Duke Energy®

BRUCE H HAMILTON
Vice President
Oconee Nuclear Station

Duke Energy Corporation
ONO1VP / 7800 Rochester Highway
Seneca, SC 29672

864 885 3487
864 885 4208 fax
bhhamilton@duke-energy.com

June 1, 2006

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555-0001

Subject: Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC
Oconee Nuclear Site, Units 1, 2, and 3
Docket Numbers 50-269, 50-270, and 50-287
License Amendment Request to Incorporate Use of Fiber-Reinforced Polymer System to Strengthen Existing Auxiliary Building Masonry Walls for Tornado Loadings
License Amendment Request No. 2006-006

In accordance with 10CFR 50.90, Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC (Duke) proposes to amend Renewed Facility Operating Licenses Nos. DPR-38, DPR-47, and DPR-55. If granted, this amendment request will revise the Updated Final Safety Analysis Report (UFSAR) to incorporate the use of a fiber-reinforced polymer (FRP) system to strengthen existing masonry walls for uniform pressure loads resulting from a tornado event. The masonry walls to be strengthened using an FRP system are located within the Units 1, 2, and 3 Auxiliary Buildings. Examples of these walls include the Unit 3 Control Room north wall and the Units 1, 2, and 3 West Penetration Room (WPR) and Cask Decontamination Tank Room (CDTR) walls; additionally, Duke may elect to use an FRP system to strengthen other similarly constructed masonry walls for comparable loading conditions as necessary.

The Auxiliary Building masonry walls to be strengthened using an FRP system are passive, non-structural elements. The walls are single and multiple wythe in-fill panels constructed of hollow or grouted concrete blocks or solid concrete bricks. The FRP system will be used for flexural strengthening of the masonry walls. The typical FRP application will consist of a matrix of fibers bonded directly to existing masonry construction with a polymer.

Duke has concluded that the use of an FRP system on existing Auxiliary Building masonry walls is safe and is necessary to support the design and implementation of the Natural Phenomenon Barrier System (NPBS) modifications previously described to the Staff in a letter dated January 31, 2006. The future use of FRP, as proposed, will be predicated on the satisfactory completion of qualification testing and commercial grade dedication of the selected FRP system and the incorporation of subsequent periodic surveillance requirements into existing plant programs. A complete list of regulatory commitments associated with this license amendment request (LAR) is contained in Attachment 3.

In accordance with Duke administrative procedures that implement the Quality Assurance Program Topical Report, these proposed changes have been reviewed and approved by the Plant Operations Review Committee and Nuclear Safety Review Board. Additionally, a copy of this

LAR is being sent to the State of South Carolina in accordance with 10CFR 50.91 requirements. Duke respectfully requests that the amendment be issued by December 1, 2006, with an implementation schedule commensurate to the NPBS modifications previously submitted to the Staff in a letter dated January 31, 2006.

Inquiries on this proposed amendment request should be directed to Stephen C. Newman of the Oconee Regulatory Compliance Group at (864) 885-4388.

Sincerely,

Bruce Hamilton

B. H. Hamilton, Vice President
Oconee Nuclear Site

Enclosures:

1. Notarized Affidavit
2. Evaluation of Proposed Change
3. Fiber-Reinforced Polymer System: Application and Technical Discussion

Attachments:

1. UFSAR – Mark Ups
2. UFSAR – Reprinted Pages
3. List of Regulatory Commitments

bc w/enclosures and attachments:

Mr. W. D. Travers, Regional Administrator
U. S. Nuclear Regulatory Commission - Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Mr. L. N. Olshan, Project Manager
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Mail Stop O-14 H25
Washington, D. C. 20555

Mr. D. Charles Payne, Acting Chief Branch 1 DRP
U.S. Nuclear Regulatory Commission – Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Mr. Robert E. Carroll
U.S. Nuclear Regulatory Commission – Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Mr. D. W. Rich
Senior Resident Inspector
Oconee Nuclear Site

Mr. Henry Porter, Director
Division of Radioactive Waste Management
Bureau of Land and Waste Management
Department of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

bcc w/enclosures and attachments:

David A. Baxter
R. Mike Glover
Larry E. Nicholson
B. Graham Davenport
Noel T. Clarkson
Richard J. Freudenberger
George K. McAninch
Robert E. Hall
Tommy D. Mills
Stephen C. Newman
Curtis Arnold
Cliff Davis
Lawrence Llibre
Jeffery Robertson
C. Jeff Thomas - MNS
Randy D. Hart – CNS
Robert L. Gill – NRI&IA
NSRB, EC05N
ELL, ECO50
File - T.S. Working
ONS Document Management

ENCLOSURE 1

NOTARIZED AFFIDAVIT

AFFIDAVIT

B. H. Hamilton, being duly sworn, states that he is Vice President, Oconee Nuclear Site, Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC, that he is authorized on the part of said Company to sign and file with the U. S. Nuclear Regulatory Commission this revision to the Renewed Facility Operating License Nos. DPR-38, DPR-47, and DPR-55; and that all statements and matters set forth herein are true and correct to the best of his knowledge.

Bruce Hamilton

B. H. Hamilton, Vice President
Oconee Nuclear Site

Subscribed and sworn to before me this 1 day of June, 2006

Reene Gambrell

Notary Public

My Commission Expires:

August 19, 2009

Date

SEAL

ENCLOSURE 2

EVALUATION OF PROPOSED CHANGE

Subject: License Amendment Request to Incorporate Use of Fiber-Reinforced Polymer System to Strengthen Existing Auxiliary Building Masonry Walls for Tornado Loadings

1.0 DESCRIPTION

The proposed license amendment request (LAR) will revise the Updated Final Safety Analysis Report (UFSAR) to incorporate the use of a fiber-reinforced polymer (FRP) system to strengthen existing masonry walls for uniform pressure loads resulting from a postulated tornado event. The masonry walls to be strengthened using an FRP system are located within the Units 1, 2, and 3 Auxiliary Buildings and are non-structural in-fill panels. Examples of these walls include the Unit 3 Control Room north wall and the Units 1, 2, and 3 West Penetration Room (WPR) and Cask Decontamination Tank Room (CDTR) walls. The locations of these walls are shown in Figure 1 of Enclosure 3.

2.0 PROPOSED CHANGE

Duke proposes to revise UFSAR Section 3.8.4.7, "Concrete Masonry Walls," to document:

- the evaluation of certain masonry walls that are part of the Units 1, 2, and 3 Auxiliary Buildings for tornado-induced differential pressure and tornado wind loadings;
- the use of an FRP system to strengthen the masonry walls to meet these loads; and,
- the applicable codes, standards, loads, and load combinations.

The proposed UFSAR changes are included in Attachment 1 (markups) and Attachment 2 (reprinted pages).

3.0 BACKGROUND

As previously stated in Reference 1 of Enclosure 3, the Natural Phenomenon Barrier System (NPBS) modifications will enhance Oconee's tornado design. These modifications will employ a fiber-reinforced polymer (FRP) system to strengthen existing masonry walls for uniform pressure loads resulting from a tornado event.

Externally bonded FRP systems have been used to strengthen and retrofit existing concrete structures around the world since the mid 1980s. Structural elements strengthened with externally bonded FRP systems include beams, slabs, columns, walls, joints/connections, chimneys and smokestacks, vaults, domes, tunnels, silos, pipes, and trusses. Externally bonded FRP systems have also been used to strengthen masonry, timber, steel, and cast-iron structures. Externally bonded FRP systems were developed as alternates to traditional external reinforcing techniques like steel plate bonding and steel or concrete column jacketing. [Reference 6 of Enclosure 3]

The masonry walls to be strengthened using an FRP system are located within the Units

1, 2, and 3 Auxiliary Buildings. The design function of the Auxiliary Building structures is to enclose, support, and protect the electrical and mechanical equipment necessary for the safe operation of the Nuclear Steam Supply System (NSSS). The Auxiliary Building structures provide environmental protection and biological shielding for this equipment.

The Auxiliary Building masonry walls to be strengthened using an FRP system are passive elements. The walls are single and multiple wythe in-fill panels constructed of hollow or grouted concrete blocks or solid concrete bricks. All masonry walls are non-structural and constructed on a structural support system. Examples of walls to be strengthened using an FRP system include the Unit 3 Control Room north wall and the Units 1, 2, and 3 WPR and CDTR walls; however, Duke may elect to use an FRP system to strengthen other similarly constructed masonry walls for comparable loading conditions as necessary.

The FRP system will be used for flexural strengthening of the masonry walls. Glass or carbon fibers when combined with epoxies (i.e., an FRP system) create a high-strength, lightweight structural laminate designed to work in conjunction with the existing structure to achieve the desired final performance. Various studies indicate that FRP systems can effectively and predictably improve the low flexural capacity and brittle failure mode of unreinforced masonry walls subjected to extreme out-of-plane loads [References 17 through 22 of Enclosure 3]. The wall loading condition would be uniform pressure resulting from tornado-induced differential pressure and/or tornado wind. The loading condition will produce tensile stresses in the FRP system. The typical FRP application will consist of a matrix of fibers bonded directly to existing masonry construction with a polymer and overlapped to provide both horizontal and vertical tensile reinforcement. Figure 2 of Enclosure 3 shows a conceptual application of an FRP system.

4.0 TECHNICAL ANALYSIS

Design

Existing masonry walls will be analyzed for tornado-induced differential pressure and/or tornado wind loadings in accordance with Standard Review Plan (SRP) Section 3.8.4 [Reference 2 of Enclosure 3], ACI 531-79 [Reference 3 of Enclosure 3], and Chapter 3 of the Oconee UFSAR [Reference 4 of Enclosure 3]. Design of the FRP system will be based upon the results of this analysis and ICC AC125 [Reference 5 of Enclosure 3] and will comply with the general design considerations contained in ACI 440.2R-02 [Reference 6 of Enclosure 3] for FRP systems used for flexural strengthening.

Installation of the FRP system will not adversely affect the current structural qualification of the masonry walls (e.g., seismic) by significantly increasing mass or stiffness nor will it have any immediate or long-term deleterious effect on the masonry wall materials of construction.

Elevated temperatures during a fire can cause epoxy resins to soften or burn, potentially compromising the structural strength provided by the FRP materials. Unless simultaneously subjected to uniform pressure loads resulting from a tornado event, the FRP system will remain in a near-zero state of stress; therefore, fire-induced degradation of the FRP system is not an immediate structural concern.

Qualification Tests and Commercial Grade Dedication

Qualification testing and reporting will be performed in accordance with ICC AC125 [Reference 5 of Enclosure 3] for the selected FRP System.

Installation of the FRP system will result in use of a commercially available item in a QA Condition 1 application. Duke will perform and document a technical evaluation of the FRP system (fibers and polymeric resin) in accordance with Reference 7 of Enclosure 3, to demonstrate that:

1. The item qualifies as a commercial grade item.
2. The supplier is capable of supplying a quality product.
3. The quality of the item can be reasonably assured.

Inspection and Verification

Duke will utilize technical procedures to control testing of concrete substrate and installation and inspection of the FRP system in accordance with ICC AC125 [Reference 5 of Enclosure 3], ACI 440.2R-02 [Reference 6 of Enclosure 3], and ICC AC178 [Reference 8 of Enclosure 3]. The installer will be required to have personnel certified and trained by the FRP system manufacturer to install the specified system. Certified installers and an accredited quality control inspector will be present during installation of the FRP system.

Hazards

The specific FRP system that Duke plans to use, Tyfo® Fibrwrap® Advanced Composite System by Fyfe Company LLC, exhibits good low and high temperature properties, long working time, and high elongation (i.e., ductility). Full cure of the epoxy ranges from 3 to 5 days depending upon ambient temperatures and field conditions. The composite is expected to "cure to the touch" within 24 hours. The epoxies are 100% solvent-free, emitting no toxic fumes or volatile organic contents (V.O.C.). [Reference 25 of Enclosure 3]

Fire performance testing involving direct exposures to an 8-hour butane fire demonstrated that the Tyfo® composite system is self-extinguishing and will not support a fire [Reference 24 of Enclosure 3]. The Tyfo® composite system tested met the requirements of a Class A fire resistive material approved by Underwriters Laboratories Inc®. The selected FRP system is rated as a Class A fire resistive material as per NFPA 101 [Reference 26 of Enclosure 3]. This requirement will apply to the as-installed composite as well as the constituent elements. In addition, it should be noted that fire protection considerations are evaluated as part of the station modification process and will be addressed for each installation of the FRP system.

Durability / Service Life

The post-exposure durability of the Tyfo® Fibrwrap® subjected to gamma radiation, loss of coolant accident conditions, sustained and cyclic high temperatures, cyclic low temperature, alkali solutions, water, and outdoor environments has been evaluated [Reference 23 of Enclosure 3]. The results of the durability tests showed that FRP materials had good resistance to all of the exposures studied; however, FRP-FRP bonds and FRP-concrete bonds are unable to maintain their load carrying capacity if they are subjected simultaneously to stress and temperatures close to the glass-transition temperature of epoxy. (The glass-transition temperature is unique to each FRP system and ranges from 140 to 180 degrees F (60 to 82 degrees C) for existing, commercially available FRP systems [Reference 6 of Enclosure 3].) It was also observed that moisture had the most deleterious effects on FRP and its bonds.

The FRP system will not be exposed to temperatures nearing the glass-transition temperature of epoxy nor will it be exposed to appreciable moisture. The FRP system will be subjected to ambient temperature and humidity conditions associated with the local climate and Auxiliary Building equipment rooms. When applied to exterior surfaces of masonry walls, the FRP system will be shielded from sunlight and adverse weather conditions (e.g., rain, snow, ice, etc.) by either structural steel barrier elements or architectural siding. The FRP system will not be exposed to high temperature gas and/or liquid or significant radiation levels when applied to either exterior or interior surfaces of masonry walls. As previously stated, unless subjected to uniform pressure loads resulting from a tornado event, the FRP system will remain in a near-zero state of stress.

In-service inspection of the FRP system will be performed on a nominal 5 year interval to monitor long-term durability. In the future, this inspection frequency may be reduced to a nominal 10-year interval with appropriate justification based on the structure, environment, and previous in-service inspection results. In-service inspection will consist of both visual inspection and physical testing of the FRP system and substrate (i.e., masonry and grout). Inspections of the installed FRP system will include:

- visual inspections for changes in color, debonding, peeling, blistering, cracking, crazing, deflections and other anomalies; and,
- tension adhesion testing of cored samples using methods specified in ASTM D4541 [Reference 9 of Enclosure 3] or ACI 530R-02 [Reference 16 of Enclosure 3].

5.0 REGULATORY SAFETY ANALYSIS

5.1 No Significant Hazards Consideration

Duke has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by adhering to standards set forth in 10CFR 50.92, "Issuance of Amendment." This ensures that operation of the facility in accordance with the proposed amendment would not:

1) Involve a significant increase in the probability or consequences of an accident previously evaluated.

   Response: Physical protection from a tornado event is a design basis criterion rather than a requirement of a previously analyzed UFSAR accident analysis. The current licensing basis (CLB) for Oconee states that systems, structures, and components (SSC's) required to shut down and maintain the units in a shutdown condition will not fail as a result of damage caused by natural phenomena.

   The in-fill masonry walls to be strengthened using an FRP system are passive, non-structural elements. The use of an FRP system on existing Auxiliary Building masonry walls will allow them to resist uniform pressure loads resulting from a tornado and will not adversely affect the structure's ability to withstand other design basis events such as earthquakes or fires. Therefore, the proposed use of FRP on existing masonry walls will not significantly increase the probability or consequences of an accident previously evaluated.

2) Create the possibility of a new or different kind of accident from any accident previously evaluated.

   Response: The final state of the FRP system is passive in nature and will not initiate or cause an accident. More generally, this understanding supports the conclusion that the potential for new or different kinds of accidents is not created.

3) Involve a significant reduction in a margin of safety.

Response: The application of an FRP system to existing auxiliary building masonry walls will either act to restore the margin of safety described in the UFSAR, e.g., the Unit 3 Control Room north wall, or enhance the margin of safety, e.g., the West Penetration Room walls, by increasing the walls' ability to resist tornado-induced differential pressure and/or tornado wind. Consequently, this change does not involve a significant reduction in a margin of safety.

In summary, based upon the above evaluation, Duke has concluded that the proposed amendment involves no significant hazards consideration.

5.2 Applicable Regulatory Requirements/Criteria

Tornado loadings for specific areas of the Units 1, 2, and 3 Auxiliary Buildings are described in Table 3-23 of the Oconee UFSAR [Reference 4 of Enclosure 3]. The CLB for the Auxiliary Building masonry walls to be strengthened using an FRP system is described in UFSAR Section 3.8.4.7. UFSAR Section 3.8.4.7 primarily discusses masonry walls in the context of Oconee's response to I. E. Bulletin 80-11. UFSAR Section 3.8.4.7 requires revision to address the use of an FRP system to strengthen certain masonry walls for uniform pressure loads resulting from a tornado event.

6.0 ENVIRONMENTAL CONSIDERATION

Duke has evaluated this license amendment request against the criteria for identification of licensing and regulatory actions requiring environmental assessment in accordance with 10CFR 51.21. Duke has determined that this license amendment request meets the criteria for a categorical exclusion as set forth in 10CFR 51.22(c)(9). This determination is based on the fact that this change is being proposed as an amendment to a license issued pursuant to 10CFR 50 that changes a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10CFR 20, or that changes an inspection or a surveillance requirement, and the amendment meets the following specific criteria.

(i) The amendment involves no significant hazards consideration.

As demonstrated in Section 5.1, this proposed amendment does not involve a significant hazards consideration.

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

The current licensing basis (CLB) for Oconee states that systems, structures, and components (SSC's) required to shut down and maintain the units in a shutdown condition will not fail as a result of damage caused by natural phenomena. Use of an FRP system on masonry walls located in tornado-vulnerable areas of the Units 1, 2, and 3 Auxiliary Buildings will better ensure that this design requirement is maintained. Since the principle barriers to the release of radioactive materials are not modified or affected by this change, no significant increases in the amounts of any effluent that could be released offsite will occur as a result of this proposed change.

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

By using an FRP system, the reduction in the probability of masonry wall failure resulting from a tornado event will better ensure that radioactive effluents, which could potentially be released to the environment in the event of a design basis tornado, are contained within the Auxiliary Building structure. Because the principle barriers to the release of radioactive materials are not modified or affected by this change, there will be no significant increase in individual or cumulative occupational radiation exposure resulting from this change.

ENCLOSURE 3

FIBER-REINFORCED POLYMER SYSTEM: APPLICATION AND TECHNICAL DISCUSSION

Application of Fiber-Reinforced Polymer System

The Natural Phenomenon Barrier System (NPBS) modifications [Reference 1] will employ a fiber-reinforced polymer (FRP) system to strengthen existing masonry walls for uniform pressure loads resulting from a tornado event.

The masonry walls to be strengthened using an FRP system are located within the Units 1, 2, and 3 Auxiliary Buildings. The walls are single and multiple wythe in-fill panels constructed of hollow or grouted concrete blocks or solid concrete bricks. All masonry walls are non-structural and constructed on a structural support system. These walls extend from the top of the supporting structural floor to the bottom of the next structural floor. All walls to be strengthened are plane and terminate either at a structural wall or column. Wall edges normally consist of mortar joints except in special cases where supplemental supporting angles are provided around the perimeter. The walls are reinforced horizontally with truss reinforcing (Dur-o-wall joint reinforcing, 9 gauge 2 wires) every other course except special cases where Dur-o-wall is placed each course. Examples of walls to be strengthened using an FRP system include the Unit 3 Control Room north wall and the Units 1, 2, and 3 West Penetration Room (WPR) and Cask Decontamination Tank Room (CDTR) walls. The locations of these walls are shown in Figure 1.

The FRP system will be used in a bond-critical application for flexural strengthening of the masonry walls. The wall loading condition will be uniform pressure resulting from tornado-induced differential pressure and/or tornado wind. The loading condition will produce tensile stresses in the FRP system. The typical FRP application will consist of a matrix of fibers bonded directly to existing masonry construction with a polymer and overlapped to provide both horizontal and vertical tensile reinforcement. The FRP system will not be relied upon as a compressive reinforcement. Figure 2 shows a typical conceptual application of an FRP system.

The FRP system will be subjected to a benign environment: ambient temperature and humidity conditions associated with the local climate and Auxiliary Building equipment rooms. When applied to exterior surfaces of masonry walls, the FRP system will be shielded from sunlight (i.e., ultraviolet radiation) and adverse weather conditions (e.g., rain, snow, ice, etc.) by either structural steel barrier elements or architectural siding depending upon the specific location. When applied to interior surfaces of masonry walls, the FRP system will not be located in any high radiation area or exposed to high temperature gas and/or liquid.

Structural Design of FRP System

Existing masonry walls will be analyzed for tornado-induced differential pressure and/or tornado wind loadings in accordance with SRP Section 3.8.4 [Reference 2], ACI 531-79 [Reference 3], and Chapter 3 of the Oconee UFSAR [Reference 4]. Design of the FRP system will be based upon the results of this analysis and ICC AC125 [Reference 5] and will comply with the general design considerations contained in ACI 440.2R-02 [Reference 6] for FRP systems used for flexural strengthening.

Installation of the FRP system will not adversely affect the current structural qualification of the masonry walls (e.g., seismic) by significantly increasing mass or stiffness nor will it have any immediate or long-term deleterious effect on the masonry wall materials of construction.

Fire can be a significant issue when using an FRP system for structural strengthening. Elevated temperatures during a fire can cause epoxy resins to soften or burn, compromising the structural strength provided by the FRP materials. Unless subjected to uniform pressure loads resulting from a tornado event, the FRP system will remain in a near-zero state of stress; therefore, fire-induced degradation of the FRP system is not an immediate structural concern.

Qualification Tests for Selected FRP System

Qualification testing and reporting will be performed in accordance with ICC AC125 [Reference 5] for the selected FRP System.

Commercial Grade Dedication of Selected FRP System

Installation of the FRP system will result in use of a commercially available item in a QA Condition 1 application. Duke will perform and document a technical evaluation of the FRP system (fibers and polymeric resin) in accordance with Reference 7 to demonstrate that:

1. The item qualifies as a commercial grade item.
2. The supplier is capable of supplying a quality product.
3. The quality of the item can be reasonably assured.

Inspection and Verification of FRP System Installation

Duke will utilize technical procedures to control testing of concrete substrate and installation and inspection of the FRP system in accordance with ICC AC125 [Reference 5], ACI 440.2R-02 [Reference 6], and ICC AC178 [Reference 8]. The installer will be required to have personnel certified and trained by the FRP system manufacturer to install the specified system. Certified installers and an accredited quality control inspector will be present during installation of the FRP system.

The accredited quality control inspector will be on site to:

- Document that all materials conform to the evaluation report, design drawings, and installation procedure.
- Verify completed surface preparation by:
    - checking surface amplitude;

- performing adhesion tests; and,
- checking for surface primer.

- Verify proper installation of FRP system by:
  - checking ambient temperature and masonry temperature and surface dryness;
  - verifying polymer mixing is correct;
  - verifying proper application (i.e., fiber orientation, fiber overlaps and splices, number of layers and absence of air pockets); and,
  - verifying test samples are prepared, labeled, and stored in accordance with the installation procedure.

As a minimum, field testing during installation will include:

- adhesion pull tests prior to system installation on masonry as per ASTM D4541 [Reference 9]; and,
- testing of sample sets by an accredited laboratory as per ASTM D3039 [Reference 10].
  - A minimum of 15% of all sample sets will be tested.
  - Tensile properties will be required to meet, or exceed, FRP composite system properties as defined in the installation procedure.

<u>In-Service Surveillance Program for FRP System</u>

Duke's inspection program for civil engineering structures and components [Reference 11] provides guidance for monitoring and assessing civil engineering structures and their condition in order to provide assurance that they are capable of performing their intended functions. This program is applicable in meeting the regulatory requirements of the Maintenance Rule [References 12 and 13] and the License Renewal Rule [References 14 and 15] and includes the Units 1, 2, and 3 Auxiliary Building walls to which the FRP system will be applied.

In-service inspection of the FRP system will be performed on a nominal 5 year interval. This inspection frequency may be reduced to a nominal 10 year interval with appropriate justification based on the structure, environment, and previous in-service inspection results. Inspections of the installed FRP system will include:

- visual inspections for changes in color, debonding, peeling, blistering, cracking, crazing, deflections and other anomalies; and,
- tension adhesion testing of cored samples using methods specified in ASTM D4541 [Reference 9] or ACI 530R-02 [Reference 16].

To avoid testing damage to the masonry walls / FRP system designed for tornado-induced loadings, the FRP system will also be applied to an adjacent masonry wall of similar construction (i.e., test wall). This test wall will be exposed to virtually identical environmental conditions, but will be more accessible for tension adhesion testing. In addition, the test wall sample areas may be restored using conventional concrete repair procedures without concern for the FRP system. Visual inspections will be performed on both the masonry walls required to be designed for tornado-induced loadings and the test wall.

Records of in-service inspection reports will be considered 10CFR 50, Appendix B, Quality Assurance Records. All inspection reports will be maintained for the life of the plant.

Relevant Performance Testing of FRP Systems

Various studies have investigated the effectiveness of using FRP systems to strengthen existing unreinforced concrete masonry walls to resist extreme out-of-plane loads [References 17 through 22]. Both static and dynamic loading conditions have been evaluated. These studies show that flexural strength and ductility of masonry walls can be increased if shear failure is controlled. Furthermore, these studies demonstrate good agreement between experimental results and analytical models. In summary, studies indicate that FRP systems can effectively and predictably improve the low flexural capacity and brittle failure mode of unreinforced masonry walls subjected to extreme out-of-plane loads.

The specific FRP system that Duke plans to use, Tyfo® Fibrwrap® Advanced Composite System by Fyfe Company LLC, exhibits good low and high temperature properties, long working time, and high elongation (i.e., ductility). Full cure of the epoxy ranges from 3 to 5 days depending upon ambient temperatures and field conditions. The composite is expected to "cure to the touch" within 24 hours. The epoxies are 100% solvent-free, emitting no toxic fumes or volatile organic contents (V.O.C.). [Reference 25]

Homam and Sheikh [Reference 23] evaluated the durability of the Tyfo® Fibrwrap®. The research report discusses durability of the Tyfo® Fibrwrap® subjected to various types of loads and environmental exposures in civil structures. Durability evaluation of materials involved testing the post-exposure performance of the specimens subjected to gamma radiation, loss of coolant accident conditions, sustained and cyclic high temperatures, cyclic low temperature, alkali solutions, water, and outdoor environments. The results of the durability tests showed that FRP materials had good resistance to all of the exposures studied; however, FRP-FRP bonds and FRP-concrete bonds are unable to maintain their load carrying capacity if they are subjected simultaneously to stress and temperatures close to the glass-transition temperature of epoxy. (The glass-transition temperature is unique to each FRP system and ranges from 140 to 180 degrees F (60 to 82 degrees C) for existing, commercially available FRP systems [Reference 6].) It was also observed that moisture had the most deleterious effects on FRP and its bonds.

The FRP system will not be exposed to temperatures nearing the glass-transition temperature of epoxy nor will it be exposed to appreciable moisture. As previously stated, the FRP system used to strengthen existing masonry walls for the NPBS modifications will be subjected to ambient temperature and humidity conditions associated with the local climate and Auxiliary Building equipment rooms. When applied to exterior surfaces of masonry walls, the FRP system will be shielded from sunlight and adverse weather conditions (e.g., rain, snow, ice, etc.) by either structural steel barrier elements or architectural siding. The FRP system will not be exposed to high temperature gas and/or liquid or significant radiation levels when applied to either exterior or interior surfaces of masonry walls. Finally, unless subjected to uniform pressure loads resulting from a tornado event, the FRP system will remain in a near-zero state of stress.

Fire performance testing involving direct exposures to an 8-hour butane fire demonstrated that the Tyfo® composite system is self-extinguishing and will not support a fire [Reference 24]. The Tyfo® composite system tested met the requirements of a Class A fire resistive material approved by Underwriters Laboratories Inc®. The selected FRP system will be rated as a Class A fire resistive material as per NFPA 101 [Reference 26]. This requirement will apply to the as-installed composite as well as the constituent elements. In addition, it should be noted that fire protection considerations are evaluated as part of the station modification process and will be addressed for each installation of the FRP system.

References

1. January 31, 2006, letter from Mr. Henry B. Barron (Duke Energy) to Mr. James E. Dyer (USNRC), Re: Oconee Nuclear Station Units 1, 2 and 3; Docket Nos. 50-269, 270 and 287; Project Plans for Tornado and High Energy Line Break Events Outside Containment.
2. NUREG-0800, Standard Review Plan, Section 3.8.4, "Other Seismic Category I Structures," Rev.1 – July 1981.
3. Building Code Requirements for Concrete Masonry Structures, American Concrete Institute (ACI) 531-79 and Commentary ACI-531R-79.
4. Updated Final Safety Analysis Report, Duke Energy Company, Oconee Nuclear Station, December 31, 2004.
5. Interim Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems, International Code Council (ICC) AC125, June 2003.
6. Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, ACI 440.2R-02.
7. Commercial Grade Items, Duke Energy Company, Nuclear Supply Chain Directive, SCD230.
8. Interim Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems, ICC AC178, July 2003.
9. Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers, American Society for Testing and Materials (ASTM) D4541.
10. Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials, ASTM D3039.
11. Inspection Program for Civil Engineering Structures and Components, Duke Energy Company, Nuclear Generation Department, Engineering Directives Manual (EDM) 410.
12. The Maintenance Rule, 10CFR Part 50.65.
13. Industry Guideline for Monitoring Structures, Nuclear Energy Institute (NEI) 96-03.
14. The License Renewal Rule, 10CFR Part 54.
15. Industry Guideline for Implementing the Requirements of 10CFR Part 54 – The License Renewal Rule, NEI 95-10.
16. Building Code Requirements for Masonry Structures, ACI 530R-02.

17. Albert, M. L., A. E. Elwi, and J. J. Roger Cheng. 2001. "Strengthening of Unreinforced Masonry Walls Using FRPs." Journal of Composites for Construction 5, no. 2 (May): 76-84.

18. Carney, P. and J. J. Myers. 2003. "Shear and Flexural Strengthening of Masonry Infill Walls with FRP for Extreme Out-of-Plane Loading." Architectural Engineering - Building Integration Solutions (2003): 1-5.

19. Hamilton III, H. R. and C. W. Dolan. 2001. "Flexural Capacity of Glass FRP Strengthened Concrete Masonry Walls." Journal of Composites for Construction 5, no. 3 (Aug.): 170-178.

20. Hamoush, S. A., M. W. McGinley, P. Mlakar, D. Scott, and K. Murray. 2001. "Out-of-Plane Strengthening of Masonry Walls with Reinforced Composites." Journal of Composites for Construction 5, no. 3 (Aug.): 139-145.

21. Tan, K. H. and M. K. H. Patoary. 2004. "Strengthening of Masonry Walls against Out-of-Plane Loads Using Fiber-Reinforced Polymer Reinforcement." Journal of Composites for Construction 8, no. 1 (Feb.): 79-87.

22. Tumialan, J. G., N. Galati, and A. Nanni. 2003. "Field Assessment of Unreinforced Masonry Walls Strengthened with Fiber Reinforced Polymer Laminates." Journal of Structural Engineering 129, no. 8 (Aug.): 1047-1056.

23. Homam, Sayed Mukhtar and Shamim A. Sheikh. 2005. "Fibre Reinforced Polymers (FRP) and FRP-Concrete Composites Subjected to Various Loads and Environmental Exposures." University of Toronto, Department of Civil Engineering, Research Report HS-01-05 (Sep.).

24. Karbhari, Vistasp M. "Fire Performance of the TYFO® SEH 51 Composite System during Direct Exposure to an 8 Hour Butane Fire." University of California, San Diego, Division of Structural Engineering. Jan. 1997.

25. Fyfe Company LLC, Tyfo® SEH-51A Composite (using Tyfo® S Epoxy) System Product Data Sheet. Dec. 2005.

26. NFPA 101: *Life Safety Code.*

FIGURE 1 – EXAMPLES OF WALLS TO BE STRENGTHENED USING AN FRP SYSTEM INCLUDE THE UNIT 3 CONTROL ROOM NORTH WALL AND THE UNITS 1, 2, AND 3 WEST PENETRATION ROOM (WPR) AND CASK DECONTAMINATION TANK ROOM (CDTR) WALLS

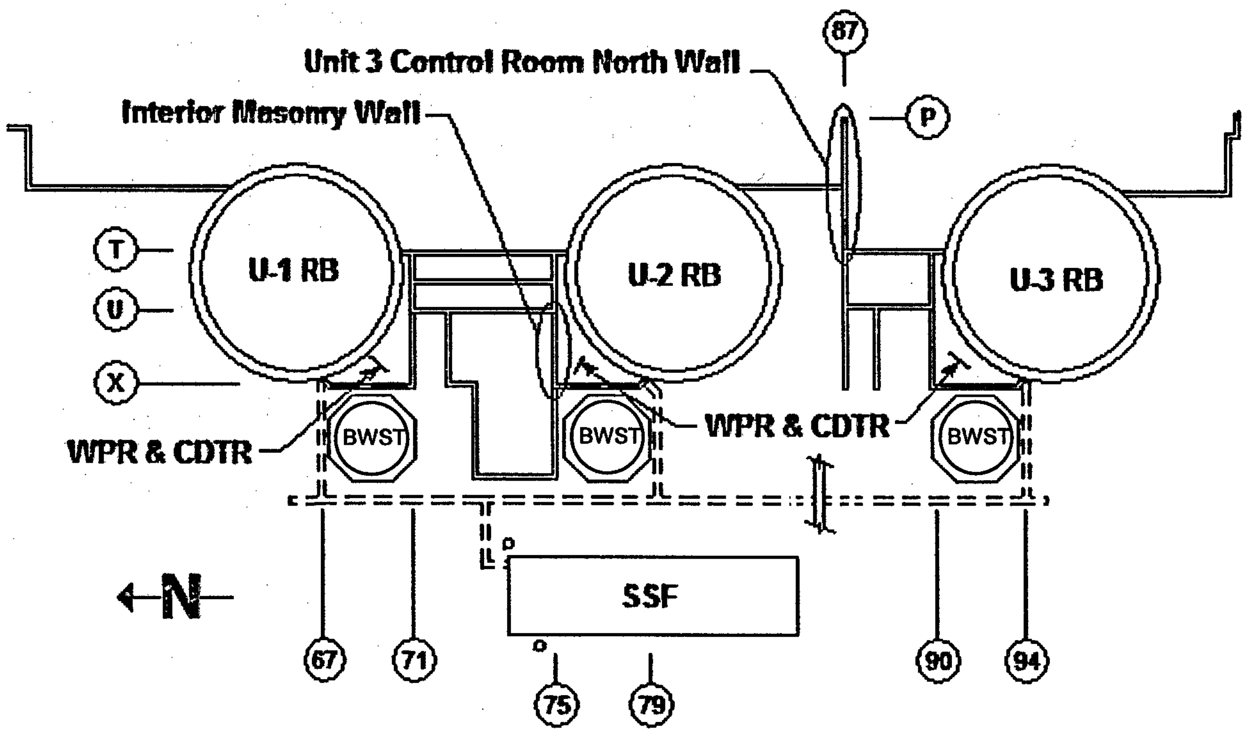
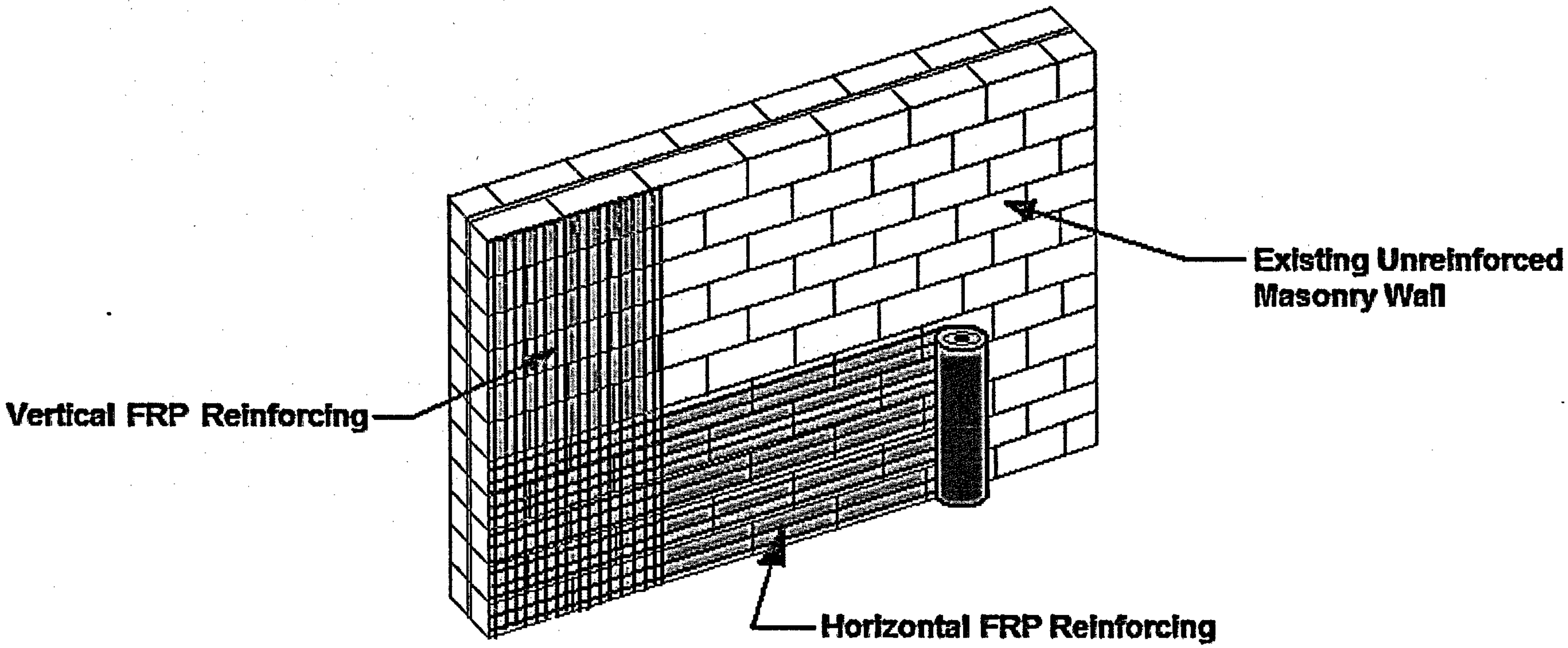


FIGURE 2 – TYPICAL CONCEPTUAL APPLICATION OF AN FRP SYSTEM



ATTACHMENT 1

UFSAR – MARK UPS

{UFSAR Section 3.8.4.5 and Section 3.8.4.6 not shown}

3.8.4.7 Concrete Masonry Walls

The masonry walls are in-fill panels serving as partitions with some walls having pressure, fire and radiation barrier applications. The walls are single or multiple wythe and ~~multiwythe,~~constructed of hollow or grouted concrete blocks or solid concrete blocks or bricks. All masonry walls are non-structural and constructed on a structural support system.

Pursuant to I.E. Bulletin 80-11, a safety re-evaluation of all masonry walls was undertaken by Duke Power Company. As a result of this reevaluation effort certain masonry walls were modified to meet minimum factors of safety.

Certain masonry walls that are part of the Units 1, 2, and 3 Auxiliary Buildings were evaluated for tornado-induced differential pressure and tornado wind loadings. The walls were subsequently strengthened to meet these loads using a fiber-reinforced polymer (FRP) system.

3.8.4.7.1 Applicable Codes and Standards

The criteria used for the re-evaluation of masonry walls pursuant to I. E. Bulletin 80-11 are ~~is~~ contained in Attachment 4 of Reference 14. These ~~This~~ criteria identify ~~uses~~ the American Concrete Institute "Building Code Requirements for Concrete Masonry Structures," ACI 531-79, as the governing code with supplemental allowables specified for cases not directly addressed in the code.

The criteria used for the re-evaluation of masonry walls to resist tornado-induced loadings are contained in Enclosure 3 of Reference 34 as approved by the NRC in Reference 36. These criteria specify ACI 531-79 and International Code Council *Interim Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems*, ICC AC125 (Reference 35), as the governing codes for this evaluation.

3.8.4.7.2 Loads and Load Combinations

The design loadings for the masonry walls at Oconee are those specified in portions of Section 3.8.4. The only thermal effects which a masonry wall experiences are those pertinent to normal operation, and these are not considered a significant design consideration.

In addition, the design differential pressure and external wind force for masonry walls evaluated for tornado-induced loadings are contained in Section 3.3.2.1. The load combinations for tornado-induced loadings are contained in NUREG-0800, *Standard Review Plan*, Section 3.8.4.

3.8.4.7.3 Upgrade and Modification of Masonry Walls

A program of repairs was performed on selected masonry walls pursuant to I. E. Bulletin 80-11. The walls included in this program were not found to be unsafe in their original configuration; however, an added margin of safety was desired for
~~3.8-60 (31-DEC-2004)~~

~~Oconee Nuclear Station UFSAR Chapter 3~~
~~-~~these walls. The repairs provide increased factors of safety by either upgrading the walls to meet the allowable stresses set forth in the re-evaluation criteria or by shielding the safety related equipment located in proximity of the walls from damage, assuming the masonry walls

were to collapse. References 12 through 24 pertain to I.E. Bulletin 80-11.

Certain masonry walls that are part of the Units 1, 2, and 3 Auxiliary Buildings were modified to resist tornado-induced differential pressure and tornado wind loadings. These walls were strengthened using a fiber-reinforced polymer (FRP) system.

3.8.5 Nonclass 1 Structures

The Turbine Building, the condenser circulating water structures, the Essential Siphon Vacuum System Intake Dike Trench, the Essential Siphon Vacuum Cable Trench, the Essential Siphon Vacuum Building, and the Keowee structures as listed in Section 3.2.1.1.2 are Class 2 structures.

Class 3 structures include all structures not included in Class 1 and 2.

3.8.5.1 Description of the Structures

1. Turbine Building

   The building was constructed of reinforced concrete below grade consisting of substructure walls and a mat foundation. Above grade, the building consists of structural steel with metal siding.

2. Keowee Structures

   The Keowee Structures considered are Powerhouse, Power and Penstock Tunnels, Spillway, Service Bay Substructure, Breaker Vault, and Intake Structure.

3. Dams and Dikes

   The Keowee Dam, the Little River Dam and Dikes, and the Oconee Intake Canal Dike impound the waters of Lake Keowee to provide the source of flowing water for the Keowee hydroelectric power plant.

4. Oconee Intake Structure

   The intake structure supports the CCW pumps, intake screens, and inlets of the CCW pipes.

5. Oconee Intake Underwater Weir

   The underwater weir retains an emergency water supply in the event that the waters of Lake Keowee are released by the failure of a dam or dike.

6. CCW Intake Piping

   The CCW Intake Piping conveys water from the CCW pumps on the intake structure to the condenser, supplies water to the LPSW Pumps, and serves as the reservior for the Auxiliary Service Water System.

{UFSAR Section 3.8.5.1(7) through Section 3.8.6 not shown}

3.8.7 References

1. Eringen, A. C., and Naghdi, A. K., "State of Stress in a Circular Cylindrical Shell with a Circular Hole."

2. Levy, Samuel, McPherson, A. E., and Smith, F. C., "Reinforcement of a Small Circular Hole in a Plane Sheet Under Tension," *Journal of Applied Mechanics*," June 1948.

3. Wichman, K. R., Hopper, A. G., and Mershon, J. L., "Local Stress in Spherical and Cylindrical Shells Due to External Loadings," *Welding Research Council Bulletin No. 107*, August 1965.

4. HTGR and Laboratory Staff, Prestressed Concrete Reactor Vessel, Model 1, *GA7097*.

5. Advance HTGR Staff, Prestressed Concrete Reactor Vessel, Model 2, *GA7150*.

6. Hardingham, R. P., Parker, J. V., and Spruce, T. W., *Liner Design and Development for the Oldbury Vessels*, London Conference on Prestressed Concrete Pressure Vessels, Group J, Paper 56.

7. Amirikian, A., Design of Protective Structures, Bureau of Yards and Docks, Department of the Navy, *NAVDOCKS P-51*, 1950.

8. AEC Publication TID-7024, *Nuclear Reactors and Earthquakes*.

9. Housner, G. W., *Design of Nuclear Power Reactors Against Earthquakes*, Proceedings of the Second World Conference on Earthquake Engineering, Volume 1, Japan 1960, Page 133.

10. Housner, G. W., *Behavior of Structures During Earthquakes*, Journal of the Engineering Mechanics Division, Proceedings of the American Society of Civil Engineers, October 1959, Page 109.

11. Task Committee on Wind Forces, *Wind Forces on Structures*, ASCE Paper No 3269.

12. IE Bulletin 80-11, "Masonry Wall Design," NRC, May 8, 1980.

13. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC), July 7, 1980.

14. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC), November 4, 1980.

15. A. C. Thies (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC), May 22, 1981.

16. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to H. R., Denton (NRC),

July 13, 1981.

17. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC) September 30, 1981.

18. W. O. Parker, Jr. (Duke Power Company) Letter with attachment to J. F. Stolz (NRC), December 29, 1981.

19. W. O. Parker, Jr. (Duke Power Company), Letter with attachments to H. R. Denton (NRC), May 18, 1982.

20. W. O. Parker, Jr. (Duke Power Company), Letter with attachments to H. R. Denton (NRC), June 15, 1982.

21. Standard Review Plan, Section 3.8.4, Appendix A, "Interim Criteria for Safety-Related Masonry Wall Evaluation," NRC, July 1981.

22. Uniform Building Code, International Conference of Building Officials, 1979.

23. ACI 531-79 and Commentary ACI 531R-79, "Building Code Requirements for Concrete Masonry Structures," American Concrete Institute, 1979.

24. Letter with attachment from John F. Stolz (NRC) to H. B. Tucker (Duke) dated March 14, 1985.

    Subject: Safety Evaluation Report on Masonry Wall Design

25. NCIG-01, Visual Weld Acceptance Criteria

26. PSAR, Supplement No. 4, Answer to Question 11.2, May 25, 1967.

27. PSAR, Supplement No. 4, Answer to Question 11.4, May 25, 1967.

28. PSAR, Supplement No. 4, Answer to Question 12.2, May 25, 1967.

29. PSAR, Supplement No. 5-11, June 16, 1967.

30. PSAR, Supplement No. 6-1, March 26, 1969.

31. M. S. Tuckman (Duke) letter dated November 11, 1998 to Document Control Desk (NRC), "Response to Generic Letter 98-04: Potential Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," Oconee Nuclear Station, Units 1, 2, and 3, Docket Nos. 50-269, -270, and -287.

~~(31 DEC 2004) 3.8 - 69~~

~~UFSAR Chapter 3 Oconee Nuclear Station~~

32. *Application for Renewed Operating Licenses for Oconee Nuclear Station, Units 1, 2, and 3*, submitted by M. S. Tuckman (Duke) letter dated July 6, 1998 to Document Control Desk (NRC), Docket Nos. 50-269, -270, and -287.

33. NUREG-1723, *Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3*, Docket Nos. 50-269, 50-270, and 50-287.

34. Duke Fiber Reinforced Polymer License Amendment Request dated June 1, 2006.

35. *Interim Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems*, International Code Council (ICC) AC125, June 2003.

36. NRC Safety Evaluation for Duke's June 1, 2006 FRP License Amendment Request dated December xx, 2006.

THIS IS THE LAST PAGE OF THE TEXT SECTION 3.8.

~~3.8 - 70~~ ~~(31-DEC-2004)~~

ATTACHMENT 2

UFSAR – REPRINTED PAGES

{UFSAR Section 3.8.4.5 and Section 3.8.4.6 not shown}

3.8.4.7 Concrete Masonry Walls

The masonry walls are in-fill panels serving as partitions with some walls having pressure, fire and radiation barrier applications. The walls are single or multiple wythe and constructed of hollow or grouted concrete blocks or solid concrete blocks or bricks. All masonry walls are non-structural and constructed on a structural support system.

Pursuant to I.E. Bulletin 80-11, a safety re-evaluation of all masonry walls was undertaken by Duke Power Company. As a result of this reevaluation effort certain masonry walls were modified to meet minimum factors of safety.

Certain masonry walls that are part of the Units 1, 2, and 3 Auxiliary Buildings were evaluated for tornado-induced differential pressure and tornado wind loadings. The walls were subsequently strengthened to meet these loads using a fiber-reinforced polymer (FRP) system.

3.8.4.7.1 Applicable Codes and Standards

The criteria used for the re-evaluation of masonry walls pursuant to I. E. Bulletin 80-11 are contained in Attachment 4 of Reference 14. These criteria identify the American Concrete Institute "Building Code Requirements for Concrete Masonry Structures," ACI 531-79, as the governing code with supplemental allowables specified for cases not directly addressed in the code.

The criteria used for the re-evaluation of masonry walls to resist tornado-induced loadings are contained in Enclosure 3 of Reference 34 as approved by the NRC in Reference 36. These criteria specify ACI 531-79 and International Code Council *Interim Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems*, ICC AC125 (Reference 35), as the governing codes for this evaluation.

3.8.4.7.2 Loads and Load Combinations

The design loadings for the masonry walls at Oconee are those specified in portions of Section 3.8.4. The only thermal effects which a masonry wall experiences are those pertinent to normal operation, and these are not considered a significant design consideration.

In addition, the design differential pressure and external wind force for masonry walls evaluated for tornado-induced loadings are contained in Section 3.3.2.1. The load combinations for tornado-induced loadings are contained in NUREG-0800, *Standard Review Plan*, Section 3.8.4.

3.8.4.7.3 Upgrade and Modification of Masonry Walls

A program of repairs was performed on selected masonry walls pursuant to I. E. Bulletin 80-11. The walls included in this program were not found to be unsafe in their original configuration; however, an added margin of safety was desired for these walls. The repairs provide increased factors of safety by either upgrading the walls to meet the allowable stresses set forth in the re-evaluation criteria or by shielding the safety related equipment located in proximity of the walls from damage, assuming the masonry walls were to collapse. References 12 through 24 pertain to I.E. Bulletin 80-11.

Certain masonry walls that are part of the Units 1, 2, and 3 Auxiliary Buildings were modified to resist tornado-induced differential pressure and tornado wind loadings. These walls were strengthened using a fiber-reinforced polymer (FRP) system.

3.8.5 Nonclass 1 Structures

The Turbine Building, the condenser circulating water structures, the Essential Siphon Vacuum System Intake Dike Trench, the Essential Siphon Vacuum Cable Trench, the Essential Siphon Vacuum Building, and the Keowee structures as listed in Section 3.2.1.1.2 are Class 2 structures.

Class 3 structures include all structures not included in Class 1 and 2.

3.8.5.1 Description of the Structures

1. Turbine Building

   The building was constructed of reinforced concrete below grade consisting of substructure walls and a mat foundation. Above grade, the building consists of structural steel with metal siding.

2. Keowee Structures

   The Keowee Structures considered are Powerhouse, Power and Penstock Tunnels, Spillway, Service Bay Substructure, Breaker Vault, and Intake Structure.

3. Dams and Dikes

   The Keowee Dam, the Little River Dam and Dikes, and the Oconee Intake Canal Dike impound the waters of Lake Keowee to provide the source of flowing water for the Keowee hydroelectric power plant.

4. Oconee Intake Structure

   The intake structure supports the CCW pumps, intake screens, and inlets of the CCW pipes.

5. Oconee Intake Underwater Weir

   The underwater weir retains an emergency water supply in the event that the waters of Lake Keowee are released by the failure of a dam or dike.

6. CCW Intake Piping

   The CCW Intake Piping conveys water from the CCW pumps on the intake structure to the condenser, supplies water to the LPSW Pumps, and serves as the reservior for the Auxiliary Service Water System.

{UFSAR Section 3.8.5.1(7) through Section 3.8.6 not shown}

3.8.7 References

1. Eringen, A. C., and Naghdi, A. K., "State of Stress in a Circular Cylindrical Shell with a Circular Hole."

2. Levy, Samuel, McPherson, A. E., and Smith, F. C., "Reinforcement of a Small Circular Hole in a Plane Sheet Under Tension," *Journal of Applied Mechanics*," June 1948.

3. Wichman, K. R., Hopper, A. G., and Mershon, J. L., "Local Stress in Spherical and Cylindrical Shells Due to External Loadings," *Welding Research Council Bulletin No. 107*, August 1965.

4. HTGR and Laboratory Staff, Prestressed Concrete Reactor Vessel, Model 1, *GA7097*.

5. Advance HTGR Staff, Prestressed Concrete Reactor Vessel, Model 2, *GA7150*.

6. Hardingham, R. P., Parker, J. V., and Spruce, T. W., *Liner Design and Development for the Oldbury Vessels*, London Conference on Prestressed Concrete Pressure Vessels, Group J, Paper 56.

7. Amirikian, A., Design of Protective Structures, Bureau of Yards and Docks, Department of the Navy, *NAVDOCKS P-51*, 1950.

8. AEC Publication TID-7024, *Nuclear Reactors and Earthquakes*.

9. Housner, G. W., *Design of Nuclear Power Reactors Against Earthquakes*, Proceedings of the Second World Conference on Earthquake Engineering, Volume 1, Japan 1960, Page 133.

10. Housner, G. W., *Behavior of Structures During Earthquakes*, Journal of the Engineering Mechanics Division, Proceedings of the American Society of Civil Engineers, October 1959, Page 109.

11. Task Committee on Wind Forces, *Wind Forces on Structures*, ASCE Paper No 3269.

12. IE Bulletin 80-11, "Masonry Wall Design," NRC, May 8, 1980.

13. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC), July 7, 1980.

14. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC), November 4, 1980.

15. A. C. Thies (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC), May 22, 1981.

16. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to H. R., Denton (NRC), July 13, 1981.

17. W. O. Parker, Jr. (Duke Power Company), Letter with attachment to J. P. O'Reilly (NRC) September 30, 1981.

18. W. O. Parker, Jr. (Duke Power Company) Letter with attachment to J. F. Stolz (NRC), December 29, 1981.

19. W. O. Parker, Jr. (Duke Power Company), Letter with attachments to H. R. Denton (NRC), May 18, 1982.

20. W. O. Parker, Jr. (Duke Power Company), Letter with attachments to H. R. Denton (NRC), June 15, 1982.

21. Standard Review Plan, Section 3.8.4, Appendix A, "Interim Criteria for Safety-Related Masonry Wall Evaluation," NRC, July 1981.

22. Uniform Building Code, International Conference of Building Officials, 1979.

23. ACI 531-79 and Commentary ACI 531R-79, "Building Code Requirements for Concrete Masonry Structures," American Concrete Institute, 1979.

24. Letter with attachment from John F. Stolz (NRC) to H. B. Tucker (Duke) dated March 14, 1985.

    Subject: Safety Evaluation Report on Masonry Wall Design

25. NCIG-01, Visual Weld Acceptance Criteria

26. PSAR, Supplement No. 4, Answer to Question 11.2, May 25, 1967.

27. PSAR, Supplement No. 4, Answer to Question 11.4, May 25, 1967.

28. PSAR, Supplement No. 4, Answer to Question 12.2, May 25, 1967.

29. PSAR, Supplement No. 5-11, June 16, 1967.

30. PSAR, Supplement No. 6-1, March 26, 1969.

31. M. S. Tuckman (Duke) letter dated November 11, 1998 to Document Control Desk (NRC), "Response to Generic Letter 98-04: Potential Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," Oconee Nuclear Station, Units 1, 2, and 3, Docket Nos. 50-269, -270, and -287.

32. *Application for Renewed Operating Licenses for Oconee Nuclear Station, Units 1, 2, and 3*, submitted by M. S. Tuckman (Duke) letter dated July 6, 1998 to Document Control Desk (NRC), Docket Nos. 50-269, -270, and -287.

33. NUREG-1723, *Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2, and 3*, Docket Nos. 50-269, 50-270, and 50-287.

34. Duke Fiber Reinforced Polymer License Amendment Request dated June 1, 2006.

35. *Interim Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems*, International Code Council (ICC)

AC125, June 2003.

36. NRC Safety Evaluation for Duke's June 1, 2006 FRP License Amendment Request dated December xx, 2006.

THIS IS THE LAST PAGE OF THE TEXT SECTION 3.8.

ATTACHMENT 3

LIST OF REGULATORY COMMITMENTS

The following commitment table identifies those actions committed to by Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC (Duke) in this submittal. Other actions discussed in the submittal represent intended or planned actions by Duke. They are described to the Nuclear Regulatory Commission (NRC) for the NRC's information and are not regulatory commitments.

Commitment	Completion Date
Duke will perform qualification testing and reporting in accordance with ICC AC125 [Reference 5 of Enclosure 3] for the selected FRP System.	Prior to initial installation of FRP system.
Duke will perform and document a technical evaluation of the FRP system (fibers and polymeric resin) in accordance with Reference 7 of Enclosure 3 to demonstrate that: 1. The item qualifies as a commercial grade item. 2. The supplier is capable of supplying a quality product. 3. The quality of the item can be reasonably assured.	Prior to initial installation of FRP system.
Duke will utilize technical procedures to control testing of concrete substrate and installation and inspection of the FRP system in accordance with ICC AC125 [Reference 5 of Enclosure 3], ACI 440.2R-02 [Reference 6 of Enclosure 3], and ICC AC178 [Reference 8 of Enclosure 3].	Prior to initial installation of FRP system.
Duke will perform in-service inspection of the FRP system on a nominal 5 year interval. This inspection frequency may be reduced to a nominal 10 year interval with appropriate justification based on the structure, environment, and previous in-service inspection results. Inspections of the installed FRP system will include: • visual inspections for changes in color, debonding, peeling, blistering, cracking, crazing, deflections and other anomalies; and, • tension adhesion testing of cored samples using methods specified in ASTM D4541 [Reference 9 of Enclosure 3] or ACI 530R-02 [Reference 16 of Enclosure 3].	Within 5 years of completion of 1st FRP-related station modification.