UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS

RELATED TO EXEMPTIONS AND AMENDMENT NOS. 106 AND 105

TO THE COMBINED LICENSE NOS. NPF-91 AND NPF-92

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

GEORGIA POWER COMPANY

OGLETHORPE POWER CORPORATION

MEAG POWER SPVM, LLC

MEAG POWER SPVJ, LLC

MEAG POWER SPVP, LLC

CITY OF DALTON, GEORGIA

VOGTLE ELECTRIC GENERATING PLANT UNITS 3 AND 4

DOCKET NOS. 52-025 AND 52-026

1.0 INTRODUCTION

By letter dated November 30, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML16335A453), Southern Nuclear Operating Company (SNC) submitted license amendment request (LAR) 16-031 and requested that the U.S. Nuclear Regulatory Commission (NRC) amend the combined licenses (COL) for Vogtle Electric Generating Plant (VEGP) Units 3 and 4, COL Numbers NPF-91 and NPF-92, respectively. The application proposes revisions to the plant-specific Tier 1 information and corresponding changes to COL Appendix C, plant-specific Design Control Document (DCD) Tier 2* and associated Tier 2 material incorporated into the VEGP Updated Final Safety Analysis Report (UFSAR), by revising the design details for the shield building roof, tension ring, and air inlets and removing tie rods. SNC also requests permanent exemptions, one for each unit, to allow departures from elements of the certified information in Tier 1 of the AP1000 Certified DCD, as specified in LAR-16-031. These exemptions are related to, and necessary for the granting of the amendments, which are being issued concurrently with these exemptions.

The proposed changes include the following change activities (CA):

- CA#1 and CA#2: Roof beam size change and roof beam material substitution;
- CA#3: Change to reinforcement in Passive Containment Cooling Water Storage Tank (PCCWST) walls and shield building conical roof and air inlet structure;
- CA#4: Figure and sketch design finalization changes

- CA#5: Design variances with critical sections; and
- CA#6: Removal of tie rods.

In a letter dated June 16, 2017 (ADAMS Accession Nos. ML17167A335), SNC submitted LAR-16-031, Revision 1, which replaced Enclosures 1 through 5 of the November 30, 2016, request with Enclosures 7 through 11. The Enclosure 6 addressed the staff's comments provided on March 7, 2017 (ADAMS Accession No. ML17066A467). In the updated enclosures, SNC added, among other changes, the welding information for the built up plate girder, identified the issues regarding the macro discrepancies and use of combination factor of 0.9 for dead load when combined with upward seismic loads, and corrected the cause of the changes in demands.

In a letter dated October 6, 2017 (ADAMS Accession Nos. ML17279B086), SNC submitted LAR-16-031, Revision 2, which replaced Enclosures 7 and 11 of the June 16, 2017, request with Enclosures 14 through 18. Enclosures 12 and 13 addressed the second set of staff's comments provided on September 7, 2017 (ADAMS Accession No. ML17250B298). In the updated enclosures, SNC provided information on the structural analysis, details of the proposed design changes, the material specification and grade for the built-up plate girders, and clarified the proposed changes to CA#4 item H with their associated technical basis, among other changes.

In order to modify the UFSAR (which includes the plant-specific DCD) Tier 2* information, including the associated Tier 2 information, the NRC must find SNC's proposed changes in the LAR acceptable. The staff's safety evaluation of the LAR is presented in this report. SNC has also requested permanent exemptions from the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix D, "Design Certification Rule for the AP1000 Design," Section III.B, "Scope and Contents," to allow departures from Tier 1 of the generic AP1000 DCD[1]. The staff's review of the exemptions requested is also included in this safety evaluation.

By the letters and revisions discussed above, SNC submitted revisions to the original LAR. The submitted revisions did not expand the scope of the original LAR and did not change the staff's original proposed no significant hazards consideration determination published in the *Federal Register* on March 8, 2017 (82 FR 13019).

2.0 REGULATORY BASIS

The LAR and exemptions concern changes to plant-specific Tier 1 information and corresponding changes to COL Appendix C, plant-specific DCD Tier 2* and associated Tier 2 material incorporated into the VEGP UFSAR, by revising the design details for the shield building roof, tension ring, and air inlets and removing tie rods. The staff considered the following regulatory requirements in reviewing the licensee's proposed LAR and exemptions:

The regulations in 10 CFR Part 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 this section.

[1] While SNC described the requested exemptions as being from Section III.B of 10 CFR Part 52, Appendix D, the entirety of the exemptions pertain to proposed departures from Tier 1 information in the generic AP1000 DCD. In the remainder of this evaluation, the NRC will refer to the exemptions as exemptions from Tier 1 information to match the language of Section VIII.A.4 of 10 CFR Part 52, Appendix D, which specifically governs the granting of exemptions from Tier 1 information.

According to 10 CFR Part 52, Appendix D, Section VIII.A.4, exemptions from Tier 1 information are governed by the requirements in 10 CFR 52.63(b)(1) and 10 CFR 52.98(f). Additionally, the Commission will deny a request for an exemption from Tier 1 if it finds that the design change will result in a significant decrease in the level of safety otherwise provided by the design.

The regulations in 10 CFR 52.63(b)(1) allows a licensee who references a design certification rule to request NRC's approval for an exemption from one or more elements of the certification information. The Commission may grant such a request only if it determines that the exemption will comply with the requirements of 10 CFR 52.7, "Specific Exemptions," which in turn points to the requirements listed in 10 CFR 50.12 for specific exemptions. In addition to the factors listed in § 52.7, the Commission shall consider whether the special circumstances that § 52.7 requires to be present outweigh any decrease in safety due to reduction in standardization caused by the exemption. Therefore, any exemption from the Tier 1 information certified by Appendix D to 10 CFR Part 52 must meet the requirements of 10 CFR 50.12, 52.7 and 52.63(b)(1).

According to 10 CFR 52.98(f), any modification to, addition to, or deletion from the terms and conditions of a COL, including inspections, tests, analyses and acceptance criteria (ITAAC) contained in the license is a proposed amendment to the license.

The regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 1, "Quality Standards and Records," require that structures, systems, and components (SSC) important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

GDC 2, "Design Bases for Protection against Natural Phenomena," require that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

GDC 4, "Environmental and Dynamic Effects Design Bases," require that SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing and postulated accidents, including loss-of-coolant accidents.

According to 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," nuclear power plants are required to be designed so that, if safe-shutdown earthquake (SSE) ground motion occurs, SSCs important to safety will remain functional and within applicable stress, strain, and deformation limits. The required safety functions of SSCs must be assured during and after the vibratory ground motion associated with the SSE ground motion through design, testing, or qualification methods.

The regulations in 10 CFR 50.150, "Aircraft impact assessment," require a design-specific assessment of the effects on the facility of the impact of a large commercial aircraft to identify and incorporate into the design those design features and functional capabilities, to show that, with reduced use of operator actions: (i) the reactor core remains cooled or the containment remains intact, and (ii) spent fuel cooling or spent fuel pool integrity is maintained.

The staff review of the LAR follows the guidance and structural acceptance criteria necessary to meet the regulatory requirements referenced in NUREG-0800, "Standard Review Plan for the

Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Revision 4 (SRP), Section 3.8.4.

3.0 TECHNICAL EVALUATION

3.1 EVALUATION OF EXEMPTIONS

Section VIII.A.4 of Appendix D to 10 CFR Part 52 requires a licensee to obtain an exemption to depart from the Tier 1 information of the generic AP1000 DCD. Because SNC has identified changes to plant-specific Tier 1 information, with corresponding changes to the associated COL Appendix C information, resulting in the need for a departure, exemptions from the certified design information within plant-specific Tier 1 material is required under 10 CFR 52.63(b)(1) to implement the LAR. The end result of these exemptions would be that SNC can implement modifications to Tier 1 information described and justified in LAR-16-031 if and only if the NRC approves LAR-16-031. These are permanent exemptions limited in scope to the particular Tier 1 information specified. As defined in Section II of Appendix D to 10 CFR Part 52, Tier 1 information includes ITAAC and design descriptions, among other things. Therefore, a licensee referencing Appendix D incorporates by reference Tier 1 information contained in the generic AP1000 DCD. The Tier 1 ITAAC and design descriptions, along with the plant-specific ITAAC, were included in Appendix C of the VEGP COL at its issuance.

As stated in Section VIII.A.4 of Appendix D to 10 CFR Part 52, exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, Section VIII.A.4 of Appendix D to 10 CFR Part 52 provides that the Commission will deny requests for exemptions from Tier 1 if it finds that the requested change will result in a significant decrease in the level of safety otherwise provided by the design. Pursuant to 10 CFR 52.63(b)(1), the Commission may grant exemptions from one or more elements of the certification information, so long as the criteria given in 10 CFR 52.7, which, in turn, references 10 CFR 50.12, is met and that the special circumstances, defined by 10 CFR 50.12(a)(2), outweigh any potential decrease in safety due to reduced standardization.

Pursuant to 10 CFR 52.7, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 52. As 10 CFR 52.7 states, the Commission's consideration will be governed by 10 CFR 50.12, "Specific exemptions." 10 CFR 50.12 states that exemptions may be granted when: (1) the exemptions are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security; and (2) special circumstances are present. Specifically, 10 CFR 50.12(a)(2) lists six special circumstances for which exemptions may be considered. It is necessary for one of these special circumstances to be present in order for the NRC to consider granting requests for exemptions.

SNC stated that the requested exemptions met the special circumstances of 10 CFR 50.12(a)(2)(ii). That subparagraph defines special circumstances as when "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of the exemption requests is presented below.

3.1.1 Authorized by Law

These exemptions would allow SNC to implement a revision to Tier 1 of the plant-specific DCD, specifically related to shield building roof changes as described in LAR-16-031 and the

exemption requests in Enclosure 16 to LAR-16-031, Revision 2. These exemptions are permanent exemptions limited in scope to particular Tier 1 information. Subsequent changes to any Tier 1 information would be subject to the exemption process specified in Section VIII.A.4 of Appendix D to 10 CFR Part 52 and the requirements of 10 CFR 52.63(b)(1). Based on the review of LAR-16-031, the staff has determined that granting of SNC's proposed exemptions will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, in accordance with 10 CFR 50.12(a)(1), the exemptions are authorized by law.

3.1.2 No Undue Risk to Public Health and Safety

The underlying purpose of Appendix D to 10 CFR 52 is to ensure that a licensee will construct and operate the plant based on the approved information found in the DCD incorporated by reference into a licensee's licensing basis. The changes proposed in the LAR will not negatively impact any design function. There is no change to plant systems or the response of systems to postulated accident conditions. There is no detriment to the predicted radioactive releases due to postulated accident conditions. Furthermore, the plant response to previously evaluated accidents or external events is not adversely affected, and the change described does not create any new accident precursors. The changes described do not introduce any new industrial, chemical, or radiological hazards that would represent a public health or safety risk, nor do they modify or remove any design or operational controls or safeguards intended to mitigate any existing on-site hazards. Furthermore, the proposed changes would not allow for a new fission product release path, result in a new fission product barrier failure mode, or create a new sequence of events that would result in significant fuel cladding failures. Therefore, in accordance with 10 CFR 50.12(a)(1), the granting of the exemptions will not present undue risk to the public health and safety.

3.1.3 Consistent with Common Defense and Security

The proposed exemptions would allow changes to elements of the plant-specific Tier 1 DCD. These proposed exemptions would be permanent exemptions limited in scope to particular Tier 1 Table information. Any changes to Tier 1 information would be subject to the exemption process in Section VIII.A.4 of Appendix D to 10 CFR Part 52. The change does not alter or impede the design, function, or operation of any plant SSCs associated with the facility's physical or cyber security and, therefore, does not affect any plant equipment that is necessary to maintain a safe and secure plant status. In addition, the changes have no impact on plant security or safeguards. Therefore, in accordance with 10 CFR 50.12(a)(1), the staff finds that the exemptions are consistent with the common defense and security.

3.1.4 Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. The rule under consideration in these exemption requests is 10 CFR Part 52, Appendix D, Section III.B., which requires that a licensee referencing the AP1000 Design Certification Rule in 10 CFR Appendix D shall incorporate by reference and comply with Appendix D, including Tier 1 information. The underlying purpose of the Tier 1 information is to ensure that a licensee will safely construct and operate a plant based on the certified information found in the AP1000 DCD, which was incorporated by reference into the VEGP's licensing bases. The proposed changes in Tier 1 of the plant-specific DCD would change the information related to the design of

the shield building roof and maintains the design functions of the systems. These changes will enable SNC to safely construct and operate the AP1000 facility consistent with the design certified by the NRC, by updating information related to the shield building roof in Tier 1 of the plant-specific DCD.

Special circumstances are present in the particular circumstances discussed in LAR-16-031 because the application of the specified Tier 1 information does not serve the underlying purpose of the rule. More specifically, the underlying purpose of this Tier 1 information is to provide system configurations that are acceptable to safely construct and operate the plant. The changes in the LAR amend Tier 1 information so that the shield building roof can be actualized in construction without changing the design function. Therefore, staff concludes these proposed changes serve the underlying purpose of the rule. These exemption requests and associated revisions to Tier 1 demonstrate that the applicable regulatory requirements will continue to be met. Based on the foregoing reasons, the staff finds that the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of exemptions from the Tier 1 information exist.

3.1.5 Special Circumstances Outweigh Reduced Standardization

Under 10 CFR 52.63(b)(1) "[i]n addition to the factors listed in § 52.7, the Commission shall consider whether the special circumstances that § 52.7 requires to be present outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption." These exemptions would allow the implementation of changes to Tier 1 in the plant-specific DCD as proposed in the LAR so that the design functions of the system associated with this request are consistent with the current design of the plant in supporting the actual system functions. These exemptions from the certification information will enable SNC to safely construct and operate the AP1000 facility consistent with the levels of safety afforded in the design certified by the NRC in 10 CFR Part 52, Appendix D. Consequently, any decrease in safety impact that may result from any reduction in standardization caused by the exemptions is minimized, because the changes ensure that the shield building roof functions are met during various modes of operation. In addition, the design functions of the systems associated with this request will be maintained. Based on the foregoing reasons, as required by 10 CFR Part 52.63(b)(1), the staff finds that the special circumstances outweigh the effects the departure has on the standardization of the AP1000 design.

3.1.6 No Significant Reduction in Safety

These exemptions would allow the implementation of changes to Tier 1 in the plant-specific DCD as proposed in the LAR. The exemption requests propose to depart from the certified design by making departures in the plant-specific DCD from the generic AP1000 DCD, and the changes ensure that the shield building roof functions are met during various modes of operation. The proposed changes in this LAR do not affect any function or feature used for the prevention and mitigation of accidents or their safety analyses. The proposed changes do not involve or interface with any SSC, accident initiator, or initiating sequence of events related to the accidents evaluated, and therefore do not have an adverse effect on any SSC's design function. The proposed changes would not adversely affect the ability of the shield building roof to perform its design functions, and the level of safety provided by the current systems and equipment would be unchanged. Therefore, based on the foregoing reasons and as required by 10 CFR Part 52, Appendix D, Section VIII.A.4, the staff finds that granting the exemptions would not result in a significant decrease in the level of safety otherwise provided by the design.

3.2 TECHNICAL EVALUATION OF PROPOSED CHANGES

The staff's evaluation of various aspects of the proposed changes included in the LAR are summarized below.

3.2.1 Structural Engineering Evaluation

In performing the technical evaluation, the staff considered VEGP Units 3 and 4 UFSAR, Section 3.8.4, "Other Category I Structures," Tier 1, and corresponding COL Appendix C. The staff also examined portions of NUREG-1793, Supplement 2, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design" (NUREG-1793) (ADAMS Accession No. ML112061231), and "The Final Safety Evaluation Report for the Vogtle Electric Generating Plant Units 3 and 4 Combined License Application" (ADAMS Accession No. ML110450302), documenting the staff's technical evaluation of those aspects of the AP1000 DCD and VEGP COL application, respectively. The staff review of the LAR follows the guidance and structural acceptance criteria in Area 5 of SRP Section 3.8.4. The focus of the review was to determine whether the proposed changes can adversely impact the functions of the PCCWST walls, shield building roof, tension ring, and air inlets structure. The shield building was designed to withstand various loading conditions including the SSE in combination with other applicable design-basis loads. The review also included a check on whether the same DCD methodology has been used for SNC's evaluation of the proposed changes.

In this LAR, SNC proposed to depart from the plant-specific DCD, Tier 1 information with corresponding changes to the associated COL Appendix C information, Tier 2*, and Tier 2 information by revising the UFSAR to: (1) change the size of the roof radial beams and the material of the roof radial and circumferential beams and provide alternate beam options (CA #1 and CA #2); (2) change the reinforcement in the shield building conical roof and the PCCWST walls and make changes to the design details of the shield building tension ring and air inlet structure (CA #3); (3) update UFSAR tables, sketches and figures to reflect CA #1 through CA #3 changes and to remove redundant information or excessive details (CA #4); (4) add a note that the design of the reinforcement in the roof and the design details of the tension ring and air inlets portions of the shield building can vary from the typical design details (critical sections) described in the UFSAR (CA #5); and (5) remove tie rods between the shield plate and the shield building roof beams in the UFSAR and Appendix C of the COL (and associated plant specific Tier 1) figures (CA #6).

The AP1000 conical shield building roof consists of reinforced concrete slabs over steel plates that are installed on the radial beams and the circumferential beams. The PCCWST is supported above the compression ring by the conical roof at the center. The entire roof is supported by the tension ring at the top of the cylindrical shield building walls.

The staff's technical evaluation of these change activities and the impact of the changes to the safety of the nuclear power plant are discussed in Subsections 3.2.1.1 through 3.2.1.6 of the safety evaluation report (SER) below.

3.2.1.1 Structural Evaluation of Change Activities CA #1 and CA#2 – Roof Beam Size Change and Roof Beam Material Substitution

In the LAR, SNC proposed to change the shield building roof beams including: 1) the thirty-two radial beams spanning between the compression ring in the center of the shield building roof and the tension ring above the shield building cylindrical wall, and 2) the circumferential beams spanning between the radial beams. These beams support the reinforced concrete shield

building roof and the PCCWST. The proposed changes can be grouped into three categories: 1) the change of the size of the roof radial beams, 2) the material substitution of the roof radial and circumferential beams, and 3) the changes to UFSAR subsections, tables, and figures. These three categories of changes are evaluated below.

3.2.1.1.1 Change of Size of the Roof Radial Beams

The LAR indicates that the radial beams that the DCD originally specified as W36x393 are no longer manufactured, and so SNC proposed to change the size of these radial beams from W36x393 to W36x395. The nominal size of W36x395 is 0.6 inches greater than that of W36x393 from the outside flange surface to outside flange surface. In its technical evaluation of the LAR, SNC indicated that its design calculations confirmed that the shield building roof design using W36x395 beams satisfies the requirements of American Institute for Steel Construction (AISC) N690-1994, "Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities," and that the change in beam size does not significantly affect the shield building seismic model. The staff evaluated the effect of the above radial beam size change in terms of major section properties, which are shown in the table below:

Beam size	Weight	Depth	Web thickness	Flange width	Flange thickness	Area	Section modulus	Moment of inertia
Symbol (dimension)	W_t (lb/ft)	d (in)	t_w (in)	b_f (in)	t_f (in)	A (in^2)	S_x (in^3)	I_x (in^4)
W36X393	393	37.8	1.22	16.8	2.20	115	1450	27500
W36X395	395	38.4	1.22	16.8	2.20	116	1490	28500
Ratio	1.005	1.016	1.000	1.000	1.000	1.009	1.028	1.036

The only dimensional change is the beam depth being increased by 0.6 inches, which leads to minor changes to other section properties such as linear weight, area, elastic section modulus, and moment of inertia. The largest change of 3.6 percent occurs for the moment of inertia. Therefore, the effect of the beam size change on the shield building seismic model is not expected to be significant and the seismic responses in these beams and other locations in the shield building are not expected to change significantly. In addition, SNC utilized the new beam size in its design calculation and found that the shield building roof design using new W36x395 beams meets the requirements of AISC N690-1994. Therefore, the staff finds SNC's proposed size change from W36x393 to W36x395 for the thirty-two radial beams is acceptable.

3.2.1.1.2 Material Substitution of the Radial and Circumferential Beams

Per AISC N690-1994 Section Q1.4.1, the shield building roof radial and circumferential beams are required to pass Charpy V-Notch impact tests at very low temperatures, to ensure their performance during postulated impact loads, such as design basis tornado generated missiles and a beyond design basis aircraft impact. The rolled wide flange radial and circumferential beams in the shield building roof are not generally available in a material that will satisfy the

required impact testing. Therefore, SNC proposed two options for the roof radial beams and roof circumferential beams. Option 1 was hot rolled shapes (W36x395 for roof radial beams, and W36x135 for roof circumferential beams), where the size change of radial beams is evaluated in Subsection 3.2.1.1(A) of this SE. Option 2 was to substitute the material of radial and circumferential beams with the built-up plate girders (BU36x395 for roof radial beams, and BU36x135 for roof circumferential beams) with material specification American Society for Testing and Materials (ASTM) A572, Grade 50. The section dimensions and flange-to-web weld options are specified in UFSAR Figure 3H.5-11, Sheet 1 of 6, evaluated in this section.

The staff reviewed the sections for the built-up girders shown in UFSAR Figure 3H.5-11, Sheet 1 of 6, and found that those section dimensions of the built-up girders are specified to be equal or greater than those of the rolled shapes. Comparing the size of BU36x395 with one of W36x395, the web thickness and the flange thickness of BU36x395 are about ¼" and 1/16" larger than those of W36x395, respectively. The table below shows the values of the section dimensions and properties for BU36x395 and W36x395. The largest change of 23 percent occurs to the web thickness, while other changes are relatively small.

Beam size	Weight	Depth	Web thickness	Flange width	Flange thickness	Area	Section modulus	Moment of inertia
Symbol (dimension)	W_t (lb/ft)	d (in)	t_w (in)	b_f (in)	t_f (in)	A (in^2)	S_x (in^3)	I_x (in^4)
BU36X395	432	38.4	1.50	16.9	2.25	127	1546	29666
W36X395	395	38.4	1.22	16.9	2.20	116	1490	28500
Ratio	1.094	1.000	1.230	1.000	1.023	1.095	1.038	1.041

Comparing the size of BU36x135 with one of W36x135, the flange width remains the same; however, the depth of the BU36x135 is about 7/8” larger than the depth of W36x135, and the web thickness and flange thickness of the BU36x135 are about 1/8” and 3/16” larger than those of W36x195. The table below shows the values of the section dimensions and properties for BU36x135 and W36x135. The area, elastic section modulus, and moment of inertia for BU36x135 are increased by at least 26 percent comparing with those of W36x135.

Beam size	Weight	Depth	Web thickness	Flange width	Flange thickness	Area	Section modulus	Moment of inertia
Symbol (dimension)	W_t (lb/ft)	d (in)	t_w (in)	b_f (in)	t_f (in)	A (in^2)	S_x (in^3)	I_x (in^4)
BU36X135	170	36.4	0.75	12.0	1.00	49.8	553	10049

W36X135	135	35.6	0.6	12.0	0.79	39.7	439	7800
Ratio	1.259	1.022	1.250	1.000	1.266	1.254	1.260	1.288

Based on the above comparisons, the staff finds the built-up girders (Option 2) lead to a stronger roof system than the rolled shapes (Option 1). This finding is consistent with SNC's evaluation of the built-up plate girders through design calculations which found that the built-up plate girders have lower maximum-demand-to-capacity ratios than the rolled shapes. The maximum-demand-to-capacity ratios are governed by the axial and bending stresses for the built-up plate girders and the hot rolled W beams. In addition, the somewhat larger sectional properties for BU36x135 make the roof more rigid, which does not significantly affect the overall shield building seismic responses. It should be noted that rigid roofs/floors are often assumed in seismic analysis of buildings. Therefore, the staff concludes that the section properties of the built-up plate girders as alternates to the hot rolled beam shapes are acceptable.

In addition to section properties and strength, SNC indicated in the LAR that the material for the built-up plate girders complies with the applicable material specification (ASTM A572, Grade 50) and satisfies the impact test requirements. The staff confirmed that the applicable material specifications (ASTM A572, Grade 50) are included in UFSAR Table 3.8.4-6, "Materials Used in Structural and Miscellaneous Steel," and they are previously approved for application in nuclear island structures. On this basis, the staff finds the material specification for the built-up plate girders acceptable.

In the LAR, SNC provided the welding information for the flange-to-web weld options used for fabricating plate girders in UFSAR Figure 3H.5-11 (Sheet 1 of 6) markup. Three flange-to-web weld options for the built-up girders BU36x395 and BU36x135 are: 1) continuous double Partial Joint Penetration (PJP) with reinforcing fillet welds; 2) continuous double fillet welds; and 3) continuous Complete Joint Penetration (CJP) welds. The maximum demand to capacity ratio of the built-up plate girder for the roof radial beam is 0.72, and is governed by the axial and bending stress. The maximum demand to capacity ratio of the built-up plate girder for the roof circumferential beam is 0.26, and is governed by the axial and bending stress. The design of the built-up plate girders related to the materials and welding requirements is based on AISC N690-1994, Sections Q1.4.1, Q1.5.3, and Q1.15.13. The fabrication and erection of the built-up plate girders are based on ASTM A572, AISC N690-1994, Sections Q1.4.1, Q1.17, and Q1.23. During a meeting between the staff and SNC, SNC stated that the welding would be in accordance with American Welding Society (AWS), "Structural Welding Code – Steel," D1.1. Specifically, as stated in the LAR, procedure qualifications shall be in accordance with Sections 3.1 through 3.13. Qualification testing for both welding procedures specifications (WPS) and welding personnel performance qualifications shall be in accordance with AWS D1.1, Sections 4.1 through 4.15 through 4.25, and 4.30 through 4.32. The fabrication and erection of the welded assemblies shall be meet the requirements of AWS D1.1, Sections 5.1 through 5.19, 5.21 through 5.24, and Sections 5.26 through 5.31 for fillet, PJP, and CJP groove welds. The inspection of the built-up plate girders will be performed based on AISC N690-1994 Section Q1.26 and AWS D1.1 Section 6. All procedures for welders and nondestructive inspectors/examiners (NDE) are required to be qualified and approved by SNC prior to performing production. In addition, all welders/welding operators and NDE personnel are required to be qualified prior to performing production. The staff compared these codes and standards with those listed in UFSAR Section 3.8.4.2, "Applicable Codes, Standards, and Specifications," and found them to be consistent.

The staff reviewed these three welding options for the built-up plate girder, and performed a confirmation analysis for the weld demand and capacity of girder flange to web. The staff finds these welds are able to transfer the required shear loads, and these welds are designed in accordance with AISC N690-1994 and AWS D1.1. SNC also confirmed by their calculations that the maximum demand of the built-up plate girder is less than its capacity for both radial and circumferential Beams. On this basis, the staff finds these three welding options for the built-up plate girder acceptable.

3.2.1.1.3 Changes to UFSAR subsections, tables and figures

In the LAR, SNC provided UFSAR markups to show the required UFSAR changes associated with the proposed size change to the roof radial beams. These UFSAR changes include:

- Removing the size designation of the roof beam in UFSAR Subsection 3H.5.6.1
- Revising the designation of the roof beam in UFSAR Table 3H.5-15 and Figure 3H.5-11 to W36x395
- Removing redundant references to beam size on UFSAR Figures 3H.5-11, Sheets 2, 3, and 4 of 6, 3H.5-14, and 3H.5-15
- Removing redundant reference to circumferential beam size from UFSAR Figure 3H.5-11, Sheets 2, 4, and 5 of 6
- Changing, on UFSAR Figure 3H.5-11, Sheet 1 of 6, the circumferential beam size of W36x135 shown on the right side of the figure near the connection of the radial beam with the tension ring and midspan of the radial beam below the exterior wall of the PCCWST

The staff reviewed the proposed changes to the UFSAR text, tables and figures. In addition to changing the beam designation for W36x395 in UFSAR Figure 3H.5-11 and Table 3H.5-15, additional text is removed to avoid redundancy, including the removal of references to circumferential beam W36x135. The staff's review finds that these changes to UFSAR are consistent with the proposed size change of the roof radial beams. On this basis, the staff finds the proposed UFSAR changes associated with the proposed size change to the roof radial beams to be acceptable

In the LAR, SNC also added Notes 6 and 7 to UFSAR Figure 3H.5-11, Sheet 1 of 6, to clarify two options for the shield building roof beams, and a note to UFSAR Table 3H.5-15 to identify that that the beams can be fabricated plate girders. The staff finds these added notes are consistent with the staff's technical evaluation described in Subsection 3.2.1.1(B), "Material Substitution of the Radial and Circumferential Beams," of this SER. Based on this review and discussion, the staff finds SNC's proposed size change to roof radial beams and the use of built-up plate girders (BU36x395 and BU36x135) with the specified material as alternate roof beams to be acceptable.

3.2.1.2 Structural Evaluation of CA#3 – Changes to Reinforcement in PCCWST Walls and Shield Building Conical Roof and Air Inlet Structure

In the LAR, SNC proposed three categories of changes for CA#3: (1) reinforcement changes due to Detailing Requirements, (2) reinforcement changes due to changes in demands, and (3) steel plate changes in air inlet region. The staff's evaluation of these three categories of changes for CA#3 is presented in Subsections 3.2.1.2.1 and 3.2.1.2.2 below. Subsection 3.2.1.2.1 evaluates the three categories in a generic manner, and Subsection 3.2.1.2.2 evaluates the individual changes to the license basis.

3.2.1.2.1 General Evaluation of Three Categories of Changes for CA#3

3.2.1.2.1.1 Reinforcement Changes due to Detailing Requirements

In the LAR, SNC indicated that design finalization and review of the reinforcement design determined that changes to shear ties in the PCCWST wall are required to fully conform to the detailing requirements of American Concrete Institute (ACI) 349-01, "Code Requirements for Nuclear Safety Related Concrete Structures," Section 11.5.4. Other changes in the reinforcement in the PCCWST walls, in the area at the interface of the PCCWST walls with the shield building roof, and in the shield building roof are required to: (1) be consistent with the changes in the shear ties, (2) satisfy ACI 349 detailing requirements, and (3) facilitate installation of the reinforcement. The staff finds that this type of reinforcement changes is acceptable because the resultant reinforcements do not change the required reinforcement area and they satisfy the ACI 349-01 detailing requirements. However, due to the large number of proposed reinforcement changes, they are evaluated in more detail in Subsection 3.2.1.2.2 of this SER below.

3.2.1.2.1.2 Reinforcement Changes due to Changes in Demands

In the LAR, SNC proposed changes in the values of required steel area and the ratios of required area to provided area of steel for the shield building roof on UFSAR Tables 3H.5-9 and 3H.5-15 due to: (1) changes in the demands of the shield building roof resulting from updates of the analysis data post-process macros; and (2) updates of demand calculations associated with Note 2[2] in UFSAR Table 3.8.4-2 by using load combination factor of 0.9 for dead load when combined with upward seismic loads.

3.2.1.2.1.3 Steel Plate Changes in Air Inlet Region

On UFSAR Figure 3H.5-11, Sheet 3 of 6, SNC proposed to change the original ¾ inch thick steel plates to 1 inch thick plates, near the bottom of the air inlet structure where the wall thickness transitions from 4.5 feet in the air inlet region to 3 feet at the top of the shield building cylinder. The air inlet region is 4.5 feet thick with 1 inch thick steel plates on each face. The purpose of this proposed change is to avoid a plate thickness transition within the air inlet structure at an elevation of approximately 251 feet, and for the ease of fabrication and construction.

The staff reviewed proposed changes to steel plates in air inlet region in UFSAR Figure 3H.5-11, Sheet 3 of 6, and found that the transition from 1 inch to ¾ inch does occur at the top portion of the concrete filled steel plate module under the air inlet region and the steel plate thickness

[2] It should be noted that the mention of "Note 2" to UFSAR Table 3.8.4-1 does not indicate that SNC requested a change in that note or the UFSAR Table. It is mentioned to provide context to the statement regarding the need for SNC to request and update to the demand calculations and associated with particular shield building roof changes.

change from ¾ inch to 1 inch will avoid a plate thickness transition within the air inlet structure at elevation of approximately 251 feet, and SNC evaluated these changes with the same methodology used for the shield building roof analysis and design. On this basis, the staff finds the steel plate thickness change from ¾ inch to 1 inch near the bottom of the air inlet structure acceptable.

3.2.1.2.2 Evaluation of Individual Changes to Reinforcements for CA#3

This section lists and evaluates all the 19 proposed changes to the licensing basis associated with CA#3. Some proposed changes listed below are also associated with CA#4, which will be evaluated in the Subsection 3.2.1.3 of this SER below.

3.2.1.2.2.1 Changes associated with UFSAR Figure 3H.5-11, Sheet 5 of 6

In the LAR, SNC proposed changes in the following 19 items to UFSAR Figure 3H.5-11, Sheet 5 of 6. The numbers below correspond to item numbers in Table 1, "Summary of Changes in UFSAR Figure 3H.5-11 Sheet 5," in Enclosure 15 of the LAR-16-031, Revision 2.

1. Passive Containment Cooling System (PCS) Tank Exterior Wall – Vertical Reinforcement
2. PCS Tank Exterior Wall – Shear Ties
3. PCS Tank Exterior Wall – Dowel of Vertical Reinforcement
4. PCS Tank Exterior Wall – Hoop Reinforcement (evaluated in CA#4C)
5. Roof Slab under the PCS Tank – Top Circumferential Reinforcement (evaluated in CA#4C)
6. Roof Slab outside the PCS Tank – Circumferential Radial Reinforcement (evaluated in CA#4C)
7. Roof Slab under/outside the PCS Tank – Bottom Radial Reinforcement (evaluated in both CA#3 and CA#4C)
8. Roof Slab under the PCS Tank – Top Radial Reinforcement (evaluated in both CA#3 and CA#4C)
9. Roof Slab outside the PCS Tank – Bottom Circumferential Reinforcement (evaluated in CA#4C)
10. Roof Slab outside the PCS Tank – Top Radial Reinforcement (evaluated in both CA#3 and CA#4)
11. Roof Top Radial Reinforcement in the Exposed Portion and Stepped into the Non-exposed Portion (evaluated in both CA#3 and CA#4)
12. Roof Top Radial Reinforcement in the Exposed Portion and Stepped into the Non-exposed Portion
13. PCS Tank Exterior Wall to Roof Connection – Stirrups
14. Concrete Clear Cover Information (evaluated in CA#4C)
15. Shear Reinforcement Extent Information (evaluated in CA#4C)
16. Lap Splice Dimension (evaluated in CA#4C)
17. Roof Circumferential Beam (evaluated in CA#1)
18. Roof Slab under/outside the PCS Tank – Shear Ties
19. PCS Tank Exterior Wall – Vertical Reinforcement Splicing Type

The staff reviewed the proposed reinforcement changes to UFSAR Figure 3H.5-11, Sheet 5 of 6, and found the following effects related to reinforcement changes due to detailing requirements: (1) change of reinforcement size and spacing to ease installation of reinforcement; (2) change of spacing for shear ties to conform to ACI 349-01 Section 11.5.4; (3) update of the top radial reinforcement development length to be consistent with design drawing; (4) change of stirrup shape to improve anchoring of the reinforcement into the slab and ease the installation of

reinforcement; (5) update of UFSAR Figure to include crosstie information that is always in the design documents; and (6) change of lap splice to the mechanical coupler for the vertical reinforcement to avoid congestion. In addition to changes in the reinforcement design for the detailing requirements, the staff also reviewed the reinforcement changes resulting from changes in demands, such as top and bottom radial reinforcement, and roof top radial reinforcement. SNC described in the LAR that all the proposed reinforcement changes meet the requirements of ACI 349-01 and are demonstrated in the associated design calculations. The staff reviewed these reinforcement changes and found that none of these changes can have a detrimental effect on the capacity of reinforced concrete structure. The use of mechanical coupler for the splicing of the vertical reinforcement is acceptable to the staff, because it matches the previously approved mechanical coupler as shown in UFSAR Figure 3H.5-11, Sheet 6 of 6. On this basis, the staff considers all these proposed reinforcement changes to UFSAR Figure 3H.5-11, Sheet 5 of 6 to be acceptable.

The staff also reviewed all other effects of proposed changes to UFSAR Figure 3H.5-11, Sheet 5 of 6, and found these effects are: (1) reformatted annotation; (2) removal of layer label that is beyond the level of detail of UFSAR figure; (3) removal of splice length information as it is beyond the level of detail of UFSAR figure; (4) addition of clarification information to allow the reinforcement arranged in two layers; (5) removal of duplicated information; and (6) removal of the beam designation that had already been addressed by CA#1. The splice length of the reinforcement is determined based on the requirements of ACI 349-01, and is generally called out in the design drawings, therefore, removal of splice length information is acceptable to the staff. The staff considers these proposed changes to UFSAR Figure 3H.5-11, Sheet 5 of 6 acceptable because the changes clarified the UFSAR figure or are beyond the level of detail of the UFSAR figure. The staff finds all the proposed changes to UFSAR Figure 3H.5-11, Sheet 5 of 6 to be acceptable.

3.2.1.2.2.2 Changes associated with UFSAR Figure 3H.5-11, Sheet 6 of 6

SNC proposed changes in the following 16 items to UFSAR Figure 3H.5-11, Sheet 6 of 6. The numbers below correspond to item numbers in Table 2, “Summary of Changes in UFSAR Figure 3H.5-11 Sheet 6,” in Enclosure 14 of the LAR-16-031, Revision 2.

1. PCS Tank Interior Wall – Vertical Reinforcement
2. PCS Tank Interior Wall – Hoop Reinforcement
3. Roof Slab near PCS Tank Interior Wall - Top Radial Reinforcement
4. Roof Slab PCS Tank Interior Wall – Bottom Radial Reinforcement
5. PCS Tank Interior Wall to Roof Intersection – Top and Bottom Hoop Reinforcement
6. PCS Tank Interior Wall to Roof Intersection – Tie Bars
7. PCS Tank Interior Wall – Dowels of Vertical Reinforcement at Inner Face of the Tank
8. PCS Tank Interior Wall to Roof Intersection – Hoop Reinforcement on the side surface
9. PCS Tank Interior Wall to Roof Intersection – Closed Stirrups
10. Roof Slab – Top and Bottom Radial Reinforcement

11, 12, 13. Detailed Information (evaluated in CA#4C)

14. Roof Slab – Crossties

15. Intersection – Hairpin

16. Intersection – Stirrup

The staff reviewed the proposed reinforcement changes to UFSAR Figure 3H.5-11, Sheet 6 of 6, and found the following effects related to reinforcement changes due to detailing requirements: (1) change of the reinforcement detailing for ease of construction and/or better configuration; (2) change of vertical reinforcement to the development length in the wall; (3) change of rebar horizontal arrangement to vertical arrangement for ease installation of reinforcement; (4) addition of hairpin and stirrups to match the design documents; (5) update of UFSAR Figure to include crossties, hairpin and stirrups information; and (6) change of reinforcement development through the dowels for ease of construction. In addition in the reinforcement design for the detailed requirements, the staff also reviewed the reinforcement changes resulting from changes in demands, such as the increased steel area of the vertical reinforcement, top and bottom radial reinforcement, tie bars, and closed stirrups. SNC described in the LAR that all the proposed reinforcement changes meet the requirements of ACI 349-01 and are demonstrated in the design calculations. SNC also described in the LAR that the development length of the reinforcement meets requirements of ACI 349-01. The staff found that none of these changes have a detrimental effect on the capacity of reinforced concrete structure. Therefore, the staff considers all the proposed reinforcement changes to UFSAR Figure 3H.5-11, Sheet 6 of 6, to be acceptable.

The staff also reviewed all other effects of proposed changes to UFSAR Figure 3H.5-11, Sheet 6 of 6, and found that these effects also included: (1) reformatted annotation; (2) removal of mislabeled reinforcement information that is not within in the scope of UFSAR figure; and (3) removal of the information that is beyond the level of detail of UFSAR figure. The staff considers these proposed other changes to UFSAR Figure 3H.5-11, Sheet 6 of 6 to be acceptable because they clarified the UFSAR figure or are beyond the level of detail of the UFSAR figure.

3.2.1.2.2.3 Changes associated with UFSAR Tables 3H.5-9 and 3H.5-15

SNC proposed the following changes to UFSAR Tables 3H.5-9 and 3H.5-15, and the governing load combinations identified in the table are changed in some cases.

1. Revise the values in UFSAR Table 3H.5-9, Sheet 1 of 3, for the tension ring for the maximum stress at specified locations, the maximum overall, the steel area required, and the design limit for ratio of required over provided.

2. Revise the values in UFSAR Table 3H.5-9 Sheets 2a, 2b, and 2c of 3 for the air inlet structure reinforcement for the maximum steel area required at specified locations, the maximum overall, steel area required and provided, and the design limit for ratio of required over provided.

3. Revise the values in UFSAR Table 3H.5-9, Sheet 3 of 3, for the exterior wall of the PCCWST for the maximum steel area required at specified locations, the minimum steel area provided, and design limit for ratio of required over provided.

4. Revise the values in UFSAR Table 3H.5-15, for required reinforcement, provided (minimum) vertical and radial reinforcement, and reinforcement ratio for the shield building roof reinforcement at specified sections.

As stated in the Subsection 3.2.1.2.1.2 of this SER, the proposed changes in the values of required steel area and the ratios of required area to provided area of steel for the shield building roof shown on UFSAR Tables 3H.5-9 and 3H.5-15 are required due to changes in the demands and update of calculations associated with Note 2 in UFSAR Table 3.8.4-2. In addition, SNC indicated in the LAR that the design of the shield building roof with the changes to the reinforcement and roof beams satisfies applicable provisions of AISC N690-1994 and ACI 349-01.

The staff reviewed the information on UFSAR Tables 3H.5-9 and 3H.5-15, and identified the changes in the following areas: (1) maximum stresses and the associated load combinations for some stress changes, (2) maximum required steel area, (3) provided streel area, and (4) ratio of maximum required over provided. The staff found that the demands are smaller than the capacities, which is reflected in UFSAR Tables 3H.5-9 and 3H.5-15, and the reinforcement and roof beam design meets the applicable provisions of AISC N690-1994 and ACI 349. On this basis, the staff finds the proposed changes to UFSAR Tables 3H.5-9 and 3H.5-15 to be acceptable.

3.2.1.2.2.4 Changes to UFSAR Figure 3H.5-11, Sheet 3 of 6, regarding steel plate thickness

On UFSAR Figure 3H.5-11, Sheet 3 of 6, SNC proposed to change the steel plates forming the lower portion of the air inlet structure from ¾ inch to 1 inch to achieve uniform steel plates thickness within the area, so that the transition is to be performed on the bottom joint to the underneath SC panel portion. The staff evaluation of this change is provided in Subsection 3.2.1.2.1.3 of this SER.

3.2.1.3 Structural Evaluation of CA#4 – Figure and Sketch Design Finalization Changes

SNC indicated in the LAR that design finalization of the shield building roof, tension ring, and air inlets has resulted in minor design changes to facilitate fabrication and construction and satisfy requirements in ACI 349-01 and AISC N690-1994. These changes result in small changes to the UFSAR sketches and figures. SNC also indicated in the LAR that the UFSAR sketches and figures include information that is redundant or has excessive detail for a UFSAR figure. SNC proposed the following eight changes to CA#4, and the staff's evaluation of these change items is presented as follows:

3.2.1.3.1 Removal of the dimensions from the locator sketches on UFSAR Table 3H.5-9

In the LAR, SNC proposed to remove the dimensions from the locator sketches on UFSAR Table 3H.5-9, Sheets 1 and 2b of 3. The staff reviewed the proposed changes to the locator sketches in UFSAR Table 3H.5-9, Sheets 1 and 2b of 3, and found that these locator sketches are provided to show the location of the sections for the stresses tabulated in this table. Therefore, the information such as dimensions of design features is not needed for these locator sketches, and section names and elevations are sufficient to locate the design features of interest. In addition, some of the dimensional information in these locator sketches is not consistent with the information in UFSAR Figure 3H.5-11, which shows the correct dimensions. On this basis, the staff finds these proposed changes to UFSAR Table 3H.5-9, Sheets 1 and 2b of 3 to be acceptable.

In the LAR, SNC proposed to identify location of sections on sketches relative to roof beams in UFSAR Table 3H.5-9, Sheets 1 and 2b of 3, replace Section 8 with Section 7 in UFSAR Table 3H.5-9, Sheets 2a and 2c of 3, and identify Section 7 in the sketch on UFSAR on UFSAR Table 3H.5-9, Sheet 2b of 3. The staff reviewed the proposed changes to UFSAR Table 3H.5-9,

Sheets 1, 2a, 2b, and 2c of 3, and determined that the purpose of these changes is to identify location of sections on sketches, and replace sections to match the design documents. On this basis, the staff finds these proposed changes to UFSAR Table 3H.5-9, Sheets 1, 2a, 2b, and 2c of 3 to be acceptable because the proposed changes improve the clarity and accuracy to UFSAR Table information.

3.2.1.3.2 Proposed revision of the shear connectors in UFSAR Figure 3H.5-11, Sheets 1, 3, and 6 of 6

On UFSAR Figure 3H.5-11, Sheet 1 of 6, SNC proposed to increase the length of the shear connectors from 6 inch to 12 inch on radial beams under the tank and outside the tank, and the size of the shear connectors on the radial beams remain the same. On UFSAR Figure 3H.5-11, Sheet 3 of 6, SNC proposed to identify the shear connectors on steel plates between radial beams, the size and length of the shear connectors between radial beams remain the same. On UFSAR Figure 3.H.5-11, Sheets 1 and 6 of 6, SNC proposed to change the shear connectors on the top of the curved girder compression ring from two rows to three rows to match the design documents.

The staff reviewed proposed changes to UFSAR Figure 3H.5-11, Sheets 1, 3, and 6 of 6, and found that the purpose of the proposed changes is to clarify the locations of the shear connectors that are different on the radial roof beams and on the steel plates between the roof radial beams and to match the design documents. The proposed changes clarify the different sizes of the shear connectors at different locations. One of the change items involves a technical change - the length of the shear connectors on the radial beams have been doubled to achieve additional anchorage. SNC indicated in the LAR that the adequacy of shear connectors with the revised length is proven through calculations and the shear connectors are evaluated and qualified in accordance with ACI 349-01, Appendix B and AISC N690-1994, Section Q1.11. The rest of the shear connectors in UFSAR Figure 3H.5-11 have not been changed in this LAR. On this basis, the staff finds proposed changes of the shear connectors in UFSAR Figure 3H.5-11, Sheet 1, 3, and 6 of 6 acceptable.

3.2.1.3.3 Removal of the dimensions on UFSAR Figure 3H.5-11, Sheets 3 and 5 of 6 and removal of section from UFSAR Figure 3H.5-11, Sheet 6 of 6

SNC indicated in the LAR that UFSAR Figure 3H.5-11, Sheet 3 of 6, includes construction detail that is not part of the structural design. On UFSAR Figure 3H.5-11, Sheet 3 of 6, SNC proposed to remove from the drawing a steel angle used for fabrication “FLP 1/2"-18" length.”

On UFSAR Figure 3H.5-11, Sheet 5 of 6, SNC proposed to remove the dimensions that show concrete cover, lap splice length, lap slice detailing, layer designation, and tank liner detailing. UFSAR Figure 3H.5-11, Sheet 5 of 6 includes design and fabrication details such as concrete cover, lap splice length, lap splice detailing, layer designation, and tank liner detailing that are inconsistently dimensioned and shown in the figure. The dimensions of the splice lengths are removed because they are changed for the revision of reinforcement size, and splice lengths are controlled by the requirements of ACI 349-01. The layer designation and tank liner detailing are used for reinforcement fabrication and concrete placement, which are not needed for the reinforcement design.

On UFSAR Figure 3H.5-11, Sheet 6 of 6, SNC proposed to remove the section that shows the fabrication details and the plate size for the beam stiffeners. UFSAR Figure 3H.5-11, Sheet 6 of 6, includes a section showing detail beam stiffener fabrication details that are not needed for the

reinforcement design. SNC justified that the removed redundant dimensions or detailed fabrication information are not needed to show reinforcement design.

The staff reviewed the above proposed changes in the LAR, and compared the proposed changes in UFSAR Figure 3H.5-11, Sheets 3, 5, and 6 of 6, with the original figure in the UFSAR. The staff found that the purpose of these proposed changes to UFSAR Figure 3H.5-11, Sheets 3, 5, and 6 of 6, is to remove detailed fabrication information and redundant dimensions, or to avoid inconsistency with revised reinforcement, and staff confirmed that this information is not needed to show reinforcement design. On this basis, the staff finds these proposed changes to UFSAR Figure 3H.5-11, Sheets 3, 5, and 6 of 6, to be acceptable.

3.2.1.3.4 Removal of the redundant dimensions in UFSAR Figure 3H.5-11, Sheets 1 through 5 of 6

On UFSAR Figure 3H.5-11, Sheet 1 of 6, SNC proposed to remove detailed design dimensions and annotations for the air inlet structure, tension ring, and connection to roof beams to tension ring including faceplate thickness and through wall tie plate dimensions, all of which are redundant, with information on UFSAR Figure 3H.5-11, Sheet 3 of 6. SNC also proposed to move detail design information from USFAR Figure 3H.5-11, Sheet 1 of 6 to Sheet 3 of 6, and rename the annotation of tie bars within the tension ring. On UFSAR Figure 3H.5-11, Sheets 2, 3, 4, and 5 of 6, and UFSAR Figures 3H.5-14 and 3H.5-15, SNC proposed to remove redundant beam size information that can be found on UFSAR Figure 3H.5-11, Sheet 1 of 6. In addition, SNC proposed to rename the #6 tie bar as ¾ inch tie bar in UFSAR Table 3H.5-9, Sheet 2c for consistency.

The staff reviewed the proposed changes to UFSAR Figure 3H.5-11, Sheets 1 through 5 of 6, and UFSAR Table 3H.5-9, Sheet 2c, and determined that these changes are to remove redundant information, relocate and rename annotations, or remove detail design dimensions for air inlet structure, tension ring and connection of roof beams to tension ring. Because these changes do not technically affect the design and the necessary information still remains in the UFSAR Figures 3H.5-9 and 3H.5-11, the staff finds these proposed changes to UFSAR to be acceptable.

3.2.1.3.5 Change of the number of digits in angular dimensions for spacing of tie bars and other design elements on UFSAR Figure 3H.5-11, Sheets 2 and 4 of 6

In the LAR, SNC proposed to reduce the number of digits in angular dimensions for spacing of tie bars and other design elements on UFSAR Figure 3H.5-11, Sheets 2 and 4 of 6. SNC indicated in the LAR that the dimensions for the spacing of reinforcement include an excessive number of digits which suggests a level of precision in constructing reinforcement that is not possible. The staff finds these proposed changes reflect common engineering practices in using practical level of precision, therefore the proposed changes to UFSAR Figure 3H.5-11, Sheets 2 and 4 of 6, are acceptable to the staff.

3.2.1.3.6 Change of designations on UFSAR Table 3H.5-15, UFSAR Figures 3H.5-11, Sheet 3 of 6, 3H.5-14, and 3H.5-15

In the LAR, SNC proposed to use “roof beam” as the standard designation for steel beams in the shield building roof. On UFSAR Table 3H.5-15, SNC proposed to change the critical section name “Conical Roof Steel Beams” to “Conical Roof Beams,” and in Note 1 change “Steel beams” and “roof steel beams” to “roof beams.” On UFSAR Figure 3H.5-11, Sheet 3 of 6, SNC proposed to change “ROOF GIRDER” to “Roof Beam.” On UFSAR Figures 3H.5-14 and 3H.5-15, SNC

proposed to change “Roof Girder” to “Roof Beam.” In addition, SNC proposed to change “PCCS water storage tank” to “PCS water storage tank” on UFSAR Figure 3H.5-11, Sheet 1 of 6.

The staff reviewed UFSAR Table 3H.5-15, UFSAR Figures 3H.5-11, Sheet 3 of 6, 3H.5-14, and 3H.5-15, and found that these proposed changes serve to improve consistency regarding the designations of different terms. Therefore, the staff finds the proposed changes in this change item acceptable.

3.2.1.3.7 The change of designation on UFSAR Figure 3H.5-11, Sheet 6 of 6

In the LAR, SNC proposed to add the designation “Curved Girder Compression Ring” to UFSAR Figure 3H.5-11, Sheet 6 of 6. The staff reviewed UFSAR Figure 3H.5-11, Sheet 6 of 6, along with UFSAR Subsections 3.8.4.1.1 and 3H.2.2, and found that the designation of “Curved Girder” is specified in UFSAR Subsections 3.8.4.1.1 and 3H.2.2, and that SNC adding “Curved Girder Compression Ring” to UFSAR Figure 3H.5-11, Sheet 6 of 6, serves to improve consistency between the UFSAR text and the UFSAR figures. On this basis, the staff finds the proposed change to UFSAR Figure 3H.5-11, Sheet 6 of 6, to be acceptable.

3.2.1.3.8 Additional Changes to UFSAR Figure 3H.5-11, Sheet 3 of 6

On UFSAR Figure 3H.5-11, Sheet 3 of 6, SNC proposed to identify the tie plate, tie bars, plate and gusset plates at rebar and change the roof ties above radial roof beams and between radial beams. SNC also proposed to add “DIA. HOLE” after one dimension and update the identification circle of roof hoop reinforcement to match the design documents.

The staff reviewed the proposed changes in UFSAR Figure 3H.5-11, Sheet 3 of 6, and compared the proposed changes with ones in the original UFSAR figure. The staff found that these proposed changes include the clarification of the purpose of the dimension, the addition of the annotation to identify structural elements that are not identified in the current UFSAR figure, and the update of identifying roof hoop reinforcement that is not consistent with the design documents. In addition, the staff found that the roof ties are revised to incorporate the finalized design configurations and improve constructability, and that SNC described in the LAR that the change of roof ties between radial beams satisfies ACI 349-01 detailing requirements. On this basis, the staff finds these proposed changes to UFSAR Figure 3H.5-11, Sheets 3 of 6, to be acceptable.

3.2.1.4 Structural Evaluation of CA#5 – Design Variances with Critical Sections

In the LAR, SNC proposed to revise the description of the critical sections for the shield building roof and connections in UFSAR Subsections 3H.5.6, 3H.5.6.1, 3H.5.6.2, and 3H.5.6.3 to specify that the design details near interferences can vary from that shown in the UFSAR Figure 3H.5-11. SNC proposed to add Notes 1 and 2 to UFSAR Figure 3H.5-11, Sheet 1 of 6, about variations to critical sections in the roof, tension ring, and air inlets structure design. SNC indicated in the LAR that the PCCWST walls, shield building roof, tension ring, and air inlet require local variations in detail design from the critical section to accommodate penetrations and other obstructions, which include openings, penetrations, embedded pipe and conduit. These local variations include reconfiguration of reinforcement in the area of the obstruction or shifting, removing, and redesigning design elements such as tie bars internal to the design of the tension ring and air inlet structures.

The staff reviewed UFSAR Subsections 3H.5.6, 3H.5.6.1, 3H.5.6.2, and 3H.5.6.3, and Notes 1 and 2 to UFSAR Figure 3H.5-11, Sheet 1 of 6, and found that SNC modified UFSAR Subsections 3H.5.6, 3H.5.6.1, 3H.5.6.2, and 3H.5.6.3 to reflect changes made to UFSAR

Figure 3H.5-11, Sheet 1 of 6. The staff also reviewed UFSAR Figure 3H.5-11, Sheet 1 of 6, and found this UFSAR figure shows the typical design of critical sections in the shield building air inlet region, tension ring, and conical roof. The staff finds that the proposed changes adding Notes 1 and 2 to UFSAR Figure 3H.5-11, Sheet 1 of 6, and the proposed changes to UFSAR Subsections 3H.5.6, 3H.5.6.1, 3H.5.6.2, and 3H.5.6.3, are acceptable because the design element details shown for the shield building roof and PCS tank, and the reinforcement and design features shown for the tension ring and air inlet structure in UFSAR Figure 3H.5-11, Sheet 1 of 6, are for critical sections only and do not apply to areas located near openings, penetrations, or other obstructions.

In the LAR-16-031, Revision 2, Enclosure 14, SNC also proposed to remove “Weep hole” from UFSAR Figure 3H.5-11, Sheet 3 of 6. Since the weep holes in the tension ring do not occur in all sections, they can be considered as variation of the typical critical section for the tension ring constructability. The weep holes are provided as one way of inspection to ensure all voids in the tension ring are filled by concrete. The staff reviewed UFSAR Figure 3H.5-11, Sheet 3 of 6, and finds removal of a description “Weep hole” from UFSAR Figure 3H.5-11, Sheet 3 of 6, to be acceptable because the removal of this note does not affect the construction quality because weep holes will still be used in the construction and are well defined in construction drawings as indicated by SNC in the LAR.

In addition, SNC proposed to add a Note 3 to UFSAR Figure 3H.5-11, Sheet 1 of 6, identifying that reinforcement size and spacing are based on the requirements in ACI 349-01, and additional reinforcement can be provided for detailing purposes. The staff finds the addition of Note 3 to be acceptable because: (1) the reinforcement design of the shield building air inlet region, tension ring, and conical roof is in accordance with the applicable provisions of ACI 349-01, (2) the size and spacing of the reinforcement are determined based on design loads for the specific locations, and (3) the additional reinforcement can be provided for better detailing and constructability.

Furthermore, SNC proposed to add Notes 4 and 5 to UFSAR Figure 3H.5-11, Sheet 1 of 6, to address variation and requirements for the design of the beam supports for the radial roof beams and connections to the beams. SNC indicated in its technical evaluation of this LAR that the design of these structures with variations in design is in conformance with the design and analysis requirements for the structures identified in the UFSAR, including the requirements of AISC N690-1994 and ACI 349-01. These variations, including the stiffeners, attachments to the beams, variations to design details of the beam support and connection configuration, including the use of plates, structural shapes, and stiffeners, are based on different loading conditions and geometry, and are designed in accordance with AISC N690-1994 and ACI 349-01. The staff reviewed UFSAR Figure 3H.5-11, Sheet 1 of 6, and found this UFSAR figure shows the typical design of critical sections in the shield building air inlet region, tension ring, and conical roof. The staff notes that critical sections, a fundamental part of the 10 CFR Part 52 approach, will have variations in the detailed design. The variations are used to accommodate local structural features and are accommodated without reducing the overall seismic performance of the shield building. The staff reviewed UFSAR Section 3.8.4.2, “Applicable Codes, Standards, and Specifications,” and confirmed that both AISC N690-1994 and ACI 349-01 were approved for use in nuclear island structures. On this basis, the staff finds the proposed additions of Notes 4 and 5 to UFSAR Figure 3H.5-11, Sheet 1 of 6, to be acceptable.

3.2.1.5 Structural Evaluation of CA#6 – Removal of Tie Rods

In the LAR, SNC proposed to remove the tie rods connecting the shield plate to the roof radial beams that support the shield building conical roof. SNC also proposed to change the following licensing basis:

- Remove the tie rods from UFSAR Figures 1.2-13, 1.2-14, 3.7.2-12 (Sheet 8 of 12), 3H.5-1 (Sheet 3 of 3), 6.2.4-13, and 9A-1 (Sheets 10 and 11 of 16); and
- Remove the tie rods from UFSAR Figures 3.3-1 and 3.3-2 of Appendix C of the COL (and associated plant-specific Tier 1).

A shield plate is installed below the chimney through the PCCWST to provide radiation shielding for the area of the chimney. The shield plate is constructed with steel and concrete and is fully supported by the steel truss hung form the curved girder compression ring. SNC described in the LAR that the vertical members of the steel truss are connected to the compression ring by moment connections and the cross bracings of the steel truss provide horizontal restrains to the shield plate. The original design of the shield plate support included tie rods that connect the shield plate to the radial beams to stabilize the shield plate. However, SNC indicated in the LAR that its structural analysis of the shield building model has shown that without the tie rods, the steel truss alone is adequate to support and stabilize the shield plate.

The staff reviewed UFSAR Section 3.8.4 and did not find any description of the tie rods regarding their design (e.g., type of section and size). These tie rods are shown in UFSAR Figures 1.2-13, 1.2-14, 3.7.2-12 (Sheet 8 of 12), 3H.5-1 (Sheet 3 of 3), 6.2.4-13, 9A-1 (Sheets 10 and 11 of 16), and other UFSAR Figures 3.3-1 and 3.3-2 in Appendix C of the COL (and the associated plant specific Tier 1 information), but their section and size information is not shown in these figures. The staff's finding is consistent with SNC's indication that the tie rods are not included in the design and structural analyses of the shield building roof and the support of the shield plate. The staff further reviewed UFSAR Figures 1.2-13, 1.2-14, 3.7.2-12 (Sheet 8 of 12), 3H.5-1 (Sheet 3 of 3), 6.2.4-13, 9A-1 (Sheets 10 and 11 of 16), and other UFSAR Figures 3.3-1 and 3.3-2 in Appendix C of the COL (and the associated plant specific Tier 1 information), and found that these changes to the licensing basis are consistent with the proposed removal of the tie rods connecting the shield plate to the radial beams that support the shield building conical roof. On this basis, the staff concludes that removal of the tie rod information from the licensing basis documents is acceptable, because the tie rods are not needed to provide support/stabilization to the shield plate, and the steel truss alone is adequate to support and stabilize the shield plate.

3.2.1.6 Aircraft Impact Evaluation

In the LAR, SNC described that all the proposed changes to the reinforcements in the PCCWST walls and shield building conical roof are due to the changes in the demands of the shield building roof resulting from: (1) updates of the analysis data post-process macros and (2) updates of calculations to implement Note 2 in UFSAR Table 3.8.4-2 by using load combination factor of 0.9 for dead load when combined with upward seismic loads. In addition, SNC confirmed by calculations that the revised reinforcements in the PCCWST walls and shield building conical roof have larger area of steel reinforcement than the original design (which was also verified by the staff) and have negligible impact to the mass and stiffness of concrete section. On this basis, the staff finds that the revised reinforcements do not change the results and conclusions of aircraft impact assessment.

3.2.2 Summary of Technical Evaluation

The staff reviewed SNC's proposed structural changes provided in the LAR. Based on the staff's technical evaluation, the staff finds that:

A. (CA#1 & CA#2) The proposed changes to roof beam size and material are acceptable because the shield building roof design using the new W36x395 beams meets the requirements of AISC N690-1994, and the design, fabrication, erection, and inspection of the built-up plate girders are based on ASTM 572, AISC N690-1994, and AWS D1.1. SNC provided sufficient justification for variations in the design of the roof radial beams, roof circumferential beams, and welding of the built-up plate girders. These changes are acceptable as they meet the structural acceptance criteria in Area 5 of SRP Section 3.8.4.

B. (CA#3) The proposed changes to reinforcements in PCCWST and shield building conical roof and air inlet structure are acceptable because the revised reinforcement design meets the requirements of ACI 349-01, and the steel design meets the requirements of AISC N690-1994. SNC provided sufficient justification for variations in the design of reinforcing bars and splices, tie bars, shear ties, stirrups, crossties, hairpins, and steel plates. These changes are acceptable as they meet the structural acceptance criteria in Area 5 of SRP Section 3.8.4.

C. (CA#4) The proposed changes to the figure and sketch design finalization changes are acceptable because the design meets the requirements of AISC N690-1994 and ACI 349-01. The proposed changes are to provide clarity, remove redundancy, improve constructability, and improve consistency within the licensing basis and with the design documents. SNC provided sufficient justification for variations in the design of the shear connectors. These changes are acceptable as they meet the structural acceptance criteria in Area 5 of SRP Section 3.8.4.

D. (CA#5) The proposed changes to design variances with critical sections are acceptable because the modified UFSAR texts, and the addition of notes to UFSAR figures reflect changes made to UFSAR figures and provide design variations with critical sections. SNC provided sufficient justification for variations to critical sections in the roof, tension ring, and air inlets structure design. These changes are acceptable as they meet the structural acceptance criteria in Area 5 of SRP Section 3.8.4.

E. (CA#6) The proposed changes to removal of tie rods are acceptable because the tie rods are not included in the design and structural analyses of the shield building conical roof. SNC provided sufficient justification for the removal of tie rods. These changes are acceptable as they meet the structural acceptance criteria in Area 5 of SRP Section 3.8.4.

For the reasons specified above, the staff finds that the proposed UFSAR changes to Subsections 3H.5.6, 3H.5.6.1, 3H.5.6.2, and 3H.5.6.3 are acceptable. The staff also finds that the proposed changes to UFSAR Figures 3H.5-11 (Sheets 1 through 6 of 6), 3H.5-14, 3H.5-15, 3H.5-1(Sheet 3 of 3), 1.2-13, 1.2-14, 3.7.2-12, 6.24-13, 9A-1 (Sheet 10, 11 of 16), Tier 1 and corresponding COL Appendix C, Figures 3.3-1, 3.3-2, and UFSAR Table 3H.5-9 (Sheets 1, 2a, 2b, 2c, 3 of 3), and Table 3H.5-15 to be acceptable.

Based on these findings, the staff concludes that there is reasonable assurance that the requirements of: GDC 1, GDC 2, GDC 4, 10 CFR 50.150, and Appendix S to 10 CFR Part 50 will continue to be met. Therefore, the staff finds the proposed changes to be acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission regulations in 10 CFR 50.91(b)(2), the designated Georgia State official was consulted. The State official had no comment (dated November 29, 2017).

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20, "Standards for Protection Against Radiation." Based on the staff evaluation and conclusion stated in Section 3.2, the staff determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (82 FR 13019 published on March 8, 2017). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

Because the exemptions are necessary to allow the changes proposed in the license amendment, and because the exemptions do not authorize any activities other than those proposed in the license amendment, the environmental consideration for the exemptions is identical to that of the license amendment. Accordingly, the exemptions meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the exemptions.

6.0 CONCLUSION

The staff has determined that pursuant to Section VIII.A.4 of Appendix D to 10 CFR Part 52, the exemptions (1) are authorized by law, (2) present no undue risk to the public health and safety, (3) are consistent with the common defense and security, (4) are a special circumstance that outweighs the reduction in standardization, and (5) do not significantly reduce the level of safety at SNC's facility. Therefore, the staff grants the exemptions from the Tier 1 information specified by SNC.

The Commission has concluded, based on the considerations discussed in Section 3.2 of this safety evaluation and the staff's confirmation that the changes proposed in this LAR do not change an analysis methodology, or assumptions that there is reasonable assurance that (1) the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission 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. Therefore, the staff finds the changes proposed in this LAR to be acceptable.

7.0 REFERENCES

1. LAR-16-031, Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment and Exception: Shield Building Roof Changes, November 30, 2016

(ADAMS Accession Nos. ML16335A453 and ML16335A454).

2. LAR-16-031, Revision 1, Vogtle Electric Generating Plant Units 3 and 4, Revision to License Amendment and Exception Request: Shield Building Roof Changes, June 16, 2017 (ADAMS Accession Nos. ML17167A335 and ML17167A336).

3. LAR-16-031, Revision 2, Vogtle Electric Generating Plant Units 3 and 4, Revision to License Amendment and Exception Request: Shield Building Roof Changes, October 6, 2017 (ADAMS Accession Nos. ML17279B086 and ML17279B088).

4. Vogtle Electric Generating Plant Units 3 and 4, Updated Final Safety Analysis Report, Revision 6, June 15, 2017 (ADAMS Accession No. ML17172A218).

5. AP1000 Design Control Document, Revision 19, June 13, 2011 (ADAMS Accession No. ML11171A500).

6. Final Safety Evaluation Report for Vogtle Electric Generating Plant Units 3 and 4 Combined License Application, August 5, 2011 (ADAMS Accession No. ML110450302 – FSER package).

7. NUREG-1793, Supplement 2, “Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design,” August 5, 2011 (ADAMS Accession No. ML112061231).

8. NUREG-0800, “Standard Review Plan for the Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” Section 3.8.4, Revision 4, March 2007 (ADAMS Accession No. ML13198A258).

9. American Concrete Institute, “Code Requirements for Nuclear Safety Related Concrete Structures,” ACI 349-01.

10. American Institute of Steel Construction, “Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities,” AISC-N690-1994.

11. American Welding Society, “Structural Welding Code - Steel,” D1.1