UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

March 19, 2008

NRC INFORMATION NOTICE 2008-02: FINDINGS IDENTIFIED DURING COMPONENT DESIGN BASES INSPECTIONS

ADDRESSES

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of issues identified during recent component design bases inspections (CDBIs) regarding the capability of selected components to perform their design bases safety functions. The NRC expects that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

BACKGROUND

Starting in January 2006, CDBIs replaced safety system design and performance capability (SSDPC) inspections in the baseline inspection program of the Reactor Oversight Process. Unlike SSDPC inspections, CDBIs are not limited to one or two systems. Instead, CDBIs verify that design bases have been correctly implemented for selected risk-significant and low-margin components and that operating procedures and operator actions are consistent with design and licensing bases. This is to ensure that selected components are capable of performing their intended safety functions. Inspectors also review the initial design and subsequent modifications to verify that important design features have not been altered or disabled during a modification. The basis for the change from SSDPC inspections to CDBIs is described in SECY-05-0118, "Results of the Pilot Program to Improve the Effectiveness of Nuclear Regulatory Commission Inspections of Engineering and Design Issues," dated July 1, 2005, available through the Agencywide Documents Access and Management System (ADAMS) Accession No. ML051390465.

DESCRIPTION OF CIRCUMSTANCES

Following is a summary of the findings identified by CDBIs from their initiation in January 2006, through September 2007. This summary also includes several findings that were identified during the pilot CDBI inspection performed in 2004. The areas of concern were identified in SECY-05-0118. Enclosure 1 lists the referenced NRC inspection reports. The specific CDBI findings can be accessed under ADAMS Accession No. ML080670419.

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

NRC inspectors identified instances where design deficiencies could have led to air entering safety-related water systems, potentially resulting in damage to pumps and a degradation or loss of system function. The majority of these design issues were related to inappropriate setpoint calculations for refueling water storage tank and condensate storage tank (CST) level instruments. These level instruments, and associated alarms, are used either to stop safety-related pumps or to realign their suctions to alternate water supplies. The failure to stop operating pumps or to transfer their suctions can result in the ingestion of gas from these tanks which could cause degraded system performance and would eventually cause damage to the pumps. In some cases, both trains of a redundant safety-related system could be affected by this design deficiency. The potentially affected systems for pressurized-water reactors included auxiliary feedwater, containment spray, high pressure safety injection, and low pressure safety injection/residual heat removal (RHR). The potentially affected systems for boiling-water reactors included high pressure core spray and reactor core isolation cooling.

The level setpoint issues included: (a) the use of inappropriate methodology to predict the onset of vortexing in tanks, (b) the failure to allow for the time required for the transfer of the pump suctions to be completed (operator response times and valve stroke times), and (c) the failure to correctly translate analysis results into operating procedures. One case involved the failure to account for instrument uncertainty, resulting in potentially inadequate vortexing margin for the RHR pumps during reactor coolant system mid-loop operation. Another case involved failure to account for the potential effect of air entrainment on the level instrument sensing lines.

Some deficiencies involved the existence of air in the suction piping associated with safety-related pumps. This stemmed from the failure to ensure that the piping was full of water following testing or maintenance activities. One case involved a system design inadequacy that created the potential for air intrusion into operating auxiliary feedwater (AFW) pumps, potentially resulting in a common mode failure of the AFW system. The AFW pump discharge pressure trip design was not in compliance with the plant licensing basis because it could not be shown that the AFW pumps would trip prior to pump damage, due to air ingestion if the CSTs or suction piping failed during a seismic or tornado event.

(2) Emergency Diesel Generators

NRC inspectors identified instances where the emergency diesel generators (EDGs) loading calculations failed to account for the increased electrical load resulting from EDG operation at the maximum frequency allowed by technical specifications. The operation of rotating equipment at higher speeds (resulting from higher electrical frequencies) would result in increased EDG loads under accident conditions. In some cases, the EDG capacity margin was found to be small compared to the potential load increase.

Other EDG deficiencies included: (a) failure to verify that fuel oil testing results were within specified limits, (b) failure to correctly determine tube plugging limits for associated heat exchangers, (c) failure to account for all potential electrical loads in analyses, (d) failure to verify fuel transfer equipment was rated for the required temperature, and (e) inadequate procedures related to ground faults and tornado depressurization.

(3) Testing

NRC inspectors identified instances where test acceptance criteria failed to ensure the capability of the equipment to perform its function under the most limiting conditions. Examples included the acceptance criteria for valve and pump surveillance tests as well as design requirements and safety-related battery tests that did not include appropriate minimum voltage acceptance criteria. NRC inspectors identified deficiencies in test programs for molded case circuit breakers. Other test deficiencies included: (a) failure to account for EDG under-frequency in pump test acceptance criteria, (b) failure to appropriately account for instrument uncertainties, (c) failure to ensure adequate test equipment, (d) failure to account for valve pressure locking effects, and (e) failure to verify the minimum containment cooling coil fouling factor assumed in analyses.

(4) Cooling Water Systems

NRC inspectors identified instances where the licensee did not demonstrate that systems were capable of performing their intended safety function under the most limiting conditions. One finding involved the failure to appropriately account for service water strainer plugging in the flow calculation. Another finding was that system design calculations did not reflect the maximum strainer pressure drop allowed by the plant operating procedures, resulting in potentially non-conservative analyses.

Other issues included: (a) failure to evaluate the potential loss of a non-safety-related service water valve positioner, (b) failure to adequately evaluate the potential effects on system performance of a closed valve that was leaking significantly, (c) failure to address maximum component cooling water piping temperatures in the pump room heat up calculation, (d) modification to remove four fans from the safety-related screenhouse ventilation system without adequately verifying the adequacy of remaining fans, and (e) potential plugging of emergency (auxiliary) feedwater flow control valves when aligned to the service water system, which served as a backup water supply.

Procedure deficiencies included: (a) failure to verify by testing that adequate flow was provided to an essential service water cooling tower, (b) inadequate operating procedures to perform time critical operations after the loss of component cooling water, and (c) plant procedures that would have allowed a plugged strainer to be bypassed without an evaluation of the potential impact on downstream equipment.

(5) Station Blackout

NRC inspectors identified deficiencies related to plant operation after a postulated loss of all alternating current (AC) power. This scenario may require equipment to operate in off-normal conditions and may require the use of non-safety-related equipment to maintain the plant in a safe condition for the design basis coping duration. The identified deficiencies included: (a) failure to perform analyses or have adequate procedures to ensure that building temperatures would be acceptable for the operation of equipment credited for coping with a station blackout, (b) failure to perform coping analyses that covered the entire coping duration, (c) failure to address the degraded reliability of a non-safety-related gas turbine, and (d) failure to perform an evaluation to support a procedure change that substituted manual actions for automatic actions during a station blackout event in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.59, "Changes, Tests and Experiments."

(6) Motor Operated Valves

NRC inspectors identified where licensees failed to identify the maximum differential pressures across containment sump isolation valves, and analyze the ability of the valves to open with these pressures. The postulated scenario involves the pressurization of the piping between these valves and the suction of the safety injection/RHR pumps after an accident where the low pressure pumps are not injecting flow. The failure of these valves to open could result in a loss of long term emergency core cooling. In addition, inspectors identified where a licensee failed to use adequate methodology to determine if a motor-operated valve (MOV) could be susceptible to pressure locking phenomenon.

NRC Inspectors identified deficiencies including non-conservative inputs to MOV voltage calculations, and incorrect control logic for containment isolation valves. NRC inspectors also identified deficiencies in MOV overload protection, as described in section (9) of this IN.

(7) Operability Evaluations

NRC inspectors identified deficiencies including the failure to identify degraded conditions and perform operability evaluations, the failure to identify past operability issues for potential reportability, and the failure to perform adequate operability evaluations for degraded conditions. One licensee failed to promptly identify and correct a long-standing condition involving an inadequate safety analysis dose calculation, and failed to maintain previously imposed compensatory measures that were credited in plant analyses.

(8) Standby Batteries and Direct Current Electrical Distribution Systems

NRC inspectors identified deficiencies in the 125 volts direct current (Vdc) system voltage drop calculations including: (a) failure to include acceptance criteria for end use equipment such as circuit breakers, (b) failure to analyze an alternate supply for the 125 Vdc system, (c) improper methodology for determining first minute voltage, (d) failure to consider effect of accident temperatures on cable resistance, and (e) failure to use conservative design inputs for battery inter-cell resistance and battery terminal voltage. Deficiencies were identified in battery sizing calculations involving failure to correctly model battery loads and charger restoration procedures.

NRC inspectors identified instances of improper battery and battery charger maintenance including failure to follow procedures for cleaning battery terminals, inadequate procedures for cleaning spilled electrolyte, use of a non-safety-related battery charger without proper isolation, failure to periodically energize a spare battery charger, improper torque values for battery terminals, and ineffective corrective action for high battery inter-cell resistance. NRC inspectors also identified instances of inadequate battery testing listed under section (3) of this IN.

(9) Alternating Current Auxiliary Power Systems

NRC inspectors identified instances of deficiencies in voltage calculations for AC auxiliary power systems. These included: (a) lack of motor starting studies, (b) use of incorrect brake horsepower, (c) using incorrect assumption for voltage drop in cables, and (d) errors in control circuit analyses for motor control centers. NRC inspectors identified instances where calculations for offsite power availability were inadequate including failure to analyze all offsite sources, and failure to properly analyze a modified transformer.

NRC inspectors also identified problems with motor overload protection including failure to provide overload protection for a deep well pump, continuously bypassing overload devices for several safety-related motors including MOVs, and failure to verify the adequate sizing of fan motor overload devices.

(10) Circuit Breakers

NRC inspectors identified instances of improper maintenance of circuit breakers involving failure to follow vendor maintenance recommendations. Other findings related to circuit breakers included failure to use the correct short circuit rating in a design calculation, and numerous testing deficiencies described under the "Testing" topic of this IN.

DISCUSSION

This IN provides examples in which the design basis was not correctly implemented for certain systems and components as required by 10 CFR Part 50, Appendix B, Criterion III, "Design Control." The issues often involved the capability of the plant system or component to perform its intended safety function under the most limiting conditions (e.g., pressure, temperature) assumed in the plant design and licensing basis. In some cases, the issues were original design deficiencies that had not been adequately addressed. In other cases, these design deficiencies were introduced as a result of plant design changes, calculation revisions, and/or changes to operating and test procedures. Some of the design basis discrepancies resulted in technical specification required systems and components being declared inoperable. There were also instances where the licensee did not incorporate the requirements and acceptance limits contained in applicable design documents into test procedures, as required by 10 CFR Part 50, Appendix B, Criterion XI, "Test Control." The issues discussed in this IN often involved plant systems and components with low design margin. Systems and components are designed and operated, as described in the current licensing basis, with design margins and engineering margins of safety to ensure, among other things, that some loss of quality does not mean immediate failure to meet a specified function. The current licensing basis includes commitments to specific codes and standards, design criteria, and some regulations that also dictate margins. Many licensees add conservatism so that a partial loss of quality does not affect their commitments for design and operational margin. The loss of conservatism that is not credited in the current licensing basis does not affect operability or functionality. The issues discussed in this IN often involved the failure to account for factors, or the use of improper assumptions (i.e., not using the most limiting conditions) that could reduce or eliminate the available design margin.

The NRC and its licensees rely on calculations and analyses that predict the performance of the facility under various accident sequences. Design deficiencies have the potential of affecting redundant systems and components and introducing common mode failures that were not considered in accident or transient analyses. The plant risk assessment model assumes the capability of safety systems and components to perform their intended safety function successfully. Therefore, the accuracy of these design basis calculations and analyses has become increasingly important as the industry and NRC implement risk-informed regulatory initiatives.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contact listed below.

/RA/

Michael J. Case, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Technical Contact: Donald Norkin, NRR/DIRS
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NRC INSPECTION REPORT REFERENCES

[Note: A brief description of the specific CDBI findings from the below inspection reports is available at ADAMS Accession No. ML080670419.]

Plant	NRC Inspection Report (IR) Number	ADAMS No.
Byron Units 1 and 2	IR 05000454/2006009; 05000455/2006009	ML070120571
Callaway	IR 05000483/2006009	ML070560002
Catawba Units 1 and 2	IR 05000413/2007006; 05000414/2007006	ML071490122
Donald C. Cook Units 1 and 2	IR 05000315/2007002; 05000316/2007002	ML071060236
Comanche Peak Units 1 and 2	IR 05000445/2006009; 05000446/2006009	ML070360606
Dresden Units 2 and 3	IR 05000237/2007006; 05000249/2007006	ML071830531
Duane Arnold	IR 05000331/2006007	ML061580073
Edwin I. Hatch Units 1 and 2	IR 05000321/2006007; 05000366/2006007	ML062370129
Fermi	IR 05000341/2007003	ML072540412
Ginna	IR 05000244/2007006	ML073060346
Grand Gulf	IR 05000416/2006008	ML061070259
Hope Creek	IR 05000354/2006015	ML070190243
Indian Point Units 2 and 3	IR 05000247/2007007; IR 05000286/2007006	ML070890270 ML080320244
James A. Fitzpatrick	IR 05000333/2007006	ML072430509
Kewaunee	IR 05000305/2005002 IR 05000305/2007006	ML050950237 ML071550470
McGuire Units 1 and 2	IR 05000369/2006007; 05000370/2006007	ML061740013
Monticello	IR 05000263/2006009	ML062190468
Nine Mile Point, Units 1 and 2	IR 05000220/2006008; 05000410/2006008	ML063350016
Oyster Creek	IR 05000219/2007006	ML071870171
Oconee Units 1, 2, and 3	IR 05000269, 05000270, 05000287/2006006	ML061180004
Palisades	IR 05000255/2006009	ML070440439
Peach Bottom Units 2 and 3	IR 05000277/2006009; 05000278/2006009	ML061520381
Pilgrim	IR 05000293/2006006	ML061800215
Point Beach Units 1 and 2	IR 05000266/2006006; 05000301/2006006	ML063200093
Prairie Island Units 1 and 2	IR 05000282/2007007; 05000306/2007007	ML072180551
Quad Cities Units 1 and 2	IR 05000254/2006003; 05000265/2006003	ML063330597
Robinson	IR 05000261/2007006	ML071100274
Saint Lucie	IR 05000335/2007006; 05000389/2007006	ML073090538
Salem Units 1 and 2	IR 05000272/2006006; 05000311/2006006	ML060930500
San Onofre Units 2 and 3	IR 05000361/2006009; 05000362/2006009	ML063420342
Seabrook Station	IR 05000443/2007006	ML071590071
Shearon Harris	IR 05000400/2006007	ML063400335
Three Mile Island Unit 1	IR 05000289/2007006	ML070920411
Virgil C. Summer	IR 05000395/2004009 IR 05000395/2006008	ML050060203 ML062080036
Vogtle Units 1 and 2	IR 05000424/2007006; 05000425/2007006	ML072050572
Vermont Yankee	IR 05000271/2004008 IR 05000271/2006007	ML043340269 ML062720159
Waterford	IR 050003822007007	ML071940133
Watts Bar	IR 05000390/2007006	ML071100271
Wolf Creek	IR 05000482/2007006	ML072880678

Enclosure