

SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS
RELATED TO AMENDMENT NOS. 101 AND 100
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 May 10, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17130A999), Southern Nuclear Operating Company, Inc., (SNC) 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 SNC proposed license amendment request (LAR) 17-016 consists of changes to the Updated Final Safety Analysis Report (UFSAR) in the form of departures from the incorporated plant-specific Design Control Document (DCD) Tier 2* and Tier 2 information (text, tables, and figures). Specifically, the amendment consists of changes related to revising the design reinforcement in the roof of the auxiliary building and the design of the girders supporting the roof.

In a letter dated May 10, 2017, SNC stated that the changes proposed in LAR 17-016 are consistent in technical content with LAR 16-03, submitted by South Carolina Electric and Gas Company (SCE&G) on June 28, 2016 (ADAMS Accession No. ML16181A097) and revised LAR 16-03 R1, submitted by SCE&G, May 3, 2017 (ADAMS Accession No. ML17123A222) that included changes made in response to NRC's comments as identified in Enclosure 3 of SNC's LAR 17-016 submittal.

In a letter dated September 20, 2017, SNC submitted a supplement to LAR 17-016 (ADAMS Accession No. ML17263B024) with a proprietary Enclosure 4 (ADAMS Accession No. ML17263B024) that provided responses to staff's requests for additional information (RAIs)

originally issued to SCE&G on July 19, 2017 (ADAMS Accession No. ML17179A207). On October 18, 2017 (ADAMS Accession No. ML17292A098), SNC provided a clarification to the information provided in Enclosure 4 (Reference 5).

The NRC staff issued an initial *Federal Register* notice of opportunity to request a hearing and a proposed No Significant Hazard Consideration Determination on June 6, 2017 (82 FR 26137). SNC's supplements to the LAR did not change the staff's original proposed no hazard determination.

2.0 REGULATORY EVALUATION

The NRC staff considered the following regulatory requirements in reviewing the LAR that included the proposed UFSAR changes.

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 52, Appendix D, Section VIII.B.6 requires NRC approval for departures from Tier 2* information. Because the proposed amendment request involves changes to Tier 2* information NRC approval is required before making the Tier 2* changes addressed in this departure. 10 CFR Part 52, Appendix D, Section VIII.B.5.a requires prior NRC approval for Tier 2 departures that involve changes to Tier 2* information. The proposed changes affect Tier 2* Tables, text and figures.

10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 1, "Quality Standards and Records," requires that structures, systems, and components (SSCs) 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," requires that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions.

GDC 4, "Environmental and Dynamic Effects Design Bases," requires 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-cooling accidents.

10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," requires that nuclear power plants shall be designed so that, if safe-shutdown earthquake (SSE) ground motion occurs, certain SSCs 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 proposed changes to the Auxiliary Building roof rebar and supporting steel roof girder design are required to comply with applicable and designated portions of American Concrete Institute (ACI) Standard ACI 349-01, "Code Requirements for Nuclear Safety Related Structures," American Institute of Steel Construction (AISC) Standard AISC N690-1994, "Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for

Nuclear Facilities,”; and supplementary requirements as described in Section 3.8.4.5, “Structural Criteria,” of the UFSAR (Reference 7).

3.0 TECHNICAL EVALUATION

3.1 Proposed Changes

The LAR consists of changes related to revising the design reinforcement in the roof of the auxiliary building and the design of the girders supporting the roof. The auxiliary building is a seismic Category I reinforced concrete and structural steel structure. It is a C-shaped section of the nuclear island that wraps around approximately 50 percent of the circumference of the shield building (SB). The floor slabs and the structural walls are structurally connected to the SB. The function of the auxiliary building is to provide protection and separation for the seismic Category I mechanical and electrical equipment located outside the containment; and to provide protection for the safety-related equipment against the consequences of postulated internal or external events. A portion of the SB wall interfacing with the auxiliary building is constructed of reinforced concrete. The design and construction of the reinforced concrete (RC) and steel plate concrete filled composite construction (SC) requires the use of both Standards ACI 349-01 and AISC N690-1994 to address the different components of the connections, including rebar and structural steel components.

The SB is a seismic Category I structure that surrounds the containment vessel. It shares a common basemat with the containment building and the auxiliary building. The SB uses concrete filled steel plate construction as well as reinforced concrete for a portion of the wall. The faceplates of the SC modules are considered as the reinforcing steel, bonded to the concrete by headed studs and tie bars. The overall configuration of the SB is established from functional requirements related to radiation shielding, missile barrier, passive component cooling, and natural disasters such as tornadoes and seismic events.

The roof of the auxiliary building is designed as reinforced concrete slabs in accordance with Standard ACI 349-01. The roof structures in the auxiliary building are constructed with metal decking supporting the wet concrete prior to the concrete setting. The metal decking is supported by steel framing. The auxiliary building roof above the fuel handling area is supported with built up steel plate girders. The design of the roof reinforcement above the fuel handling area, shown in UFSAR Figure 3H.5-7, includes the use of #9, #10, and #11 reinforcement. The portion of the proposed roof reinforcement changes is located above the fuel handling area in Areas 5 and 6 on the south end of the auxiliary building. Design finalization of the cask crane in this portion of the building determined that interference exists between the crane and the girders supporting the roof.

In the LAR, SNC proposed to depart from the UFSAR Tier 2* information by requesting to:

- Change the reinforcement design in the roof of the auxiliary building because the size of the standard hooks does not permit the #10 and # 11 reinforcement to be fully developed in the exterior walls;
- Change the design of the girder supporting the auxiliary building roof to resolve an interference between the girders and the cask crane ;
- Change the information on the spacing of the roof girders to a range of spacing to clarify that the spacing from the edge girder to the adjacent interior girder is 13'-0";

- Change UFSAR to note that the design of the reinforcement and the supporting beam at other locations vary from the typical design information for the critical sections shown in UFSAR Subsection 3H.5.2.1 and UFSAR Figure 3H.5-7 because load and geometry varies in different locations on the roof; and
- Revise applicable sections of UFSAR as a result of the proposed design changes

Roof Reinforcement Changes

SNC proposed to change the reinforcement design in Regions A and B of the auxiliary building roof because the size of the standard hooks does not permit the #10 and # 11 reinforcement to be fully developed in the exterior walls. SNC provided roof reinforcement detail changes in the UFSAR Appendix 3H, Figure 3H.5-7 (Enclosure 2 to Reference 1).

In Enclosure 3 (page 2 of 7) of Reference 2, SNC stated that at the time of the AP1000 certification, the auxiliary building roof reinforcement in Areas 5 and 6 met Standard ACI 349-01 requirements for full development in the surrounding walls as it was based on the assumption that the reinforcement is developed by using standard 90 degree reinforcement hooks without mechanical connectors. However, SNC selected the construction approach that uses standard hooks with mechanical connectors at those locations. By using this approach, the length of the mechanical connector is not credited as development length, which results in the reduction in development length. SNC stated that the #9 and #10 standard hooks with mechanical connectors in the auxiliary building wall along Column Line 4, and the #11 standard hooks with mechanical connectors along Column Lines I and N cannot be fully developed into the auxiliary building walls.

The portion of the proposed roof reinforcement changes is located above the fuel handling area in Areas 5 and 6 on the south end of the auxiliary building. Area 5 is bounded by Column Lines I and J-2 and Column Lines 1 and 4. Area 6 is bounded by Column Lines J-2 and N and Column Lines 1 and 4. The design of the roof reinforcement above the fuel handling area, is shown in UFSAR Figure 3H.5-7 (Reference 2, Enclosure 5). In order to meet Standard ACI 349-01 requirements for full development of reinforcement, SNC proposed to change the detailing of the roof reinforcement above the fuel handling area by using smaller reinforcement bar sizes spaced closer together in areas where the current reinforcement cannot be fully developed in the supporting walls with the use of mechanical connectors.

SNC proposed to change the following reinforcement detail in Regions A and B by specifying the use of the smaller reinforcement bar sizes spaced closer so that they can meet Standard ACI 349-01 requirements for full development of reinforcement into the auxiliary building walls:

- In Region A, the east-west roof reinforcement is changed from #11@12" (1.56 sq. in.) to #8@6" (1.58 sq. in.) to be fully developed into auxiliary building exterior walls along Column Lines I and N,
- A small portion of north-south roof reinforcement in Region A (from Column Line K-2 to approximately 6' to the west of Column Line K-2) is changed from #9@12" (1.0 sq. in.) to #9@6" (2.0 sq. in.),

- The north-south roof reinforcement in Region A remains #9@12" except for a small portion of reinforcement that is to be lap spliced with the closely spaced north-south reinforcement in a portion of Region B (#8@3"), and
- The north-south roof reinforcement dowels along Column Line 4 in Region A are revised from #9@12" (1.0 sq. in.) to #7@6' (1.2 sq. in.).

The roof reinforcement in Region B that is mechanically connected to the SB faceplates as part of the connections between the RC and SC is not changed from the design approved as part of Amendment No. 26 for VEGP Units 3 and 4. However, the remaining east-west roof reinforcement in Region B oriented parallel to Column Line 4 is changed from #11@6' (3.12 sq. in.) to #8@3" (3.16 sq. in.) to achieve full development into the wall on Column Line N. The remaining north-south roof reinforcement in the portion of Region B (from Column Line K-2 to approximately 6' to the west of Column Line K-2) is changed from #10@6" (2.54 sq. in.) to #8@3" (3.16 sq. in.) to achieve full development in the wall on Column Line 4.

Roof Girder Design and Spacing Changes

The auxiliary building roof above the fuel handling area is supported with built up plate girders. SNC proposed to change the design of the roof girders supporting the auxiliary building roof to resolve an interference between the roof girders and the cask crane. The roof girder spacing remains unchanged from the spacing in the VEGP Units 3 & 4 UFSAR, Revision 6. The 14'-2" spacing is specified for girders in the middle, and the spacing from the edge girder to the adjacent interior girder is 13'-0". This is consistent between the original design document and the latest design document. However, the current UFSAR Subsection 3H.5.2.1 did not mention that the edge girder to the adjacent interior girder spacing is 13'-0". SNC proposed a change in the UFSAR to include the 13'-0" spacing condition to specifically address the differing configuration for the edge girder. The size of the girders supporting the roof and the spacing of the girders is provided in UFSAR Figure 3H.5-7 and Subsection 3H.5.2.1, respectively.

SNC revised the design of roof girders to have a smaller depth to permit clearance for the crane. The overall depth of the girder is reduced by 1 ft. and uses thicker plates for the flanges and webs of the girders. The change in the girder design does not change the reinforced concrete design of the roof slabs including the roof reinforcement, concrete, thickness, or dimensions of the metal decking. The reinforced concrete portion of the roof remains in conformance with Standard ACI 349-01.

Specifically, the proposed changes to roof girders design are:

- Flanges changed from 20"x2" to 26"x2 1/2"
- Web changed from 56"x7/16" to 43"x1"
- Intermediate stiffeners on the web previously shown on the girder are removed
- Girders material is changed to A572 Grade 50 from the original steel material and grade (ASTM A36)
- Change the UFSAR to include the 13'-0" spacing condition to specifically address the differing configuration for the edge girder

3.2 Evaluation of Proposed Changes

The staff reviewed SNC's proposed changes to evaluate the impact of the proposed UFSAR changes to the design of the reinforcement in the roof of the auxiliary building and the design of the roof girders on the overall safety of the plant and conformance with 10 CFR 50.55a and GDC 1 and 2. To perform the technical review of the proposed changes, the NRC staff considered sections of the VEGP Units 3 and 4 UFSAR, as well as portions of the AP1000 DCD, Revision 19, NUREG-1793 "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design" and its supplements, and the "Final Safety Evaluation Report for the Vogtle Electric Generating Plant Units 3 and 4 Combined License Application," documenting the staff's technical evaluation of those aspects of the AP1000 DCD and VEGP Units 3 and 4 COL applications, respectively.

During the review, the staff applied the guidance of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 3.8, as well as relevant regulatory guides, with references to related industry standards. The staff's technical evaluation of the LAR focused on verifying whether the proposed changes are consistent with applicable codes and standards, and is carried out using acceptable analysis and design methods. For determining the adequacy of the proposed UFSAR changes, the staff focused its review on the potential effects of the change in roof reinforcement detail and roof girder design on the safety functions of the auxiliary building structures to be constructed at the VEGP site; the design and analysis procedures; the stiffness of the structure; and the local and global response of the overall structure. The staff also reviewed applicable portions of Standards ACI-349-01 and AISC N690-1994 for the slab reinforcement details and the roof girder design.

In Enclosure 5 of Reference 4, SNC submitted its current markup of the UFSAR Table 3H.5-10 that shows the revised governing load combinations, required concrete slab reinforcement, and roof girder design demands. In general, the staff noted that the governing load combinations have changed, and the required concrete slab reinforcement and roof girder design demands are higher than the design bases demands. The staff evaluated the changes in structural design and analysis methodology, governing load and load combinations, required roof reinforcement and the roof girder design and spacing.

Evaluation of Structural Design and Analysis

In order to gain an understanding of the structural design and analysis addressed in the LAR, the staff had previously issued an RAI to SCE&G to provide a comparison summary of the licensing basis and the revised composite concrete-roof girder structural system properties, mass, and natural frequency. These structural parameters collectively represent the key characteristics of the structural system that govern the demands due to applied static and dynamic loads. In Enclosure 3 of Reference 4, SNC responded to the RAI previously issued to SCE&G by providing the requested comparison of the structural parameters. The staff notes from the comparison that there is minimal change (4 percent) in the mass and the natural frequency of the revised concrete-roof girder structural system is changed to 6.02 hertz (Hz) from the original girder frequency of 6.58 Hz. SNC considered the reduced girder spacing of 13' from the edge girder to the adjacent interior girder in the structural model and in the evaluation of the girder design. The change in girder frequency reflects the overall change in the mass and stiffness of the composite roof-girder structural design system.

The comparison of the composite concrete-roof girder system natural frequencies indicates that the revised girder is relatively flexible (6.02 Hz) compared to the original girder (6.58 Hz). The staff notes from the fuel building roof spectra in Appendix G (page 3G-69 through 3G-71) of the VEGP Units 3 and 4 UFSAR, Revision 6 that the spectral acceleration corresponding to the revised girder frequency remains unchanged from the licensing basis acceleration corresponding to 6.58 Hz and, therefore, the applied inertia forces due to seismic loading are expected to remain the same. The resulting overall seismic demand of the revised composite concrete-roof girder structural system, therefore, will essentially remain unchanged. As such, only a minor change in the demands is expected for a given loading because of the minimal change in the overall weight and stiffness of the structure. This comparison further indicates that the overall stiffness of the structure, and therefore the local and global response of the overall structure, will also remain essentially unchanged. The staff notes from the response to staff's Question 1 in Reference 5, Table 1, that the change in the roof girder moment demand for the SSE load combination (without thermal load) compares well (minimal 6 percent difference) with the licensing basis demand. The staff attributes this relatively small difference in the demand to the difference between SNC's hand calculation and the finite element analysis (FEA) methodology that SNC used for computing demands for the licensing basis and the revised structural design, respectively.

Based on SNC's summary of the structural analysis results and the response provided to the staff's question 1, the staff concludes that there is minimal change in the overall weight and stiffness of the structure and as such, there will be minimal impact on the local and global response of the overall structure. SNC's revised structural analysis and resulting demands are reasonable and the changes in structural demand are acceptable. Accordingly, the staff finds that SNC is not departing from the COL design bases methods of structural design and analysis.

Evaluation of Governing Load and Load Combinations Change

The staff reviewed the proposed revision to UFSAR Table 3H.5-10 in Enclosure 5 to Reference 4 and noted some increase in roof girder design demand (24 percent) and in the required slab reinforcement (46 percent). The staff also noted that the governing load combination for the roof girder and the required concrete slab reinforcement is changed from load combination 3 to load combination 7. The main difference between the two load combinations is that load combination 3 includes normal operating thermal load and load combination 7 includes accident thermal load in combination with dead, live, and seismic loads. SNC attributed the increase in the slab reinforcement and roof girder demand to more refined analysis and the combined seismic and thermal loads. In response to the staff's question 1, in Reference 5, SNC provides further clarification and describes the changes that have been made to the structural analysis and how these refinements lead to higher demands in roof girder forces and in the required reinforcement in the concrete slab.

In Reference 5, SNC stated that part of the reason for the difference in demands is that the demands in the UFSAR Table 3H.5-10 were based on hand calculations whereas the demand in the proposed revision to UFSAR Table 3H.5-10 is based on an FEA of the structural model that includes the SB and the auxiliary building roof details. The staff considers that the FEA results reflect a more realistic representation of complex SB and the auxiliary building roof structural system. In response to the staff's RAI, SNC provided (Tables 1, 2, and 3 in Reference 5) a comparison of the difference between the hand calculation of the demand reflected in UFSAR Table 3H.5-10 and the proposed demand obtained directly from the FEA. The comparison shows that the peak difference in demands varies from -6 percent to 10

percent with an average difference of 2 percent. In consideration of the complexity of the analyzed structural system, the difference in the required reinforcement and the roof girder demands between the hand calculation and FEA is minimal and reasonable and, therefore, it meets the design bases requirements and it is acceptable to the staff.

In response to the staff's question (Reference 3), SNC further explained (Reference 5) that the main reason for the increase in the demands in the UFSAR Table 3H.5-10 is that the thermal accident load was not considered and then SNC's response also added in the licensing basis governing load combinations. In Tables 1, 2, and 3 (Reference 5), SNC summarized the contribution of demand due to dead, live, SSE, and the accident thermal loads. Based on its review of Tables 1, 2 and 3, the staff finds that the accident thermal load demand is a significant contributor (6 percent to 36 percent) to the total demand in the proposed controlling load combination. For example, the contribution of accident thermal load towards north-south reinforcement in concrete slab is 36 percent of the total demand. On this basis, the staff concludes that the main reason for increase in the demand in UFSAR Table 3H.5-10 for the required reinforcement in concrete slab and the roof girder is due to the addition of thermal accident load in the governing load combination that was not added before. The staff also notes that since the accident thermal load is now added in the load combinations, the governing load combination will change. Under this LAR, the governing load combination for the roof girder and the concrete slab changes from load combination 3 to load combination 7. The change in governing load combination is expected and therefore acceptable because load combination 7 includes accident thermal load. In the proposed change to UFSAR Table 3H.5-10 in the LAR, SNC proposed to remove Note 1 from UFSAR Table 3H.5-10 since the values in revised Table 3H.5-10 reflect the load combinations including thermal demand. Therefore, Note 1 is no longer needed. On this basis, the staff finds the revised governing load combinations and removal of Note 1 from UFSAR Table 3H.5-10 acceptable.

SNC provided a clarification to the governing load combination 3 for the required concrete slab reinforcement perpendicular to the roof. SNC stated that the largest demand occurs in the roof slab at the intersection with the SB and controls the design. SNC further clarified that most significant contributor to the thermal demand is the effect of the SB "shrinking" under -40°F outside ambient steady-state conditions. Further away from this region, the thermal demand is controlled by the thermal gradient due to an accident thermal temperature of 212°F within the spent fuel pool and the -40°F outside ambient temperature. In Table 4 (References 5 and 6), SNC showed that the difference between the required reinforcement perpendicular to the roof girder for the average normal and accident thermal demands is relatively small (5 percent). The staff finds the thermal behavior and variation of normal thermal and accident thermal loads near the intersection of the roof slab with the SB reasonable because the maximum stress for normal and accident thermal loads occur at different locations consistent with the structural stiffness and the internal and external temperature profiles. On this basis and because the difference in the average normal and accident thermal demands is relatively small (5 percent), the staff finds the governing load combination 3 acceptable for the required concrete slab reinforcement perpendicular to the roof girder. Accordingly, the staff concludes that the changes proposed by SNC are consistent with the structural load combinations referenced in the VEGP Units 3 and 4 UFSAR, Revision 6.

Evaluation of Roof Reinforcement Changes

In Enclosure 5 to Reference 4, SNC provides a proposed revision to UFSAR Table 3H.5-10, "Design Summary of Roof at Elevation 180'-0", Area 6 (near SB Interface)". UFSAR

Table 3H.5-10 provides the governing load combination and acceptance criteria for the concrete roof slab reinforcement. The table shows the governing load combination and the reinforcement requirements in the directions parallel and perpendicular to the roof girders. The staff notes an increase in the required reinforcement from 1.74 in²/ft to 2.54 in²/ft parallel to girders and a change in governing load combination from load combination 3 to load combination 7. Load combination 3 includes gravity loads, SSE, and operating thermal loads whereas the load combination 7 includes gravity loads, SSE, and postulated thermal accident loads as specified in UFSAR Tables 3.8.4-1 and 2. The staff also notes that the required reinforcement in the direction perpendicular to girders also increased from 1.68 in²/ft to 2.37 in²/ft.

In response to the staff's RAIs (Reference 3), in Reference 5, SNC states that it used a more refined FEA model for the detailed structural analysis. It further stated that as a result of the refined analysis, the governing load combination for the roof girders and roof reinforcement along north-south direction (parallel to girder) changed from load combination 3 to load combination 7.

The staff in UFSAR Table 3H.5-10 notes an increase in the reinforcement requirement in both the north-south and the east-west directions primarily due to the addition of accident thermal load in the governing load combination. However, in all cases the required reinforcement is equal or less than that is provided in both the directions. The provided slab reinforcement based on Standard ACI 349-01 is not changed and continues to be more than or equal to the required reinforcement. In the direction parallel to the girders, the required reinforcement is the same as provided (2.54 in²/ft) and in the direction perpendicular to the girders, the required reinforcement is 2.37 in²/ft, which is less than the provided reinforcement of 3.12 in²/ft. The staff also notes that although the demand in the required reinforcement is increased, it does not result in the need for additional reinforcement than already provided for in the existing or current design. Therefore, staff finds that the increase in the reinforcement has no effect on the local and global behavior of the Auxiliary Building and SB structures.

In Enclosure 3 (page 2 of 7) of Reference 4, SNC states that the construction approach at the auxiliary building roof reinforcement uses standard hooks with mechanical connectors in Areas 5 and 6 and meets Standard ACI 349-01 requirements for full development in the surrounding walls by changing the reinforcement detailing to smaller diameter reinforcement bars that are spaced closer together in order to provide equal or greater area of required reinforcement in the auxiliary building roof. For example, in Region A, the east-west roof reinforcement is changed from #11@12" (1.56 sq. in.) to #8@6" (1.58 sq. in.) to be fully developed into auxiliary building exterior walls along Column Lines I and N. The length required for reinforcement development in Standard ACI 349-01, Section 12 is proportional to the reinforcement bar diameter. The diameter of # 11 and # 8 rebar is 1.41" and 1.0", respectively. The change of #11 bar to #8 bar results in the required development length reduction in the ratio of (1.0" diameter / 1.41" diameter = 0.70) or a reduction in the required development length of #8 bar by (1.0-0.7 = 0.3) 30 percent. On this basis, the staff notes that by changing to smaller diameter bar, the required development length is reduced. The staff accepts SNC's approach of changing the reinforcement detail to smaller diameter reinforcement bars that are spaced closer to meet the Standard ACI 349-01 requirements for full development length. The construction of the roof is not changed and the thickness and strength of the reinforced concrete portion of the roof is not reduced by the proposed change.

The staff concludes that SNC in its proposed changes to the reinforcement detail provides smaller diameter bars of an equal to or greater area of the required reinforcement to fully

develop in the auxiliary building walls in accordance with the Standard ACI 349-01 code. The concrete strength, the roof slab thickness and the commitment to governing design Standard ACI 349-01 code remain unchanged from the certified AP1000 design. This change encompasses a relatively small area when compared to the overall structure of the auxiliary building and SB. The local changes in reinforcement detailing are not expected to have any adverse impact on the structural analysis and design or the safety of the overall structure because the configuration, thickness, and the concrete strength of the roof slab remains unchanged.

The proposed change in the reinforcement detailing is acceptable because it did not impact the safety design function of the auxiliary building and SB wall; did not change the local and global response of the SB because the overall change in weight and stiffness of the auxiliary building is minimal.

The proposed revision to UFSAR Table 3H.5-10 with regard to the governing load combination and the amount of required reinforcement in the directions parallel and perpendicular to the roof girders is acceptable.

On the basis of the above, the staff finds the proposed changes to UFSAR Table 3H.5-10 and Figure 3H.5-7 are acceptable.

Evaluation of Roof Girder Design and spacing Changes

In the LAR, SNC revised the design of roof girders to have a smaller depth to permit clearance for the crane. The size of the girders supporting the roof and the spacing of the girders is provided in UFSAR Figure 3H.5-7 and Subsection 3H.5.2.1, respectively. In the LAR, the overall depth of the girder is reduced by 1 ft. and uses thicker plates for the flanges and webs of the girders, intermediate stiffeners on the web are removed, and the girder material is changed to ASTM A572 Grade 50 from the original steel material and grade (ASTM A36).

SNC revised the material grade of the girder from ASTM A36 to ASTM A572 Grade 50 and calculated the allowable shear and bending stresses in accordance with the AISC N690 code used in the certification of AP1000 design. SNC, consistent with Standard AISC N690-1994 Sections Q1.5.1.2.1, and Q1.5.1.4.1, computed the allowable shear and bending stresses of 26.4 kilopound per square inch (Ksi) and 53.0 Ksi respectively by considering the stress limit coefficient of 1.4 for shear and 1.7 for bending stress under abnormal load condition and the reduction factor (0.944) in yield strength at 200°F. The staff finds that the allowable stresses are acceptable since they are based on the code accepted in the AP1000 certified design.

SNC provided the revised stresses in roof girders due to shear and bending moment demands and allowable stresses in UFSAR Table 3H.5-10. The staff finds that the ratio of actual to allowable stress is 0.43 and 0.51 for shear and bending moment demands respectively is well below the acceptable value of 1.0 and therefore the revised roof girder design is acceptable.

In Reference 5, SNC stated that the intermediate stiffeners on the web previously shown on the girder are not needed to prevent buckling per requirements in Standard AISC N690-1994 Section Q1.10.5.3, and therefore are removed. The staff notes that per Standard AISC N690-1994 Section Q1.10.5.3, intermediate stiffeners are not required when the web depth to width ratio (h/t) is less than 260 and the maximum web shear stress is less than the permitted value by Standard AISC N690-1994 Section Q1.10.5.2. In UFSAR Table 3H.5-10, SNC reported a shear force of 553 kilopound (kips) for load combination 7. Based on the

revised web dimension of 43'x1", the maximum web shear stress is $553/43 = 12.9$ Ksi that is less than the permitted shear stress value of 26.4 Ksi per Standard AISC N690-1994 for load combination 7. Therefore, the staff concludes that no intermediate web stiffener is required for the revised girder section.

In UFSAR Subsection 3H.5.2.1, SNC specified the 14'-2" spacing of the girders. The spacing specified is for all of the interior girders; however, the spacing between the last interior girders and the girders adjacent to the exterior walls on the west and east side (Column Lines I and N) of the fuel handling area is 13'-0". SNC proposed to change the UFSAR to include the 13'-0" spacing condition to specifically address the differing configuration for the edge girder. This change in the UFSAR Subsection 3H.5.2.1 is acceptable to the staff because the proposed change to include the 13'-0" spacing condition is an editorial clarification that further clarifies that the spacing from the edge girder to the adjacent interior girder is 13'-0". The girders in the middle of the roof are spaced at 14'-2". This change does not affect the design and analysis of the roof girders, and the girder spacing remains consistent between the AP1000 certified design document and the current UFSAR.

The proposed revision to Table 3H.5-10 with regards to the governing load combination for the roof girder design, bending moments and shear stress demands, and the corresponding allowable stresses are acceptable because the governing ratio of the actual bending stress to the allowable bending stress ($27.1 \text{ Ksi} / 53.0 \text{ Ksi} = 0.51$), and the ratio for the shear stress ($11.5 \text{ Ksi} / 26.4 \text{ Ksi} = 0.43$) is well below 1.0, providing adequate design margin to the revised roof girder design. The staff notes a significant margin of almost 100 percent in the girder design over code allowable stresses and concludes that the revised girder design satisfies the requirements of Standard AISC N690-1994.

Based on SNC's commitment to the design and analysis of the steel roof girders consistent with the current commitment and criteria in the UFSAR and commitment to use the applicable portions of the Standard AISC N690-1994 code, the staff finds the proposed roof girder design change to have a minimal impact on the local and global behavior of the overall structure and therefore to be acceptable. On the basis of the above, the staff finds the proposed changes to UFSAR Table 3H.5-10, Figure 3H.5-7 and Subsection 3H.5.2.1 are acceptable.

Licensing Basis Changes

This LAR proposes licensing basis changes to Tier 2 and Tier 2* information in UFSAR Subsection 3H.5.2.1 (Reference 1, Enclosure 2), UFSAR Table 3H.5-10 (Reference 4, Enclosure 5), and UFSAR Figure 3H.5-7 (Reference 1, Enclosure 2). The staff reviewed the markups of UFSAR Subsection 3H.5.2.1, UFSAR Table 3H.5-10, and UFSAR Figure 3H.5-7 against applicable and designated portions of Standards ACI 349-01 and AISC N690-1994; and Revision 6 of the VEGP UFSAR.

The staff reviewed the markups of the licensing basis changes and evaluated the basis of markups in Section 3 of the LAR and finds that SNC remains committed to the analysis and design criteria prescribed in the UFSAR; SNC remains committed to performing the design in accordance with applicable portions of Standard AISC N690-1994 code; and SNC is committed to design and detailing of the roof reinforcement consistent with the relevant requirements of Standard ACI 349-01. Based on the above, staff finds the changes identified in UFSAR Subsection 3H.5.2.1, UFSAR Table 3H.5-10 and UFSAR Figure 3H.5-7 with regard to the auxiliary building roof reinforcement detail and the roof girder design to be acceptable.

3.3 SUMMARY OF THE TECHNICAL EVALUATION

The NRC staff reviewed the licensee's proposed changes provided in LAR 17-016. Based on the staff's technical evaluation described in this safety evaluation, the staff found that:

1. The proposed change to the reinforcement design detail in the roof of the auxiliary building was performed in accordance with codes and standards committed to in the UFSAR including the provisions of Standard ACI 349-01 code Chapter 12.
2. The proposed change to revise the design of roof girders supporting the auxiliary building roof was performed in accordance with codes and standards committed to in the UFSAR. The revised roof girder design satisfies the requirements of Standard AISC N690-1994 code with almost 100 percent margin over code allowable stresses. SNC demonstrated, with an updated structural model that includes the changes that impact the configuration, mass, and stiffness of the auxiliary building roof structure, that the impact of the design change on the local and global response of the structure is minimal.
3. The proposed change to include the 13'-0" girder spacing condition was made to specifically address the differing configuration for the edge girder. This change is an editorial clarification that addresses the 13'-0" spacing from the edge girder to the adjacent interior girder. The proposed change only clarifies that girder spacing is a range of 13'-0" to 14'-2" center to center, does not change the spacing of the girders, and is consistent between the current UFSAR design and the proposed design.
4. The proposed change to note 1 in UFSAR Figure 3H.5-7 is made to address the design of the reinforcement (size and spacing) and the supporting beam at other locations that vary from the typical design information for the critical section shown in UFSAR Figure 3H.5-7 and described in UFSAR Subsection 3H.5.2.1 due to variation in load and geometry in different locations on the roof. The licensee is committed to comply with applicable UFSAR codes and standards, including Standards ACI 349-01 and AISC N690-1994 for both the critical section and the non-critical section portions of the roof.

For the reasons specified above, the staff finds that the proposed UFSAR changes to Subsection 3H.5.2.1, Table 3H.5-10, and Figure 3H.5-7, acceptable. Furthermore, the supporting analysis provided in the LAR meets the relevant design code provisions and does not alter the relevant conclusions made for the AP1000 standard design.

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

4.0 STATE CONSULTATION

In accordance with the Commission's regulations in 10 CFR 50.91(b) (4), the Georgia State official was consulted on the amendments on November 7, 2017. The State official had no comment.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change 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.*” The NRC staff has determined that the amendments involve 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 has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (*Federal Register*, 82 FR 26137 (June 6, 2017)). Accordingly, the amendments meet 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 amendments.

6.0 CONCLUSION

Based on the technical evaluation presented in Section 3.0 above, the staff has concluded that: (1) there is reasonable assurance that 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's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. VEGP Units 3 and 4 – Request for License Amendment: Auxiliary Building Roof Rebar Configuration Design (LAR-17-016), May 10, 2017 (ADAMS Accession No. ML17130A999).
2. Virgil C. Summer Nuclear Station Units 2 and 3 – LAR-16-03 R1 Revision to License Amendment Auxiliary Building Roof Rebar Configuration Design, May 3, 2017 (ADAMS Accession No. ML17123A222).
3. NRC Staff's RAIs (originally issued) to South Carolina Gas and Electric, July 19, 2017 (ADAMS Accession No. ML17179A207).
4. VEGP Units 3 and 4 – Supplement to Request for License Amendment: Auxiliary Building Roof Rebar Configuration Design (LAR-17-016S1), September 20, 2017 (ADAMS Accession No. ML17263B024).
5. Proprietary Enclosure 4 to VEGP Units 3 and 4 – Supplement to Request for License Amendment: Auxiliary Building Roof Rebar Configuration Design (LAR-17-016S1), September 20, 2017 (ADAMS Accession No. ML17263B025).
6. VEGP Units 3 and 4, “LAR-17-016S1 Clarification,” October 18, 2017 (ADAMS Accession No. ML17292A098).
7. VEGP Units 3 and 4, Updated Final Safety Analysis Report, Tier 1, “Technical Requirements,” June 15, 2017 (ADAMS Accession No. ML17172A218).

8. AP1000 Design Control Document, Revision 19, June 13, 2011 (ADAMS Accession No. ML11171A500).
9. NUREG-2124, Volume 1, "Final Safety Evaluation Report Related to the Combined Licenses for Vogtle Electric Generating Plant, Units 3 and 4," August 5, 2011 (ADAMS Accession No. ML12271A045).
10. Code Requirements for Nuclear Safety Related Concrete Structures (American Concrete Institute (ACI)) Standard ACI 349-01, February 1, 2001.
11. Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities, American National Standards Institute (ANSI)/American Institute of Steel Construction (AISC) N690-94, 2006.