March 13, 2009

LICENSEE: DUKE ENERGY CAROLINAS, LLC

FACILITY: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

SUBJECT: SUMMARY OF CLOSED DECEMBER 4, 2008, MEETING TO DISCUSS THE DUKE ENERGY CAROLINAS, LLC's, SEPTEMBER 26, 2008, RESPONSE TO THE U.S. NUCLEAR REGULATORY COMMISSION'S, AUGUST 15, 2008, 50.54(f) LETTER ON EXTERNAL FLOODING AT OCONEE NUCLEAR STATION (TAC NOS. MD8224, MD8225, AND MD8226)

On December 4, 2008, the U.S. Nuclear Regulatory Commission (NRC) had a closed meeting with Duke Energy Carolinas, LLC (Duke, the licensee) to allow a technical exchange between the NRC staff and the licensee's staff to discuss the licensee's September 26, 2008, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML082750106), response to the NRC's August 15, 2008, Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) letter (ADAMS Accession No. ML081640244) on external flooding at Oconee Nuclear Station. A copy of the slides presented by the NRC staff is available under (ADAMS Accession No. ML090480058). A copy of the slides presented by the licensee is available under (ADAMS Accession No. ML090480044). Enclosed is a list of the meeting attendees.

The meeting was opened with introductions of the NRC staff and licensee personnel in attendance. The meeting was closed to the public.

Melanie Galloway, Deputy Director of the Division of Risk Assessment in the Office of Nuclear Reactor Regulation, opened the meeting by stating the meeting's purpose and objectives:

(1) Provide the NRC staff an opportunity to discuss specific technical concerns, as introduced at the November 5, 2008, meeting, about the licensee's proposed analyses,

(2) Provide the licensee an opportunity to address NRC staff's concerns and provide technical details on the analytical approach outlined in its September 26, 2008, response to the 50.54(f) letter and the previous November 5, 2008, meeting between the NRC staff and the licensee, and

(3) Reach alignment with the licensee on a path forward.

Specifically, Ms. Galloway noted that the NRC expressed concerns, at the November 5, 2008, meeting, that the licensee's assessment of the breach parameters used appeared to be

non-conservative, that the probabilistic approach did not appear to provide a success path, and that conclusions regarding non-credible seismic failure and overtopping did not to be appear supported. Ms Galloway also reiterated the timeframe for resolution conveyed at the November 5, 2008, meeting, that is, one year for technical resolution and one year for completing further modifications to the plant, if necessary.

Issues associated with the design and construction of the Jocassee Dam, and potential on-site flooding of Oconee Nuclear Station, were discussed between the NRC staff and the licensee during the meeting, including: (1) failure modes and analyses of the Dams, generically and specifically, as they relate to the Jocassee Dam, (2) inundation analyses for the Oconee Nuclear Station, (3) seismic and civil/structural analyses for the Jocassee Dam, (4) status and content of procedures for responding to a flooding event at the Oconee Nuclear Station, and (5) status of engineered solution analyses for the resolution of the flooding issues at the Oconee Nuclear Station.

Failure Modes and Analyses of the Dams

In introducing this topic, Ms. Galloway noted that the NRC's regulatory requirements for demonstrating adequate protection against external flooding are deterministic in nature. Therefore, the licensee needs to consider dam failures, including probable maximum flood (PMF) and seismic failures, and demonstrate that the Oconee Nuclear Station site is protected from the effects of such floods. Ms. Galloway further noted that the licensee would need to demonstrate a probability of failure of the Jocassee Dam 1E-7 or less, to consider a failure to be incredible.

The licensee stated that since the Jocassee Dam was seismically designed and was constructed to high standards, upstream dam failures were not considered in determining external flood threats to the Oconee Nuclear Station site.

The NRC staff responded that if the probability of a random failure of the Jocassee Dam was 1E-7 or less, it would not have to be considered as part of Oconee's licensing basis.

The licensee presented information with respect to the core damage frequency of 1E-4 (CDF) estimate performed by the NRC staff. The licensee stated that the NRC staff's estimate does not include evaluation of individual initiating events and defense-in-depth measures that apply to each dam. The licensee further stated that the NRC staff's evaluation does not reflect current design conditions nor maintenance and operational practices that are the existing conditions at any specific site that would decrease or increase risk exposure. In the licensee's view, the NRC staff's evaluation provided no risk insights.

The licensee stated it has commissioned a risk study with Utah State University to be completed by February 2010, to determine appropriate dam failure probabilities and resulting inundation

levels. The licensee stated that it will evaluate engineered solutions, as appropriate, once realistic and reasonable design inputs are determined.

The licensee presented information that unsafe dams are those in poor material condition or with deficiencies in design or construction that leave them susceptible to failure. The licensee stated that the common reasons for unsafe dams include: (1) inadequate spillway capacity/poor gate reliability, (2) excessive seepage/piping, and (3) inadequate seismic capacity.
The licensee presented information on the design and operation of the Jocassee Dam's spillways and spillway gates. The licensee stated the Jocassee Dam spillway gates are designed similarly to most industry radial gates; they are not unique. The Keowee Dam's 4 spillway gates are identical to the Jocassee Dam's spillway gates and have been used to pass several flood events. The licensee described the maintenance and testing of the spillway gates, as well as other components of the dam as required by the Federal Energy Regulatory Commission (FERC). The NRC staff questioned whether the licensee inspects for cracks. The licensee responded that visual inspections are performed and none have been found.

The licensee indicated that risk assessment tools should be used by the dam safety community to consider both the potential failure modes and the relative quality of the design, maintenance, and operation of a dam in quantifying its failure probability. The NRC staff presented preliminary results of its independent evaluation showing that the random failure probability for rock-fill dams including Jocassee Dam was in the range of 1E-4 – 1E-5. The NRC staff and the licensee discussed the evaluation, specifically about the population of dam failures that were included in the NRC staff's evaluation, but did reach consensus on the population of failures that should be included in the evaluation.

The NRC staff raised concerns with the licensee's plan to perform a probabilistic risk study to eliminate random failures of the Jocassee Dam. The NRC staff noted it was unlikely that the study could prove random failure probability of the Jocassee Dam is less than 1E-7.

Inundation Analyses for the Oconee Nuclear Station Site

During the meeting, the licensee presented the following information concerning the new inundation study it will be performing for a random failure of the Jocassee Dam:

(1) The HEC-RAS model will be used instead of the 1992 Dam Break (DAMBRK) Inundation model that the licensee ran for FERC.

(2) The new model will be from Jocassee Dam to Lake Hartwell, sufficiently below the Keowee Dam so that the sensitivity of the Keowee Tailrace is insignificant.

(3) The HEC-RAS model will have many more cross sections between Jocassee and Keowee Dams than the original model, providing more definition to the topography.

(4) The HEC-RAS model will have more cross sections between the Keowee Dam and the control point than the original model, providing more downstream topographic detail.

(5) Large tributaries along Keowee and the Little River arm of Lake Keowee will be modeled as storage areas, unlike the original model.

(6) The model will use the same breach sizes as the 1992 study for both Jocassee and Keowee Dams.

(7) The HEC-RAS model will assume Keowee Dam fails due to overtopping.

(8) The HEC-RAS model will be a random sunny day break of Jocassee Dam in order to compare the model sensitivity conversion.

During the presentation, the NRC staff raised a number of concerns with assumptions used by the licensee and as a result, requested additional information as documented later in the meeting summary. The major concerns raised by the NRC staff include:

(1) Regarding breach size, the NRC staff was concerned with the limited breaching data. The NRC staff further noted that the breaching process was not well understood and that great uncertainty exists in the breach parameters used and the resultant outflow hydrograph. The NRC staff further stated that breach parameters affect flood height at the Oconee Nuclear Station site and, the licensee should consider using breach widths of 575, 700, 800, 900 and 1100 feet in the sensitivity study.

(2) Regarding the time to failure, the NRC staff noted that the time considered may not be conservative. The NRC staff recommended dam failure times of 1, 2, 3 and 4 hours be used in the sensitivity study. The NRC staff cautioned that not considering that the Keowee Dam does not fail following failure of the Jocassee Dam may affect flood height at the Oconee Nuclear Station site.

(3) Regarding the sensitivity analysis, the NRC staff noted that the licensee's assumptions may not be conservative and further recommended larger breach sizes and earlier dam failure times be considered in the sensitivity study.

(4) Regarding the licensee's PMF calculation, the NRC staff noted that this calculation used for the current licensing basis may not be conservative.

Seismic and Civil/Structural Analyses for the Jocassee Dam

The licensee presented information on the construction and seismic design of the Jocassee Dam. The details are contained on the licensee's slides.

During the meeting, the NRC staff raised questions associated with the seismic and structural capabilities of the Jocassee Dam and as a result, requested additional information from the licensee as documented later in this meeting summary. The areas of concern include: (1) dam foundation and construction, (2) seismic hazards curves used by the licensee, (3) potential for liquefaction under the Jocassee Dam, and (4) seepage and settlement of the Jocassee Dam.

Status and Content of Procedures in Response to External Flooding at the Oconee Site

During the meeting, the licensee discussed creating interim guidance to address mitigation of postulated flood events that could render the standby shutdown facility (SSF) inoperable.

Status of Engineered Solution Analyses for the Resolution of the Flooding Issues at the Oconee Nuclear Station Site

During the meeting, the licensee provided a proposed schedule for the completion of regulatory commitments associated with the protection of the Oconee Nuclear Station site from external flooding events.

NRC Staff's Requests for Additional Information

Based on the discussion with the licensee during the meeting, the NRC staff made the following requests for additional information from the licensee:

(1) What is the actual height of the Jocassee Dam from the foundation, given that approximately a 100-foot depth of saprolite was excavated from the foundation?

(2) What percentage of the length of the Jocassee Dam is not located on sound rock, and where is this area located?

(3) What is the basis for the PMF inflow hydrograph? Does the selection of the hydrograph consider antecedent rainfall and the soil saturation that could occur during that rainfall? The infiltration rate assumed appears to be high (i.e., the runoff rate is too low).

(4) The licensee should reconsider the assumption that Keowee Dam fails due to overtopping following the failure of Jocassee Dam. Provide the results of the new inundation study for the worst case flooding of the Oconee, yard, considering the Keowee Dam fails and does not fail following failure of the Jocassee Dam.

(5) The licensee should consider Jocassee Dam failure breach sizes up to an average breach width of 1100 feet, if seismic failures are not discounted. The breach sizes considered in the 1983 and 1992 inundation studies, respectively, appear to be not conservative. Provide a sensitivity study on breach sizes and resulting inundation levels.

(6) The seismic hazard curve assumed in the Applied Research and Engineering Sciences (ARES) Corporation fragility report appears not to be conservative and not current with recent United States Geological Survey curves. Provide a justification for the use of the curve.

(7) What is the composition of the random rock fill that comprises a large portion of the shell? What is the density of this fill? How was this fill compacted? Are there records on the density tests that were completed? Provide the results of the seismically-induced liquefaction potential evaluation of the materials constituting the Jocassee Dam.

(8) Describe in more detail the construction and preparation of the foundation of the main Jocassee Dam.

(9) What are the thresholds values governing the monitoring of seepage and observation wells at the Jocassee Dam that would cause additional review and analysis and/or action?

(10) What were the magnitudes of the settlement prior to the 1992 baseline at the Jocassee Dam? What is the threshold value related to the monitoring of settlement of the Jocassee Dam that would cause additional review and analysis and/or action?

(11) Why is the horizontal displacement greater for the monuments located on the crest, than at the monument located at lower elevations of the Jocassee Dam?

(12) Describe why a failure of the saddle dikes would not cause flooding in the Oconee Nuclear Station yard.

(13) Describe the degree of saturation of the core and its potential affect on liquefaction, in light of the un-conservative seismic hazard curve, noted in item 6 (above).

(14) Provide, if available, an inflow flood frequency analysis for the Jocassee Reservoir.

(15) Provide storage curves for the Jocassee Reservoir.

(16) Determine the amount of sediment accumulated in the Keowee Reservoir and its potential to affect HEC-RAS calculated inundation levels.

(17) The outflow volume provided in the 1992 inundation study appears to be too low. Provide a justification for this magnitude of outflow.

(18) Provide a copy of a cross section of the Bad Creek Dam.

The licensee requested the NRC provide a listing of the 34 dam failures used in the NRC staff's probabilistic risk assessment analysis.

At the conclusion of the meeting, the NRC staff and the licensee agreed to hold biweekly phone conversations on the status of the completion of the requested above information.

Sincerely,

/RA/

John Stang, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Enclosure:
Meeting Attendees

At the conclusion of the meeting, the NRC staff and the licensee agreed to hold biweekly phone conversations on the status of the completion of the requested above information.

Sincerely,

/RA/

John Stang, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Enclosure:
Meeting Attendees

DISTRIBUTION:

NON-PUBLIC	RidsNrrPMJStang Resource	R. Pichumani, NRR	RidsNrrDss Resource
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R. Carroll, DRP	RidsRgn2MailCenterResource	RidsNrrDorlLpl2-1 Resource	K. Manoly, NRR
RidsNrrLAMO'Brien	RidsNrrAdes Resource	J. Vail, NRR	M. Franovich, NRR
RidsNrrDorl Resource	ResourceRidsAcrsAcnw_	S. Campbell, EDO Region II	M. Galloway, NRR
K. See, NRO	D. Skeen, NRR	R. Schaaf, NRO	G. Bagchi, NRO
E. Riggs, Region II	RidsNrrDpr Resource	C. Tucci, NRR	RidsOgcRp

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OFFICIAL AGENCY RECORD

MEETING ATTENDEES AT THE CLOSED DECEMBER 4, 2008, MEETING WITH DUKE ENERGY CAROLINAS, LLC (DUKE) TO DISCUSS THE LICENSEE'S SEPTEMBER 26, 2008, RESPONSE TO THE NUCLEAR REGULATORY COMMISSION'S, AUGUST 15, 2008, 50.54(f) LETTER ON EXTERNAL FLOODING AT THE OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

NRC	DUKE
K. See	L. Kanipe
J. Stang	R. Freudenberger
D. Skeen	T. Brown
M. Galloway	E. Luttrell
R. Schaaf	R. McCoy
M. Franovich	S. Nader
G. Bagchi	G. Davenport
L. Olshan	
K. Manoly	
R. Pichumani	
J. Vail	
R. Carroll*	
B. Davis*	
E. Riggs*	

*Participated by phone

Enclosure