January 5, 2016

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 NO. 99900404/2016-201

Dear Ms. DiTommaso:

On October 26 to October 30, 2015, and November 16 to November 19, 2015, 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."

This inspection evaluated aspects of WEC's programs for the design, implementation, and
testing of the Component Interface Module (CIM), a sub-system within the 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. This
NRC inspection report does not constitute NRC endorsement of your overall quality assurance
(QA) or 10 CFR Part 21 programs.

During this inspection, the NRC staff evaluated aspects of WEC's design and testing of the CIM,
and observed on-going system integration testing for the PMS. 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 2.5.02.11, 2.5.02.12, and 2.5.02.14.

Within the scope of this inspection, no violations or nonconformances were identified and no
response is necessary.

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 (if
applicable) 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/

Greg S. Galletti, Acting Chief
Electrical Vendor Inspection Branch
Division of Construction Inspection
 and Operational Programs
Office of New Reactors

Docket No.: 99900404

Enclosure:
Inspection Report No. 99900404/2016-201
 and Attachment

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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Inspection Report No. 99900404/2016-201
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NAME	JZhao*	KMott*	RMathisIII*	PNatividad*
DATE	01/04/2016	01/04/2016	01/05/2016	01/04/2016
OFFICE	NRO/DCIP/EVIB	RII	NRO/DCIP/IGCB	NRO/DCIP/EVIB
NAME	SSmith*	LCastelli*	BAnderson	GGalletti
DATE	01/04/2016	01/05/2016	01/04/2016	01/05/2016

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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.:   99900404/2016-201

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: October 26-30, 2015 and November 16-19, 2015

Inspection Team Leader: Greg Galletti, NRO/DCIP/EVIB

Inspectors: Lisa Castelli   R-II/DCI/CIB1
                                   Robert Mathis   R-II/DCI/CIB1
                                   Philip Natividad   NRO/DCIP/EVIB
                                   Stacy Smith   NRO/DCIP/EVIB
                                   Jack Zhao   NRO/DE/ICE
                                   Kenneth Mott   NRO/DE/ICE

Approved by: Greg S. Galletti, Acting Chief
                                   Electrical Vendor Inspection Branch
                                   Division of Construction Inspection
                                    and Operational Programs
                                   Office of New Reactors

EXECUTIVE SUMMARY

Westinghouse Electric Company
99900404/2016-201

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, and "Domestic Licensing of Production and Utilization Facilities," 10 CFR Part 21, "Reporting of Defects and Noncompliance." The inspectors conducted this inspection at the WEC facility in Warrendale, Pennsylvania, on October 26-30, 2015, and November 16-19, 2015.

This inspection specifically evaluated aspects of WEC's design and testing of the Component Interface Module (CIM) and Safety Remote Node Controller (SRNC) subsystem (CIM-SRNC) of the Protection and Safety Monitoring System (PMS) for new construction commercial nuclear plants in the US associated with functional and design requirements, design and implementation, integration and testing of the CIM-SRNC subsystem, as well as, PMS engineering effort associated with the Maximum CPU (MaxCPU) analysis. These activities are associated with ITAACs 2.5.02.14, 2.5.02.11, and 2.5.02.12, respectively.

With respect to ITAAC 2.5.02.12, the inspectors observed attributes and elements associated with implementation of the CIM-SRNC subsystem software management plan (SMP), software configuration management plan (CMP), and software verification & validation (IV&V) plan. These attributes are observed and assessed for each inspection involving ITAACs 2.5.02.11 and 2.5.02.14.

The following regulations served as the bases for this NRC inspection:

- Appendix B to 10 CFR Part 50
- 10 CFR Part 21
- 10 CFR 50.55a

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.

CIM-SRNC Subsystem Requirements Phase Review (ITAAC 2.5.02.14b)

The inspectors determined that WEC's implementation of their policy and procedures for control of the design and implementation of the CIM-SRNC subsystem requirements phase satisfy the regulatory requirements set forth in Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

<u>CIM-SRNC Receipt Inspection (ITAAC 2.5.02.14.c)</u>

The inspectors determined that the implementation of WEC's program for control of CIM-SRNC inspection activities were consistent with the regulatory requirements of Criterion X, "Inspection," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

<u>CIM-SRNC Requirements and Design/Implementation Phase Review (ITAAC 2.5.02.14b.c)</u>

The inspectors determined that WEC's implementation of their policy and procedures for control of design and implementation requirements phase for the CIM-SRNC software and hardware satisfy the regulatory requirements set forth in Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

<u>CIM-SRNC Software Design and Implementation Phase Review (ITAAC 2.5.02.14c, 2.5.02.12)</u>

The inspectors determined that WEC's implementation of their policy and procedures for CIM-SRNC software design and implementation phase satisfy the regulatory requirements set forth in Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

<u>CIM-SRNC FPGA System Integration and Test Phase Review (ITAAC 2.5.02.14d)</u>

The inspectors determined that WEC's implementation of its policies and procedures that govern the CIM-SRNC FPGA system integration and test phases were consistent with the requirements of Criterion III, "Design Control," and Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

<u>CIM-SRNC Installation Phase Review (ITAAC 2.5.02.14e)</u>

The inspectors determined that WEC's implementation of their policy and procedures for control of portions of the CIM-SRNC subsystem installation phase satisfy the regulatory requirements set forth in Criterion III, "Design Control," Appendix B to 10 CFR Part 50. No findings of significance were identified.

<u>CIM-SRNC Corrective Action Program Implementation Review (ITAAC 2.5.02.14.c, 2.5.02.12)</u>

The inspectors determined that WEC had adequately accounted for and addressed issues associated with two NONs identified in the NRC Inspection Report 99900404/2014201. Issues were captured, tracked, and adequately resolved through the Replacement and Automation Services Issue Tracking System (RITS) process. These two NONs were associated with ITAAC 2.5.02.14(a). Based on the sample of corrective actions reviewed the inspectors determined that WEC was adequately implementing processes and procedures associated with their corrective action program consistent with the requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50.

<u>PMS Design Evaluation (ITAAC 2.5.02.11c)</u>

The inspectors concluded that WEC's implementation of their policy and procedures for control of design and testing of portions of the PMS system associated with the Maximum CPU design engineering analysis 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.

CIM-SRNC Software Lifecycle Software Management, Configuration Management and Verification & Validation Processes (ITAAC, 2.5.02.12)

The inspectors determined that WEC's implementation of its policies and procedures that govern the PMS software design phase lifecycle activities associated with the design, implementation, integration and testing of the CIM-SRNC subsystem were consistent with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. CIM-SRNC development was adequately controlled through processes for configuration management, independent verification and validation, quality assurance and software safety in accordance with WEC's management plan. No findings of significance were identified.

REPORT DETAILS

Background:

The AP1000 Component Interface Module-Safety Remote Node Controller (CIM-SRNC) field programmable gate array (FPGA) is implemented with a standard set of generic logic that will be applied to all Appendix B engineered safety features (ESF) component's CIM-SRNC which will provide the ESF component-level control across different ESF components. As stated in "Standard System Design Criteria: Component Control," WNA-DB-00102-GEN, Revision 0, January 2008, Section 3.2, "Interface," the CIM-SRNC FPGA is a standardized module that contains universal component control logic to accommodate various component types. The specific component control functional logic requirements that will be implemented in the CIM-SRNC FPGA module are defined in "Component Interface Module Logic Specification," WNA-DS-02331-GEN, Revision 2, March 2014. Therefore, each applicable safety-related engineered safety features (ESF) actuation end component is controlled using the same generic CIM-SRNC FPGA functional control logic. This generic CIM-SRNC FPGA functional control logic is the scope of this portion of this inspection.

1. CIM-SRNC Subsystem Requirements Phase Review (ITAAC 2.5.02.14b)

   a. Inspection Scope

      The inspection scope for the CIM-SRNC functional control logic was performed by tracing several CIM-SRNC requirements through the lifecycle development process. The inspectors selected several functional CIM-SRNC requirements to trace as listed in the "Component Interface Module Requirement Traceability Matrix," 6105-20010, Revision 20, dated October 2015. These requirements are listed below in Table 1.

Table 1 – Selected CIM-SRNC FPGA Requirements Sampled During Inspection

CIM-SRNC Requirement Identification	Description
R3.11.7	The control logic module disables an active output when a valid Thermal Overload is detected, as long as there is not presently an active X-Bus command.
R3.11.8	Utilizing feedback, the control logic module inserts a one second full-stroke lockout delay if the torque limit latch has been set.
R3.11.9	The control logic module latches and holds the active command until a stop command or an opposing command is detected.
R3.11.10	The control logic module requires a stop command to reset the Torque Limit Latch.

The inspectors used the CIM-SRNC traceability matrix to verify that the CIM-SRNC functional control logic requirements were correctly derived.

Additionally, the NRC inspector reviewed the CIM-SRNC software and hardware design life cycle documents to make sure that consistency has been maintained with the licensing basis, design commitments, and acceptance criteria for the pertinent ITAAC items. Logic diagrams, such as for automatic depressurization system depressurization valves, containment and filtration system isolation and vacuum relief valves, were evaluated and verified to appropriately implement the regulatory and technical requirements for the CIM-SRNC subsystem.

The inspectors also reviewed a sample of priority logic requirements implemented in the CIM-SRNC subsystem and verified that each of the sampled requirements were traceable from the logic control commands of the PMS and Plant Control System (PLS) to the execution commands sent to the field ESF components. The NRC inspector confirmed that the requirements adequately defined all four safeguards designed to account for spurious or erroneous PLS controls. These four requirements include: (1) When a PMS command is issued, a latch function is set inside the CIM-SRNC to make sure that the PMS required actuation will be completed; (2) The PLS control must be enabled via issuing an enabling bit for the Y-Port by the PMS system; (3) If process conditions require, the PMS command is also latched inside the PMS to make sure that the PMS command is still there even after the actuation action is completed; (4) Following completion of an ESF actuation, PLS requires additional operator action before the PMS component can be re-positioned into its non-actuated, normal state. The inspectors also confirmed that the CIM-SRNC priority logic has been adequately designed to incorporate those requirements in accordance with the licensing basis and design commitments.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined that activities related to the CIM-SRNC subsystem requirements phase implementation had been adequately performed. The inspectors determined that WEC's implementation of its policies and procedures that govern CIM-SRNC subsystem software and hardware requirements phase implementation activities were consistent with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

2. Receipt Inspection

a. Inspection Scope

The inspectors reviewed inspection records and discussed receipt inspection activities that were completed for the CIM-SRNC with WEC management to determine if WEC's controls were in compliance with the regulatory requirements of Criterion X, "Inspection," of Appendix B to 10 CFR Pat 50. The inspector's reviewed CIM-SRNC receipt inspection documentation completed during the inspection period dated September 4, 2012, to November 6, 2012. The inspection sample included quality

control (QC) / quality Assurance (QA) worksheets, documentation of inspection results, certificate of conformance and documentation of serial numbers to verify that adequate QC/QA oversight activities were completed and adequately documented.

Observations and Findings

No findings of significance were identified in this area.

b.   Conclusions

The inspectors determined that the implementation of WEC's program for control of inspection activities were consistent with the regulatory requirements of Criterion X, "Inspection," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

3.   CIM-SRNC Requirements and Design/Implementation Phase Review (ITAAC 2.5.02.14b,c)

a.   Inspection Scope

The CIM-SRNC is a subsystem of the PMS and includes the CIM, SRNC, CIM base plate, SRNC base plate, single-width transition panel and double width transition panel and branch terminating device. The CIM and SNRC are logic modules that utilize FPGA technology. The CIM-SRNC is designed to interface an ESF component to the PMS, the PLS, and the local controls on the CIM module. The CIM ensures the automatic safety feature and class 1E manual controls both have priority over the non-class 1E controls. The safety-related function of the CIM module is to receive a set of commands through dedicated input ports from PMS, perform priority arbitration, and to use the arbitrated output to control an external load through dedicated output ports. The SRNC provides the communication interface to PMS for the CIM-SRNC subsystem.

CIM

The inspection team interviewed responsible personnel and reviewed documentation as part of the review of the requirements phase for the CIM-SRNC module. The requirements phase, as documented in 6105-00000, "CIM-SRNC Management Plan," Revision 12, dated August 2015, is to capture the CIM-SRNC system requirements into the CIM-SRNC project documentation. The inspectors noted that CIM-SRNC system requirements were captured in WNA-DS-01271-GEN, Component Interface Module Hardware Requirements Specification," Revision 10, dated January 2013 and WNA-DS-02331-GEN, "Component Interface Module Logic Specification," Revision 2, dated March 2014. The inspectors reviewed system requirements to ensure that applicable codes, standards, and regulatory requirements were satisfied and that the system requirements were traceable to the functional and design basis requirements. Traceability was also verified to include an output to a test and validation process. The inspectors verified the following requirements documented in WNA-DS-01271-GEN, and WNA-DS-02331-GEN:

Hardware
- R004.3 Field Interface to Component Command Output Response
- R004.4 CIM Control Ports
- R004.5 Port X and Y Independence
- R004.6 Port X Communication

Software
- R004.1, CIM System Initialization
- R004.50, Initialization Response
- R004.43-1, CIM Module Address Comparison
- R004.2, CIM Serial Link Step Response
- R004.3, Field Interface to Component Command Output Response

The inspection team reviewed CIM-SRNC hardware design document 6105-20003, "CIM Hardware Specification," Revision 4, dated January 24, 2013, and CIM-SRNC Software design documents 6105-20004, "CIM FPGA Software Requirements Specification," Revision 17, dated July 2015 and 6105-20014, "CIM FPGA Software Design Description," Revision 5, dated July 2015, in relation to the above requirements, to ensure system requirements were adequately decomposed into hardware design and software design specifications. CIM-SRNC design requirements were reviewed to ensure that the implementation of those requirements were appropriately depicted in design documentation. The inspectors reviewed engineering and independent verification and validation (IV&V) testing procedures and specifications including 6105-00021, "CIM SRNC IV&V Simulation Environment Specification," Revision 5, dated September 2015 and WNA-TP-04019-GEN, "CIM SRNC Subsystem Test Procedure," Revision 2, dated September 2014, to ensure design elements were included for verification and validation.

SRNC

6105-00000, "CIM-SRNC Management Plan," Revision 12, dated August 2015, documents that there are seven primary components of the CIM-SRNC. For this sample, the inspectors focused on the SRNC and the SNRC base plate. The main functions of the SRNC are:

- Receive data from two separate PM646A process modules via HSL links
- Transmit data from the X1 and X2 internal bus to the PM 646A process modules via HSL links
- Receive and transmit information to/from CIM I/O modules mounted on the four branches
- Transmit health to the PM646A processor via the HSL

The safety-related function of the SRNC is to receive data through an EIA-485 port using the High Speed Link (HSL) protocol, and transmit this information through an EIA-485 port using the X-bus protocol to the respective CIM using the four X branches.

The requirements phase, as documented in the CIM-SRNC Management Plan, is to capture the CIM-SRNC system requirements in to the CIM-SRNC project documentation. These requirements are then decomposed into FPGA software requirements. The NRC verified the following design requirements documented in

WNA-DS-01272-GEN, "Safety System Remote Node Controller Requirements Specification," Revision 9, dated September 2013, were implemented and tested:

Hardware
- R003.2, "Nonvolatile Memory"
- R003.4, "Design Life"
- R004.5 EIA-485
- R009.6, "EMC Design"
- R007.10, "Power Supply"

Software
- R004.1, "SRNC Response Time"
- R004.19, "Initialization Response" (Software and hardware)
- R004.8 "HSL Physical Layer Requirements"
- R0005.5, "Fusing"
- R007.2 "HSL Data Verification Stream Error"
- R007.8, "X Bus Message CRC Error"
- R007.11, "Failure Latching"

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

No findings of significance were identified.

c. <u>Conclusions</u>

The inspectors determined that activities related to the CIM-SRNC requirements phase and design/implementation phase had been adequately performed. Traceability from higher level system and functional requirements through detailed design documentation was verifiable. The inspectors determined that WEC's implementation of its policies and procedures that govern CIM-SRNC software and hardware development activities were consistent with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

4. <u>CIM-SRNC Software Design and Implementation Phase Review (ITAAC 2.5.02.14c, 2.5.02.12)</u>

a. <u>Inspection Scope</u>

The inspectors traced the selected CIM-SRNC functional requirements to the CIM-SRNC FPGA chip code development processes, procedures, and to the correct requirements code design engineer verification testing by using the CIM-SRNC traceability matrix.

The inspectors reviewed the process and procedures, as stated in "CIM FPGA Software Design Description," 6105-20014, Revision 5, July 2015, to translate the CIM-SRNC functional logic requirement statements into software code and data, which are utilized by the design engineer to implement the CIM-SRNC FPGA logic.

The inspectors also reviewed and verified the forward traceability of the design engineers documented test case specifications that were used to test and validate that the FPGA logic requirements have been implemented. These test case specifications were listed in "ATB-CIM Test Case Specification," 6105-20032, Revision 5, dated August 2012. The inspectors traced the selected CIM-SRNC FPGA functional control requirements from table 1 to the design engineer's test(s) that were used to confirm that the CIM-SRNC FPGA logic has been correctly designed.

Detailed Design & Implementation (Code Development)

The vendor provided a demonstration of how the CIM-SRNC FPGA Hardware Description Language (HDL) software code is stored and accessed. The vendor explained that the CIM-SRNC FPGA HDL code is developed and digitally data stored on a secure isolated development infrastructure (IDI). The IDI is a secure system that is separate from the general server network(s) and access is granted only to persons who are deemed to need access to the IDI. The vendor demonstrated that any changes to the CIM-SRNC FPGA HDL code stored on the IDI would be identified by time, date, and author of the change, with a corresponding new revision number being created to identify the change. Therefore, a comparison could be made between revisions to identify all changes made to the original revision as captured in the new revision.

The inspectors verified that the developed CIM-SRNC FPGA HDL functional logic code was stored in an environment in accordance to Section 11, "Project Methodologies," of 6105-00000, CIM-SRNC Management Plan, Revision 12, August 2015, and verified that all CIM-SRNC FPGA HDL code was documented.

The vendor provided several printed lists of lines of CIM-SRNC FPGA HDL code and used these lists to demonstrate that the above Table 1 CIM-SRNC FPGA functional requirements were correctly included in the final implemented HDL code. The vendor presented a code line-by-line review to display which lines of code represented the selected Table 1 CIM-SRNC FPGA functional control logic requirements.

CIM-SRNC FPGA Binary Image Build Execution

The inspectors interviewed the WEC FPGA Design Engineer responsible for the CIM-SRNC development and conducted document reviews of the CIM-SRNC design process procedures. Specifically, the inspectors reviewed the WEC process for taking an FPGA design from the hardware description language (Verilog) to the binary image as documented in procedure 6105-20025, "CIM FPGA Build Procedure" Revision 4, and in procedure 6105-10025, "SRNC FPGA Build Procedure", Revision 4. This process includes executing the FPGA design tools synthesis, and place and route using the Actel tool suite. The process was verified to follow a controlled procedure with the proper reviews and acceptance criteria. The binary image build execution is documented in a build report. Logs and reports generated between these steps are archived in the configuration management repository for review during IV&V activities. The result of the synthesis and the place and route tool are verified with the gate-level simulations to ensure proper function and timing. The inspectors sampled the completed FPGA build reports to verify the completion of the procedures and to verify the acceptance criteria was met as required.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined that activities related to the CIM-SRNC software coding design and implementation phase had been adequately performed. The inspectors determined that WEC's implementation of its policies and procedures that govern CIM-SRNC software and hardware development activities were consistent with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

5. CIM-SRNC FPGA System Integration and Test Phase Review (ITAAC 2.5.02.14d)

a. Inspection Scope

The NRC inspectors reviewed WEC's process for implementation of the ITAAC 2.5.02.14d requirements. The CIM-SRNC subsystem integration, consists of combining smaller software modules for CIM and SRNC into a software image for each FPGA, then the IV&V team performs testing of that image in software form within an FPGA gate-level simulation environment. Since an FPGA is a programmable circuit, an FPGA design can be tested as software code within a gate-level simulation environment prior to "flashing" the software onto the CIM-SRNC FPGA chip/module.

The NRC inspectors reviewed test report results (summarized in 6105-00092 sections 2.12 and 2.13) for this IV&V Simulation Environment (ISE) testing performed through 2015. Inspectors reviewed WEC procedure 6105-60136 specifically documenting the completed ISE tests (including inspector tracing of a sampling of software and hardware requirements, as noted in an above section of this inspection report. The inspectors also reviewed the 6105-00021 documentation of the specifications for ISE as a testing tool (including ISE peer validation 6105-10037). The ISE test task report 6105-60136 summarizes the acceptable completion of testing, and inspectors noted that the peer reviews in 6105-10037 are validation of the initiating test setup and acceptance criteria.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

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

6. CIM-SRNC Installation Phase Review (ITAAC 2.5.02.14e)

a. Inspection Scope

The NRC inspectors reviewed WEC procedures for flashing the FPGA software images onto the FPGA chip/module, which accomplishes programming of the FPGA hardware. Assembly of the CIM and SRNC FPGA boards onto the CIM-SRNC subsystem hardware marks the completion of CIM-SRNC subsystem (ITAAC 2.5.02.14e). Installation of the CIM-SRNC into the PMS system is part of ITAAC 2.5.02.11d, where it is being integration-tested as part of PMS System Integration Testing (SIT) (ITAAC 2.5.02.11d, is currently undergoing SIT for PMS baseline 8 design revisions after baseline 7.8). Inspectors also reviewed WEC procedures for hardware pre-tests for installation of the CIM and SRNC printed circuit board assemblies onto baseplates, transition panels, and termination units. Inspectors noted that the actual CIM-SRNC assemblies used for Vogtle and Summer AP1000 PMS were completed using previous revisions of these pre-test procedures, and inspectors reviewed a sampling of CSI "traveler" documentation and the pre-test steps, assembly, and Quality Assurance steps from that previous revision as used.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors determined that WEC's implementation of their policy and procedures for control of portions of the CIM-SRNC subsystem installation into the PMS satisfy the regulatory requirements set forth in Criterion III, "Design Control," Appendix B to 10 CFR Part 50. No findings of significance were identified.

7. CIM-SRNC Corrective Action Program Implementation Review (ITAAC 2.5.02.14.a 2.5.02.12)

a. Inspection Scope

The inspectors reviewed policies, procedures, work instructions, and interviewed vendor personnel responsible for the identification and implementation of Corrective Actions (CAs) associated with two previous notices of nonconformance (NONs) identified in NRC inspection number 99900404/2014-201. These NONs were:

(1) WEC did not apply appropriate design control measures to correctly translate applicable regulatory requirements and the design basis into specifications, drawings, procedures, and instructions.

(2) WEC did not apply appropriate design control measures to verify the adequacy of design associated with the performance of safety analyses, system requirements review, and concept documentation evaluation

The inspection team reviewed a sample of the compliance matrices (IEEE-1012, IEEE-1074). The compliance matrices were developed by the vendor's licensing, engineering and IV&V personnel in accordance with NA 4.53, Revision 2, "Compliance

with Foundational Regulatory Bases for Safety-Related I&C Processes," dated May 9, 2014, and distributed to all effected Technical managers for the AP1000 I&C project for review and impact assessment. The inspectors selected specific requirements identified in the matrices, and verified applicability of requirement to the associated PMS Lifecycle stages, including verification of specific requirement fulfillment activities as documented in test result reports and analyses. These fulfillment activities included, specific process step requirements, such as performance of evaluation or analyses including traceability, hazards, and risk. The inspectors noted that for the IEEE-1012 sample, these fulfillment steps were incorporated into 6105-00013, Revision 10, "CIM SRNC IV&V Plan." 6105-00013 contains revised language to address each of the NONs.

The inspectors noted that the vendor had performed an extensive review and decomposition of the various standards and guidelines committed to as part of the licensing basis. The inspectors also evaluated a sample of the verification of activities performed by the vendor to revise various software lifecycle plans, procedures, and work instructions. This included a review of approximately twenty additional work instructions, including IV&V, which encompassed all phases of CIM-SRNC development. The inspectors noted that Implementation of those instructions resulting in the vendor a re-performing all of lifecycle phases of CIM-SRNC development from concept through design, testing, and integration. For example, as part of the decomposition of the lifecycle requirements, the vendor identified missed test requirements during test activities using the simulation environment test tool. The CAs required, in part, that new test instructions be developed to address the missed requirements, and all tests were re-performed on the FPGA to confirm adequate performance of the code under additional required test conditions.

The inspectors reviewed the revised hazard analyses and confirmed that risk factors were identified and analyzed, including the use of the two highest priority CIM-SRNC control ports, the Z ports, were adequately identified and incorporated into the analysis.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The inspectors confirmed that WEC had adequately identified and implemented CAs, including revisions to WEC policies, procedures, work instructions, reports, tests, as well as re-performance of CIM-SRNC lifecycle activities consistent with those CAs. No findings of significance were identified. The inspectors concluded that WEC's implementation of their policy and procedures associated with CAs in response to two NONs identified in NRC inspection report 99900404/2014201 satisfy the regulatory requirements set forth in Criterion XVI, "Corrective Actions," of Appendix B to 10 CFR Part 50. These two NONs were associated with ITAAC 2.5.02.14(a).

8. PMS Design Evaluation (ITAAC 2.5.02.11c)

    Vogtle Unit 4 Maximum CPU (MaxCPU) Design Analysis

    a. Inspection Scope

    At the time of this inspection, the Vogtle Unit 4 PMS hardware cabinets (including CIM-SRNC) were undergoing a design engineering runtime analysis observing CIM-SRNC subsystem performance at conditions of maximum (>70%) central processor unit (CPU) loading. Although each of these CPUs for AP1000 normally run well below (e.g., at 15% to 50%) of the manufacturer's 70% maximum recommended loading, this runtime analysis is intended to provide the design engineers with assurance that the CIM-SRNC would continue to function properly above that threshold. The NRC inspectors witnessed a demonstration of MaxCPU data capture under the guidance of Manufacturing Work Order WNA-MWO-15-00410, and also reviewed basis documentation in WNA-AR-00438-GEN. The inspectors interviewed design engineers conducting the analysis and found them to be knowledgeable regarding the process and also demonstrating appropriate precautions near the energized production equipment (such as using a personnel grounding strap to protect the CIM-SRNC components from static discharges, as well as demonstrating personnel safety/trip precautions near the energized cabling).

    The rationale and bases for the analysis methodology were discussed with the engineers at the time of this inspection, although were still being documented at the time of inspection and will be finalized in the same document as the MaxCPU analysis results (expected to be APP-PMS-GER-004 planned to be issued in November 2015). Appropriate configuration procedures, for loading MaxCPU software and the test harnesses to the PMS were observed to be attached to the manufacturing work order.

    b. Observations and Findings

    No findings of significance were identified.

    c. Conclusions

    The inspectors concluded that WEC's implementation of their policy and procedures for control of testing associated with the MaxCPU design engineering analysis satisfy the regulatory requirements set forth in Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. No findings of significance were identified.

9. CIM-SRNC Software Lifecycle Software Management, Configuration Management and Verification & Validation Processes (ITAAC, 2.5.02.12)

    a. Scope

    The NRC inspectors assessed WEC's software program management, configuration management, and IV&V processes, specifically implementation of those processes throughout the CIM-SRNC subsystem design life cycle phase. The inspectors selected and verified a representative sample of lifecycle phase-specific attributes to determine the effectiveness of the processes in complying with commitments outlined in ITAAC 2.5.2.12 and the AP1000 licensing basis.

Software Management

The inspectors reviewed the CIM-SRNC Management Plan, CIM-SRNC Quality Assurance Plan, and CIM-SRNC Software Program Manual (SPM), all of which contains elements of software management for safety-related I&C applications. The inspectors verified that these high level documents promulgated processes for key digital system and software development, including configuration management, IV&V, quality assurance, and software safety. Additionally, the inspectors confirmed that issues identified as part of the CIM-SRNC development were captured and addressed through WEC corrective action processes.

Software Configuration Management

The inspectors evaluated various WEC documents related to software configuration management to verify compliance with the CIM-SRNC SPM and the CIM-SRNC Configuration Management Plan (CMP). Through interviews, review of configuration management records, including the Configuration Management Report and Configuration Status Accounting document, and a walk-through of processes, the inspectors determined that WEC's process for release of configuration items against a software baseline was adequate.

Software Verification & Validation

The inspectors evaluated various WEC V&V documents to verify compliance with the CIM-SRNC SPM and the CIM-SRNC IV&V Plan. Various IV&V output documents and task reports developed throughout the CIM-SRNC design and implementation phase were sampled to verify alignment with the higher level process requirements. The inspectors selected a sample of attributes from the required IV&V phase activities and interviewed IV&V personnel to assess whether the IV&V effort adequately performed the required tasks. Specifically, the inspectors reviewed WEC's IV&V documentation to verify completion of application code review, IV&V configuration management release records, risk analysis, and traceability, and the IV&V baseline configuration management assessment.

The inspectors verified that the process developed and actions taken by WEC IV&V to review open items for the planning phase was adequate and in accordance with documented reports. In addition, the inspectors verified IV&V team independence from the design organization in their reviews of the safety related software as required by procedures and regulatory requirements.

b. Observation and Findings

No findings of significance were identified.

c. Conclusion

The inspectors determined that WEC's implementation of its policies and procedures that govern the CIM-SRNC software design phase lifecycle activities were consistent with the requirements of Criterion III, "Design Control," Criterion XI, "Test Control," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. CIM-SRNC development was adequately controlled through processes for configuration

management, V&V, quality assurance, and software safety in accordance with WEC's management plan. No findings of significance were identified.

10. Entrance and Exit Meetings

On October 17, 2015, the inspectors presented the inspection scope during an entrance meeting with Mr. Paul Russ, Director, Licensing, of WEC, and other WEC personnel. On November 19, 2015, the inspectors presented the inspection results during an exit meeting with Mr. Jan Dudiak, Vice President, Automation and Field Services, and other WEC personnel.

ATTACHMENT

1. <u>PERSONS CONTACTED AND NRC STAFF INVOLVED:</u>

Name	Affiliation	Entrance	Exit	Interviewed
Jan Dudiak	WEC-AFS		X	
Bob Philips	WEC	X	X	X
Gregory Glenn	WEC-AFS	X	X	X
Sarah DiTomasso	WEC	X	X	X
Bob Hirmanpour	SNC	X	X	X
Steve Packard	WEC	`	X	
Warren Odess-Gillett	WEC			X
Pietro Porco	WEC-AFS	X		X
Jerry Money	SCANA	X	X	X
Ron Wessel	WEC		X	
Michael Shaffer	WEC-AFS	X	X	X
John Wiessmann	WEC-AFS	X		X
Rick Paese	WEC	X		X
Michael Klinuex	WEC		X	X
Matt Shakun	WEC			X
Marci Maher	WEC	X	X	X
Steve Radmoski	WEC		X	
Hason S. Uyar	WEC	X	X	X
Edmond Barakat	WEC	X	X	X
Jim Rozum	WEC	X		X
David Tyler	WEC			X
Kasey Corbin	WEC			X
Kevin Neumann	WEC	X	X	X
Brock Wilbanks	SNC	X	X	X
Robert Lane	WEC	X	X	X
Greg Cesare	WEC		X	
Dale Harmon	WEC	X		
Gary Osborn	WEC	X		
Steve Bransfield	WEC	X	X	X
Shawn Downey	WEC	X	X	X
Mark Stofko	WEC		X	
Mike Yox	SNC		X	
Cherie Paugh	WEC			X
Julia Forbes	WEC/Altran	X	X	X
John Hefler	WEC/Altran	X		X
Andrew Neal	SNC		X	
Chunming Zhao	WEC/Altran		X	
Brian Bedford	WEC	X		
Ken Lunz	WEC	X	X	
Quang Nguyen	WEC		X	
Gary Ament	WEC		X	
Paul Russ	WEC	X	X	
David Hooten	WEC/Altran	X		X

Name	Affiliation	Entrance	Exit	Interviewed
John Zuemie	WEC		X	
Mike Rubin	WEC	X		
Dan Darr	WEC	X		
Don Durkosh	WEC	X	X	
Jason Weathersby	SCANA	X	X	
Chris Srock	WEC	X		
Nancy Zupetic	WEC	X		
Lisa Fowler	WEC	X	X	
Greg Galletti	NRC	X	X	
Lisa Castelli	NRC	X	X	
Robert Mathis III	NRC	X	X	
Philip Natividad	NRC	X	X	
Jack Zhao	NRC	X		
Ken Mott	NRC		X	
Stacy Smith	NRC	X		

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	closed	NON	Criterion III	2.5.02.14(a)
99900404/2014-201-02	closed	NON	Criterion III	2.5.02.14(a)

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

The 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 MaxCPU design engineering testing using the Vogtle Unit 4 AP1000 reactor design. For the ITAAC listed below, the inspectors reviewed WEC's quality assurance (QA) controls in the areas of design control, test control, inspection, nonconforming materials parts and components, and CAs. 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.

This section of the inspection report focuses on the vendor's implementation of aspects of their QA program for the activities affecting quality associated with the design and testing of the aspects of the AP1000 CIM-SRNC subsystem. This included a review of completed Generic AP1000 Baseline (BL) 7.8.2 CIM-SRNC software and hardware design, implementation, integration, and testing documentation as well as currently on-going design

engineering activities related to the MaxCPU analysis. These activities are associated with ITAAC 2.5.02.14(b-e) and 2.5.02.11(c-d) as well as ITAAC 2.5.02.12.

With respect to ITAAC 2.5.02.12, the inspectors observed attributes and elements associated with implementation of the CIM-SRNC SPM, Software Configuration Management Plan (CMP), and the Software IV&V Plan. These attributes are observed and assessed for each inspection involving ITAACs 2.5.02.11 and 2.5.02.14.

COL#	DCD#	Design Commitment	Component/Activity
550	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 (subtasks [c,d] of design commitment – system design and implementation, and system integration and testing)	Vogtle Unit 4 - Observed in-process MaxCPU data capture associated with design engineering analysis
553	2.5.02.14	The Component Interface Module (CIM) is developed using a planned design process which provides for specific design documentation and reviews. (subtask [b-e] of design commitment: b. System definition phase c. Hardware and software development phase, consisting of hardware and software design and implementation d. System integration and test phase e. Installation phase	Reviewed various policies, procedures, work instructions, drawings, requirement specifications, detailed design documents, test procedures, records, and reports associated with the various CIM-SRNC Software and Hardware lifecycle activities. Including requirements tracing, code development, FPGA programming, hardware and software design and testing, and IV&V activities
551	2.5.02.12	The PMS software is designed, tested, installed, and maintained using a process which incorporates a graded approach according to the relative importance of the software to safety and specifies requirements for: a) Software management including documentation requirements, standards, review requirements, and procedures for problem reporting and corrective action. b) Software configuration management including historical records of software and control of software changes. c) Verification and validation including requirements for reviewer independence.	Observed attributes and elements associated with implementation of the CIM-SRNC SMP, software CM Plan, and software IVV Plan. These attributes are observed and assessed for each inspection involving ITAACs 2.5.02.11 and 2.5.02.14.

5. DOCUMENTS REVIEWED:

Design Specifications, Design Requirements, Functional Drawings, Plans, Procedures, and Design Reports

- 1200-00007, "CIM FPGA Binary," Revision 1.155, dated March, 2012
- 6105-00000, "CIM-SRNC Management Plan," Revision 12, dated August 2015
- 6105-00002, "CIM-SRNC Quality Assurance Plan," revision 10, dated September 2015
- 6105-00002, "CIM-SRNC CM Plan," Revision 12, dated September 2015
- 6105-00011, "CIM-SRNC Protocol Specification," Revision 10, dated February 2015
- 6105-00013, "CIM-SRNC IV&V Plan," Revision 14, dated September 2015
- 6105-00015, "CIM-SRNC Software Program Manual," Revision 7, dated September 2015
- 6105-00016, "CIM-SRNC Software Life Cycle Mapping," Revision 1, dated May 2015
- 6105-00017, "CIM-SRNC Regulatory Guide and Industry Standards Compliance Exceptions," Revision 0, dated March 2015
- 6105-00019, "CIM-SRNC Software Hazards Analysis Report," Revision 3, dated January 2015
- 6105-00030, "CIM-SRNC Design Tools," Revision 8, dated April 2015
- 6105-00053, "CIM-SRNC Configuration Status Accounting," dated October 2015
- 6105-00070, "CIM-SRNC CM Report," Revision 14, dated October 2015
- 6105-10025, "SRNC FPGA Build Procedure," Revision 4, dated February 2015
- 6105-20003, "CIM Hardware Specification," Revision 4, dated January 24, 2013
- 6105-20004, "CIM FPGA Software Requirements Specification," Revision 17, dated July 2015
- 6105-20010, "Component Interface Module Requirement Traceability Matrix," Revision 20, dated October 2015
- 6105-20014, "CIM FPGA Software Design Description," Revision 5, dated July 2015
- 6105-20025, "CIM FPGA Build Procedure," Revision 4, dated February 2015
- 6105-50019, "CIM/SRNC Software Hazard Analysis Methodology," Revision 3
- 9006-00021, "Software Transfer to Manufacturing," Revision 1, dated January 2015
- APP-PMS-J1-101, "AP1000 Functional Diagrams Index and Symbols," Revision 16
- APP-PMS-J3-362, "AP1000 Detailed Functional Diagram Containment Radioactivity," Revision 6
- APP-PMS-J3-562, "AP1000 Detailed Functional Diagram PMS Loads and Component Types – PMS Loads and Component Types – Containment Air Filtration System Isolation and Vacuum Relief Valves," Revision 7
- APP-PMS-J3-502, "AP1000 Detailed Functional Diagram Second Stage ADS Depressurization Valves APP-RCS-PL-V002A and APP-RCS-PL-V002B Component Functional Logic Divisions C and D," Revision 6
- APP-PMS-J3-579, "AP1000 Detailed Functional Diagram PMS Loads and Components Types – Second Stage ADS Depressurization Valves," Revision 6
- APP-PMS-J3-548, "AP1000 Detailed Functional Diagram Motor Operated Valves (MOV)," Revision 3
- APP-GW-GEF-633, "Update to PMS/PLS Interface Specification for IEEE 603 Traceability," Revision 0
- APP-GW-J4-076, "PMS/PLS Inter-Subsystem Interface Specification," Revision 1
- APP-PMS-J4-020, "System Design Specification for the Protection and Safety Monitoring System," Revision 10, dated October 2013

- APP-PMS-GHY-004, "PMS Software Design Description for Integrated Logic Processor," Revision 11, Dated October 2013
- APP-PMS-J7-001, "PMS System Specification," Revision 1
- APP-GW-GLR-611, "AP1000 ITAAC 2.5.02.14: Component Interface Module Design Process Technical Report," Revision 0, dated October 2015
- WNA-DB-00102-GEN, Standard System design Criteria: Component Control," Revision 0, dated January 2008
- WNA-DS-01271-GEN, Component Interface Module Hardware Requirements Specification," Revision 10, dated January 2013
- WNA-DS-01272-GEN, "Safety System Remote Node Controller Requirements Specification," Revision 9, dated September 2013
- WNA-DS-02331-GEN, "Component Interface Module Logic Specification," Revision 2, dated March 2014
- WNA-MWO-15-00410, "Manufacturing Work Order – MWO is for performing a design analysis on the A.W. Vogtle 4 PMS system," Revision 00, dated October 30, 2015
- WNA-AR-00510-GEN, "Custom PC Element Branch Execution Time Analysis," Revision 0, dated September 2015
- WNA-AR-00438-GEN, "AC160 CPU Load and Performance Analysis," Revision 1, dated September 2015
- IL-453210, "Inspection Lot 453210- Receipt Inspection CIM"
- Certificate of Conformance, Purchase Order 45003826, Revision CN4, dated March 16, 2011
- QC/QA Review Worksheet," PO/IL Reviewed 4500382680/453201, dated September 9, 2012
- "Inspection Record," dated September 9, 2012

Test Procedures, Plans, and Reports

- 6105-00021, "CIM SRNC IV&V Simulation Environment Specification," Revision 5, dated September 2015
- 6105-00092, "CIM SRNC IV&V Summary Report," Revision 10, dated October 2015
- 6105-10033, "ATB-SRNC Test Procedure," Revision 1, dated July 2015
- 6105-10073, "SRNC PCBA Pre-test Procedure," Revision 3, dated July 2015
- 6105-20031, ATB-CIM Test Design Specification," Revision 4, dated August 16, 2012
- 6105-20032, "ATB-CIM Test Case Specification," Revision 5, dated August 21, 2012
- 6105-20073, "CIM PCBA Pre-test Procedure," Revision 4, dated January 11, 2012
- 6105-20073, "CIM PCBA Pre-test Procedure," Revision 5, dated July 2015
- 6105-30033, "Safety Remote Node Controller Baseplate Test Procedure," Revision 1, dated April 2015
- 6105-30033, "SRNC Baseplate Test Procedure," Revision 0, dated September 20, 2010
- 6105-60136, "CIM-SRNC ISE Test Task Report," Revision 1, dated July 2015
- 6105-60137, "IV&V Task Report for IVV Simulation Environment (ISE) Peer Review," Revision 0, dated July 2015
- CSI Manufacturing Traveler 6105-10047-1, "SRNC Baseplate," dated November 14, 2011
- WNA-TP-04019-GEN, " CIM SRNC Subsystem Test Procedure," Revision 2, dated September 2014
- W001#00825, Test Report, Test Suite: Release Test, dated April 2012

6. <u>ACRONYMS:</u>

ADAMS	Agencywide Documents Access and Management System
AFS	Automation and Field Services
BL	Baseline
CAPAL	Corrective Action Program and Learning system
CFR	*Code of Federal Regulations*
CIM	Component Interface Module
CMP	Software Configuration Management Plan
CPU	Central Processing Unit
DAC	design acceptance criteria
DCD	Design Control Document
DCIP	Division of Construction Inspection and Operational Programs
DI&C	Digital Instrumentation and Control
ESF	engineered safety features
EVIB	Electrical Vendor Inspection Branch
FPGA	Field Programmable Gate Array
HDL	Hardware Description Language
HSL	High Speed Link
IDI	isolated development infrastructure
IEEE	Institute of Electrical and Electronics Engineers
IP	inspection procedure
ISE	IV&V Simulation Environment
ITAAC	Inspections, tests, analyses, and acceptance criteria
IV&V	independent verification and validation
NON	Notice of Nonconformance
NRC	(U.S.) Nuclear Regulatory Commission
NRO	Office of New Reactors
PLS	Plant Control System
PMS	Protection and Safety Monitoring System
QA	quality assurance
QC	quality control
RITS	Replacement and Automation Services Issue Tracking System
SIT	system integration testing
SMP	Software Management Plan
SR	safety-related
SRNC	Safety Remote Node Controller
SSC	Systems, Structures, and Components
U.S.	United States (of America)
WEC	Westinghouse Electric Company