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Virgil C. Summer Nuclear Station (VCSNS) Units 2 & 3
Combined License Nos. NPF-93 and NPF-94
Docket Nos. 52-027 & 52-028

Subject: VCSNS Units 2 & 3 LAR 13-36: Request for License Amendment: Component Interface Module (CIM) / Diverse Actuation System (DAS) Diversity

References: 1. Southern Nuclear Operating Company Vogtle Electric Generating Plant Units 3 and 4 Request for License Amendment: Component Interface Module (CIM) / Diverse Actuation System (DAS) Diversity (LAR-13-020) Dated March 17, 2014 (Accession Number ML14076A173)

In accordance with 10 CFR 50.90, South Carolina Electric & Gas Company (SCE&G),the Licensee for Virgil C. Summer Nuclear Station Units 2 & 3, requests an amendment to Combined License (COL) Numbers NPF-93 and NPF-94, for VCSNS Units 2 & 3, respectively.

The requested amendment proposes changes to revise the COLs by clarifying the position on design diversity, specifically human diversity, as related to the Component Interface Module (CIM) and Diverse Actuation System (DAS) design. This license amendment request (LAR) seeks approval of a proposed change to Tier 2* reference document WCAP-17179, “AP1000™ Component Interface Module Technical Report,” and changes to the two Tier 2 reference documents, WCAP-17184, “AP1000® Diverse Actuation System Planning and Functional Design Summary Technical Report," and WCAP-15775, “AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report,” that are involved with the revision to the Tier 2* document.

The description, technical evaluation, regulatory evaluation (including the Significant Hazards Consideration determination), and environmental considerations for the proposed changes in this license amendment request are contained in Enclosure 1. Enclosure 2 provides licensing basis markups depicting the requested changes for the VCSNS Units 2 & 3 Updated Final Safety Analysis Report.

This license amendment request is identical in technical content with Reference 1.

SCE&G requests staff approval of this license amendment by March 4, 2016 to support installation of the DAS control cabinets in the Auxiliary Building at Elevation 100'-0". Delayed approval of this license amendment may result in a delay in the installation of these DAS control cabinets and subsequent related activities for VCSNS Unit 2. SCE&G expects to implement the proposed amendment (through incorporation into the licensing basis documents) within 30 days of approval of the requested changes.

In accordance with 10 CFR 50.91, SCE&G is notifying the State of South Carolina of this LAR by transmitting a copy of this letter and its enclosures to the designated state official.

Should you have any questions about this letter, please contact Justin Bouknight, Supervisor, Nuclear Licensing, by telephone at (803) 941-9828, or by email at justin.bouknight@scana.com.

This letter contains no regulatory commitments.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 11th day of September, 2014.

Sincerely,

April R. Rice
Manager, Nuclear Licensing
New Nuclear Deployment

DK/ARR/dk

Enclosure 1: Virgil C. Summer Units 2 & 3 –License Amendment Request: Component Interface Module (CIM) / Diverse Actuation System (DAS) Diversity (LAR 13-36)

Enclosure 2: Proposed Changes to the Updated Final Safety Analysis Report (LAR 13-36)

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South Carolina Electric & Gas Company

Virgil C. Summer Nuclear Station Units 2 & 3

NND-14-0234

Enclosure 1

Request for License Amendment
Component Interface Module (CIM) / Diverse Actuation System (DAS) Diversity
(LAR-13-36)

(26 pages, including this cover page)

Table of Contents

Documentation revision is needed to address the differences that exist between the previous licensing commitments and the results of a review with respect to Component Interface Module (CIM) and Diverse Actuation System (DAS) life-cycle (human) diversity. Complete human diversity was not maintained during the requirements life-cycle phase, simulation testing and fabrication as originally planned.

1. Summary Description

Pursuant to 10 CFR 50.90, South Carolina Electric & Gas Company (SCE&G) requests an amendment to Combined License (COL) Nos. NPF-93 and NPF-94 for Virgil C. Summer Nuclear Station (VCSNS) Units 2 & 3, respectively. The requested amendment proposes changes to revise the Updated Final Safety Analysis Report (UFSAR) by clarifying how human diversity was applied during the design process for the CIM and DAS. This license amendment request (LAR) proposes the addition of Appendix 7A to UFSAR Chapter 7 to modify information related to human diversity, as presented in a Tier 2* document, WCAP-17179, and two Tier 2 documents, WCAP-15775 and WCAP-17184, that are incorporated by reference in the UFSAR.

The proposed addition of UFSAR Appendix 7A, WCAP CHANGES FOR CIM/DAS DIVERSITY LICENSE AMENDMENT, modifies information in UFSAR reference documents, as follows:

- WCAP-17179, “AP1000 Component Interface Module Technical Report,” Revision 2 [ADAMS Accession No. ML102170265] is modified to include changes provided in UFSAR Appendix 7A. (Tier 2*).

- WCAP-17184, “AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," [ADAMS Accession No. ML102170267] is modified to include changes provided in UFSAR Appendix 7A. (Tier 2)

- WCAP-15775, “AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report,” Revision 4 [ADAMS Accession No. ML101530048] is modified to include changes provided in UFSAR Appendix 7A. (Tier 2)

The proposed change to add a new UFSAR Appendix 7A, “WCAP CHANGES FOR CIM/DAS DIVERSITY LICENSE AMENDMENT,” also requires changes to the associated UFSAR references to each of the three WCAPs to refer to the changes and additions in Appendix 7A.

This LAR requests approval of the proposed addition of UFSAR Appendix 7A and the resultant changes to information presented in Tier 2* reference document WCAP-17179, and Tier 2 reference documents, WCAP-17184 and WCAP-15775, as presented in Appendix 7A.

2. Detailed Description and Technical Evaluation

Background

NRC regulatory guidance regarding diversity issues is provided in the Digital Instrumentation and Controls (DI&C) Interim Staff Guidance (ISG) DI&C-ISG-02, Diversity and Defense-in-Depth Issues, Revision 2, June 5, 2009. DI&C-ISG-02 applies to both new nuclear power plants and current operating plants. Typically, licensees/vendors perform a diversity and defense-in-depth (D3) analysis to demonstrate that vulnerabilities to common cause failure (CCF) are adequately addressed. DI&C-ISG-02 defines that NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems," dated December 1994, and Branch Technical Position (BTP) 7-19, "Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems," of NUREG-0800, "Standard Review Plan," describe an acceptable process for performing a D3 analysis.

The purpose of BTP 7-19 is to provide guidance for digital, software-based or software-logic-based Reactor Protection Systems (RPS), which includes the Reactor Trip System (RTS) and Engineered Safety Features Actuation System (ESFAS). Specifically, the BTP provides guidance for the NRC staff's evaluation of applicant diversity and defense-in-depth (D3) assessment, diversity in design and design of manual controls and displays. The guidance is used to confirm conformance with the NRC position on D3 to verify adequate defense-in-depth, adequate diversity, and displays and manual controls for (plant) critical safety functions are diverse from automatic portions of RPS.

BTP 7-19 states that if a postulated CCF could disable a safety function, a diverse means, with a documented basis that the diverse means is unlikely to be subject to the same CCF, should be required to perform either the same function as the safety system function that is vulnerable to CCF or a different function that provides adequate protection. The diverse or different function may be performed by a nonsafety-related system if the system is of sufficient quality to perform the necessary function under the associated event conditions. The Advanced Logic System (ALS) based DAS is the nonsafety-related system that provides the diverse means of protection for AP1000 nuclear power plants when other nonsafety-related systems do not have that same provision.

The DAS complies with the BTP 7-19, Revision 4, Section B.1, Position/points 3 and 4 only. Note that Revision 4 was the version of record when the original AP1000 design certification was obtained on January 23, 2006. Position/point 3 establishes staff review guidance for allowing a DAS to be a nonsafety system if of sufficient quality. Position/point 4 of Section B.1 establishes staff review guidance for a set of diverse and independent manual controls and displays for critical safety functions in the main control room (MCR).

BTP 7-19, Revision 4 was recently revised (Revision 6) to incorporate selected areas of DI&C-ISG-02 as well as Advisory Committee on Reactor Safeguards comments. BTP 7-19, Revision 6, was issued July 2012 and supersedes ISG-02; however, the facility licensing basis pre-dates Revision 6. Therefore, the applicable aspects of DAS design process are in accordance with Regulatory Positions 3 and 4 of BTP 7-19, Revision 4, as identified in WCAP-17184.

BTP 7-19 Revision 5 was issued in anticipation of new advanced light-water reactor (ALWR) design certification applications.

BTP 7-19 Revision 6 is an extensive revision providing specific guidance in addressing a number of stakeholder items as identified in Interim Staff Guidance DI&C-ISG-02, Revision 2, “Diversity and Defense-in-Depth (D3).” BTP 7-19, Revision 6 has not changed any guidance from BTP 7-19 Revision 4 that impacts the human diversity changes identified in this license amendment request. Therefore, the aspects of the DAS design process applicable to the human diversity changes identified in this license amendment request are in accordance with Regulatory Positions 3 and 4 of BTP 7-19, Revision 4, as identified in WCAP-17184, and remain valid through the current revision of BTP 7-19.

The AP1000 nuclear power plant’s DAS would operate in the unlikely event of a postulated software CCF that could disable the Protection and Safety Monitoring System (PMS). The PMS is the reactor protection system for the AP1000 reactor system. The PMS includes the RTS and the ESFAS. 10 CFR 50, Appendix A, General Design Criterion (GDC) 22, “Protection System Independence,” requires that the protection system be designed to assure that the effects of natural phenomena and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function. Design techniques, such as functional diversity or diversity in component design and principles of operation, are integrated into the DAS to prevent loss of the protection function.

The PMS includes a Component Interface Module (CIM) that provides the interface between the PMS ESFAS functions and plant components. The CIM provides for individual plant component control and includes priority logic to arbitrate between safety system ESFAS actuations (both automatic and manual) and nonsafety-related control of safety components. The CIM was developed by CS Innovations based on Microsemi Corporation (formerly Actel Corporation) Field Programmable Gate Arrays (FPGAs). The term “CIM” refers to both the FPGA-based component interface module and its companion FPGA-based safety remote node controller (SRNC).

The level of diversity between CIM and DAS designs meets GDC 22 as demonstrated in UFSAR Subsections 7.7.1.11, 7.2.2.2.2, 7.3.1.5.5, and 7.2.1.2.5. UFSAR Tier 2 document WCAP-15775, “AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report,” encompasses the design diversity criteria defined in NUREG/CR-6303. Chapter 9 of UFSAR Tier 2 document WCAP-17184, “AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," addresses each of NUREG/CR-6303 diversity criteria. Finally, Section 2.9.7 of Tier 2* document WCAP-17179, “AP1000 Component Interface Module Technical Report,” addresses NUREG/CR-6303 diversity criteria in a diversity summary. The licensing basis for design diversity between CIM (PMS) and DAS systems, as described in the UFSAR, is consistent with NUREG/CR-6303. NUREG/CR-6303 describes six important types of diversity to consider; design diversity, equipment diversity, functional diversity, human diversity, signal diversity, and software diversity. Tier 2 reference document WCAP-15775 encompasses the design diversity criteria defined in NUREG\CR-6303, as described in UFSAR subsection 7.7.1.11, Diverse Actuation System. Specifically, WCAP-15775 describes the type of diversity that exists among the four echelons of defense for AP1000 and identifies dependencies among the echelons.

UFSAR subsection 7.2.2.2.2 discusses redundancy of equipment diversity of reactor trip functions. Functional diversity is used in determining the actuation signals for engineered safety features (UFSAR subsection 7.3.1.5.5) and the reactor trips for accident conditions (UFSAR subsection 7.2.1.2.5). The UFSAR descriptions of functional diversity are not intended to be exhaustive, but rather illustrate the licensing basis commitment to NUREG/CR-6303. Furthermore, Chapter 9 of WCAP-17184 addresses each of NUREG/CR-6303 diversity criteria. Finally, WCAP-17179, "AP1000 Component Interface Module Technical Report," addresses NUREG/CR-6303 diversity criteria in a diversity summary in Section 2.9.7 by stating, "By partitioning and assigning design tasks, different designers were used for the CIM and DAS designs. There is no common logic used in the DAS and CIM designs. The designs perform fundamentally different functions, and this provides diversity in signals and functions that are used. There is no common hardware used in the design except for simple, single purpose, passive parts like resistors and capacitors. This includes the use of different FPGAs. Based on all of the elements of diversity, sufficient diversity between the CIM and DAS is provided."

The following is a summary regarding system design process licensing commitments related to CIM-DAS diversity:

- Design Diversity: The design process is valid as originally submitted. The current approach to design diversity adequately meets current licensing commitments.

- Equipment Diversity: The design process is valid as originally submitted. The present status adequately meets current licensing commitments.

- Functional Diversity: The design process is valid as originally submitted. The present status adequately meets current licensing commitments.

- Human Diversity: Changes to design process documentation and the associated licensing documents are required to account for some cases where complete human diversity was not maintained as originally planned. This clarification will not change the CIM or DAS products, but revisions to design process and licensing documentation are required as there are inconsistencies in the design process.

- Signal Diversity: The design process is valid as originally submitted. The present status adequately meets current licensing commitments.

- Software Diversity: The design process is valid as originally submitted. The present status adequately meets current licensing commitments.

The CIM/DAS Design Diversity Criteria with respect to NUREG/CR-6303 are as follows:

1) Design diversity is the use of different approaches, including both software and hardware, to solve the same or similar problem. Factors increasing diversity between two designs meeting the same requirements excluding the effects of human diversity are listed here in decreasing order of effect:

    - Different Technologies - This diversity criterion was not applied (NA) in describing the level of design diversity between the CIM and DAS.

- Different Approach - Same Technology: Fully Diverse

  At the system level, the DAS and CIM perform the same function, which is to provide actuation signals to components; however, there is no common system or sub-system application specific functional logic between the DAS and CIM. As previously noted, the DAS and CIM both use architectures based on FPGA technology. The DAS does not perform field component control logic. The DAS simply generates required actuation signals based on the functional logic required for reactor trip and ESF calculations to protect against design basis accidents. In contrast, the CIM performs priority and actuation logic to field components but does not itself generate the actuation signals to field components. The field component actuation signals are inputs to the CIM.

  Regarding PMS-DAS diversity, there are different functional algorithms between PMS and DAS that are designed to address the same design basis accidents. These different algorithms are implemented using different technologies, i.e., ALS versus Common Qualified Platform (Common Q).

- Different Architecture - Fully Diverse

  The CIM and DAS system architectures are different. The CIM performs priority logic and component control logic; whereas, the DAS reads field inputs, performs system-level functional logic to determine safety actuations, and outputs actuation signals to field components independent of the CIM. This results in different architectures to fulfill the different DAS and CIM functions. In addition, the CIM and DAS have different power supplies and no common hardware except for simple, single purpose, passive parts like resistors and capacitors. Moreover, there are no parts in common between the CIM and DAS on the circuit boards, except for simple components such as resistors and capacitors.

  In addition, the CIM and DAS products design uses different FPGAs produced by the same manufacturer. The CIM uses the ProASICplus device, and the DAS uses the ProASIC3/EL device. Both parts are made by Microsemi Corporation (formerly Actel Corporation), but the parts are different in structure and design. A chip manufacturing line has unique hardware to make a specific geometry of the device. Since two different geometries are used, the same production lines cannot be used.

2) Equipment diversity is the use of different equipment to perform similar safety functions, where the term “different” means sufficiently unlike as to significantly decrease vulnerability to common failure. Factors increasing equipment diversity between two groups or items of equipment are listed here in decreasing order of effect:

   - Different Manufacturers - Different Designs: This diversity criterion was not applied in describing the level of equipment diversity between the CIM and DAS during reactor design certification.

   - Same Manufacturer - Different Designs: Fully Diverse

     As discussed above for the design diversity attributes, the CIM and DAS design uses different FPGAs with different chip geometries produced on different manufacturing

lines. Moreover, there are no parts in common between the CIM and DAS on the circuit boards, except for simple components such as resistors and capacitors.

- Different Manufacturers - Same Design: This diversity criterion was not applied in describing the level of equipment diversity between the CIM and DAS during reactor design certification.

- Same Manufacturer – Different Version: This diversity criterion was not applied in describing the level of equipment diversity between the CIM and DAS during design certification.

3) Functional diversity means two systems are functionally diverse if they perform different physical functions though they may have overlapping safety effects. Factors increasing functional diversity between two independent subsystems are listed here in decreasing order of effect:

   - Different Underlying Mechanisms: Fully Diverse

     The CIM performs priority logic and component control logic by interfacing to other systems (i.e., Ovation and AC160) communication interfaces. There are no field inputs and there is a unique communication bus structure within the CIM architecture. The DAS reads field inputs, executes bistable logic, and sends output commands to field actuators. The DAS backplane communication bus is diverse from the CIM internal bus structure.

   - Different Purpose, Function, Control Logic, or Actuation Means: Fully Diverse

     The CIM performs priority logic and interfaces/controls individual plant components. The DAS performs limited safety function processing and controls plant components through different paths.

     The functional requirements for the DAS are different than the functional requirements for the CIM. At the system level, the DAS and CIM perform the same function, which is to provide actuation signals to components; however, there is no common system or sub-system application specific functional logic between the DAS and CIM. The DAS does not perform field component control logic. The DAS simply generates required actuation signals based on the functional logic required for reactor trip and ESF calculations to protect against design basis accidents. In contrast, the CIM performs priority and actuation logic to field components. Moreover, the CIM only implements priority and actuation logic for field components, but does not itself generate the actuation signals to field components. The field component actuation signals are inputs to the CIM.

   - Different Response-Time Scale: Fully Diverse

     The time response for the CIM function is limited to performing component control only (from AC160 HSL output to output relay), whereas the DAS time response encompasses reading field inputs, performing analog to digital conversion, performing bistable logic and sending outputs to field actuators. The latter time response is a greater time scale than the CIM time response.

4) Human diversity uses separate designers to design functionally diverse safety systems that may reduce the possibility of similar design process errors. Factors increasing the human diversity of the design process in decreasing order of effect are:

   - Different Design Organizations/Companies: This diversity criterion was not applied in describing the level of human diversity between the CIM and DAS during reactor design certification.

   - Different Management Teams within Same Company: This diversity criterion was not applied in describing the level of human diversity between the CIM and DAS during reactor design certification.

   - Different Design/Development Teams (designers, engineers, programmers): Partially Diverse

     Different design teams were used to develop CIM and DAS with exceptions as denoted in the tables below. There was some overlap with designers and engineers where complete human diversity was not maintained at the requirements phase of the CIM and DAS design lifecycles. Complete human diversity was maintained for the CIM and DAS FPGA design and implementation phases for the preparation of design specifications, development of the application logic in the hardware descriptive language, and configuration items for the FPGA chip including simulation, synthesis, and “place and route” tasks.

   - Different Implementation/Validation Teams (testers, installers, or certification personnel): Partially Diverse

     DAS is a nonsafety-related system; however, the DAS FPGA logic is subjected to Independent Verification and Validation (IV&V). The scope of IV&V is described in an IV&V plan in the DAS management plan. DAS documents are independently verified by individuals who were not responsible for the design process and who did not work on CIM.

     Different test teams were used to develop CIM and DAS with exceptions. The FPGA designers use desktop simulation (i.e., informal checking of the logic by the design team) as a part of their overall FPGA design process (diversity maintained), whereas as part of IV&V testing, simulation testing is a formal test function to verify the logic as implemented by the design team was correct (diversity overlaps occurred). There was some overlap in testers and IV&V personnel where complete human diversity was not maintained at the testing phase of the CIM and DAS design lifecycles for simulation testing (testing not on the target platform used to verify the logic to be implemented within the FPGA). As shown in Table 2, complete human diversity was used for black box testing (the testing of a component or system in the target hardware without reference to the internal structure of the component or system) and not for simulation testing.

   NUREG/CR-6303 was the primary document used to establish licensing commitments with respect to CIM/DAS diversity. The application of human diversity credits the use of separate designers to design functionally diverse safety systems as a means to reduce

the possibility of similar design errors. As previously noted, the attributes are directly derived from NUREG/CR-6303.

The licensed human diversity position is shown in Table 1. "P" is used to designate a human diversity atrribute that was only partially diverse between the CIM and the DAS. "NA" designates that the human diversity attribute was not part of the original diversity model and therefore was not applied. CSI and Westinghouse were used for both the CIM and DAS design process life-cycle. In addition, different management teams within Westinghouse were not implemented in regards to the CIM and DAS design process life cycle.

Table 1 - Licensed Human Diversity Position

ID	Life-Cycle Attribute	Fulfillment
A	Different design organizations/companies	NA
B	Different management teams within same company	NA
C	Different design/development teams (designers, engineers, programmers):	P
D	Different implementation/validation teams (testers, installers, or certification personnel):	P

As a result of an evaluation of the Human Diversity status between the CIM and DAS products, this position on Human Diversity was revised to that shown in Table 2. The "P'" used in Table 1 for attributes C and D were decomposed into sub-attributes, C.1/C.2 and D.1/D.2/D.3 in Table 2, to show where complete human diversity was maintained and not maintained. The "F" designates that the human diversity attribute was fully diverse between the CIM and the DAS and "NM" designates that the human diversity attribute was not met as identified in the original diversity model. The revised position was the result of a review of the authors and reviewers of the design documents for each product. In some cases, there were identified overlaps where common personnel served as an author and/or reviewer on both CIM and DAS product design documents. It is noted that the use of common authors and reviewers was used as the criteria for evaluating human diversity as both these roles can have an impact on the development of a work product. A conservative approach was taken that only identifies that human diversity was maintained for a given attribute if no overlaps occurred. No credit is taken for a partial fulfillment of human diversity. Human diversity was fully diverse for the CIM and DAS FPGA logic design teams and related testing teams for black box testing. However, complete human diverisity was not maintained for requirements generation, simulation testing, and verification activities. It is noted that IV&V for CIM and DAS is independent from the associated design activities.

Table 2 - Modified Human Diversity Position		
ID	**Life-Cycle Attribute**	**Fulfillment**
A	Different design organizations/companies	NA
B	Different management teams within same company	NA
C.1	Different design requirements/development teams for requirements generation (designers and engineers)	NM
C.2	Different FPGA logic designers/development teams for FPGA design and implementation activities (designers, engineers, programmers)	F
D.1	Different independent design verification teams (requirements and implementation document reviews)	NM
D.2	Different test teams for black box testing (test procedures, test cases, test execution and test reporting)	F
D.3	Different test teams for simulation testing (test procedures, test cases, test execution and test reporting)	NM

5) Signal diversity is the use of different sensed parameters to initiate protective action. Factors increasing signal diversity between two signal sources are listed here in decreasing order of effect:

- Different Parameters Sensed by Different Physical Effects: Fully Diverse

  From a component level diversity point of view the CIM is sensing digital logic from the Ovation control system and the AC160 protection system whereas the DAS is reading field signals. The only similarity is that both CIM and DAS interface to field actuators on the output.

- Different Parameters Sensed by Same Physical Effects: Fully Diverse

  Because of the diverse parameters sensed between CIM and DAS as described above, CIM and DAS are inherently diverse from the point of view of different parameters sensing the same physical effects.

- Same Parameter Sensed by a Different Redundant Set of Similar Sensors: Fully Diverse

  There is no sharing of input signals between PMS and DAS. Both read core exit thermocouple (CET) sensors; however, PMS has its own set of dedicated CET sensors and DAS has a different set of dedicated CET sensors. The emphasis relative to this factor is with respect to CIM and DAS diversity from a component perspective. CIM does not read any field process sensor inputs; however, CIM does receive status feedback from actuated components.

6) Software diversity is the use of different programs designed and implemented by different development groups with different key personnel to accomplish the same safety goals. Factors increasing diversity between software designs meeting the same requirements, excluding the effects of human diversity, are listed here in decreasing order of effect:

- Different Algorithms, Logic and Program Architecture: Fully Diverse

  The CIM executes single component control logic algorithms, priority logic algorithms, and unique communication protocols and therefore the FPGA logic architecture is different from the DAS that executes safety bistable logic, analog-to-digital conversion and logic output signals to field actuators.

  Regarding software diversity for maintenance and test systems; PMS uses the Common Q Personal Computer (PC) Node Box and Flat Panel Display Screen System and DAS uses an industrial PC from Core Systems (a third party vendor), respectively. For these maintenance and test systems, the PMS uses the QNX operating system, QSSL Photon Display tool and the C programming language and DAS uses the Windows operating system and the Java programming language.

  Process indication is implemented in DAS via dedicated numerical readout meters which are only used in the DAS product. The CIM and SRNC modules have no displays other than LED status indicators.

  Both the CIM and DAS design process use software from Actel for the generation of FPGA-compatible functional logic and the associated mapping needed to configure FPGA internal elements per the resulting functional logic. However, the tool uses two unique libraries for the different FPGA models used by the CIM and the DAS. As a result, the output of the software tool used to implement the FPGA is device specific. The output of the software tool is different for the CIM versus the DAS because different FPGAs are used. However, no credit is taken for software tool diversity in the overall CIM DAS diversity model.

- Different Timing or Order of Execution: Fully Diverse

  This criterion assumes similar logic algorithms but executed in a different order and with different timing. Because the algorithms and program architecture are different as described above, the diverse timing and order attribute is fulfilled.

- Different Runtime Environment: This diversity criterion was not applied in describing the level of software diversity between the CIM and DAS during reactor design certification.

- Different Functional Representation: Fully Diverse

  As described above the component control logic, priority logic and unique communication protocols are inherently a diverse functional representation from the DAS bistable logic and analog-to-digital conversion logic.

The CIM performs priority logic and interfaces with/controls individual plant components. The DAS performs limited safety function processing and controls plant components through different paths.

The functional requirements for the DAS are different than the functional requirements for the CIM. At the system level, the DAS and CIM perform the same function, which is to provide actuation signals to components; however, there is no common system or sub-system application specific functional logic between the DAS and CIM. The DAS does not perform field component control logic. The DAS simply generates required actuation signals based on the functional logic required for reactor trip and ESF calculations to protect against design basis accidents. In contrast, the CIM performs priority and actuation logic to field components but does not itself generate the actuation signals to field components. The field component actuation signals are inputs to the CIM.

In addition, an independent review of requirements and testing phase documents was conducted by industry experts outside of the Westinghouse organization to develop an independent opinion concerning human diversity as applied to the document sets. It was the opinion of the independent review team that the requirements and testing phase documents will support the reduction of the likelihood of CCF modes for CIM and DAS (i.e., no fatal flaws). Even though complete human diversity was not maintained during their development and issuance, the resulting CIM and DAS products are still functionally diverse.

Because only partial human diversity was realized in the development, review, and issuance of these documents, no credit for human diversity was taken for these documents.

The review team found there were no undue influences on functional diversity in the documents that were reviewed, including requirements, design, and testing documents. Common functions such as power up, power down, actuation methods, and internal communications were evaluated.

NUREG/CR-7007 Analysis

In February 2010, the NRC published the results of additional research in NUREG/CR-7007, “Diversity Strategies for Nuclear Power Plant Instrumentation and Control Systems.” The research described in this report provides guidance to the staff and nuclear industry after a licensee or applicant has performed a diversity and defense-in-depth assessment per NUREG/CR-6303 and determined that diversity in a safety system is needed for mitigating the consequences of potential CCFs identified in the evaluation of the safety system design features. Succinctly, the purpose of the research described in this report was to answer the question, "If diversity is required in a safety system to mitigate the consequences of potential CCFs, how much diversity is enough?" NUREG/CR-7007 was used by Westinghouse to perform a confirmatory review only. The review’s goal was to achieve some level of assurance that sufficient diversity between the PMS/CIM and DAS systems was in place based on NRC endorsed NUREG/CR-6303 criteria to ensure that the CCFs cannot adversely affect the safety of both systems concurrently.

The methodology used by Westinghouse evaluated the diversity as a whole. In evaluating all diversity aspects of the CIM and DAS using the NUREG/CR 7007 evaluation worksheet,

the normalized diversity score for the CIM/DAS comparison was above the nominal value considered adequate for an acceptable level of diversity. This result was used by Westinghouse as a confirmatory check only of Westinghouse diversity position developed based on the regulatory guidance in NUREG/CR-6303.

Overview

Diversity is designed into the CIM and DAS systems products based on NUREG/CR-6303. The I&C design has a specific combination of diversity attributes and associated attribute criteria that meet the regulatory required level for reducing the risk and resulting consequences of unmitigated CCFs in the PMS. The approach to diversity is addressed in an internal and third party review that evaluated implementation of licensing commitments. The diversity attributes for the DAS and the PMS/CIM were reviewed to establish a clarified position that this diversity provides credible defense against a postulated CCF of the PMS and to identify the necessary actions to achieve and sustain this level of diversity. Based on the internal and third party review, it is concluded that sufficient diversity exists between the PMS/CIM and DAS systems such that the same CCF cannot adversely affect the safety of both systems concurrently. That is, the PMS, CIM and DAS are all subject to CCF, but not to the same CCF and not at the same time.

As a result the internal and third party review, a clarified position has been developed based on the regulatory guidance in NUREG/CR-6303. Although the review of the diversity attributes shows sufficient diversity exists between the CIM and DAS products, it also identified some cases where human diversity was not maintained as originally planned. As such, revisions to information presented in WCAP-17179 (Tier 2*), WCAP-17184 (Tier 2), and WCAP-15775 (Tier 2) are required to clarify the actual design process used to implement the CIM and DAS functions. This clarified position does not change the CIM or DAS products, but instead requires revisions to supporting design process documentation. This position identifies a specific combination of diversity attributes and associated attribute criteria that provides reasonable assurance of sufficient diversity as a means of reducing the risk and resulting consequences of unmitigated CCFs in the PMS.

No safety concerns are identified by this overall diversity analysis. No equipment is impacted. The CIM and the DAS products have not changed and still comply with regulatory requirements and guidance. However, some design process documentation (WCAP-17179, WCAP-17184, and WCAP-15775) regarding human diversity was not maintained as originally planned.

The clarified design process position on human diversity is unrelated to any aspects of plant construction or operation that would introduce any changes to effluent types (e.g., effluents containing chemicals or biocides, sanitary system effluents, and other effluents) or affect any plant radiological or non-radiological effluent release quantities. Furthermore, these changes do not diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation.

This clarification of the design process used for the CIM and DAS does not affect the design, construction, or operation of any equipment that provides a fission product barrier. The proposed changes do not affect any structural aspects of the plant design; accordingly there are no changes to any aspects of the plant design that provide radiological shielding to

plant workers. Plant radiation zones are not affected, nor are there any changes to the controls required under 10 CFR Part 20 that preclude a significant increase in occupational radiation exposure.

Therefore, it is concluded that the level of diversity in the design process is acceptable.

UFSAR Changes

The changes to the UFSAR are based on a review of the elements of design diversity previously discussed for CIM/DAS resulting in a need for change in documentation.

1. The following UFSAR changes are proposed to cite the licensed revisions of WCAP-17179, "AP1000 Component Interface Module Technical Report," WCAP-17184, "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," and WCAP-15775, AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report," with changes noted in UFSAR Appendix 7A. The use of green underline font indicates new text.

   - In Table 1.6-1, Material Referenced, change the information in the Title cell for Westinghouse Topical Report Number WCAP-15775, under DCD Section Number 7.1, from:

     AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report

     To read:

     AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report (as modified by changes provided in UFSAR Appendix 7A)

   - In Table 1.6-1, Material Referenced, change the information in the Title cell for Westinghouse Topical Report Number "[*WCAP-17179-P* [and] *WCAP-17179-NP*," under DCD Section Number 7.1, from:

     AP1000 Component Interface Module Technical Report]*

     To read:

     AP1000 Component Interface Module Technical Report (as modified by changes provided in UFSAR Appendix 7A)]*

   - In Table 1.6-1, Material Referenced, change the information in the Title cell for Westinghouse Topical Report Number WCAP-17184-P (P), under DCD Section Number 7.1, from:

     AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report

     To read:

AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report (as modified by changes provided in UFSAR Appendix 7A)

- In Table 1.6-1, Material Referenced, change the information in the Title cell for Westinghouse Topical Report Number WCAP-17184-P, under DCD Section Number 7.7, from:

  AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report

  To read:

  AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report (as modified by changes provided in UFSAR Appendix 7A)

- Section 7.1.7, References, is changed from:

  24. [*WCAP-17179-P (Proprietary) and WCAP-17179-NP (Non-Proprietary), "AP1000 Component Interface Module Technical Report," Revision 2*.]*

  To read:

  24. [*WCAP-17179-P (Proprietary) and WCAP-17179-NP (Non-Proprietary), "AP1000 Component Interface Module Technical Report," Revision 2 (as modified by changes provided in UFSAR Appendix 7A)*.]*

2. Chapter 7, Instrumentation and Controls, is revised by incorporating a new Appendix 7A, WCAP CHANGES FOR CIM/DAS DIVERSITY LICENSE AMENDMENT, at the end of the current Chapter 7. UFSAR Appendix 7A is entirely new and presents changes to information in the three WCAPs; therefore, to minimize the potential for misinterpretation, the revised WCAP text extracts in UFSAR Appendix 7A are depicted in black font only, with deleted WCAP text shown as lined out and added WCAP text shown as underlined, as follows:

APPENDIX 7A WCAP CHANGES FOR CIM/DAS DIVERSITY LICENSE AMENDMENT

Note: Revised text within the WCAPs is identified in this appendix with strikethrough font for deleted text, underlined font for new text, and three asterisks (* * *) where text is omitted for clarity.

WCAP-15775, AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report

The UFSAR incorporates by reference Tier 2 document WCAP-15775, AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report. See Table 1.6-1. WCAP-15775, Revision 4, includes the following revisions and additions as indicated by strikethroughs and underlines

- Revise the LIST OF ACRONYMS AND ABBREVIATIONS as follows:

* * *

ALS Advanced Logic System

* * *

CIM Component Interface Module

* * *

FPGA Field Programmable Gate Array

- Revise Section 4.2, Determining Diversity – Guideline 2, under diversity aspect number 4, Human Diversity, as follows:

The design, verification, and validation programs for instrumentation and control systems, as described in described in WCAP-13383 (Reference 3) and CE-CES-195 (Reference 4), require and specify the use of independent review. ~~It is a requirement of the DAS that different people will be responsible for its design and fabrication, including verification and validation.~~ At the system level, different design and IV&V teams are used on the DAS and PMS systems.

The AP1000 Component Interface Module (CIM), provides the priority logic between PMS and plant control for component control. The AP1000 CIM Technical Report (Reference 9), identifies how diversity is maintained between the ALS-based DAS and the CIM.

The functionality of the CIM and DAS are different, and this reduces the chances that a common cause failure can be made in both designs. The FPGA Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse with respect to the following lifecycle activities:

- Design Activities (i.e., different FPGA logic design teams for activities such as the preparation of design specifications and development of the application logic in the hardware descriptive language)

- Implementation Activities (i.e., different FPGA logic design teams for activities required to physically program the FPGA chip such as simulation, synthesis and "place and route" tasks)
- Black Box Test Activities (i.e., different IV&V test teams).

Black Box Testing is the testing of a component or system in the target hardware without reference to the internal structure of the component or system. Testing focuses solely on the outputs generated in response to selected inputs and execution conditions.

- Revise Section 6, References, by adding Reference 9, as follows:

9. WCAP-17179, "AP1000 Component Interface Module Technical Report"

[*WCAP-17179-P and WCAP-17179-NP, AP1000™ Component Interface Module Technical Report*]

The UFSAR incorporates by reference Tier 2 document WCAP-17179-P and WCAP-17179-NP, AP1000™ Component Interface Module Technical Report. See Table 1.6-1. WCAP-17179-P and WCAP-17179-NP, Revision 2, include the following revisions and additions as indicated by strikethroughs and underlines.*

- *Revise the DEFINITIONS as follows:*

Black Box Testing The testing of a component or system in the target hardware without reference to the internal structure of the component or system. Testing focuses solely on the outputs generated in response to selected inputs and execution conditions.

- *Revise Section 2.9.4, Human Diversity, as follows:*

The purpose of human diversity is to reduce the chance of common errors in similar designs. ~~[~~The functionality of the CIM and DAS are not similar, and this reduces the chances that a common error can be made in both designs. ~~For any functionality that is similar between the two designs, different designers were used for the CIM and DAS designs. In addition the different design teams and different test teams will be used to test the CIM and DAS designs.]~~[a,c] The FPGA Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse with respect to the following lifecycle activities:

- *Design Activities (i.e., different FPGA logic design teams for activities such as the preparation of design specifications and development of the application logic in the hardware descriptive language)*

- *Implementation Activities (i.e., different FPGA logic design teams for activities required to physically program the FPGA chip such as simulation, synthesis and "place and route" tasks)*

- *Black Box Test Activities (i.e., different IV&V test teams).*]*

WCAP-17184-P, AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report

The UFSAR incorporates by reference Tier 2 document WCAP-17184-P, AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report. See Table 1.6-1. WCAP-17184-P, Revision 2, includes the following revisions and additions as indicated by strikethroughs and underlines.

- Revise the DEFINITIONS section as follows:

  Black Box Testing

  The testing of a component or system in the target hardware without reference to the internal structure of the component or system. Testing focuses solely on the outputs generated in response to selected inputs and execution conditions.

- Revise Section 9.4, HUMAN DIVERSITY as follows:

  The design, verification, and validation programs for I&C systems, ~~[~~as described in WNA-PN-00056-WAPP, "NuStart/DOE Design Finalization Diverse Actuation System Project Plan" (Reference 14)~~]~~[a,c] and the DAS Design Process (Reference 15), require and specify the use of independent review. At the system level, different design and IV&V teams are used on the DAS and PMS systems. ~~It is a requirement of the DAS that different people (personnel not assigned to safety system engineering) will be responsible for its design and fabrication.~~

  ~~[~~The AP1000 Component Interface Module (CIM)~~, which~~ provides the priority logic between PMS and plant control for component control~~, is also provided by CS Innovations~~. The AP1000 CIM Technical Report (Reference 20), identifies how diversity is maintained between the ALS-based DAS and the CIM.~~]~~[a,c]

  The functionality of the CIM and DAS are different, and this reduces the chances that a common cause failure can be made in both designs. The FPGA Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse with respect to the following lifecycle activities:

  - Design Activities (i.e., different FPGA logic design teams for activities such as the preparation of design specifications and development of the application logic in the hardware descriptive language)
  - Implementation Activities (i.e., different FPGA logic design teams for activities required to physically program the FPGA chip such as simulation, synthesis and "place and route" tasks)

- Black Box Test Activities (i.e., different IV&V test teams)

The above changes are made to clarify the position in the area of human diversity. These changes are needed to address human diversity in Tier 2* and related Tier 2 documentation, because the human diversity aspects presented in some design process documentation did not align with the licensing commitments. WCAP-17179 is added to WCAP-15775 as a reference to link the application of human diversity to the CIM design process.

The addition of the term "Black Box Testing" is for the clarified position on Human Diversity. The change in the description of human diversity characteristics reflects the clarified position on human diversity in the area of design process and implementation activities for the field programmable gate array technology. This is intended to illustrate human diversity regarding logic design teams and independent verification and validation teams for Black Box Testing activities. These are the specific activities where human diversity was maintained. Human diversity was not maintained during the requirements life cycle phase, simulation testing and fabrication.

Based on internal and third party review, it was determined that there were no undue influences on functional diversity in the documents that were reviewed, including requirements, design, and testing documents. Although human diversity was not maintained during their development and issuance, the resulting CIM and DAS products remain functionally diverse. Furthermore, although human diversity during fabrication and assembly was not maintained, manufacturing contribution to the overall diversity argument is considered minimal.

3. Technical Evaluation (Incorporated within Section 2 above)

4. Regulatory Evaluation

4.1 Applicable Regulatory Requirements/Criteria

The following regulations and design criteria in 10 CFR Part 50 are applicable in whole or in part for general review of the suitability of design diversity as described in WCAP-17179, WCAP-17184, and WCAP-15775:

- 10 CFR Part 52, Appendix D, VIII.B.6 requires prior NRC approval for departure from Tier 2* information. The proposed changes to the design process for human diversity require changes to information presented in WCAP-17179, which is referenced in the UFSAR as a Tier 2* document. Therefore, a license amendment request (LAR) (as supplied herein) is required.

- 10 CFR 52, Appendix D, Section VIII.B.5.a allows an applicant or licensee who references this appendix to depart from Tier 2 information, without prior NRC approval, unless the proposed departure involves a change to or departure from

Tier 1 information, Tier 2* information, or the Technical Specifications, or requires a license amendment under paragraphs B.5.b or B.5.c of the section. The proposed changes to information presented in Tier 2 documents, WCAP-17184 and WCAP-15775, involves a change to plant-specific Tier 2* information, and thus requires prior NRC approval for the involved Tier 2 departures.

- 10 CFR 50, Appendix A, General Design Criterion (GDC) 22, "Protection System Independence," requires that the protection system shall be designed to assure that the effects of natural phenomena, and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function, or shall be demonstrated to be acceptable on some other defined basis. Design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function.

  The proposed changes clarify design process documentation and the associated licensing documents required to account for some cases where human diversity was not maintained as originally planned. This clarification will not change the CIM or DAS products but revisions to design process and licensing documentation are required as there are inconsistencies in the design process as identified in the WCAP-17179, a Tier 2* document. In addition, a clarification is made to use more precise wording to describe that DAS uses no operating system or executable software loops for its control functions (i.e. DAS uses no software for its control functions), but software-based tools are used to configure and test the DAS platform. These software tools are unique and diverse as compared to PMS software. Nonetheless, the CIM/DAS system remains in compliance with GDC 22.

- 10 CFR 50.55a(a)(1), "Quality Standards for Systems Important to Safety," requires that "Structures, systems, and components must be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed." Digital Instrumentation and Controls Interim Staff Guidance, DI&C-ISG-02, Diversity and Defense-in-Depth Issues, Revision 2, June 5, 2009, applies to both new nuclear power plants and current operating plants. DI&C-ISG-02 defines that NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems," dated December 1994 and Branch Technical Position (BTP) 7-19, "Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems," of NUREG-0800, "Standard Review Plan," describe an acceptable process for performing a D3 analysis. The CIM and DAS products meet the requirements of BTP-7-19 and NUREG\CR-6303 as demonstrated in this LAR. Therefore, the CIM and DAS products comply with 10 CFR 50.55a(a)(1).

The changes reflect the clarified description on design diversity in accordance with NUREG/CR-6303 in the area of Human Diversity.

4.2 Precedent

None

4.3 No Significant Hazards Consideration Determination

South Carolina Electric & Gas Company (SCE&G) is requesting an amendment to Combined License (COL) Nos. NPF-93 and NPF-94 for Virgil C. Summer Nuclear Station (VCSNS) Units 2 & 3, respectively. The requested amendment proposes changes to revise the COLs by clarifying how human diversity was applied during the design process for the Component Interface Module (CIM) and the Diverse Actuation System (DAS). The CIM/DAS clarified diversity position is addressed in an analysis based on the regulatory guidance in NUREG/CR-6303. In addition, a clarification is made to use more precise wording to describe that DAS uses no operating system or executable software loops for its control functions (i.e. DAS uses no software for its control functions), but software-based tools are used to configure and test the DAS platform. These software tools are unique and diverse as compared to PMS software. There is no physical change to the plant itself.

The requested amendment reflects proposed changes to the Updated Final Safety Analysis Report (UFSAR) that would revise information presented in a Tier 2* reference, WCAP-17179, “AP1000 Component Interface Module Technical Report.” Proposed change to information presented in Tier 2* reference WCAP-17179 also involves changes to information presented in two other Tier 2 documents WCAP-17184, “AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," and WCAP-15775, “AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report,” in support of the change to the updated position on human diversity.

This license amendment request seeks approval of the proposed changes to the UFSAR that affect the information in Tier 2* reference document WCAP-17179 and associated information in two Tier 2 reference documents, WCAP-17184 and WCAP-15775.

An evaluation to determine whether or not a significant hazards consideration is involved with the proposed amendment was completed by focusing on the three standards set forth in 10 CFR 50.92, “Issuance of Amendment,” as discussed below:

4.3.1 Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The requested amendment proposes changes to licensing basis documents to clarify the position on the human diversity aspects of design diversity as related to the Component Interface Module (CIM) and Diverse Actuation System (DAS) design processes. A review confirmed that the clarified position on human diversity would not change the CIM or DAS design. The requested changes to information presented in the Tier 2* and Tier 2 supporting documentation clarify the level of human diversity applied. The change continues to comply with the regulatory guidance in NUREG/CR-6303 regarding credible defenses against a postulated Common Cause Failure (CCF) of the Plant Monitoring and Safety System. The proposed change does not affect the plant itself. The change does

not affect prevention and mitigation of abnormal events, e.g., accidents, anticipated operational occurrences, earthquakes, floods and turbine missiles, or their safety or design analyses. No safety-related structure, system, or component (SSC) or function is adversely affected. The change does not involve nor interface with any SSC accident initiator or initiating sequence of events, and thus, the probabilities of the accidents evaluated in the Updated Final Safety Analysis Report (UFSAR) are not affected. This activity will not allow for a new fission product release path, nor will it result in a new fission product barrier failure mode, nor create a new sequence of events that would result in significant fuel cladding failures. Because the proposed changes do not change any safety-related SSC or function credited in the mitigation of an accident, the consequences of the accidents evaluated in the UFSAR are not affected.

Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

4.3.2 Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

The proposed changes clarify the position on human diversity and show that the CIM/DAS diversity meets the regulatory guidance in NUREG/CR-6303. The clarified descriptions do not affect the plant itself. Therefore, the proposed changes do not affect any safety-related equipment itself, nor do they affect equipment whose failure could initiate an accident or a failure of a fission product barrier. No analysis is adversely affected by the proposed changes. No system or design function or equipment qualification would be adversely affected by the proposed changes. Furthermore, the proposed changes do not result in a new failure mode, malfunction or sequence of events that could affect safety or safety-related equipment.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident than any accident previously evaluated.

4.3.3 Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No

The proposed changes to information presented in referenced licensing basis documents clarify the position regarding human diversity and do not affect the plant itself. The proposed changes do not adversely affect the design, construction, or operation of any plant SSCs, including any equipment whose failure could initiate an accident or a failure of a fission product barrier. No analysis is adversely affected by the proposed changes. Furthermore, no system function, design function, or equipment qualification will be adversely affected by the changes.

Therefore, the proposed amendment does not result in a significant reduction in a margin of safety.

Based on the above, it is concluded that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.4 Conclusions

Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public. The above evaluations demonstrate that the proposed changes can be accommodated without an increase in the probability or consequences of an accident previously evaluated, without creating the possibility of a new or different kind of accident from any accident previously evaluated, and without a significant reduction in a margin of safety. Having arrived at negative declarations with regard to the criteria of 10 CFR 50.92, this assessment determined that the proposed change does not involve a Significant Hazards Consideration.

5. Environmental Consideration

South Carolina Electric & Gas Company (SCE&G) is requesting an amendment to Combined License (COL) Nos. NPF-93 and NPF-94 for Virgil C. Summer Nuclear Station (VCSNS) Units 2 & 3. The requested amendment proposes changes to revise the COLs by clarifying how human diversity was applied during the design process for the Component Interface Module (CIM) and the Diverse Actuation System (DAS). The CIM/DAS clarified diversity position is addressed in an evaluation based on the regulatory guidance in NUREG/CR-6303. There is no physical change to the plant itself.

The requested amendment proposes to add an appendix to the UFSAR that changes information presented in Tier 2* reference document, WCAP-17179, "AP1000 Component Interface Module Technical Report," and two associated Tier 2 documents that are incorporated by reference in the UFSAR, WCAP-17184, "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," and WCAP-15775, "AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report," to address the updated position on human diversity.

This LAR requests approval of the proposed addition of UFSAR Appendix 7A, which changes information presented in Tier 2* reference document WCAP-17179, and the two Tier 2 reference documents, WCAP-17184 and WCAP-15775.

The proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9), in that:

(i) There is no significant hazards consideration.

As documented in Section 4.3, No Significant Hazards Consideration, of this license amendment request, an evaluation was completed to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment." As discussed in Section 4.3 above, the clarified description on human diversity will not change the CIM or DAS design. The associated changes to information presented in WCAP-17179, WCAP-17184, and WCAP-15775 does not affect the plant itself. The No Significant Hazards Consideration determined that (1) the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated; (2) the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated; and (3) the proposed amendment does not involve a significant reduction in a margin of safety. Therefore, it is concluded that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of "no significant hazards consideration" is justified.

(ii) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

The proposed amendment to clarify the position on human diversity would not change the CIM or DAS products. Nor would the associated changes to information presented in WCAP-17179, WCAP-17184, and WCAP-15775 affect the design or construction of the plant itself. The proposed changes add information to these three licensing basis documents (WCAP-17179, WCAP-17184 and WCAP-15775) to support the clarified position on human diversity. The clarified description on human diversity is unrelated to any aspects of plant construction or operation that would introduce any changes to effluent types (e.g., effluents containing chemicals or biocides, sanitary system effluents, and other effluents) or affect any plant radiological or non-radiological effluent release quantities. Furthermore, these changes do not diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation. Therefore, the proposed amendment does not involve a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure.

The proposed amendment provides the clarified position on human diversity regarding the design process used to develop the CIM and DAS products. These proposed changes do not adversely affect the design, construction, or operation of any plant SSCs, including any equipment that provides a fission product barrier. The proposed changes do not affect any structural aspects of the plant design, accordingly there are no changes to any aspects of the plant design that provide radiological shielding to plant workers. Plant radiation zones are not affected, nor are there any changes to the controls required under 10 CFR Part 20 that preclude a significant increase in occupational radiation exposure. Consequently, the proposed changes have no effect on individual or cumulative occupational radiation exposure during plant operation. Therefore, the proposed amendment does not involve a significant increase in individual or cumulative occupational radiation exposure.

Based on the above review of the proposed amendment, it has been determined that there are no anticipated construction and operational effects of the proposed amendment involving (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment of the proposed amendment is not required.

6. REFERENCES

None

South Carolina Electric & Gas Company

Virgil C. Summer Nuclear Station Units 2 & 3

NND-14-0234

Enclosure 2

Proposed Changes to the Updated Final Safety Analysis Report

(LAR 13-36)

Insertions are shown as blue font, with underlined text for deletions by strike-through text for deletions.

(6 pages, including this cover page)

UFSAR Chapter 1, Introduction and General Description of the Plant, Section 1.6, Table 1.6-1, Material Referenced:

1. **Revise Tier 2 information in the Title cell for Westinghouse Topical Report Number WCAP-15775, under DCD Section Number 7.1, as follows:**

DCD Section Number	Westinghouse Topical Report Number	Title
* * *		
7.1	WCAP-15775	AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report (as modified by changes provided in UFSAR Appendix 7A)
* * *		

2. **Revise Tier 2* information in the Title cell for Westinghouse Topical Report Number "[*WCAP-17179-P* [and] *WCAP-17179-NP*," under DCD Section Number 7.1, as follows:**

DCD Section Number	Westinghouse Topical Report Number	Title
* * *		
7.1	[*WCAP-17179-P* *WCAP-17179-NP*	*AP1000 Component Interface Module Technical Report (as modified by changes provided in UFSAR Appendix 7A)*]*
* * *		

3. **Revise Tier 2* information in the Title cell for Westinghouse Topical Report Number WCAP-17184-P (P), under DCD Section Number 7.1, as follows:**

DCD Section Number	Westinghouse Topical Report Number	Title
* * *		
7.1	WCAP-17184-P (P)	AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report (as modified by changes provided in UFSAR Appendix 7A)
* * *		

4. Revise Tier 2* information in the Title cell for Westinghouse Topical Report Number WCAP-17184-P, under DCD Section Number 7.7, as follows:

DCD Section Number	Westinghouse Topical Report Number	Title
* * *		
7.7	WCAP-17184-P	AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report (as modified by changes provided in UFSAR Appendix 7A)
* * *		

5. UFSAR Chapter 7, Instrumentation and Controls, Subsection 7.1.7, References – Revise Tier 2* information by changing the revision number of Reference 24, to read:

24. [*WCAP-17179-P (Proprietary) and WCAP-17179-NP (Non-Proprietary), "AP1000 Component Interface Module Technical Report," Revision 2 (as modified by changes provided in UFSAR Appendix 7A).*]*

6. Chapter 7, Instrumentation and Controls, is revised by incorporating a new Appendix 7A, WCAP CHANGES FOR CIM/DAS DIVERSITY LICENSE AMENDMENT, at the end of the current Chapter 7, as shown on the following pages:

APPENDIX 7A WCAP CHANGES FOR CIM/DAS DIVERSITY LICENSE AMENDMENT

Note: Revised text within the WCAPs is identified in this appendix with strikethrough font for deleted text, underlined font for new text, and three asterisks (* * *) where text is omitted for clarity.

WCAP-15775, AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report

The UFSAR incorporates by reference Tier 2 document WCAP-15775, AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report. See Table 1.6-1. WCAP-15775, Revision 4, includes the following revisions and additions as indicated by strikethroughs and underlines.

- Revise the LIST OF ACRONYMS AND ABBREVIATIONS as follows:

* * *

ALS Advanced Logic System

* * *

CIM Component Interface Module

* * *

FPGA Field Programmable Gate Array

- Revise Section 4.2, Determining Diversity – Guideline 2, under diversity aspect number 4, Human Diversity, as follows:

The design, verification, and validation programs for instrumentation and control systems, as described in described in WCAP-13383 (Reference 3) and CE-CES-195 (Reference 4), require and specify the use of independent review. ~~It is a requirement of the DAS that different people will be responsible for its design and fabrication, including verification and validation.~~ At the system level, different design and IV&V teams are used on the DAS and PMS systems.

The AP1000 Component Interface Module (CIM), provides the priority logic between PMS and plant control for component control. The AP1000 CIM Technical Report (Reference 9), identifies how diversity is maintained between the ALS-based DAS and the CIM.

The functionality of the CIM and DAS are different, and this reduces the chances that a common cause failure can be made in both designs. The FPGA Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse with respect to the following lifecycle activities:

- Design Activities (i.e., different FPGA logic design teams for activities such as the preparation of design specifications and development of the application logic in the hardware descriptive language)
- Implementation Activities (i.e., different FPGA logic design teams for activities required to physically program the FPGA chip such as simulation, synthesis and “place and route” tasks)

- Black Box Test Activities (i.e., different IV&V test teams).

  Black Box Testing is the testing of a component or system in the target hardware without reference to the internal structure of the component or system. Testing focuses solely on the outputs generated in response to selected inputs and execution conditions.

- Revise Section 6, References, by adding Reference 9, as follows:

  9. WCAP-17179, "AP1000 Component Interface Module Technical Report"

[*WCAP-17179-P and WCAP-17179-NP, AP1000™ Component Interface Module Technical Report*

The UFSAR incorporates by reference Tier 2 document WCAP-17179-P and WCAP-17179-NP, AP1000™ Component Interface Module Technical Report. See Table 1.6-1. WCAP-17179-P and WCAP-17179-NP, Revision 2, include the following revisions and additions as indicated by strikethroughs and underlines.*

- *Revise the DEFINITIONS as follows:*

  Black Box Testing The testing of a component or system in the target hardware without reference to the internal structure of the component or system. Testing focuses solely on the outputs generated in response to selected inputs and execution conditions.

- *Revise Section 2.9.4, Human Diversity, as follows:*

  The purpose of human diversity is to reduce the chance of common errors in similar designs. [The functionality of the CIM and DAS are not similar, and this reduces the chances that a common error can be made in both designs. ~~For any functionality that is similar between the two designs, different designers were used for the CIM and DAS designs. In addition the different design teams and different test teams will be used to test the CIM and DAS designs.~~][a,c] *The FPGA Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse with respect to the following lifecycle activities:*

  - *Design Activities (i.e., different FPGA logic design teams for activities such as the preparation of design specifications and development of the application logic in the hardware descriptive language)*
  - *Implementation Activities (i.e., different FPGA logic design teams for activities required to physically program the FPGA chip such as simulation, synthesis and "place and route" tasks)*
  - *Black Box Test Activities (i.e., different IV&V test teams).*]*

WCAP-17184-P, AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report

The UFSAR incorporates by reference Tier 2 document WCAP-17184-P, AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report. See Table 1.6-1. WCAP-17184-P, Revision 2, includes the following revisions and additions as indicated by strikethroughs and underlines.

- Revise the DEFINITIONS section as follows:

  Black Box Testing

  The testing of a component or system in the target hardware without reference to the internal structure of the component or system. Testing focuses solely on the outputs generated in response to selected inputs and execution conditions.

- Revise Section 9.4, HUMAN DIVERSITY as follows:

  The design, verification, and validation programs for I&C systems, ~~[~~as described in WNA-PN-00056-WAPP, "NuStart/DOE Design Finalization Diverse Actuation System Project Plan" (Reference 14)~~]~~[a,c] and the DAS Design Process (Reference 15), require and specify the use of independent review. At the system level, different design and IV&V teams are used on the DAS and PMS systems. ~~It is a requirement of the DAS that different people (personnel not assigned to safety system engineering) will be responsible for its design and fabrication.~~

  ~~[~~The AP1000 Component Interface Module (CIM)~~, which~~ provides the priority logic between PMS and plant control for component control~~, is also provided by CS Innovations~~. The AP1000 CIM Technical Report (Reference 20), identifies how diversity is maintained between the ALS-based DAS and the CIM.~~]~~[a,c]

  The functionality of the CIM and DAS are different, and this reduces the chances that a common cause failure can be made in both designs. The FPGA Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse with respect to the following lifecycle activities:

  - Design Activities (i.e., different FPGA logic design teams for activities such as the preparation of design specifications and development of the application logic in the hardware descriptive language)
  - Implementation Activities (i.e., different FPGA logic design teams for activities required to physically program the FPGA chip such as simulation, synthesis and "place and route" tasks)
  - Black Box Test Activities (i.e., different IV&V test teams)