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

January 11, 2012

Mr. Preston Gillespie
Site Vice President
Oconee Nuclear Station
Duke Energy Carolinas, LLC
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3, CORRECTION LETTER FOR AMENDMENT NOS. 373, 375, AND 374 REGARDING AUTHORIZING A CHANGE TO THE UPDATED FINAL SAFETY ANALYSIS REPORT (UFSAR) ALLOWING THE USE OF FIBER REINFORCED POLYMER ON MASONRY BRICK WALLS FOR THE MITIGATION OF DIFFERENTIAL PRESSURE CREATED BY HIGH WINDS (TAC NOS. ME1710, ME1711, AND ME1712)

Dear Mr. Gillespie:

By letter dated June 27, 2011 (Agencywide Documents Access and Management System Accession No. ML11164A257), the U.S. Nuclear Regulatory Commission (NRC) issued Amendment Nos. 373, 375, and 374 to Renewed Facility Operating Licenses DPR-38, DPR-47, and DPR-55, for the Oconee Nuclear Station, Units 1, 2, and 3, respectively. These amendments authorize changes to the UFSAR, to allow the use of fiber reinforced polymer to strengthen masonry brick walls for uniform pressure loads resulting from a tornado event. The safety evaluation enclosed with the amendments contained errors that are being acknowledged and corrected by this letter.

The errors do not have any bearing on the NRC staff's technical evaluation or conclusions. The revised safety evaluation pages are enclosed.

If you have any questions, please call me at 301-415-1345.

Sincerely,

John Stang, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosure:
Revised Safety Evaluation Pages 1-6, 12, and 14

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UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 373 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-38

AMENDMENT NO. 375 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-47

AND

AMENDMENT NO. 374 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-55

DUKE ENERGY CAROLINAS, LLC

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-269, 50-270, AND 50-287

1.0 INTRODUCTION

By application dated June 29, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091871223), as supplemented by letters dated June 24, 2010 (ADAMS Accession No. ML101830011), February 15, 2011 (ADAMS Accession No. ML110490532), June 6, 2011 (ADAMS Accession No. ML11159A211), and June 15, 2011 ADAMS Accession No. ML11167A237), Duke Energy Carolinas, LLC (Duke, the licensee), requested approval of changes to the Updated Final Safety Analysis Report (UFSAR) for the Oconee Nuclear Station, Units 1, 2, and 3 (Oconee 1/2/3). The supplements dated June 6, 2011, and June 15, 2011, provided additional information that clarified the application, did not expand the scope of the application as originally noticed and renoticed, and did not change the staff's proposed no significant hazards consideration determination as published in the *Federal Register* on December 14, 2010 (75 FR 77908), and May 25, 2011 (76 FR 30399).

The proposed license amendment request (LAR) requested authorization of changes to the UFSAR to allow the use of fiber reinforced polymer (FRP) to strengthen masonry brick walls for uniform pressure loads resulting from a tornado event. Installation of the FRP system will not adversely affect the current structural qualification of the masonry walls (e.g., seismic) nor will it have immediate or long-term deleterious effect on the masonry wall materials of construction. The use of the FRP system on these walls will ensure that the wall units are able to withstand the differential pressure load resulting from a tornado.

Corrected by letter dated January 11, 2012

2.0 REGULATORY EVALUATION

Section 3.8.4.7 of the Oconee 1/2/3 UFSAR states that, (1) the auxiliary building concrete masonry walls are non-structural, in-fill panels serving as partitions with some walls having pressure, fire, and radiation barrier applications; and (2) pursuant to I.E. Bulletin 80-11 "Masonry Wall Design" (ADAMS Accession No. ML080310664), all masonry walls were re-evaluated. I.E. Bulletin 80-11 was issued, because of the Nuclear Regulatory Commission's (NRC's) concerns with the adequacy of design criteria used for the design of masonry walls at nuclear power plants. The governing code used by the licensee in the re-evaluation of the masonry walls was the American Concrete Institute (ACI) 531-79, "Building Code Requirements for Concrete Masonry Structures." In addition, "NUREG-0800, Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light Water Reactor] Edition," Section 3.8.4, Appendix A, "Interim Criteria for Safety-Related Masonry Wall Evaluation," Revision 1, July 1981 (ADAMS Accession No. ML052340580) was the guidance used by the licensee in evaluation of masonry walls.

Oconee 1/2/3 UFSAR, Section 3.3.2 indicates that Revision 1 of Regulatory Guide (RG) 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants" (ADAMS Accession No. ML070360253, March 2007), was incorporated into the plant's licensing basis. Any new systems (and their associated components and/or structures) installed at the site will be required to resist tornado loading and will conform to the tornado wind, differential pressure, and missile criteria specified in RG 1.76, Revision 1.

The application of FRP and its ability to strengthen existing masonry brick walls to withstand tornado-induced pressure was evaluated by the NRC staff in accordance with guidance contained in the SRP, Section 3.8.4, "Other Seismic Category I Structures." This section of the SRP references ACI 531-79. Its provisions were also used by the NRC staff in the review of the LAR.

The licensee submitted a similar LAR to the NRC for authorization of the application of the FRP system on masonry block walls dated June 1, 2006 (ADAMS Accession No. ML061580078), and was subsequently approved by the NRC in License Amendment Nos. 360, 362, and 361 dated February 21, 2008 (ADAMS Accession No. ML080320065). This license amendment served as a precedent for the NRC staff's review of this LAR.

3.0 TECHNICAL EVALUATION

The Oconee 1/2/3 auxiliary buildings' west penetration rooms' walls discussed in the LAR are double-wythe 8-inches thick solid masonry brick walls constructed as in-fill exterior panels between the Oconee 1/2/3 auxiliary buildings reinforced concrete structural framing members. The FRP system will be used on the exterior face of the existing brick walls for flexural strengthening. The typical FRP application will consist of a matrix of glass fiber bonded directly to the existing masonry brick walls with a polymer and overlapped to provide both horizontal and vertical reinforcement to resist tensile stresses induced at the exterior face of the brick walls by the tornado differential pressure.

The licensee stated, in the June 29, 2009, LAR, that (1) the FRP system will be used in a bond-critical application for flexural strengthening of the existing brick walls; (2) the wall loading condition is determined in accordance with the Oconee 1/2/3 current licensing basis, UFSAR 3.3.2, to be a uniform pressure of 1.2 pounds per square inch (psi) resulting from tornado-induced

differential pressure; (3) the FRP system will be subjected to a benign environment of ambient temperature and humidity conditions associated with the local climate; (4) although applied to the exterior surfaces of masonry brick walls, the FRP system will be shielded from sunlight (i.e., ultraviolet radiation), adverse weather conditions (e.g., rain, snow, ice, etc.) by structural siding supported by a structural steel girt system attached to the auxiliary building structural framing members; and (5) future use of FRP, as proposed, will be predicated on the satisfactory completion of performance testing, commercial grade dedication of the FRP system and the incorporation of subsequent periodic surveillance requirements into the existing plant programs.

In the June 15, 2011, LAR supplement, the licensee clarified that the protection for the existing masonry walls against tornado wind and tornado generated missiles will be addressed in a separate license amendment.

The NRC staff's technical review covered information found in the LAR, and LAR supplements provided by the licensee. The NRC staff reviewed the licensee's proposed design methodology for FRP strengthening of the existing masonry brick walls that had been established based on a performance testing program. The acceptability and applicability of the licensee's methods for design, qualification, installation and preservice inspection, and inservice inspection are discussed below.

3.1 Performance Testing Program

Due to a lack of available research on FRP strengthened double-wythe solid masonry brick walls, the licensee sponsored a performance testing program conducted at North Carolina State University (NCSU). The objective of the performance testing program was to determine the effectiveness of the strengthening of brick walls with glass FRP sheets to increase their flexural capacity.

As stated in the LAR, 14 wall specimens were tested in the NCSU performance testing program. These test specimens were constructed using construction materials as closely as possible to the as-built materials of the existing brick walls of the Oconee 1/2/3 auxiliary buildings' west penetration rooms. The test specimens were both single- and double-wythe and were built, within reinforced concrete frames, using 4-inch solid concrete bricks. The brick wall test specimens were constructed under the supervision of the licensee's representatives to ensure that they were built in a manner consistent with the existing brick walls.

The testing program consisted of unstrengthened walls (control specimens) and strengthened walls with 50/50 to 100/100 percentages of FRP coverage in the vertical and horizontal directions. The aspect ratios of the test specimens were selected as 1.0, 1.2, 1.4 and 1.6, which closely correlated with the aspect ratios of the existing brick walls. A uniform loading simulating the tornado-induced differential pressure load was applied to the test specimens using an air bag.

FRP composite system materials proposed for strengthening the Oconee 1/2/3 auxiliary buildings' west penetration rooms' brick walls, Tyfo® SEH-51A composite system (using Tyfo® S Epoxy) manufactured by Fyfe Company LLC, were utilized in the performance testing program. The licensee stated that the same FRP material will be used in modifying the existing brick walls.

As stated in the LAR, shrinkage cracks along the sides and settlement cracks along the top of the test specimens, at the mortar joint interface with the reinforced concrete framing members, were discovered during the course of the performance testing program conducted at NCSU. As a result, structural steel restraints were installed at the sides and top of the five final test specimens to preclude premature sliding shear failure of the test specimens. These five test specimens were constructed of double-wythe with no mortar in the collar joint between the wythes. The licensee confirmed that this construction detail is consistent with the as-built condition of the existing brick walls at Oconee 1/2/3. These five test specimens were loaded to 3.9 psi, with the shear restraints in place, and no visible damage was indicated. One of the five test specimens were loaded beyond 3.9 psi with shear restraints in place and the results showed an elastic load-deflection behavior up to an applied pressure of approximately 5 times the design pressure of 1.2 psi.

3.1.1 NRC Staff's Evaluation

The NRC staff finds the installation of the shear restraints necessary (1) to eliminate the premature sliding shear failure; (2) to provide consistency between the configuration of test specimens and the as-installed wall configuration at Oconee 1/2/3; and (3) to provide assurance that using a simply supported flat plate model, to determine the forces and moments in the masonry brick wall, is reasonable. In addition, although a total of fourteen specimens were tested, the NRC staff finds the results of the performance testing of these five test specimens, that were constructed consistent with the as-built condition of the existing brick walls with shear restraints installed at the top and sides of the wall, to be relevant in determining the acceptability of the proposed FRP system design methodology.

3.2 FRP System Design Methodology

The licensee proposes (1) to use working stress design for the FRP system design considering only the outer 4-inches wythe effective; (2) to use simply supported flat plate classical solution or computer analysis to determine the forces and moments in the wall; (3) to install shear restraints at the top and sides of the walls; (4) to use flexural and shear capacities based on allowable stresses provided in ACI 531-79 as supplemented by SRP 3.8.4, Appendix A; (5) to use an upper limit of 50 psi for the masonry shear stress allowable and an upper limit of 0.7 times compressive strength of masonry for the allowable flexural compressive stress; and (6) to use a maximum effective FRP strain of 0.0029 in/in, considering an environmental reduction factor of 0.65 and a bond dependent coefficient factor of 0.2.

The NRC staff's review primarily focused on the methodology of working stress design and its applicability to the masonry brick walls considering the results of the performance tests conducted at NCSU.

The proposed design methodology only focuses on flexural strengthening of unreinforced brick walls and sizing the FRP system to resist the tornado differential pressure of 1.2 psi. In the June 24, 2010, LAR supplement, the licensee stated that field walk-downs of the Oconee 1/2/3 auxiliary building west penetration room exterior masonry walls have been performed in August 2009 and these walk-downs were repeated in April 2010. The licensee stated that no safety-related attachments would be adversely affected by outward deflection of the brick walls resulting from the design-basis tornado differential pressure loading condition.

In the June 6, 2011, LAR supplement, the licensee stated that, (1) the inspection of each of the masonry wall elements subject to FRP-strengthening is performed and documented by the responsible plant civil engineer, in accordance with Duke's Engineering Directive EDM-410; (2) this individual, who is a professional engineer, will examine the masonry walls for cracks in joints, unsealed penetrations, missing or broken bricks/blocks, sharp edges, protrusions, separation from supports and other defects; (3) in addition to the inspection performed by the professional civil engineer, a second inspection of the masonry walls surface areas and perimeters is performed by the Duke's craft supporting the FRP installer, prior to FRP installation, in accordance with the FRP installation procedure and any observed structural defect is brought to the attention of the responsible plant civil engineer for further evaluation; and (4) as part of the inservice inspection program of the FRP-strengthened walls, the bottom edge of the masonry walls will be inspected periodically to ensure its integrity.

In the June 24, 2010, LAR supplement, the licensee stated that (1) these shear restraints will be fastened to the auxiliary buildings' reinforced concrete structural framing members to provide support for the existing FRP strengthened brick walls; (2) the reaction forces imposed on these restraints resulting from the design basis tornado envelope those associated with the design basis seismic event; (3) all shear restraints will be designed to resist masonry wall reactions resulting from the design-basis tornado differential pressure loading while meeting the design code allowable stresses; and (4) these restraints will be designed to ensure that their deflection, at the design loading, would not exceed the prescribed deflection criterion of 1/16 (0.0625) inch.

The licensee stated, in its LAR supplements dated June 24, 2010, and June 6, 2011, that Duke has evaluated the effects of the increased masonry walls' stiffness resulting from the installation of FRP on the existing Oconee 1/2/3 auxiliary building masonry walls and concluded that the use of the FRP system on these walls has no adverse effect on the analyses and/or modifications performed in response to I.E. Bulletin 80-11.

3.2.1 NRC Staff's Evaluation

The NRC staff considers the proposed design methodology for the design of the FRP system acceptable because (1) based on a review of the results of the performance tests, the ultimate strength of the test specimens with double-wythes was approximately 5 times the ultimate strength of the test specimens with single wythe, demonstrating that considering only the outer 4-inch wythe effective, provides additional margin of safety; (2) installation of shear restraints and the inspection of the bottom edge of the masonry walls, prior to FRP installation and during the inservice inspection program, will provide assurance that the boundary conditions assumed in the proposed analytical plate model are reasonable; (3) the allowable masonry stress levels for flexural compression and for shear conform to ACI 531-79, as supplemented by SRP 3.8.4, Appendix A with limitations on the shear stress allowable and allowable flexural compressive stress, are consistent with the previous NRC License Amendment Nos. 360, 362, and 361 dated February 21, 2008, approving FRP; (4) the results of the performance test of five test specimens with shear restraints indicate that the walls are capable of resisting 3.9 psi pressure with no visible damage; (5) the results of the performance test of one test specimen with shear restraints indicated an elastic load-deflection behavior up to an applied pressure of approximately five times the design pressure of 1.2 psi; (6) the licensee demonstrated that when the proposed design methodology was applied to the test specimens' configuration, the results indicated that there is sufficient margin of safety to resist the flexural and shear stresses due to 1.2 psi pressure; (7) the proposed design methodology effectively limits the FRP maximum strain to only 13 percent of the

ultimate strain by considering an environmental reduction factor of 0.65 and a bond dependent coefficient factor of 0.2; (8) there is sufficient margin against the FRP maximum effective strain of 0.0029 in/in used in the proposed design methodology when compared against the recorded strains during the performance test due to 1.2 psi pressure; (9) no safety-related attachments to the FRP strengthened brick walls would be adversely affected by outward deflection of these walls resulting from the design-basis tornado differential pressure loading condition; and (10) the installation of the proposed FRP system has no adverse effects on the analyses and/or modifications performed in response to I.E. Bulletin 80-11.

In addition, the NRC staff finds the licensee's proposed methodology for the design of the shear restraints, based on a deflection criterion of 1/16 inch and compliance with the allowable stresses of the Oconee 1/2/3 structural steel design basis code, acceptable.

3.3 Applicability of the FRP System Design Methodology

The licensee stated, in the LAR, that test specimens were subjected to a statically applied uniform loading to simulate a tornado-induced differential pressure load. In its June 15, 2011, LAR supplement, the licensee clarified that the protection for the existing masonry walls against tornado wind and tornado generated missiles will be addressed in a separate LAR. Therefore, the NRC staff's scope of review related to this LAR is limited to the design of the FRP system to resist the differential pressure load resulting from a design-basis tornado event.

The NRC staff reviewed the FRP system design methodology proposed in the LAR, considering the results of the experimental test of the masonry brick walls. As such, the NRC staff considers the proposed design methodology for the FRP system only applicable to flexural strengthening of the Oconee 1/2/3 auxiliary buildings brick walls to resist statically applied uniformly distributed out of plane loading.

Enclosure 3 of the LAR lists 31 brick walls in the Oconee 1/2/3 auxiliary buildings that will be modified to install FRP. The aspect ratios, width-to-height or height-to-width ratio, of these walls range from approximately 1.0 to 1.6 with the exception of one wall located in Oconee 2 at elevation 809'-3", column line X and between column line 78a and the Oconee 2 reactor building. The aspect ratio of this wall is approximately 3.0 and is outside of the range of the aspect ratios used for the test specimens. In the June 24, 2010, LAR supplement, the licensee stated that the height of this wall will not be modified to bring its aspect ratio within the range used in the performance test program conducted at NCSU. Accordingly, the NRC staff finds this wall outside of the parameters used in the performance test program. Thus, the design methodology for the FRP system design discussed in this safety evaluation is not applicable to this wall.

3.4 FRP System Qualification Method

As stated in the LAR, installation of the FRP system will result in the use of a commercially available item in a QA Condition 1 application. The licensee committed to perform a technical evaluation of the FRP system (fibers and polymeric resin) to demonstrate that (1) the FRP system qualifies as commercial grade in accordance with the licensee's Supply Chain Directive (SCD) 230, "Commercial Grade Items;" (2) the supplier is capable of supplying a quality product in

Commitment	Completion Date	Staff's Evaluation Addressed in SE
5. Duke will install mechanical shear restraints along the brick masonry wall perimeter (top and sides only) and block masonry wall perimeter (top only) to remediate potentially limiting conditions of construction.	Prior to implementation of the approved license amendment for the FRP UFSAR changes.	Sections 3.1.1 and 3.2.1
6. Duke will incorporate the FRP testing and inspection program into Oconee 1/2/3 aging management program.	Prior to implementation of the approved license amendment for the FRP UFSAR changes.	Sections 3.6 and 3.6.1
7. As discussed with the Staff, Fyfe Company, LLC, the manufacturer of the FRP products, will provide Duke with a Certificate of Compliance certifying that both the FRP product and its installation meet all applicable requirements.	Complete	Section 3.4.1

4.0 SUMMARY

In the June 15, 2011, LAR supplement, the licensee clarified that the protection for the existing masonry walls against tornado wind and tornado generated missiles will be addressed in a separate LAR. Therefore, the NRC staff's scope of review related to this LAR was limited to the acceptability of the proposed design methodology of the FRP system, supported by the results of the performance test program conducted at NCSU, to strengthen the existing masonry brick walls to resist the differential pressure load resulting from a design basis tornado event.

On the basis of the technical evaluation of the licensee's proposed design methodology, qualification, installation and preservice inspection, inservice inspection of the FRP system, and the licensee's regulatory commitments, the NRC staff concludes that the proposed design methodology for the FRP system is acceptable for use to strengthen the existing masonry brick walls in the Oconee 1/2/3 auxiliary buildings' west penetration rooms to withstand the differential pressure loads resulting from a design basis tornado event. The NRC staff notes that 10 CFR Part 50, Appendix B requirements are applicable to the design, purchase, fabrication, handling, shipping, storage, inspection, testing, and installation of the FRP system.

The NRC staff also notes that the aspect ratio of one wall, located in Oconee 2 at elevation 809'-3", column line X and between column line 78a and the Oconee 2 reactor building, is approximately 3.0 and is outside of the range of the aspect ratios used in the performance test program. Thus, the design methodology for the FRP system design discussed in this Safety Evaluation is not applicable to this wall.

Consequently, this change does not involve a significant reduction in a margin of safety.

Based on this review, the NRC staff has concluded that the three standards of 10 CFR 50.92(c) are satisfied. Therefore, the NRC staff has made a final determination that the proposed amendment involves no significant hazards consideration.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the South Carolina State official was notified of the proposed issuance of the amendments. The State official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20 and change surveillance requirements. 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 made a final no significant hazards consideration finding with respect to the amendments. 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.

8.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, 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) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: F. Farzam

Date: June 27, 2011

January 11, 2012

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Site Vice President
Oconee Nuclear Station
Duke Energy Carolinas, LLC
7800 Rochester Highway
Seneca, SC 29672

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Sincerely,

/RA/

John Stang, Senior Project Manager
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