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June 26, 2008

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

Subject: Duke Energy Carolinas, LLC
Oconee Nuclear Station, Units 1, 2, and 3
Renewed Facility Operating Licenses Numbers DPR-38, DPR-47, and DPR-55;
Docket Numbers 50-269, 50-270, and 50-287
License Amendment Request to Revise Portions of the Updated Final Safety Analysis Report Related to the Tornado Licensing Basis;
License Amendment Request No. 2006-009

References:

1. Letter to Mr. James Dyer, Director, Office of Nuclear Reactor Regulation, from Henry B. Barron, Group Vice President and Chief Nuclear Officer, Nuclear Generation, Duke Energy Corporation, "Tornado/HELB Mitigation Strategies and Regulatory Commitments," dated November 30, 2006.
2. Letter from Leonard N. Olshan, Project Manager, Plant Licensing Branch II-1, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation, "Summary of March 5, 2007, Meeting to Discuss the November 30, 2006, Letter Regarding Oconee High-Energy Line Break (HELB) and Tornado Mitigation Strategies," dated March 28, 2007.
3. Letter from Timothy J. McGinty, Deputy Director, Division of Operating Reactor Licensing, USNRC Office of Nuclear Reactor Regulation, to Bruce H. Hamilton, Oconee Nuclear Station, Units 1, 2, and 3 (Oconee) – Tornado and High-Energy Line Break (HELB) Mitigation Strategies, dated May 15, 2007.
4. Letter to the U. S. Nuclear Regulatory Commission from Henry B. Barron, Group Vice President and Chief Nuclear Officer, Nuclear Generation, Duke Energy Corporation, "Revision to Tornado/HELB Mitigation Strategies and Regulatory Commitments," dated January 25, 2008.

In accordance with 10 CFR 50.90, Duke Energy Carolinas, LLC (Duke) proposes to amend Renewed Facility Operating Licenses Nos. DPR-38, DPR-47, and DPR-55. This License Amendment Request (LAR) will result in a revision to portions of the Oconee Nuclear Station (ONS) Updated Final Safety Analysis Report (UFSAR) regarding the tornado Licensing Basis (LB). Specifically, this LAR proposes a number of plant modifications to enhance the station's

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capability to withstand the effects of a damaging tornado, revises the ONS UFSAR sections associated with the tornado LB, and expands the use of the tornado missile probabilistic methodology (TORMIS) in determining which unprotected systems, structures, or components (SSCs) are required to be physically protected from tornado generated missiles. The TORMIS methodology may be used when assessing the need for missile protection in accordance with the criteria of the Standard Review Plan Section 3.5.1.4, "Missiles Generated by Natural Phenomena." Duke has also reviewed the recently released Regulatory Issue Summary (RIS) 2008-14, "Use of TORMIS Computer Code for Assessment of Tornado Missile Protection." Duke believes that the issues identified in this RIS have been addressed in the LAR.

The specific actions proposed in this LAR have been selected and prioritized based upon a thorough assessment of operational, risk and safety benefits, as well as regulatory considerations and resource requirements. These actions will require a significant investment of resources by Duke and are intended to resolve outstanding tornado licensing basis issues. Duke believes these actions collectively represent the most appropriate use of resources to enhance safety and resolve regulatory issues. Implementation of the revised tornado LB and the related commitments will clarify and, in some cases, revise the ONS Current LB to address issues raised by the Nuclear Regulatory Commission (NRC) and to collectively enhance the station's overall design, safety and risk margin.

The actions selected for implementation include: (1) station modifications that will provide additional protection of key structures to better withstand the effects of postulated tornadoes, (2) installation of a new Protected Service Water System capable of establishing and maintaining safe shutdown conditions independent of the Standby Shutdown Facility (SSF) and, (3) the submittal of future, supplemental LARs which support the revised tornado LB as discussed later in this letter. However, ongoing safety analysis work is in progress relative to operation of the SSF with a compromised main steam pressure boundary due to potential breaks in the main steam system. This analysis will be completed and submitted on or before June 30, 2009 (also see page 8 of Enclosure 2) and is listed as a commitment in the Unit-1 High Energy Line Break LAR.

Attachment 1 and Reference 4 contain a list of regulatory commitments made as a result of this LAR. Attachments 2 and 3 provide the marked-up and reprinted UFSAR pages; Attachment 4 is a summary of how the TORMIS methodology was applied to the ONS; Attachment 5 is a copyrighted© study prepared for Duke by Dr. L. A. Twisdale (creator of the TORMIS code) containing a tornado risk analysis for ONS. Duke requests that Attachments 4 and 5 be withheld from public disclosure. Attachment 4 contains sensitive commercial information and meets the criteria for exemption from disclosure per 10 CFR 2.390(d)(1). Attachment 5 contains information that is proprietary to Duke and in accordance with 10 CFR 2.390, Duke requests that this information be withheld from public disclosure (see Enclosure 3).

Enclosure 2 is a technical evaluation of the proposed changes. In addition to the UFSAR updates contained in this request, future revisions to the ONS UFSAR as well as a new Technical

Specification (TS) will be necessary in association with the design and licensing of the PSW System. These future revisions will be contained in a separate High Energy Line Break LAR submittal. Future licensing actions will also be required to support MSIV installation for all three units and application of Fiber Reinforced Polymer in strengthening the West Penetration Room brick walls against the effects of tornado differential pressure.

As described herein, the revised tornado LB is based on the plant configuration that will exist after implementation of several modifications to the site as described in previous correspondence (References: 1, 2, 3, and 4) and in this LAR. Accordingly, implementation of the revised tornado LB will be integrated upon completion of those associated plant modifications. Duke requests approval of this amendment by July 2009, with a staggered implementation period in accordance with the commitment completion dates provided in Attachment 1 and Reference 4.

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. A copy of this LAR is being sent to the State of South Carolina in accordance with 10 CFR 50.91 requirements.

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

Very sincerely yours,

Dave Baxter, Vice President,
Oconee Nuclear Station

Enclosures:

1. Notarized Affidavit
2. Evaluation of Proposed Changes
3. Notarized Affidavit for Duke Proprietary Information

Attachments:

1. List of Regulatory Commitments
2. UFSAR – Marked-Up Pages
3. UFSAR – Reprinted Pages
4. Application of the TORMIS Study at ONS
5. "Tornado Risk Analysis for Oconee Nuclear Station," by L. A. Twisdale and M. B. Hardy, Applied Research Associates, Inc., dated June 21, 2007.

bc w/enclosures and attachments:

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ENCLOSURE 1

NOTARIZED AFFIDAVIT

AFFIDAVIT

Dave Baxter, being duly sworn, states that he is Vice President, Oconee Nuclear Station, 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.

Dave Baxter, Vice President
Oconee Nuclear Station

Subscribed and sworn to before me this 26 day of June, 2008

Notary Public

My Commission Expires:

6/15/2016
Date

ENCLOSURE 2

EVALUATION OF PROPOSED CHANGES

Subject: Proposed License Amendment Request to Revise the Updated Final Safety Analysis Report Related to the Oconee Tornado LB

1. SUMMARY DESCRIPTION
2. BACKGROUND/CIRCUMSTANCES
3. DETAILED DESCRIPTION OF PROPOSED CHANGES
4. TECHNICAL EVALUATION
5. REGULATORY EVALUATION
    - Significant Hazards Consideration
    - Applicable Regulatory Requirements/Criteria
    - Precedent
    - Conclusions
6. ENVIRONMENTAL CONSIDERATION
7. ACRONYMS AND ABBREVIATIONS

1 SUMMARY DESCRIPTION

In accordance with 10 CFR 50.90, Duke Energy Carolinas, LLC (Duke) proposes to amend Renewed Facility Operating Licenses Nos. DPR-38, DPR-47, and DPR-55. This License Amendment Request (LAR) will result in a revision of portions of the Oconee Nuclear Station (ONS) Updated Final Safety Analysis Report (UFSAR) regarding the tornado Licensing Basis (LB). Specifically, the LAR proposes a number of plant modifications to enhance the station's capability to withstand the effects of a damaging tornado, revises the ONS UFSAR sections associated with the tornado LB and expands the use of the tornado missile probabilistic methodology (TORMIS) to determine which unprotected systems, structures, or components (SSCs) are required to be physically protected from tornado-generated missiles. The TORMIS methodology may be used when assessing the need for missile protection in accordance with the criteria of the Standard Review Plan (SRP) Section 3.5.1.4, "Missiles Generated by Natural Phenomena." Implementation of the revised tornado LB and the related commitments will clarify and, in some cases, revise the ONS Current Licensing Basis (CLB) to address issues raised by the Nuclear Regulatory Commission (NRC) and collectively enhance the station's overall design, safety and risk margin.

2 BACKGROUND/CIRCUMSTANCES

The original 1973 Final Safety Analysis Report contained a description of tornado protection design requirements which relied on:

- Physical protection of Class 1[1] structures, such as the Reactor Building (RB) and selected portions of the Auxiliary Building (AB).
- Sufficient supply of secondary side cooling water for safe shutdown[2] (SSD)
- Diverse sources of emergency power and,
- Physical separation of systems as defense against tornado missiles. The application of physical separation was applied to the 'A' and 'B' steam generator (SG) paths of the station Auxiliary Service Water (ASW) system since either path was considered capable of providing the necessary flow to restore secondary side decay heat removal (SSDHR) and was physically separated by the RBs. Additionally, physical separation was applied to the Keowee Hydro Units (KHU) and the station. The NRC acknowledged the use of physical separation as a viable means of defending against missiles in the original Safety Evaluation Report (SER[3]), stating, "*With regard to Class I (seismic) components in the AB [such components] will be protected by concrete walls and roofs to prevent potential missile penetration, or be separated to prevent failures in redundant systems from such*

[1] See Section 5.2.6 of this LAR for a list of Oconee Class 1 structures.

[2] Safe shutdown is defined as Mode 3 with RCS temperature ≥ 525 °F.

[3] Weins, Leonard A., Project Manager, Division of Reactor Projects I/II, Office of Nuclear Reactor Regulation, to Tucker, H. B., Vice President, Nuclear Production Department, Duke Power Company, "Safety Evaluation report of Effect of Tornado Missiles on Oconee Emergency Feedwater System," dated July 28, 1989.

missiles."

In the late 1970s, there was regulatory activity pertaining to the NRC's Systematic Evaluation Program (SEP) to establish a standard tornado LB for pre-Standard Review Plan (SRP) plants that received their operating licenses before 1975 since the tornado design requirements differed significantly for pre- and post-SRP plants. In resolving SEP Issue 156.1.5, "Tornado Missiles," the NRC concluded that the guidance relative to tornado missile protection prior to 1972 was not adequate. The NRC recommended that this issue be resolved by the NRC's Individual Plant Examination of External Events (IPEEE)[4] process.

In February 1978, Duke proposed the Standby Shutdown Facility (SSF) as an alternate and independent means to achieve and maintain SSD conditions for one or more of the three ONS units for approximately three days following a loss of normal AC power. The SSF was designed to provide a means to meet SSD requirements for fire protection, Turbine Building (TB) flooding and physical security. The SSF was also credited as the alternate AC power source and the source of SSDHR to demonstrate SSD during the required station blackout (SBO) coping duration.

The SSF is a seismic Category I structure housing subsystems that provide adequate SSDHR and reactor coolant makeup (RCMU) to all three units. The SSF subsystems are not designed to meet the single failure criterion, but are designed such that failures in these systems do not cause failures or inadvertent operations in existing plant systems. The subsystems are manually initiated such that multiple actions must be performed to provide flow to existing safety systems. SSF functions are completely controlled from the SSF. The SSF was approved[5] by the NRC in 1983 and was put into service soon thereafter.

Between 1982 and 1984, Duke began development of a Probabilistic Risk Assessment (PRA) model in accordance with NSAC/60[6] that included a tornado assessment. Also in the early 1980's, to resolve Emergency Feedwater (EFW) (for SSDHR) tornado missile issues related to the post-TMI actions (NUREG 0737), TORMIS was introduced by Duke to evaluate missile mitigation vulnerabilities associated with the EFW system. In 1989, the NRC issued an SER that acknowledged Duke's specific application of the TORMIS methodology. In the 1989 SER[3] which closed out the post-TMI EFW issue, the NRC stated,

"*....the undamaged EFW system in one unit can supply feedwater to the SGs in a unit with damaged EFW system cross-connections in the pump discharge piping.....Based on review of your probabilistic analysis, the staff concludes that the ONS secondary side heat removal capability complies with the criterion for protection against tornadoes, and is therefore acceptable. This conclusion is*

[4] On June 28, 1991, the NRC issued GL 88-20, Supplement 4 that requested all licensees perform Individual Plant Examination of External Events (IPEEE).

[5] Stolz, Chief, Operating Reactors Branch #4, Division of Licensing, U. S. Regulatory Commission, to Tucker, H. B. , Vice President, Nuclear Production Department, Duke Power Company, "Safety Evaluation by the Office of Nuclear Reactor Regulation, Oconee Nuclear Station Standby Shutdown Facility," dated April 28, 1983.

[6] NSAC/60, "A Probabilistic Risk Assessment by Oconee Unit 3," Electric Power Research Institute, June 1984.

primarily based on the availability of the SSF ASW system."

The SSF ASW, Station ASW and the EFW systems from an unaffected unit were credited with supplying SSDHR following a damaging tornado.

Duke submitted an IPEEE on December 18, 1997, that included a tornado PRA to address the high winds portion of the IPEEE's high winds, flood, and other external events requirement. The NRC approved the ONS IPEEE on March 15, 2000[7]. As stated in the Technical Evaluation Report (TER),

"*On the basis of our review of your submittals only, the staff has concluded that your IPEEE process is capable of identifying the most likely severe accident and severe accident vulnerabilities at the Oconee Nuclear Station, Units 1, 2, and 3 and therefore, that the Oconee IPEEE has met the intent of Supplement 4 to Generic Letter 88-20.*"

In June 2002, following two (2) tornado-related White findings in the 1999-2000 timeframe and in an effort to strengthen the current tornado LB, Duke submitted a "risk-informed" LAR using an upgraded PRA tornado model. The LAR requested approval for removal of the High Pressure Injection (HPI) pump from the Spent Fuel Pool (SFP) flowpath that was used as a backup to the HPI from the Borated Water Storage Tank (BWST) primary makeup flowpath. The backup flow path had low risk significance, was unreliable and involved significant operator actions outside the main CRs. Although the SSF structure is tornado protected, there are vulnerable areas of the SSF systems primarily where the piping and cabling enters the Auxiliary Building (AB) via the West Penetration Rooms (WPR) and Cask Decontamination Tank Rooms (CDTR). Duke proposed to physically protect the exterior walls of these rooms, thus fully protecting the SSF from a damaging tornado. Duke also upgraded the station's tornado PRA model to address multi-unit events (prior model assumed damage to one unit with a loss of offsite power to the station). This upgrade introduced additional interaction vulnerabilities that were not addressed in earlier tornado models; however, Duke concluded that the modifications resulted in an overall risk reduction relative to the effects of a damaging tornado.

After two years of deliberation on the LAR, the NRC stated that the agency would not approve the submittal on the grounds that defense-in-depth was not preserved and in late 2004, Duke retracted the LAR. In a 30-day response to the NRC's withdrawal acknowledgment letter, Duke provided a program schedule for re-evaluating the WPR and CDTR modification effort and evaluating other alternatives that would result in an appreciable risk benefit for both tornadoes and other current design basis issues such as a High Energy Line Break (HELB). To further reduce plant risk and future regulatory challenges, Duke initiated a risk reduction initiative in 2004. The goal of this initiative was

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7 LaBarge, David E., Senior Project Manager, Division of Licensing Project Management, Office of Nuclear Reactor Regulation, "Oconee Nuclear Station, Units 1, 2, and 3 RE: Review of Individual Plant Examination of External Events (TAC Nos. MA83649, M83650, and M83651)," dated March 15, 2000.

to further clarify the LB and produce a set of design, program, and procedure changes that will reduce safe shutdown vulnerability concerns. Duke believed that this integrated approach was more beneficial than recommending changes that targeted individual design basis events.

Duke's risk reduction initiative report was completed in May 2005 and recommended a number of modifications to resolve old design basis issues that included both HELB and tornado. The proposed modifications would result in a significant improvement in overall core damage frequency (CDF).

In light of the risk reduction team's recommendations and as a result of continued communications with the NRC regarding resolution of tornado and HELB outstanding issues, Duke submitted a combined tornado and HELB mitigation strategies letter[8] on November 30, 2006. The submittal contained a number of regulatory commitments as well as responses to key issues identified by the NRC related to HELB outside containment and to the tornado licensing basis[9].

In 2007, there were additional communications between Duke and the NRC regarding the mitigation strategies in the November 2006 submittal. The result of this effort is documented in a NRC letter to Duke dated March 28, 2007[10]. Finally, as concluded in a May 15, 2007 NRC letter[11] to Duke,

> "*...as a result of the extensive dialogue that we have had concerning your proposed modifications and mitigation strategies, we believe that the future LARs based on this approach could be found acceptable.*"

Since that time, Duke has submitted two follow-up letters[12, 13] to refine and adjust implementation schedules of several of the commitments made in the November 30, 2006, letter. The submittal of this LAR is a commitment from the November 2006 letter.

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8 Letter to Mr. James Dyer, Director, Office of Nuclear Reactor Regulation, from Henry B. Barron, Group Vice President and Chief Nuclear Officer, Nuclear Generation, Duke Energy Corporation, "Tornado/HELB Mitigation Strategies and Regulatory Commitments," dated November 30, 2006.

9 Letter from Christopher Miller, Deputy Director, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation to Mr. Bruce H. Hamilton, Vice president, Oconee Site, Duke Power Company LLC, "Tornado and High-Energy Line Break Mitigation Strategies," dated July 12, 2006.

10 Letter from Leonard N. Olshan, Project Manager, Plant Licensing Branch II-1, Division of Operating Reactor Licensing, USNRC Office of Nuclear Reactor Regulation, to Duke Power Company LLC, "Summary of March 5, 2007, Meeting to Discuss the November 30, 2006, Letter Regarding Oconee High-Energy Line Break (HELB) and Tornado Mitigation Strategies," dated March 28, 2007.

11 Letter from Timothy J. McGinty, Deputy Director, Division of Operating Reactor Licensing, USNRC Office of Nuclear Reactor Regulation, to Bruce H. Hamilton, Oconee Nuclear Station, Units 1, 2, and 3 (Oconee) – Tornado and High-Energy Line Break (HELB) Mitigation Strategies, dated May 15, 2007.

12 Letter to the U. S. Nuclear Regulatory Commission from Bruce H. Hamilton, Vice President, Oconee Site, "Revision to Tornado/HELB Mitigation Strategies and Regulatory Commitments," dated June 28, 2007.

13 Letter to the U. S. Nuclear Regulatory Commission from Henry B. Barron, Group Vice President and Chief Nuclear Officer, Nuclear Generation, Duke Energy Corporation, "Revision to Tornado/HELB Mitigation Strategies and Regulatory Commitments," dated January 25, 2008.

3 DETAILED DESCRIPTION OF PROPOSED CHANGES

This LAR incorporates revisions to the tornado CLB and includes a number of plant modifications, UFSAR revisions, and an expansion of the use of the tornado missile probabilistic methodology (TORMIS) in determining which systems, structures, or components require physical protection from tornado-generated missiles at the site. As described herein, the revised tornado LB is based on the plant configuration that will exist after implementation of several physical modifications to the station as described in previous correspondence with the NRC and in this LAR. Implementation of the revised tornado LB into the ONS design basis will be integrated with the completion of those associated plant modifications.

Specifically, NRC approval is requested of: (1) the revised tornado LB, (2) the station modifications that provide additional protection of key structures to better withstand the effects of postulated tornadoes and (3) the application and use of the TORMIS methodology at the ONS, and (4) UFSAR revisions associated with the revised tornado LB. Relative to the modification that will result in the installation of the new PSW system, approval is requested of the strategy regarding PSW operation following a damaging tornado and of its general design requirements. Specific elements of the revised tornado LB are as follows:

3.1. Improve the protection of tornado mitigation equipment located within the West Penetration Room (WPR) and Cask Decontamination Tank Room (CDTR) from the effects of a tornado. The CDTR block walls will be upgraded to UFSAR Class 1 structure differential pressure (per Regulatory Guide 1.76, Rev. 1 criteria), using Fiber Reinforced Polymer. Loads generated by the design tornado wind will be resisted by external siding and transferred directly into the reinforced concrete frame of the Auxiliary Building (AB) via structural steel members. Based on TORMIS results, the need for additional missile protection of the CDTR/WPR walls is not required; however, a steel plate fronting a portion of the SSF cables passing through each unit's CDTR and WPR will be installed.

3.2. Revise and clarify the tornado LB description documented in UFSAR Section 3.2.2; add the TORMIS results to UFSAR Section 3.5.1.3, and correct inaccurate tornado design description information for the AB Cable and Electrical Equipment Rooms in UFSAR Table 3-23.

3.3. Upgrade the current low-head Station ASW system to a new high-head system, renamed PSW for providing SSDHR and RCMU. The current ASW pump will be replaced with a high head pump located in the same room. The PSW electrical system provides power to the PSW System and portions of the existing HPI system for RCMU purposes. The PSW system will:

3.3.1. Be capable of being actuated, aligned and controlled from the Unit 1 and 2 main CR to supply water to all three unit's SGs concurrently (at full secondary-side pressure) so that SSDHR can be promptly and concurrently established to each Steam Generator (SG). Upon demand, PSW will be capable of being aligned to feed any SG within 15 minutes. Additionally, an HPI pump (one from each unit) will have the capability to supply RCMU. The PSW pump will provide cooling to the HPI pump motors.

3.3.2. Be installed as a safety-related, Seismic Category I system that will be controlled in accordance with 10 CFR 50 Appendix B requirements. The new alternate overhead power line to the PSW switchgear building will be non-QA.

3.3.3. Include related isolation and control valves located below grade in the AB that are therefore protected against tornado missiles.

3.3.4. Include the installation of new PSW switchgear with power provided from the KHUs via a tornado-protected, underground feeder path. The PSW switchgear and supporting equipment will be located in a new tornado-protected building. Alternate power will be provided using the existing 100 kV transmission line from the Central switchyard to ONS, a new 100/13.8 kV substation and a new 13.8 kV overhead path from the new substation that connects to the PSW underground path.

The new 100/13.8 kV substation is strategically placed to reduce the probability of concurrent tornado damage to the station switchyard, KHUs, and the new substation. The PSW switchgear will provide power to the PSW pump and valves, each unit's vital I & C normal battery chargers, an HPI pump and associated RCMU valves, valves to align the Borated Water Storage Tanks (BWSTs) to the HPI pump, Pressurizer (PZR) heaters, and reactor coolant system (RCS) high point and reactor head vent valves for boration and RCS inventory control. These valves are used to release non-condensable gases and/or steam from the RCS that could inhibit natural circulation core cooling and provide a letdown path to relieve RCS volume, maintain PZR level and regulate RCS pressure.

3.4. For each Main Steam (MS) header, install a main steam isolation valve (MSIV) to eliminate the adverse effects of a tornado missile on the steam piping in the TB. The MSIVs will be located downstream of the MS Relief Valves outside the TB.

3.5. Each unit's BWST will be physically protected to the extent necessary, to assure that the tank and flowpath are available following a tornado. Since the BWSTs are vented, tornado-induced ΔP damage is not a concern. Duke will reconstitute the original wind analysis to ensure that the tanks can withstand UFSAR Class 1 wind criteria. As required, vulnerable areas of the tanks and flow paths will be physically modified to protect against UFSAR Class 1 tornado missiles.

3.6. Eliminate crediting the Spent Fuel Pool (SFP) to HPI flow path for RCMU.

3.7. Reroute and/or protect from tornado affects, the 125 VDC vital I & C primary and backup power cables and KHU emergency start circuitry located in the TB to the AB to eliminate vulnerabilities from tornado effects.

3.8. Analyze the double column set which support each unit's Main Steam line outside of the containment building, and provide modifications, as necessary, to meet tornado criteria.

3.9. Physically protect the Atmospheric Dump Valves (ADVs) per UFSAR Class 1 tornado criteria.

3.10. Improve protection of the SSF double doors (large 8'x12' doors located on the south side of the SSF structure).

NOTE: Items 3.4, 3.8 and 3.9 are contingent on the completion of ongoing safety analysis work relative to operation of the SSF with a compromised main steam pressure boundary due to potential breaks in the main steam system. This analysis will be completed and submitted on or before June 30, 2009.

4. TECHNICAL EVALUATION

The following sections provide a comparison of the existing and revised tornado LBs, application of the TORMIS methodology, and a description of post-tornado damage repair guidelines to be implemented in order to restore the PSW System within 72 hours if it is damaged by a tornado.

4.1 Tornado LB Description

Current LB

The tornado CLB is derived from information presently contained within several sections[14] of the ONS UFSAR and generally relies on probabilistic insights and defense-in-depth concepts to provide reasonable assurance that SSD can be achieved. To achieve SSD, in addition to the SSF, other systems involved include Station ASW, HPI and EFW from an unaffected unit. However, these latter systems rely heavily on local and manual operator actions and provide less margin to principal safety barriers, i.e., RCS pressure boundary, than the SSF. In addition, the degree of use of these latter systems depends on the level of tornado damage to the plant. For instance, use of EFW from an unaffected unit is only available for tornadoes that do not adversely affect all three units.

For SSDHR, EFW from an unaffected unit, Station ASW or the SSF ASW systems are used. None of these systems are completely protected from a severe tornado and timely local and manual operator actions are necessary to align and provide flow from the Station ASW and EFW systems which may delay restoration of SSDHR.

For RCMU, either a SSF RCMU pump or HPI pump is used. The BWST is the water

[14] Ref.: LAR Section 5.2 "Applicable Regulatory Requirements/Criteria."

source for the HPI pump or alternatively, the pump can be manually aligned to a SFP should the BWST be unavailable. For the SSF RCMU pump, water from the SFPs is used and RCS inventory is managed from the SSF CR.

As described in UFSAR Sections 3.3.2 and 3.8.4.3, certain structures that house systems and components necessary to achieve SSD have been constructed to withstand the effects of a tornado (wind, ΔP, and missiles). Other specific structures necessary to achieve SSD, while designed to withstand wind and ΔP, were evaluated for the probability of a damaging missile strike using risk analysis. An example of the latter includes the WPR walls. Longer-term recovery actions beyond the current SSF 72 hour mission time are not addressed in the CLB.

Revised LB

The overall objective of the revised tornado LB is to utilize the SSF for SSDHR and RCMU following a loss of all normal and emergency systems which usually provide these functions. The SSF systems can maintain all three units in a safe shutdown condition, i.e., Mode 3 with average RCS temperature ≥ 525 °F (unless the initiating event causes the unit(s) to be driven to a lower temperature[15]) for up to 72 hours while damage control measures are completed to restore any unavailable PSW System equipment needed to cooldown the units to ~250 °F. This mission time is in accordance with the SSF CLB. The ~250 °F temperature is the lowest that can be attained using the steam generators (SGs) for cooldown.

The existing Station ASW system will be replaced with a new PSW system and be capable of cooling the units to approximately 250 °F where they would remain until additional damage control measures can facilitate cooldown to cold shutdown (CSD)[16] conditions. Although the SSF or the new PSW systems both have the capability to restore SSDHR and RCMU for all three units, the PSW system is not fully protected from a severe tornado and as such, is not credited in the revised LB within the first 72 hours after a tornado.

The revised tornado LB assumes that a tornado strikes the plant site during full power operation and disables the emergency and non-emergency electrical buses located in the TB resulting in a station blackout condition. A further assumption is that due to the approximate ¾ mile separation between the KHUs and the Oconee Nuclear Units, a tornado missile will not cause concurrent damage to both the KHUs and the Oconee Nuclear Units. As added margin, alternate power (primary power is from the KHU underground feed) to the new PSW System is provided from the Central Tie Switchyard

[15] TORMIS results (Attachment 4) have shown that the probability of a damaging missile striking the MS lines upstream of the new MSIVs to be extremely low and as such, there is reasonable assurance that a rapid RCS cooldown transient resulting in RCS temperatures falling below the SSF threshold temperature, to be remote. Therefore, tornado induced MS line breaks are not postulated in the revised tornado mitigation strategy.

[16] Cold shutdown is Mode 5 with RCS temperature < 200 °F.

via a 100 kV transmission line to a 100/13.8 kV substation located adjacent to the station and then via a 13.8 kV overhead path where it enters an underground ductbank leading to the PSW switchgear building. This 13.8 kV overhead path is located on the opposite side of the station from KHU and will have the capability not only to power the PSW system protected switchgear but also to be manually aligned to power SSF systems through the PSW switchgear.

Restoration plans will be employed to effect repair within 72 hours, any tornado induced damage to the new 13.8 kV overhead line from the new 100/13.8 kV substation to where it enters the PSW underground power path. The existing 100 kV transmission line from the Central Tie Switchyard to the new 100/13.8 kV substation are not included in the scope of tornado damage repair.

The '"Severe Weather" emergency procedure is entered for a tornado watch[17], severe thunderstorm warning, or high wind warning. At that time, the main Control Room (CR) Senior Reactor Operator (SRO) will appraise the situation, via National Weather Service (NWS) bulletins received in the CR, and determine the need to staff the SSF. If required, the SRO will dispatch one (1) licensed operator to the Standby Shutdown Facility (SSF) to establish communication with the main CRs. The SRO will consider each specific situation for example, if a hurricane has come through the Gulf and the tornado watch and warning boxes are tracking toward ONS, it would be prudent to man the SSF. However, if the storm is an afternoon thunderstorm that just pops up or the storm is tracking away from ONS, the SRO may decide not to staff the SSF.

Because a tornado is a design criterion and does not constitute a design basis accident or transient as described in 10 CFR 50.36(c)(2)(ii), degradation of passive civil features protecting the SSF will not apply to operability under Technical Specifications Limiting Condition for Operation (TS LCO) 3.10.1, "Standby Shutdown Facility." Implementation of UFSAR criteria for tornado wind, ΔP, and missiles or approved applications of TORMIS evaluation for tornado missiles will apply as UFSAR commitments outside of the ONS TS. The SSF BASES for TS 3.10.1 will be clarified to address this point when the revised tornado LB is implemented. Duke maintains an administrative process to manage and control the use of passive design features.

Secondary Side Decay Heat Removal

Current LB

The current tornado LB relies on the SSF ASW, Station ASW, or EFW from an undamaged unit, to provide SSDHR. The degree of use of these systems depends on the level of tornado damage to the plant. For instance, use of EFW from an unaffected unit is only available for tornadoes that do not damage multiple units. In addition, local

[17] A tornado watch is issued to alert for the possibility of tornado development in the area. A tornado warning means that a tornado has actually been sighted or is indicated by NWS radar.

and manual operator actions to align and provide flow from EFW and Station ASW systems are necessary. For the SSF, as directed by the CR-SRO, Operators are dispatched to the SSF CR and await further instructions before starting up the SSF diesel. Once the CR-SRO decides to use the SSF ASW system, the system can be started in approximately 14 minutes from onset of the event.

The EFW system provides sufficient feedwater supply to the SGs of each unit, during events that result in a loss of the Condensate/Main Feedwater, to remove energy stored in the core and primary coolant. For diversity, the EFW system includes two AC motor-driven pumps and one turbine-driven pump that is independent of AC power. Sources of steam for driving the turbine-driven EFW pump are available from both SGs. Following a loss of all AC power, the turbine-driven EFW pump will automatically actuate and is capable of operating for at least two hours completely independent of AC power. The water inventory that is immediately available to the turbine-driven EFW pump (Upper Surge Tank) is sufficient to supply feedwater to the SGs for at least 40 minutes assuming automatic steam generator level control and no reliance on operator action. After this time, operators would align the water source to the condenser hotwell. Portions of the EFW system are vulnerable to tornado missiles. Thus, the plant relies upon diverse means to provide feedwater to the SGs in the event of a tornado. These diverse means include the SSF ASW and the Station ASW systems.

The SSF is a seismic Category I structure housing subsystems that provide adequate SSDHR and reactor coolant makeup (RCMU) to all three units. The SSF ASW and RCMU subsystems are not designed to meet the single failure criterion but are designed such that failures in these systems do not cause failures or inadvertent operations in existing plant systems. The subsystems are manually initiated and completely controlled from the SSF.

The SSF ASW system is a high head, high volume system that provides sufficient SG inventory for adequate decay heat removal for all three units during a loss of normal AC power in conjunction with the loss of normal and emergency feedwater systems. The SSF ASW pump is the major component of the system and is housed in the SSF building. The water contained in the buried CCW piping for Unit 2 serves as the water supply. The buried portion of the CCW piping is designed to withstand the effects of a seismic event. The intake and discharge piping is Class 2 equipment and is not required to be tornado protected.

The SSF ASW system is designed to seismic Category I and Quality Group B and C requirements. Failure of the SSF ASW components will not affect the operation of the normal "in-plant" components. The SSF ASW system is operated and/or tested only from the SSF. The SSF Portable Pumping System includes a submersible pump and a flow path capable of taking suction from the intake canal and discharging into the Unit 2 CCW line. This pump and cable spool is located in the tornado-protected SSF building and is powered from the SSF diesel generator. This system provides a backup supply of water to the SSF in the event of loss of CCW and subsequent loss of CCW siphon flow. The SSF Portable Pumping System is installed manually according to procedures.

The Station ASW system is a low head system that requires depressurization of the SGs prior to its use. Similar to the SSF subsystems, the Station ASW system is not designed to single failure criterion. The system is manually placed into service by local operator actions including depressurizing the SGs using the atmospheric dump valves (ADVs), starting the Station ASW pump, and opening manual valves in the penetration rooms. The current plant safety analysis credits operator action to place this system in service within 40 minutes from onset of the event.

Revised LB

The tornado-protected SSF ASW system is credited in the first 72 hours after a damaging tornado and can be started in approximately 14 minutes from onset of the event. Operation of the SSF as described in the current LB does not change. Improvements proposed to resolve existing SSF tornado vulnerabilities will establish the SSF as the assured means of achieving SSD following a tornado. The SSF ASW system can maintain the units in a SSD condition for up to 72 hours while damage control measures are implemented to restore any damaged or otherwise unavailable equipment needed to cooldown the units to ~250 °F. Although not credited in the first 72 hours, the CR SRO may choose alternative means of SSDHR such as remaining on EFW, cross-connecting EFW from a different unit or utilizing the PSW System rather than starting the SSF diesel for SSF ASW operation.

A significant benefit of the PSW System compared to the EFW or the existing Station ASW system is the elimination of certain operator actions outside the main CRs. Specifically, the actions eliminated include the initial manual operation of the ADVs for once-through SG depressurization and manual alignment of the Station ASW valves and breakers to initiate SSDHR and to throttle flow to a single unit's SGs.

Similar to the SSF, the PSW System will not be designed to meet single failure criterion; however, the system will be installed such that it can be placed into service quickly in order to minimize inventory loss from the PZR safety relief valves following a complete loss of main and emergency feedwater systems. As a result, natural circulation will be established and maintained.

The PSW System also has been designed to provide an alternate power source to the existing SSF Portable Pumping System via a dedicated connection at the PSW switchgear building. A submersible pump will be stored at the SSF which can be deployed and powered from either the SSF or PSW as the power source. As an additional defense-in-depth measure, an identical spare submersible pump will be stored in either an on-site tornado protected building or at a nearby off-site location.

Reactor Coolant Make-Up

Current LB

Either the SSF RCMU system or an HPI pump, powered from the Station ASW switchgear, is credited for RCMU. If the SSF diesel fails to start or a RCMU pump (1 pump located in the basement of each reactor building) fails to operate, operators must manually connect the HPI pump to the Station ASW switchgear and align its suction source to the BWSTs. Alternatively, if the BWSTs are unavailable, the HPI suction source will be from the SFPs. For SSF RCMU, increases in PZR level are controlled by aligning letdown from the RCS to the SFP. Cooling water to HPI motor is provided by the Station ASW pump. Sufficient PZR heaters can be energized and powered from the SSF CR to offset ambient heat losses and steam leakage from the PZR.

Revised LB

In the revised tornado LB, the SSF RCMU system is credited for makeup during the first 72 hours and its operation, as described in the current LB, does not change. The system is powered from the protected SSF diesel generator. As needed during the initial 72 hour period, restoration actions will be completed to recover electrical power to an HPI pump needed to cool down the units to ~250 °F. To eliminate past operator actions needed to manually align an HPI flowpath, a dedicated power supply will be added from the PSW System's tornado-protected switchgear to the HPI pump motor and valves necessary to control RCMU flow to each unit directly from inside the main CRs.

Each unit's BWST will be physically protected to the extent necessary, to assure that the tank and flowpath are available following a tornado. Since the BWSTs are vented, tornado-induced ΔP damage is not a concern. Duke is reconstituting the original wind analysis to ensure that the tanks can withstand UFSAR Class 1 tornado wind criteria. As required, vulnerable areas of the tanks and flow paths will be physically modified to protect against UFSAR Class 1 tornado missiles. The BWSTs are located external to, and west of, each unit's WPR and consist of a steel tank supported by a reinforced concrete foundation. The BWSTs are Nuclear Safety Related structures and are designed for appropriate combinations of dead, live (including design wind and stored borated water) and seismic loads.

Crediting of the SFP as a backup water source to the HPI pump will be eliminated from the tornado LB and HPI motor cooling will be provided by the PSW pump. Pressurizer heater electrical power supplies and controls and the reactor vessel head and RCS high point vent valves, will be powered from the tornado-protected PSW switchgear. Operators will be able to manage PZR pressure and level control from the main CRs.

Emergency Power

Current LB

A protected diesel generator supplies power to the SSF and its support systems for up to 72 hours. The SSF power supply system is designed to provide normal and independent emergency sources of AC and DC electrical power to their associated electrical distribution systems and various support systems. The SSF diesel generator would only be operated in the event where normal power systems are unavailable. Manual operator action is required to actuate the SSF.

Power to the Station ASW switchgear, located below grade in the AB, is supplied from the KHU underground feed. This switchgear can power a Station ASW pump and one HPI pump per unit. The structures that comprise the KHUs are the Powerhouse, Power and Penstock Tunnels, Spillway, Service Bay Substructure, Breaker Vault, and Intake Structure. The KHUs are Class 2 structures which have not been designed and built to resist tornado loads. At ONS, the wind loading of a Class 2 structure is 95 miles per hour.

Revised LB

A protected diesel generator supplies power to the SSF and its support systems for up to 72 hours. The SSF power supply system is designed to provide normal and independent emergency sources of AC and DC electrical power to their associated electrical distribution systems and various support systems. The SSF diesel generator would only be operated in the event where normal power systems are unavailable. Manual operator action is required to actuate the SSF systems.

The Station ASW switchgear will be replaced with the PSW System switchgear located in a new tornado-protected PSW building. New power cables will be routed from the KHUs to the PSW building through an underground path. Alternate power to the PSW System switchgear will be provided by a new transformer connected to the existing 100 kV transmission line that receives power from the Central Tie Switchyard located approximately 8 miles from the plant. This new power path is strategically located on the opposite side of the station from the KHUs which reduces the chance of concurrent tornado damage to both power sources.

The new tap-off portion from the 100 kV line will not adversely affect the operation of the station's CT5 emergency transformer. Any fault that occurs on this new portion of line will be isolated from the 100 kV line with either the high side circuit switcher or the low side breaker installed at the PSW substation. The PSW switchgear will also provide a backup power supply to the SSF via an underground path as additional defense-in-depth. An electrical diagram displaying the revised power arrangement for the SSF and PSW Systems and the location of the CT5 transformer is shown on Figure 1.

Although the power lines from the alternate offsite power supply to the PSW switchgear are above ground and potentially vulnerable to the effects of a tornado, repair provisions will be implemented to restore (either permanent or temporary if necessary) within 72 hours, damaged portions of the 13.8 kV overhead line from (but not including) the new 100/13.8 kV substation to the point where it enters the PSW underground power path. Duke retains a fleet of transmission service repair teams in the surrounding area that can be quickly mobilized in order to support restoration efforts. In the unlikely event that both the KHUs and the Central power sources are damaged by a tornado, depending on the extent of damage to each, the primary focus of Duke's restoration plans will be the expedited recovery of emergency power from the system with the shortest return to service time.

Physical Separation of Systems

Current LB

The application of physical separation is applied to the 'A' and 'B' steam generator (SG) paths of the Station ASW and SSF systems since either path is considered capable of providing the necessary flow to restore SSDHR and is physically separated by the RBs. Additionally, physical separation is applied to the KHUs and the Oconee Nuclear Units. The Station ASW and SSF ASW pumps both take suction from the CCW header located beneath the TB on the east side of the RB. Although the suction source is not physically separated between systems, it is almost completely protected from tornado missile strikes (see Attachment 4).

For the SSF RCMU pumps, all piping is located in the protected RB. Supporting I & C cables enter the RB though the WPR. Additional defense-in-depth is provided by HPI that enters the RB through the EPR and WPR.

Revised LB

The physical separation concept will be maintained in the revised LB. Piping and instrumentation and control (I & C) cables that support PSW to the 'A' SG enter the RB through the East Penetration Room (EPR). I & C power supply components located in the control battery rooms, equipment rooms and cable rooms that support the PSW System are also located on the east side of the RB. Piping and I & C cables that support the SSF ASW system enter the RB through the WPR. I & C power supply components are located in the SSF on the west side of the RB. The suction source for the PSW System will be the Unit 2 CCW header. There remains physical separation between the KHUs and the main plant as well as between KHUs and the 100 kV Central Tie Switchyard.

Additional defense-in-depth is provided by the piping and I & C cables that support PSW to the 'B' SG. These components enter the RB through the WPR (with the exception of I & C cable that enters the WPR through the EPR in a portion of the EPR that is largely protected from missiles).

PSW System SSDHR supply headers pass through the EPR and WPR before entering containment. The EPR supply headers are located in an alcove formed by the RB, AB, SFP building, and the main steam lines (located outside of each RB) such that they are unlikely to be damaged from a tornado missile. In addition, the WPR header is physically separated from the EPR header by the RB.

There are four (4) HPI to RCP supply headers that pass through either the EPR or WPR before entering the RB. These lines are unlikely to sustain damage from tornado missiles because of the heavy gauge of the pipe, the small diameter (i.e., small target area of the pipe) and the protection afforded them by the large BWSTs.

4.2 Damage Repair Guidelines and Procedures

In order to facilitate further cooldown to approximately 250 °F, the RCS temperature will be lowered using either the PSW pump or SSF ASW pump, and makeup will be provided by an HPI pump from the BWST to the RCS to compensate for shrinkage. The SSF ASW pump and power supplies are located in the SSF building and are protected against the effects of a tornado. The portions of the SSF in the WPR/CDTR will be protected from wind and ΔP, and a TORMIS analysis has concluded that the probability of damage from a tornado missile is acceptably low. As such, restoration procedures will not be required to maintain SSF ASW flow and RCS indication.

Some I & C power cables that support operation of PSW and HPI functions are not fully protected from tornado wind and ΔP nor have been evaluated for the probability of missile damage using TORMIS. Specifically, these PSW System cables pass from the main CRs to the cable spreading and control battery/equipment rooms. The walls for these rooms are not directly exposed to tornado wind loads and consequently, pursuant to UFSAR 3.3.2, "Tornado Loadings" requirements, they were neither required nor constructed to withstand tornado loadings. However, Duke has evaluated that only two relatively small areas, i.e., the cable and equipment room walls facing the Turbine Building, which comprise less than 1-percent of the available target area, could be vulnerable to a missile strike. Consequently, there it is unlikely that the integrity of these walls would not be compromised by a damaging tornado missile.

If the PSW System is damaged by a tornado such that it cannot be used to support cooldown, system recovery measures will be provided by using existing damage repair guidelines and procedures to establish the conditions for cooldown to approximately 250 °F. As part of post-tornado recovery, repairs to restore the 13.8 kV overhead path from (but not including) the 100/13.8 kV substation to the PSW underground path could be required. The scenario is that the KHU source is damaged by the tornado and cannot be repaired within 72 hours. Although the 13.8 kV overhead path has been designed and installed to withstand strong winds, it is possible that portions of the line could be damaged by a tornado either due to direct or indirect damage. Repair guidelines will be developed to restore localized damage to the 13.8 kV overhead power path following a tornado. Duke intends to use industry standard materials and construction techniques to facilitate expedited repair as much as possible.

4.3 Other Safety Considerations

4.3.1 Chlorine Gas Tank Rupture

A small amount of chlorine is stored in tanks located on the east exterior wall of the water treatment room. The chlorine tanks are approximately 500 feet northeast of the Unit 1 CR and approximately 800 feet northeast of the operator's path to the SSF. Although the straight line wind path between the SSF Operator's pathway and the tanks is blocked by the TBs and ABs, if the tanks are damaged by a tornado, the chlorine gases are assumed to be dispersed by the tornado winds.

4.3.2 Ammonia, Nitrogen, Hydrogen, Liquid Propane, Carbon Dioxide, Welding gasses and Hydrazine Tank Ruptures

Nitrogen tanks and one standard LP tank are located outside the northeast corner of the TB. They are approximately 550 feet northeast of the SSF Operator pathway. The straight line wind path between the SSF Operator pathway and the tanks is blocked by the TBs and ABs.

Hydrogen storage tanks are located at the northeast corner of the station site more than 900 feet from the SSF Operator path. Several buildings exist between the hydrogen tanks and the SSF Operator path including the TB and AB.

Welding gas tanks are stored at the welding shop located northeast of the Maintenance Support Building more than 700 feet from the SSF Operator pathway. The TB, Maintenance Support Building and AB stand between the welding gas storage area and the SSF operator pathway.

The aforementioned gas cylinders are stored in approved containers located in approved chemical storage areas meeting all applicable Occupational Safety and Health Administration (OSHA) requirements. Similar to a chlorine tank rupture, in the event that a tornado missile strikes and ruptures a chemical container, it is assumed that the high winds will rapidly disperse any chemical releases. As an added precaution, self contained breathing apparatuses are available to operators (the Unit 1 and 2 CRs have six apparatuses and the Unit 3 CR has three apparatuses and the SSF has three apparatuses staged near its CR).

4.4 TORMIS Methodology

The TORMIS methodology is used to establish compliance with the SRP guidance for tornado missile protection by demonstrating that the probability of significant damage, resulting from a missile strike to SSCs required to prevent a radioactive release in excess of 10 CFR Part 100, is less than a mean value of 1E-06/yr, assuming a loss of offsite power. For a multi-unit site, this criterion is applied to each unit individually, i.e., 1E-06/rx-yr for each unit. Significant damage is defined as damage that would prevent meeting a design basis safety function. The TORMIS code accounts for the frequency and severity of tornadoes that could strike the plant site, performs aerodynamic calculations to predict the transport of potential missiles around the site, and assesses the annual frequency of these missiles striking and damaging structures and other targets of interest.

Elements within the TORMIS computer code provide additional analysis margin as described in the Technical Evaluation Report (TER)[18] used to support the NRC's SER[19] on TORMIS. This includes the missile injection model, damage assessment analysis, and other elements.

The NRC has approved the use of the TORMIS methodology, provided five conditions are addressed. These concerns and the manner in which they are addressed are described below:

Concern No. 1

"Data on tornado characteristics should be employed for both broad regions and small regions around the site. The most conservative value should be used in the risk analysis or justification provided for those values selected."

Response No. 1

An Oconee specific tornado hazard was developed from a statistical analysis of 1- degree latitude-longitude "squares" from within a much larger 15° x 15° region. This analysis compared the local area around the Oconee site with larger areas ("clusters" of squares) across the broad region to determine an appropriate Oconee subregion to develop TORMIS input parameters. The results of the analysis are conservative because it includes areas of higher tornadic activity primarily to the west of Oconee and excludes areas of lower tornadic activity immediately to the north of the plant. See Attachment 5 for more information.

Concern No. 2

"The EPRI study proposes a modified tornado classification, F'-scale, for which the velocity ranges are lower by as much as 25 percent than the velocity ranges originally proposed in the Fujita F-scale. Insufficient documentation was provided in the studies in support of the reduced F'-scale. The F-scale tornado classifications should therefore

[18] Electric Power Research Institute Report - EPRI NP-2005, Volumes 1 and 2, "Tornado Missile Risk Evaluation Methodology," dated August 1981.

[19] Memorandum from L. S. Rubenstein to Frank J. Miraglia, "Safety Evaluation Report - Electric Power Research Institute (EPRI) Topical Reports concerning Tornado Missile Probabilistic Risk Assessment (PRA) Methodology," dated October, 1983.

be used in order to obtain conservative results."

Response No. 2

The EPRI modified tornado classification, F'-scale, is not used in the ONS analysis. Instead, the recently approved Enhanced Fujita Scale is used.

The modified scale proposed in the original EPRI reports (1981) reflected the opinion of some experts at the time that the traditional Fujita scale was not consistent with newer information regarding tornado wind speeds. As stated, the NRC rejected the modified scale (1983) based on a lack of adequate justification. However, research on tornado wind characteristics continued until approximately 2002 when academic and government experts developed a formal process to update the Fujita scale and incorporate more recent data and insights. This effort resulted in the development of the Enhanced Fujita Scale (EF Scale) in 2004.

The National Weather Service formally adopted the EF Scale in 2006 with field implementation beginning in February 2007. In conjunction with this change, the NRC updated NUREG/CR-4461 and Regulatory Guide 1.76 to reflect the associated wind speeds for the EF scale in February and March 2007, respectively. With the approval of RG 1.76, Rev. 1, the NRC position reflects that the EF Scale is now the appropriate tornado classification system for the design of nuclear power plants. By extension, the EF Scale is also an appropriate tornado classification system when the TORMIS methodology is used to justify the design of an existing nuclear power plant design. Therefore, use of the EF Scale instead of the traditional Fujita scale is appropriate and justified for the ONS tornado missile analysis.

Concern No. 3

"Reductions in tornado wind speed near the ground due to surface friction are not sufficiently documented in the EPRI study. Such reductions were not consistently accounted for when estimating tornado wind speeds at 33 feet above grade based on observed damage at lower elevations. Therefore users should calculate the effect of assuming ground velocity profiles with ratios V0 (speed at ground level)/V33 (speed at 33 feet elevation) higher than at the EPRI study. Discussions of sensitivity of the results of the changes in the modeling of the tornado wind speed profile near the ground should be provided."

Response No. 3

The approach taken in a tornado missile assessment for DC Cook and other licensees in TORMIS submittals, which have been reviewed and approved by the NRC, is employed for ONS.

In this approach, the following parameters defining the velocity profile in Figure II-12 of NP-2005 were used:

- $\alpha = 10$
- $\zeta = 30$

The velocity profile defined using these values yields a ratio of ground velocity to velocity at 33' of 0.82. This has been found to be acceptable by the NRC. These parameters are also the default values for TORMIS.

Concern No. 4

"The assumptions concerning the locations and numbers of potential missiles presented at a specific site are not well established in the EPRI studies. However, the EPRI methodology allows site specific information on tornado missile availability to be incorporated in the risk calculation. Therefore, users should provide sufficient information to justify the assumed missile density based on specific missile sources and dominant tornado paths of travel."

Response No. 4

The missile inventory used in this analysis is based on site-specific counts documented in a site calculation. ONS has implemented a program to periodically monitor site missile inventories.

Concern No. 5

"Once the EPRI methodology has been chosen, justifications should be provided for any deviations from the calculational approach."

Response No. 5

The analysis is performed consistent with the approved EPRI methodology. TORMIS calculations[20, 21, 22] provide additional information regarding the assumptions and engineering judgments used to adapt site specific features and structural properties to the EPRI analysis methodology.

4.4.1 TORMIS Model Inputs

The TORMIS methodology seeks to demonstrate that the annual probability of a radioactive release in excess of 10CFR100 limits resulting from tornado missile damage to unprotected SSCs used to mitigate a tornado event is less than the

[20] Oconee Nuclear Station - Unit 3, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 3," OSC-8860, Rev. 0, dated May 19, 2008.
[21] Oconee Nuclear Station - Unit 2, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 2," OSC-9308, Rev. 0, dated June 16, 2008.
[22] Oconee Nuclear Station - Unit 1, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 1," OSC-9307, Rev. 0, dated June 25, 2008.

acceptance criterion of 1E-06/Rx-Yr. This means that the unprotected SSCs are evaluated collectively against the acceptance criterion rather than individually. For a multi-unit site such as Oconee, this criterion is applied to each unit individually.

For this evaluation, the prevention of a "release in excess of 10CFR100" is accomplished by establishing safe shutdown conditions following a tornado strike and maintaining these conditions for up to 72 hours. The following safety functions are required for safe shutdown of all three Oconee units for up to 72 hours:

- SSDHR
- RCMU[23]
- Reactor Coolant System Pressure Boundary Integrity

Through a process of plant walkdowns and reviews of plant drawings and other references, a detailed list of structures and equipment lacking deterministic protection was individually developed for Units 1, 2, and 3. It is noted that some SSCs within the TORMIS scope were identified which have redundancy such that missile damage to that specific SSC would not fail the required SSF function. Such redundant SSCs are not automatically screened out and must be considered in the evaluation. However, the joint probability may be applied for these redundant SSCs instead of the independent damage probabilities. A detailed list of the SSCs modeled in the TORMIS calculation is given in Attachment 4.

4.4.2 TORMIS Results

The mean annual frequency of a damaging tornado missile strike resulting in a release in excess of 10CFR100 limits is less than the acceptance criteria of 1E-06 based on the Oconee tornado hazard data given in Attachment 5. The analysis was performed in a manner consistent with the requirements of the TORMIS User's Manual and with the requirements set forth in the NRC's SER dated October 1983.

Important Sources of Conservatism used in the TORMIS Analysis

- No credit was given for the availability of PSW System for accident mitigation.
- A conservative estimate of the site tornado hazard was used for the analysis.

[23] Reactivity control is an implied function that can be provided by either HPI or by the SSF RCMUP, with control rod insertion assumed to occur on a loss of off-site power. Since all SSF equipment needed for RCS boration is the same as for RCMU, all required SSCs associated with reactivity control are considered covered in the scope of the RCMU function.

- A conservative estimate of the site missile inventory was used for the analysis. The entire site missile population is treated as being minimally restrained. The missile injection model used by the TORMIS code is designed to release potential missiles into simulation windfield at the point in time that would lead to maximum transport resulting in conservative estimates of impact and damage probabilities.
- Due to limitations in modeling the trajectory of missiles, the code is unable to account for the interactions of missiles with Auxiliary Building concrete beams and columns. A small adjustment was made for very long missiles which can span between these beams. However, the effect of off-set missile hits for missile types could be significant in the prevention of missile impacts on safety targets inside the WPR and EPR and represents a conservative analysis assumption.
- No credit was taken for the substantial number of interferences inside in the East and West Penetration Rooms from other piping systems, electrical conduits & cable trays, hangers and steel supports, platforms, handrails, and ventilation ductwork. These rooms are in fact quite congested and would likely dissipate and stop most missiles from damaging critical equipment in the rooms. This "congestion" is in part why modifications inside the room to protect these specific pieces of equipment are not practical or feasible.
- The treatment of the Turbine Building is conservative in that it (1) minimizes the shielding effects that it would provide with its massive superstructure and metal siding, and (2) optimizes the availability of potential missiles located on the turbine deck for injection into the tornado windfield.
- No credit is given for SSF cables surviving a missile impact at any velocity. The horizontal cable trays provide a reasonable amount of protection in the horizontal direction, plus the cables themselves are armored-jacketed cables which are much more rugged than ordinary power plant cable.

The results show that with the planned modifications most of the risk contribution is attributable to the SSF cable trays in the WPR. The SSF cables are relatively "soft" targets which cover a significant area. However, as noted above, no credit is given for the interferences in the room which would dissipate the energy of most missiles and prevent their transport across the room to the SSF cables. Considering these qualitative factors and the availability of PSW for tornado mitigation, the actual risk of missile damage is less than the quantified analysis value.

4.5 Conclusions

Implementation of the revised tornado LB and the related commitments will clarify and, in some cases, revise the ONS CLB to address issues raised by the NRC and collectively enhance the station's overall design, safety and risk margin. The safety margins afforded by the revised tornado LB will be improved by:

- Verification that the SSF is the assured means of achieving SSD conditions for one, two, or all three units,
- Replacing the single-unit low-head Station ASW system with a 3-unit high-head PSW System that:
  - is controllable from the main CRs,
  - can be placed into service quickly to minimize inventory loss from the PZR safety valves,
  - increases assurance that natural circulation will be established and maintained,
  - can be powered from either the KHU underground or alternatively, the 100 kV Central substation path located on the opposite side of the station from the KHUs which reduces the chance of concurrent tornado damage to both emergency power sources,
- Physically protecting the BWST to the extent necessary, to assure that the tank and flowpath are available following a tornado,
- Installation of MSIVs for each unit's main steam header,
- The elimination of several time-critical manual operator actions outside of the CRs including:
  - ADV operation for SG depressurization,
  - Alignment of the Station ASW valves and breakers,
  - Connection of the Station ASW switchgear power supply to an HPI pump and,
  - Alignment of the SFP to HPI flow path.

5 REGULATORY EVALUATION

5.1 SIGNIFICANT HAZARDS CONSIDERATION

Duke has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1) Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   Justification: Although a tornado does not constitute a previously-evaluated UFSAR Chapter 15 design basis accident or transient as described in 10 CFR 50.36(c)(2), it is a design basis criterion that is required to be considered in plant equipment design. The possibility of a tornado striking the ONS is appropriately considered in the UFSAR and Duke has concluded that the proposed changes do not increase the possibility that a damaging tornado will strike the site or increase the consequences from a damaging tornado.

   The modifications associated with the revised tornado LB will be designed and installed such that failures in these new or modified SSCs will not initiate failures or inadvertent operations of existing ONS accident mitigating SSCs, such as the KHUs, SSF, or HPI systems. The use of the NRC-approved TORMIS methodology confirmed that the risk from missile damage was acceptably low to vulnerable areas of the SSF structures and other SSCs required for SSD. As a result, there is reasonable assurance that a tornado missile will not prohibit the SSF system from fulfilling its tornado LB or other functions.

   Also, there are additional electrical power sources available which provide increased assurance that systems used to transition the units to SSD can be readily powered following a damaging tornado. The PSW System will provide additional assurance that SSD can be established and maintained.

   Overall, the changes proposed will increase assurance that potential challenges to the integrity of the RCS due to the effects of a damaging tornado will not result in a radioactive release to the environment. In conclusion, the changes will collectively enhance the station's overall design, safety, and risk margin; therefore, the probability or consequences of accidents previously evaluated are not significantly increased.

2) Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   Justification: Although only the SSF is credited for establishing and maintaining SSDHR and RCMU during the first 72 hours following a damaging tornado, there are two relatively independent, diverse and redundant systems capable of safely shutting down all three units in the revised LB (SSF and PSW). Other modifications improve the ability of the SSF and PSW systems to perform their functions following a damaging tornado. The modifications will be designed and installed such that they will not introduce new failure mechanisms, malfunctions or accident initiators not already considered in the design and LB.

   In conclusion, the changes to the tornado LB will not degrade existing plant systems and will significantly enhance the station's ability to achieve SSD following a damaging tornado. The design and installation of the PSW system will be such that there is reasonable assurance that the system, including new power paths, will not contribute to the possibility of new or different kind of accident from any accident previously evaluated.

3) Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.

   Justification: The revised tornado LB will collectively enhance the station's overall design, safety, and risk margin; therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Duke concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significance hazards consideration" is justified.

5.2 APPLICABLE REGULATORY REQUIREMENTS/CRITERIA

ONS received its original operating license before implementation of the SRP (NUREG 0800) and Regulatory Guide 1.70. The Principle Design Criteria for ONS Units 1, 2 and 3 were developed in consideration of the seventy (70) General Design Criteria for Nuclear Power Plant Construction Permits proposed by the Atomic Energy Commission in a rule-making published for 10 CFR Part 50 in the Federal Register of July 11, 1967. The following are applicable criteria as currently specified in the ONS UFSAR:

5.2.1 UFSAR 3.1 (Conformance with NRC General Design Criteria)

Criterion 2 (Performance Standards) states that those systems and components of reactor facilities which are essential to the prevention of accidents which could affect the public health and safety or the mitigation of their consequences be designed, fabricated and erected to performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice, and other local site effects. The design basis established reflects: a) appropriate consideration of the most severe of these natural phenomena that have been recorded for the site and the surrounding area and, b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design. Plant features and details related to natural phenomena events are specified in UFSAR section 3.2.2.

5.2.2 UFSAR 3.2.1.1.1 (Classification of Structures, Components, and Systems - Class 1) denotes portions of the AB, as Class 1 structures. Class 1 structures are those which prevent uncontrolled release of radioactivity and are designed to withstand all loadings without loss of function.

5.2.3 UFSAR 3.2.2 (4) (System Quality Group Classification - Tornado) states that "The Reactor Coolant System will not be damaged by a tornado. A loss of Reactor Coolant Pump (RCP) seal integrity was not postulated as part of the tornado design basis. Capability is provided to shutdown safely all three units.

The Reactor Coolant System, by virtue of its location within the Reactor Building, is protected from tornado damage. A sufficient supply of secondary side cooling water for SSD is assured by an auxiliary service water pump located in the AB and taking suction from ONS Unit 2 CCW intake piping. Redundant and diverse sources of secondary makeup water are credited for tornado mitigation. These include: 1) the other units' EFW Systems, 2) the ASW "tornado" pump, and 3) the SSF ASW pump.

Protected or physically separated lines are used to supply cooling water to each SG. One of the six sources of electric power for the pump is supplied from KHU.

An external source of cooling water is not immediately required due to the large quantities of water stored underground in the intake and discharge CCW piping. The stored volume of water in the intake and discharge lines below elevation 791 ft would provide sufficient cooling water for all three units for approximately 37 days after trip of the three reactors.

Although not fully protected from tornadoes, the following sources provide reasonable assurance that a sufficient supply of primary side makeup water is available during a tornado initiated loss of offsite power.

a. The SSF Reactor Coolant Makeup Pump can take suction from the Spent Fuel Pool. The pump can be supplied power from the SSF Diesel.
b. A High Pressure Injection Pump can take suction from either the Borated Water Storage Tank or the Spent Fuel Pool. Either the "A" or "B" High Pressure Injection Pump can be powered from Keowee via the Auxiliary Service Water Pump Switchgear.

Protection against tornado is an ONS design criteria, similar to the criteria to protect against earthquakes, wind, snow, or other natural phenomena described in UFSAR Section 3.1.2. A specific occurrence of these phenomena is not postulated, nor is all equipment that would be used to bring the plant to safe shutdown comprehensively listed. The statement, "Capability is provided to shutdown safely all three units" is intended to be a qualitative assessment that, after a tornado, normal shutdown systems will remain available or alternate systems will be available to allow shutdown of the plant. It was not intended to imply that specific systems should be tornado-proof. As part of the original FSAR development, specific accident analyses were not performed to prove this judgment, nor were they requested by the NRC. Subsequent probabilistic studies have confirmed that the original qualitative assessments were correct. The risk of not being able to achieve safe shutdown after a tornado is sufficiently small that additional protection is not required.

In addition, there was considerable correspondence between Duke and the NRC in post-TMI years discussing ONS's ability to survive tornado-generated missiles. Based primarily on PRA justifications, the NRC concluded that the secondary side heat removal function complied with the criterion for protection against tornadoes."

5.2.4 UFSAR 3.3 (Wind and Tornado Loadings) states that all Class 1 structures, "*except those structures not exposed to wind,*" are designed to withstand the effects of wind and tornado loadings, without loss of capability of the systems to perform their safety functions. As noted in UFSAR Section 3.2.1.1.1 (Class 1), the SSF is a Class 1 structure. UFSAR Section 3.3.2 (Tornado Loadings) also notes that all Class 1 structures, *except those structures not exposed to wind*, are designed for tornado loads.

5.2.5 UFSAR 3.3.2 (Tornado Loadings) states that "All Class 1 structures, except those structures not exposed to wind, are designed for tornado loads." Section 3.3.2.1 (Applicable Design Parameters) states that "simultaneous external loading used in the tornado design of Class 1 structures, with the exception of the Standby Shutdown Facility, are: (a) Differential pressure of 3 psi developed over 5 seconds, and (b) External wind forces resulting from a tornado having a velocity of 300 mph. The spectrum and characteristics of tornado-generated missiles is covered in Section 3.5.1.3. Tornado loading parameters for the Standby Shutdown Facility are described in Section 9.6.3.1.

Revision 1 to Regulatory Guide 1.76, "*Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants*," was released in March 2007. The design of new systems (and their associated components and/or structures) that are required to resist tornado loadings will conform to the tornado wind, differential pressure, and missile criteria specified in Regulatory Guide 1.76, Revision 1.

5.2.6 UFSAR 3.2.1.1.1 (Classification of Structures, Components, and Systems – Class 1) describes that Class 1 structures are those which prevent uncontrolled release of radioactivity and are designed to withstand all loadings without loss of function. Class 1 structures include the following:

- Portions of the Auxiliary Building that house engineered safeguards systems, control room, fuel storage facilities and radioactive materials.
- Reactor Building and its penetrations.
- CT-4 Transformer and 4KV Switchgear Enclosures (Blockhouses) Unit Vent.
- Standby Shutdown Facility (SSF) (Reference UFSAR Section 9.6.3.4.1).

5.2.7 UFSAR 3.2.1.1.2 (Classification of Structures, Components, and Systems – Class 2) describes that Class 2 structures are those whose limited damage would not result in a release of radioactivity and would permit a controlled plant shutdown but could interrupt power generation. Class 2 structures include the KHU, CCW intake and discharge piping, ECCS piping (structural portion outside of the TB), Little River Dam and Dikes, and the Essential Siphon Vacuum System intake dike trench, cable trench, and building.

5.2.8 UFSAR 3.5 (Missile Protection); Section 3.5.1 provides three subsections that discuss specifics related to missile protection requirements for (a) internally generated missiles (inside the RB) described in UFSAR Section 3.5.1.1, (b) turbine missiles described in UFSAR Section 3.5.1.2, and (c) missiles generated by natural phenomena, given in UFSAR Section 3.5.1.3. The missile evaluation results described in UFSAR Section 3.5.1.3 are limited to the missile effects on the RB only. In this particular section, there is neither mention of nor conclusions drawn with respect to tornado missile protection for other areas of the plant.

5.2.9 UFSAR 3.8.4.3, (Design of Structures-Auxiliary Building - Loads and Load Combinations) states that the loads and load combinations for the design of the AB are listed in Table 3-23. Table 3-23, titled "Auxiliary Building Loads and Conditions," lists the design load conditions, as shown by [A] through [E] below, for the individual rooms that comprise the AB. The tornado design load requirements are given by [B] and [C].

[A] All normal dead, equipment, live, and wind loads due to 95 mph wind or design basis earthquake;
[B] Normal dead and equipment loads plus tornado wind load due to 300 mph wind;
[C] Tornado missiles of (1) 8 inch diameter x 12 foot-long piece of wood, 200 pounds, 250 mph, and (2) 2,000 pound automobile, 100 mph, 20 square foot impact area, for 25 ft. above grade;
[D] Normal dead and equipment loads plus maximum hypothetical earthquake loads;
[E] Turbine-generator missile, 5,944 pounds, 502 fps, kinetic energy of 23.25 E06 ft-lbs, side on impact area of 8.368 square feet (sq-ft) and end on impact area of 3.657 sq-ft.

5.2.10 UFSAR 9.6.3.1 (SSF- System Descriptions - Structure) states that the tornado loadings calculated for the SSF are in conformance with RG 1.76 (Revision 0) with the following exceptions:

1. Rotational wind speed is 300 mph.
2. Translational speed of tornado is 60 mph.
3. Radius of maximum rotational speed is 240 ft.
4. Tornado induced negative pressure differential is 3 psi, occurring in three seconds.

Tornado-generated missiles which apply to the SSF design are given in UFSAR Table 9-17 (Design Basis Tornado Missiles and Their Impact Velocities). The SSF is designed to resist the effects of tornado-generated missiles in combination with other loadings. Note that the only reference to Table 9-17 in the UFSAR text is in Section 9.6.3.1.

In March 2007, the NRC issued RG 1.76, Revision 1. The RG 1.76 information is based upon tornadoes that have a probability of occurrence of 10^{-7} per year. RG 1.76 Revision 1 states, in part, the following:

This regulatory guide provides licensees and applicants with new guidance that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for use in selecting the design-basis tornado and design-basis tornado-generated missiles that a nuclear power plant should be designed to withstand to prevent undue risk to the health and safety of the public. This guidance applies to the contiguous United States, which is divided into three regions; this document provides separate guidance for each region. Note: ONS is located in Region I.

The NRC determined that the design-basis tornado wind speeds for new reactors should correspond to the exceedance frequency of 10^{-7} per year (calculated as a best estimate), thus using the same exceedance frequency as the original version of this regulatory guide. The results of the NRC analysis indicated that a maximum wind speed of 103 meters per second (m/s) [230 miles per hour (mph)] is appropriate for Region I.

On October 17, 2007, Duke incorporated via 10 CFR 50.59, Regulatory Guide (RG) 1.76, Revision 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," for future design changes of SSF-related SSCs and to new systems and structures. The activity addressed by the 50.59 did not retroactively apply the new design criteria to existing SSCs. Revisions to UFSAR Sections 3.3.2.1 (Applicable Design Parameters), 3.3.3 (References), 3.5.1.3 (Missiles Generated by Natural Phenomena), 3.5.3 (References) and 9.6 (Standby Shutdown Facility) have incorporated the most recent tornado design criteria requirements as published in RG 1.76, Revision 1. Consequently, the current tornado design bases are RG 1.76, Revisions 0 and 1 for the SSF and Class 1 tornado criteria for Class 1 structures exposed to tornado winds.

5.2.11 The following list depicts the current Technical Specifications (TSs) and Selected Licensee Commitments (SLCs) associated with SSF equipment:

1. TS 3.10.1 provides controls and testing requirements for the SSF, specifically:
   - SSF ASW system
   - Portable Pumping system
   - Reactor Coolant Makeup system
   - Power (& Instrumentation) system.
2. TS 3.10.2 provides controls and testing requirements for the SSF Battery Cell Parameters;
3. TS 5.5.14 describes the requirement for the SSF fuel oil testing program;
4. SLC 16.7.12 provides controls for the SSF diesel generator air start pressure instrumentation;
5. SLC 16.7.13 provides controls for SSF instrumentation; and
6. SLC 16.9.14 provides criteria for inspection of the SSF diesel generator.

In addition, the ONS In-Service Testing and Generic Letter 89-10 programs provide controls for SSF components to ensure that system reliability and performance is fully monitored. SSF components found to not be in compliance with any of these controls are addressed via Duke's corrective action program.

5.2.12 SLC 16.9.9, (Auxiliary Service Water (ASW) System and Main Steam Atmospheric Dump Valves) – Describes the controls and testing requirements for the Station ASW system which is designed to mitigate the consequences of a tornado or a loss of Lake Keowee event by providing emergency cooling water to one or more of the three ONS unit's SGs and HPI pump motor coolers. The MS ADVs are required to be operable for the ASW system to be considered operable because the ADVs must be opened to depressurize the SGs to allow the low-head ASW pump to supply water to the SGs. While in Modes 1, 2, or 3, operability of the system includes an operable ASW pump, the associated piping and valves necessary to supply water as well as an operable 4160 volt Switchgear. Limiting Conditions for Operation include (A) restoring the ASW system to an operable status within 30 days if the SSF ASW system is operable; (B) restoring the ASW system to an operable status within 7 days if the SSF ASW system is inoperable and (C) submitting a report to the NRC outlining plans and procedures to be used to provide for a loss of the system within 30 days if the completion times of (A) or (B) are not met.

5.2.13 UFSAR Section 10.4.7.3.6 (EFW Response Following a Tornado) describes that a PRA was developed to address the plant's capability to provide SSDHR via the EFW, SSF ASW, and Station ASW systems (see UFSAR Section 10.4.7.3.8) in the event of a tornado. As concluded in the accompanying 1989 SER, the SRP probabilistic criterion was met based on the probability of failure of the EFW and Station ASW systems combined with the protection against tornado missiles afforded by the SSF ASW System.

5.2.14 UFSAR Section 9.2.3 (Auxiliary Service Water System) describes the Station ASW system that is designed for decay heat removal following a concurrent loss of the main feedwater system, EFW, and SSDHR system. The system will maintain decay heat removal for a minimum of 37 days. The ASW utilizes the plant CCW intake and discharge conduits as a source of raw cooling water for decay heat removal. The raw water is vaporized in the steam generator removing residual heat and dumped to the atmosphere. The ASW pump is an end suction centrifugal pump with a rated capacity of 3000 gpm at a total head of 180 feet. All valves required for operation of the ASW system are either check valves or manually operated.

The pump suction is equipped with a manually operated butterfly valve and the discharge with a check valve and manually operated gate valve. The pump is equipped with a minimum flow path to the CCW discharge crossover line, which is isolated by a globe valve. The individual lines to each steam generator auxiliary feedwater header are equipped with a check valve and one normally closed gate valve which is used to control flow. The majority of non-embedded piping is Duke Class F. ADVs on each main steam line are equipped with one normally closed gate valve and one normally closed control valve which must be opened to reduce SG shell side pressure before placing the ASW system into operation.

5.2.15 Independent Spent Fuel Storage Installation (ISFSI) - Evaluation of Reactor Site Parameters – Tornado

10 CFR 72.212(b)(3) requires that prior to the use of the ISFSI general license, that licensees validate that reactor site parameters, including analyses of earthquake intensity and tornado missiles, are enveloped by the cask design bases. The ONS site is analyzed for 2 specific tornado missiles (1) a 2000 lbm automobile traveling at 100 mph with 20 square foot contact area and (2) a 12 foot long 8-inch diameter wooden pole traveling at 250 mph. The first case is bounded by the Standardized NUHOMS FSAR massive missile impact analysis of a 3967 lbm automobile traveling at 126 mph with a frontal area of 20 square feet against the HSM. For the second case, the Transnuclear analysis is for a 13.5-inch diameter 35-foot long 1500 lbm projectile with a velocity of 294 ft/s. This projectile bounds the Oconee wooden pole missile.

5.3 PRECEDENT

Use of the TORMIS methodology was previously approved by the NRC for the Perry[24], Haddam Neck[25], Waterford[26], and Farley[27] nuclear stations.

5.4 CONCLUSIONS

In conclusion, based on the considerations discussed above, (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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

6 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 10 CFR 51.21. Duke has determined that this license amendment request meets the criteria for a categorical exclusion as set forth in 10 CFR 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 10 CFR 50 that changes a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or that changes an

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[24] Letter from L. Myers from D. Pickett, "Amendment No. 90 to Facility Operating License No. NPF 58 - Perry Nuclear Power Plant, Unit 1 (TAC No. M99447)," dated November 4, 1997.

[25] Letter to J. Opeka from A. Wang, "Haddam Neck Plant – Systematic Evaluation Program Topics III-2 and III-4A, Wind and Tornado Loading and Tornado Missiles (TAC No. 51935)," dated October 21, 1992.

[26] Letter to C. Dugger from N. Kalyanam, "Waterford Steam Electric Station, Unit 3 – Issuance of Amendment No. 168 Re: Amendment for a Previously Unreviewed Safety Question Regarding Design Basis Concerning Tornado Missile (TAC No. MA7359)," dated September 7, 2000.

[27] Letter to D. Morey from F. Rinaldi, "Joseph M. Farley Nuclear Plant, Units 1 and 2 Re: Issuance of Amendment (TAC Nos. MA9495 and MA 9496)," dated September 26, 2001.

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 CLB for ONS states that SSCs 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 change proposed in this amendment request will enhance and clarify the overall tornado LB to 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.

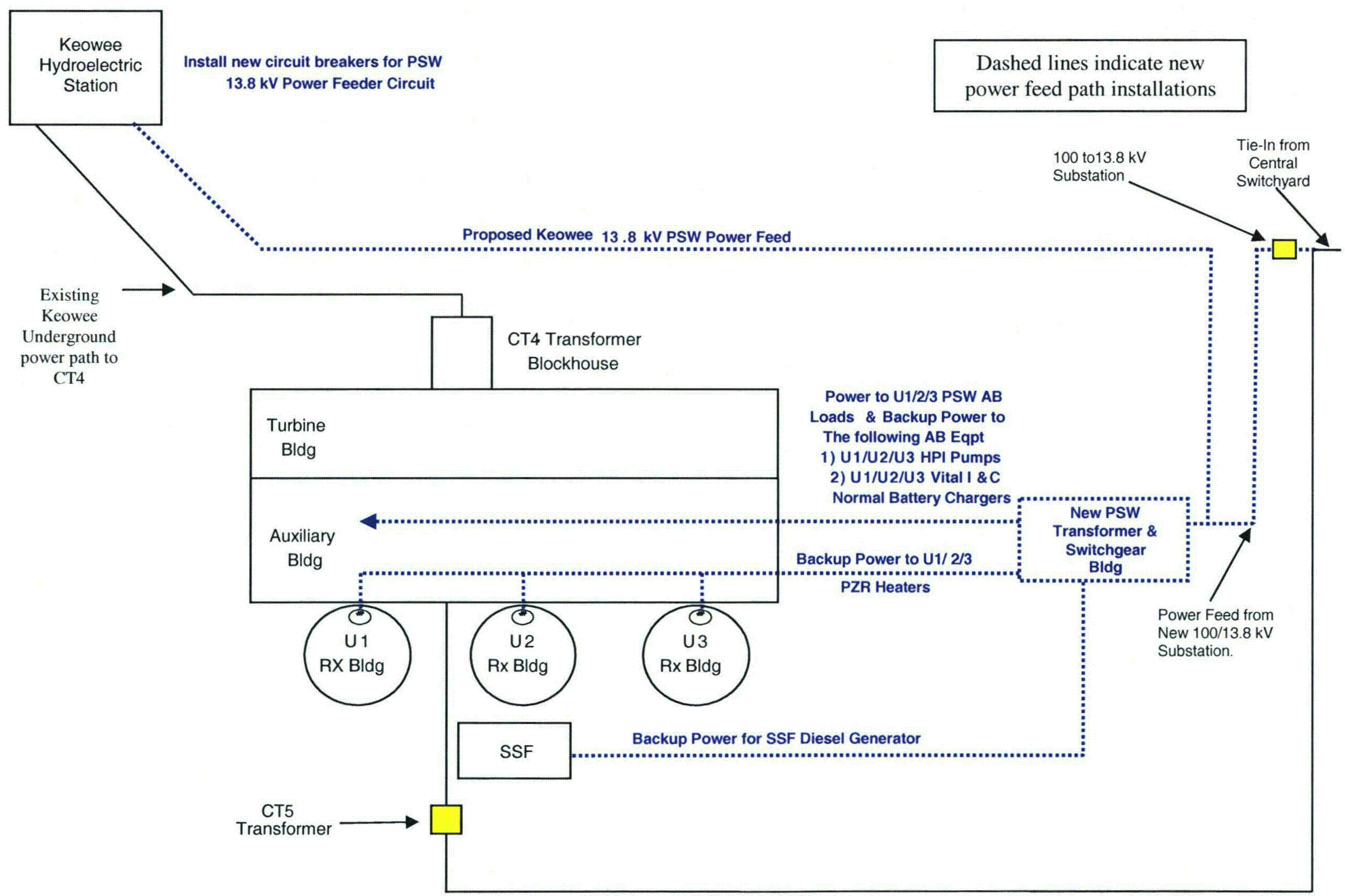
Because the principle barriers to the release of radioactive materials are not modified or affected by this change, there will be no significant increase in individual or cumulative occupational radiation exposure resulting from this change.

7 ACRONYMS AND ABBREVIATIONS

AB	Auxiliary Building
ADV	Atmospheric Dump Valve
AEC	Atomic Energy Commission
ASW	(SSF or Station) Auxiliary Service Water (System)
BWST	Borated Water Storage Tank
CCW	Condenser Circulating Water
CDF	Core Damage Frequency
CDTR	Cask Decontamination Tank Room
CFR	Code of Federal Regulations
CLB	Current Licensing Basis
CR(s)	Main (Units 1 and 2, and Unit 3) or SSF Control Rooms
CR-SRO	Control Room Senior Reactor Operator
CSD	Cold Shutdown (Mode 5 with RCS temperature ≤ 200 °F.)
EFW	Emergency Feedwater (System)
ES	Engineered Safeguards (Systems)
EPR	East Penetration Room
EPRI	Electric Power Research Institute
FRP	Fiber-Reinforced Polymer
FSAR	Final Safety Analysis Report
HELB	High Energy Line Break
HPI	High Pressure Injection (System)
HPI-RCP	High Pressure Injection to Reactor Coolant Pump
HPSW	High Pressure Service Water
IPEEE	Individual Plant Examination of External Events
I & C	Instrument and Control
KHU	Keowee Hydroelectric Unit(s)
LAR	License Amendment Request
LB	Licensing Basis
LOOP	Loss-of-Offsite-Power
LP	Low Pressure Service Water
LPSW	Low Pressure Service Water
MS	Main Steam (System)
MSIV	Main Steam Isolation Valve
MSLB	Main Steam Line Break
MSRV	Main Steam Relief Valve
NRC	Nuclear Regulatory Commission
ONS	Oconee Nuclear Station
OSHA	Occupational Safety and Health Administration
PORV	Power Operated Relief Valve

PRA	Probabilistic Risk Assessment
PSAR	Preliminary Safety Analysis Report
PSW	Protected Service Water System
PZR	Pressurizer
RB	Reactor Building
RCP	Reactor Coolant Pump
RCMU	Reactor Coolant System Makeup
RCS	Reactor Coolant System
RG	Regulatory Guide
RPC	Reactor Coolant Pump
SCBA	Self Contained Breathing Apparatus
SER	Safety Evaluation Report
SFP	Spent Fuel Pool
SFP-HPI	Spent Fuel Pool to HPI Pump (flowpath)
SG(s)	Steam Generator(s)
SLC	Selected Licensee Commitments
SRP	Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (NUREG-0800)
SRV	(PZR) Safety Relief Valve
SSC	System, Structure, and/or Component
SSD	Safe Shutdown Condition (Mode 3 with RCS temperature $\geq$ 525 ^{o}F.)
SSDHR	Secondary-Side Decay Heat Removal
SSF	Standby Shutdown Facility (System)
SSF RCPMU	SSF Reactor Coolant Pump Makeup (System)
SSF ASW	SSF Auxiliary Service Water
TB	Turbine Building
TMI	Three Mile Island
TORMIS	TORnado-MISsile Risk Analysis Computer Code
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report
WPR	West Penetration Room
ΔP	Tornado-Induced Differential Pressure

Figure 1
Major SSF & PSW Electrical Power Upgrades



ATTACHMENT 1

LIST OF REGULATORY COMMITMENTS

The following commitment table identifies those actions committed to by 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
15T	Analyze the double column set which support each unit's Main Steam lines outside of the containment building, and provide modifications, as necessary, to meet tornado criteria	To be provided after completion of the SSF/MS line safety analysis
16T	Physically protect the Atmospheric Dump Valves (ADVs) per UFSAR Class 1 tornado criteria.	To be provided after completion of the SSF/MS line safety analysis
17T	Improve protection of the Standby Shutdown Facility (SSF) double doors (large 8'x12' doors located on the south side of the SSF structure) per UFSAR SSF tornado criteria.	12-2011
18T	Revise and clarify the tornado LB description as documented in UFSAR Section 3.2.2; add the TORMIS methodology results to UFSAR Section 3.5.1.3, and correct inaccurate tornado design information for the Auxiliary Building Cable and Electrical Equipment Rooms as described in UFSAR Table 3-23.	12-2010
19T	The SSF BASES for TS 3.10.1 will be clarified to address degradation of passive civil features as not applying to operability under Technical Specifications Limiting Condition for Operation (TS LCO) 3.10.1, "Standby Shutdown Facility," but rather as UFSAR commitments outside of the ONS TS.	12-2010

ATTACHMENT 2

UFSAR – MARKED UP PAGES

3.2-3
3.2-4
3.2-7
Table 3-23
3.5-6
3.5-7

The Reactor Coolant System will not be damaged by a turbine missile. Capability is provided to safely shutdown the affected units.

3. Earthquake

Major equipment and portions of systems that can withstand the maximum hypothetical earthquake include the following:

a. Reactor Coolant System.
b. Borated water storage tank and piping to high pressure and low pressure injection pumps and Reactor Building spray pumps.
c. HP injection pumps and piping to Reactor Coolant System.
d. LP injection pumps, LP injection coolers and piping to both Reactor Coolant System and Reactor Building spray pumps.
e. Core flood tanks and piping to Reactor Coolant System.
f. Reactor Building spray pumps, piping to spray headers, and the spray headers.
g. Reactor Building coolers.
h. Low pressure service water (LPSW) pumps, LPSW piping to LP injection coolers and Reactor Building coolers and LPSW piping from these coolers to the condenser circulating water (CCW) discharge.
i. CCW intake structure, CCW pumps, pump motors, CCW intake piping to the LPSW pumps, also through the condenser and emergency CCW discharge piping and CCW discharge piping.
j. Upper surge tanks, and piping to the emergency feedwater pump.
k. Emergency feedwater pump and turbine and auxiliary feedwater piping to the steam generators.
l. Main steam lines to and including turbine stop valves. Turbine bypass system up thru Main Steam System isolation valves, and steam supply lines to the emergency feedwater pump turbine.
m. Penetration Room Ventilation System. (not required to operate for accident mitigation due to adoption of alternate source terms) (Reference 3)
n. Reactor Building penetrations and piping through isolation valves.
o. Siphon Seal Water System.
p. Essential Siphon Vacuum System.
q. Electric power for above.
r. Nitrogen supply to the EFW control valves FDW-315 and FDW-316.

Add: Insert 1

4. Tornado

~~The Reactor Coolant System will not be damaged by a tornado. A loss of Reactor Coolant Pump (RCP) seal integrity was not postulated as part of the tornado design basis. Capability is provided to shutdown safely all three units.~~

~~The Reactor Coolant System, by virtue of its location within the Reactor Building, is protected from tornado damage. A sufficient supply of secondary side cooling water for safe shutdown is assured by an auxiliary service water pump located in the Auxiliary Building and taking suction from Oconee 2 CCW intake piping. Redundant and diverse sources of secondary makeup water are credited for tornado mitigation. These include: 1) the other units' EFW Systems, 2) the ASW "tornado" pump, and 3) the SSF ASW pump.~~

Protected or physically separated lines are used to supply cooling water to each steam generator. One of the six sources of electric power for the pump is supplied from Keowee Hydro Station.

An external source of cooling water is not immediately required due to the large quantities of water stored underground in the intake and discharge CCW piping. The stored volume of water in the intake and discharge lines below elevation 791ft would provide sufficient cooling water for all three units for approximately 37 days after trip of the three reactors.

Although not fully protected from tornadoes, the following sources provide reasonable assurance that a sufficient supply of primary side makeup water is available during a tornado initiated loss of offsite power.

a. The SSF Reactor Coolant Makeup Pump can take suction from the Spent Fuel Pool. The pump can be supplied power from the SSF Diesel.

b. A High Pressure Injection Pump can take suction from either the Borated Water Storage Tank or the Spent Fuel Pool. Either the "A" or "B" High Pressure Injection Pump can be powered from Keowee via the Auxiliary Service Water Pump Switchgear.

Protection against tornado is an Oconee design criteria, similar to the criteria to protect against earthquakes, wind, snow, or other natural phenomena described in UFSAR section 3.1.2. A specific occurrence of these phenomena is not postulated, nor is all equipment that would be used to bring the plant to safe shutdown comprehensively listed. The statement, "Capability is provided to shutdown safely all three units" is intended to be a qualitative assessment that, after a tornado, normal shutdown systems will remain available or alternate systems will be available to allow shutdown of the plant. It was not intended to imply that specific systems should be tornado proof. As part of the original FSAR development, specific accident analyses were not performed to prove this judgement, nor were they requested by the NRC. Subsequent probabilistic studies have confirmed that the original qualitative assessments were correct. The risk of not being able to achieve safe shutdown after a tornado is sufficiently small that additional protection is not required.

In addition, there was considerable correspondence between Duke and NRC in the years post TMI discussing Oconee's ability to survive tornado generated missiles. Based primarily on PRA justifications, the NRC concluded that the secondary side heat removal function complied with the criterion for protection against tornadoes.

3.2.2.1 System Classifications

Plant piping systems, or portions of systems, are classified according to their function in meeting design objectives. The systems are further segregated depending on the nature of the contained fluid. For those systems which normally contain radioactive fluids or gases, the Nuclear Power Piping Code, USAS B31.7 and Power Piping Code USAS, B31.1.0 are used to define material, fabrication, and inspection requirements.

Diagrams for each system are included in the FSAR sections where each system is described.

Fabrication and erection of piping, fittings, and valves are in accordance with the rules for their respective classes. Welds between classes of systems (Class I to II, I to III, or II to III) are performed and inspected in accordance with the rules for the higher class. This preceding sentence does not apply to valves where the class break has been determined to occur at the valve seat, and to pipe with 1" nominal diameter and less.

In-line instrument components such as turbine meters, flow nozzle assemblies, and control valves, etc. are classified with their associated piping unless their penetration area is equal to or less than that of a 1 inch i.d. pipe of appropriate schedule for the system design temperature and pressure, in which case they are placed in Class III. Definitions of the three classes are listed below:

3.2.3 Reference

1. *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.
2. 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.
3. License Amendment No. 338, 339, and 339 (date of issuance - June 1, 2004); Adoption of Alternate Source Term.
4. Add-→NRC Safety Evaluation Report (for Tornado LAR), dated xx-xxx-xxxx.

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Table 3-23. Auxiliary Building Loads and Conditions

AREA	CONDITIONS	
Control Room	A,B,C,D,E	See Note 1
Cable Room	A,~~B,C,~~D,E	
Electrical Equipment Room	A,~~B,C,~~D,E	
Spent Fuel Pool	A,B,C,D,E	Blow out panels designed to relieve 3 psi differential pressure
Spent Fuel Storage Racks	A,D	Inherently resistant to wind loads
Spent Fuel Handling Crane	A,D,E	Inherently resistant to wind loads. Hold down device provided
Penetration Room Frames	A,B,D	Physical separation provided for missile protection
Cable Shaft	A,B,C,D,E	
Elevator Steel Shaft	A,D	
Main Steam Pipe Supports	A,B,D	
Hot Machine Shop	A,D	
Balance of Auxiliary Building	A,B,D	Frame designed for B, but not external walls above grade. Areas below grade are inherently protected against missiles in C and E.

Add: "See Note 2"

A = All normal dead, equipment, live, and wind loads due to 95 mph wind or design basis earthquake.

B = Normal dead and equipment loads plus tornado wind load due to 300 mph wind.

C = Tornado missiles of (1) 8 in. diameter x 12 ft. long piece of wood, 200 pounds, 250 mph, and (2) 2,000 pound automobile, 100 mph, 20 sq. ft. impact area, for 25 ft. above grade.

D = Normal dead and equipment loads plus maximum hypothetical earthquake loads.

E = Turbine-generator missile, 5,944 pounds, 502 fps, kinetic energy of 23.25×10^6 ft.-lbs., side on impact area of 8.368 sq. ft. and end on impact area of 3.657 sq. ft.

Note:

1. The information concerning tornado loads for Unit 3 Control Room North wall presently is incorrect and should not be used.

Add: Insert 2

2. If the engineered safety feature is located within the missile strike zone, evaluate the probability of the engineered safety feature being struck and damaged by an equipment failure per Regulatory Guide 1.115 Revision 1, "Protection against Low-Trajectory Turbine Missiles", and NUREG 0800, Revision 2, "Standard Review Plan", Section 3.5.1.3. Should the probability of that particular engineered safety feature being struck and damaged be less than that specified, no protection would be required or provided.
3. Should the probability of the engineered safety feature being struck and damaged be greater than that specified, protection would be provided in the form of physical separation or shielding. A minimum of seven feet of separation, as viewed from the missile generation point on the turbine, constitutes adequate physical separation for low trajectory turbine missiles.

High Trajectory Turbine Missiles

High trajectory turbine missiles are characterized by their nearly vertical trajectories. Missiles ejected more than a few degrees from the vertical, either have sufficient speed such that they land offsite, or their speeds are low enough so that their impact on most plant structures is not a significant hazard.

1. The probability of a high trajectory turbine missile landing within a few hundred feet from the turbine is on the order of 10^{-7} per square foot of horizontal surface area. Consequently the risk from high trajectory turbine missiles is insignificant unless the vulnerable target area is on the order of 10^4 square feet or more.
2. Should the probability of the engineered safety feature being struck and damaged be greater than that specified, protection would be provided in the form of physical separation or shielding. A minimum of seven feet of separation, as shown in the plan view, constitutes adequate physical separation for high trajectory turbine missiles.

3.5.1.3 Missiles Generated by Natural Phenomena

For an analysis of missiles created by a tornado having maximum wind speeds of 300 mph, two missiles are considered. One is a missile equivalent to a 12 foot long piece of wood 8 inches in diameter traveling end on at a speed of 250 mph. The second is a 2000 pound automobile with a minimum impact area of 20 square feet traveling at a speed of 100 mph.

For the wood missile, calculations based on energy principle indicate that because the impact pressure exceeds the ultimate compressive strength of wood by a factor of about four, the wood would crush due to impact. However, this could cause a secondary source of missiles if the impact force is sufficiently large to cause spalling of the free (inside) face. The compressive shock wave which propagates inward from the impact area generates a tensile pulse, if it is large enough, will cause spalling of concrete as it moves back from the free (inside) surface. This spalled piece moves off with some velocity due to energy trapped in the material. Successive pieces will spall until a plane is reached where the tensile pulse becomes smaller than the tensile strength of concrete. From the effects of impact of the 8 inch diameter by 12 foot long wood missile, this plane in a conventionally reinforced concrete section would be located approximately 3 inches from the free (inside) surface. However, since the Reactor Building is prestressed, there will be residual compression in the free face, as the tensile pulse moves out and spalling will not occur. Calculations indicate that in the impact area a 2 inch or 3 inch deep crushing of concrete should be expected due to excessive bearing stress due to impact.

For the automobile missile, using the same methods as in the turbine failure analysis, the calculated depth of penetration is ¼ inch and for all practical purposes the effect of impact on the Reactor Building is negligible.

From the above, it can be seen that the tornado generated missiles neither penetrate the Reactor Building wall nor endanger the structural integrity of the Reactor Building or any components of the Reactor Coolant System.

Revision 1 to Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," was released in March 2007. Revision 1 to Regulatory Guide 1.76 was incorporated into the plant's licensing basis in the 4th quarter of 2007. The design of new systems (and their associated components and/or structures) that are required to resist tornado loadings will conform to the tornado wind, differential pressure, and missile criteria specified in Requlatory Guide 1.76, Revision 1.

Add: Insert 3

3.5.2 Barrier Design Procedures

The Reactor Building and Engineered Safeguards Systems components are protected by barriers from all credible missiles which might be generated from the primary system. Local yielding or erosion of barriers is permissible due to jet or missile impact provided there is no general failure.

The final design of missile barrier and equipment support structures inside the Reactor Building is reviewed to assure that they can withstand applicable pressure loads, jet forces, pipe reactions and earthquake loads without loss of function. The deflections or deformations of structures and supports are checked to assure that the functions of the Reactor Building and engineered safeguards equipment are not impaired. Missile barriers are designed on the basis of absorbing energy by plastic yielding.

3.5.3 References

1. Amirikian, A., Design of Protective Structures, Bureau of Yards and Docks, Department of the Navy, *NAVDOCKS P-51*, 1950.
2. Alvy, R. R., and Willimson, R. A., "Impact Effect of Fragments Striking Structural Elements."
3. Regulatory Guide 1.115, Revision 1, "Protection Against Low-Trajectory Turbine Missiles, dated July 1977.
4. Internal Duke Memorandum from Robert E. Miller to P.N. Hall et al, titled "Turbine Missile Properties", dated June 3, 1970.
5. NUREG 0800, Revision 2, "Standard Review Plan", Section 3.5.1.3, dated July 1981.
6. Letter from D. W. Montgomery (B&W) to W. H. Owen (Duke) regarding Potential Reactor Building Missiles, dated November 14, 1967.
7. Calculation BWC-006K-B932 (OSC-8433), Weight, Impact Area and Velocity, and Kinetic Energy of ROTSG Missiles, May 20, 2004, Rev.0.
8. Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1.

~~THIS IS THE~~ LAST PAGE OF THE TEXT SECTION 3.5.

Add: Insert 3 References

Insert 1

"4. Tornado

The Reactor Coolant System will not be damaged by a tornado. A loss of Reactor Coolant Pump (RCP) seal integrity was not postulated as part of the tornado design basis. Capability is provided to shutdown safely all three units. The Reactor Coolant System, by virtue of its location within the Reactor Building, is protected from tornado damage.

The overall tornado mitigation strategy utilizes the tornado-protected Standby Shutdown Facility (SSF) for secondary-side decay heat removal (SSDHR) and reactor coolant make-up (RCMU) following a loss of all normal and emergency systems which usually provide these safety functions. The safety function of the SSF is to maintain the reactor(s) in a safe shutdown condition with average Reactor Coolant System (RCS) temperature ≥ 525 ^{0}F (unless the initiating event causes the unit(s) to be driven to a lower temperature) for up to 72 hours while additional systems, structures, and components (SSCs) required to cooldown the units to cold shutdown, are restored. This includes the Protected Service Water (PSW) System that, similar to the SSF, can provide SSDHR and RCMU functions for all three units. However, since the PSW system is not fully protected from the effects of a tornado, it may not be available following certain, severe tornadoes and is not credited in the tornado mitigation strategy during the first 72 hours after an event.

The SSF is a seismic Category I structure housing subsystems that provide adequate SSDHR and RCMU to all three units. The SSF Auxiliary Service Water (ASW) and RCMU subsystems are not designed to meet the single failure criterion but are designed such that failures in these systems do not cause failures or inadvertent operations in existing plant systems. The subsystems are manually initiated such that multiple actions must be preformed to provide flow to existing safety systems. SSF functions are completely controlled from the SSF. Additional SSF design features and functions are given in UFSAR Section 9.6, "Standby Shutdown Facility."

With some exceptions, the SSF has been designed to RegGuide 1.76 (Rev. 0) tornado protection requirements. The following exceptions at the SSF are not physically protected from the effects of tornado missiles and have been evaluated probabilistically using the TORMIS methodology:

- Certain electrical penetrations and vertical cable trays in the West Penetration Room (WPR) and Cask Decontamination Tank Rooms (CDTR),
- SSF ASW piping in the WPR/CDTR (all in guard pipe except for feedwater check valves and CCW-125),
- SSF cable trench at north end of SSF building,
- SF double door (south end of SSF structure),
- SSF Diesel Service Water (DSW) Discharge Pipe (at west wall).

In addition, the following SSCs, although not directly associated with the SSF system, are required to support SSF operation:

- "A" Main Steam (MS) system header from Reactor Building (through the East Penetration Room [EPR]) up to Main Steam Isolation Valve (MSIV) "A"
- "B" MS header from Reactor Building up to MSIV "B"

- "A" MS branch header for Main Steam Relief Valves (including riser section)
- "B" MS branch header for Main Steam Relief Valves (including riser section),
- Main Feedwater "A" header in EPR downstream of last check valve to the containment liner,
- Main Feedwater "B" header in EPR downstream of last check valve to the containment liner,
- Reactor Coolant System Letdown Line.

TORMIS evaluates the chances of a damaging tornado striking an unprotected target that would lead to a radiological release in excess of 10 CFR Part 100 limits. If the risk of a release is within acceptance limits, physical protection of the target is not necessary. Additional TORMIS details are described in UFSAR Section 3.5.1.3, "Missiles Generated by Natural Phenomena."

The PSW system is designed as a standby system for use under emergency conditions. The PSW System will include a dedicated power system. The PSW system provides additional "defense in-depth" protection by serving as a backup to existing safety systems and as such, the system is not required to comply with single failure criteria. The PSW system is provided as an alternate means to achieve and maintain a stable RCS pressure and temperature for one, two, or three units following postulated events.

Additionally, the PSW System is also capable of cooling the RCS to 250 °F and maintaining this condition until damage repairs can be implemented to proceed to cold shutdown. Failures in the PSW system will not cause failures or inadvertent operations in existing plant systems. The PSW system is fully operational from the Main Control Rooms and will be activated when existing redundant emergency systems are not available.

The safety function provided by the PSW system is supplying cooling water for decay heat removal at full system pressure to all six (6) steam generators following postulated event scenarios. A second safety function of the PSW electrical power system, in combination with the HPI System, is providing borated water to the RCS pump seals and to provide primary RCS makeup. Two redundant sources of electrical power serve PSW SSCs.
Although the majority of the PSW Systems equipment is fully protected from the effects of a tornado, portions of the system are not completely protected from tornado damage. Consequently, the system is not credited during the initial 72 hours after a tornado strike to the station. During the first 72-hours, the SSF will be utilized until damaged portions of the PSW system, which would be required for continued cooldown of the units to approximately 250 °F., are repaired. Additional PSW design features and functions are given in UFSAR Chapter 9.7, "Protected Service Water System.""

Add Reference:

4. NRC Safety Evaluation Report (for Tornado LAR), dated xx-xxx-xxxx.

INSERT 2

"2. The walls for these rooms are not directly exposed to tornado wind loads and consequently, pursuant to UFSAR 3.3.2, "Tornado Loadings" requirements, they were neither required nor constructed to withstand tornado loadings. However, Duke has evaluated that only two relatively small areas, i.e., the cable and equipment room walls which face the Turbine Building, that comprise less than 1-percent of the available target area, could be vulnerable to a missile strike. Consequently, there is reasonable qualitative assurance that the integrity of these walls would not be compromised by a damaging tornado missile (Ref.: Duke Calculation: OSC-9180, "Tornado LAR (2007), Documentation of Miscellaneous Civil Inputs," Rev. 0)

INSERT 3

"3.5.1.3.1 <u>TORMIS Methodology</u>

The TORMIS methodology is used to establish compliance with the Standard Review Plan (SRP) guidance for tornado missile protection by demonstrating that the probability of significant damage, resulting from a missile strike to systems, structures, or components (SSCs) required to prevent a radioactive release in excess of 10 CFR Part 100, is less than a mean value of 1E-06/yr, assuming a loss of offsite power. For a multi-unit site, this criterion is applied to each unit individually, i.e., 1E-06/rx-yr for each unit. Significant damage is defined as damage that would prevent meeting a design basis safety function. The TORMIS code accounts for the frequency and severity of tornadoes that could strike the plant site, performs aerodynamic calculations to predict the transport of potential missiles around the site, and assesses the annual frequency of these missiles striking and damaging structures and other targets of interest.

Elements within the TORMIS computer code provide additional analysis margin as described in the Technical Evaluation Report (Ref.: 9) used to support the NRC's Safety Evaluation Report (SER) (Ref.: 10) on TORMIS. This includes the missile injection model, damage assessment analysis, and other elements.

<u>TORMIS Model Inputs</u>

The TORMIS methodology seeks to demonstrate that the annual probability of a radioactive release in excess of 10CFR100 resulting from tornado missile damage to unprotected SSCs used to mitigate a tornado event is less than the acceptance criterion of 1E-06/rx-yr. This means that the unprotected SSCs are evaluated collectively against the acceptance criterion rather than individually. For a multi-unit site such as Oconee, this criterion is applied to each unit individually.

For this evaluation, the prevention of a "release in excess of 10CFR100" is accomplished by establishing safe shutdown conditions following a tornado strike and maintaining these conditions for up to 72-hours. The following safety functions are required for safe shutdown of all three Oconee units for up to 72-hours:

- Secondary Side Decay Heat Removal (SSDHR),
- Reactor Coolant Makeup (RCMU),
- Reactor Coolant System (RCS) pressure boundary integrity.

Through a process of plant walk-downs and reviews of plant drawings and other references, a detailed list of structures and equipment lacking deterministic protection was individually developed for Units 1, 2, and 3. It is noted that some SSCs within the TORMIS scope were identified which have redundancy such that missile damage to that specific SSC would not fail the required SSF function. Such redundant SSCs are not automatically screened out and must be considered in the evaluation. However, the joint probability may be applied for these redundant SSCs instead of the independent damage probabilities.

<u>TORMIS Results</u>

The analysis was performed consistent with the approved EPRI methodology. TORMIS calculations (Ref.: 11, 12, 13) provide additional information regarding the assumptions and engineering judgments used to adapt site specific features and structural properties to the EPRI analysis methodology.

For each Oconee unit, the mean annual frequency of a damaging tornado missile strike resulting in a radiological release in excess of 10CFR100 limits was determined to be less than the acceptance criteria of 1E-06 based on the Oconee tornado hazard data (Ref.: 14). The analysis was performed in a manner consistent with the requirements of the EPRI topical reports and with the requirements set forth in the NRC's SER."

<u>Add References</u>:

9. Electric Power Research Institute Report - EPRI NP-2005. Volumes 1 and 2, "Tornado Missile Risk Evaluation Methodology," dated August 1981.

10. Memorandum from L. S. Rubenstein to Frank J. Miraglia, "Safety Evaluation Report - Electric Power Research Institute (EPRI) Topical Reports concerning Tornado Missile Probabilistic Risk Assessment (PRA) Methodology," dated October 1983.

11. Oconee Nuclear Station - Unit 3, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 3," OSC-8860, Rev. 0, dated May 19, 2008.

12. Oconee Nuclear Station - Unit 2, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 2," OSC-9308, Rev. 0, dated June 16, 2008.

13. Oconee Nuclear Station - Unit 1, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 1," OSC-9307, Rev. 0, dated June 25, 2008.

14. "Tornado Risk Analysis for Oconee Nuclear Station," by L. A. Twisdale and M. B. Hardy, Applied Research Associates, Inc., June 21, 2007.

15. NRC Safety Evaluation Report (for tornado LAR). dated xx-xxx-xxxx.

ATTACHMENT 3

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The Reactor Coolant System will not be damaged by a turbine missile. Capability is provided to safely shutdown the affected units.

3. Earthquake

   Major equipment and portions of systems that can withstand the maximum hypothetical earthquake include the following:

   a. Reactor Coolant System.
   b. Borated water storage tank and piping to high pressure and low pressure injection pumps and Reactor Building spray pumps.
   c. HP injection pumps and piping to Reactor Coolant System.
   d. LP injection pumps, LP injection coolers and piping to both Reactor Coolant System and Reactor Building spray pumps.
   e. Core flood tanks and piping to Reactor Coolant System.
   f. Reactor Building spray pumps, piping to spray headers, and the spray headers.
   g. Reactor Building coolers.
   h. Low pressure service water (LPSW) pumps, LPSW piping to LP injection coolers and Reactor Building coolers and LPSW piping from these coolers to the condenser circulating water (CCW) discharge.
   i. CCW intake structure, CCW pumps, pump motors, CCW intake piping to the LPSW pumps, also through the condenser and emergency CCW discharge piping and CCW discharge piping.
   j. Upper surge tanks, and piping to the emergency feedwater pump.
   k. Emergency feedwater pump and turbine and auxiliary feedwater piping to the steam generators.
   l. Main steam lines to and including turbine stop valves. Turbine bypass system up thru Main Steam System isolation valves, and steam supply lines to the emergency feedwater pump turbine.
   m. Penetration Room Ventilation System. (not required to operate for accident mitigation due to adoption of alternate source terms) (Reference 3)
   n. Reactor Building penetrations and piping through isolation valves.
   o. Siphon Seal Water System.
   p. Essential Siphon Vacuum System.
   q. Electric power for above.
   r. Nitrogen supply to the EFW control valves FDW-315 and FDW-316.

4. Tornado

   The The Reactor Coolant System will not be damaged by a tornado. A loss of Reactor Coolant Pump (RCP) seal integrity was not postulated as part of the tornado design basis. Capability is provided to shutdown safely all three units. The Reactor Coolant System, by virtue of its location within the Reactor Building, is protected from tornado damage.

   The overall tornado mitigation strategy utilizes the tornado-protected Standby Shutdown Facility (SSF) for secondary-side decay heat removal (SSDHR) and reactor coolant make-up (RCMU) following a loss of all normal and emergency systems which usually provide these safety functions. The safety function of the SSF is to maintain the reactor(s) in a safe shutdown condition with average Reactor Coolant System (RCS) temperature ≥ 525 ^{0}F (unless the initiating event causes the unit(s) to be driven to a lower temperature) for up to 72 hours while additional systems, structures, and components (SSCs) required to cooldown the units to cold shutdown, are restored. This includes the Protected Service Water / High Pressure Injection (PSW/HPI) System that, similar to the SSF, can provide SSDHR and RCMU functions for all three units. However, since the PSW/HPI system is not fully protected from the effects of a tornado, it may not be available following certain, severe tornadoes and is not credited in the tornado mitigation strategy during the first 72 hours after an event.

The SSF is a seismic Category I structure housing subsystems that provide adequate SSDHR and RCMU to all three units. The SSF Auxiliary Service Water (ASW) and RCMU subsystems are not designed to meet the single failure criterion but are designed such that failures in these systems do not cause failures or inadvertent operations in existing plant systems. The subsystems are manually initiated such that multiple actions must be preformed to provide flow to existing safety systems. SSF functions are completely controlled from the SSF. Additional SSF design features and functions are given in UFSAR Section 9.6, "Standby Shutdown Facility."

With some exceptions, the SSF has been designed to RegGuide 1.76 (Rev. 0) tornado protection requirements. The following exceptions at the SSF are not physically protected from the effects of tornado missiles and have been evaluated probabilistically using the TORMIS methodology:

- Certain electrical penetrations and vertical cable trays in the West Penetration Room (WPR) and Cask Decontamination Tank Rooms (CDTR),
- SSF ASW piping in the WPR/CDTR (all in guard pipe except for feedwater check valves and CCW-125),
- SSF cable trench at north end of SSF building,
- SF double door (south end of SSF structure),
- SSF DSW Discharge Pipe (at west wall).

In addition, the following SSCs, although not directly associated with the SSF system, are required to support SSF operation:

- "A" Main Steam (MS) system header from Reactor Building (through the East Penetration Room [EPR]) up to Main Steam Isolation Valve (MSIV) "A"
- "B" MS header from Reactor Building up to MSIV "B"
- "A" MS branch header for Main Steam Relief Valves (including riser section)
- "B" MS branch header for Main Steam Relief Valves (including riser section),
- Main Feedwater "A" header in EPR downstream of last check valve to the containment liner,
- Main Feedwater "B" header in EPR downstream of last check valve to the containment liner,
- Reactor Coolant System Letdown Line.

TORMIS evaluates the chances of a damaging tornado striking an unprotected target that would lead to a radiological release in excess of 10 CFR Part 100 limits. If the risk of a release is within acceptance limits, physical protection of the target is not necessary. Additional TORMIS details are described in UFSAR Section 3.5.1.3, "Missiles Generated by Natural Phenomena."

The PSW system is designed as a standby system for use under emergency conditions. The PSW System will include a dedicated power system. The PSW system provides additional "defense in-depth" protection by serving as a backup to existing safety systems and as such, the system is not required to comply with single failure criteria. The PSW system is provided as an alternate means to achieve and maintain a stable RCS pressure and temperature for one, two, or three units following postulated events.

Additionally, the PSW System is also capable of cooling the RCS to 250 °F and maintaining this condition until damage repairs can be implemented to proceed to cold shutdown. Failures in the PSW system will not cause failures or inadvertent operations in existing plant systems. The PSW system is fully operational from the Main Control Rooms and will be activated when existing redundant emergency systems are not available.

The safety function provided by the PSW system is supplying cooling water for decay heat removal at full system pressure to all six (6) steam generators following postulated event scenarios. A second safety function of the PSW electrical power system, in combination with the HPI System (designated as PSW/HPI), is providing borated water to the RCS pump seals and to provide primary RCS makeup. Two redundant sources of electrical power serve PSW SSCs.

Although the majority of the PSW Systems equipment is fully protected from the effects of a tornado, portions of the system are not completely protected from tornado damage. Consequently, the system is not credited during the initial 72 hours after a tornado strike to the station. During the first 72-hours, the SSF will be utilized until damaged portions of the PSW system, which would be required for continued cooldown of the units to approximately 250 °F., are repaired. Additional PSW/HPI design features and functions are given in UFSAR Chapter 9.7, "Protected Service Water System."

3.2.2.1 System Classifications

Plant piping systems, or portions of systems, are classified according to their function in meeting design objectives. The systems are further segregated depending on the nature of the contained fluid. For those systems which normally contain radioactive fluids or gases, the Nuclear Power Piping Code, USAS B31.7 and Power Piping Code USAS, B31.1.0 are used to define material, fabrication, and inspection requirements.

Diagrams for each system are included in the FSAR sections where each system is described.

Fabrication and erection of piping, fittings, and valves are in accordance with the rules for their respective classes. Welds between classes of systems (Class I to II, I to III, or II to III) are performed and inspected in accordance with the rules for the higher class. This preceding sentence does not apply to valves where the class break has been determined to occur at the valve seat, and to pipe with 1" nominal diameter and less.

In-line instrument components such as turbine meters, flow nozzle assemblies, and control valves, etc. are classified with their associated piping unless their penetration area is equal to or less than that of a 1 inch i.d. pipe of appropriate schedule for the system design temperature and pressure, in which case they are placed in Class III. Definitions of the three classes are listed below:

Class I

This class is limited to the Reactor Coolant System (RCS) and Reactor Coolant Branch lines, as described herein. The Reactor Coolant Branch lines include connecting piping out to and including the first isolation valve. This section of piping is Class I in material, fabrication, erection, and supports and restraints. A Class I analysis of the piping to the first isolation valve has been completed for the following systems:

1. High Pressure Injection (Emergency Injection)
2. High Pressure Injection (Normal Injection)
3. High Pressure Injection (Letdown)
4. Low Pressure Injection (Decay Heat Removal Drop-line)
5. Low Pressure Injection (Core Flood)
6. Reactor Coolant Drain Lines

7. Pressurizer Spray
8. Pressurizer Relief Valve Nozzles

Modifications that affect the Reactor Coolant System and the Class I portion of the branch lines must demonstrate that the impact on the Class I piping is acceptable. The impact may be assessed by performing a Class I analysis or by other conservative techniques to assure Class I allowable limits are not exceeded. Isolation valves can be either stop, relief, or check valves. Piping 1 inch and less is excluded from Class I.

Class II

Class II systems, or portions of systems, are those whose loss or failure could cause a hazard to plant personnel but would represent no hazard to the public. Class II systems normally contain radioactive fluid whose temperature is above 212°F, and in addition, those portions of Engineered Safeguards Systems outside the Reactor Building which may see recirculated reactor building sump water following a LOCA. Piping l inch and less is excluded.

Class III

Class III systems, or portions of systems, are those which would normally be Class II except that the contained fluid is less than 212°F. Valves, piping, instrument fittings and thermowells with a penetration area equal to or less than a 1 inch i.d. pipe or less (all schedules) are placed in Class III regardless of system temperature or pressure, when such equipment is connected to Class I, II, or III systems.

3.2.2.2 System Piping Classifications

System piping is divided into eight classes, depending on the required function of the system or portion of a system. These eight piping classes result from the combination of the preceding system classifications with and without design for seismic loading, as indicated in Table 3-1. Piping classes A through C meet the intent of USAS B31.7 Nuclear Power Piping Code (February 1968) and Addenda (June 1968) with the exception of those portions of the code which lack adequate definition for complete application. The Class I RCS piping was redesigned to the 1983 ASME Code (No Addenda) during the Steam Generator replacement project.

Code Applicability: Due to the numerous code references located throughout this UFSAR, no attempt is made to revise these references as Codes are amended, superseded or substituted. Consequently, the station piping specifications should be relied upon to determine applicable codes. The existing Code references are the basis for design and materials; however, it is Duke Power Company's intent to comply with portions of, or all of, the latest versions of existing Codes unless material and/or design commitments have progressed to a stage of completion such that it is not practical to make a change. When only portions of Code Addenda are utilized, the appropriate engineering review of the entire addenda will be made to assure that the overall intent of the Code is still maintained. Detailed information for each station unit and code applicability with respect to design, material procurement, fabrication techniques, Nondestructive Testing (NDT) requirements and material traceability for each piping system class is described in the station piping specifications.

Table 3-1 applies uniformly to all piping except auxiliary systems in the Reactor Building. Due to schedule commitments, and concern over lack of definitive design guidance in B31.7, it was decided to use B31.1 and applicable nuclear cases in the Reactor Building, but the materials were bought, erected, and inspected to the standards set down in B31.7. The Reactor Coolant System was designed to B31.7, Class I. The Class I portion of the connecting piping to the RCS will have Class I analyses completed by August 31, 1999 (See Section 3.2.2.1). The Class I RCS piping was redesigned to the 1983 ASME Code (No Addenda) during the Steam Generator replacement project.

Oconee has a number of systems that were designed to USAS B31.7 Class II and Class III and to USAS B31.1.0 requirements [Reference Table 3-1]. Piping analyses for these systems include stress range reduction factors to provide conservatism in the design to account for thermal cyclic operations. Thermal fatigue of mechanical systems designed to USAS B31.7 Class II and Class III and to USAS B31.1 is considered to be a time-limited aging analysis because all six of the criteria contained in Section 54.3 of Reference 4 Section 3.12.1 are satisfied.

From the license renewal review, it was determined that the existing analyses of thermal fatigue of these mechanical systems are valid for the period of extended operation.

3.2.2.3 System Valve Classifications

In the absence of definitive codes, the non-destructive testing criteria applied to system valves are consistent with the intent of Par. 1-724 of USAS B31.7 Nuclear Power Piping Code (Feb. 1968) and the piping classification applicable to that portion of the system which includes the valve. On this basis, valves are grouped into the same eight classes as shown for piping in Table 3-1, and a valve is in the same class as the portion of system piping which includes the valve.

Code Applicability: Due to the numerous code references located throughout this UFSAR, no attempt is made to revise these references as Codes are amended, superseded, or substituted. Consequently, the station specifications applicable to a given valve should be relied upon to determine applicable codes.

3.2.2.4 System Component Classification

In the absence of definitive codes, the design criteria applied to pressure retaining system components are generally consistent with the intent of Sections III and VIII of the ASME Boiler and Pressure Vessel Code, the piping system classification applicable to that portion of the system which includes the component, and the required function of the component. Atmospheric water storage tanks important to safety conform to American Waterworks Association Standard for Steel Tanks, Standpipes, Reservoirs and Elevated Tanks for Water Storage, D100, or equivalent.

Components are listed by system in Table 3-2. This tabulation shows the code to which the component was designed, whether the component was designed to withstand the seismic load imposed by the maximum hypothetical earthquake, and the analytical technique employed in seismic analysis.

Code Applicability: Due to the numerous code references located throughout the UFSAR, no attempt is made to revise these references as codes are amended, superseded, or substituted. Consequently, the station specifications applicable to a given component should be relied upon to determine appplicable codes.

3.2.3 Reference

1. *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.
2. 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.
3. License Amendment No. 338, 339, and 339 (date of issuance - June 1, 2004); Adoption of Alternate Source Term.
4. NRC Safety Evaluation Report (for Tornado LAR), dated xx-xxx-xxxx.

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Table 3-23. Auxiliary Building Loads and Conditions

AREA	CONDITIONS	
Control Room	A,B,C,D,E	See Note 1
Cable Room	A,D,E	See Note 2
Electrical Equipment Room	A,D,E	See Note 2
Spent Fuel Pool	A,B,C,D,E	Blow out panels designed to relieve 3 psi differential pressure
Spent Fuel Storage Racks	A,D	Inherently resistant to wind loads
Spent Fuel Handling Crane	A,D,E	Inherently resistant to wind loads. Hold down device provided
Penetration Room Frames	A,B,D	Physical separation provided for missile protection
Cable Shaft	A,B,C,D,E	
Elevator Steel Shaft	A,D	
Main Steam Pipe Supports	A,B,D	
Hot Machine Shop	A,D	
Balance of Auxiliary Building	A,B,D	Frame designed for B, but not external walls above grade. Areas below grade are inherently protected against missiles in C and E.

A	=	All normal dead, equipment, live, and wind loads due to 95 mph wind or design basis earthquake.
B	=	Normal dead and equipment loads plus tornado wind load due to 300 mph wind.
C	=	Tornado missiles of (1) 8 in. diameter x 12 ft. long piece of wood, 200 pounds, 250 mph, and (2) 2,000 pound automobile, 100 mph, 20 sq. ft. impact area, for 25 ft. above grade.
D	=	Normal dead and equipment loads plus maximum hypothetical earthquake loads.
E	=	Turbine-generator missile, 5,944 pounds, 502 fps, kinetic energy of 23.25×10^6 ft.-lbs., side on impact area of 8.368 sq. ft. and end on impact area of 3.657 sq. ft.

Notes:

1. The information concerning tornado loads for Unit 3 Control Room North wall presently is incorrect and should not be used.
2. The walls for these rooms are not directly exposed to tornado wind loads and consequently, pursuant to UFSAR 3.3.2, "Tornado Loadings" requirements, they were neither required nor constructed to withstand tornado loadings. However, Duke has evaluated that only two relatively small areas, i.e., the cable and equipment room walls which face the Turbine Building, that comprise less than 1-percent of the available target area, could be vulnerable to a missile strike. Consequently, there is reasonable qualitative assurance that the integrity of these walls would not be compromised by a damaging tornado missile. (Ref.: Duke Calculation: OSC-9180, "Tornado LAR (2007), Documentation of Miscellaneous Civil Inputs," Rev. 0)

1. If the engineered safety feature is located outside of the missile strike zone as defined in Reg. Guide 1.115 Revision 1, no additional protection is required.
2. If the engineered safety feature is located within the missile strike zone, evaluate the probability of the engineered safety feature being struck and damaged by an equipment failure per Regulatory Guide 1.115 Revision 1, "Protection against Low-Trajectory Turbine Missiles", and NUREG 0800, Revision 2, "Standard Review Plan", Section 3.5.1.3. Should the probability of that particular engineered safety feature being struck and damaged be less than that specified, no protection would be required or provided.
3. Should the probability of the engineered safety feature being struck and damaged be greater than that specified, protection would be provided in the form of physical separation or shielding. A minimum of seven feet of separation, as viewed from the missile generation point on the turbine, constitutes adequate physical separation for low trajectory turbine missiles.

High Trajectory Turbine Missiles

High trajectory turbine missiles are characterized by their nearly vertical trajectories. Missiles ejected more than a few degrees from the vertical, either have sufficient speed such that they land offsite, or their speeds are low enough so that their impact on most plant structures is not a significant hazard.

1. The probability of a high trajectory turbine missile landing within a few hundred feet from the turbine is on the order of 10^{-7} per square foot of horizontal surface area. Consequently the risk from high trajectory turbine missiles is insignificant unless the vulnerable target area is on the order of 10^4 square feet or more.
2. Should the probability of the engineered safety feature being struck and damaged be greater than that specified, protection would be provided in the form of physical separation or shielding. A minimum of seven feet of separation, as shown in the plan view, constitutes adequate physical separation for high trajectory turbine missiles.

3.5.1.3 Missiles Generated by Natural Phenomena

For an analysis of missiles created by a tornado having maximum wind speeds of 300 mph, two missiles are considered. One is a missile equivalent to a 12 foot long piece of wood 8 inches in diameter traveling end on at a speed of 250 mph. The second is a 2000 pound automobile with a minimum impact area of 20 square feet traveling at a speed of 100 mph.

For the wood missile, calculations based on energy principle indicate that because the impact pressure exceeds the ultimate compressive strength of wood by a factor of about four, the wood would crush due to impact. However, this could cause a secondary source of missiles if the impact force is sufficiently large to cause spalling of the free (inside) face. The compressive shock wave which propagates inward from the impact area generates a tensile pulse, if it is large enough, will cause spalling of concrete as it moves back from the free (inside) surface. This spalled piece moves off with some velocity due to energy trapped in the material. Successive pieces will spall until a plane is reached where the tensile pulse becomes smaller than the tensile strength of concrete. From the effects of impact of the 8 inch diameter by 12 foot long wood missile, this plane in a conventionally reinforced concrete section would be located approximately 3 inches from the free (inside) surface. However, since the Reactor Building is prestressed, there will be residual compression in the free face, as the tensile pulse moves out and spalling will not occur. Calculations indicate that in the impact area a 2 inch or 3 inch deep crushing of concrete should be expected due to excessive bearing stress due to impact.

For the automobile missile, using the same methods as in the turbine failure analysis, the calculated depth of penetration is ¼ inch and for all practical purposes the effect of impact on the Reactor Building is negligible.

From the above, it can be seen that the tornado generated missiles neither penetrate the Reactor Building wall nor endanger the structural integrity of the Reactor Building or any components of the Reactor Coolant System.

Revision 1 to Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," was released in March 2007. Revision 1 to Regulatory Guide 1.76 was incorporated into the plant's licensing basis in the 4th quarter of 2007. The design of new systems (and their associated components and/or structures) that are required to resist tornado loadings will conform to the tornado wind, differential pressure, and missile criteria specified in Requlatory Guide 1.76, Revision 1.

3.5.1.3.1 TORMIS Methodology

The TORMIS methodology is used to establish compliance with the Standard Review Plan (SRP) guidance for tornado missile protection by demonstrating that the probability of significant damage, resulting from a missile strike to systems, structures, or components (SSCs) required to prevent a radioactive release in excess of 10 CFR Part 100, is less than a mean value of 1E-06/yr, assuming a loss of offsite power. For a multi-unit site, this criterion is applied to each unit individually, i.e., 1E-06/rx-yr for each unit. Significant damage is defined as damage that would prevent meeting a design basis safety function.

TORMIS is a tornado missile risk analysis code developed by Applied Research Associates, Inc. of Raleigh, NC (Dr. Lawrence A. Twisdale, Principle Author). This code is an updated version of the original TORMIS code developed for the Electric Power Research Institute (EPRI). The TORMIS code accounts for the frequency and severity of tornadoes that could strike the plant site, performs aerodynamic calculations to predict the transport of potential missiles around the site, and assesses the annual frequency of these missiles striking and damaging structures and other targets of interest.

Elements within the TORMIS computer code provide additional analysis margin as described in the Technical Evaluation Report (Ref.: 9) used to support the NRC's Safety Evaluation Report (SER) (Ref.: 10) on TORMIS. This includes the missile injection model, damage assessment analysis, and other elements.

<u>TORMIS Model Inputs</u>

The TORMIS methodology seeks to demonstrate that the annual probability of a radioactive release in excess of 10CFR100 resulting from tornado missile damage to unprotected SSCs used to mitigate a tornado event is less than the acceptance criterion of 1E-06/rx-yr. This means that the unprotected SSCs are evaluated collectively against the acceptance criterion rather than individually. For a multi-unit site such as Oconee, this criterion is applied to each unit individually.

For this evaluation, the prevention of a "release in excess of 10CFR100" is accomplished by establishing safe shutdown conditions following a tornado strike and maintaining these conditions for up to 72-hours. The following safety functions are required for safe shutdown of all three Oconee units for up to 72-hours:

- Secondary Side Decay Heat Removal (SSDHR),
- Reactor Coolant Makeup (RCMU),
- Reactor Coolant System (RCS) pressure boundary integrity.

Through a process of plant walk-downs and reviews of plant drawings and other references, a detailed list of structures and equipment lacking deterministic protection was individually developed for Units 1, 2, and 3. It is noted that some SSCs within the TORMIS scope were identified which have redundancy such that missile damage to that specific SSC would not fail the required SSF function. Such redundant SSCs are not automatically screened out and must be considered in the evaluation. However, the joint probability may be applied for these redundant SSCs instead of the independent damage probabilities.

TORMIS Results

The analysis was performed consistent with the approved EPRI methodology. TORMIS calculations (Ref.: 11, 12, 13) provide additional information regarding the assumptions and engineering judgments used to adapt site specific features and structural properties to the EPRI analysis methodology.

The results show that most of the risk contribution is attributable to the SSF cable trays in the West Penetration Room. The SSF cables are relatively "soft" targets which cover a significant area. However, as noted above, no credit is given for the interferences in the room which would dissipate the energy of most missiles and prevent their transport across the room to the SSF cables. Considering these qualitative factors and the availability of PSW/HPI for tornado mitigation, the actual risk of missile damage is less than the quantified analysis value.

For each Oconee unit, the mean annual frequency of a damaging tornado missile strike resulting in a radiological release in excess of 10CFR100 limits was determined to be less than the acceptance criteria of 1E-06 based on the Oconee tornado hazard data (Ref.: 14). The analysis was performed in a manner consistent with the requirements of the EPRI topical reports and with the requirements set forth in the NRC's SER.

3.5.2 Barrier Design Procedures

The Reactor Building and Engineered Safeguards Systems components are protected by barriers from all credible missiles which might be generated from the primary system. Local yielding or erosion of barriers is permissible due to jet or missile impact provided there is no general failure.

The final design of missile barrier and equipment support structures inside the Reactor Building is reviewed to assure that they can withstand applicable pressure loads, jet forces, pipe reactions and earthquake loads without loss of function. The deflections or deformations of structures and supports are checked to assure that the functions of the Reactor Building and engineered safeguards equipment are not impaired. Missile barriers are designed on the basis of absorbing energy by plastic yielding.

3.5.3 References

1. Amirikian, A., Design of Protective Structures, Bureau of Yards and Docks, Department of the Navy, *NAVDOCKS P-51*, 1950.
2. Alvy, R. R., and Willimson, R. A., "Impact Effect of Fragments Striking Structural Elements."
3. Regulatory Guide 1.115, Revision 1, "Protection Against Low-Trajectory Turbine Missiles, dated July 1977.
4. Internal Duke Memorandum from Robert E. Miller to P.N. Hall et al, titled "Turbine Missile Properties", dated June 3, 1970.
5. NUREG 0800, Revision 2, "Standard Review Plan", Section 3.5.1.3, dated July 1981.
6. Letter from D. W. Montgomery (B&W) to W. H. Owen (Duke) regarding Potential Reactor Building Missiles, dated November 14, 1967.
7. Calculation BWC-006K-B932 (OSC-8433), Weight, Impact Area and Velocity, and Kinetic Energy of ROTSG Missiles, May 20, 2004, Rev.0.
8. Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1.

9. Electric Power Research Institute Report - EPRI NP-2005. Volumes 1 and 2, "Tornado Missile Risk Evaluation Methodology," dated August 1981.

10. Memorandum from L. S. Rubenstein to Frank J. Miraglia, "Safety Evaluation Report - Electric Power Research Institute (EPRI) Topical Reports concerning Tornado Missile Probabilistic Risk Assessment (PRA) Methodology," dated October 1983.

11. Oconee Nuclear Station - Unit 3, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 3," OSC-8860, Rev. 0, dated May 19, 2008.

12. Oconee Nuclear Station - Unit 2, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 2," OSC-9308, Rev. 0, dated June 16, 2008.

13. Oconee Nuclear Station - Unit 1, "Evaluation of Tornado Missile Damage Frequency for Oconee Unit 1," OSC-9307, Rev. 0, dated June 25, 2008.

14. "Tornado Risk Analysis for Oconee Nuclear Station," by L. A. Twisdale and M. B. Hardy, Applied Research Associates, Inc., June 21, 2007.

15. NRC Safety Evaluation Report (for tornado LAR). dated xx-xxx-xxxx.

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ENCLOSURE 3

NOTARIZED AFFIDAVIT

FOR DUKE PROPRIETARY INFORMATION

AFFIDAVIT OF DAVE BAXTER

1. I am Vice President, Oconee Nuclear Station, Duke Energy Carolinas, LLC (Duke), and as such, have the responsibility of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear plant licensing and am authorized to apply for its withholding on behalf of Duke.

2. I am making this affidavit in conformance with the provisions of 10 CFR 2.390 of the regulations of the Nuclear Regulatory Commission (NRC) and in conjunction with Duke's application for withholding which accompanies this affidavit.

3. I have knowledge of the criteria used by Duke in designating information as proprietary or confidential.

4. Pursuant to the provisions of paragraph (b) (4) of 10 CFR 2.390, the following is furnished for consideration by the NRC in determining whether the information sought to be withheld from public disclosure should be withheld.

   (i) The information sought to be withheld from public disclosure is owned by Duke and has been held in confidence by Duke and its consultants.

   (ii) The information is of a type that would customarily be held in confidence by Duke.

   (iii) The information was transmitted to the NRC in confidence and under the provisions of 10 CFR 2.390; it is to be received in confidence by the NRC.

   (iv) The information sought to be protected is not available in public to the best of our knowledge and belief.

   (v) The Duke proprietary information sought to be withheld is the submittal "Tornado Risk Analysis for Oconee Nuclear Station," by L. A. Twisdale and M. B. Hardy, Applied Research Associates, Inc., dated June 21, 2007.

   (vi) The proprietary information sought to be withheld from public disclosure has substantial commercial value to Duke and is also necessary for the NRC to adequately conduct its review of this License Amendment Request.

(Continued)

Dave Baxter

5. Public disclosure of this information is likely to cause harm to Duke because it would allow competitors in the nuclear industry to benefit from the results of a significant development program without requiring a commensurate expense or allowing Duke to recoup a portion of its expenditures or benefit from the sale of the information.

Dave Baxter, affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

Dave Baxter, Vice President
Oconee Nuclear Station

Subscribed and sworn to before me this 26 day of June, 2008

Notary Public

My Commission Expires:

6/15/2016
Date