September 27, 2011

Mr. Ricardo Pérez, President, Operations
Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

SUBJECT: NRC INSPECTION REPORT NO. 99900404/2011-201, NOTICE OF NONCONFORMANCE

Dear Mr. Pérez:

During the weeks of June 20, June 27, and July 10, 2011, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an Engineering Design Verification Inspection of the Westinghouse AP1000 reactor design at your offices in Cranberry Township, PA. Unlike the extensive licensing review which the NRC staff recently completed of the information contained in the Design Control Document (DCD) itself, the purpose of this inspection was to assess the implementation of Westinghouse's processes for transferring the design requirements contained in the DCD into detailed engineering, procurement, and construction documents. The inspection team focused its review on the Passive Core Cooling System, the Class 1E Direct Current (dc) and Uninterruptable Power Supply (UPS) System, Structural Module CA5, and Equipment Module Q240. The inspection scope included a review of both system level and component level design information.

On July 15, 2011, the NRC inspectors presented the preliminary results of the inspection during an exit meeting with you and your staff. On August 18, 2011, a re-exit teleconference was held with your staff to discuss the results of the NRC's review of additional information provided by Westinghouse after the close of the inspection. The enclosed report presents the results of this inspection.

Based on the results of this inspection, the NRC concluded that, in general, Westinghouse was properly controlling the design approved in the DCD. However, the inspection team identified three examples where the detailed design did not meet the requirements contained in the DCD. In addition, the team also identified several Open Items associated with the Passive Core Cooling System and the Class 1E dc and UPS system. While the large majority of technical work associated with these systems was found to be complete and technically accurate, several key calculations and analyses were incomplete or undergoing revision at the time of the inspection. Consequently, the team was not able to complete its technical review of these systems. The specific findings and references to the pertinent requirements are identified in the enclosures to this letter.

Please provide a written explanation or statement within 30 days of this letter in accordance with the instructions specified in the enclosed Notice of Nonconformance. We will be performing additional inspections as necessary to ensure satisfactory resolution of the identified issues and to review completion of the technical work associated with the identified Open Items. We will consider expanding our inspection sample based upon the thoroughness of your response.

In accordance with Title 10 of the Code of Federal Regulations (10 CFR) 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the "NRC's Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,
/RA/

Juan D. Peralta, Chief
Quality and Vendor Branch 1
Division of Construction Inspection
& Operational Programs
Office of New Reactors

Docket No. 99900404

Enclosures:
1. Notice of Nonconformance
2. Inspection Report No. 99900404/2011-201

In accordance with Title 10 of the Code of Federal Regulations (10 CFR) 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the "NRC's Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,
/RA/

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Division of Construction Inspection
& Operational Programs
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OFFICE	NRO/DSRA/SRSB	NRO/DE/SEB1	NRO/DE/EEB	NRO/DE/EMB2	NRO/DCIP/CQVB
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DATE	09/27/2011				

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NOTICE OF NONCONFORMANCE

Westinghouse Electric Company
Cranberry Township, PA 16066

Docket Number 999000404
Inspection Report No. 2011-201

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the Westinghouse Electric Company (Westinghouse) offices in Cranberry Township, PA during the period of June 20 – July 15, 2011, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on Westinghouse:

A. Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," states, in part, that "measures shall be established to assure that applicable regulatory requirements and the design basis . . . are correctly translated into specifications, drawings, procedures, and instructions . . . . ."

   Section 3.1.4 of Tier 2 of the AP1000 Design Control Document (DCD), "Conformance with Nuclear Regulatory Commission General Design Criteria (GDC)," Revision 19, dated 6/13/2011, states, in part, the following with respect to compliance with Appendix A to 10 CFR Part 50, General Design Criterion 35–Emergency Core Cooling, "The AP1000 design provides a passive core cooling system that functions independent of ac power supplies, assuming single active failures."

   Contrary to the above, as of July 15, 2011, Westinghouse failed to establish measures to assure that applicable regulatory requirements and the design basis were correctly translated into specification, drawings, procedures, and instructions. Specifically, Westinghouse failed to establish measures to ensure that the design of the control logic for isolation valve RNS-V023, a motor operated valve located between the In-Containment Refueling Water Storage Tank (IRWST) and the Normal Residual Heat Removal System (RNS) meets the single failure requirements of NRC General Design Criteria 35.

   This issue has been identified as Nonconformance 99900404/2011-201-01.

B. Criterion III, of Appendix B to 10 CFR Part 50, states, in part, that "measures shall be established to assure that applicable regulatory requirements and the design basis . . . are correctly translated into specifications, drawings, procedures, and instructions . . . . ."

   Section 6.3.2.2.8.9 of Tier 2 of the AP1000 DCD states in part, "inadvertent opening of these squib valves will not result in loss of reactor coolant or in draining of the in-containment refueling water storage tank."

   Contrary to the above, as of July 15, 2011, Westinghouse failed to establish measures to assure that the design of the check valves, piping, and related components located in-between the IRWST and the Direct Vessel Injection Line appropriately considered the potentially large hydrodynamic forces that could occur due to a spurious actuation of the IRWST squib valves while the reactor is at operating pressure. Specifically, Westinghouse failed to implement a formal process to ensure that once completed, the transient analysis being performed in response to Open Item DI-OI-028536, dated 7/7/2010, would be appropriately incorporated into the specifications and requirements for the related components. Also, Westinghouse failed to specify whether the analysis should be performed at the reduced reactor coolant system pressure that might be expected during a normal accident mitigation sequence, or at the much higher reactor coolant system pressure that might exist during an inadvertent operation of the valves at full reactor coolant system pressure.

These issues have been identified as Nonconformance 99900404/2011-201-02.

C. Criterion III of Appendix B to 10 CFR Part 50 states, in part, that "measures shall be established to assure that applicable regulatory requirements and the design basis . . . are correctly translated into specifications, drawings, procedures, and instructions . . . . ."

   Section 3.7.3.7.1.2, of Tier 2 of the AP1000 DCD states in part, "The total combined response to high-frequency modes (Step 3) is combined by the square root of sum of the squares method with the total combined response from lower-frequency modes (Step 1) to determine the overall structural peak responses." This information is classified in the DCD as Tier 2* information that requires approval from the NRC prior to implementing a change to the methodology.

   Contrary to the above, as of July 15, 2011, in calculation APP-1100-S2C-002, "Response Spectrum Analysis of AP1000 Containment Internal Structures," Westinghouse used an alternate direct algebraic summation method to combine the periodic and rigid seismic responses of the containment internal structures that was different than that specified in the DCD.

   This issue has been identified as Nonconformance 99900404/2011-201-03.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Quality and Vendor Branch 1, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Nonconformance. This reply should be clearly marked as a "Reply to a Notice of Nonconformance" and should include for each noncompliance: (1) the reason for the noncompliance, or if contested, the basis for disputing the noncompliance; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid noncompliance; and (4) the date when your corrective action will be completed. Where good cause is shown, the NRC will consider extending the response time.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC'S Agencywide Documents Access and Management System, which is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html, to the extent possible, it should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld, you <u>must</u> specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information).

If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, “Protection of Safeguards Information: Performance Requirements.”

Dated this the 27th day of September 2011.

ENGINEERING DESIGN VERIFICATION INSPECTION

Docket No.:	99900404
Report No.:	99900404/2011201
Facility:	Westinghouse, Cranberry Township, PA
Location:	Cranberry Township, PA
Inspection Dates:	June 20 – July 15, 2011
Inspectors:	Jeffrey Jacobson, NRO/DCIP, Team Leader Kerri Kavanagh, NRO/DCIP, Assistant Team Leader Bradley Davis, Region II Coleman Abbott, Region II Xing Wei, Brookhaven National Laboratory, Consultant John Bartleman, Region II John Budzynski, NRO/DSRA Michael Shlyamberg, Consultant Milton Valentin, NRO/DE Om Chopra, NRO/DE Omar Mazzoni, Consultant Richard Morante, Brookhaven National Laboratory, Consultant Sarah Alexander, Region II Sardar Ahmed, NRO/DE Yang Xinli, Chinese National Nuclear Safety Authority, (observer)
Approved:	Juan D. Peralta, Chief Quality and Vendor Branch 1 Division of Construction Inspection & Operational Programs Office of New Reactors

EXECUTIVE SUMMARY

During the weeks of June 20, June 27, and July 10, the Nuclear Regulatory Commission conducted an Engineering Design Verification Inspection of the AP1000 reactor design. The inspection was performed at Westinghouse Electric Company's engineering offices in Cranberry, Pennsylvania. The purpose of the inspection was to assess the implementation of Westinghouse's processes for completing the detailed design of the AP1000 reactor and for transferring the design requirements contained in the Design Control Document (DCD) into engineering, procurement, and construction documents. Using the guidance contained in Inspection Procedure 37805, "Engineering Design Verification Inspection," the NRC inspection team focused its review on the Passive Core Cooling System, the Class 1E Direct Current (dc) and Uninterruptable Power Supply (UPS) System, Structural Module CA5, and Equipment Module Q240.

The inspection scope included a review of both system level and component level design information. The team reviewed applicable calculations, analyses, drawings, component specifications, qualification test plans, and other documents as necessary to assess whether the detailed design for the selected safety systems and components would support the safety functions as described in the DCD. Not included within the scope of this inspection were large portions of the piping design and the detailed design for the instrumentation and control systems. These portions of the AP1000 design were not sufficiently complete to perform an inspection of this type and will be inspected by the NRC at a later date, either through an additional Engineering Design Verification Inspection or through other focused inspections.

In parallel with the above technical system and component level reviews, the team also reviewed the implementation of related portions of Westinghouse's Quality Assurance Program, including those related to the development and control of the detailed design. This included processes related to design verification, software validation, corrective action, design modifications, sub-vendor control, and procurement.

Based on the results of this inspection, the NRC concluded that, in general, Westinghouse was properly controlling the design approved in the DCD. However, the inspection team identified three examples where the detailed design did not meet the requirements contained in the DCD. The first example concerned isolation valve RNS-V023, located in-between the In-Containment Refueling Water Storage Tank (IRWST) and the Normal Residual Heat Removal System (RNS). The control scheme for this valve was identified as being vulnerable to a single failure that could result in an inadvertent opening of the valve while the RNS system is in operation. Should this occur, an unanalyzed loss of reactor coolant system inventory through this valve and into the IRWST could occur. This issue was identified as Non Conformance 99900404/2011-201-01.

The second example concerned the design of the check valves, piping, and related components located in-between the IRWST and the Direct Vessel Injection Line. The team identified that the purchase specifications and technical design requirements for these components did not account for the potentially large hydrodynamic forces that could occur due to a spurious opening of the IRWST squib valves while the reactor is at operating pressure. While Westinghouse was able to show that an open item had been created to perform a transient analysis to quantify the subject hydrodynamic forces, the open item did not specify whether the analysis should be performed at the reduced reactor coolant system pressure that might be expected during a normal accident mitigation sequence, or at the much higher reactor coolant system pressure that might exist during an inadvertent operation of the valves at full reactor coolant system pressure. Also, the team identified that Westinghouse had not developed a formal process to ensure that once completed, the transient analysis results would be appropriately transferred back into the specifications and requirements for the related components. These issues were identified as Non-Conformance 99900404/2011-201-02.

The third example concerned Westinghouse's use of an alternate algebraic summation method rather than the DCD described square root sum of the squares method for combining the periodic and rigid seismic responses of the containment internal structures, including those for module CA05. The square root sum of the squares methodology for combining the periodic and rigid seismic responses was designated as DCD Tier 2* information that requires NRC approval prior to implementing a change. This issue was identified as Non-Conformance 99900404/2011-201-03.

In addition to the three Non Conformances described above, the team also identified that some key calculations and analyses associated with the Passive Core Cooling System and the Class 1E dc and UPS system were still incomplete or undergoing revision due to recently identified technical issues. As such, the team was not able to complete its technical review of these systems. The more significant of these open items are described below and are identified in the inspection report as NRC Open Items that will require additional NRC inspection once the calculations and analyses are complete. These open items include:

- Analysis of the flow resistance for the IRWST injection line
- Establishing proper qualification requirements for the Core Make-up Tank in-line check valves
- Establishment of seismic qualification and manufacturing requirements for Diverse Actuation System (DAS) components
- Completion of a number of key calculations and analyses for Class 1E dc and UPS systems
- Analysis of electric power distribution equipment for common cause single failure due to embedded software

With regard to the above open items, the team identified that the calculation for establishing the flow resistance of the IRWST injection line was under revision, due to a recent issue that Westinghouse had identified regarding the associated check valve position during the injection phase of an assumed accident mitigation sequence. Recent analysis of this issue performed by Westinghouse indicates that this check valve will not be fully open, thus increasing the previously calculated flow resistance in this line. As of the completion date of the inspection, Westinghouse had not quantified the exact position of the valve and thus had not completed its analysis of the flow resistance.

The team also identified an open item concerning a recent design change associated with the Core Make-up Tank (CMT) check valves. Previously, these check valves were specified as standard "swing type" valves, but were changed to a new in-line type of check valve in Revision 18 to the DCD. The team identified that the current qualification plan for these in-line check valves might be insufficient to demonstrate their reliability, as these valves have to perform under challenging conditions that will not be mimicked during periodic surveillance testing. The team noted the importance of properly qualifying these valves for design basis conditions as these valves are credited in the DCD as being exempt from single failure requirements due to their assumed low failure probability.

The team identified that unlike the squib valves used in the IRWST injection lines, a spurious actuation of the Stage 4 Automatic Depressurization System (ADS) squib valves is not assumed to be a credible failure in the DCD, and as such, an analysis of the effects of a spurious actuation of the ADS squib valves has not been performed. In response to questions previously raised by the NRC staff during review of the AP1000 DCD, a modification was made to the PMS system's control circuitry to install a non-software based interlock to minimize the probability of spurious action of the ADS valves. A similar modification was not, however, made to the DAS system's circuitry as its design is different and requires the actuation of two independent relays in the DAS cabinet to activate the squib valve firing circuitry.

The team questioned whether a simultaneous unintended actuation of these relays, perhaps due to a seismic event, could result in the spurious actuation of the Stage 4 ADS squib valves. In response, Westinghouse provided documentation that outlined their plans to seismically qualify the DAS equipment to prevent such an occurrence; however, the documentation was not conclusive as to exactly what was being qualified (the structural cabinets or the actual internal components). The team also expressed concern with how Westinghouse would be able to control the design once qualified since the production units will likely not be the ones tested and would not be subject to the full quality requirements contained in Appendix B to 10 CFR Part 50.

With regard to the Class 1E dc Electrical System and UPS System, the team found that a significant number of calculations and analyses were still incomplete. Among the key analyses that were not complete were the short circuit and voltage regulation calculations for the non-Class 1E ac system, the short circuit calculations for the Class 1E ac and dc systems, the protective device coordination study, and certain calculations necessary for establishing the environmental envelopes for the areas that will house the batteries and other Class 1E equipment. In addition, the team identified that Westinghouse had not developed a process for analyzing the possibility of a common cause failure of redundant Class 1E electrical equipment with imbedded software.

Except for the issue concerning the spurious actuation of valve RNS-V023 described above, the team had no findings or open items with regard to its review of RNS Containment Isolation Module Q240. The team found that the detailed design of this equipment module including the structural and mechanical analyses, drawings, and specifications adequately implemented the requirements of the DCD. For the CA05 module, other than the non-conformance described above concerning the error term summation methodology, the team found the detailed design to be in accordance with the DCD requirements.

Report Details

1. Background and General Scope

Following the guidance contained in IP37805, "Engineering Design Verification Inspection," the following AP1000 systems/structures/modules (items) were selected for review by the inspection team:

Passive Core Cooling System (PXS)
Class 1E Direct Current (dc) and UPS Systems
Q240 - Normal Residual Heat Removal Module
CA5 - CVS/Access Tunnel/Passive Core Cooling System Walls

For the above set of systems and components, the team reviewed applicable calculations, analyses, drawings, procurement specifications, qualification test plans, and other documents as necessary to assess whether the completed technical work demonstrates that the selected safety systems and components can perform their intended safety functions. This included a review of both system level and component level design information. Not included within the scope of this inspection were large portions of the piping design and the detailed design for the instrumentation and control systems. These portions of the AP1000 design were not sufficiently complete to perform an inspection of this type and will be inspected by the NRC at a later date, either through an additional Engineering Design Verification Inspection or through other focused NRC inspections.

The inspection team utilized the guidance contained in Appendix A to IP 37805 for performing the mechanical, electrical, and civil/structural reviews. In parallel with the above system and component level reviews, the team also utilized the guidance in IP 37805 for reviewing the portions of Westinghouse's Quality Assurance Program related to the development and control of the detailed design. This included a review of Westinghouse's implementation of design verification, software validation, corrective action, design modifications, sub-vendor control, and procurement processes.

2. Passive Core Cooling System (PXS)

a. Scope of System Review

The PXS is a safety-related system designed to provide sufficient core cooling for design basis events. The PXS is designed to perform the following major safety-related functions:

- Emergency RCS Makeup and Boration
- Safety Injection
- Emergency Core Decay Heat Removal
- Post-Accident Containment pH Control

The team focused its review on the overall system level analyses, mechanical system interfaces (including interfaces with non-safety systems), and selected aspects of the control interfaces between the PXS system and the Protection and Monitoring System (PMS) and Diverse Actuation System (DAS). In addition, in order to assess the adequacy of the functional and performance requirements imposed on selected components, the team reviewed the design of selected components contained within the PXS system, including the Core Make-up Tank

(CMT), the CMT in-line check valves, and the Passive Residual Heat Removal (PRHR) heat exchanger.

b. Findings and Observations

For the PXS system, the team identified two examples where the detailed design did not conform to Tier 2 of the Westinghouse AP1000 Design Control Document, Revision 19 (DCD). In addition, several open items were identified regarding specific aspects of the Passive Core Cooling System design.

RNS Suction from IRWST Isolation Valves RNS-V023

The first non-conformance concerns the potential for a single active failure of valve RNS-V023 to prevent the PXS system from performing its safety related function. In Figure 6.3-2 of the DCD (Sheet 2), a 10-inch line connecting the PXS system to the suction of the Normal Residual Heat Removal System (RNS) pump is shown. This connection is provided for train "B" of the PXS only. Figure 5.4-7 of the DCD indicates that this connection is accomplished through a single, normally closed (NC) isolation valve, RNS-V023.

The team expressed a concern that this single valve arrangement could lead to a potential for an unanalyzed loss of coolant inventory from the RCS into the IRWST, should RNS-V023 be mispositioned or should the valve spuriously open during Mode 4 of operation where the reactor is shutdown but the reactor coolant system is still at pressure. The team identified that power to this valve is not locked out and that control of the valve is from the PMS system. Unlike the control scheme for the Automatic Depressurization System (ADS) stage 4 valves, there is no diverse, non-software based interlock that would provide protection against a single failure from within the PMS system that could result in a spurious opening of the valve.

Paragraph 3.1.4 of Tier 2 of the DCD, "Conformance with Nuclear Regulatory Commission General Design Criteria" states, in part, the following with respect to AP1000 compliance with Criterion 35 of the General Design Criteria (GDC)–Emergency Core Cooling, "The AP1000 design provides a passive core cooling system that functions independent of ac power supplies, assuming single active failures." Contrary to the above, the team identified that a single active failure of RNS-V023 has the potential to prevent the PXS system from performing its safety related function. The team identified this issue as Non-Conformance 99900404/2011-201-01.

Effect of Squib Injection Valve Transient on IRWST Check Valves and Related Components

The second non-conformance concerns Westinghouse's failure to account for the dynamic hydraulic forces that would result from a spurious actuation of the IRWST squib valves while at full reactor coolant system pressure. Valves PXS-V123A/B and PXS-V125A/B are normally closed (NC) explosively opening (squib) valves and are designed to open during a loss of coolant accident to allow coolant to flow from the IRWST into the reactor coolant system, following initiation of Stage 4 of ADS. The squib valves are designed to open automatically on an ADS Stage 4 actuation signal generated by the safety related PMS system. The control logic also allows for manual operation of these valves from the Main Control Room, via actuation from the safety related PMS or the non-safety related Diverse Actuation System (DAS).

These valves are designed to open by an explosive charge and will undergo a change from a fully closed to fully open in about 15 to 45 milliseconds. The inadvertent opening of these valves while at full reactor coolant system (RCS) pressure could result in large hydrodynamic forces due to the very rapid increase in the static pressure from about 15 psig (IRWST static pressure) to 2485 psig (design RCS pressure). The team's review of the system design identified that the hydrodynamic forces generated by the very rapid opening of the IRWST squib valves, combined with a relatively small volume between the squib valve and the check valve, could result in stresses significantly in excess of the design limits for the associated piping, pipe supports, check valves, and related components. The team identified that Westinghouse had not accounted for the hydrodynamic loads into the purchase specifications for these components.

Section 6.3.2.2.8.9 of the DCD states that the "……inadvertent opening of these squib valves will not result in loss of reactor coolant or in draining of the in-containment refueling water storage tank." During the inspection, Westinghouse provided to the team a copy of Open Item DI-OI-028536, dated 7/7/2010, which was written to evaluate the subject hydrodynamic loads; however, the open item did not specify whether the analysis should be performed at the reduced reactor coolant system pressure that might be expected during a normal accident mitigation sequence, or at the much higher reactor coolant system pressure that might exist during an inadvertent operation of the squib valves. Also, the open item was related only to the piping stress analysis reports and could not be tied directly to the check valves or other related components.

Westinghouse indicated that the check valve and other component specification requirements would be re-reviewed once the hydrodynamic analysis was complete and that if necessary a modification would be made to capture the new requirements should they exceed the originally specified design requirements. The team identified, however, that a documented process or procedure had not be developed to verify that this re-review of the component specifications would actually be completed.

Westinghouse's failure to establish measures to assure that the design of the check valves, piping, and related components located in-between the IRWST and the Direct Vessel Injection Line appropriately considered the potentially large hydrodynamic forces that could occur due to a spurious actuation of the IRWST squib valves while the reactor is at operating pressure was identified by the team as Non-Conformance 99900404/2011-201-02.

Qualification of Diverse Actuation System Equipment

The team identified that unlike the squib valves used in the IRWST injection lines, a spurious actuation of the Stage 4 Automatic Depressurization System (ADS) squib valves is not assumed to be a credible failure in the DCD, and as such, an analysis of the effects of a spurious actuation of the ADS squib valves has not been performed. The ADS squib valves can be activated from either the safety related PMS or the non safety-related DAS systems. In response to questions raised by the NRC staff during review of the AP1000 DCD, a modification was made to the PMS system's control circuitry to install a non-software based interlock to minimize the probability of spurious action of the ADS valves. A similar modification was not, however, made to the DAS system's circuitry as its design is different and requires the actuation of two independent relays in the DAS cabinet to activate the squib valve firing circuitry.

The team questioned whether a simultaneous unintended actuation of these relays, perhaps due to a seismic event, could result in the spurious actuation of the Stage 4 ADS squib valves. In response, Westinghouse provided documentation that outlined their plans to seismically qualify the DAS equipment to prevent such an occurrence; however, the documentation was not conclusive as to exactly what was being qualified (the structural cabinets or the actual internal components), since the DAS equipment is classified as non safety-related. The team also expressed concern with how Westinghouse would be able to control the design once qualified since the production units will likely not be the ones tested and would not be subject to the full quality requirements contained in Appendix B to 10 CFR Part 50. The team identified the qualification and design/manufacturing controls for the DAS system as NRC Open Item 99900404/2011-201-04. No other findings of significance were identified by the inspection team.

<u>IRWST Injection Line Resistance</u>

Section 14.2.9.1.3 of the DCD, states in part: "…The proper flow resistance of each of the in-containment refueling water storage tank injection lines is verified by gravity draining water from the tank through the direct vessel injection flow path, while measuring the water level (driving head) and discharge flow rate using temporary instrumentation. A test fixture with prototypical resistance may be used to simulate the squib valves in the flow paths tested." The same requirements are also provided in ITAAC Table 2.2.3-4, item 8.c). Verifying the proper flow resistance in the IRWST injection line is important as it is an input to the overall accident analysis.

The team identified that Calculation APP-PXS-M3C-019, which calculates the resistance of the IRWST injection lines, was performed with the assumption that the check valves, PXS-V122A/B and PXS-V124A/B, would be fully full open. The team questioned the validity of this assumption since as the IRWST level decreases the available pressure may decrease and may be insufficient to maintain these valves in the full open position. Westinghouse concurred with this concern and stated that a recent internal review had also identified a similar concern and that CAP IR 11-076-C001 was tracking its resolution. Westinghouse further indicated that their evaluation had determined that these check valves will not be fully open even with a full IRWST. This issue was identified by the team as NRC Open Item 99900404/2011-201-05.

The team also identified that calculation APP-PXS-M3C-195, erroneously credited maximum containment pressure for determination of the maximum differential pressure (dP) across these check valves. The applicant concurred with the team's assessment and issued a CAP IR 11-192-M005 to correct this error. The applicant further stated that this error was minor and did not affect the maximum design requirements imposed on these valves. The team concurred with this assessment. No findings of significance were identified by the inspection team.

<u>CMT Injection Line Resistance</u>

Section 14.2.9.1.3 of the DCD states in part, "…Proper flow resistance of each of the core makeup tank injection lines is verified by gravity draining each tank filled with cold water through the direct vessel injection flow path, while measuring the CMT level (driving head) and discharge flow rate. Air enters the top of the draining tank from the reactor coolant system cold leg via the cold leg balance line. If necessary, the flow limiting orifice in the core makeup tank discharge line is to be resized, and the core makeup tank retested to obtain the required line resistance. The acceptance criteria for the resistance of these lines are < 2.25×10^{-5} ft/gpm^2 and > 1.81×10^{-5} ft/gpm^2 with all valves open." The same requirements are also provided in ITAAC Table 2.2.3-4, item 8.c).

The team identified, however, that Table 3.9-17 of the DCD, that provides the requirements for In-Service Testing has a greater value for the flow resistance lower limit. Table 3.9-17 states, “The allowable calculated flow resistance between each CMT and the reactor vessel is ≥ 1.83 x 10^{-5} ft/gpm^2 and ≤ 2.25 x 10^{-5} ft/gpm^2.” The team considered this to be a minor issue and Westinghouse initiated CAP IR 11-195-M011 to resolve the discrepancy.

The team also identified a discrepancy with calculation APP-PXS-M3C-004, for calculating the resistance path of the CMT. Section 2.2 of the calculation states in part that in the Max DVI LOCA case, the CMT drains in 19.6 minutes. However, the DCD, Technical Specifications Bases Section B 3.5.2 states that this duration should be at least 20 minutes. The team considered this to be a minor issue and to resolve this discrepancy Westinghouse initiated CAP IR 11-194-M019.

The team also reviewed the design details for the orifice installation and determined that the design appeared to be adequate to prevent the potential for gas trapping, as the orifice specification includes a requirement to include both a vent and a drain hole.

No findings of significance were identified by the inspection team.

PXS Core Make Up Tank (CMT) Discharge Check Valves PXS-V016A/B and PXS-V017A/B

The team identified that Westinghouse had modified the design of the 8-inch PXS CMT Discharge Check Valves, PXS-PL-V016A/B and V017A/B, from conventional swing-type check valves to in-line, nozzle type check valves. The modification was documented via Design Change Proposal (DCP) APP-GW-GEE-864 and was reflected in the revision 18 of DCD. In addition to changing the type of the CMT check valve, the DCP also added test connections for testing these valves in the reverse direction and removed position indication from the CMT and accumulator check valves.

The DCD revision did not explicitly describe the change of the check valve design, but rather just deleted the reference to a swing type of check valve. Section 5.2.2.3 of the PXS System Specification Document APP-PXS-M3-001, defines the safety-related function for these check valves as “…to prevent reverse flow from the Accumulators through the CMT for large cold leg LOCA events, with a break either in the cold leg near the CMT pressure balance line or in the pressure balance line upstream of the CMT isolation valves.” Hence, the safety-related function for these valves includes closing under a rapid application of high differential pressure (600 psid or higher) and subsequently re-opening under a very low differential pressure (10 to 15 psid). The team questioned the use of these valves in this application since there is a lack of industry experience using in-line check valves in similar applications and this modification potentially introduced new failure mechanisms that have not been fully evaluated.

The design of these inline check valves includes a centrally located sliding stem attached to the valve disc that is housed inside a stationary bushing-type support. The minimal radial clearance for these valves is as low as 76 μm, and that these very tight clearances could result in the valve being susceptible to blockage. The team identified that Westinghouse had not specifically evaluated these clearances with respect to particulate that might exist in the Reactor Coolant System water chemistry. Table 5.1 of APP-GW-GER-002, states that: “Most particulate is less than 1μm in size, though particles up to 47 microns long have been observed.” However, neither this nor any other AP1000 document requires periodic sampling or other controls to prevent blockage of these check valves from particles greater than 47 microns. Additionally, water in each CMT injection path, including the CMT, will be stagnate and the Chemical Volume and Control System (CVS) may not be capable of providing sufficient control of particulate with respect to this issue.

Section 6.3.2.5.1 of the DCD exempts these check valves from a postulated failure to re-open after they have closed during an accident. The DCD justifies this exemption based on “the low probability of these check valves not re-opening within a few minutes after they have cycled closed during accumulator operation.” With respect to the above statement, Westinghouse indicated that they had requested the vendor to provide a reliability assessment for the subject valves, but as of the conclusion of the inspection, this information had not been provided.

The team also reviewed Westinghouse’s plans to qualify the valves in accordance with ASME QME-1-2007. The team identified that the specific issues identified above regarding reliability and operability under end of life design basis conditions had not been fully addressed in the initial qualification plans. It was not clear that the qualification plan would demonstrate the reliability of these valves to re-open following the most conservative application closing forces, closing time, and break location. Also, the plan did not address the recommended frequency of replacement for metallic consumable parts (e.g., spring), the potential for galling due to a contact surfaces being stainless steel, and the potential for binding due to RCS particulate build-up. The team identified the qualification of these valves as NRC Open Item 99900404/2011-201-06.

No other findings of significance were identified by the inspection team.

<u>PXS CMT Discharge Isolation Valves PXS-V014A/B and PXS-V015A/B</u>

Technical Specifications Surveillance Requirement SR 3.5.2.5, contained in Chapter 16 of the DCD, requires the boron concentration in each CMT to be verified to be greater than 3400 ppm, and less than or equal to 3700 ppm every 7 days. The team identified that Westinghouse had not explicitly accounted for this requirement when developing the purchase specifications for the air operated PXS CMT A/B Discharge Isolation Valves V014A/B and V015A/B, with respect to a maximum leakage rate. In response, Westinghouse stated that the nominal born concentration in the CMT is 3500 ppm and at the currently specified leakage it will take a significantly greater time than 7 days to challenge the Technical Specifications limits. However, Westinghouse concurred that the valve design documents should specify a maximum leakage rate that corresponds to the 7-day Technical Specifications surveillance frequency for the CMT. The applicant generated CAP IR 11-195-M003 to address resolution of this item.

No findings of significance were identified by the inspection team.

<u>IRWST Gutter Collection System and Isolation Valves (V130A/B)</u>

Section 6.3.2.1.1 of the DCD provides a description of the gutter collection system which is used to collect condensation from the steel containment vessel and return it to the in-containment refueling water storage tank. Recovery of the condensate maintains the passive residual heat removal heat exchanger heat sink for an indefinite period of time.

The team reviewed calculation APP-PXS-M3C-001 for the sizing of the gutter system and identified the following inconsistencies:

- Section 5.1.4 of the calculation states that the water level should be assumed to be 10 inches above the bottom edge of the drain pipe, but 1.08 ft is used instead
- The maximum condensate used for the IRWST gutter only takes into account the short branch and not the long branch

In response, Westinghouse indicated that the 10-inch assumption in the calculation was incorrect and the 1.08 ft input was correct based on the physical layout. They also indicated that that the calculation should have captured both the short and long branches; however, the effect on the resulting piping size was insignificant. The team concurred with the results of this reanalysis. Westinghouse indicated they would resolve these discrepancies in the next revision of the calculation and initiated CAP IR 11-186-M004 to track the incorporation of these changes.

No findings of significance were identified by the inspection team.

CMT and PRHR Heat Exchanger

The team reviewed procurement specifications, supporting drawings, and calculations for the CMT and the PRHR Heat Exchanger to ensure they appropriately captured the functional and performance requirements imposed by the DCD and the system specifications. The relationship between these documents is represented in Figure 1 (below). These documents are also listed in Appendix A to this report. The team focused its review on the calculations that supported the CMT and PRHR HX parameters listed in ITAAC Table 2.2.3-4 and the component data in Table 6.3-2 of the DCD. For the CMT, the team reviewed the associated documents for calculating and specifying design volume, pressure, temperature, inlet diffuser flow area, and upper level tap line slope. The team also reviewed the calculated flow resistances between the CMT inlet and outlet lines and the RCS cold and hot legs. For the PRHR HX, the team reviewed the calculation and specifications for design temperature, pressure, flow, inlet/outlet temperatures, and calculated heat transfer rate.

The inspectors evaluated the documents and found they properly addressed the CMT and PRHR HX component design characteristics. No items of safety significance were identified during the team's review.

3. Class 1E dc and Uninterruptible Power Supply (IDS)

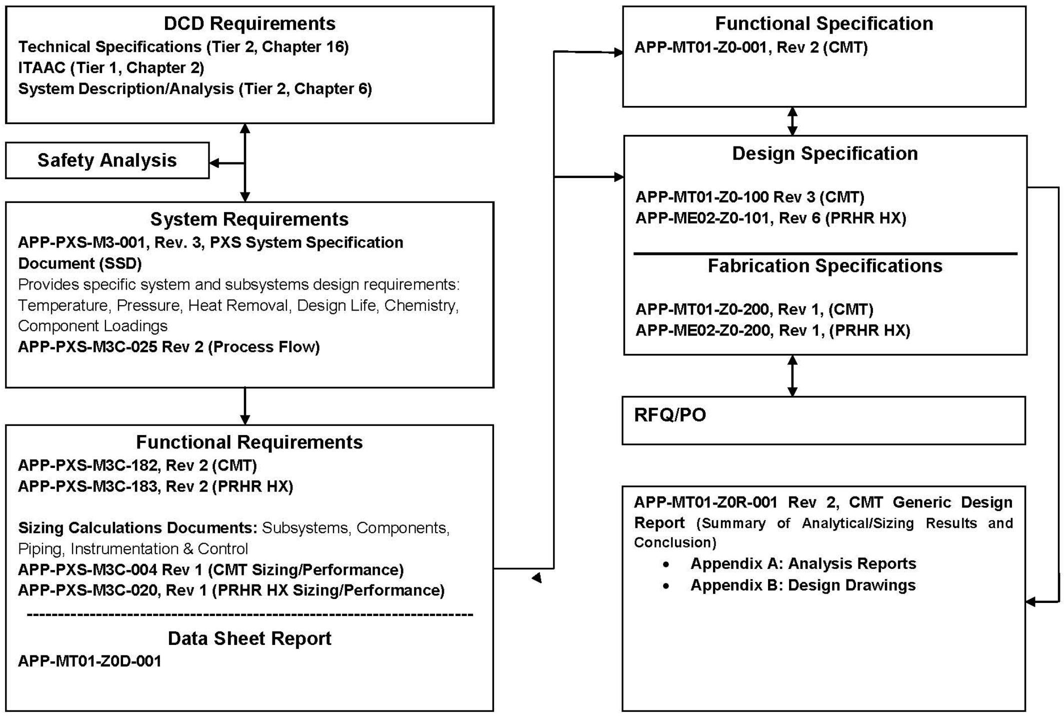
a. Scope of System Review

The IDS system provides dc and uninterruptible ac electrical power for safety-related equipment during normal and off normal conditions. The team reviewed selected attributes of the following components within the IDS system to ensure compliance to the DCD: 24 hour battery; 72 hour battery; inverters and static switches; battery chargers; regulating transformers; distribution panels; motor control centers; power, control and instrumentation cables; 120/208 Vac distribution system. The team reviewed pertinent specifications, calculations, drawings, test plans, and procedures associated with the above components.

b. Findings and Observations

While the team was able to complete its review of portions of the IDS system, as described in the following section of this report, a significant number of calculations and analyses for the IDS were still incomplete at the time of the inspection. Consequently, a re-performance of this portion of the EDV will need to be completed at a later date. Among the key analyses that were not complete were the short circuit and voltage regulation calculations for the non-Class 1E ac system, the short circuit calculations for the Class 1E ac and dc systems, the protective device coordination study, and certain calculations necessary for establishing the environmental

Figure 1
Review Process Used in Inspection
(CMT & PRHR HX)



envelopes for the areas that will house the batteries and other Class 1E equipment. The need to re-perform this portion of the EDV inspection for selective portions of the IDS was identified as NRC Open Item 99900404/2011-201-07.

Class 1E 250 V dc Battery System Sizing and Specifications

The team reviewed the battery sizing calculations contained in, APP-IDS-EOC-001, Rev. 0, “Class 1E 250V dc Battery Sizing, Charger Sizing and Available Short Circuit Current”, to verify that the Class 1E loads and their periods of operation were properly accounted for in the battery loading cycle, and to ascertain that the calculation methodology was adequate. The team verified that each IDS 24-hour battery bank was capable of supplying a dc switchboard bus load for a period of 24 hours without recharging as stated in DCD section 8.3.2.1.1.1. The team also verified that each IDS 72-hour battery bank was capable of supplying a dc switchboard its assigned bus load for a period of 72 hours without recharging as required by DCD section 8.3.2.1.1.1. The verification also included the capability of the spare battery bank to supply a dc load equal to or greater than the most severe switchboard bus load for the required period without need for recharging. The team found that the battery sizing and short circuit calculations had been appropriately performed in accordance with IEEE 485, “IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications,” as committed to in the DCD.

The battery specifications were reviewed to ascertain that end of voltage, float voltage, equalization voltage, and number of cells were adequately incorporated and corresponded with the 250V DC system requirements. The team reviewed the electrical isolation between the non-Class 1E ac power system and the non-Class 1E lighting in the main control room. The team reviewed the battery test plan to ascertain that the testing configuration and testing parameters were properly included. The team verified that the IDS 24-hour and IDS 72-hour battery chargers provided for adequate isolation between the Class 1E and non-1E portions of the electrical system and that the chargers were properly sized to allow for charging of the connected battery while supplying the continuous safety related loads.

The team verified that the IDS dc system was designed to supply adequate voltage to the terminals of the Class 1E motor-operated valves (MOVs) under design basis event conditions. However, the team found that calculations for evaluating the capability of the MOVs to deliver sufficient torque under accident conditions (elevated temperatures) were still under development. Westinghouse indicated that this work was being tracked by open item DI-OI-036413.

No findings of significance were identified.

<u>Battery Room and Inverter Room Temperatures</u>

Calculations for evaluating the maximum and minimum temperatures in the battery and inverter rooms were not complete and thus the team was not able to assess whether the minimum calculated battery room temperature was in agreement with the temperature included in the battery calculations. Likewise, the team could not verify that the maximum battery room temperature would be enveloped by ongoing testing program to qualify the batteries. The inverter room temperature calculations were also incomplete. Westinghouse indicated they were tracking the completion of the calculation under Open Item DI-OI-020962. Other than the incomplete status of these calculations, no findings of significance were identified.

<u>Voltage Profile for Batteries</u>

The team found that Westinghouse had sized the batteries in accordance with IEEE 485. The methodology in this standard is designed to ensure that the average cell voltage will not drop below the specified minimum voltage (e.g., 1.75 V) at any point in the duty cycle. The team concluded that as long as the battery minimum voltage is used to determine the connected load terminal voltages, it is not necessary to calculate battery terminal voltage at any point in the duty cycle. The above satisfies the recommendations of RG 1.212 which endorses IEEE 485. No findings of significance were identified in this area.

<u>Class 1E 72-hour battery sizing</u>

The team noted that the battery qualification test plan required testing of a 2400 AH battery, which was not in agreement with the calculated battery sizing of 2430 AH. The team indicated that the qualification requirement should agree with the calculated sizing. Westinghouse stated that it was in the process of re-performing the sizing calculation to ensure that the calculated and tested battery capacity were in agreement. This open item will be tracked by Westinghouse's tracking system under CAP 11-179-M017. No findings of significance were identified in this area.

Class 1E 250 V Direct Current Distribution System

The team found acceptable the voltage drop calculations that were performed to ascertain that adequate voltage would be supplied to all connected Class 1E dc loads. However, the short circuit and coordination studies for the dc systems were incomplete at the time of the inspection. The team identified that the detailed drawings for the Class 1E dc system were also incomplete. Consequently, the team was unable to verify that the system design provides for supplying redundant motor operated valves and squib valves from separate MCCs of the dc distribution system, as required by GDC 17. Westinghouse stated that the detailed drawings for the Class 1E dc system were under development. Other than the incomplete status of the design, no findings of significance were identified in this area.

Class 1E UPS System

The team reviewed the specifications for the inverters and static switch in order to determine if these components of the UPS system would be capable of providing adequate voltage and current to the Class 1E ac system loads. The team identified that the sizing of these devices was adequate to appropriately handle the loading requirements under design basis events. The team also reviewed the specifications for the regulating transformers used as a back-up source to the inverters, while the inverters are under maintenance. The team found that the regulating transformers were adequately sized to provide back-up power to the inverters when the inverters are under maintenance.

The team identified that the short circuit current rating for the inverter input circuit breakers were specified as 20,000 amps; however, this rating of the breakers was inadequate because the fault current contribution from the batteries was calculated to be about 30,000 amps. Westinghouse provided documentation that this issue had been previously identified and was being tracked internally as an open item.

The team identified that Westinghouse had not developed a sufficient justification for the statement in paragraph 4.1.2.12 of the inverter specification which states that "The transformer shall provide a minimum available short circuit current of two times full load..." The team identified that the current value of two times full load would be a maximum at the terminals of the regulating transformer, but may be significantly reduced due to the circuit impedance up to the point of the assumed circuit fault. The team questioned whether the value of two times full load current would be sufficient in case of a downstream fault to provide for activation of the protective devices, particularly for those that are remotely located. This item could not be assessed as the applicable coordination study was not complete.

The team identified that although the specifications for the inverters and static switches referenced RG 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," the purchase specifications did not include specific requirements to evaluate the adequacy of the design with respect to common cause failures that could be caused by software errors. Such failures could defeat the redundancy achieved by the hardware architecture. As are result of the team's questions, Westinghouse generated open item DI-OI- 034382 to develop procedures to assess the adequacy of the component designs for Class 1E digital based devices once final component information is obtained from the applicable vendors. The diversity of the Class 1E electrical system is identified as NRC Open Item 99900404/2011-201-08. No findings of significance were identified in this area.

Adequacy of Designed Voltages for Battery Chargers and Regulating Transformers

The team noted that battery chargers were design to operate at +10% and -20% of the supplied voltage while the regulating transformers were design to operate at ±10% of the supplied voltage. The team questioned the apparent difference in the voltage variations specified for these devices. Westinghouse stated that open item DI-OI-036103 had been generated to verify that a variation of ±10% for the regulating transformers is an acceptable value for these devices. No findings of significance were identified in this area.

Class 1E Cable, Design and Specifications

The team reviewed the specification APP-EW50-Z0-002 being developed to environmentally qualify, in accordance with IEEE 323, the Class 1E power, control, and instrumentation cables. The team noted that the current Westinghouse specification would allow the use of analysis alone, to address test failures that might require changes to the actual cable material properties. While technically allowed by the specification, Westinghouse indicated that they understood that such changes to the test specimen would require an actual retest. No findings of significance were identified in this area.

Class 1E 120/208 Vac Distribution System

The team reviewed the voltage drop calculations for the Class 1E ac system to ensure the calculations demonstrated that adequate voltage would be supplied to all connected Class 1E ac loads. The short circuit and coordination studies for the ac systems were incomplete at the time of the inspection and were being tracked by Open Item DI-OI-036103. Likewise, there were no short circuit calculations for the non-safety ac system available for the team's review. These calculations are necessary to evaluate the adequacy of the fault current interrupting ratings of the protective devices used for the battery chargers and the voltage regulating transformers fed from the non-Class 1E ac system. In the absence of the ac short circuit calculations, the team was unable to complete its review in this area.

The team also identified that the detailed drawings for the non-safety ac system were incomplete. As such, the team was unable to verify whether the design provides for the battery chargers and regulating transformers being powered from redundant MCCs of the non-safety related ac distribution system, as required by GDC 17. Westinghouse stated that detailed drawings for the non-safety ac system were under development.

No findings of significance were identified in this area.

Class 1E dc Motor Control Centers

The team reviewed the Class 1E 250 V dc Motor Control Centers specifications and found that a modification had been performed to change the previously specified reduced voltage starters to across-the-line starters. Also, the overload protection technology had been changed to a solid state overload device. The team was concerned that the proposed change from the reduced voltage starters (limits the inrush current to 5 times the full load current) to the across-the-line starters would result in higher inrush currents, thus resulting in a higher demand from the batteries. The team also questioned the impact of this change on the operation of the MOV's as the new starters would result in an increased voltage drop on starting. In addition, the team identified that a failure modes and effects analysis for the change to the solid state overload devices had yet to be performed. Westinghouse indicated that the above issues were being tracked as an Open Item DI-OI-032656. No findings of significance were identified in this area.

4. Structural Module CA05

a. Inspection Scope

CA05 is a steel and concrete composite structural module which forms a portion of the internal containment structure. CA05 divides the PXS Valve/Accumulator Room B from the CVS Room, and provides structural support to piping, smaller structural modules, and mechanical modules. It also protects the PXS room and the CVS room from flooding during a LOCA and provides radiation shielding.

The team reviewed Westinghouse's implementation of the AP1000 DCD commitments in the development of design guidance, structural load calculations, and design validation for the CA05 structural module. The inspection team also reviewed the planned construction sequence for assembly of the 8 sub-modules that form CA05, including details of structural connections, welding tolerances, lifting and handling considerations, and other related procedures.

b. Observations and Findings

The team reviewed APP-1100-S2C-034, "Finite Element Solid-Shell Model of Containment Internal Structures", which provides technical details about the three dimensional finite element (FE) solid-shell model prepared to analyze the containment internal structures (CIS). This FE model was subjected to static, dynamic, internal pressure and thermal loads to obtain the member forces for the structural members of the CIS. References to all independent load evaluation documents were also included in the above document. Member forces from these independent evaluations were combined to obtain the design member forces for the load combinations documented in APP-1100-S2C-006, "Static Analysis of Containment Internal Structures – Load Combinations." Using the design member forces, Westinghouse determined the reinforcement required for the structural modules, in order to satisfy the applicable design criteria in American Concrete Institute (ACI) 349-01 and American National Standards Institute (ANSI) N690-1994. The team reviewed detailed analysis methodology documents, a complete set of drawings for CA05, and specifications for construction, handling and placing the steel and concrete. In order to validate the information provided, the inspection team requested that Westinghouse also provide a sample of the CA05 structural evaluation results. Tabulated member forces and contour plots were provided.

During its review, the team identified that the method used by Westinghouse to combine the high frequency and low frequency periodic and rigid seismic responses of the CIS was contrary to the method specified in the DCD. In paragraph 3.7.3.7.1.2, the DCD states, "The total combined response to high-frequency modes (Step 3) is combined by the square root of sum of the squares method with the total combined response from lower-frequency modes (Step 1) to determine the overall structural peak responses." This information is classified in the DCD as Tier 2* information that requires approval from the NRC prior to implementing a change to the methodology. Contrary to the above, in calculation APP-1100-S2C-002, "Response Spectrum Analysis of AP1000 Containment Internal Structures", Westinghouse used an alternate direct algebraic summation method to combine the periodic and rigid seismic responses of the CIS.

The inspection team was concerned about the effect that this different approach could have on the predicted CIS seismic response. Westinghouse explained that the direct algebraic summation of the rigid and periodic seismic responses resulted in a more conservative result; however, the team identified that this conclusion was based upon a limited set of data. As a result of the team's questions, Westinghouse indicated that they would reanalyze the data using the methodology specified in the DCD. Westinghouse's use of an alternate method to combine the rigid and periodic seismic forces was identified as Non Conformance 99900404/2011-201-03.

The inspection team also reviewed the methods being used by Westinghouse to account for the stiffness reduction factors for thermal loading utilized in performing the static analysis of the containment internal structures. In reviewing APP-1100-S2C-006, "Static Analysis of Containment Internal Structures – Load Combinations", the team identified that the stiffness reduction factors for thermal loading were not implemented as stated in Table 3.8.3-1 of the AP1000 DCD. Table 3.8.3-1 identifies stiffness reduction factors for cracked and uncracked concrete sections as 0.47 and 0.59 for 48" and 30" CIS module walls, respectively. Westinghouse, however, used an averaged value of 0.52 for all CIS module walls to account for the effect of reduction in concrete section stiffness due to concrete cracking. The team was concerned about use of 0.52 stiffness reduction factors for the 30" (and thinner) walls since this value is less conservative than the 0.59 value stated in the DCD for walls of 30".

In response to the team's questions, Westinghouse provided an analysis, APP-CA00-CAC-204, "Thermally Induced bending moment comparison between a non-linear composite and a fully linear composite beam", which seemed to validate the use of the average 0.52 reduction factor, albeit for a single load combination. In order to further validate the use of the 0.52 reduction factor, Westinghouse indicated that they would be performing a comparison of the FE modeling results using both 0.52 and 0.59 reduction factors for the 30" (and thinner) modular walls and that they would include the results in APP-CA00-CAC-204.

As part of its review, the inspection team also reviewed the requirements for the protective coatings to be utilized on systems, structures, and components inside containment contained in Section 6.1.2.1.2 of the DCD, Rev. 19, against the design specifications contained in APP-GW-Z0-604, "Application of Protective Coatings to Systems, Structures, and Components for the AP1000 Reactor Plant", APP-G1-SX-001 "AP1000 Painting of Shop Fabricated Steel", and APP-G1-AX-001, "Field Coating and Lining for Concrete and Metal Surfaces", to determine if the coating requirements specified in the DCD were adequately translated into specifications and design documents. The inspectors verified that the coating requirements for module CA05 were adequately specified in procurement and fabrication documents.

The team also reviewed selected documents related to recent changes made to the CIS design, including a reduction of stud spacing, a change to a higher strength steel material for module face plates, and the use of self-consolidating concrete (SCC) to fill the CIS modules. The inspection team reviewed applicable design documents to verify conformance to statements made in the DCD regarding maximum stud spacing and minimum strength. The inspection team was concerned about over-stressing effects that might be created from the additional reinforcement and higher strength material; however, Westinghouse confirmed that the reinforcement stresses would still be within the maximum allowable reinforcement per APP-1000-CCC-001, "Verification of Design Macro for Reinforced Concrete Walls and Floors."

The use of SCC for the CIS modules was evaluated by the team to ensure that its use would meet the compressive strength and other engineering properties as specified in section 3.8 of the DCD. The team verified that Westinghouse had revised the construction specifications for the testing and handling of concrete to include ASTM and ACI standards applicable to SCC and confirmed that these standards are adequate for SCC testing and handling. Also, ACI 237-R, “Self-Consolidating Concrete” was reviewed to confirm that Westinghouse had provided guidance to account for deviations in the curing and hardening process from that of regular concrete.

Design Change Proposals APP-GW-GEE-2434 and APP-GW-GEE-2090 were reviewed by the inspection team to ensure that the design refinements were adequately addressed by the vendor’s design control process and appropriately incorporated into design documents. The inspectors also reviewed procedure APP-GW-GAP-420, “Engineering Design and Coordination Reports”, to verify that design refinements were communicated between design disciplines and all potential impacts regarding the design changes were considered. The inspection team concluded that the CIS design refinements were implemented in accordance with the vendor’s documented change control program. Design calculation documents, drawings and construction specifications were inspected to confirm the effectiveness of this program. The inspection team did not identify any significant findings or observations about documentation and changes pertaining CA05 revised documents.

Other than the issue described above regarding the deviation from the DCD specified methodology for combining the periodic and rigid responses of the CIS, no findings of significance were identified in this area.

5. Normal Residual Heat Removal (RNS) Containment Isolation Valve Module – Q240

a. Inspection Scope

Q240 is a mechanical module containing RNS piping, valves, and pipe supports. The inspectors evaluated APP-Q240-S3C-001, “AP1000 Design and Analysis of RNS Containment Isolation Valve Module Q240,” to determine if calculations and analyses were performed in accordance with the DCD and Westinghouse design criteria. The team’s review included the codes and standards used, computer aided analysis inputs and outputs, and samples of design calculations. The inspectors reviewed the structural frame analysis for operational loads (including seismic), transportation loads, and lifting loads to verify that all pertinent loads and load combinations were considered in the analysis. The load path of the structure was evaluated to ensure that the applied loads were properly carried through the structure to the supporting points. Inspectors also examined resulting structural deformations from the various load combinations.

Using pipe support and mechanical system analysis outputs, model and boundary conditions used in structural analysis of module Q240 were evaluated to confirm correctness. Drawings of the module and module components were reviewed to verify that member dimensions, weld sizing requirements, and configurations used in analysis were correctly translated. The inspectors compared APP-GA-G1-001, “APP1000 Module Design Criteria;” APP-GW-C1-001, “AP1000 Civil/Structural Design Criteria;” and APP-GW-G1-006, “AP1000 Structural Frame Design Criteria for Mechanical Modules,” for consistency between the documents. The inspectors verified that structural safety categories were consistent and correct throughout these documents, and that they were compatible with mechanical fluid system safety categories. Westinghouse Issue Reports and Design Change Plans were also reviewed to verify adequacy of corrective actions and disposition of design changes.

The inspectors reviewed pipe support analyses for rigid supports within module Q240 to verify inputs used from pipe analyses, outputs used for frame analysis, and load combinations were correct and consistent with other analyses. Drawings of the pipe configurations within the module were reviewed to verify that the configuration and requirements used in the calculation notes and analyses were accurately translated. Safety-related valve functional and design requirements were evaluated to verify consistency with system and modular analysis requirements. Test qualification requirements for these valves were evaluated for completeness and conformance with design requirements. The inspectors compared APP-PV01-Z0-001, 419A35, "3" and Larger Motor Operated Gate and Globe Valves, ASME Boiler and Pressure Vessel Code Section III Class 1, 2, and 3," and APP-RNS-M3C-100, "RNS Component Control Requirements," to verify consistency between the documents.

No significant issues were identified from the team's review of the above information.

6. <u>Design Control</u>

a. <u>Inspection Scope</u>

The team reviewed the Westinghouse Quality System Manual (QSM) and implementing procedures that govern the process associated with the development and control of the AP1000 design to verify compliance with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. In addition, the team reviewed a sample of Design Change Proposals (DCPs) and Engineering and Design Coordination Reports (E&DCRs) associated with the selected systems and components to evaluate compliance with program requirements. The specific Westinghouse policies, procedures, and supporting documentation reviewed by the NRC inspection are documented in Appendix A of this report.

b. <u>Observations and Findings:</u>

<u>Policies and Procedures</u>

The team reviewed Westinghouse QMS Section 4.2, Design Control, and NSNP 3.4.1 which requires that DCPs be initiated as an alpha revision. When final approval is obtained, it will then be issued as a Revision 0. DCPs cannot have a revision greater than 0 in order to prevent confusion and errors due to possible use and incorporation of different information from different configuration control revisions of the same DCP.

The team also reviewed the following Westinghouse design control implementing procedures:

- NSNP 3.3.3, "Design Verification by Independent Review or Alternate Calculations" - establishes the process for performing design verification;
- Westinghouse 3.1.1, "Design Planning and Project Development" - establishes the process for implementing, maintaining and developing a design project plan;
- Westinghouse 3.3.1, "Design Reviews" - establishes the process for conducting and handling preliminary, intermediate, and final design reviews; and
- Westinghouse 6.1, "Document Control" - establishes the requirements for controlling documents.

No significant issues were identified from the team's review of the above information.

Design Change Proposals

The team reviewed a sample of DCPs associated with the PXS system, the IDS system, equipment module Q240, and structural module CA05. These DCPs were identified by the team during the review of corrective actions associated with the above systems and modules. The team was able to verify that DCPs were generated based on approved corrective actions consistent with Westinghouse implementing procedures. No significant issues were identified from the team's review of the above information.

DCPs Associated with the PXS System

The team reviewed the Westinghouse design guidelines and selected a sample of calculation packages associated with the PXS system to verify adequate implementation of the design process and that the calculations were completed in accordance with applicable policies and procedures. During this review, the team identified some minor discrepancies with a few PXS calculations. These calculation discrepancies were entered into Westinghouse's Corrective Action Process (CAPs) as documented in Issue Reports (IRs) 11-181-M028 and 11-181-M029.

The team reviewed DCP APP-GW-GEE-864 (DCP 864) associated with SI Accumulator and CMT Outlet Check Valve Design Changes. DCP 864 proposed to add six safety-related 1-inch manual valves to facilitate testing of the CMT outlet check valves with flow, change the valve type from a tilting disk to an in-line (nozzle) check valve, and remove the remote position indication for these valves. The team verified that DCP 864 was incorporated into the AP1000 DCD consistent with Westinghouse policy and procedures.

The team also reviewed the Change Control Board (CCB) meeting minutes and the affected AP1000 design documents associated with this DCP. The team that contrary to the requirements of NSNP 3.4.1 Section 7.14, three of the four affected AP1000 design documents did not list DCP 864 on the cover sheet indicating that the DCP had been incorporated. This was a considered to be a minor issue and Westinghouse initiated IR 11-195-M009 to correct the documents.

In addition, the team reviewed APP-PV03-Z0-001, the design specification for the in-line check valves, which delineates the supplier requirements for providing an experience reliability assessment, FMEA, environmental and valve operability qualification for the in-line check valves. The team noted that Westinghouse had not yet received the requested information from the valve vendor. The team also identified concerns regarding the qualification requirements for the subject valves, as detailed previously in this inspection report and listed as NRC Open Item 99900404/2011-201-06.

No significant issues were identified from the team's review of the above information.

DCPs Associated with the Q240 Module and IDS System

The team reviewed seven DCPs associated with the Q240 module and IDS system. The team noted that two DCPs, APP-GW-GEE-666 (DCP 666) and APP-GW-GEE-1852 (DCP 1852), had resulted in revisions to the AP1000 Design Control Document (DCD) revision. DCP 666, was written to address inconsistencies in the safety related valve tables contained in Tiers 1 and 2 of the DCD and DCP 1852 was written to update the valve tables in the DCD based upon corrections to the RNS piping and instrumentation drawings (P&IDs). The team verified that the

DCPs were incorporated into the AP1000 DCD consistent with Westinghouse policy and procedures.

No significant issues were identified from the team's review of the above information.

DCPs Associated with the CA05 Module

For the CA05 module, the team reviewed DCPs APP-GW-GEE-2090 and APP-GW-GEE-2434 to determine whether Westinghouse had properly implemented Procedure NSNP 3.4.1 which defines the process for proposing, evaluating, and implementing changes to the AP1000 design. The team noted that there were differences in the design change process for the sample of DCPs reviewed. These differences in process were due to the complete rewrite of NSNP 3.4.1 in March 2011, in order to incorporate recommendations from a process improvement initiative. The team verified that the DCPs had been implemented consistent with the applicable Westinghouse procedures.

No significant issues were identified from the team's review of the above information.

Verification and Validation (V&V) of GT STRUDL used in Structural Design Analyses of AP1000 Q240 Module

The team reviewed the Westinghouse policies and procedures for the planning, development, and retirement of computer software, including single application computer programs associated with engineering products and services. The team also reviewed a selected sample of calculation packages to verify V&V activities had been properly performed by Westinghouse.

The team reviewed Westinghouse procedures NSNP 3.6.2, 3.6.3, and 3.6.6, which define the responsibilities and requirements for the validation, verification, configuration control of computer programs, and generation and maintenance of documentation to ensure that safety-related design analysis codes satisfy all identified requirements and produce correct results. The team reviewed the Westinghouse validation and installation testing packages for GT STRUDL versions 29, 30, and 31 and noted that Westinghouse does not have the source code for GT STRUDL just the executable files. The team observed that Westinghouse verified the results of test cases against those provided by the Georgia Institute of Technology – CASE Center to ensure adequate installation of GT STRUDL.

The team identified that Westinghouse IR 10-057-M029 evaluated an issue with the usage of GT STRUDL. IR 10-057-M029 identified that GT STRUDL allows an analyst to run multiple stiffness analyses in the same computer run and then envelope results such as local member forces and moments, stresses, displacements, reactions, etc. Errors in the results can occur if the analyst envelopes results from multiple stiffness analyses and the loadings and load combinations are not assigned unique numbers throughout the coding (for all stiffness analyses). If unique numbers are not used, then load combinations may use load results from the wrong stiffness analysis.

Westinghouse entered IR 10-057-M029 into the Westinghouse Part 21 process as a potential deviation PD-724. Westinghouse performed an extent of condition and determined that seven of 35 completed mechanical module calculation notes were affected by this load case numbering error. All seven of the affected calculation notes were for non-safety related module designs. Furthermore, Westinghouse concluded that this IR was not a software error but rather a training issue related to GT STRUDL. The team met with representatives of the

Westinghouse management to discuss Westinghouse assessment and corrective actions associated with IR 10-057-M029. Westinghouse confirmed that training has been provided for individuals that perform non-safety and safety-related design analysis. No findings of significance were identified.

Review of Engineering and Design Coordination Reports

The team reviewed APP-GW-GAP-420 which establishes the requirements for justifying, documenting, and approving design changes to issued design documents under configuration control when shop or site work must be performed before the affected design document can be formally revised and re-issued. The team reviewed four E&DCRs related to the PXS system and the CA05 module that were generated based on lessons learned from the AP1000 units currently under construction in China. These E&DCRs had been identified by Westinghouse as affecting the entire AP1000 fleet. In addition, the team reviewed 15 E&DCRs that had been classified as applicable only to the Chinese AP1000, to verify that Westinghouse had properly evaluated the E&DCRs for applicability to the US AP1000 fleet.

The team concluded that the Westinghouse design control process conformed to the requirements of Criterion III of Appendix B to 10 CFR Part 50, the Westinghouse QMS, and applicable implementing procedures; and was being effectively implemented. No findings of significance were identified.

7. Control of Purchased Material, Equipment, and Services

a. Inspection Scope

The team reviewed the Westinghouse QMS and implementing procedures that govern Westinghouse's process for controlling purchased material, equipment, and services to verify compliance with Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50. The team reviewed the purchase orders (POs), change notices (CNs), and associated Westinghouse external audit reports of Westinghouse design partners Electric Boat, Shanghai Nuclear Engineering Research and Design Institute (SNERDI), and Ansaldo Nucleare to evaluate compliance with program requirements and to verify adequate implementation of those requirements. In addition, the team reviewed the process used at Westinghouse for accepting the design work of design partners and Westinghouse affiliates (i.e., Westinghouse Belgium, Westinghouse South Africa, Westinghouse Fluid Systems etc.). The specific Westinghouse policies, procedures, and supporting documentation reviewed by the NRC inspection are documented in Appendix A of this report.

b. Observations and Findings

Policies and Procedures

The team reviewed Westinghouse QMS Section 4.3, Procurement, and Westinghouse NSNP 7.1 which establishes the requirements for evaluation and qualification of suppliers and for conducting a quality program audit. NSNP 7.7 establishes the responsibilities and requirements for the handling and disposition of documents submitted between suppliers and Westinghouse, and APP-GW-GAP-124 establishes the process for reviewing, and archiving AP1000 design partner generated documents submitted by AP1000 design partners to Westinghouse. This procedure applies to documents generated by AP1000 design partners that are submitted to

New Plants Engineering for use as design documents or other information identified as pertinent to the AP1000 Program.

Westinghouse Design Partner Purchase Orders (POs)

The team reviewed the Westinghouse POs associated with the PXS system to verify adequate quality and technical requirements were imposed on AP1000 design partners that are providing input into the AP1000 design finalization project. The team verified that up until June 2011, Westinghouse's external design partners of SNERDI and Rolls-Royce had provided staff augmentation to support design activities associated with the PXS system. The staff augmentation services provided by SNERDI and Rolls-Royce consisted of technical personnel who worked at Westinghouse facilities under Westinghouse supervision and under the Westinghouse Quality Programs. The other AP1000 design partners, Westinghouse Belgium and Westinghouse South Africa, performed work on the design of the AP1000 PXS system and were Westinghouse organizations that maintained qualified Westinghouse employees working under the same Westinghouse quality and design programs and processes.

The team also reviewed the process Westinghouse used to contract work with Electric Boat Corporation to support the design of the Q240 module. The team reviewed PO 4500273727 and the associated Change Notices (CNs) which establish the quality and technical requirements of the integrated work package (IWP) of the PO.

Lastly, the team reviewed Westinghouse POs 4500299762 and 4500246636 to determine whether adequate quality and technical requirements were included in the PO to Ansaldo Nucleare concerning their performance of engineering services for the design of the CA05 structural module.

No findings of significance were identified in this area.

Westinghouse External Audits and Evaluations of Design Partners

The team reviewed audit reports WES-2008-112 and WES-2010-175 which contained the results of Westinghouse's initial and follow-up audits of SNERDI. Westinghouse's original intention was to qualify the SNERDI organization in Shanghai, China to be capable of performing safety-related design work on the PXS system. As a result of the audits, Westinghouse issued two supplier corrective action requests (SCARs). The SCARs concerned the lack of adequate procedures for procurement and procurement document control. The team also reviewed the findings from the June 2008, Westinghouse audit of SNERDI as documented in IR 08-178-M015. These findings concerned the fact that not all SNERDI documents were in English, that the SNERDI QA Manual had not been submitted to Westinghouse within 60 days, a lack of audit personnel training records, expired auditor certifications, and the fact that lead auditors had been trained to ISO standards rather than NQA-1. IR 08-178-M016 contained findings related to a lack of established interfaces between SNERDI and Westinghouse for conceptual design document packages and SNERDI's failure to notify Westinghouse of errors contained in documents submitted to them from Westinghouse. The team verified that Westinghouse took actions to ensure the above issues were being addressed.

Subsequent to these audits, a decision was made to limit the SNERDI design work being performed in China that is applicable to the U.S. plants. Consequently, SNERDI staff were sent to Westinghouse to perform work under Westinghouse's Quality Assurance Program.

According to Westinghouse, no safety-related design work is being performed in China that is applicable to the U.S.

For AP1000 design work performed by other Westinghouse organizations, Westinghouse utilized work authorization forms (WAFs) to transmit the scope of design work to their internal design partner(s). These WAFs defined the scope of work, deliverables, and key dates, as applicable. The team reviewed WAF NPP-WNS-000340, “Work Authorization for Westinghouse-South Africa and Staff Augmentation Fluid Systems Support (NSE Project Management)”; and WAF NPP-WNS-000342, “Work authorization for ES Fluid Systems (SEE) and Project Management Support.”

The team reviewed the Westinghouse qualified supplier list (QSL), the initial qualification audit report WES-2008-225, and annual evaluations performed of design partner Electric Boat.

Both Westinghouse and Electric Boat utilized the GT STRUDL structural design and analysis software program to assist in the structural analysis of the Q240 module. The team verified that the supplier of GT STRUDL, Georgia Institute of Technology – CASE Center, was a safety-related supplier on the Westinghouse QSL. The Westinghouse supplier audit / evaluation summary (SAES) 16316 for Georgia Institute of Technology – CASE Center stated that while no annual evaluation was performed in 2010, Westinghouse determined that the supplier was acceptable for continued qualification since there has been no reduction in their quality program. Westinghouse issued IR 11-132-M032 to address this Westinghouse identified issue.

The team reviewed the Westinghouse audit report, WES-2009-178, of Ansaldo Nucleare as well as Westinghouse IRs created as a result of the Significant Condition Adverse to Quality Reports (SCARs) generated from the five audit findings. During the review, the team determined that the IRs accurately identified the significant conditions adverse to quality identified in the SCARs. The team concluded that the IRs were closed in accordance with Westinghouse procedures and that the corrective actions implemented to meet quality requirements were appropriate. Furthermore, as a result of the audit, procurement restrictions were placed on Ansaldo Nucleare. The team reviewed the associated IRs and noted that the procurement restrictions were removed once the IRs were closed. The team reviewed the closed IRs to determine whether the status of Ansaldo Nucleare was commensurate with the status documented on the SAES as well as the QSL. The team also reviewed the lead auditor training records to determine whether training was current at the time of the audit in June 2009. The team concluded that training records were being maintained in accordance to Westinghouse 2.8 as well as Westinghouse commitments to ASME NQA-1-1994, specified in Appendix A of the Westinghouse QMS.

The team concluded that Westinghouse’s control of purchased material, equipment, and services was in conformance to the regulatory requirements of Criterion VII of Appendix B to 10 CFR Part 50, the Westinghouse QMS, and applicable implementing procedures.. Based on the sample of documents reviewed, the team also concluded that Westinghouse was effectively implementing its policies and procedures associated with control of purchased material, equipment, and services. No findings of significance were identified.

8. Corrective Actions

a. Inspection Scope

The team reviewed Westinghouse's implementation of its policies and procedures that govern the corrective action process to ensure conformance with the requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. In addition, the team reviewed a sample of IRs that Westinghouse had previously evaluated for Part 21 applicability. The specific Westinghouse policies, procedures, and supporting documentation reviewed by the NRC inspection are documented in Appendix A of this report. The team also reviewed a sample of IRs and SCARs associated with the PXS system, the IDS system, the Q240 equipment module, and the CA05 structural module to determine whether they were properly documented and whether they properly described the conditions adverse to quality and the corrective actions taken. The team also reviewed selected DCPs which were generated as a result of corrective actions.

b. Observations and Findings

The team reviewed a sample of 15 out of 230 IRs that had been written against the PXS system, the majority of which had been closed at the time the inspection. The team reviewed one IR related to the PXS system that was classified as "High Significance", and thus required a root cause analysis to be performed. This IR, 11-076-C001, was issued to address the issue that the IRWST injection line check valves may not fully open under expected flow conditions. This concern is also discussed previously in this report and was identified as NRC Open Item 99900404/2011-201-05.

The team also reviewed four of the eight IRs issued for the Q240 module and 18 of 189 IRs issued for the IDS system. All of the IRs that were reviewed were categorized at the watch/trend level of significance, with the majority closed at the time of the inspection.

The team reviewed one high-significance, one medium-significance, and several watch/trend IRs related to the CA05 module. The team also reviewed the root cause analysis associated with the high-significance IR.

The team reviewed a sample of IRs for Part 21 applicability. At the time of the inspection, Westinghouse had not made any Part 21 notifications to the NRC related to the AP1000 design. The team reviewed 9 of the 96 IRs that were evaluated for Part 21, including the applicable potential deviation and close out reports. The team concluded that, based on the sample reviewed, Westinghouse was adequately evaluating corrective action reports for Part 21 applicability.

The team concluded that Westinghouse was properly implementing a corrective action program the met the requirements of Criterion XVI, "Corrective Actions," of Appendix B to 10 CFR Part 50. No issues of significance were identified.

9. Exit Meeting

On July 15, 2011, the NRC inspectors presented the preliminary results of the inspection during an exit meeting with Westinghouse personnel. On August 18, 2011, a re-exit teleconference was held with Westinghouse to discuss the results of the NRC's review of additional information provided by Westinghouse after the close of the inspection.

10. List of Items Opened, Closed, and Discussed

Item Number	Status	Type	Description
99900404/2011-201-01	Open	Nonconformance	Criterion III
99900404/2011-201-02	Open	Nonconformance	Criterion III
99900404/2011-201-03	Open	Nonconformance	Criterion III
99900404/2011-201-04	Open	Open Item	
99900404/2011-201-05	Open	Open Item	
99900404/2011-201-06	Open	Open Item	
99900404/2011-201-07	Open	Open Item	
99900404/2011-201-08	Open	Open Item	

Appendix A – Supplemental Information

Documents Reviewed

Design Specifications

APP-PV20-Z0R-001, Ball Valves, ASME Boiler and Pressure Vessel Code Class 1, Rev. 1
APP-PV03-Z0-001, 3” & Larger Manually Operated Gate, Stop Check and Check Valves, ASME Boiler and Pressure Vessel Code Section III Class 1, 2, and 3, Rev. 5
APP-PV20-Z0-001, Passive Residual Heat Removal discharge valve, ASME boiler and Pressure vessel code, section III class 1, Rev. 1
APP-PY25-Z0-001, Single Stage, ASME Boiler and Pressure Vessel Code Section III Class 1, 2, and 3 Orifices, Rev. 3
APP-DU01-Z0-001, Rev. 3, “Design Specification for Class 1E Inverters, Static Transfer and Manual Bypass Switches”
APP-DT01-Z0-010, Rev 3, “Design Specification for Class 1E Regulating Transformer”
APP-IDS-E8-001, Rev. 2, “Class 1E DC and UPS System, System Specification Document”
APP-DB01-VPH-001, Rev. 0, “AP1000 Test Plan For Safety Related 250 VDC Batteries”
LES-S-05130, Fabrication of Structural and Miscellaneous Steel, Rev. 2
APP-PXS-M3-001, Passive Core Cooling System, System Specification Document, Rev.3
APP-RNS-M3-001, Normal Residual Heat Removal System, System Specification Document, Rev. 1

Piping and Instrumentation Diagrams

APP-PXS-M6-001, Piping and Instrumentation Diagram Passive Core Cooling System, Rev. 8
APP-PXS-M6-002, Piping and Instrumentation Diagram Passive Core Cooling System, Rev. 8
APP-PXS-M6-003, Piping and Instrumentation Diagram Passive Core Cooling System, Rev. 8
APP-PXS-M6-004, Piping and Instrumentation Diagram Passive Core Cooling System, Rev. 8
APP-RCS-M6-001, Piping and Instrumentation Diagram Reactor Cooling System, Rev. 9
APP-RCS-M6-002, Piping and Instrumentation Diagram Reactor Cooling System, Rev. 9
APP-RNS-M6-001, Piping and Instrumentation Diagram Normal Residual Heat Rem. System, Rev. 8
APP-SFS-M6-001, Piping and Instrumentation Diagram Spent Fuel Pool Cooling System, Rev. 7

Functional Diagrams

APP-PMS-J1-112, CMT Actuation, Rev. 8
APP-PMS-J1-113, Containment and Other Protection, Rev. 5
APP-PMS-J1-119, RNS Isolation Valve Interlocks, Rev. 5

Isometric Drawings

APP-PXS-PLW-010, Passive Core Cooling System Containment Building Room 11206, Module Q2-33 CMT-A Discharge Piping, Rev. 6
APP-PXS-PLW-02Y, Passive Core Cooling System Containment Building Room 11207, RNS Connection to DVI-B Connection, Rev. 1

Procedures:

APP-GW-GAP-118, “AP1000 Work Instruction for Processing Supplier Documents Submitted to Westinghouse for Information, or for Review and Approval,” Revision 0
APP-GW-GAP-124, “Acceptance of AP1000 Design Partner Generated Documents for New Plants Engineering (NPE)”, Revision 2
APP-GW-GAP-128, “Procedure for Identifying Input References in AP1000 Documents and Drawings”, Revision 1
APP-GW-GAP-420, “Engineering & Design Coordination Reports,” Revision 4
APP-GW-P1-010, “Lisega Standard Component Vendor Information,” Revision 2
NSNP 3.3.3, “Design Verification by Independent Review or Alternate Calculations”, Revision 4
NSNP 3.4.1, “Change Control for the AP1000 Program”, Revision 2
NSNP 3.4.1, “Change Control for the AP1000 Program”, Revision 3
NSNP 3.6.2, “Validation of Computer Software,” Revision 2
NSNP 3.6.3, “Configuration Control of Computer Programs and Systems,” Revision 1
NSNP 3.6.5, “External Computer Software,” Revision 1
NSNP 3.6.6, “Single Application Computer Programs,” Revision 0
NSNP 7.7, “Control of Supplier Generated Documents,” Revision 1
Westinghouse 2.8, "Qualification of Audit Personnel". Revision 0
Westinghouse 3.1.1, “Design Planning and Project Development”, Revision 1
Westinghouse 3.3.1, “Design Reviews”, Revision 2
Westinghouse 6.1, “Document Control”, Revision 2
Westinghouse 6.1, "Control of Purchased Items and Services," Revision 11
Westinghouse 6.9, “Trending Process”, Revision 0
Westinghouse 7.1, ”Supplier Qualification and Evaluation," Revision 2
Westinghouse 7.5, "Control of Purchased Items and Services," Revision 0
Westinghouse 16.2, "Westinghouse Corrective Action Process," Revision 2
Westinghouse 16.3, “Corrective Action Review Board”, Revision 1
Westinghouse 16.4, "Root Cause Analysis," Revision 1
Westinghouse 16.5, "Apparent Cause Analysis," Revision 0
Westinghouse 21.0, “Identification and Reporting of Conditions Adverse to Safety,” Revision 6,
EG-3-4100-05, Engineering Change Request, Rev. 8
EG-3-6000-01, Construction Work Plans, Rev. 10
IT-3-2000-07, System Data Backup, Rev. 0
PR-3-2000-01, LES Control of Procurement, Rev. 4
PR-3-2000-02, Purchase Requisitions, Rev. 9
PP-QA-0807, Parsons Corrective Action, Rev. 1
LS-3-1000-01, Implementation of 10 CFR 21, Rev. 2
CA-3-1000-01, Performance Improvement Program, Rev. 12
MA-3-1000-02, Calibration and Control of Measuring and Test Equipment, Rev. 2
QA-3-1000-02, Calibration and Control of Measuring and Test Equipment Used by LES QC, Rev. 1
QA-3-2000-01, Quality Assurance Audit, Rev. 4 and 5
QA-3-2000-07, Quality Assurance Surveillance, Rev. 3
QA-3-2000-08, Approved Supplier List, Rev. 4, 5, and 6
RM-3-2000-01, Records Management Program, Rev. 7
RM-3-3000-01, Control of Documents, Rev. 7
RM-4-3000-01, Processing Released Documents in Documentum, Rev. 4
RM-4-3000-02, Updating Controlled Document Sets, Rev. 2
RM-43-3000-10, Creating and Updating Controlled Sets in Documentum, Rev. 0
TQ-3-13000-01-F-1, Functional Area Lesson Plan, Rev. 1

Purchase Orders (POs):

Ansaldo Nucleare, PO No. 4500246636, “Ansaldo Nucleare, AP1000 Engineering Services,” dated November 7, 2007 and Change Notices (CN) 1,2,4,5,6,7,8,9,13
Ansaldo Nucleare, PO No. 4500251263, “Ansaldo Nucleare, AP1000 Engineering Services,” dated March 31, 2008
Ansaldo Nucleare, PO No. 4500299762, “Ansaldo Nucleare, AP1000 Engineering Services,” dated April 6, 2009 and Change Notices 1-22
Ansaldo Nucleare, PO No. 4500393239, “Ansaldo Nucleare, AP1000 Engineering Services,” dated June 9, 2011Electric Boat Department 498, PO 4500273727, July 28, 2008 and Change Notices 1-13

Rolls-Royce Power Engineering PLC, PO No. 4500316532, dated September 3, 2009 and Change Notices 1 and 2

Shanghai Nuclear Engineering Research and Design Institute (SNERDI), PO 4500238372, dated August 10, 2007 and Change Notices 1-10

- Work Package associated with Line Item No. 2, CMT, Accumulator Component Design
- Work Package associated with Line Item No. 14, Diverse Actuation System
- Work Package associated with Line Item No. 32, Mechanical Equip. Qual.
- Work Package associated with Line Item No. 39, Civil Structural Design
- Work Package associated with Line Item No. 40, Mechanical System Design
- Work Package associated with Line Item No. 42, Component Design – Electrical

CR 2010-3702Purchase order initiated by H-Y Tech prior to required surveillance being performed by QA

Calculations:

APP-CA05-S2C-001, “Containment Internal Structures - Required Steel Area Calculation of Concrete Filled Module Wall CA05”, Rev 0.
APP-G1-C1R-001, “AP1000 Performance Requirements for Concrete” Rev 0.
APP-GA-G1-001, “AP1000 Module Design Criteria”, Rev 2.
APP-GW-G1-001, “AP1000 Plant Design Criteria”, Rev 4.
APP-GW-C1-001, “AP1000 Civil/Structural Design Criteria”, Rev 2.
APP-GW-G1-003, “AP1000 Seismic Design Criteria”, Rev 5.
APP-GW-SUP-001, “Design Methodology for Structural Modules”, Rev 2.
APP-1100-S2C-034, “Finite Element Solid-Shell Model of Containment Internal Structures”, Rev 1.
APP-1100-S2C-001, “Static Analysis of Containment Internal Structures - Dead Load and Live Load”, Rev 3.
APP-1100-S2C-002, “Response Spectrum Analysis of AP1000 Containment Internal Structures”, Rev 6.
APP-1100-S2C-003, “Static Analysis of Containment Internal Structures - Pressures”, Rev 4.
APP-1100-S2C-005, “Static Analysis of Containment Internal Structures – Thermal Analysis”, Rev 4.

APP-1100-S2C-006, “Static Analysis of Containment Internal Structures – Load Combinations”, Rev 4.
APP-1100-S2C-010, “Static Analysis of Containment Internal Structures - Reactions”, Rev A.
APP-CA05-S3C-001, “CA05 Connection Design: Module Wall to Reinforced Concrete”, Rev 0.
APP-CA00-SUC-002, “Calculation of Truss Welds for CA Modules”, Rev 0.
APP-PXS-M3C-024, CMT Actuation Recovery, Revision 0
APP-PXS-M3C-024, CMT Actuation Recovery, Revision 1
APP-PXS-M3C-032, IRWST Overflow Size, Revision 0
APP-PXS-M3C-032, IRWST Overflow Size, Revision 1
APP-PXS-M3C-162, AOV Functional Requirements for PXS CMT A/B Discharge Isolation Valves V014A/B and V015A/B, Revision 1
APP-PXS-M3C-176, Functional Requirements for Core Makeup Tank Orifices (R01A, R01B), Revision 0
APP-PXS-M3C-176, Functional Requirements for Core Makeup Tank Orifices (R01A, R01B), Revision 1
APP-PXS-M3C-178, Functional Requirements for CMT to RCDT Orifices (R04A, R04B), Revision 0
APP-PXS-M3C-178, Functional Requirements for CMT to RCDT Orifices (R04A, R04B), Revision 1
APP-PXS-M3C-178, Functional Requirements for CMT to RCDT Orifices (R04A, R04B), Revision 3
APP-PXS-M3C-182, Tank Functional Requirements for PXS Core Makeup Tank, Revision 2
APP-PXS-M3C-189, Functional Requirements for PXS IRWST Gutter, Revision 0, dated
APP-PXS-M3C-189, Functional Requirements for PXS IRWST Gutter, Revision 1, dated
APP-PXS-M3C-214, Functional Requirements for the IRWST Hood Vent Covers, Revision 1
APP-PXS-M3C-215, Functional Requirements for the IRWST SG Wall Vent Covers, Revision 1
APP-PXS-M3C-216, Functional Requirements for the IRWST Overflow Weir Covers, Revision 1
APP-Q240-S3C-001, “AP1000 Design and Analysis of RNS Containment Isolation Valve Module Q240,” Revision 1
APP-RNS-M3C-069, Functional Requirements for the RNS to IRWST Line Orifice (R03), Revision 0
APP-RNS-M3C-069, Functional Requirements for the RNS to IRWST Line Orifice (R03), Revision 1
APP-GW-GER-002, Summary of AP1000 Chemistry Characterizations, Rev. 5
APP-PXS-M3C-001, PXS IRWST Gutter Sizing Calculation, Rev. 1
APP-PXS-M3C-004, CMT Sizing/Performance for AP1000, Rev. 1
APP-PXS-M3C-008, Safety Injection Functional Requirements, Rev. 0
APP-PXS-M3C-019, IRWST / Containment Sump Injection Lines and ADS Line Resistances, Rev. 2
APP-PXS-M3C-034, Containment Flood-Up Level, Rev. 2
APP-PXS-M3C-038, Squib Valve Functional Requirements for Reactor Coolant System (RCS) Automatic Depressurization System Stage 4 (ADS-4) Valves, Rev. 4
APP-PXS-M3C-101, PXS Instrumentation and Packaged Mechanical System Interface Requirements, Rev. 7
APP-PXS-M3C-158, Check Valve Functional Requirements for PXS CMT Discharge Check Valves PXS-PL-V016A/B and V017A/B, Rev. 2
APP-PXS-M3C-162, AOV Functional Requirements for PXS CMT A/B Discharge Isolation Valves V014A/B and V015A/B, Rev. 1
APP-PXS-M3C-163, AOV Functional Requirements for PXS PRHR HX Control Valves V108A/B, Rev. 2

APP-PXS-M3C-190, MOV Functional Requirements for CMT Inlet Isolation Valves PXS-PLV002A/B, Rev. 0
APP-PXS-M3C-195, Check Valve Functional Requirements for PXS IRWST Isolation Check Valves, Rev. 1
APP-RCS-M1-001, Reactor Coolant System Design Transients, Rev. 3
APP-RNS-M3C-050, MOV Functional Requirements for RNS Hot Leg Suction Isolation Valves, V001A/B, V002A/B, Rev. 1
APP-RNS-M3C-052, MOV Functional Requirements for RNS IRWST Suction Isolation Valve, V023, Rev. 2
APP-RNS-M3C-053, MOV Functional Requirements for RNS Hot Leg Suction Isolation Valve, V022, Rev. 2
APP-RNS-M3C-100, RNS Component Control Requirements, Rev. 5
APP-SFS-M3C-148, MOV Functional Requirements for SFS Pump Suction Inside Containment Isolation Valve, V034, Rev. 0
APP-SFS-M3C-155, MOV Functional Requirements for SFS Pump Discharge Containment Isolation Valve, V038, Rev. 0
APP-SFS-M3C-156, MOV Functional Requirements for SFS Pump Suction Outside Containment Isolation Valve, V035, Rev. 2
APP-SFS-M3C-157, Check Valve Functional Requirements for SFS Discharge Containment Isolation Check Valve, V037, Rev. 1
AFD-STD-006, Standard Spreadsheet Calculation using Excel, Rev. 0
APP-IDS-EOC-001, "Class 1E 250V DC Battery Sizing, Charger Sizing and Available Short Circuit Current," Rev. 0
APP-IDS-EOC-004, "Power Cable Sizing and Voltage Drop Analysis," Rev. 0
APP-IDS-EOC-002, "Class 1E DC and UPS Inverter and Regulating Transformer Sizing Calculation," Rev. 0
APP-IDS-EOC-007, "AP1000 Safety-Related Battery Load Sequence," Rev. 0

Design Change Proposals (DCPs):

APP-GW-GEE-308, "Temperature Measurement in Small Diameter Lines," Revision 0APP-GW-GEE-380, "Containment Penetration Valve and Piping Revision," Revision 2
APP-GW-GEE-454, "Additional Makeup Line to PCS Water Distribution Bucket," Revision 1
APP-GW-GEE-622, Revision 1 of APP-GW-GRR-040, Revision 0
APP-GW-GEE-666, "Reconciliation of DCD Revision 17 Valve Tables," Revision 0
APP-GW-GEE-687, Core Makeup Tank Instrumentation Nozzles, Revision 0
APP-GW-GEE-690, "Modifications to DWS Piping in Accordance with APP-GW-M1-005," Revision 1
APP-GW-GEE-829, "PV01 Motor Operated Gate and Globe Valve – Envelope Change," Revision 0
APP-GW-GEE-864, "SI Accumulator and CMT Outlet Check Valve Design Changes," Revision 0
APP-GW-GEE-1083, Updating APP-GW-VP-030 Master Equipment Environmental Summary, Revision 0
APP-GW-GEE-1852, "RNS P&ID Changes to Support Piping Isometrics," Revision 0
APP-GW-GEE-1887, CMT Vent Line Orifice Safety Class Change, Revision B
APP-GW-GEE-1887, CMT Vent Line Orifice Safety Class Change, Revision 0
APP-GW-GEE-2090, "Structural Module Connections to Reinforced Concrete," Revision 0
APP-GW-GEE-2280, Addition of New Commodity Code MY78, Revision 0
APP-GW-GEE-2292, Changes to PXS High Point Gas Accumulation Measurement, Revision A
APP-GW-GEE-2292, Changes to PXS High Point Gas Accumulation Measurement, Revision B

APP-GW-GEE-2292, Changes to PXS High Point Gas Accumulation Measurement, Revision0
APP-GW-GEE-2317, “Clarification of RNS Sloping Requirements,” Revision 0, May 31, 2011
APP-GW-GEE-2434, “CA Module Liner Plate Material Change,” Revision 0
APP-GW-GEE-2764, “Accountability for Field Mounted Non-1E Appurtenances Associated with ASME Section III Air Operated Valves,” Revision B
APP-GW-GEE-2812, “Q240 Addition of Pipe Support to On-Module Piping,” Revision 0
DCP-Westinghouse-000007, “Mechanical Modules Documentation of GTStrudl Error”

<u>Engineering & Departure Change Requests (E&DCRs)</u>:

E&DCR APP-CA05-GEF-001W, “Welding Clarification on CA05 Sub-Module 03,” Revision 1
E&DCR CPP-CA05-GEF-002H, “CA05 Penetrations Design Changes,” Revision 1
E&DCR CPP-CA05-GEF-005H, “CA05 Book 1 OLP / Penetration Design Finalization,” Revision 0
E&DCR CPP-CA05-GEF-003W, “CA05 Module Structural Details,” Revision 4
E&DCR CPP-CA05-GEF-004W, “CA05 Bottom Plates, Mechanical Connectors,” Revision 1,
E&DCR CPP-CA05-GEF-008W, “CA05 Lift Lug Weld Size Change,” Revision 0
E&DCR APP-PXS-GEF-001W, “E&DCR for IRWST to DVI Line-Pipe and Sleeve,” Revision 0
E&DCR CPP-PXS-GEF-001W, “E&DCR for PXS CAP Material Substitution Request,” Revision 0
E&DCR CPP-PXS-GEF-100003, “Add Support Components to APP-GW-P1-010,” Revision 0
E&DCR CPP-Q240-GEF-001W, “E&DCR for Q240 Weld Detail Change Request,” Revision 0
E&DCR SM1CA05-GEF-001, “CA05 Module Structure Changes,” Revision 2
E&DCR SM1-PXS-GEF-100003, “E&DCR for SM1-PXS-PLB1-019,” Revision 0
E&DCR SM1-Q240-GEF-100003, “E&DCE to Modify Module Q240 Base Plates,” Revision 0

<u>Correction Action Documents</u>:

CAPs-RCA-11-076-C001, Root Cause Analysis - AP1000 Passive Core Cooling Test Issue, Draft 0, dated June 30, 2011
Root Cause Analysis, CA05 Module Design Package Revision Errors, Revision 0, dated February 9
Apparent Cause Analysis, Loss of Configuration Control of CA05
Issue Report (IR) No. 02-246-M011, Component computations with WCOBRA/TRAC code simulation of AP1000 PXS system performance
IR No. 06-249-M018, DCD Tier 1 and Tier 2 inconsistency
IR No. 06-354-M026, Conflicting information on AP1000 Steam Generator drawings
IR No. 07-249-M014, Document revisions not listing DCP’s incorporated
IR No. 08-059-M012, Material substitution
IR No. 08-064-W003, AP1000 Passive Core Cooling System System Specification Document (SSD), dated April 3, 2008
IR No. 08-116-M007, Inconsistency in AP1000 DCD values for minimum IRWST water volume
IR No. 08-150-M007, Incorrect incorporation of DCP into calculation, dated May 29, 2008
IR No. 08-150-M007.01, Revise APP-PXS-M3C-100, dated July 1, 2008
IR No. 08-178-M015, Findings from Westinghouse audit of SNERDI performed in 2008, dated June 26, 2008
IR No. 08-178-M016, Findings from Westinghouse audit of SNERDI performed in 2008, dated June 26, 2008
IR No. 08-232-M010, Penetration & sleeve details are incomplete for structural module CA05
IR No. 08-294-M010, “Incorrect incorporation of DCP into DCD,” October 20, 2008

IR No. 08-323-M003, “Unincorporated DCP Resulting in Incorrect Valve Data Sheet Report – DCP 380,” November 18, 2008
IR No. 08-323-M004, “Unincorporated DCPs resulting in Incorrect Valve Data Sheet Reports – DCP 454,” November 18, 2008
IR No. 08-336-M004, Piping system design pressures and/or temperature outside design limits
IR No. 09-014-M018, Conditional releases not QA/QC Controlled
IR No. 09-093-M004, “Modifications to Demineralized Water System (DWS) Piping in Accordance with APP-GW-M1-005,” April 3, 2009
IR No. 09-125-M023, Errors in pipe analysis results for pipe support loads from APP-PXS-PLR-010, R2; APP-PXS-PLR-020, R1; and APP-PXS-PLR-040 R1
IR No. 09-156-M019, “SGS Valve Position Indication EQ Requirements,” June 5, 2009
IR No. 09-175-M020, Discrepancies between open items identified in AP1000 documents and those same documents listed in the Open Tracking System
IR No. 09-195-M011, “Potential Trend of Configuration Management (CM) Issues,” July 14, 2009
IR No. 09-220-M002, “CMT Outlet Check Valves Cannot be Tested as Required by the ASME OM Code,” August 8, 2009
IR No. 09-257-M030, “Improper DCP Incorporation in PSS PI&Ds,” September 14, 2009
IR No. 09-261-M010, Open Items not being properly tracked in Safety Analysis
IR No. 09-282-W002, “Discrepancies Between CAS SSD, CAS P&IDs, and DCD, October 9, 2009
IR No. 09-292-W016, “Discrepancy Between the IDS DID Functions in DCD and SSD, October 19, 2009
IR No. 09-308-M015, “Production of Module R474 Certified for Construction (CFC) Process Pipe Isometrics Without Finalization System Design Input,” November 4, 2009
IR No. 10-042-M045, “Gas Intrusion in the PXS System,” February 11, 2010
IR No. 10-057-M029, “GTStrudl Quality Issue,” February 26, 2010
IR No. 10-074-M009, “Conditional Release: Completion of Module R451’s Certified for Construction (CFC) Design Including Piping Isometrics From Non-Finalized Shaw-owned Systems: CAS, DWS, FPS, VWS and VYS,” March 15, 2010
IR No. 10-084-M006, Loss of configuration control of CA05 - drawing modified w/o proper design control
IR No. 10-085-M032, “Errors in AP1000 RV Generic Design Report (APP-MV01-A0R-101) Discovered,” March 26, 2010
IR No. 10-102-M008, “Q240 GTStrudl Input Geometry,” April 12, 2010
IR No. 10-132-M017, “High Normal Temperatures at ADS-4 Squib Valve Inlet,” May 12, 2010
IR No. 10-141-M037, Incorrect IRWST water level values used in PXS calculations
IR No. 10-153-M025, Inconsistencies with several module drawings generated by Subcontractors
IR No. 10-167-M041, “PCS Recirculation Pump Motor Size,” June 16, 2010
IR No. 10-173-M006, “Outdated Impacts on Older, Unincorporated DCPs,” June 22, 2010
IR No. 10-188-M016, AP1000 document closed without final peer check
IR No. 10-203-M010, Module design packages and released document lists
IR No. 10-203-M020, “Missed Markup of DCD Figure 7.2.1 (Sheet 2 of 20) as Impacted by APP-GW-GEE-854,” July 22, 2010
IR No. 10-223-M036, Impact of liner punch-outs required to install overlay plates on CA structural modules
IR No. 10-223-M037, “Squib Valve Arm-Fire Delay,” August 11, 2010
IR No. 10-230-M011, “Nonconformance with DCD, SER, and P&ID,” August 18, 2010
IR No. 10-245-M011, “Incomplete Floor Structural Analysis in Containment,” September 2, 2010
IR No. 10-246-A001, CA05 module design package revision errors

IR No. 10-257-M045, PRHR Hx inlet piping change
IR No. 10-281-M025, “Invalid ADS Assumptions Regarding AP1000 Pipe Break Hazards Safety Evaluation,” October 8, 2010
IR No. 10-334-M012, Update Impacted Documents list for CA05 drawing revision DCPs
IR No. 10-348-M018, DCP and Drawing Relationship Missing in SPF
IR No. 10-357-M003, “Flow Direction Correction of PSS Air-Operated Containment Isolation Valves,” December 23, 2010
IR No. 11-011-M029, “Nuclear Island Waterproof Membrane – Design Control Document Revision 18 Versus Vogtle Early Site Permit and Combined License Application,” January 11, 2011
IR No. 11-014-M004, CA05 E&DCR SM1-CA05-GEF-007W, Rev. 0 impacted document reference and incorporation errors
IR No. 11-031-M032, Applicability of CA05 DCPs and impact on SM1 drawing package
IR No. 11-041-M029, “Correction to DCD Tier 1 Table 2.3.7-2,” February 10, 2011
IR No. 11-063-M017, SET 2 AP1000 documents that the cover sheet has been altered
IR No. 11-069-M014, “DCP APP-GW-GEE-2526 Rev. 0 – Update MTS P&IDs to Revision 2 per Toshiba Markups,” March 10, 2011
IR No. 11-076-C001, Passive Core Cooling Testing Issues, dated March 17, 2011
IR No. 11-084-M030, “Wrong Drawings Archived In EDMS,” March 25, 2011
IR No. 11-123-M002, “Accountability for ‘Loose’ Hardware Associated with Air Operated Safety Valves,” May 3, 2011
IR No. 11-123-M024, “Topworx Limit Switch Part 21,” May 3, 2011
IR No. 11-129-M027, “Class 1E Inverter Input Voltage,” May 9, 2011
IR No. 11-131-M025, “Add A Pipe Support for Q240 Safety Related Module
IR No. 11-132-M032, “Past Due Annual Evaluations (escape),” May 12, 2011
IR No. 11-181-M028, Incorrect radiation level used, dated June 30, 2011
IR No. 11-181-M029, RNS calculation inputs reversed, dated June 30, 2011
IR No. 11-195-M009, “DCP Impacts Which Were Properly Identified Were Improperly Added to Smart Plant Foundation,” July 14, 2011
Supplier Corrective Action Request (SCAR) No. 09-198-M002
SCARs 09-198-M003 through M007
SCAR No. 10-054-M030, Quality Assurance Program, Procurement Document Control, and Control of Purchased Items and Services, dated February 25, 2010
SCAR No. 10-054-M031, Procurement Document Control, dated February 25, 2010
CAP 11-179-M017

Open Items Reviewed by the team

DI-OI-018422
DI-OI- 034382
DI-OI-020962
DI-OI-036103
DI-OI-018561
DI-OI-036150
DI-OI-036413
DI-OI-032656

Drawings:
APP-CC01-Z0-026, “Safety Related Mixing and Delivering Concrete”, Rev 3.
APP-CC01-Z0-031, “Safety Related Placing Concrete and Reinforcing Steel”, Rev 1.

APP-CC01-Z0-027, “Safety Related Concrete Testing Services”, Rev 2.
APP-CA05-CAC-001, “AP1000 Lifting and Handling Analysis of CA05”, Rev 1.
APP-1000-CCC-001, “Verification of Design Macro for Reinforced Concrete Walls and Floors”, Rev 4.
APP-GW-G8Y-201, “Structural Modules Detailed Division of Responsibility”, Rev 0.
APP-CA00-CAC-204, “Thermally Induced bending moment comparison between a non-linear composite and a fully linear composite beam”, Rev 0.
APP-GW-Z0-604, Application of Protective Coatings to Systems, Structures, and Components for the AP1000 Reactor Plant, Rev. 4
APP-G1-SX-001, AP1000 Painting of Shop Fabricated Steel, Rev. 4
APP-G1-AX-001, Field Coating and Lining For Concrete and Metal Surfaces, Rev. 3
APP-GW-G1X-001, Governing AP1000 Codes and Standards, Rev. 6
APP-GW-GL-700, AP1000 Design Control Document, Rev. 19
WCAP-17249-P, Rev. 0, Epoxy Coating Failure and Transport to Pressurized Water Reactor Containment Sump Screens
APP-CA01-S5-06007, CONTAINMENT BUILDING AREA 2 MODULE CA05 SUBMODULE CA05_06 STRUCTURAL OUTLINE SPECIFIC DETAILS I
APP-CA05-S5B-06001, Containment Building Area 2 Module CA05 Submodule CA05_06 Bill of Materials
APP-PMS-J1-113, Rev 5, “AP1000 Functional Diagram Containment and Other Protection,” May 2, 2011
APP-CA05-S8X-001, CONTAINMENT BUILDING AREA 2 & 3 MODULE CA05 INDEX
APP-CA05-S8-001, CONTAINMENT BUILDING AREA 2 & 3 ASSEMBLED CA05 ISOMETRIC VIEW A
APP-CA05-S8-100, Containment Building Area 2&3 Assembled CA05 Specific Details
APP-CA05-S8-101, CONTAINMENT BUILDING AREA 2 & 3 ASSEMBLED CA05 LIFTING LUG LOCATIONS AND DETAILS
APP-CA05-S8-102, CONTAINMENT BUILDING AREA 2 & 3 ASSEMBLED CA05 LIFTING DETAILS
APP-CA05-S8-103, CONTAINMENT BUILDING AREA 2 & 3 ASSEMBLED CA05 INSTALLATION DETAILS
APP-CA05-S8-104, CONTAINMENT BUILDING AREA 2 & 3 ASSEMBLED CA05 LOCATING TOLERANCES
APP-CA05-S8B-001, Containment Building Area 2&3 Assembled CA05 Bill of Materials
APP-CA05-S4-100, Containment Building Areas 2 & 3 Module CA05 Structural Outline - Plan View (not outfitted)
APP-CA05-S4-101, Containment Building Areas 2 & 3 Module CA05 Structural Outline - Vertical View Looking South (Not Outfitted)
APP-CA05-S4-102, Containment Building Areas 2 & 3 Module CA05 Structural Outline - Vertical View Looking West (not outfitted)
APP-CA05-S4-103, Containment Building Areas 2 & 3 Module CA05 Structural Outline - Vertical View Looking North (not outfitted)
APP-CA05-S4-104, Containment Building Areas 2 & 3 Module CA05 Structural Outline - Vertical View Looking East (Not Outfitted)
APP-CA05-S4Y-401, Containment Building Areas 2 & 3 Module CA05 Embed & Attachment - Vertical View Looking South
APP-CA05-S4Y-402, Containment Building Areas 2 & 3 Module CA05 Embed & Attachment - Vertical View Looking West
APP-CA05-S4Y-403, Containment Building Areas 2 & 3 Module CA05 Embed & Attachment - Vertical View Looking North

APP-CA05-S4Y-404, Containment Building Areas 2 & 3 Module CA05 Embed & Attachment - Vertical View Looking East
APP-CA05-S4Y-405, Containment Building Areas 2 & 3 Module CA05 Embed & Attachment Details
APP-CA05-S4Y-406, CONTAINMENT BUILDING AREAS 2&3 MODULE CA05 STRUCTURAL OUTLINE - SPECIFIC DETAILS (OUTFITTED) - I
APP-CA05-S4Y-407, Containment Building Areas 2 & 3 Module CA05 Structural Outline - Specific Details (Outfitted) - II
APP-CA05-S4B-001, Containment Building Areas 2 & 3 Module CA05 Bill of Materials
APP-CA05-S5-06001, Containment Building Area 2 Module CA05 Submodule CA05_06 Isometric Views
APP-CA05-S5-06002, CONTAINMENT BUILDING AREA 2 MODULE CA05 SUBMODULE CA05_06 BREAK-DOWN
APP-CA05-S5-06003, Containment Building Area 2 Module CA05 Submodule CA05_06 Structural Outline Vertical Sections / Views
APP-CA05-S5-06004, CONTAINMENT BUILDING AREA 2 MODULE CA05 SUBMODULE CA05_06 STRUCTURAL OUTLINE HORIZONTAL SECTIONS / VIEWS
APP-CA01-S5-06005, Containment Building Area 2 Module CA05 Submodule CA05_06 Structural Outline - Specific Details
APP-CA05-S5-06006, CONTAINMENT BUILDING AREA 2 MODULE CA05 SUBMODULE CA05_06 STRUCTURAL OUTLINE VERTICAL SECTIONS / VIEWS I
APP-1000-P2-901, Nuclear Island General Arrangement Section A-A, Revision 1, dated May 25, 2007
APP-1000-P2-902, Nuclear Island General Arrangement Section B-B, Revision 1, dated May 25, 2007
APP-1030-P2-001, Nuclear Island General Arrangement Plan at El. 100'-0" & 107'-2", Revision 1, dated May 25, 2007
APP-Q240-V1-003, "Module 1120-Q2-40 RNS System Lifting Sketch," Revision 1, June 23, 2011
APP-Q240-V1-008, "1120-Q2-40 RNS System Transportation Detail View B-B & C-C," Revision 0, September 9, 2009
APP-Q240-V1-302, "1120-Q2-40 RNS System Structural Interface Welding Details," Revision 0, September 10, 2009
APP-Q240-V1-304, "1120-Q2-40 RNS System Structural – Interface Location Details Elevation View 304-A," Revision 0, September 10, 2009
APP-Q240-SS-214, "1120-Q2-40 RNS System Sliding Feet Weldment Details," Revision 1, March 22, 2011
APP-Q240-SS-214, "1120-Q2-40 RNS System Sliding Feet Weldment Details," Revision 2, June 23, 2011
APP-RNS-PH-11R00421, "Pipe Support Drawing RNS System," Revision 1, June 13, 2011
APP-RNS-PH-11R01271, "Pipe Support Drawing RNS System," Revision 0, September 15, 2009
APP-IDS-E3-001, Rev. D, "Class 1E DC System Station One Line Diagram Divisions A & C"
APP-IDS-E3-002, Rev. D, "Class 1E DC System Station One Line Diagram Divisions B & D & Spare"
APP-IDS-E3-003, Rev. C, "Class 1E UPS System Station One Line Diagram"
APP-IDS-E8-001, Rev. 2, "System Specification Document, Class 1E DC and UPS System"

Audits:

Ansaldo Nucleare Supplier Audit / Evaluation Summary ID 13773
Ansaldo Nucleare Supplier Audit / Evaluation Summary ID 13827
Ansaldo Nucleare Supplier Audit / Evaluation Summary ID 14635
Ansaldo Nucleare Supplier Audit / Evaluation Summary ID 14814
Ansaldo Nucleare Supplier Audit / Evaluation Summary ID 14912
SAESID 12732, "Update – Supplier Audit/Evaluation Summary for Electric Boat," July 19, 2008.
SAESID 13923, "Annual Evaluation – Supplier Audit/Evaluation Summary for Electric Boat 2009," May 11, 2010
SAESID 15348, "Annual Evaluation – Supplier Audit/Evaluation Summary for Electric Boat 2010," June 2, 2011
Supplier Annual Evaluation Questionnaire for Electric Boat, August 24, 2009
Supplier Annual Evaluation Questionnaire for Electric Boat, September 10, 2010
Westinghouse Audit Package, WES-2008-112, SNERDI, dated July 3, 2010
Westinghouse Audit Package, WES-2008-225, "Audit Package Electric Boat," August 21, 2008
Westinghouse Audit Package, WES-2009-178, Ansaldo Nucleare S.p.A., dated June 2009
Westinghouse Audit Package, WES-2010-175, SNERDI, dated February 25, 2010

Miscellaneous:

RG 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," Rev 2, January 2006.
WCAP-17249-P, Rev. 0, Epoxy Coating Failure and Transport to Pressurized Water Reactor Containment Sump Screens
WCAP-15846, Rev. 1, WGOTHIC Application to AP600 and AP1000
CN-SST-07-8, "Installation Testing of GTSTRUDL Version 29 on the Windows XP System State," Revision 0, September 6, 2007.
CN-SST-09-10, "Installation Testing of GT STRUDL Version 30 on the XP System State," Revision 0, September 8, 2009.
CN-SST-11-2, "Installation Testing of GE STRUDL Version 31 w/ Base Plate on the XP System State," Revision 0, May 3, 2011.
CPP-GX-GAP-001, SNERDI QA Program for Nuclear Power Self-Reliance Program Supporting Projects Westinghouse Engineering & Design Subcontract, Revision 2, dated March 10, 2010
DCP_NPP_000051, "AP1000 Design Change Proposals Reviewed at August 13, 2009 Session," August 13, 2009.
DCP_NRC_002744, "Re-submittal of Proposed Changes for AP1000 Design Control Document Rev. 18," January 20, 2010.
DCP_NRC_002818, "Supplementary Information to DCP_NRC_002744 – Re-submittal of Proposed Changes for AP1000 Design Control Document Rev. 18," March 12, 2010.
DCP_NRC_003087, "Final Information on Proposed Changes for the AP1000 Design Control Document Rev. 18," November, 17, 2010.
Engineering & Design Subcontract Terms and Conditions between Westinghouse and SNERDI, dated July 25, 2007
Georgia Institute of Technology, "Verification Letter for GTSTRUDL 29.1," September 19, 2008.
LTR-SRC-10-31, "PD-724 Closeout, "GTStrudl Quality Issue,"" May 11, 2010
LTR-SRC-10-75, "PD-758 Closeout, 'AP1000 Normal Residual Heat Removal System (RNS) Noncompliance,'" September 28, 2010
LTR-SST-11-64, "Release of GTStrudl 31 and Base Plate on XP," June 17, 2011

NPP_WNS-000471, “Evaluation of PD-0759 for Determination of Condition Adverse to Safety,” October 1, 2010
SAES ID 16316, “Georgia Institute of Technology – Case Center,” July 5, 2011
Westinghouse QMS Section 4.2, “Design Control,” Revision 5, dated October 1, 2002
Westinghouse QMS Section 4.3, “Procurement,” Revision 5, dated October 1, 2002
Westinghouse QMS Section 5.5, “Corrective and Preventive Action,” Revision 5, dated October 1, 2002
Work Authorization Form, NPP_WNS_000340, Work Authorization for Westinghouse-South Africa and Staff Augmentation Fluid Systems Support (NSE Project Management), dated January 19, 2010
Work Authorization Form, NPP_WNS_000342, Work Authorization for ES Fluid Systems (SEE) and Project Management Support, dated January 20, 2010
WCAP-15846, Rev. 1, WGOTHIC Application to AP600 and AP1000

Abbreviations

ACA	Apparent Cause Analysis
ADAMS	Agency-Wide Document Access and Management System
ADAMS	Agency-Wide Document Access and Management System
ASL	Approved Supplier List
ASL	Approved Supplier List
CAPs	Corrective Actions Process
CE	Construction Engineer
CFR	Code of Federal Regulations
CMT	Core Makeup Tank
CN	Change Notice
CR	Condition Report
DAS	Diverse Actuation System
DCP	Design Change Proposal
E&DCR	Engineering & Design Coordination Report
EDV	Engineering Design Verification
ESSOW	Engineering Services Scope of Work
IP	Inspection Procedure
IR	Issue Report
IRWST	In-Containment Refueling Water Storage Tank
M&TE	Materials Testing Equipment
NRC	Nuclear Regulatory Commission
P.O.	Purchase Order
PD	Potential Deviation;
PO	Purchase Order
PRHR	Passive Residual Heat Removal
PXS	Passive Core Cooling System
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QC	Quality Control
QMS	Quality Management System
QL	Quality Level
QSL	Qualified Supplier List
RCA	Root Cause Analysis
RCDT	Reactor Coolant Drain Tank
RNS	Normal Residual Heat Removal System
SAES	Supplier Audit / Evaluation Summary
SCAR	Supplier Corrective Action Request
SNERDI	Shanghai Nuclear Engineering Research and Design Institute
TCA	Task Change Authorization
VIO	Violation
WAF	Work Authorization Form
Westinghouse	Westinghouse Electric Corporation
WP	Work Plan

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