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SCE&G®
A SCANA COMPANY

October 15, 2014
NND-14-0601
10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

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

Subject: VCSNS Units 2 & 3 LAR 13-36S1: Supplement to License Amendment
             Request 13-36 Component Interface Module (CIM) / Diverse Actuation
             System (DAS) Diversity

Reference: 1. NND-14-0234 LAR 13-36: Request for License Amendment:
             Component Interface Module (CIM) / Diverse Actuation System (DAS)
             Diversity, dated September 11, 2014

             2. 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 14, 2014 (Accession Number
             ML14076A173)

             3. Audit Report and Request for Additional Information Letter No. 1
             Related to License Amendment Request (LAR 13-020) for the Vogtle
             Electric Generating Plant Units 3 and 4: Component Interface Module
             (CIM) / Diverse Actuation System (DAS) Diversity (TAC. No. RP9465),
             dated July 17, 2014 (Accession Number ML14198A481)

             4. Southern Nuclear Operating Company, Vogtle Electric Generating
             Plant Units 3 and 4 Response to Request for Additional Information and
             Supplement to Request for License Amendment Component Interface
             Module (CIM) / Diverse Actuation System (DAS) Diversity (LAR-13-
             020S2) , dated September 02, 2014 (Accession Number ML14251A301)

In accordance with the provisions of 10 CFR 50.90, South Carolina Electric & Gas Company (SCE&G) requested an amendment to the Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3 combined license numbers NPF-93 and NPF-94, respectively, in Reference 1. The requested amendment proposed to depart from approved AP1000 Design Control Document (DCD) Tier 2* information as incorporated into the Updated Final Safety Analysis Report (UFSAR) by clarifying the position on design diversity, specifically human diversity, as related to the Component Interface Module (CIM) and Diverse Actuation System (DAS) design.

On July 17, 2014, the Nuclear Regulatory Commission (NRC) issued a Request for Additional Information (Reference 3) to Southern Nuclear Operating Company (SNC) regarding Reference 2. SNC responded to Reference 3 with Reference 4

Since Reference 1 is within the scope of this Request for Additional Information (Reference 3), SCE&G elects to provide a response to these questions, which will be similar to the responses provided by SNC in Reference 4. The SCE&G response is found in Enclosures 3 and 4 of this letter, which supplement Reference 1. Enclosures 1 and 2 were provided in Reference 1.

In Reference 3, the NRC Staff requested that SNC submit several proprietary documents on the Vogtle Electric Generating Plant (VEGP) Units 3 and 4 dockets (Docket Nos. 52-025 and 52-026, respectively) to support staff review of Reference 2. These proprietary documents were submitted by SNC in Reference 4 pursuant to eRAI 7572 question numbers 2, 7, and 9. Since SCE&G elects to respond to Reference 3 with information identical to that provided to the NRC by SNC in Reference 4, SCE&G also incorporates by reference those proprietary attachments provided by SNC in Reference 4 to be included in the VCSNS Units 2&3 dockets (Docket Nos. 52-027 and 52-028, respectively) with this response.

The proprietary documents to be incorporated by reference include:

- APP-GW-GEE-3892, Attachment A – Position Paper on Diversity between AP1000 PMS CIM/SRNC and DAS, Revision 0, June 25, 2013 (**Proprietary**)
- Independent Review of AP1000 CIM/SRNC – DAS Diversity, January 11, 2013 (**Proprietary**)
- Independent Review of AP1000 ALS/DAS vs. CIM/SRNCE Human Diversity Overlap, May 23, 2013 (**Proprietary**)
- 6105-00012, "CIM/SRNC vs. DAS Diversity" Revision 1, October 11, 2012 (**Proprietary**)

The information provided in Enclosures 3 and 4 of this letter does not change the scope of, nor affects the Technical Evaluation or the conclusions of the No Significant Hazards Consideration determination of the LAR provided in Reference 1.

In addition, Enclosures 3 and 4 do not alter the initial request date provided in Reference 1.

This letter contains no regulatory commitments.

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 enclosures to the designated State Official.

Should you have any questions, please contact Ms. April R. Rice by telephone at (803) 941-9858, or by email at arice@scana.com.

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

Executed on this 15ᵗʰ day of October, 2014.

Sincerely,

Ronald A. Jones
Vice President
New Nuclear Operations

MRP/RAJ/mrp

Enclosure 3:   SCE&G Response to eRAI No. 7572, Related to License Amendment Request 13-36

Enclosure 4:   Proposed Changes to the Licensing Basis Documents - Revised

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        Ravindra Joshi
        David Jaffe
        Tom Freddette
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South Carolina Electric & Gas Company (SCE&G)

Virgil C. Summer Nuclear Station Units 2 and 3

NND-14-0601

Enclosure 3

SCE&G Response to eRAI No. 7572

Related to License Amendment Request 13-36

(This enclosure contains 18 pages, including this cover page.)

By letter dated September 11, 2014, South Carolina Electric & Gas Company (SCE&G), the Licensee for Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3, requested an amendment, LAR-13-36, to Combined License (COL) Numbers NPF-93 and NPF-94 for VCSNS Units 2 and 3, respectively. SCE&G requested the amendment that proposed to depart from approved AP1000 Design Control Document (DCD) Tier 2* information as incorporated into the Updated Final Safety Analysis Report (UFSAR) by clarifying the position on design diversity, specifically human diversity, as related to the Component Interface Module (CIM) and Diverse Actuation System (DAS) design. Between June 9 and June 12, 2014 the NRC staff conducted a technical review audit of the documents supporting Southern Nuclear Operating Company's (SNC) LAR-13-020 (an LAR of identical scope as SCE&G's LAR-13-36). During the course of this audit, the staff identified the need for additional information relative to this licensing action. The Nuclear Regulatory Commission (NRC) staff subsequently issued the Audit Report and Request for Additional Information (RAI) Letter No. 1, also referred to as electronic RAI (eRAI) 7572, associated with SNC's License Amendment Request on July 17, 2014 [ADAMS Accession No. ML14198A481]. SCE&G elects to respond to eRAI 7572 by providing this enclosure. This enclosure also contains clarification of a statement regarding the human diversity aspect regarding the use of different implementation/validation teams (testers, installers, or certification personnel).

Deletion of sentence regarding use of Different Implementation/Validation Teams

In addition to including responses to eRAI 7572, this enclosure also presents a proposed change to SCE&G LAR-13-36 text to clarify a statement regarding the diversity between the CIM and DAS design teams. In Reference 1 (NND-14-0234), Enclosure 1, "Request for License Amendment Component Interface Module (CIM) / Diverse Actuation System (DAS) Diversity (LAR-13-36)," page 9 of 26 states:

> *DAS documents are independently verified by individuals who were not responsible for the design process and who did not work on CIM.*

The Licensee is concerned that this sentence could be misleading if read out of context. The following paragraph in this section clarifies that there was human diversity overlap during the design process for CIM and DAS by stating, "… different test teams were used to develop CIM and DAS with exceptions." The LAR also states, "… 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 lifecyles for simulation testing (testing not on the target platform used to verify the logic to be implemented within the FPGA)." Therefore, to avoid misinterpretation of the aspect of human diversity regarding the use of different implementation and validation teams for the CIM/DAS design process, it is proposed that the above sentence be deleted from the LAR. Deleting this sentence will minimize the potential for misinterpretation of the text.

Note

The questions contained in this enclosure are unedited from their original issue by the NRC. Where they reference Southern Nuclear Operating Company (SNC), LAR-13-020, Vogtle UFSAR, or Vogtle Units 3 & 4, they are accepted as referring to SCE&G, LAR-13-36, VCSNS UFSAR, and Virgil C. Summer Nuclear Station Units 2 & 3 (respectively) for the purposes of SCE&G's responses below.

RAI Tracking No. 7572

NRC Question 1:

Describe how the technical reports (WCAPs) that describe the diversity requirements of the Component Interface Module (CIM), Safety Remote Node Controller (SRNC), and Diverse Actuation System (DAS) will be permanently updated.

Title 10 of the Code of Federal Regulations (10 CFR), Part 52, Appendix D, "Design Certification Rule for the AP1000 Design," Section X, "Records and Reporting," Items B.2 and B.3.b, state, in part, that updates to the plant-specific design control document (DCD), which reflect the generic changes to and plant-specific departures from the generic DCD, must be submitted annually and may be submitted along with amendments to the application.

The license amendment request (LAR 13-020) proposes to add a new Appendix 7A, "WCAP Changes For CIM/DAS Diversity License Amendment," to the Vogtle Units 3 and 4 updated final safety analysis report (UFSAR) Chapter 7, to modify diversity design requirements related to human design diversity, in Tier 2* document, WCAP-17179, and two Tier 2 documents, WCAP-15775 and WCAP- 17184, that are incorporated by reference in the Vogtle Units 3 and 4 UFSAR. Appendix 7A will capture the lifecycle development diversity design requirement revisions for the listed UFSAR Reference Documents. However, staff was not able to identify in the LAR when or how the final updates to the Reference Documents would be submitted to the NRC. The concern is the WCAP documents would contain information different from the new Appendix 7A. This condition may be sufficient on a temporary basis, but eventually the WCAP documents would also need to be revised to avoid any future inconsistencies.

Please provide details about the process and schedule that will be utilized to submit the final revision updates of the referenced documents listed in LAR 13-020 Appendix 7A.

This question is also being asked for the UFSAR Chapter 1, Section 1.6, Table 1.6-1 updates, as stated in LAR 13-020 Enclosure 2, "Proposed Changes to the Updated Final Safety Analysis Report."

SCE&G Response:

WCAP-17184 (Revision 2), WCAP-17179 (Revision 2), and WCAP-15775 (Revision 4) would continue to be the licensed revisions for these three WCAPs upon the approval of this LAR. Appendix 7A would be used as a supplement to these three WCAPs, as indicated in the UFSAR markups provided with this LAR. The proposed changes to Appendix 7A are expected to be incorporated in the UFSAR within the 30-day license amendment implementation period, as specified in the Licensee's letter that submitted the subject LAR. Following implementation of the license amendment associated with this LAR, the UFSAR update, including Appendix 7A, will be provided to the NRC in accordance with the requirements of 10 CFR 50.71(e).

The three WCAPs that are amended by the changes presented in proposed UFSAR Appendix 7A have already been revised and archived in Westinghouse's document management system to reflect the changes presented in proposed Appendix 7A. However, the Licensee does not intend to incorporate the newer revisions of these WCAPs into the plant's licensing basis immediately following approval of this LAR because the new WCAP revisions also include other changes that will be evaluated as departures in future licensing change packages or LARs. Therefore, by using UFSAR Appendix 7A to capture changes to certain documents that are incorporated by reference into the UFSAR, the Licensee is able to efficiently implement the processes for changes and

departures outlined in 10 CFR Part 52, Appendix D, Section VIII to request licensing changes on an individual topic (such as human diversity).

The Licensee plans to follow a similar approach for other LARs that will propose changes to information in these WCAPs. Following NRC approval of the LARs that affect WCAP-17179, WCAP-17184, and WCAP-15775 the Licensee plans to submit an administrative LAR to incorporate the final revisions of the WCAPs into the licensing basis and delete Appendix 7A. This final LAR is currently envisioned as an administrative change, because the technical changes to the WCAPs will have already been approved via the previous LARs (such as this LAR on CIM/DAS Diversity).

In addition to the information requested by this RAI question, the NRC staff also requested in a public meeting on August 21, 2014, that the licensee specifically reference the licensing basis revision number for each of the three WCAPs at each location in which references to these documents are cited. A review of the licensing basis documentation identified the need to revise several references in the UFSAR, WCAP-15775, WCAP-17179, and WCAP-17184, as well as a reference to WCAP-15775 in another document (WCAP-16438-P/NP) that is incorporated by reference in the UFSAR. Therefore, to maintain consistency throughout the UFSAR and the documents incorporated by reference in the UFSAR, changes are proposed to add the licensing basis revision numbers for WCAP-17184, WCAP-17179, and WCAP-15775 along with the reference to the changes provided in UFSAR Appendix 7A at each location in which these three WCAPs are referenced in the UFSAR (including Appendix 7A).

The following UFSAR changes are proposed to cite the licensing basis 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. In this RAI response, underlined text indicates changes that were not previously provided in LAR-13-36. In the revised proposed changes to the licensing basis documents (Enclosure 4), revision bars are provided in the right-hand margin adjacent text that is changed by this RAI response. In addition, for clarity, section numbers (7A.1, 7A.2, and 7A.3) are added to the proposed licensing basis changes in Enclosure 4.

Change 1

In UFSAR 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, to read:

> AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report, Revision 4 (as modified by changes provided in UFSAR Appendix 7A)

Change 2

In UFSAR 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, to read:

> *AP1000 Component Interface Module Technical Report, Revision 2 (as modified by changes provided in UFSAR Appendix 7A)]**

Change 3

In UFSAR 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, to read:

> AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report, Revision 2 (as modified by changes provided in UFSAR Appendix 7A

Change 4

In UFSAR Table 1.6-1, Material Referenced, change the information in the Title cell for Westinghouse Topical Report Number WCAP-16438-P and WCAP-16438-NP under DCD Section Number 7.2, to read:

> FMEA of AP1000 Protection and Safety Monitoring System, Revision 3 (as modified by changes provided in UFSAR Appendix 7A)

Change 5

In UFSAR 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, to read:

> AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report, Revision 2 (as modified by changes provided in UFSAR Appendix 7A

Change 6

In UFSAR Section 7.1.2.14.1, Design Process, change the citation to Document 15 to read:

> Document 15: APP-GW-GLR-143 (WCAP-17179), "AP1000™ Component Interface Module Technical Report," Revision 2 (as modified by changes provided in Appendix 7A)

Change 7

In UFSAR Section 7.1.7, References, change Reference 7 for WCAP-15775, to read:

> 7. WCAP-15775, "AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report," Revision 4 (as modified by changes provided in Appendix 7A)

Change 8

In UFSAR Section 7.1.7, References, change Reference 23 for WCAP-17184-P, to read:

> 23. WCAP-17184-P, "AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report," Revision 2 (as modified by changes provided in Appendix 7A)

Change 9

In UFSAR Section 7.1.7, References, change Reference 24 for WCAP-17179, to read (Note: this proposed change is unchanged from that previously provided in LAR-13-36):

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)*.]*

Change 10

In UFSAR Section 7.2.4, References, change Reference 1 for WCAP-16438-P and WCAP-16438-NP, to read:

1. WCAP-16438-P (Proprietary), WCAP-16438-NP (Non-Proprietary), "FMEA of AP1000 Protection and Safety Monitoring System," Revision 3 (as modified by changes provided in UFSAR Appendix 7A).

Change 11

In proposed UFSAR Section 7A.2, "WCAP-17179-P and WCAP-17179-NP, AP1000™ Component Interface Module Technical Report," add a change to the REFERENCES section for References 13 and 22, to read:

13. WCAP-15775, Revision 4 (as modified by changes provided in UFSAR Appendix 7A), "AP1000 Instrumentation and Control Defense-In-Depth and Diversity Report," Westinghouse Electric Company LLC.

22. WCAP-17184-P (Proprietary), Revision 2 (as modified by changes provided in UFSAR Appendix 7A), "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," Westinghouse Electric Company LLC.

Change 12

In proposed UFSAR Section 7A.3, "WCAP-17184-P, AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report," add a change to the REFERENCES section for Reference 20, to read:

20. APP-GW-GLR-143 (Proprietary), Revision 2 (as modified by changes provided in UFSAR Appendix 7A), "AP1000 Component Interface Module Technical Report," Westinghouse Electric Company LLC.

Change 13

In proposed UFSAR Appendix 7A, add Section 7A.4, "WCAP-16438-P and WCAP-16438-NP, Revision 3, FMEA of AP1000**™** Protection and Safety Monitoring System," to change the REFERENCES section for Reference 6 to read:

6. WCAP-15775, Revision 4 (as modified by changes provided in UFSAR Appendix 7A), "AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report," Westinghouse Electric Company LLC.

NRC Question 2:

Define the term "humanly diverse" and submit on the docket for NRC staff review the document titled, "Attachment A - Position Paper on Diversity between AP1000 CIM/SRNC and DAS," Revision 0, June 25, 2013.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the final safety analysis report (FSAR) descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of Standard Review Plan (SRP), Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items, taken alone and in combination, should have one and only one interpretation. The proposed Vogtle UFSAR Appendix 7A, "WCAP Changes for CIM/DAS Diversity License Amendment," states that "The FPGA [field programmable gate array] Logic used in the DAS, as compared to the FPGA logic used in the CIM, is humanly diverse…." The NRC staff was not able to identify a definition for the term "humanly diverse" or understand how this term addresses the human diversity guidance of NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems." Define the term "humanly diverse" as it relates to NRC regulatory diversity criterion and guidance and discuss how this term addresses the human diversity guidance of NUREG/CR-6303. Additionally, in an effort to obtain additional design details demonstrating adequate diversity in the CIM/SRNC and DAS FPGA designs after implementation of the LAR proposed diversity design revisions, staff requests submission of the internal review document "Attachment A – Position Paper on Diversity between AP1000 PMS CIM/SRNC and DAS," Revision 0, June 25, 2013, on the docket.

SCE&G Response:

The term "humanly diverse" was proposed to be used in three places in UFSAR Appendix 7A. In the modifications to WCAP-15775, WCAP-17179-P/NP, and WCAP-17184-P provided proposed UFSAR Sections 7A.1, 7A.2 and 7.3, respectively, there is an identical sentence using this term. In each of these three occurrences, the UFSAR Appendix 7A markups will be revised to remove the term "humanly diverse." Therefore a change is proposed to revise the UFSAR Appendix 7A markups for WCAP-15775, WCAP-17179-P/NP, and WCAP-17184-P, from:

"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."

To read:

"The FPGA Logic used in the DAS, maintains human diversity with respect to the FPGA Logic used in the CIM, for the following lifecycle activities."

APP-GW-GEE-3892, Attachment A – "Position Paper on Diversity between AP1000 PMS CIM/SRNC and DAS," Revision 0, June 25, 2013 was originally submitted by SNC in their response to eRAI 7572, in Enclosure 6 of Reference 4 (SNC Letter ND-14-1306, Accession # ML14251A301) SCE&G incorporates this document by reference to be included in the VCSNS Units 2 & 3 dockets (Docket Number 52-027 and 52-028, respectively), and it is therefore not included as a separate enclosure in SCE&G's response.

NRC Question 3: Clarify the lifecycle phases where human diversity was not maintained between the CIM and DAS development.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of the SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items, taken alone and in combination, should have one and only one interpretation, and should be analyzed to demonstrate its consistency with the plant safety analysis and other plant system designs. The Tier 1, Vogtle UFSAR, Table 2.5.2-8, "Inspections, Tests, Analyses, and Acceptance Criteria," Item 14, and "Project Plan Component Interface Module (CIM) and Safety Remote Node Controller (SRNC) Development" (WNA-PD-00050-GEN), Section 4.12, "Regulatory and Life-Cycle Requirements," list the CIM lifecycle development phases as

- Design Requirements Phase;
- System Definition Phase;
- Hardware and Software Development Phase (Design and Implementation);
- System Integration and Test Phase;
- Installation Phase

The "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report" (APP-GW-GLR-145), WCAP-17184-P (ML102170267), Section 1, "AP1000 DAS Design Process," list the DAS lifecycle development phases as:

- Design Requirements Phase
- System Definition
- Hardware and any Software Development Phase
- System Test Phase
- Installation Phase
- Please note that there is not a listing for the DAS lifecycle phase of "Implementation" phase.

a) The LAR states that some overlap with designers and engineers where complete human diversity was not maintained at the requirements phase of the CIM and DAS design lifecycles occurred. However, the LAR also states that "Complete human diversity was maintained for the CIM and DAS FPGA design and implementation phases…." Staff could not discern a difference between the "requirements phase" and the "design phase." Both phases appear to occur at the same time in development and thus the two design statements listed appear to conflict with one another. There is some overlap in the design-requirements phase, yet complete human diversity was maintained for the … FPGA design phase. Provide detailed descriptions, throughout each phase of the lifecycle development process, where human diversity "overlap" occurred and where complete human diversity requirements were maintained.

b) The LAR states that "Complete human diversity was maintained for the CIM and DAS FPGA … implementation phases…." Staff was not able to identify an "implementation phase" for the DAS. Provide detailed descriptions of the DAS "implementation phase" that the LAR is referencing. In addition, for all UFSAR Appendix 7A bullet items that list "Design Activities," it is not clear to staff what phase these activities are occurring. As stated above, "design-

requirements" is a defined lifecycle development phase for the CIM and DAS and the LAR states that the "requirements phase" is where diversity "overlaps" occurred. As stated above, please clarify how the diversity "overlaps" and "complete human diversity" for the Appendix 7A "design activities" can occur simultaneously in the same phase.

SCE&G Response:

The following table maps the DAS and CIM-SRNC Life Cycle Phases and the overlaps in human diversity that occurred in each life cycle phase. To help understand the context of each life cycle phase, the column "Coinciding IEEE 1012-1998 Activities" (see Figure 1 in the Standard) is added. This column is used here only to provide context for the NRC staff from the point of view of an endorsed NRC standard (IEEE 1012-1998) on the activities that are performed for that phase. DAS, as a nonsafety-related system, was not required to comply with IEEE 1012.

The last column of this table identifies the refined human diversity attribute ID code from LAR-13-36 Table 2, as appropriate, to indicate where in the life cycle these attributes were met or not met.

	CIM Life Cycle Phase	DAS Life Cycle Phase	Coinciding IEEE 1012-1998 Activities	Overlaps per LAR Table 2
1	Design Requirements	Design Requirements	Acquisition, Planning, Concept	No licensing commitment for human diversity
2	System Definition	System Definition	Acquisition, Planning, Concept (System Requirements)	No licensing commitment for human diversity
3	Hardware and Software Development (Design and Implementation)	Hardware and any Software Development	Requirements, Design, Implementation	LAR Table ID: C.1 Not met – human diversity overlap existed for FPGA logic requirements. LAR Table ID: C.2 Design Team – Fully met. Human diversity licensing commitment for software development portion of this phase (i.e., FPGA logic) was fully met including design team simulation testing. No licensing commitment for human diversity for hardware design. LAR Table ID: D.1 & D.3 IV&V Team – Not met (overlap existed in human diversity for ISE simulation testing)
4	System Integration and Test	System Test	Test	LAR Table ID: D.2 Fully complied to human diversity commitment
5	Installation	Installation	Installation and Checkout	No licensing commitment for human diversity

Part a) of this question states that the NRC staff could not discern a difference between the "requirements phase" and the "design phase". In this table the "requirements phase" was the requirements portion of the Hardware and Software Development phase (row 3). Also, in part b) the RAI states that the NRC staff is not clear what phase "Design Activities" occur in the Appendix 7A bulleted items. These "Design Activities" were in the design portion of the Hardware and Software Development phase (row 3) in the table above.

The activities associated with the System Definition phase include performing the system requirements analysis. The resultant documents of this phase were the functional and system requirements documentation that form the initial basis for the project.

The "requirements phase" was the FPGA requirements portion of the Hardware and Software Development phase (row 3). The activities associated with the requirements phase were the development of the FPGA logic requirements.

The "design phase" was the design portion of the Hardware and Software Development phase (row 3). The activities associated with the design portion of the Hardware and Software Development phase were development of the detailed FPGA logic and hardware specifications.

For the DAS, the hardware specifications included cabinet configuration drawings and cabinet interconnecting wiring diagrams.

Part b) of this question indicated that the NRC staff was not able to identify an "implementation phase" for the DAS. As presented in the above table, for the AP1000, the "implementation phase" is defined by the activities performed in the Hardware and Software Development phase (row 3 in the table above). The activities associated with the DAS implementation included coding of the FPGA logic, simulation testing of the FPGA logic by the design team, and IV&V ISE simulation testing of the application FPGA logic. Hardware implementation includes fabrication of the first article (i.e. first production unit) including the production of the first article cabinets. Hardware implementation also included flashing of the application logic onto the system's FPGA(s) in preparation for system testing.

NRC Question 4: Clarify where implementation and simulation occur in the CIM and DAS lifecycles and how it relates to the loss of human diversity during CIM and DAS development.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of the SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items, taken alone and in combination, should have one and only one interpretation. Both the CIM and the DAS have defined system "test" phases." The LAR states:

> *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 ... and **not for simulation testing**.*

a) The LAR also states that "…complete human diversity was not maintained for requirements generation, simulation testing, and verification activities." However, UFSAR Appendix 7A, states that for "Implementation activities," FPGA logic used in the CIM and DAS is humanly diverse for the lifecycle implementation activities of physically programming the FPGA chip such as simulation…. NRC staff reviewed LAR Tables 1 and 2. However, the tables do not appear to relate design activities according to the CIM/SRNC and DAS lifecycle development phases. Provide a table such as the LAR lifecycle Tables 1 and 2 that list the UFSAR Tier 1 CIM/SRNC and DAS development lifecycles and for each of the CIM/SRNC and DAS lifecycle phases (1) display where simulation occurs, (2) where LAR listed simulation diversity overlaps occurred, (3) where the UFSAR Appendix 7A "Implementation Activities" simulation is diverse, and (4) any other details that support the LAR and Appendix 7A listed design revisions. Define the term simulation as discussed in the LAR and the different simulation types (i.e., simulation versus simulation testing) that the LAR makes reference to.

b) For all UFSAR Appendix 7A bullet items that list "Implementation Activities," it is not clear to staff what phase these activities will occur for simulation. Provide design descriptions that would clarify when the "Implementation Activities" listed in UFSAR Appendix 7A would occur for simulation. Note that Tier 1 of the Vogtle UFSAR, Table 2.5.1-4, "Design Commitment," Item #4, and WCAP-17184-P, Section 1, does not list an "Implementation phase" for the DAS.

SCE&G Response:

Part a) of this question requests a life cycle table to show where simulation activities occur. The table provided in the response to question 3 identifies in row 3 that simulation activities occur in the hardware and software development phase of the life cycle. Row 3 of this table also identifies IV&V simulation testing as the simulation activity with overlaps in human diversity. Therefore, row 3 identifies the life cycle phase in which the design team simulation testing was conducted and met the human diversity licensing commitments.

The table provided in the response to question 3 provides the refined human diversity attribute ID code from LAR Table 2 to indicate where in the life cycle these attributes were met or not met.

Part a) also requests a definition for the different simulation types. Simulation and simulation testing are equivalent terms in the LAR. IV&V Simulation (ISE testing) is done by the IV&V team.

Design simulation testing is done by the design team. In both cases, simulation testing emulates code written in a Hardware Description Language (HDL), providing user-defined external stimulus to and collecting output from the design under test (DUT). Simulation testing is used for both ASICs and FPGAs. Simulators provide waveform viewers, HDL browsers, coverage collection, viewing and log printout, and gate-level simulation functionality. Simulation test benches include user-defined models, sometimes called bus functional models or transaction level models, used to provide stimulus to the DUT and collect output from the DUT. Both stimulus generation and output collection and prediction (pass fail criteria) are defined by the same design requirements as the HDL. User-defined test cases are generated to exercise the DUT functionality. Coverage metrics are collected to provide feedback to the user on the coverage of the design space and allow for analysis of requirements and coverage.

For both the CIM and DAS, the design team performed simulation of the design using the Verilog language and simulated their designs using Aldec Riviera Pro. IV&V performed a parallel simulation of the design using the SystemVerilog language and simulated using Synopsys VCS (Verilog Compiled code Simulator).

Part b) of this question requests an identification of the phase in which the Implementation activities occur, specifically for simulation activities. The table in the response to question 3 shows that the implementation activities occurred in row 3 for the CIM and DAS life cycle phases. It was in these hardware and software development phases that simulation activities occurred. The simulation activities are also identified in row 3 of the table.

NRC Question 5: **Clarify the human diversity commitments for system test phase activities as they are described in the license amendment request and the Vogtle Units 3 and 4 UFSAR.**

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items should be technically accurate. The LAR states that "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."

Figure 1-1, "DAS Life Cycle Phases," in WCAP-17184, "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," Revision 2, displays a diversity model for CS Innovations (CSI) and Westinghouse. The figure describes CSI as wholly responsible for all system test phase activities. However, WEC currently performs certain DAS system test phase activities for the Vogtle nuclear power plant build. Provide appropriate updates and mark-ups to Figure 1-1 to ensure that it is consistent with current Vogtle UFSAR Tier 1 design commitments. In addition, for all Tier 2* and Tier 2 documents listed in Vogtle UFSAR Appendix 7A, perform a review to ensure that current CIM, SRNC, and DAS diversity descriptions are current, accurate and technically correct.

SCE&G Response:

As stated on page 9 of the LAR, there are no licensing requirements that require different design organizations/companies. Therefore, it is SCE&G's position that the changes to Figure 1-1 in WCAP-17184 have no impact on the overall diversity model for CIM and DAS. Westinghouse has an open corrective action item, which was provided to the staff during the CIM/DAS Diversity LAR audit, to correct this figure in a future revision of WCAP-17184 and to include this in a separate licensing departure.

The responses to questions 3 and 4 indicate that simulation testing is performed during the hardware and software development phases for the CIM and DAS projects. Page 9 of the LAR states:

> *"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)."*

Note that "testing phase" here is referring to the hardware and software development phase of the CIM and DAS design lifecycles. There was a licensing requirement to maintain human diversity during these simulation testing activities (i.e. different people doing the same tasks on both the CIM and DAS projects); however, there is no licensing commitment to use separate organizations.

Finally, a review of the documents listed in the proposed UFSAR Appendix 7A confirmed that the current CIM, SRNC, and DAS diversity descriptions are current, accurate, and technically correct.

NRC Question 6: Identify the correct Tier 2* documents for the proposed design revisions.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of the SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items should be technically accurate. In Enclosure 2 of the LAR, "Proposed Changes to the Updated Final Safety Analysis Report," design revision items #3 and #4 propose to revise Tier 2* documents. However, the documents that are referenced in design items #3 and #4 are not Tier 2* documents. Provide the correct Tier 2* document(s) for these proposed design revision items.

SCE&G Response:

The changes identified as items 3 and 4 in Enclosure 2 of Reference 1 are to UFSAR Table 1.6-1, "Material Referenced." The introductions to the UFSAR markups for items 3 and 4 incorrectly identify this Table 1.6-1 text as Tier 2* information. However, the marked up text does correctly present this text as Tier 2 information (i.e., no brackets or italicized text). Accordingly, only the introductions to items 3 and 4 were incorrect, and should be rewritten as follows:

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:

And:

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:

NRC Question 7: Submit the independent, third-party assessments of the CIM/DAS human diversity overlap, including those associated with common functions such as power up, power down, actuation, and internal communication.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of the SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items, taken alone and in combination, should have one and only one interpretation, and should be analyzed to demonstrate its consistency with the plant safety analysis and other plant system designs. LAR Appendix 7A proposes to remove the Tier 2* CIM diversity requirement of "For any functionality that is similar between the two designs, different designers were used for the CIM and DAS designs." However, the LAR also states that "Common functions such as power up, power down, actuation methods, and internal communications were evaluated." NRC staff was not able to identify the diversity analysis process used by the independent third party reviewers for these common functions. NRC staff reviewed the diversity analysis performed by the independent third party reviews that were contained in (1) "Independent Review of AP1000 CIM/SRNC-DAS Diversity," January 11, 2013, and (2) "Independent Review of AP1000 ALS/DAS vs CIM/SRNC Human Diversity Overlap," May 23, 2013, during the technical audit. Provide the results of the independent third party review diversity analysis which also analyze common functions between the CIM/SRMC and DAS. Also, the independent third party review documents have not been submitted for docketing with the LAR application. In order for staff to apply the engineering analysis and results from the independent third party review team documents, submit these documents on the docket.

SCE&G Response:

The following two independent, third-party reports were originally submitted by SNC in their response to eRAI 7572 (Enclosure 7 of Reference 4).

1. Independent Review of AP1000 CIM/SRNC – DAS Diversity, January 11, 2013

2. Independent Review of AP1000 ALS/DAS vs. CIM/SRNC Human Diversity Overlap, May 23, 2013

SCE&G incorporates these documents by reference to be included in the VCSNS Units 2 & 3 dockets (Docket Number 52-027 and 52-028, respectively), and these documents are therefore not included as a separate enclosure in SCE&G's response.

NRC Question 8: Describe how the different geometries of the CIM and DAS FPGA chips require different manufacturing processes.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of the SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items should be technically accurate. The LAR states that the CIM and DAS FPGA devices are different in structure and design and the same production lines cannot be used for the CIM and DAS FPGA manufacture since the chips use two different geometries. Provide design details that demonstrate that the CIM and DAS FPGA chips have two different geometries. Also provide the basis that demonstrates that an FPGA chip manufacturing line has to use unique hardware to make a specific geometry of the device and that if two different FPGA geometries are used, the same FPGA production line cannot manufacture these two geometrically different FPGA chips.

SCE&G Response:

Section 2.4, "FPGA Chip Diversity" of 6105-00012, "CIM/SRNC vs. DAS Diversity," Revision 1 (provided as Enclosure 8 of Reference 4) provides the design details demonstrating the CIM/SRNC FPGAs are diverse from the FPGA used in the DAS design. Section 3.3 of this document also concludes that the two FPGAs are fabricated with different chip geometries on different manufacturing lines. This point was confirmed with the FPGA manufacturer, Microsemi.

NRC Question 9: Address the use of software in the DAS and submit Document 6105-00012, "CIM/SRNC vs DAS Diversity," Revision 1, to support the staff's review of the LAR.

10 CFR Part 52.79, "Contents of Applications; Technical Information In Final Safety Analysis Report," Sections (a) and (a)(2), state in part, that the FSAR descriptions shall be sufficient to permit understanding of the system designs and their relationship to safety evaluations. The guidance of the SRP, Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," Revision 4, Section 4, states that the information provided for the design basis items, taken alone and in combination, should have one and only one interpretation. The LAR states that the "…DAS uses no operating system or executable software loops for its control functions…" and that "DAS uses no software for its control functions." However, staff questioned the results captured in Document 6105-00012, "CIM/SRNC vs DAS Diversity," Revision 1, Section 3.2.5, "Software Diversity,' where the results state that the CIM and SRNC contain no software. However, the results of Document 6105-00012 did not find the same for the DAS. NRC staff requests clarification and details of the DAS's utilization of software during (1) plant start-up and shut down, (2) during normal online plant operations and (3) during the DAS's performance of mitigation actions and protective functions. NRC staff also requests the applicant to submit on the docket Document 6105-00012 so staff can review the diversity engineering analysis and results contained within this document.

SCE&G Response:

The use of software in the DAS is limited to the ALS Service Unit (ASU) which is the DAS maintenance work station. The ASU is not operational during normal DAS operation and therefore cannot impact plant functionality. The displays in the MCR and on the remote panel for DAS are 7-segment displays that do not use software. Therefore, there is no software that affects (1) plant start-up and shut down, (2) normal online plant operations and (3) DAS's performance of mitigation actions and protective functions.

Document 6105-00012, "CIM/SRNC vs. DAS Diversity", Revision 1 was originally submitted by SNC in their response to eRAI 7572 (Enclosure 8 of Reference 4). SCE&G incorporates this document by reference to be included in the VCSNS Units 2 & 3 dockets (Docket Number 52-027 and 52-028, respectively), and it is therefore not included as a separate enclosure in SCE&G's response.

South Carolina Electric & Gas Company (SCE&G)

Virgil C. Summer Nuclear Station Units 2 and 3

NND-14-0601

Enclosure 4

Proposed Changes to the Licensing Basis Documents – Revised

(This enclosure contains 8 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, Revision 4 (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, Revision 2 (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, Revision 2 (as modified by changes provided in UFSAR Appendix 7A)
		* * *

4. **Revise Tier 2 information in the Title cell for FMEA of AP1000^{TM} Protection and Safety Monitoring System, Revision 3, under DCD Section Number 7.2, as follows:**

DCD Section Number	Westinghouse Topical Report Number	Title
* * *		
7.2	WCAP-16438-P WCAP-16438-NP	FMEA of AP1000^{TM} Protection and Safety Monitoring System, Revision 3 (as modified by changes provided in UFSAR Appendix 7A)
* * *		

5. **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^{TM} Diverse Actuation System Planning and Functional Design Summary Technical Report, Revision 2 (as modified by changes provided in UFSAR Appendix 7A)
* * *		

6. **UFSAR Chapter 7, Instrumentation and Controls, Subsection 7.1.2.14.1, Design Process, change the citation to Document 15 to read:**

   Document 15:   APP-GW-GLR-143 (WCAP-17179), "AP1000^{TM} Component Interface Module Technical Report," Revision 2 (as modified by changes provided in Appendix 7A)

7. **UFSAR Chapter 7, Instrumentation and Controls, Subsection 7.1.7, References – Revise Tier 2 and Tier 2* information by changing the revision number of References 7, 23 and 24, to read:**

    7.   WCAP-15775, "AP1000 Instrumentation and Control Defense-in-Depth and Diversity Report." Revision 4 (as modified by changes provided in Appendix 7A)

    23.   WCAP-17184-P, "AP1000™ Diverse Actuation System Planning and Functional Design Summary Technical Report," Revision 2 (as modified by changes provided in UFSAR Appendix 7A).

    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).*]*

8. **UFSAR Chapter 7, Instrumentation and Controls, Subsection 7.2.4, References – Revise Tier 2 information by changing the revision number of Reference 1, to read:**

    1.   WCAP-16438-P (Proprietary), WCAP-16438-NP (Non-Proprietary), "FMEA of AP1000 Protection and Safety Monitoring System," Revision 3 (as modified by changes provided in UFSAR Appendix 7A).

9. **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.

7A.1   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 maintains human diversity with respect to the FPGA logic used in the CIM, for 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, Revision 2 (as modified by changes provided in Appendix 7A), "AP1000 Component Interface Module Technical Report"

7A.2 [*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 the REFERENCES as follows:*

  13. WCAP-15775, Revision 4 (as modified by changes provided in Appendix 7A), "AP1000 Instrumentation and Control Defense-In-Depth and Diversity Report," Westinghouse Electric Company LLC.

  22. WCAP-17184-P (Proprietary), Revision 1 2 (as modified by changes provided in Appendix 7A), "AP1000 Diverse Actuation System Planning and Functional Design Summary Technical Report," Westinghouse Electric Company LLC.

- *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 maintains human diversity with respect to the FPGA logic used in the CIM, for 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).]**

7A.3 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 the REFERENCES section as follows:

  20. APP-GW-GLR-143 (Proprietary), Revision 0 2 (as modified by changes provided in UFSAR Appendix 7A), "AP1000 Component Interface Module Technical Report," Westinghouse Electric Company LLC.

- 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 maintains human diversity with respect to the FPGA logic used in the CIM, for 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)

7A.4   WCAP-16438-P and WCAP-16438-NP, FMEA of AP1000^{TM} Protection and Safety Monitoring System

The UFSAR incorporates by reference Tier 2 document WCAP-16438-P and WCAP-16438-NP, FMEA of AP1000^{TM} Protection and Safety Monitoring System. See Table 1.6-1. WCAP-16438-P and WCAP-16438-NP, Revision 3, include the following revisions and additions as indicated by strikethroughs and underlines.

- Revise the REFERENCES section as follows:

    6.   WCAP-15775, Revision 4 (as modified by changes provided in UFSAR Appendix 7A), "AP1000^{TM} Instrumentation and Control Defense-In-Depth and Diversity Report," Westinghouse Electric Company LLC