either the pressure locking analysis or actuator capability calculations. (Indian Point 3 IR 2007006)

## (7) Operability Evaluations

The licensee failed to perform an operability evaluation for a water hammer event in accordance with plant procedures. (Callaway IR 2006009)

The licensee failed to promptly identify and correct condition involving inadequate safety analysis dose calculations. The licensee failed to maintain previously imposed compensatory measures required by these analyses. (D.C. Cook IR 2007002)

The licensee failed to identify the need to initiate a condition report, perform an operability determination, or place controls on the use of the battery number 23 due to known errors in design calculations. (Indian Point 2 IR 2007007)

The licensee failed to analyze past operability and submit a licensee event report when the startup transformer 1-2 tap changer control was found to be non-operational. (Palisades IR 2006009)

The operability evaluation for a HPCI trip solenoid valve failure failed to support the technical specification requirement that the HPCI system automatically isolates upon high reactor vessel water level. (Pilgrim IR 2006006)

The licensee failed to take appropriate corrective actions regarding significant flow oscillations that were experienced by both the RCIC and HPCI systems after a plant trip. The operability determination performed after the event failed to address all equipment performance deficiencies. (Vermont Yankee IR 2006007)

The licensee performed inadequate operability determinations for corroded battery terminals. (Quad Cities IR 2006003)

The operability determination for overdutied circuit breakers failed to analyze a potential common mode failure. (Point Beach IR 2006006)

The licensee failed to report inoperability of the offsite power supply resulting from the failure of an automatic load tap changer. (Palisades IR 2006009)

## (8) Standby Batteries and Associated DC Distribution Systems

Safeguard battery load profiles did not include the loss of offsite power/LOCA loads. (Kewaunee IR 2007006)

The licensee failed to use the actual minimum voltage in the 125 Vdc voltage drop calculations. (Kewaunee IR 2007006)

Voltage drop calculations failed to consider effects of accident temperatures on cable resistance. (Kewaunee IR 2007006, Palisades IR 2006009)

The licensee used an incorrect methodology for determining first minute battery voltage for circuit breaker operation. (San Onofre IR 2006009)

The licensee used questionable circuit breaker closing coil voltage acceptance criteria. (Dresden IR 2007006, Kewaunee IR 2007006)

The licensee failed to verify adequate voltage to circuit breaker spring charging motors. (Prairie Island IR 2007007)

There was no analysis to support the adequacy of the 125 Vdc auxiliary power system as the alternate power supply to support the 125 Vdc vital instrumentation and control distribution panel loading during a design basis accident. (Catawba IR 2007006)

Worst case inter-cell and terminal resistance were not properly considered in voltage drop calculations. (St. Lucie IR 2007006, Waterford IR 2007007, Wolf Creek IR 2007006, Quad Cities IR 2006003)

Non-conservative assumptions for the uninterruptible power supply load and motor inrush were used in the safety-related battery sizing calculation. (Nine Mile Point IR 2006008)

The licensee failed to periodically energize a spare battery charger in accordance with vendor recommendations. (Kewaunee IR2007006)

A non-safety-related battery charger was connected to a safety-related battery without a qualified isolation device. (Duane Arnold IR 2006007)

The licensee's actions to correct high battery inter-cell resistance were not effective. (Indian Point 2 IR 2007007)

The licensee failed to coat battery terminals in accordance with vendor recommendations. (Palisades IR 2006009)

The licensee failed to clean corrosion on battery terminals and verify adequate resistance. The licensee also used an improper technique for cleaning spilled electrolyte and failed to properly clean battery terminals prior to retorquing. (Quad Cities IR 2006003)

The licensee failed to clean spilled electrolyte in accordance with procedures. (Wolf Creek IR 2007006)

The licensee failed to ensure that the torque values specified in the maintenance procedure for safety-related and important to safety 250 Vdc, 125 Vdc, and 48 Vdc batteries were correctly incorporated from vendor specified design data and from the licensee's design standard. (Duane Arnold IR 2006007)

#### (9) Alternating Current (AC) Auxiliary Power Systems

The licensee had failed to perform motor starting studies to verify adequate voltage to safety-related motors. (Kewaunee IR 2007006, Fitzpatrick IR 2007006)

Incorrect motor brake horsepower data was used in voltage drop calculations. (Byron IR 2006009)

Calculations for motor control center control circuit voltage drop were non-conservative. (Palisades IR 2006009)

Incorrect motor control center voltages were used in control circuit calculations. (Quad Cities IR 2006003)

The licensee failed to properly analyze a modified transformer in offsite power availability calculations. (Palisades IR 2006009)

The licensee failed to analyze one of the offsite power supplies. (Kewaunee IR 2007006)

The motor for a deep well pump was not provided with overload protection. (Robinson IR 2007006)

Thermal overload protection for several motors, including MOVs, was bypassed continuously. (Hatch IR 2006007)

The licensee failed to verify proper overload protection for fan motors. (Prairie Island IR 2007007)

The licensee failed to verify the calculation assumption that the voltage drop from the motor control center to the load was below 2.5 percent. In several cases, this assumption was not met, which resulted in little or no available margin to the safety-related equipment. (Monticello IR 2006009)

#### (10) Circuit Breakers

The licensee failed to evaluate the impact of vendor technical information on procedures for maintenance of safety-related circuit breakers. (Catawba IR 2007006)

The licensee failed to follow vendor maintenance recommendations for reactor trip circuit breakers. (Kewaunee IR 2007006)

The licensee failed to use the proper circuit breaker ratings in short circuit calculations. (Kewaunee IR 2007006)