October 8, 2014

Sarah DiTommaso, Manager,
AP1000 Instrumentation & Control Licensing
Westinghouse Electric Company
5000 Ericsson Dr.
Warrendale, PA 15086

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION OF WESTINGHOUSE ELECTRIC COMPANY REPORT NUMBER 99900404/2014-203

Dear Ms. DiTommaso:

On August 25 to August 29, 2014, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Westinghouse Electric Company (WEC) facility in Warrendale, PA. The purpose of the limited-scope inspection was to assess WEC's compliance with the provisions of selected portions 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," 10 CFR Part 21, "Reporting of Defects and Noncompliance," and 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants."

This inspection evaluated aspects of the WEC's programs for the design, implementation, and testing of the Diverse Actuation system (DAS) and Protection and Safety Monitoring System (PMS) systems for the Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3 currently under construction. The enclosed report presents the results of this inspection.

During this inspection, the NRC staff evaluated implementation of WEC's design, fabrication, and testing programs as it relates to the development of the DAS and PMS and inspected on-going system integration testing for the PMS, as well as the design, fabrication, and testing programs for the Diverse Actuation System. These activities were associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from Appendix C from the Combined License for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3. Specifically, these activities were associated with ITAACs 2.5.01.04, and 2.5.02.11. The NRC inspectors did not identify any findings associated with the ITAAC contained in Section 4 of the attachment to this report. This NRC inspection report does not constitute NRC endorsement of your overall quality assurance (QA), 10 CFR Part 21, or 10 CFR 50.62 programs.

Within the scope of this inspection, no violations or nonconformances were identified.

In accordance with 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 the NRC's document system, Agencywide Documents Access and Management System, which is accessible from the NRC Web site at http://www.nrc.gov/readingrm/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/

Richard A. Rasmussen, Chief
Electrical Vendor Inspection Branch
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 99900404

Enclosures:
1. Inspection Report No. 99900404/2014-203
and Attachment

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."

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/RA/

Richard A. Rasmussen, Chief
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Docket No.: 99900404

Enclosures:
1. Inspection Report No. 99900404/2014-203
   and Attachment

DISTRIBUTION:
ASakadales
ERoach
KKavanagh
ditomms@westinghouse.com

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS
VENDOR INSPECTION REPORT

Docket No.:	99900404
Report No.:	99900404/2014-203
Vendor:	Westinghouse Electric Company 5000 Ericsson Dr. Warrendale, PA 15086
Vendor Contact:	Sarah DiTommaso, Manager, AP1000 Instrumentation & Control Licensing Westinghouse Electric Company 5000 Ericsson Dr. Warrendale, PA 15086 Email: ditomms@westinghouse.com
Nuclear Industry Activity:	Westinghouse Electric Company, LLC, located at 5000 Ericsson Drive, Suite 517, Warrendale, PA 15086, whose scope of supply includes but not limited to safety-related design, fabrication, testing, and delivery of the Protection and Safety Monitoring System and the non-safety Diverse Actuation System instruments and controls products to the current US AP1000 plants under construction.
Inspection Dates:	August 25 - 29, 2014
Inspection Team Leader:	Greg Galletti, NRO/DCIP/EVIB
Inspectors:	Lisa Castelli, R-II/DCI/CIB1 Robert Mathis III, R-II/DCI/CIB1 Hyung Je, NRO/DE/ICE1 Kenneth Mott, NRO/DE/ICE1 George Lipscomb, NRO/DCIP/EVIB Philip Natividad, NRO/DCIP/EVIB Thomas Fredette, NRO/DCIP/CIPB Brij Verma, FANR Observer
Approved by:	Richard A. Rasmussen, Chief Electrical Vendor Inspection Branch Division of Construction Inspection and Operational Programs Office of New Reactors

Enclosure

EXECUTIVE SUMMARY

Westinghouse Electric Company
99900404/2014-203

The U.S. Nuclear Regulatory Commission (NRC) staff conducted this vendor inspection to verify that Westinghouse Electric Company, LLC (hereafter referred to as WEC), implemented an adequate quality assurance program that complies with the requirements 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," 10 CFR Part 21, "Reporting of Defects and Noncompliance," and 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants." The inspectors conducted this inspection at the WEC facility in Warrendale, PA, on August 25-29, 2014.

This inspection specifically evaluated WEC's inspection and testing of safety-related components for new construction commercial nuclear plants in the US. The inspectors reviewed the aspects of the vendor's design, fabrication, and testing of safety-related components of the Protection and Safety Monitoring System (PMS), and the non-safety related Diverse Actuation System (DAS).
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The following regulations served as the bases for this NRC inspection:

- Appendix B to 10 CFR Part 50
- 10 CFR Part 21
- 10 CFR 50.62

The inspectors used Inspection Procedure (IP) 43002, "Routine Inspections of Nuclear Vendors," dated July 15, 2013, and IP 65001.22, "Inspection of Digital Instrumentation and Control (DI&C) System/Software Design Acceptance Criteria (DAC)-Related ITAAC," dated December 19, 2011.

The information below summarizes the results of this inspection.

DAS Design Control and Implementation

The inspectors determined that WEC's implementation of their policy and procedures for the design, fabrication, and testing of the DAS system satisfy the regulatory requirements set forth in 10 CFR Part 50.62, generic letter (GL) 85-06, "Quality Assurance Guidance for ATWS Equipment that is not Safety-Related," and the associated QA programmatic controls described in the Westinghouse AP1000 "Design Certification Document," Revision 19, Chapter 17, "Quality Assurance," table 17-1. No findings of significance were identified.

PMS Regression Testing and Analysis

The inspectors determined that WEC's implementation of their policy and procedures for control of design and testing associated with the AP1000 generic baseline (BL) 7.8.0 to AP1000 generic BL 7.8.2 regression activities for the PMS system satisfy the regulatory requirements set forth in Criterion III, "Design Control," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

PMS Test Control

The inspectors determined that WEC's implementation of their policy and procedures for control of testing of portions of the PMS system satisfy the regulatory requirements set forth in Criterion XI, "Test Control," Appendix B to 10 CFR Part 50. No findings of significance were identified.

Review Previous NRC Inspection Reports Corrective Action Implementation

The NRC staff reviewed documentation to verify closure of previous nonconformances from the NRC Inspections conducted in April 2011 at CS Innovations and in January 2014 at WEC.

The NRC reviewed and determined that corrective and preventive actions related to April 2011 NRC inspection findings are appropriate and complete. As a result, Nonconformance 99901404/2011-201-03 and Nonconformance 99901404/2011-201-04 are closed.

The NRC staff determined that WEC's assessment of the CIM product quality, independent verification and validation (IV&V) processes, and corrective and preventive actions related to January 2014 inspection findings are currently in-process and will be reviewed after completion.

REPORT DETAILS

1. Diverse Actuation System (DAS) Design Control and Implementation

DAS Design Requirements Review

a. Inspection Scope

The DAS is a non-safety system that is designed to conform to the Code of Federal Regulations (CFR), Title 10, Part 50, Section 62 (10 CFR 50.62), "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants," and provides a diverse backup to the safety-related PMS. The enclosure to GL 85-06, "Quality Assurance Guidance for ATWS Equipment that is not Safety-related," (ML031140390) provides the QA guidance required by 10 CFR 50.62. In addition, the DAS architecture and associated licensing bases at the functional design level are identified in WCAP-17184-NP, "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," July 2010, Revision 2 (ML102170263).

The inspectors focused on verifying adequate design and implementation controls associated with DAS design requirements. The inspectors evaluated the DAS design process lifecycle documents as well as the specific implementation of a sample of design elements. The inspectors reviewed the DAS Design System Architecture, Software Design Specification (SDS), Detailed Code Development Design & Implementation, Design Phase Documentation, and Design Safety Analysis.

Specifically, the inspectors reviewed WEC procedures and drawings, interviewed WEC personnel and reviewed the traceability of the sample of automatic and manual DAS actuation requirements through the DAS design and implementation process, as well as the completed DAS manual actuation test program documentation. The sample specifically included:

- Automatic actuations - the Reactor and Turbine Trip on Low Wide-Range Steam Generator Water Level or Low Pressurizer Water Level or High Hot Leg Temperature, and the Core Makeup Tank (CMT) Actuation and Trip All Reactor Coolant Pumps on Low Wide-Range Steam Generator Water Level or Low Pressurizer Water Level.

- Manual actuations - the Manual Fourth-stage Automatic Depressurization System (ADS) Valve Actuation, and the Manual In-containment Refueling Water Storage Tank (IRWST) Injection Actuation.

System Architecture

The inspectors verified that APP-DAS-J4-001, "AP1000 Diverse Actuation System Design Specification," Section 2.1, "DAS Overview," provides a brief description of the architecture. Section 2.3, "DAS Architecture," depicts an architecture diagram. The inspectors verified that the DAS Architecture diagram and associated Figure 2.2-1 "DAS Actuation Block Diagram" identified the specific architectural details.

Software Design Specification (SDS)

The inspectors selected a sample of manual and automatic actuation DAS design requirements and traced those design requirements from the requirements phase through the development phase of the software lifecycle. Traceability of these design elements were verified in the APP-DAS-J0R-001, "Diverse Actuation System Requirements Traceability Matrix" (RTM). The inspectors identified logic diagrams associated with each design element to support the design requirements. The inspectors verified that the DAS design requirements were adequately identified and described in appropriate design documentation, including functional logic diagrams and design statements.

Traceability of DAS Manual Actuation Design Characteristics

The inspectors traced the sampled DAS manual actuations requirements from the overall AP1000 instrumentation and control (I&C) system design specifications to the development of the applicable factory acceptance test (FAT) test datasheets for manually actuated functions to verify adequate implementation of DAS design requirements. The inspectors reviewed the DAS traceability matrix to verify that requirements defined in the AP1000 I&C system design specification for the DAS manual actuations were traceable to the system definition, development, and testing requirements design documents (i.e., forward traceability) and vice versa (i.e., backwards traceability).

The inspectors reviewed the high level DAS design requirements for the sampled manual actuations noted above, as well as overall requirements for DAS manual RTM in order to assess whether the requirements in the DAS sub-system definition documentation and DAS functional requirements documentation were complete, correct and unambiguous.

The inspectors traced the sampled DAS manual actuations starting with the AP1000 system design specification, to the DAS sub-system requirements specifications, to the system design requirements, to the DAS functional requirements, to the system specification documents, to the system design specification documents, to the functional logic diagrams, to the cabinet hardware wire routing sheets, to the FAT test data sheets. The inspectors assessed the quality of the sub-system requirements specifications and the translation of these DAS manual system requirements into the lifecycle development and testing phase documents listed. The inspectors also assessed the backward traceability of the sampled DAS manual actuations starting from the FAT test data sheets with the aid of the RTM.

DAS Design Lifecycle Phase Documentation

The inspectors reviewed various documents related to the AP1000 DAS development phase to verify compliance with the DAS Project Plan and the DAS Design Process. Design process outputs, including System Design Specification and Advanced Logic System (ALS) Field Programmable Gate Array (FPGA) software documentation were assessed to ensure alignment with higher level requirements. Document hierarchy was verified to be in accordance with the ALS Management Plan. A sample of design changes were reviewed to verify that selected changes to the DAS system were reflected in the System Design Specification. The inspectors also reviewed condition

reports that had been initiated during the development phase, and verified that the DAS development team had adequately prioritized and addressed specific issues. The inspectors also verified that DAS Design Reviews (Preliminary, Intermediate and Final) had been completed in compliance with the DAS Project Plan.

In addition, the inspectors verified that the hardware architecture descriptions for the DAS manual engineered safety features (ESF) actuations were prepared as committed to in the design. The overall AP1000 I&C system design specification requirement states that the DAS manual ESF actuations shall bypass the automatic logic in the DAS and will be directly hardwired to the output relays. The inspectors verified, through review of system design specification documents, cabinet hardware drawings, FAT test data sheets inputs and output results, and physically viewing assembled DAS cabinet hardware, that the DAS manual actuation system architecture lifecycle document design descriptions demonstrate how the various hardware elements are connected together and were consistent, unambiguous, and verifiable.

The inspectors verified that reviewed DAS development phase documentation supporting DAS design, definition, hardware development, and testing phase for DAS manual actuations were adequately documented and that all reviewed design documents had been developed in accordance with the approved QA plan, and that the documentation was representative of good practices appropriate for non-safety related system development.

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DAS Manual Actuations Test Phase Activities

The inspectors verified that the sampled DAS manual actuations testing process and documentation included attributes related to test plans and test procedures and results and that the testing process produced evidence of acceptable design outputs. The inspectors reviewed FAT test documentation which demonstrated adequate DAS manual test item descriptions, test procedures and processes, test equipment identification, expected test results and the pass/fail test results criteria. The inspectors reviewed the test procedures for completeness by reviewing the detailed test set-up information, the test equipment calibration procedures, and the required test input data and output datasheets.

The inspectors were provided a presentation by WEC that demonstrated how an internal review of test results by WEC identified errors with the recording of certain test results (erroneous pass results). WEC also demonstrated the activities they initiated in response to the identified deficiencies. These activities included: (1) documenting the incorrect test results in the corrective action process; (2) examining why the test results were improperly recorded; (3) evaluating the extent of condition; (4) determining the effects on the completed system operation that was the target of the test; (5) identifying additional training and possible re-certification requirements for testing personnel; and (6) reviewing the test process and procedure to re-verify appropriateness.

DAS Detailed Code Development Design & Implementation

The inspectors conducted document reviews of software design life cycle procedures; interviewed WEC personnel assigned to FPGA development and the IV&V activities; and reviewed a sample of the code listing for an automatic trip function.

The Verilog file is produced as an implementation of the design. The "pre-synthesized" Verilog file is the source code of the application software and the "synthesized" file is the "compiled" source code. The Verilog files and "synthesized" files associated with each revision of the design is controlled within the WEC controlled software storage. The process was verified to follow a documented design process where preparation, review, and approval steps were completed.

The inspectors identified that the DAS IV&V team builds its own separate test setup using the same input used by the design organization. The FPGA is independently tested by IV&V in accordance with WEC 6002-00018, "ALS Platform FPGA VV Test Plan," Revision 9.

The inspectors determined that DAS design requirements were adequately captured in design documentation, and the source code was developed according to WEC NA 4.51, "Field programmable Gate Array (FPGA) Development Procedure," and maintained within WEC controlled software storage.

DAS Design Safety Analysis

The inspectors determined that the DAS, as a non-safety related AP1000 system, was not subject to digital system and software hazards analyses as part of the detailed design. The inspectors reviewed the DAS Failure Modes and Effects Analysis (FMEA) and determined that reliability and functional performance goals for the DAS were supported by this analysis, and single failure requirements were met. The inspectors walked through a portion of the DAS ALS detailed software design for selected logic functions, including Steam Generator Water Low Level, Pressurizer Water Low Level, and Reactor Coolant Hot Leg High Temperature. The inspectors determined that the logic functions and setpoints were accurately translated into the ALS FPGA Verilog code. Additionally, the inspectors verified that the diverse reactor trip functionality to de-energize control rod drive motor generator sets, in accordance with ATWS requirements, was reflected in the code.

DAS Design Implementation

The inspectors sampled several DAS cabinet design drawings and specifications to verify they conformed to the as-built DAS cabinets. Specifically, the inspectors sampled various hardware drawings from WEC SV3-DAS-J8Y-001, "Vogtle Unit 3 AP1000 Diverse Actuation Cabinet Configuration Drawing Package," Revision 0, and observed through markings, indications and tagging that the as-built DAS cabinet hardware was consistent with those detailed design drawings and specifications. The inspectors also reviewed WEC APP-DAS-J4-005, "AP1000 Diverse Actuation System Squib Valve Blasting Design Specification," Revision 1, hardware drawings to the as-built blasting device mounting and labeling and confirmed the as-built configuration was consistent with the specification. The inspectors verified for the samples selected that the cabinet hardware drawings and the as-built DAS cabinet configurations were consistent with each other.

DAS Factory Acceptance Testing

The inspectors reviewed the FAT reports for each of the DAS systems for the four AP1000 units under construction. Test configuration requirements, set up

documentation, procedures and data were verified to be addressed in the test reports. Anomalies, issues, and open items identified during testing were determined to be adequately addressed and closed out through the Westinghouse Corrective Action Program and Learning (CAPAL) system. The inspectors verified that anomalies associated with RTM alignment for three of the four DAS systems had been captured and tracked to resolution in the CAPAL system. The inspectors also determined that the implementation of WEC's programs for control of testing activities for the DAS were consistent with the DCD quality assurance commitments regarding the regulatory treatment of non-safety related systems (RTNSS).

b. Observations and Findings

No findings of significance were identified in this area.

c. Conclusion

The inspectors concluded that the implementation of WEC's design and implementation program controls for the DAS were consistent with the regulatory requirements of 10 CFR Part 50.62, Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment that is not Safety-Related," and the associated QA programmatic controls described in the Westinghouse AP1000 "Design Certification Document," Revision 19, Chapter 17, "Quality Assurance," table 17-1. No issues of significance were identified.

2. AP1000 PMS In-Process Testing

a. Inspection Scope

The inspectors observed in-process system integration testing (SIT) of the AP1000 PMS that included Maintenance and Test Panel Level 2 Reactor Trip display testing for Vogtle Unit 4 and Partial Actuation/Partial Bypass display testing for VC Summer Unit 2. The inspectors witnessed the execution of several test cases that involved test configuration setup and testing actions were performed in accordance with approved procedures. The use of testing tools were observed by the inspectors including the display capture tool (DCT), the automatic display judgment tool (ADJT), and the standard input/output simulator (SIOS) to ensure testing was being conducted within the validated capabilities of the tools.

The inspectors reviewed design and functional specifications, test plans and procedures, testing configuration records, and test data sheets to verify that the testing basis and execution followed a documented process and was consistent with the approved design. The inspectors also reviewed test tool validation records and testing personnel qualification records to ensure observed testing was conducted appropriately by qualified individuals. The inspectors reviewed entries into the issue tracking system from prior testing to ensure that anomalies encountered during testing were being properly identified and addressed.

PMS Testing Tools Evaluation

The inspectors assessed the validity of the IV&V testing tools including the DCT, ADJT, and the SIOS tool used for the AP1000 project, to assure the tools were adequately

qualified and validated for use in testing of the PMS. Specifically, the inspectors interviewed key vendor personnel involved with the development and use of the tools and evaluated selected technical documents relevant to both the testing process and the testing tools.

The DCT is formally known as the "Automatic Display Testing Tool (ADT)" as described in WEC 6E2D1320, "Automatic Display Testing Tool User's Manual," and was developed from an earlier version of a Toshiba display capture tool. WEC 5B2D5831, "The Requirement Specifications for Automatic Display Testing Tool," specifies the functional requirements of the DCT.

The ADJT was developed by WEC to complement the DCT, and is responsible for judging the correctness of the screen shot images captured by the DCT. The ADJT was also developed from an earlier version of a Toshiba Display Judgment Tool, and the requirement specifications for the ADJT are described in WNA-DS-03297-GEN, "Automatic Display Judgment Tool Requirements Specification."

The SIOS tool was developed by WEC as a general purpose testing platform for Common-Q based systems. It is capable of reading and writing analog and digital I/O signals, as well as high speed links (HSL) and Advant Ovation Interface (AOI) signals. The SIOS makes use of a LabVIEW-based graphical user interface (GUI) and National Instruments hardware to interface with the Equipment Under Test (EUT). The SIOS requirements specifications are descried in WNA-DS-01069-GEN "Standard I/O Simulator System Requirements Specification."

The DCT, ADJT, and SIOS tools were all developed utilizing pre-existing software and hardware products as its core. The test tools were described as being developed under a documented design process. The DCT functions to capture and save specified displays images resulting from testing. The saved display images are utilized by ADJT and compared to a reference set of display images for testing verification. The SIOS functions as an underlying system to provide necessary I/O to perform the overall hardware and software testing. The tool validations are captured in documents WNA-VR-00393-GEN, "Display Capture Tool Validation," WNA-VR-00414-GEN, "Automatic Display Judgment Tool Validation Report," and WNA-VR-00320-GEN, "Standard I/O Simulator Software Validation."

The test plan, test specification, and test procedures for a specific project were developed under a design test process which utilized all three test tools. The inspectors verified the use of a test plan APP-PMS-T5-001, "Protection and Safety Monitoring System Test Plan," which specifies the criteria to develop testing for the PMS.

b. Observations and Findings

No findings of significance were identified in this area.

c. Conclusion

The inspectors concluded that the in-process display testing of the PMS for Vogtle Unit 4 and VC Summer Unit 2, and the development and use of the testing tools, were being controlled and implemented consistent with the regulatory requirements of Criterion III,

"Design Control," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No issues of significance were identified.

5. AP1000 Protection and Safety Monitoring System Baseline Regression Activities

a. Inspection Scope

The inspectors reviewed WEC's IV&V and independent system test (IST) regression activities associated with the changes made to the PMS system between WEC generic AP1000 baseline (BL) version 7.8.0 and WEC generic BL version 7.8.2. WEC generic AP1000 BL version 7.8.2 is currently the baseline for the control room simulator model that is being used for Integrated System Validation (ISV) activities.

Specifically, the inspectors reviewed WEC's documentation associated with the PMS baseline analyses and testing. The IV&V organization has responsibility for source code evaluation and functional logic tracing, element/processor module software and reusable software regression testing, software hazards analysis, interface analysis, and requirements traceability analysis. The IST organization has primary responsibility for CIT/SIT regression testing activities. Each of these activities are evaluated below.

IV&V Regression Activities

Source Code Evaluation

For the source code evaluation and functional logic tracing, the inspectors determined that the task reports were completed in accordance with the associated work instructions, and that there was appropriate documentation of corrective action procedures initiated for variances noted in the task reports during the testing. The inspectors reviewed APP-IVV-JQR-012, "PMS QDPS Code Review Report," and found it to be in accordance with its associated work instructions WNA-WI-00241 and WNA-WI-00398, and included self-identified documentation of variances in RITS 36252, "Application Trouble Summary Exceptions in the SRS and QDPS SDD." Additionally, an IV&V Task Report, WNA-VT-00062-WAPP was reviewed and found to be in accordance with its associated work instruction. The inspectors confirmed that the vendor adequately implemented their evaluation process, and verified that the task report identified examples of differences in source code from AP1000 generic BL version 7.8.0 to AP1000 generic BL version 7.8.2 that are necessary to assure continued functionality of the code logic.

Element/Processor Module Software and Reusable Software Element Regression Testing

The inspectors assessed the regression analysis activities of the IV&V team as it related to the testing of processor module and element software testing to verify that design changes were properly analyzed. Specifically, the inspectors reviewed IV&V regression testing documentation including work instructions, test procedures, and test reports associated with the Qualified Data Processing System for the processor module and the Heart Beat Check Type Circuit for a reusable software element to verify that regression testing was conducted in accordance with approved procedures and testing results were properly documented. Inspectors also reviewed entries into the issue tracking system

that initiated the proposed design changes to ensure that regression testing activities were aligned with the identified deficiency precipitating the design change.

Software Hazard Analysis

The inspectors assessed the AP1000 software IV&V safety hazard analysis regression activities supporting WEC generic AP1000 BL version 7.8.0 (additional IV&V analysis was not required for WEC generic AP1000 BL version 7.8.2 as the Hazards Analysis did not change) to confirm changes in the analysis were properly analyzed. Specifically, the inspectors reviewed the controlling IV&V work instruction, evaluated the completed implementation phase IV&V task report for completeness and accuracy, and interviewed associated personnel to assess knowledge and conformance with WEC IV&V requirements. The WEC IV&V verification activities only evaluated changes to the safety hazard analysis since the previous IV&V task report.

Interface Analysis

The inspectors assessed the AP1000 software IV&V interface data analysis regression activities supporting Vogtle plant PMS software BL version 7.4.2 to confirm changes in the analysis were properly analyzed. Vogtle plant BL version 7.4 is equivalent to WEC generic AP1000 BL version 7.8 and V.C. Summer BL version 7.3. Specifically, the inspectors reviewed the controlling IV&V work instruction, evaluated the completed IV&V task report for completeness and accuracy, and interviewed associated personnel to assess knowledge and conformance with WEC IV&V requirements. The WEC IV&V verification activities focused on changes in the interface data analysis since the previous IV&V task report. In addition, a sample of identified changes in the analysis was evaluated by the inspectors for appropriate control and disposition.

The inspectors also assessed IV&V activities associated with the Interface Data Analysis Tool (IDAT), which is the IV&V software used to conduct the interface data analysis to confirm appropriate verification. Specifically, the inspectors reviewed original IDAT validation documentation, and interviewed design and IV&V personnel to assess knowledge and confirm the independence between design and IV&V tools used for PMS interface analysis.

Configuration Management Assessment

The inspectors evaluated the AP1000 software IV&V configuration management assessment regression activities supporting Vogtle plant PMS software BL version 7.4.2 to confirm design changes were properly reflected in the updated assessment. Specifically, the inspectors evaluated the completed configuration management IV&V task report, related process input documents, and related RITS tracking items for completeness and accuracy, and interviewed IV&V personnel to assess knowledge of WEC IV&V processes. Additionally, the process associated with closing IV&V RITS tracking items was evaluated for appropriate disposition.

Requirements Traceability Analysis (RTA)

The inspectors reviewed the RTA work instructions implemented during software requirements traceability matrix validation as well as the output task reports associated

with Software Requirements Specifications, Software Design Descriptions, and Subsystem Software Requirements Evaluation.

The inspectors confirmed that WEC performed the activities, by initially identifying each affected subsystem, consistent with their work instructions, and employed the use of two separate electronic comparison tools developed by IV&V, to trace requirements and to perform comparisons between the set of requirements. The comparisons were used to identify missing or incomplete tracing of software requirements, inconsistencies in those documented requirements, and accuracy of those requirements. The inspectors also verified that the activities compared the software design descriptions to the software requirements specifications to ensure correctness, detail consistency, and completeness in order to confirm that all requirements were adequately addressed and updated as needed as part of the regression activities.

IST Regression Activities

The inspectors reviewed the change management result reports (CMRRs) associated with WEC generic BL version 7.8.0 to WEC generic BL version 7.8.2 changes and confirmed the documents identified the software changes captured in the latest release supported by the CMRR and identified additional design documentation that provides additional technical details associated with the software changes. These CMRRs also identified the specific plant configuration management release reports that describe the software changes resulting from the disposition of various input items from change drivers.

The inspectors reviewed the Regression Analysis Change Report (RACR) associated with PMS software changes that were released as part of the CMRRs for system WEC generic BL version 7.8.0 to WEC generic 7.8.2. The changes affected both Common Q platform software and Flat Panel Display System software for the AP1000 project. The changes between the CMRR releases were primarily from RITS and CAP IRS generated from design and test activities. The inspectors confirmed that for each change, the change drivers as well as the origin of the change drivers were documented.

The RACR identified system requirements, system design, software, and hardware changes that are effected by the CMRRs. The inspectors sampled the functional code and logic changes to verify they had been adequately evaluated and captured by IST in their regression analysis activities and report. The inspectors reviewed the regression test instructions (PMS channel integration test procedure) which identified the specific test cases that were affected by the RACR item. In most cases these items were the result of IST test activities and the effected test cases were well known. For those cases where the RACR item was identified through activities other than IST testing (Example safety display color coding logic revision as a result if ISV/HF activities), the IST subject matter expert with the CIT testing (ex. QDPS) would review the functional logic diagrams to identify which specific test cases would require retest.

The inspectors reviewed regression testing work instructions and sampled detailed difference files generated as part of the regression testing work instruction and verified that specific code changes were identified and adequately annotated to document the origin of the change (change driver), and the acceptability of the change.

The inspectors reviewed the regression test results report and verified that the report encompassed all test cases identified in the IST Regression test procedure, provided objective evidence of the results of the regression testing for each test activity, and adequately identified regression test results which failed to verify the implementation of specific software changes as part of the latest PMS software release. For a test failure, the inspectors reviewed the issue report that documented the test failure (RITS #33347 – original RITS that required functional logic change) RITS#38805, and verified that the item description was consistent with the regression test results report finding and adequately entered into the RITS system.

b. Observations and Findings

No findings of significance were identified in this area.

c. Conclusion

The inspectors concluded that the implementation of WEC's programs for IV&V and IST regression analysis and testing activities were consistent with the regulatory requirements of Criterion III and Criterion XI of Appendix B to 10 CFR Part 50. No issues of significance were identified.

5. Review Previous NRC Inspection Reports Corrective Action Implementation

a. Inspection Scope

The inspectors reviewed the vendor's implementation of corrective actions associated with findings from a previous NRC Inspection conducted at CS Innovations, a wholly-owned subsidiary of WEC, from April 25, 2011, through April 29, 2011. NRC Inspection Report No. 99901404/2011-201, dated July 20, 2011, documents the results of this inspection (Agencywide Document Access and Management System (ADAMS) Accession No. ML1118900005).

Additionally, the inspectors discussed the status of in-process corrective actions associated with findings from a previous NRC Inspection conducted at WEC from January 13, 2014, through January 17, 2014. NRC Inspection Report No. 99900404/2014-201, dated March 25, 2014, documents the results of this inspection (ADAMS Accession No. ML14058A995).

b. Observations and Findings

Nonconformance 99901404/2011-201-03 was issued for failure to establish and implement provisions to collect information on error reports (product deficiency reports) related to discrete components (micro-electronics). The inspectors assessed documentation of corrective actions, preventive actions, evaluation of extent of condition and resolution, and observed implementation of current control processes for discrete component product deficiency reports at WEC.

Nonconformance 99901404/2011-201-04 was issued for failure to develop an independent testing tool during the development of the component interface module (CIM) and safety remote node controller (SNRC). The inspectors noted that new independent test tools were deployed to address the nonconformance. The inspectors

assessed the documentation related to the qualification of the tools, configuration management of the tools and training requirements.

c. Conclusions

The assessment of the CIM product quality, IV&V processes, and corrective and preventive actions associated with findings from the January 2014 NRC Inspection conducted at WEC were not complete at the time of the inspection and are not scheduled to be complete until early 2015. These actions will be reviewed after completion.

WEC and CS Innovations corrective and preventive actions related to the deficiencies identified in the nonconformances from the April 2011 NRC Inspection conducted at CS Innovations are appropriate and complete. Therefore, the inspectors determined Nonconformance 99901404/2011-201-03 and Nonconformance 99901404/2011-201-04 are closed.

6. Entrance and Exit Meetings

On August 25, 2014, the inspectors presented the inspection scope during an entrance meeting with Mr. David Howell, Vice President, New Plant Automation, of WEC, and other WEC personnel. On August 29, 2014, the inspectors presented the inspection results during an exit meeting with Mr. Jan Dudiak, Director, Automation and Field Services, and other WEC personnel.

ATTACHMENT

1. PERSONS CONTACTED AND NRC STAFF INVOLVED:

Name	Affiliation	Entrance	Exit	Interviewed
David Howell	WEC	X		
Thomas Geer	WEC	X		
Jan Dudiak	WEC-AFS	X	X	
Kyra Durinsky	WEC-AFS	X	X	X
Dave Jarosh	WEC	X	X	
Dale Harmon	WEC	X	X	
John Perock	WEC	X		
Sarah DiTomasso	WEC	X	X	X
Bob Hirmanpour	SNC	X	X	X
Warren Odess-Gillett	WEC	X	X	X
Pietro Porco	WEC-AFS	X	X	X
Jason Perine	WEC-AFS	X	X	X
Stephanie Seager	WEC-AFS	X	X	
Sam Yackovich	WEC-AFS	X		
Brian Bedford	WEC	X	X	X
Michael Shaffer	WEC-AFS	X	X	X
Ken Lunz	WEC-AFS	X	X	
John Wiessmann	WEC-AFS	X	X	X
Chris Srock	WEC-AFS	X		
Wes Vaughn	SNC	X	X	X
Jerry Money	WEC	X	X	X
Bob Phillips	WEC	X	X	
Steve Radomski	WEC	X		
Dan Harris	WEC		X	
Ryder Thompson	SCE3G		X	
Andy Underwood	SCE3G		X	
Paul Sirianni	WEC-AFS	X	X	
John Faulkner	WEC-AFS	X		
Stephen Packard	WEC-AFS	X	X	
Steve Adams	SNC	X		
Quang Nguyen	WEC		X	
Rick Connolly	SNC		X	
Paul Russ	WEC	X	X	X
Dino Copetas	WEC	X	X	X
Bob Cortese	WEC	X		X
Nicole Stadelman	WEC-AFS	X		
Guy Guerrier	WEC	X	X	X
Andy Breneman	WEC	X	X	X
Bob Peters	WEC	X	X	X
Michael Tatko	WEC	X		X
Murat Uzman	WEC	X	X	X
Joe Carretta	WEC	X		X
Terry Tuite	WEC	X	X	X

Name	Affiliation	Entrance	Exit	Interviewed
Matt Shakun	WEC	X	X	X
Mark Stofko	WEC		X	X
Kevin Neumann	WEC	X		X
Daniel Stanley	WEC			X
Marci Maher	WEC			X
Secil Karaslan	WEC			X
Adam Laubham	WEC			X
Rick Very	WEC			X
Frank Ponko	WEC			X
Amy Pazur	WEC			X
Dan Peabody	WEC			X
Madhu Rao	WEC			X
Erin Kunz	WEC			X
Sandra Glasser	WEC			X
Eli Knebel	WEC			X
Vasilii Savtchouk	WEC			X
T. McLaughlin	WEC			X
B. Sebesta	WEC			X
B. Domitrovich	WEC			X
Arati Chandrasekhara	WEC			X
Greg Galletti	NRC	X	X	
Thomas Fredette	NRC	X	X	
Kenneth Mott	NRC	X	X	
Lisa Castelli	NRC	X	X	
Robert Mathis III	NRC	X	X	
George Lipscomb	NRC	X	X	
Hyung Je	NRC	X	X	
Philip Natividad	NRC	X	X	
Brij Verma	FANR	X	X	
Anthony Masters	NRC			

2. INSPECTION PROCEDURES USED:

IP 43002, “Routine Inspections of Nuclear Vendors,” dated July 15, 2013

IP 60001.22, “Inspection of Digital Instrumentation and Control (DI&C) System/Software Design Acceptance Criteria (DAC)-Related ITAAC,” dated December 19, 2011

3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED:

Item Number	Status	Type	Description	Applicable ITAAC
99900404/2014-201-01	Discussed	NON	Criterion III	2.5.02.14
99900404/2014-201-02	Discussed	NON	Criterion III	2.5.02.14
99901404/2011-201-03	Closed	NON	Criterion XV	N/A
99901404/2011-201-04	Closed	NON	Criterion III	N/A

4. INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA:

The U.S. Nuclear Regulatory Commission (NRC) inspectors identified the following ITAAC related to components being designed, manufactured, and tested at Westinghouse Electric Company (WEC). At the time of the inspection, WEC was involved in certain testing activities including PMS Factory Acceptance Testing (FAT) for the AP1000 reactor design. For the ITAAC listed below, the inspectors reviewed WEC's QA controls in the areas of design control, test control, inspection, nonconforming materials parts and components, and corrective actions. The ITAAC design commitments referenced below are for future use by the NRC staff during the ITAAC closure process; the listing of these ITAAC design commitments does not constitute that they have been met and/or closed. The inspectors did not identify any findings associated with these ITAAC during this inspection.

This section of the inspection report focuses on the vendor's implementation of aspects of their quality assurance (QA) program for the activities affecting quality associated with the design, fabrication, and testing of the AP1000 diverse actuation system (DAS). This included a review of completed DAS test program documentation addressing AP1000 ITAAC 2.5.01.4.b design activities. Specifically the inspectors reviewed the DAS design and implementation phases of development for automatic and manually initiated DAS protective functions to verify consistency with the design commitments and the acceptance criteria of ITAAC 2.5.01.4.a. The goal of these inspection activities is to examine the governing documents and samples of design activities that demonstrate the implementation of the design commitments and design attributes in order to provide a comprehensive inspection of the digital instrumentation and control (DI&C) development process as stated in the ITAAC design commitments. In addition, the inspectors reviewed aspects of the vendor's design control and testing processes associated with the PMS Generic AP1000 BL revision 7.8.0 to Generic AP1000 BL revision 7.8.0 regression activities and ongoing PMS system integration testing. These activities are associated with ITAAC 2.5.02.11c and 2.5.02.11d, respectively.

COL #	DCD#	Design Commitment	Component/Activity
519	2.5.01.04	The DAS hardware and any software are developed using a planned design process which provides for specific design documentation and reviews during the following lifecycle stages (subtask [a] of design commitment - system design phase)	The inspectors evaluated the DAS design control and implementation processes through a detailed review of design documentation and activities related to Design System Architecture, Software Design Specification (SDS), Detailed Code Development Design & Implementation, Design Phase Documentation, and Design Safety Analysis.
		The DAS hardware and any software are developed using a planned design process which provides for specific design documentation and reviews during the following lifecycle stages (subtask [b] of design commitment - system test phase)	The inspectors evaluated the completed DAS Test Summary documentation and performed walk-downs of the as-built DAS cabinets to confirm the tested cabinets conformed to the detailed design drawings.
542	2.5.02.11	The PMS hardware and software are developed using a planned design process during hardware and software development phase, consisting of hardware and software design and implementation (subtask [c] of design commitment - Hardware and software development phase)	IV&V and IST Regression Analysis Activities – Reviewed regression analysis activities associated with the baseline 7.8.0 to 7.8.2 design changes documented in the CMRRs and RACR reports, and IV&V Regression Testing Activities – Reviewed regression testing activities associated with the Qualified Data Processing System Processor Module Software and Heart Beat Check Type Circuit Reusable Element Software
		The PMS hardware and software are developed using a planned design process during the system integration and test phase for system hardware and software (subtask [d] of design commitment - system integration and test phase)	VC Summer 2 SIT – Observed in-process testing of Partial Actuate/Partial Bypass Display Vogtle Unit 4 - Observed in-process testing of Maintenance and Test Panel Level 2 Reactor Trip Display

5. DOCUMENTS REVIEWED:

Design Specifications, Plans, and Procedures

- 6105-00030, “CIM-SRNC Design Tools,” Revision 7, dated July 2014
- 6002-10204 “ALS-102 Core B FPGA Design Specification,” Revision 1, dated August 23, 2012
- 6105-00053, “CIM-SNRC Configuration Status Accounting,” Revision 13, dated January 2014
- 6106-10216, “DAS VV Simulation Environment Specification,” Revision 0, dated March 2013
- 9006-00316, “Hardware Description Language (HDL) Coding Guideline,” Revision 0, dated August 2012
- 6106-00120, “DAS ALS Signal Table,” Revision 2, dated December 2010
- 6105-00021, “CIM SNRC IV&V Simulation Environment Specification,” Rev. 1, dated August, 2012
- 6106-00501, “DAS FPGA Design Specification,” Revision 3, dated August 2014
- 6106-00105, "DAS ALS Design Specification,” Revision 6, dated August 2014
- 6106-00401, "DAS FPGA Functional Requirements Processor Cabinet,” Revision 3, dated August 2014
- 9006-00071, “ALS Core B FPGA Build Procedure,” Revision 1, dated December 20, 2012
- 6106-00000, “DAS ALS Management Plan,” Revision 5, dated August 2014
- 6002-00030, “Advanced Logic System Design Tools,” Revision 12, dated June 2014
- APP-DAS-J0R-001, "Diverse Actuation System Requirements Traceability Matrix,” Revision 4, dated August 2014
- APP-DAS-GEH-001, “Diverse Actuation System Design Process,” Revision 1, dated May 2010
- APP-GW-GLR-145 WCAP-17184-P, “AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report,” Revision 2, dated July 2010
- APP-DAS-J7-001, “Diverse Actuation System - System Specification Document,” Revision 1, dated August 2014
- APP-DAS-J4-003, “DAS Sub-System Requirements Specification,” Revision 6, July 2014
- APP-DAS-J4-004, ” DAS System Design Requirements,” Revision 4, dated July 2014
- APP-DAS-J3-331, “DAS Detailed Functional Logic Diagram,” Revision 2, dated June 2014
- APP-DAS-J3-326, "AP1000 Functional Logic Diagram Reactor Trip," Revision 2, dated June 23, 2014
- APP-DAS-J3-327, "AP1000 Functional Logic Diagram Turbine Trip," Revision 2, dated August 29, 2013
- APP-DAS-J4-005. “AP1000 Diverse Actuation System Squib Valve Blasting Design Specification,” Revision 1, dated July 2014
- APP-PMS-J4-020, “System Design Specification for the AP1000 Protection and Safety Monitoring System,” Revision 8, dated October 2013
- APP-PMS-J4V-001, “PMS Safety Display Functional Specification,” Revision 7, dated September 2013
- APP-DAS-J4-001, “AP1000 Diverse Actuation System Design Specification,” Revision 4, dated July 2014

- APP-DAS-J1-001, "AP1000 Diverse Actuation System Functional Requirements," Revision 6, dated June 2014
- APP-DAS-J1-102, "AP1000 Functional Diagram Diverse Actuation System Logic," Revision 4, dated September 15, 2010
- APP-DAS-G1-001, "Diverse Actuation System Design Basis Document," Revision 1, dated August 2012
- APP-IVV-JQR-012, "AP1000 PMS Qualified Data Processing System Code Review Report" Revision 2, dated May 2014
- FPGA Build Report, "ALS 102B DAS v3.00 Release." Dated February 19, 2013
- FPGA Build Report, "v2.00 of the ALS 102B DAS. Release to test and IV&V," dated April 25, 2012
- FDR1-12-063, Working Design Review Action Item Report, "6106-00000-DAS ALS Management Plan should reference 6002-00008-ALS Application guideline," dated November 14, 2012
- Hardware Drawing 10066D67, Sheet 20, Revision 0, Label Item #44
- Project Plan "AP1000 I&C Diverse Actuation System," Revision 1, dated February 2012
- NA 4.51, "Field Programmable Gate Array Development Procedure," Revision 1, dated January 1, 2013
- RITS #40758, "DAS SV3 CHT: Requirements in datasheets do not align with RTM," dated August 19, 2014
- RITS #36252, "Application Trouble Summary Exceptions in the SRS and QDPS SDD"
- SV3-DAS-J8Y-001, "Vogtle Unit 3 AP1000 Diverse Actuation Cabinet Configuration Drawing Package," Revision 0
- WNA-RL-03189-SV0, "Vogtle AP1000 Protection and Safety Monitoring System Software Configuration Management Release Report," Revision 11 (Release 7.4.2 for Baseline SV0-ISIP-J0R-007 Revision 4), dated April 2014
- WNA-RL-02791-SV4, "Vogtle Unit 4 AP1000 Protection and Safety Monitoring System Software Hardware Management Release Report," Revision 2 (Release 7.8.3 for Baseline APP-ISIP-J0R-007 Revision 8), dated April 2014
- WNA-RL-03929-VSG, "V.C. Summer AP1000 Protection and Safety Monitoring System Software Configuration Management Release Report," Revision 3 (Release 7.3.1 for Baseline VSG-ISIP-J0R-007 Revision 3), dated April 2014
- WNA-RL-02578-VS2, "V.C. Summer Unit 2 AP1000 Protection and Safety Monitoring System Software Hardware Management Release Report," Revision 2 (Release 7.8.0 for Baseline APP-ISIP-J0R-007 Revision 8), dated December 2013
- WNA-WI-00497-GEN, "Common Q Regression Analysis Preparation Work Instruction," Revision 0, dated August 2014
- WNA-RL-02195_WAPP, "Common Q Software Release Record for QDPSC1_1," Revision 4, dated November 22, 2013
- WNA-PV-00054-WAPP, "AP1000 PMS Software V&V Plan," Revision 2, dated July 2013
- WNA-VR5B2D5831 "The Requirement Specifications For Automatic Display Testing Tool," Revision 4, dated January 2013
- WNA-VR-00393-GEN, "Display Capture Tool Validation," Revision 1, dated December 2013
- WNA-DS-03297-GEN, "Automatic Display Judgment Tool Requirements Specification," Revision 1, dated September 2013
- WNA-DS-03343-GEN, "System Design Specification for the Automatic Display Judgment Tool," Revision 1, dated December 2013

- WNA-DS-03346-GEN, “Software Requirements Specification for the Automatic Display Judgment Tool,” Revision 1, dated January 2014
- WNA-SD-00498-GEN, “Software Design Description for the Automatic Display Judgment Tool,” Revision 1, dated January 2014
- WNA-VR-00414-GEN, “Automatic Display Judgment Tool Validation Report,” Revision 1, dated January 2014
- WNA-DS-01069-GEN, “Standard I/O Simulator System Requirements Specification,” Revision 1, dated February 2010
- WNA-DS-01298-GEN, “Standard I/O Simulator Design Specification,” Revision 3, dated March 2010
- WNA-DS-01357-GEN, “Standard I/O Simulator Software Requirements Specification,” Revision 3, dated March 2013
- WNA-DS-02224-GEN, “Standard I/O Simulator Software Design Description,” Revision 1, dated July 2010
- WNA-GEN-00365-GEN, “Synopsys VCS D-2010.06-4 Software Validation Report,” dated July 2012
- WNA-VR-00320-GEN, “Standard Input/output Simulator Software Validation,” Revision 2, dated September 2011
- WNA-PC-00005-WAPP, “AP1000 I&C Projects Configuration Management Plan,” Revision 4, dated November 2013
- WNA-PD-00239-WAPP, “Project Plan: AP1000 I&C Diverse Actuation System,” Revision 1, dated December 2013
- WNA-ER-00217-WAPP, “Automation and Field Services Systems Integration & Safety Platforms DAS Advanced Logic System Final Design Review Report,” Revision 0, dated June 2014
- WNA-RL-03929-VSG, “VC Summer AP1000 Protection and Safety Monitoring System Software Configuration Management Release Report,” Revision 2, dated December 2013 (APP BL 7.8.0)
- WNA-WI-00333-GEN, “Common Q Application Software Hazard Analysis Work Instructions,” Revision 2, dated February 2013
- WNA-VT-00078-WAPP, “IV&V Task Report for AP1000 PMS Software Hazards Analysis Evaluation,” Revision 0, dated May 2014
- WNA-WI-00396-WAPP, “IV&V Interface Data Analysis Work Instruction,” Revision 0, dated April 2013
- WNA-VT-00057-WAPP, “IV&V Task Report for Interface Data Analysis,” Revision 1, dated June 2014
- WNA-SD-00483-WAPP, “Interface Data Analysis Tool (IDAT),” Revision 4, dated October 2013
- WNA-RL-03189-SV0, “Vogtle AP1000 Protection and Safety Monitoring System Software Configuration Management Release Report,” Revision 11, dated April 2014
- WNA-VT-00046-SV0, “IV&V Task Report for Vogtle AP1000 Baseline 7.4 Configuration Management Assessment,” Revision 1, dated April 2014
- WNA-WI-00362-GEN, “Instructions for Updating IV&V RTA Modules,” Revision 5, dated July 2013
- WNA-VT-00003-SV0, “IV&V Task Report for RTA of Software Requirements Specification,” Revision 1, dated June 2014
- WNA-VT-00007-SV0, “IV&V Task Report for RTA of Software Design Descriptions,” Revision 1, dated June 2014

- WNA-VT-00004-SV0, “IV&V Task Report for Subsystem Software Requirements Evaluation,” Revision 1, dated June 2014
- WNA-AR-00363-WAPP, “AP1000 Protection and Safety Monitoring System Regression Analysis Change Report,” Revision 4, dated April 2014
- WNA-WI-00241-GEN, “Common Q AC160 Application Code Review Work Instructions,” Revision 1, dated August 2013
- WNA-WI-00398-GEN, “Common Q Procedural Language Code Review Work Instructions,” Revision 1, dated August 2014
- WNA-WI-00241-GEN, “Common Q AC160 Application Code Review Work Instructions,” Revision 1, dated August 2013
- WNA-VT-00062-WAPP, “IV&V Task Report for Evaluation of FLD to Code Translation for QDPS,” Revision 0, dated April 2014
- WNA-WI-00372-WAPP, “IV&V Functional Logic Diagram to Application Software Implementation Tracing Work Instructions,” Revision 0, dated February 2013
- WNA-DS-01069-GEN, “Standard I/O Simulator System Requirements Specification,” Revision 1, dated February 2010
- WNA-DS-01298-GEN, “Standard I/O Simulator Design Specification,” Revision 3, dated March 2010
- WNA-DS-01357-GEN, “Standard I/O Simulator Software Requirements Specification,” Revision 3, dated March 2013
- WNA-DS-02224-GEN, “Standard I/O Simulator Software Design Description,” Revision 1, dated July 2010

Test Procedures and Documents

- 6105-00007, “CIM-SNRC Test Plan,” Revision 7, dated September 2013
- 6105-00013, “CIM-SNRC IV&V Plan,” Revision 10, dated August 2014
- 6002-00018, “ALS Platform FPGA VV Test Plan,” Revision 9, dated February 2013
- 6106-00005, “DAS ALS Integration Test Plan,” Revision 1, dated March 2013
- APP-DAS-T1P-300, “DAS Factory Acceptance Test Procedure,” Revision 7, dated August 2014
- APP-DAS-T1D-300, “DAS Factory Acceptance Test Data Sheets,” Revision 7, dated August 2014
- APP-PMS-T5-001, “Protection and Safety Monitoring System Test Plan,” Revision 3, dated April 2013
- APP-PMS-T1P-013, “Protection and Safety Monitoring System Integration Test Maintenance Test Panel Displays and Safety Panel Displays Test Procedure,” Revision 1, dated July 2013
- APP-IVV-T1P-110, “AP1000 Protection and Safety Monitoring System Qualified Data Processing System Processor Module Software Test Procedure,” Revision 0, dated May 2014
- APP-IVV-T2R-110, “AP1000 Protection and Safety Monitoring System Qualified Data Processing System Processor Module Software Test Report,” Revision 0, dated May 2014
- APP-PMS-T1D-026, “AP1000 Protection and Safety Monitoring System Display Partial Actuate / Partial Bypass Test Data Sheets,” Revision 3, dated August 2014
- APP-PMS-T1D-030, “AP1000 Protection and Safety Monitoring System Maintenance and Test Panel Level 2 Reactor Trip Injection Test Data Sheets,” Revision 1, dated March 2014

- SV4-PMS-T7X-008, “Vogtle Unit 4 AP1000 Protection and Safety Monitoring System Integration Test Configuration Record,” Revision 0, dated July 2014
- VS2-PMS-T7X-008, “V.C. Summer Unit 2 AP1000 Protection and Safety Monitoring System Integration Test Configuration Record,” Revision 2, dated August 2014
- VS2-PMS-T1P-050, “VC Summer Unit 2 AP1000 Protection and Safety Monitoring System Channel Integration Regression Test Procedure,” Revision 1, dated June 2014
- VS2-PMS-T1R-050, “VC Summer Unit 2 AP1000 Protection and Safety Monitoring System Channel Integration Regression Test Procedure,” Revision 0, dated July 2014
- WNA-TP-00410-GEN, “Processor Module Software Test Procedure,” Revision 6, dated July 2012
- WNA-TP-04019-GEN, “CIM SRNC Subsystem Test Procedure,” Revision 1, dated April 2012
- WNA-TR-02714-GEN, “CIM SRNC Test Tool Validation Report,” Revision 0, dated April 2012WNA-TP-00357-GEN, “Element Software Test Procedure,” Revision 7, dated May 2013
- WNA-TP-02353-GEN, “Element Software Test Procedure for HB_CHK Type Circuit,” Revision 1, dated February 2014
- WNA-TR-01475-GEN, “Element Software Test Report for HB_CHK Type Circuit,” Revision 2, dated February 2014
- WNA-VR-00393-GEN, “Display Capture Tool Validation,” Revision 1, dated December 2013
- WNA-WI-00452-GEN, “Regression Testing Work Instruction,” Revision 0, dated February 2014
- WNA-5B2D5831, “The Requirement Specifications For Automatic Display Testing Tool,” Revision 4, dated January 2013
- WNA-TP-5B2D5848, “Test Procedures for Automatic Display Testing Tool Ver. 3.4,” Revision 1, dated October 2013
- WNA-6E2D1320, “Automatic Display Testing Tool User’s Manual,” Revision 6, dated March 2013 WNA-TP-04538-WAPP, “Software Validation Test Procedure for IV&V Interface Data Analysis Tool (IDAT),” Revision 1, dated September 2013
- WNA-TR-03014-WAPP, “Test Report for IV&V Interface Data Analysis Tool (IDAT),” Revision 1, dated January 2014
- WNA-VT-00006-WAPP, “IV&V Verification Task Report for IV&V Interface Data Analysis Tool (IDAT),” Revision 1, dated December 2013

Corrective Action Documents

- Issue Report (IR) 11-206-M051, “NRC Inspection CSI 4-25-11 Nonconformance 99901404/2011-201-03,” dated July 25, 2011
- IR 13-267-M061, “Error Report Evaluation,” dated September 24, 2013
- IR 13-269-M023, “Supplier Error Reporting Process,” dated September 26, 2013
- CAPAL 100040376, “Emerson Product Advisory for Controller Intermittent Failure,” dated August 27, 2014 (in-process)
- CAPAL 100020877, “Supplier NRC Nonconformance – Steris Isomedix,” dated May 29, 2014 (in-process)
- CAPAL 100000587, “CIM Product Quality Assessment,” dated August 2013
- IR 11-206-M052, “CIM Test/IVV Tools,”
- IR 14-009-W005, “CIM Significant Breakdown in Quality Assurance,” dated January 9. 2014

Miscellaneous Documents

- IEEE Standard 730-1998, “IEEE Standard for Software Quality Assurance Plans,” Institute of Electrical and Electronics Engineers, dated 1998
- IEEE Std. 1074-1995, "IEEE Standard for Developing Software Life Cycle Processes," dated 1995
- IEEE Standard 1012-1998, “IEEE Standard for Software Verification and Validation,” dated 1998
- Regulatory Guide 1.173, “Developing Software Life Cycle Processes for Digital Computer Software used in Safety Systems of Nuclear Power Plants,” dated September 1997
- Regulatory Guide 1.169, “Configuration Management Plans for digital Computer Software used in Safety Systems of Nuclear Power Plants,” dated 1997
- NUREG/CR-6101, “Software Reliability and Safety in Nuclear Reactor Protection Systems,” US Nuclear Regulatory Commission,” dated June 11, 1993
- Regulatory Guide 1.152, “Criteria for Use of Computers In Safety Systems of Nuclear Power Plants”
- IEEE Standard 7.4.3.2-2003, “IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations,” dated 2003
- National Instruments letter to CS Innovations, “Product Notification: Possible System Hang with Third-Party PXI Modules for Some NI PXI Systems with a 64-Bit Operating System,” dated May 15, 2012
- National Instruments automated notification, “Product Notification: Data Corruption Issues with NI LabVIEW 2012 FPGA Module,” dated November 27, 2012
- Business Management System (BMS)-SCM-10, “Administrative Specification for Procurement of Items and Services 54823,” Revision 11, dated July 9, 2014
- BMS-CI-5, “Operating Experience Guideline,” Revision 1, dated May 7, 2014
- NA 4.4.7, “Standard Parts Specification List,” Revision 5, dated August 1, 2014
- Selected Test technician Qualification Record
- Selected “on-the-job” training logs, Course Number 11146381

6. ACRONYMS USED:

ADAMS	Agencywide Documents Access and Management System
ADJT	Automatic Display Judgment Tool
ADS	Automatic Depressurization System
BMS	Business Management System
CAPAL	Corrective Action Program and Learning system
CGD	Commercial Grade Dedication
CFR	*Code of Federal Regulations*
CHT	Cabinet Hardware Testing
CIM	Component Interface Module
CIT	Channel Integration Testing
CMRR	Configuration Management Release Record
CSI	CS Innovations, Inc.
DAC	Design Acceptance Criteria
DAS	Diverse Actuation System
DCD	Design Control Document
DCIP	Division of Construction Inspection and Operational Programs
DCT	Display Capture Tool
DI&C	Digital Instrumentation and Control

EDMS	Equipment and Database System
EUT	Equipment Under Test
EVIB	Electrical Vendor Inspection Branch
FAT	Factory Acceptance Testing
FMEA	Failure Modes and Effects Analysis
FPGA	Field Programmable Gate Array
IDAT	Interface Data Analysis Tool
IEEE	Institute of Electrical and Electronics Engineers
ILP	Integrated Logic Processor
IP	Inspection Procedure
IR	Issue Report
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
IV&V	Independent Verification and Validation
M&TE	Measuring and Test Equipment
MTP	Maintenance and Test Panel
NA	Nuclear Automation
NON	Notice of Nonconformance
NOV	Notice of Violation
NRC	(U.S.) Nuclear Regulatory Commission
NRO	Office of New Reactors
PRHR HX	Passive Residual Heat Removal Heat Exchanger
PMS	Plant Monitoring System
PC	Processor Cabinet
PO	Purchase Order
QA	Quality Assurance
QC	Quality Control
RACR	Regression Analysis Change Report
RCDP	Remote DAS Control Panel
RITS	Replacement and Automation Services (RRAS) Issue Tracking System
RTM	Requirements Traceability Matrix
RTNSS	Regulatory Treatment of Non-Safety Systems
RWST	Refueling Water Storage Tank
SDP	Software Development Plan
SIL	Software Integrity Level
SIOS	Standard Input/Output Simulator
SIT	System Integration Testing
SLC	Software Life Cycle
SLCM	Software Life Cycle Model
SOP	Standard Operation Procedures
SQAP	Software Quality Assurance Program
SQV	Squib Valve Controller
U.S.	United States (of America)
WEC	Westinghouse Electric Company