Template NRR-092

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

March 15, 2000

Mr. W. R. McCollum, Jr.
Vice President, Oconee Site
Duke Energy Corporation
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2 AND 3 RE: REVIEW OF INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (TAC NOS. MA83649, M83650, AND M83651)

Dear Mr. McCollum:

By letter dated December 28, 1995, and supplements dated December 18, 1997, March 31, 1999, and October 4, 1999, the Duke Energy Corporation supplied the results of the Individual Plant Examination of External Events (IPEEE) review for the Oconee Nuclear Station, Units 1, 2, and 3 (Oconee). This was in response to Generic Letter 88-20, Supplement 4, that was issued on June 28, 1991, to all licensees and Construction Permit holders.

The staff and our contractors, the Brookhaven National Laboratory and the Sandia National Laboratories, have completed the reviews of your submittals. Enclosed is our evaluation report (Enclosure 1), the contractors' Technical Evaluation Reports (TERs) that address the seismic analysis (Enclosure 2) and fire analysis (Enclosure 3), and the staff's TER addressing high winds, flood, and other external events (Enclosure 4).

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 accidents 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.

We have also concluded based on the information that you supplied, that you have adequately addressed Unresolved Safety Issue (USI) USI A-45, "Shutdown Decay Heat Removal Requirements;" Generic Safety Issue (GSI) GSI-57, "Effects of Fire Protection System Actuation on Safety-Related Equipment;" and GSI-103, "Design for Probable Maximum Precipitation (PMP)," as well as four Sandia Fire Risk Scoping Study (FRSS) issues that were explicitly requested in Supplement 4 to Generic Letter 88-20 and the associated guidance in NUREG-1407. On the basis that no vulnerabilities associated with the external events aspects of these issues were identified at Oconee, the staff considers that these safety issues have been satisfactorily resolved.

The staff has, however, determined that one FRSS issue was not explicitly or completely addressed in the submittal and remains open, as explained in the enclosed safety evaluation. The need for any additional assessment or actions related to a smoke control and manual fire fighting effectiveness issue will be addressed by the staff separately from the IPEEE program.

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In addition, the IPEEE submittal contains some specific information that addresses the external event aspects of GSI-147, "Fire-Induced Alternate Shutdown/Control Room Panel Interactions;" GSI-156, "Systematic Evaluation Program (SEP);" and GSI-172, "Multiple System Responses Program" (MSRP). The specific information associated with each of these issues is identified and discussed in the enclosed staff safety evaluation. Based on the review of the information contained in the submittal, the staff considers your process capable of identifying potential vulnerabilities associated with these issues at Oconee. On the basis that no vulnerabilities associated with the external events aspects of these issues were identified, the staff considers these issues resolved.

However, GSI-148, "Smoke Control and Manual Fire-Fighting Effectiveness," which is described in the enclosed staff safety evaluation, was not explicitly or completely addressed in the submittal. Therefore, this issue is not resolved. The need for any additional assessment or actions related to the resolution of GSI-148 for Oconee will also be addressed by the staff separately from the IPEEE program.

Sincerely,

/RA/

David E. LaBarge, Senior Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

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

Enclosures:
1. Staff IPEEE Evaluation Report
2. Seismic TER
3. Fire Areas TER
4. High Winds, Flood, and Other External Events TER

cc w/encls: See next page

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However, GSI-148, "Smoke Control and Manual Fire-Fighting Effectiveness," which is described in the enclosed staff safety evaluation, was not explicitly or completely addressed in the submittal. Therefore, this issue is not resolved. The need for any additional assessment or actions related to the resolution of GSI-148 for Oconee will also be addressed by the staff separately from the IPEEE program.

Sincerely,

David E. LaBarge, Senior Project Manager, Section 1
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OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS

TECHNICAL EVALUATION REPORT

BY THE OFFICE OF NUCLEAR REACTOR RESEARCH

Enclosure 1

STAFF EVALUATION REPORT OF

INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS

SUBMITTAL BY THE DUKE ENERGY CORPORATION FOR THE

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

I. INTRODUCTION

On June 28, 1991, the NRC issued Generic Letter (GL) 88-20, Supplement 4 (with NUREG-1407, Procedural and Submittal Guidance) requesting that all licensees perform individual plant examinations of external events (IPEEE) to identify plant-specific vulnerabilities to severe accidents and report the results to the Commission together with any licensee-determined improvements and corrective actions. In a letter dated December 28, 1995, the Duke Energy Corporation (the licensee)[1], submitted to the NRC its IPEEE without a relay review because the relay review was ongoing under the Unresolved Safety Issue (USI) A-46 program. After the completion of the USI A-46 program, the licensee provided a Supplemental IPEEE Report to the NRC by letter dated December 18, 1997, that included an assessment of relay chatter.

The staff contracted with the Brookhaven National Laboratory and the Sandia National Laboratories to conduct screening reviews of the licensee's IPEEE submittal in the seismic and fire areas, respectively. The NRC staff conducted a screening review in the high winds, floods, and other external events (HFO) area of the submittal. The staff sent a request for additional information (RAI) to the licensee on January 5, 1999. The licensee responded to the RAI on March 31, 1999 and October 4, 1999. Based on the results of the review of the submittal and the responses to the RAIs, the staff concluded that the aspects of seismic events; fires; and high winds, floods, and other external events were adequately addressed. The review findings are summarized in the evaluation section below. Details of the staff's and contractors' findings are contained in three technical evaluation reports attached to this staff evaluation report.

In accordance with Supplement 4 to GL 88-20, the licensee provided information to address the resolution of Fire Risk Scoping Study (FRSS) issues, generic safety issue (GSI)-57, "Effects of Fire Protection System Actuation on Safety-Related Equipment," GSI-103, "Design for Probable Maximum Precipitation (PMP)," and USI A-45, "Shutdown Decay Heat Removal Requirements." These issues were explicitly requested in Supplement 4 to GL 88-20 and its associated guidance in NUREG-1407. The licensee also proposed to resolve USI A-17 "System Interactions in Nuclear Power Plants," and the Eastern U.S. Seismicity issue.

An IPEEE Senior Review Board (SRB) was established and meets on a regular basis. The purposes of the SRB are (1) for the contractor to present the findings and conclusions of its review and the bases for its conclusions, and (2) for the SRB members to provide their perspectives on the contractor's findings and conclusions and to make recommendations

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[1] On September 16, 1997, the licensee's name changed from Duke Power Company to Duke Energy Corporation.

based on their expertise. In this manner, the SRB provides additional assurance that (1) the scope of the review meets the objectives of the program, and (2) critical issues that have the potential to mask vulnerabilities are not overlooked.

II. EVALUATION

The Oconee Plant is a three-unit, Babcock & Wilcox pressurized-water reactor with a large dry containment. The safe shutdown earthquake for the plant is 0.1g for rock and 0.15g for soil. The licensee used a NUREG/CR-0098 median ground response spectrum anchored at 0.18g at top of rock for the review level earthquake. With respect to the seismic IPEEE, Oconee is assigned to the full-scope 0.3g seismic review category in NUREG-1407. For the seismic IPEEE area, the licensee used a seismic Probabilistic Risk Assessment (PRA) and later updated it with a relay chatter evaluation in conjunction with the results of USI A-46 analysis. In addition, the licensee conducted a seismic walkdown using the Electric Power Research Institute (EPRI) seismic margin methodology walkdown procedures.

The licensee performed an original Oconee Level 3 PRA that included internal and external events, prior to the IPEEE program. This PRA was issued in 1984 as EPRI National Safety Analysis Center (NSAC)-60. In 1990, the licensee submitted an Individual Plant Examination (IPE) with a Level 3 Oconee Unit 3 PRA as an update of NSAC-60. In 1995, the licensee submitted an IPEEE that included another revision of the Oconee PRA with the fire PRA evaluation for Unit 3. The licensee conducted walkdowns and supporting evaluations for all three units as part of this PRA to determine the applicability of the Unit 3 PRA results to Units 1 and 2. The licensee concluded that differences between the three units did not measurably change the estimated CDF or risk between the units.

In the HFO area, the licensee performed a tornado analysis using PRA techniques, and a core damage frequency (CDF) estimate of external flooding. Other external events were assessed using a screening approach as described in NUREG-1407.

Core Damage Frequency Estimates

Oconee is a full-scope 0.3g plant; the licensee's seismic analysis included quantitative estimates of seismic CDF and high confidence low probability of failure. The licensee conducted seismic walkdowns in order to confirm the validity of fragility assessments, to verify seismic adequacy of equipment anchorage, and to identify any other seismic concerns. The licensee estimated a seismic CDF of 3.5E-5/reactor-year (RY). The licensee estimated a fire CDF of 5.0E-6/RY. (The licensee estimated a CDF due to internal events of about 2.3E-5/RY, including internal flooding.)

The licensee estimated a CDF due to tornadoes of 1.3E-5/RY. External flooding events contribute about 7.0E-6/RY to the CDF. Other external events (transportation and nearby facilities accidents) were screened out because they contribute insignificantly to the CDF.

Dominant Contributors

The licensee conducted seismic walkdowns consistent with the guidelines in EPRI NP-6041, "A Methodology for Assessment of Nuclear Power Seismic Margin." The licensee did not identify any seismic vulnerabilities. The licensee estimated that seismic events contribute about 60 percent to the total external event CDF. The dominant seismic sequences involve loss of power events coupled with standby shutdown facility (SSF) failures.

The fire sequences contribute about 8 percent to the total external event CDF. The dominant fire sequences involve a fire in the turbine building and a failure of the SSF diesel to run.

The licensee estimated that tornadoes contribute about 20 percent to the total external event CDF. The dominant tornado sequences involve failure of the Keowee Hydro Station, failure to establish SSF seal cooling, and failure of the West Penetration Room exterior wall.

Flooding events, which contribute about 10 percent to the CDF, are due to seismically-induced failure of the Jocassee Dam. The dominant cut set involves flood heights exceeding the 5-foot high SSF flood barrier, thus rendering the SSF inoperable.

The licensee's IPEEE assessment appears to have examined the significant initiating events and dominant accident sequences.

Containment Performance

The licensee has assessed containment performance under seismic conditions at Oconee by assessing the capability of the containment structure, containment isolation system, and containment safeguards components to withstand seismic events. The licensee has performed seismic containment walkdowns, including an assessment of relay chatter.

The licensee has also reviewed containment performance issues as part of the evaluation of fire-initiated accident sequences. The licensee has examined containment isolation and safeguards as part of the fire analysis. The IPEEE walkdown did not identify any fire-related containment failure modes.

The licensee's containment performance analyses for seismic and internal fire events appeared to have considered important containment performance issues and are consistent with the intent of Supplement 4 to GL 88-20.

Generic Safety Issues

As a part of the IPEEE, a set of generic and unresolved safety issues (USI A-45, GSI-131, GSI-103, GSI-57, and the FRSS issues) were identified in Supplement 4 to GL 88-20 and its associated guidance in NUREG-1407 as needing to be addressed in the IPEEE. These safety issues were evaluated by the NRC's contractors and the results of these evaluations are contained in the attached technical evaluation reports (TERs). For those safety issues that were not completely resolved by the contractors, the NRC staff performed additional reviews in order to arrive at a satisfactory conclusion. The final resolution of these issues is provided below.

1. USI A-45, Shutdown Decay Heat Removal (DHR) Requirements

   The licensee's process of addressing USI A-45 external events was similar to that used for internal events quantification. The DHR capability was addressed in Section 8 of the IPE report. The overall calculated CDF due to failure of DHR systems for external initiators is lower than that for internal initiators but did not change significantly as a result of the IPEEE analysis. The staff finds that the licensee's USI A-45 evaluation is consistent with the guidance provided in Section 6.3.3.1 of NUREG-1407. Therefore, the staff considers this issue resolved.

2. GSI-131, Potential Seismic Interaction Involving the Movable In-Core Flux Mapping System Used in Westinghouse Plants

   GSI-131 does not apply to Oconee since it is not a Westinghouse plant.

3. GSI-103, Design for Probable Maximum Precipitation

   The licensee has assessed the effects of flooding and roof ponding as a result of PMP (information provided in the licensee's RAI responses dated March 31, 1999, and October 4, 1999). The staff finds that the licensee's GSI-103 evaluation is consistent with the guidance provided in Section 6.2.2.3 of NUREG-1407. Therefore, the staff considers this issue resolved.

4. GSI-57, Effects of Fire Protection System Actuation on Safety-Related Equipment

   As noted in Section 4.8.5 of the IPEEE, the licensee addressed GSI-57 as part of plant walkdowns (seismic and fire walkdowns). As a result of the walkdowns, the licensee recommended that the open head sprinklers in the cable room and equipment rooms be replaced with closed head sprinklers. The staff finds that the licensee's GSI-57 evaluation is consistent with the guidance provided in NUREG-1407. Therefore, the staff considers this issue resolved.

5. Fire Risk Scoping Study (FRSS) Issues

   The licensee has addressed the FRSS issues: fire-induced alternate shutdown/control room panel interaction in Section 4.8.7 of the IPEEE; seismic-fire interactions in Section 4.8.6 of the IPEEE; effects of fire protection system actuation on safety-related equipment in Section 4.8.5 of the IPEEE; and adequacy of fire barriers in Section 4.8.8 of the IPEEE. Based on the results of the IPEEE submittal review, the staff considers that the licensee's process is consistent with the guidance provided in NUREG-1407. Therefore, the staff considers these issues resolved.

   With respect to the FRSS issue on smoke control and manual fire-fighting effectiveness, the licensee did not provide information on the potential of fire-fighting efforts to breach fire barriers and jeopardize the separation between redundant trains, the staff therefore considers this issue unresolved.

In addition to those safety issues discussed above that were explicitly requested in

Supplement 4 to GL 88-20, four generic safety issues were not specifically identified as issues to be resolved under the IPEEE program; thus, they were not explicitly discussed in Supplement 4 to GL 88-20 or NUREG-1407. However, subsequent to the issuance of the GL, the NRC evaluated the scope and the specific information requested in the GL and the associated IPEEE guidance, and concluded that the plant-specific analyses being requested in the IPEEE program could also be used, through a satisfactory IPEEE submittal review, to resolve the external event aspects of these four safety issues. These GSIs were initially evaluated by the NRC's contractors, and the results of these evaluations are contained in the attached TERs. For those GSIs that were not completely resolved by the NRC's contractors, the NRC staff performed additional reviews in order to arrive at a satisfactory conclusion. The final resolution of these issues is provided below.

1. GSI-147, Fire-Induced Alternate Shutdown/Control Room Panel Interactions

   The licensee has examined fire-induced alternate shutdown/control room interactions for Oconee in Section 4.8.7 of the IPEEE. Oconee is designed with an independent remote shutdown panel that can be isolated from the control room for a fire event that causes loss of control from the control room. Based on the results of the IPEEE submittal review, the staff considers that the licensee's process is capable of identifying potential vulnerabilities associated with this issue. On the basis that no vulnerability associated with this issue was identified in the IPEEE submittal, the staff considers this issue resolved.

2. GSI-148, Smoke Control and Manual Fire-Fighting Effectiveness

   The licensee discussed smoke generation and migration effects. The licensee has also performed walkdowns and identified areas where smoke migration might affect redundant safety equipment. However, as discussed previously on the FRSS issue "Smoke Control and Manual Fire-Fighting Effectiveness," the licensee provided no information on the potential for fire-fighting efforts to jeopardize the separation between redundant trains. Therefore, the staff considers GSI-148 not completely resolved.

3. GSI-156, Systematic Evaluation Program (SEP)

   The licensee's IPEEE submittal and other associated documentation were reviewed for information directly addressing the following external events-related SEP issues: settlement of foundations and buried equipment in Section 3.1 of the IPEEE; dam integrity and site flooding in Section 5.2 of the IPEEE; seismic design of structures, systems, and components in Sections 3.1 of the IPEEE; site hydrology and ability to withstand floods in Section 5.2 of the IPEEE; industrial hazards in Section 5.3 of the IPEEE; tornado missiles in Section 5.1.2 of the IPEEE; severe weather effects on structures in Section 5 of the IPEEE; and design codes, criteria, and load combinations in Section 3.1 of the IPEEE. Based on the results of the IPEEE submittal review, the staff considers that the licensee's process is capable of identifying potential vulnerabilities associated with this issue. On the basis that no potential vulnerability associated with this issue was identified in the IPEEE submittal, the staff considered the IPEEE-related aspects of this issue resolved.

4. GSI-172, Multiple System Responses Program (MSRP)

The licensee's IPEEE submittal contains information directly addressing the following external events-related MSRP issues: (1) effects of fire protection system actuation on non-safety related and safety-related equipment in Section 4.8.6 of the IPEEE; (2) seismically induced spatial and functional interactions Sections 3.1.2.3 and 4.8.6 of the IPEEE; (3) seismically induced fires in Section 3.1.2.3 of the IPEEE; (4) non-safety-related control system/safety-related system dependencies in Section 4.8.7 of the IPEEE; (5) effects of flooding and/or moisture intrusion on non-safety related and safety-related equipment in Section 3.1.2.3 of the IPEEE; (6) seismically induced fire suppression system actuations in Section 3.1.2.3 of the IPEEE; (7) seismically induced flooding Sections 3.1.2.3 and 3.1.5 of the IPEEE; and (8) evaluation of earthquake magnitude greater than the SSE in Section 3.1.5 of the IPEEE. Based on the overall results of the staff's IPEEE submittal review, the staff considers that the licensee's process is capable of identifying potential vulnerabilities associated with these issues. On the basis that no potential vulnerability associated with these issues was identified in the IPEEE submittal, the staff considers the IPEEE-related aspects of these issues resolved.

In addition, the staff considers that the following MSRP issues are resolved for Oconee for the reasons given below:

(i) With respect to seismically induced relay chatter, Oconee has examined the effects of relay chatter in accordance with the A-46 review. As a result, the licensee has identified low-ruggedness relays for replacement in Section 3.1.2.3 of the IPEEE.

(ii) The effects of hydrogen line ruptures were considered as part of the fire-seismic walkdowns in Sections 3.1.2.3 and 4.8.6 of the IPEEE.

(iii) Regarding the IPEEE-related aspects of common cause failures associated with human errors, human errors occurring as part of recovery actions during certain fire scenarios were addressed in Section 4.6 of the IPEEE. With respect to the seismic events, human errors related to recovery actions were addressed in Section 3.1.5 of the IPEEE.

Plant Safety Features, Potential Vulnerabilities, and Improvements

The licensee did not identify any unique plant safety features. However, Oconee has a SSF that provides a totally independent means of achieving and maintaining safe shutdown conditions. The licensee did not provide a definition of a severe accident vulnerability. However, many enhancements were recommended as a result of the seismic reviews. A large number of plant improvements are listed in Table 6-1 of the 1997 Supplemental IPEEE Report, as well as the status of the proposed improvements. In addition, a total of 142 low-ruggedness relays are listed in Table 3-1 of the 1997 Supplemental Report for possible replacement. The licensee plans to complete resolution of all outliers by the end of 2002. This would entail either replacement of the low ruggedness relays or analysis to determine whether they need to be replaced.

With respect to fire events, the licensee provided a list of thirteen recommendations for improvement. The licensee noted, at the time of the IPEEE submittal dated December 28, 1995, that these recommendations were currently being reviewed or were in progress. Three of these recommendations involve changes to documentation (pre-fire plan and fire protection drawings). Another three recommendations involve improvements in the seismic resistance of combustible storage containers (cabinets, lockers, and drums). Other recommendations include sealing a wall to limit smoke migration, replacing open head sprinklers with a closed head design in several areas, installing fire detectors in one section of the turbine building, removing an unnecessary Unit 2 room smoke purge fan, and evaluating a water suppression system for the turbine bearings.

With respect to HFO events, the licensee recommended that station personnel study enhancements to the natural disaster procedure to provide guidance to ensure that prompt activation of the SSF is achieved following a tornado event. The licensee noted that this review should also consider the adequacy of sheltering plans of all plant personnel needed during the post-event recovery stage following a tornado event that might cause some structural damage to the plant. With respect to preventing an explosion accident from a release of combustible gases stored on site, the licensee also made two recommendations to modify the ventilation system exhaust in each letdown storage tank room and to provide guidance to operators to prevent hydrogen buildup in the upper parts of these rooms if the ventilation system becomes unavailable.

CONCLUSION

On the basis of the above findings, the staff notes that: (1) the licensee's IPEEE is complete with regard to the information requested by Supplement 4 to GL 88-20 (and associated guidance in NUREG-1407), and (2) the IPEEE results are reasonable given the Oconee design, operation, and history. This conclusion is based on the findings as presented in the attached TERs and the additional reviews conducted by the NRC staff. Therefore, the staff concludes that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities and, therefore, that the Oconee IPEEE has met the intent of Supplement 4 to GL 88-20 and the resolution of specific generic safety issues discussed in this report.

As indicated in Section II of this report, there are two issues (one issue under the Fire Risk Scoping Study and another related GSI-148) that the licensee did not appear to address fully in its submittal. The need for any additional assessment or actions related to the resolution of these issues for Oconee will be addressed by the NRC staff separately from the IPEEE program.

It should be noted that the staff focused its review primarily on the licensee's ability to examine Oconee for severe accident vulnerabilities. Although certain aspects of the IPEEE were explored in more detail than others, the review was not intended to validate the accuracy of the licensee's detailed findings (or quantification estimates) that underlie or stemmed from the examination. Therefore, this report does not constitute NRC approval or endorsement of any IPEEE material for purposes other than those associated with meeting the intent of Supplement 4 to GL 88-20 and the resolution of specific generic safety issues discussed in this report.

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS

TECHNICAL EVALUATION REPORT

FOR SEISMIC ANALYSIS

Enclosure 2