ATTACHMENT 1A
Marked Up Version of UFSAR

3.5.1.2.3 APPLICATION OF TURBINE MISSILE DESIGN TO ENGINEERED SAFEGUARDS SYSTEMS

INSERT A

3.1.40 CRITERION 40 - MISSILE PROTECTION (CATEGORY A)

Protection for engineered safety features shall be provided against dynamic effects and missiles that might result from plant equipment failures.

Discussion

Engineered safety features are redundant and either physically separated or shielded to provide protection against dynamic effects and missiles resulting from hypothesized plant equipment failure (Section 3.5, "Missile Protection" on page 3-51).

3.1.41 CRITERION 41 - ENGINEERED SAFETY FEATURES PERFORMANCE CAPABILITY (CATEGORY A)

Engineered safety features such as Emergency Core Cooling and Containment Heat Removal Systems shall provide sufficient performance capability to accommodate partial loss of installed capacity and still fulfill the required safety function. As a minimum, each engineered safety feature shall provide this required safety function assuming a failure of a single active component.

Discussion

All Engineered Safeguards Systems are designed so that a single failure of an active component will not prevent operation of that system or reduce the system capacity below that required to maintain a safe condition. Redundancy is provided in equipment and piping so that the failure of a single active component of any system will not impair the required safety function of that system (Section 7.3, "Engineered Safeguards Protective System" on page 7-19).

3.1.42 CRITERION 42 - ENGINEERED SAFETY FEATURES COMPONENTS CAPABILITY (CATEGORY A)

Engineered safety features shall be designed so that the capability of each component and system to perform its required function is not impaired by the effects of a loss-of-coolant accident.

Discussion

The Engineered Safeguards System design meets this criterion. A single-failure analysis of the Emergency Core Cooling Systems (Section 6.3.2.6, "System Reliability" on page 6-38) and the Reactor Building Heat Removal Systems (Sections 6.2, "Containment Systems" on page 6-9; 6.2.2, "Containment Heat Removal Systems" on page 6-22) demonstrates that these systems have sufficient redundancy to perform their design functions.

The core flooding tanks contain check valves which operate to permit flow of emergency coolant from the tanks to the reactor vessel. These valves are self-actuating and need no external signal or external supplied energy to make them operate. Accordingly, it is not considered credible that they would fail to operate when needed.

The engineered safeguards features are designed to function in the unlikely event of a loss of coolant accident with no impairment of function due to the effects of the accident.

vertical tendons in the cylinder wall. The local effect in the impact area would be as described in Case II above even though the depth of penetration is greater.

Depths of penetration of Reactor Building wall are summarized in Table 3-11.

INSERT B

Since the thicknesses of the cylinder wall and dome are 45 inches and 39 inches respectively, it can be seen that the turbine missile, even under extreme assumptions, does not penetrate the Reactor Building.

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.

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."

INSERT C

INSERT A (replace existing 3.1.40):

3.1.40 CRITERION 40 - MISSILE PROTECTION (CATEGORY A)

Protection for engineered safety features shall be provided against dynamic effects and missiles that might result from plant equipment failures.

Discussion

Engineered safety features are defined as Engineered Safeguards Systems. Engineered Safeguards System features are redundant. Engineered Safeguards Systems at Oconee are protected against dynamic effects and missiles resulting from hypothesized plant equipment failures. In general, missile protection for Oconee is described in Section 3.5. Two basic categories of plant equipment failure are hypothesized and considered in the Oconee design:

1) Missiles generated inside Containment - Assumptions and design requirements for missiles generated inside containment are described in Section 3.5.1.1.

2) Missiles generated by a main turbine failure - Assumptions and design requirements for missiles generated by a main turbine failure are described in Section 3.5.1.2.

INSERT B (new section):

3.5.1.2.3 Application of Turbine Missile Design to Engineered Safeguards Systems

Low Trajectory Turbine Missiles

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.

INSERT C (Section 3.5.3):

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.

ATTACHMENT 2

Technical Justification

Executive Summary

The Oconee UFSAR currently specifies that all Engineered Safeguards (ES) structures, systems, and components be designed to withstand turbine-generated missiles by means of shielding or separation. With respect to portions of Low Pressure Service Water (LPSW) System piping located in the turbine building, Oconee does not meet this design criterion if high trajectory turbine missiles are considered. Oconee's UFSAR is currently not clear on whether or not high trajectory turbine missiles must be considered in the facility design other than for the reactor buildings. It is Duke's conservative position that this situation constitutes an unreviewed safety question.

Therefore, it is Duke's intent to clarify the UFSAR with respect to Oconee's turbine missile design criterion by means of this license amendment. In clarifying this design criterion at Oconee, it has been determined that additional design options should be provided, consistent with turbine missile design guidance provided in Regulatory Guide 1.115 "Protection Against Low Trajectory Missiles", and NUREG 0800 "Standard Review Plan". Regulatory Guide 1.115 Revision 1 and Section 3.5.1.3 of NUREG 800 Revision 2 provide turbine missile design criteria which are consistent with current industry practices.

In addition to resolving the clarity issues associated with the currently licensed turbine missile design criterion at Oconee, conversion to Regulatory Guide 1.115 and NUREG 0800 methodology will permit implementation of modifications associated with the Oconee Service Water Project as described in a letter to your staff dated December 28, 1995.

Detailed Description of Problem

UFSAR Section 3.1.40, "Missile Protection", and UFSAR Section 3.5.1.2, "Turbine Missiles", describe the turbine missile design criterion applied at Oconee Nuclear Station. UFSAR Section 3.1.40 requires Engineered Safeguards (ES) equipment to be protected from "missiles resulting from hypothesized plant equipment failure" by means of physical separation or shielding. UFSAR Section 3.1.40 references UFSAR Section 3.5, "Missile Protection", for further details. UFSAR Section 3.5.1.2 provides a description of the hypothesized turbine missiles at Oconee. Section UFSAR 3.5.1.2 focuses on the effects of turbine missiles impacting the reactor building. UFSAR Section 3.5.1.2 does not provide clear criteria for designing against high trajectory

or low trajectory turbine missiles for ES equipment outside the reactor building.

Therefore, Oconee's existing licensing basis is interpreted to mean that either shielding or separation must be provided for ES equipment, regardless of whether or not the equipment is likely to be hit by a turbine missile. In addition, since the UFSAR sections pertaining to turbine missile design do not specifically exclude consideration of high-trajectory turbine missiles, it has been conservatively assumed that high-trajectory missiles must be considered in Oconee's design. Therefore, Duke will justify an amendment to the license regarding the design criteria for high trajectory and low trajectory turbine missiles.

Turbine Missile Design Scope

UFSAR Section 3.1.40 has been clarified to clearly define the scope of equipment required to be protected against turbine missiles. The existing UFSAR Section 3.1.40 identifies "engineered safety features" as being the scope of equipment requiring turbine missile design. Engineered safety features are defined in other UFSAR design criteria as Engineered Safeguards Systems. The scope of Engineered Safeguards Systems is defined in UFSAR Chapter 6. Therefore, a change is being made to define engineered safety features as Engineered Safeguards Systems. This change is being made to establish consistency with the rest of the Oconee UFSAR content. This change does not change Duke's current interpretation of the Oconee UFSAR.

High Trajectory Turbine Missile Design

Oconee's UFSAR currently does not explicitly describe requirements for high trajectory turbine missile design. However, UFSAR Section 3.1.40 describes equipment-generated missile protection design requirements for Oconee. This UFSAR section is interpreted as requiring ES equipment to be shielded or separated to protect against high trajectory turbine missiles. UFSAR Section 3.5.1.2 does not provide any guidance with respect to designing ES equipment outside the reactor building for high trajectory turbine missiles.

Portions of the Units 1 and 2 LPSW System do not meet this implicit design requirement. Specifically, the Units 1 and 2 LPSW System main supply headers are physically located directly beside each other in the following places:

1) At the LPSW pump discharges prior to becoming embedded.

2) After resurfacing inside the turbine building near the auxiliary building wall.

Oconee is currently performing extensive Service Water System modifications as described in a letter to the staff dated December 28, 1995. As part of this Service Water Project, it will be necessary to install certain equipment outside the turbine building which, under the current Oconee licensing basis, will require either shielding or separation for protection from high trajectory turbine missiles. Specifically, the following equipment will need shielding or separation under the existing Oconee licensing basis:

1) Siphon Seal Water (SSW) System lines from the turbine building to the Essential Siphon Vacuum (ESV) Building and to the Condenser Circulating Water (CCW) intake structure.

2) ESV System lines to the CCW intake structure.

3) ESV System power and control cabling.

In order to establish adequate separation for ES equipment to protect it against turbine generated missiles, a minimum separation of 7 feet is maintained. This distance is based on the postulated size of turbine missiles which could occur. This information is not currently described in the Oconee UFSAR but is located in internal Duke design engineering memorandums. As part of the changes to include more information about turbine missile design, this information is being included in the proposed UFSAR revisions to Section 3.5.1.2.

In order to clearly address high trajectory turbine missile design in Oconee's UFSAR, Section 3.1.40 will be revised to reference Section 3.5.1.2 regarding the specific requirements for turbine missile design criteria. A new section will be added to Section 3.5.1.2 to describe how to implement the high trajectory turbine missile design criterion at Oconee. This new section will implement a high trajectory turbine missile design criterion in accordance with that described in NUREG 0800, "Standard Review Plan", Revision 2, dated July 1981, Section 3.5.1.3, Subsection III Item # 5. This guidance allows consideration of a vulnerable target area prior to requiring shielding or separation. It is Duke's conservative interpretation of the current Oconee licensing basis that additional design options are not allowed in consideration of the probability of equipment being impacted by a high trajectory turbine missile.

High trajectory turbine missiles are characterized by their nearly vertical trajectories. Missiles which are 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. The proposed new high trajectory turbine missile design criterion would allow Duke the option of evaluating whether or not a significant probability exists that a high trajectory turbine missile could impact a certain structure, system, or component (SSC). The proposed UFSAR change would adopt the NUREG 0800 guidance which allows the designer to waive shielding or separation requirements if the vulnerable target area (as viewed from the vertical) is less than 10^4 square feet.

This proposed change to the Oconee UFSAR provides additional design options with respect to this design criterion by eliminating the need for modifications with a cost which is not commensurate with the level of increase in safety. In addition, this proposed design practice for high trajectory turbine missiles will be consistent with current industry guidance.

The portions of LPSW System piping which do not meet Oconee's current high trajectory turbine missile design have been evaluated under the new design criterion. This LPSW System piping will present a vulnerable target area less than 10^4 square feet and is therefore not a candidate for shielding or separation. The three items being addressed under the Service Water Project have also been evaluated and present a vulnerable target area less than 10^4 square feet.

Low Trajectory Turbine Missile Design

Oconee's UFSAR currently does not explicitly describe requirements for low trajectory turbine missile design. However, UFSAR Section 3.1.40 describes equipment-generated missile protection design requirements for Oconee. This UFSAR section is interpreted as requiring ES equipment to be shielded or separated to protect against low trajectory turbine missiles. UFSAR Section 3.5.1.2 does not provide any specific guidance with respect to designing ES equipment outside the reactor building for low trajectory turbine missiles.

Oconee's existing ES equipment currently meets the design requirements for low trajectory turbine missiles because of shielding. Engineered Safeguards equipment below an elevation of 822 feet is protected from low trajectory missiles by the massive turbine pedestal and the concrete operating floor of the turbine building. Therefore, for low trajectory turbine missile design, no potential unreviewed safety questions exist.

In order to clearly address low trajectory turbine missile design in Oconee's UFSAR, Section 3.1.40 will be revised to reference Section 3.5.1.2 regarding the specific requirements for turbine missile design criteria. A new section will be added to Section 3.5.1.2 to describe how to

implement the low trajectory turbine missile design criterion at Oconee. This new section will implement a low trajectory turbine missile design criterion in accordance with that described in Regulatory Guide 1.115, Revision 1, dated July 1977, and NUREG 0800, Revision 2, Section 3.5.1.3, dated July 1981. This guidance allows consideration of equipment location relative to the likely missile strike zones and probability of a missile strike prior to requiring shielding or separation. Currently, it is Duke's interpretation of the Oconee licensing basis that other design options are not allowed in consideration of the location of equipment relative to the missile strike zone or probability of equipment being impacted by a low trajectory turbine missile.

Conclusions

This proposed license amendment proposes revisions to the Oconee UFSAR to clarify the turbine missile design licensing basis. In addition, while clarifying the licensing basis, the UFSAR revision will permit application of the turbine missile design criterion to permit exclusion of equipment for which a turbine missile strike is not probable. Currently, the Oconee licensing basis is insufficiently detailed to permit this design option. The proposed UFSAR revisions are consistent with industry practice and with guidance provided by the NRC staff. If Duke is permitted to invoke this proposed amendment at Oconee, certain ES equipment may not be required to be shielded or separated for protection against turbine missiles. However, this equipment will have been evaluated as being 1) outside credible missile strike zones, or, 2) a very low probability target based on NRC approved methodologies. Therefore, this proposed amendment will not impact public health and safety.

ATTACHMENT 3

No Significant Hazards Consideration Evaluation

Determination of No Significant Hazards

This proposed change has been evaluated against the standards in 10 CFR 50.92 and has been determined to involve no significant hazards considerations, in that operation of the facility in accordance with the proposed amendment would not:

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

   No. The proposed license amendment proposes the use of less restrictive guidance with respect to application of the turbine missile design criterion. Oconee's current licensing basis is to protect ES equipment against turbine missiles by use of shielding or separation. The proposed changes to the Oconee licensing basis would allow Oconee to use NRC approved methodology, as described in Regulatory Guide 1.115, Revision 1 and NUREG 0800 Revision 2 (for low trajectory turbine missiles) and NUREG 0800 Revision 2 (for high trajectory turbine missiles) in evaluating the credibility and probability of a turbine missile strike on ES equipment prior to imposing a separation or shielding design requirement. If the probability is sufficiently low of a turbine missile strike, then shielding or separation would not be required. Therefore, the separation and shielding design requirements would only be waived on equipment which has a very low probability of being struck by a turbine missile.

   Design to protect ES equipment against a turbine missile as described above is not an accident initiator. In addition, under this new license amendment, some ES equipment would be exempted from separation and shielding design requirements for turbine missiles. The basis for this exemption is that the probability of this equipment being hit by a turbine missile is very low as evaluated through NRC approved methods.

   Therefore, based on this analysis and the information presented in Attachment 2, the probability or consequences of an accident previously evaluated will not be significantly increased by the proposed change.

2. Create the possibility of a new or different kind of accident from the accidents previously evaluated?

   No. Design to protect ES equipment against a turbine missile as described above is not an accident initiator.

   Therefore, based on this analysis and the supporting information in Attachment 2, no new failure modes or credible accident scenarios are postulated.

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

   No. Under this new license amendment, some ES equipment would be exempted from separation and shielding design requirements for turbine missiles. The basis for this exemption is that the probability of this equipment being hit by a turbine missile is very low as evaluated through NRC approved methods.

   Therefore, based on this analysis and the supporting information in Attachment 2, the margin of safety is not significantly reduced as a result of this proposed amendment.

Duke has concluded based on the above information that there are no significant hazards considerations involved in this amendment request.

Attachment 4

Environmental Assessment

Environmental Assessment

Pursuant to 10 CFR 51.22 (b), an evaluation of the proposed amendment has been performed to determine whether or not it meets the criteria for categorical exclusion set forth in 10 CFR 51.22 (c) 9 of the regulations. The proposed amendment does not involve:

1) A significant hazards consideration.

This conclusion is supported by the determination of no significant hazards.

2) A significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

This amendment will not change the types or amounts of any effluents that may be released offsite.

3) A significant increase in the individual or cumulative occupational radiation exposure.

This amendment will not increase the individual or cumulative occupational radiation exposure.

In summary, this amendment request meets the criteria set forth in 10 CFR 51.22 (c) 9 of the regulations for categorical exclusion from an environmental impact statement.