November 6, 2008

MEMORANDUM TO: David Terao, Chief
Component Integrity, Testing,
and Performance Branch 1
Division of Engineering
Office of New Reactors

FROM: Thomas G. Scarbrough ***/RA/***
Component Integrity, Testing,
and Performance Branch 2
Division of Engineering
Office of New Reactors

SUBJECT: ONSITE REVIEW OF DESIGN AND PROCUREMENT SPECIFICATIONS FOR PUMPS, VALVES, AND DYNAMIC RESTRAINTS FOR THE AP1000 REACTOR

On October 14 and 15, 2008, NRC staff members from the Component Integrity, Performance, and Testing Branch (CIB) of the Division of Engineering in the NRC Office of New Reactors conducted an onsite review of design and procurement specifications for pumps, valves, and dynamic restraints to be used for the AP1000 reactor.

The onsite review took place at the Westinghouse offices in Monroeville, PA, and the Westinghouse Repair, Replacement & Automation Services Center in New Stanton, PA. The CIB staff performed a detailed review of a sample of design and procurement specifications in support of the AP1000 Design Certification amendment review. The staff identified several items that Westinghouse will need to address. These items will be documented in the staff's safety evaluation report with open items being prepared in conjunction with the AP1000 Design Certification amendment review.

Enclosed is a summary of the results of the CIB onsite review.

Enclosure:
As stated

CONTACT: Thomas G. Scarbrough, NRO/DE/CIB2
301-415-2794

MEMORANDUM TO: David Terao, Chief
Component Integrity, Testing,
and Performance Branch 1
Division of Engineering
Office of New Reactors

FROM: Thomas G. Scarbrough
Component Integrity, Testing,
and Performance Branch 2
Division of Engineering
Office of New Reactors

SUBJECT: ONSITE REVIEW OF DESIGN AND PROCUREMENT SPECIFICATIONS FOR PUMPS, VALVES, AND DYNAMIC RESTRAINTS FOR THE AP1000 REACTOR

On October 14 and 15, 2008, NRC staff members from the Component Integrity, Performance, and Testing Branch (CIB) of the Division of Engineering in the NRC Office of New Reactors conducted an onsite review of design and procurement specifications for pumps, valves, and dynamic restraints to be used for the AP1000 reactor.

The onsite review took place at the Westinghouse offices in Monroeville, PA, and the Westinghouse Repair, Replacement & Automation Services Center in New Stanton, PA. The CIB staff performed a detailed review of a sample of design and procurement specifications in support of the AP1000 Design Certification amendment review. The staff identified several items that Westinghouse will need to address. These items will be documented in the staff's safety evaluation report with open items being prepared in conjunction with the AP1000 Design Certification amendment review.

Enclosed is a summary of the results of the CIB onsite review.

Enclosure:
As stated

CONTACT: Thomas G. Scarbrough, NRO/DE/CIB2
301-415-2794

Distribution: CIB R/F AHowe MMiernicki EMcKenna BGleaves MMayfield LDudes JDixon-Herrity AHsia ArnoldLee PUBLIC

ADAMS Accession Number: ML083110154

OFFICE	NRO/DE/CIB2	NRO/DE/CIB1	NRO/DE/CIB1
NAME	TScarbrough	JStrnisha	DTerao
DATE	11/06/2008	11/06/2008	11/06/2008

OFFICIAL RECORD COPY

ONSITE REVIEW OF DESIGN AND PROCUREMENT SPECIFICATIONS FOR PUMPS, VALVES, AND DYNAMIC RESTRAINTS FOR THE AP1000 REACTOR

Introduction

The Design Control Document (DCD) Tier 2 for the AP1000 reactor design discusses the functional design and qualification of safety-related valves and dynamic restraints in several sections. For example, Subsection 3.9.3.2, "Pump and Valve Operability Assurance," in AP1000 DCD Tier 2, Chapter 3, "Design of Structures, Components, Equipment and Systems," refers to operational tests to verify that the valve opens and closes prior to installation. AP1000 DCD Tier 2, Subsection 3.9.3.2.2 specifies cold hydro tests, hot functional tests, periodic inservice inspections, and periodic inservice operations to be performed in situ to verify the functional capability of the valves. Section 5.4.8, "Valves," of Section 5.4, "Component and Subsystem Design," in AP1000 DCD Tier 2, Chapter 5, "Reactor Coolant System and Connected Systems," includes provisions regarding design and qualification, and preoperational testing of valves within the scope of Chapter 5, and refers to these activities for other safety-related valves. AP1000 DCD Tier 2, Section 5.4.9, "Reactor Coolant System Pressure Relief Devices," includes provisions for design, testing, and inspection of relief devices in the reactor coolant system. AP1000 DCD Tier 2, Section 5.4.10, "Component Supports," includes provisions for design, testing, and inspection of component supports in the reactor coolant system. These AP1000 DCD sections provide general guidance for the functional design and qualification of safety-related equipment that is acceptable for AP1000 Design Certification. AP1000 DCD Tier 2, Subsection 3.9.6.1, "Inservice Testing of Pumps," specifies that the AP1000 reactor design does not include pumps with safety-related functions with the exception of the coastdown of the reactor coolant pumps.

During a public meeting with the NRC staff on March 26 and 27, 2008, Westinghouse discussed its development of procurement specifications for the AP1000 reactor design. In Request for Additional Information RAI-SRP-3.9.6-CIB1-01, the NRC staff requested that Westinghouse provide a schedule for the availability of the procurement specifications for components to be used in the AP1000 reactor for NRC staff review. In its response to this RAI in a letter dated July 18, 2008, Westinghouse reported that the safety-related design specifications would be available for NRC review later in 2008. The NRC staff determined that an onsite review of the Westinghouse design procurement documents would be performed to address this RAI.

NRC Staff Onsite Review

On October 14 and 15, 2008, NRC staff members from the Component Integrity, Performance, and Testing Branch (CIB) of the Division of Engineering in the NRC Office of New Reactors (NRO) conducted an onsite review of design and procurement specifications for pumps, valves, and dynamic restraints to be used for the AP1000 reactor. The onsite review took place at the Westinghouse offices in Monroeville, PA, and the Westinghouse Repair, Replacement & Automation Services Center in New Stanton, PA. On October 7, 2008, the staff had performed an initial review of several design and procurement documents at the Westinghouse office in Rockville, MD. Table 1 provides a list of attendees during the onsite review on October 14 and 15, 2008. Table 2 provides a list of the Westinghouse documents reviewed by the CIB staff. NRC staff members from the NRO Engineering Mechanics Branch performed a parallel onsite review of design and procurement specifications for other major plant components during the week of October 13, 2008, at the Westinghouse offices in Monroeville, PA.

Enclosure

Based on the onsite review, the CIB staff found that significant effort was underway at Westinghouse to prepare design and procurement specifications for pumps, valves, and dynamic restraints to be used for the AP1000 reactor. Piping and instrumentation diagrams (P&IDs) and isometric diagrams for AP1000 plant systems were available for review. Westinghouse is addressing lessons learned from operating experience at current nuclear power plants in the design and procurement specifications. Westinghouse will review vendor analyses for plant components as part of its oversight of the procurement process. In its procurement process, Westinghouse will verify the inservice testing provisions specified in the AP1000 DCD Tier 2, Table 3.9-16. The staff discussed with Westinghouse the importance of transferring component knowledge to Combined License (COL) applicants for the development of inservice testing and environmental qualification operational programs at their specific nuclear power plants.

CIB found that Westinghouse had recently transitioned to ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," in its design and procurement specifications for nuclear power plant components. ASME QME-1-2007 incorporates lessons learned from valve testing and research programs performed by the nuclear industry and NRC Office of Nuclear Regulatory Research. The NRC is preparing a revision to Regulatory Guide 1.100 to address the acceptability of ASME QME-1-2007. The staff considers the incorporation of ASME QME-1-2007 into the AP1000 design and procurement specifications to represent a major step forward in establishing an effective and consistent approach for the qualification of plant components to be used in the AP1000 reactor. Westinghouse has revised Chapter 5 of the AP1000 DCD Tier 2 to reference ASME QME-1-2007 in DCD Revision 17, but does not reference this standard in AP1000 DCD Tier 2, Section 3.9, "Mechanical Systems and Components."

CIB reviewed AP1000 Design Specification APP-GW-VP-010 (Revision 1, dated October 2008), "Equipment Qualification Methodology and Documentation Requirements for AP1000 Safety-Related Valves and Valve Appurtenances." The design specification references ASME Standard QME-1-2007 for the equipment qualification requirements for safety-related valves and valve appurtenances. The design specification references AP1000 Design Specification APP-PV95-Z0-001 for motor operators, and also includes the use of ASME QME-1-2007, Appendix QR-B, for the environmental qualification of nonmetallic parts in safety-related valves. For valves not specifically addressed in ASME Standard QME-1-2007, the design specification includes qualification requirements based on the provisions in QME-1-2007. These additional valves include manual valves, squib valves, and pressure regulating valves to be used for the AP1000 reactor. For the most part, the staff considered the design specification to provide an acceptable summary of the applicable qualification provisions for those valves not specifically addressed in QME-1-2007. The staff provided comments on the qualification provisions in the design specification for these valves. For example, the design specification includes references to pressure locking, thermal binding and stem packing for the qualification of squib valves that might not be applicable to this valve design. The staff commented that the qualification provisions for pressure regulating valves in the design specification did not provide an overview of functional qualification as described in QME-1-2007, and did not address diagnostic data and baseline testing for these valves. The staff also noted that the discussion of generic qualification of valve appurtenances in the design specification should be clarified as applying to small internal parts, such as switches.

CIB reviewed AP1000 Design Specification APP-PV01-Z0-001 (Revision 1, dated September 12, 2008), "3 inch and Larger Motor Operated Gate and Globe Valves, ASME Boiler and Pressure Vessel Code Section III, Class 1, 2 and 3," and its Data Sheet Report APP-PV01-Z001. The design specification references APP-GW-VP-010, which specifies the use of ASME QME-1-2007. The design specification includes seat coefficient of friction values to be applied in the design of gate valves under water and steam fluid conditions. The staff stated that the design specification needs to justify the basis for these coefficient of friction values. In addition to the testing discussed in this specification, Westinghouse indicated that valve suppliers must satisfy the qualification testing provisions in ASME QME-1-2007. The staff determined that the Westinghouse requirement that valve vendors satisfy the ASME QME-1-2007 provisions in addition to the specific tests identified in the design specification was not clear in the specification. The staff also commented that the design specification should indicate the importance of valve disc clearance and manufacturing tolerance in ensuring predictable valve performance. The staff found that the design specification did not include a specific calculation method accepted by Westinghouse, or the preferred approach for consideration of various parameters and their bias error and random uncertainty, in the determination of actuator output capability and valve operating requirements. Westinghouse indicated that a specific calculation method had not been included in the design specification in order to allow flexibility for the vendor in its proposed approach, but that the vendor analyses would be evaluated by Westinghouse prior to acceptance. CIB considers that the NRC staff will need to review the specific calculation method for valve qualification as part of a future review or inspection. This finding is also applicable to design specifications for other valves to be procured for the AP1000 reactor.

CIB reviewed AP1000 Design Specification APP-PV95-Z0-001 (Revision 1, dated September 30, 2008), "Electric Motor Actuators for ASME Code Section III Class 1, 2 and 3 Nuclear Valves," used in the design and procurement of motor-operated valves (MOVs). The design specification indicates that electric motor actuator sizing takes into account any testing performed by electric motor manufacturers, valve suppliers, utility test programs, and NRC documents such as Bulletin 85-03, Generic Letters 89-10, 95-07,and 96-05, and Regulatory Issue Summary 2001-15 (the staff alerted Westinghouse to a typographical error in the list of NRC documents). The design specification references APP-GW-VP-010, which specifies the use of ASME Standard QME-1-2007. The staff commented that the design specification did not include a preferred approach for the consideration of motor thermal overloads, and did not address the acceptability of magnesium rotors in MOV motors. In addition to the testing discussed in this specification, Westinghouse indicated that actuator suppliers must satisfy the qualification testing specified in QME-1-2007. Similar to the finding on APP-PV01-Z0-001, the staff found that the design specification did not include a specific calculation method accepted by Westinghouse, or the preferred approach for consideration of various parameters and their bias error and random uncertainty in the determination of actuator output capability and valve operating requirements. As discussed above, CIB considers that the NRC staff will need to review the specific calculation method for MOV qualification as part of a future review or inspection.

CIB reviewed AP1000 Design Specification APP-GW-G1-002 (Revision 1, dated October 2008), "AP1000 Plant Equipment Qualification Methodology," that provides guidelines, acceptable methods, and procedures for environmental, seismic, and electromagnetic compatibility qualification of AP1000 safety-related electrical equipment, mechanical and electro-mechanical equipment, and valves. In addition to IEEE Standards 323 and 382, the design specification

references ASME QME-1-2007, including Appendix QR-B for environmental qualification of non-metallic components. The design specification indicates that vibration testing will be conducted up to 100 Hz. The staff commented that the design specification needs to ensure that the licensee will evaluate flow-induced vibration for frequencies beyond 100 Hz as part of the initial test program at the specific nuclear power plant. The staff commented that the provision in the design specification allowing a vendor to perform qualification by an existing program needs to ensure that the vendor satisfies the provisions of ASME QME-1-2007.

CIB reviewed AP1000 Design Calculation APP-PXS-M3C-162, "AOV Functional Requirements for PXS CMT A/B Discharge Isolation Valves V014A/B and V015A/B." In reviewing the P&ID for this system, the staff discussed the absence of test connections for the check valves PXS-V016A/B and V017A/B. In response to RAI 03.09.06-09 in its letter dated September 9, 2009, Westinghouse reported that all AP1000 check valves can be full stroke exercised with flow. The staff stated that Westinghouse needs to resolve this apparent difference in check valve testing indicated by the P&ID and the RAI response.

CIB reviewed AP1000 Design Specification APP-MP08-Z0-001 (Revision 0, dated March 2008), "RNS Centrifugal Normal RHR Pumps," and its Data Sheet Report APP-MP08-Z0R-001. These non-safety related pumps are addressed by the Design Reliability Assurance Program (D-RAP) for such functions as mid-loop and long-term cooling. The design specification includes seismic and environmental qualification provisions for these valves. With respect to functional capability, the design specification includes testing for each pump from mini-flow to run-out conditions, and the consideration of operating experience. The staff commented that the design specification should more clearly indicate that functional capability qualification will be addressed for these pumps as part of the D-RAP program.

With respect to qualification testing, Westinghouse indicated that testing of some valves will begin in the near future. The staff requested that Westinghouse notify the NRO Project Manager of the schedule for qualification testing to allow the NRC staff to observe a sample of qualification testing. Westinghouse agreed to provide qualification schedule information to the NRO Project Manager.

In addition to the document review at the Westinghouse offices in Monroeville, CIB visited the Westinghouse Repair, Replacement & Automation Services Center in New Stanton, PA. During a tour of the facility, the staff observed ongoing seismic testing of an electrical cabinet. The tour also included a walkdown of the process for commercial grade dedication of nuclear power plant components. Westinghouse stated that the process follows a 10 CFR Part 50, Appendix B, quality assurance (QA) program and recently underwent an ISO-9000 QA audit. CIB considered Westinghouse to be implementing an organized approach to commercial grade dedication.

Conclusion

At the exit briefing with the Westinghouse representatives on October 15, 2008, the CIB staff discussed the results of the onsite review of AP1000 design and procurement specifications. Westinghouse indicated that the CIB comments would be addressed in a future revision of the specifications. The following open items resulted from the onsite review: (1) the absence of a reference to ASME QME-1-2007 in Section 3.9 of the AP1000 DCD Tier 2, (2) the need to provide a basis for the seat coefficient of friction assumptions for gate and globe valves,

(3) the need to clarify that vendors must satisfy the QME-1-2007 qualification requirements in addition to the specific testing indicated in the design specifications, and (4) the need to resolve the difference between the RAI response for check valve testing and the P&ID for PXS-V016A/B and V017A/B. These items will be documented in the staff's safety evaluation report with open items being prepared in conjunction with the AP1000 Design Certification amendment review. In that Westinghouse is allowing flexibility to the vendors in their calculation methods, CIB considers that the NRC staff will need to review the specific calculation method for component qualification as part of a future review or inspection.

Table 1
Attendees at CIB Onsite Review of AP1000 Design and Procurement Specifications
October 14 and 15, 2008

Name	Organization
Billy Gleaves	NRO/DNRL/DDLO/NW
Thomas Scarbrough	NRO/DE/CIB2
James Strnisha	NRO/DE/CIB1
Sean Boyle	Westinghouse
Edward Drake	Westinghouse
Dan Frederick	Westinghouse
David Kanuch	Westinghouse
Dave Kitch	Westinghouse
James Konias	Westinghouse
Don Lindgen	Westinghouse
Terry Matty	Westinghouse
Kyle Noel	Westinghouse
James Parello	Westinghouse
Ron Wessel	Westinghouse
Mike Wilkie	Westinghouse
Preston Vock	Westinghouse

Table 2
Westinghouse Documents Reviewed by NRC Staff

AP1000 Design Calculation APP-PXS-M3C-162, "AOV Functional Requirements for PXS CMT A/B Discharge Isolation Valves V014A/B and V015A/B"

AP1000 Design Calculation APP-RNS-M3C-030 (Revision 1), "Pump Functional Requirements for the RNS Pumps"

AP1000 Design Calculation APP-SGS-M3C-034 (Revision 2, dated February 2008), "Safety/Relief Valve Functional Requirements for SGS Main Steam Safety Valves"

AP1000 Design Specification APP-GW-G1-002 (Revision 1, dated October 2008), "AP1000 Plant Equipment Qualification Methodology"

AP1000 Design Specification APP-GW-VP-010 (Revision 1, dated October 2008), "Equipment Qualification Methodology and Documentation Requirements for AP1000 Safety-Related Valves and Valve Appurtenances"

AP1000 Design Specification APP-GW-VP-020 (Revision 0, dated June 2007), "Equipment Qualification Methodology and Documentation Requirements for AP1000 Safety-Related Mechanical Equipment"

AP1000 Design Specification APP-MP08-Z0-001 (Revision 0, dated March 2008), "RNS Centrifugal Normal RHR Pumps," and Data Sheet Report APP-MP08-Z0R-001

AP1000 Design Specification APP-PV01-Z0-001 (Revision 1, dated September 12, 2008), "3 inch and Larger Motor Operated Gate and Globe Valves, ASME Boiler and Pressure Vessel Code Section III, Class 1, 2 and 3," and Data Sheet Report APP-PV01-Z001

AP1000 Design Specification APP-PV13-Z0-001 (Revision 1, dated September 2008), "Solenoid Valves, ASME Boiler and Pressure Vessel Code, Section III, Class 1, 2 and 3"

AP1000 Design Specification APP-PV14-Z0-001 (Revision 1, dated September 2008), "), "Air Operated Globe and Stop Check Valves, ASME Boiler and Pressure Vessel Code, Section III, Class 1, 2 and 3," and Data Sheet Report APP-PV14-Z0R-001

AP1000 Design Specification APP-PV70-Z0-001 (Revision D), "Squib (Pyrotechnic Actuated) Valves, ASME Boiler and Pressure Vessel Code, Section III, Class 1"

AP1000 Design Specification APP-PV95-Z0-001 (Revision 1, dated September 30, 2008), "Electric Motor Actuators for ASME Code Section III Class 1, 2 and 3 Nuclear Valves"

AP1000 Design Specification APP-PXS-M3-001 (Revision 1, dated May 2008), "Passive Core Cooling System Specification Document"

AP1000 P&ID APP-PXS-M6-001 (Revision 2, dated March 2008), "Passive Core Cooling System"

AP1000 P&ID APP-SGS-M6-001 (Revision 5, dated August 2008), "Steam Generator System"