Mr. W. R. McCollum
Vice President, Oconee
Duke Energy Corporation
P. O. Box 1439
Seneca, SC 29679

January 5, 1999

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE), OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 (TAC NOS. M83649, M83650, AND M83651)

Dear Mr. McCollum:

Based on our ongoing review of the Oconee IPEEE submittals dated December 28, 1995, December 30, 1996, March 31, December 15, and December 18, 1997, the enclosed request for additional information has been prepared. The questions are related to the fire; seismic; and high wind, flood, and other external events (HFO) areas of the IPEEE submittal. The questions related to fire and seismic were developed by our contractors, the Sandia National Laboratories and Brookhaven National Laboratories, respectively; and the question related to the HFO area was developed by the NRC Office of Nuclear Regulatory Research.

We request that you provide your response within 120 days of the date of this letter, as discussed with Mr. Ed Burchfield of your staff.

Sincerely,

ORIGINAL SIGNED BY:

David E. LaBarge, Senior Project Manager
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

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

Enclosure: Request for Additional Information

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Request for Additional Information

Oconee Nuclear Station Units 1, 2, and 3

Individual Plant Examination of External Events (IPEEE)

A. FIRE

1. The cable shaft fire was one of only two fires analyzed in detail. There are a number of specific points of concern related to this analysis, as discussed below:

   a. The chosen analysis method credits detection and suppression twice as fully independent steps in the fire progression, which can result in an optimistic credit for detection/suppression.

   b. The only fire that has been considered is a fully engulfing fire (a fire that spreads to the entire fire area). While an all-engulfing fire may bound the damage state for the plant, it is not clear that this fire is the most significant risk threat. Apparently, no consideration has been given to smaller fires that might cause localized, but still critical, damage to a subset of the cables present before detection/suppression can intervene. The importance of smaller fires will depend on the presence and location of postulated fire threats and the details of cable routing within the fire area.

   c. Self-ignition of shielded cable was assumed to not be credible. Given the age of the Oconee units, the presence of pre-IEEE-383 cables (i.e., cables that are not qualified as low-flame-spread) should be assumed; hence, self-ignited cable fires should also be considered (per industry guidance, e.g., the Electric Power Research Institute (EPRI) fire-induced vulnerability evaluation (FIVE) method).

   d. Failure to achieve shutdown using the standby shutdown facility (SSF) was apparently considered as a human error probability (HEP) related to manning the SSF. It appears that potential system, control, and/or instrumentation hardware failures, including both fire-related damage and other failures (random failure on demand, maintenance outages, etc.), that might render the SSF functions unavailable or unreliable were not considered.

   e. Apparently, only two scenarios were analyzed, and both involved a reactor coolant pump (RCP) seal loss-of-coolant accident (LOCA). Other scenarios should also be considered. For example, general transients, hot shorts producing a LOCA (e.g., due to damage to power-operated relief valve (PORV) cabling), and the potential for fire-induced loss of station power (LOSP) should also be considered.

   f. It does not appear that the analysis has included the consideration of hot shorts that may lead to the spurious operation of systems and components including motor-operated valves (MOVs) and PORVs.

Please provide a detailed analysis of cable shaft fires with an explanation of how each of the concerns identified above has been addressed. Describe the results of the analysis including a discussion of the dominant risk sequences and fire scenarios along with their estimated CDFs.

2. Fire risk in the auxiliary building was assumed to be bounded by the cable shaft risk estimates. Further, several auxiliary building sub-zones (levels) were qualitatively screened out, apparently based on an assumption that the fire frequencies were bounded by the cable shaft fire. However, the auxiliary building includes a number of critical fire zones that may represent unique fire risk contributors in comparison to the cable shaft. For example, Level 809 contains cabling for the SSF. Hence, fires in this area may compromise instrumentation or control functions of the SSF, and/or the ability to transfer control to the SSF. In the cable shaft analysis, the SSF was credited with mitigating the fire risk, which may not be appropriate when considering fires in other areas of the auxiliary building. Therefore, the submittal has not provided an adequate basis to screen out whole areas of the auxiliary building based on the analysis of a single fire area as the assumed bounding case.

   Please reexamine the various fire areas in the auxiliary building (excluding in this context the cable shaft, which is discussed in Question 1 above, and the main control room (MCR), which is discussed below). The analysis should include initial screening of each fire area based on consideration of fire sources, potential fire damage, and mitigating features specifically relevant to each area. More detailed assessments should also be provided for areas that survive the initial screening process. All fires that can either lead to the failure of safe shutdown equipment/systems or lead to a reactor trip, either automatic or manual, should be considered.

3. The Oconee IPEEE fire analysis has screened out the MCR for each unit on the basis that these areas are constantly occupied, contain smoke detectors, and the fire risk is bounded by the cable shaft fire risk. This result is inconsistent with typical fire risk assessment findings. As a result of the qualitative screening, the submittal does not provide a specific analysis of MCR fires and their impact on plant operations. Further, NUREG-1407, Section 4.2 and Appendix C, and Generic Letter 88-20, Supplement 4, request that documentation be submitted with the IPEEE submittal with regard to the Fire Risk Scoping Study (FRSS, NUREG/CR-5088) issues including the issue of control systems interactions. The premature screening out of the MCR has apparently precluded such an analysis.

   Too further clarify, the issue of control systems interactions is associated primarily with the potential that a fire in the plant (including, in particular, the MCR) might lead to unanticipated control systems vulnerabilities. The analysis should, in particular, consider the potential that in the event of an MCR fire, functions or instrumentation at the SSF might be compromised before the transfer of control to the SSF. Specific areas that have been identified as requiring attention in the resolution of this issue include:

   a. Loss of control equipment or power before transfer: The potential for loss of control power for certain control circuits as a result of hot shorts and/or blown fuses before transferring control from the MCR to remote shutdown locations needs to be assessed.

b. Spurious actuation of components leading to component damage, LOCA, or interfacing systems LOCA: The spurious actuation of one or more safety-related or safe-shutdown-related components or redundant divisions as a result of fire-induced cable faults, hot shorts, or component failures leading to component damage, LOCA, or interfacing systems LOCA, prior to transferring control to or taking control from the SSF, needs to be assessed. This assessment also needs to include (1) the spurious starting and running of pumps as well as the spurious repositioning of valves, (2) the possibility that spurious operations and actions may not be indicated at the transfer panel in the auxiliary building and may not be directly recoverable from remote shutdown locations, and (3) the effects of potential hot shorts leading to damage to MOVs per Information Notice 92-18.

c. Total loss of system function: The potential for total loss of system function as a result of fire-induced redundant component failures or electrical distribution system (power source) failure needs to be addressed.

d. Misleading instrumentation circuit readings: Hot shorts may cause misleading plant readings, potentially leading to inappropriate control actions or generation of actuation signals for emergency safeguard features. These effects of these potential faults need to be evaluated.

Please provide a detailed fire analysis of the Oconee main control rooms. The analysis should include consideration of MCR fire frequencies; the effect of electrical control panel fires, including the potential for the spread of fire or fire damage; the resulting damage to plant systems under various postulated fire scenarios; the potential for forced abandonment of the MCR due to either smoke, heat, or the loss of a sufficient set of control functions; the timing of events related to MCR abandonment and recovery from the SSF; and each of the above identified aspects of the control systems interaction issues. Include in the response a description of the control and instrumentation functions that are provided at the SSF. For each function indicate whether or not it can be isolated from damage in the main control room even assuming MCR faults prior to transfer. Also, describe the physical location of the MCR/SSF transfer switches, the procedures for affecting the transfer, and provide an evaluation of the reliability of operator recovery using the SSF.

4. A large fire in the Unit one-half block house is considered to be bounded by the turbine building fire scenario because the latter assumes the loss of emergency feedwater (EFW) as well as ac power. While this may be true in terms of the plant damage state, it may not hold true in terms of the overall fire risk. For example, the fire frequency in the block house may be significantly higher given the fire sources located there; even small fires in the block house may compromise the critical set of risk-important equipment located there; and the detection/suppression capability in the block house may not be the same as that in the turbine building. The submittal has not substantiated that blockhouse fire risk is bounded by the turbine building scenarios analyzed in the IPEEE.

   Please provide a risk evaluation for blockhouse fires using data and assumptions specific to that particular plant area (fire frequency, fire damage, detection, suppression, mitigation and recovery, etc.) and describe the results.

5. Except for the turbine building and blockhouse, fires that could affect more than one unit did not appear to be considered. The submittal indicated that some fire areas contain elements of both units. For multi unit sites, there are four issues of potential interest:

   a. A fire in a shared area might cause a simultaneous trip demand for more than one unit. This may considerably complicate the response of operators to the fire event, and may create conflicting demands on plant systems that are shared between units or on plant personnel. The fire analysis should identify plant fire areas that are shared between units, and identify potentially risk important systems/components for each unit that are housed in each such area.

   b. At some sites, the safe shutdown path for a given unit may call for cross-connects to a sister unit in the event of certain fires. This, for example, appears to apply to those scenarios that have apparently been considered in the event of an LOSP at Oconee, and may also apply to other scenarios. The fire analysis of such scenarios should include the unavailability of the cross-connected equipment due to outages at the sister unit (e.g., routine in-service maintenance outages and/or the potential that normally available equipment may be unavailable during extended or refueling outages at the sister unit). The analysis should identify any fire-related safe shutdown procedures that call for unit cross-connects and assess the impact of unavailability on fire risk.

   c. Propagation of fire, heat, smoke, and suppressants between fire zones containing equipment for one unit to fire zones containing equipment for the other unit also can result in multi unit scenarios. The fire assessment should include the consideration of multi compartment fire scenarios. For multi unit sites, this should include consideration of unit-to-unit compartment interactions.

   d. There may be fires that might lead to MCR evacuation for more than one unit simultaneously. This might result from a fire in a shared control room, a fire in adjacent control rooms that are not separated by fire rated boundaries, or a fire in an area with shared equipment that might compromise MCR functions for more than one unit simultaneously (for example, a fire in a shared cable spreading room or cable shaft/tunnel area). This might lead to a demand for a simultaneous remote shutdown of more than one unit and this potential should be included in the analysis. Consideration should include an assessment of the adequacy of plant mitigation strategies (e.g., the SSF) under these circumstances.

   Please provide an analysis of fires that might lead to multi unit risk scenarios that includes consideration of these four issues.

6. The Oconee IPEEE submittal presents fire analyses for only five "critical zones." However, no basis has been established to support a conclusion that other fire areas are not risk-significant. Further, it is unclear what fire areas were actually considered in the analysis and what criteria were used for screening of fire areas.

   In order to better understand important IPEEE results, please provide a discussion of the fire area screening criteria used in the IPEEE fire analysis for the balance of plant areas that are not specifically addressed in the previous questions. Identify those areas that were screened from the analysis and the basis for the screening of each area. In particular,

screening bases should be specific to the fire sources, fire targets, and mitigation features relevant to each fire area considered.

B. SEISMIC

1. Two key, but apparently inappropriate, assumptions in the Oconee IPEEE analysis would appear to have a significant impact on the results obtained:

   a. Regarding the scaling of the zero peak acceleration (ZPA) of ground motion spectra, it is stated on page 3-8 of the 1995 IPEEE submittal: "A NUREG/CR-0098 median ground response spectrum anchored at 0.18g at top of rock was used for the review level earthquake for the Oconee site. This corresponds to a 0.3g free-field acceleration as recommended in NUREG-1407." This assumption is not appropriate for the following reasons:

      - Table 3.1 of NUREG-1407 classifies the Oconee site as a shallow soil site. According to Section 3.2.2 of NUREG-1407, the free-field motions should be determined using a proper soil structure interaction (SSI) analysis method for such a site. This procedure was not followed in the seismic analysis.

      - Since the free-field surface motions were not determined in the analysis, the NUREG/CR-0098 spectrum anchored at 0.3g at the top of rock should be considered as the basis of the analysis and the review level earthquake.

      - In the IPEEE analysis, not only an artificially low screening level of 0.18g was used, but also all the component capacities seemed to be increased by a factor of 1.67 (=0.30g/0.18g).

      Please evaluate the impact of using a NUREG/CR-0098 spectrum anchored at 0.30g at the top of rock (and, if necessary, eliminating or correcting the uniform hazard spectrum (UHS) scaling factors discussed in (b) below) on the following analysis results:

      - CDF values
      - dominant contributors
      - fragility values
      - component screening
      - identification of vulnerabilities

   b. On page 3-34 of the 1995 IPEEE submittal, the footnote for Table 3-1 indicated a "UHS scaling factor" was used to modify the existing fragility values, which were based on the NUREG/CR-0098 spectra. A clear definition of the "UHS scaling factor" was not provided. The use of a scaling factor does not appear appropriate for the following reasons:

      - Both the NUREG/CR-0098 spectra and the Electric Power Research Institute (EPRI) UHS were developed for the free-field surface motions. However, brief descriptions of the spectral ratios in the submittal imply that they were applied to the base motion at the bottom of the soil layer.

- According to Section 4 of EPRI NP-6041, page 4-16, the use of spectral ratios is not recommended when two spectra are dissimilar in shape, as is the case with the NUREG/CR-0098 spectra and EPRI's UHS.

Therefore, please provide the following:

i. a concise definition of the UHS scaling factor used in the seismic analysis;

ii. a rationale for using the spectral ratios when the corresponding spectra, NUREG/CR-0098 and EPRI's UHS, are significantly dissimilar; and

iii. a rationale for applying the ratios to the base motions at the bottom of the soil layer, although the spectra were developed for the free-field surface motions.

2. Table 2-2 of the 1997 Supplemental Report (or Table 3-2 of the 1995 IPEEE submittal) shows the probability values of the basic events used in the seismic analysis. Many of the basic events consist of operator actions. However, the basis for the derivation of the probability values associated with these actions is not provided in the submittal.

   a. Please describe the sources of the probability values used in the analysis.

   b. Please discuss in more detail the derivation of the probability values of the following basic events:

      i. CEQUIPMRHE (Operators fail to restart equipment);

      ii. NSFTIMEDHE (Operators fail to deploy to the standby shutdown facility in time);

      iii. all basic events that do not have sufficient plant procedures in place; and

      iv. all basic events that involve operator actions out of the main control room.

      Please include in the discussion the time allowed for operator actions, the procedures involved in the basic events, and how potential adverse effects of a seismic event on operator actions were considered.

3. Cut sets obtained from the updated seismic analysis are presented in Table 5-1 of the 1997 Supplemental Report. However, analysis result summaries that could provide insights on dominant contributors to the IPEEE are not provided in the report.

   Please provide summary information for the updated results similar to that provided in Table 3-6 of the 1995 IPEEE submittal for sequence CDF, and to that discussed in Section 3.1.5.4 of the 1995 IPEEE submittal for dominant contributors (e.g., the contribution of dam failure to total CDF). If the results have changed due to the response to Question 1 above, please provide these revised results as well.

4. The contribution of the auxiliary building surrogate to the total CDF can be significant (e.g., 23 percent of total CDF based on the results presented in the 1995 IPEEE submittal), and its contribution to the total CDF may be increased if the 142 relays with fragilities less than

the auxiliary building surrogate that are excluded from the analysis are included in the auxiliary building surrogate. According to the submittal, these relays (Table 3.1 of the 1997 Supplemental Report) are being considered for further analysis or replacement. Please discuss the current status and any schedule for completion of this effort. If the fragilities of some relays cannot be raised above that of the surrogate element, please provide the impact this would have on the CDF.

C. HIGH WINDS, FLOODING, AND OTHER EXTERNAL EVENTS

As noted in NUREG-1407, Section 2.4, the latest probable maximum precipitation (PMP) criteria published by the National Weather Service calls for higher rainfall intensities over shorter time intervals and smaller areas than have previously been considered; this could result in higher site flooding levels and greater roof ponding levels. Please assess the effects of applying these new PMP criteria to Oconee. Additional information is given in Generic Letter 89-22.