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CNS-15-024

April 23, 2015

10 CFR 50.90

U. S. Nuclear Regulatory Commission (NRC)
Attention: Document Control Desk
Washington, D. C. 20555-0001

Subject: Duke Energy Carolinas, LLC (Duke Energy)
Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414
License Amendment Request (LAR) for Measurement Uncertainty Recapture (MUR) Power Uprate
Response to NRC Requests for Additional Information (RAIs)
(TAC Nos. MF4526 and MF4527)

References:
1. Letters from Duke Energy to NRC, dated June 23, 2014 (ADAMS Accession Number ML14176A109), August 26, 2014 (ADAMS Accession Number ML14245A059), December 15, 2014 (ADAMS Accession Number ML14353A027), and January 22, 2015 (ADAMS Accession Number ML15029A417)
2. Letters from NRC to Duke Energy, dated November 4, 2014 (ADAMS Accession Number ML14303A279), November 26, 2014 (ADAMS Accession Number ML14325A667), and February 9, 2015 (ADAMS Accession Number ML15030A460)

The Reference 1 letters submitted and supplemented a LAR for the Renewed Facility Operating Licenses (FOLs) for Catawba Nuclear Station (CNS) Units 1 and 2 NPF-35 and NPF-52 and the subject Technical Specifications (TS) to support a MUR power uprate for Catawba Unit 1. The Reference 2 letters transmitted three sets of RAI questions from the NRC associated with the LAR.

The purpose of this letter is to formally respond to the third set of RAIs. The attachment to this letter constitutes Duke Energy's response to these RAIs. The format of the attachment is to re-state each RAI question, followed by its associated response. Note that with respect to question EEEB RAI 6 in the November 26, 2014 Reference 2 letter, Duke Energy has provided information regarding our plans and schedule for resolving this issue.

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The January 22, 2015 Reference 1 letter included a compact disc (CD) containing pdf versions of Updated Final Safety Analysis Report (UFSAR) figures in response to question EEEB RAI 3. The NRC Project Manager notified Catawba that these figures were marked as proprietary; however, no request for withholding of proprietary information was included in the letter. By this letter, the following request for withholding of information is being made with respect to this CD.

The information in this CD is sensitive security-related information which Duke Energy requests to be withheld from public disclosure per 10 CFR 2.390(d)(1). Upon removal of this CD, the January 22, 2015 Reference 1 letter is uncontrolled. As per NRC Regulatory Issue Summary (RIS) 2005-026, "Control of Sensitive Unclassified Nonsafeguards Information Related to Nuclear Power Reactors", an affidavit is not required for sensitive security-related information withheld under 10 CFR 2.390(d)(1).

The conclusions of the original Regulatory Evaluation and Environmental Consideration are unaffected as a result of this RAI response.

There are no regulatory commitments contained in this letter or its attachment.

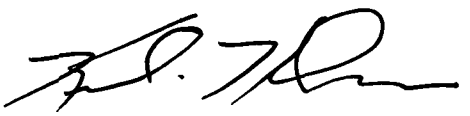
Pursuant to 10 CFR 50.91, a copy of this amendment request supplement is being sent to the designated official of the State of South Carolina.

Inquiries on this matter should be directed to L. J. Rudy of Catawba Regulatory Affairs at (803) 701-3084.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on April 23, 2015.

Very truly yours,



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LJR/s

Attachment

xc (with attachment):

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Attachment

Response to NRC Requests for Additional Information (RAIs)

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST TO SUPPORT THE

MEASUREMENT UNCERTAINTY RECAPTURE POWER UPRATE

DUKE ENERGY CAROLINAS, LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

TAC NOS. MF4328 AND MF4329

By letter dated June 23, 2014, Duke Energy Carolinas, LLC (Duke), the licensee for Catawba Nuclear Station, Units 1 and 2 (Catawba), requested a measurement uncertainty recapture (MUR) power uprate (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14176A109). The proposed revision would increase the Catawba, Unit 1, authorized core power level from 3411 megawatts thermal (MWt) to 3469 MWt, an increase of 1. 7 percent rated thermal power.

Based on the review of the amendment request, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that additional information is required regarding the MUR power up rate.

Reactor Systems Branch (SRXB) - RAI 8

The RAPTOR3G code used to calculate fluence for MUR conditions does not appear to be approved by the NRC for use in this scenario. The NRC staff requests that the licensee provide justification for the use of RAPTOR3G for fluence calculations for MUR conditions, or provide an alternative fluence calculation using an NRC approved method.

Duke Energy Response:

Refer to the enclosed document WCAP-17993-NP, Revision 0-B, "Justification for the Use of RAPTOR-M3G for the Catawba Unit 1 Measurement Uncertainty Recapture (MUR) Power Uprate Fluence Evaluations", dated April 2015, for the requested justification for the use of RAPTOR3G for fluence calculations for MUR conditions. This document is enclosed at the end of this RAI response package. In addition, Catawba has contracted for an alternative fluence calculation using an NRC approved method (TORT code). The schedule for completion of this alternative calculation is January 2016.

SRXB - RAI 9

In response to SRXB- RAI 1, Duke indicated that it was Catawba's "intention" to directly trend different measurements of plant power. Please clarify the use of the word intention.

Duke Energy Response:

Catawba's original response to SRXB - RAI 1 was stated as follows:

"Cameron document ML205 describes a methodology for identifying drift in baseline differences (biases) between independent parameters with a known relationship to feedwater mass flow rate. The ML205 method calculates a best-estimate feedwater mass flow rate by summing weighted diverse measurements. The difference between each diverse measurement and the best-estimate is then trended.

Catawba's intention is to directly trend different measurements of plant power. This is considered to be equivalent to the ML205 method and allows direct comparison with additional diverse parameters (e.g., reactor coolant system delta-T and megawatt indicators). Also, comparison trending between venturi delta-P flow measurements and LEFM flow measurements will also be performed. Trend monitoring is not required to validate the LEFM calorimetric uncertainty; however, it is a prudent step that will be taken to further reduce the unlikely possibility of an overpower event."

This response is being revised to state as follows:

"Cameron document ML205 describes a methodology for identifying drift in baseline differences (biases) between independent parameters with a known relationship to feedwater mass flow rate. The ML205 method calculates a best-estimate feedwater mass flow rate by summing weighted diverse measurements. The difference between each diverse measurement and the best-estimate is then trended.

Catawba will directly trend different measurements of plant power. This is considered to be equivalent to the ML205 method and allows direct comparison with additional diverse parameters (e.g., reactor coolant system delta-T and megawatt indicators). Also, comparison trending between venturi delta-P flow measurements and LEFM flow measurements will also be performed. Trend monitoring is not required to validate the LEFM calorimetric uncertainty; however, it is a prudent step that will be taken to further reduce the unlikely possibility of an overpower event."

SRXB - RAI 10

Please indicate whether the Leading Edge Flow Meter transducers have been evaluated for environmental qualification with respect to the radiological environment in which they will be used.

Duke Energy Response:

The LEFM transducers are located in the Turbine Building and the Turbine Building is a mild environment with respect to radiation. Per 10 CFR 50.49, mild environment equipment is excluded from the requirements for Environmental Qualification. Therefore the LEFM transducers are not applicable to the Duke Energy EQ program due to being located in a mild environment.

Steam Generator and Chemical Engineering Branch (ESGB) - RAI 3

Describe the evaluations performed to assess the potential impact of the power uprate on steam generator (SG) tube vibration response and consequential wear degradation (wear at tube support locations, tube-to-tube wear) and fatigue. This should include a description of the

impact of the power uprate on average and peak thermal hydraulic parameters (e.g., gap velocities, dynamic pressures, void fractions, and steam quality) and how these were considered in assessing tube wear and fatigue performance. This should also include a discussion of whether these thermal hydraulic conditions are within the envelope of successful experience at other plants of similar design and size. "Successful experience" in this context refers to avoiding rapidly developing degradation mechanisms that cannot be successfully managed through the SG program.

Duke Energy Response:

This response applies to the Catawba Unit 1 Replacement Steam Generators (RSG) only. Calculations and evaluations were performed to assess the potential impact of the 1.7% Measurement Uncertainty Recapture (MUR) power uprate at Catawba Unit 1 on the B&W Replacement Steam Generator (RSG) tube vibration response, consequential tube wear, and fatigue.

The assessment is based on an analysis of the impact of uprated thermal hydraulic parameters on the Catawba Unit 1 RSGs, as well as an assessment of other steam generators of similar design that have successful operating experience at uprated power levels. A steam generator is considered to have successful operating experience if the tubes are not subject to a rapidly developing degradation mechanism that cannot be successfully managed through Catawba's steam generator program.

A three-dimensional thermal-hydraulic analysis for a 2% power uprate of the Catawba Unit 1 RSGs was completed using analytical techniques previously employed in support of other plant uprates. The codes used for the uprate analysis are the current version of the codes that were originally used to qualify the Catawba Unit 1 and McGuire Units 1 and 2 RSGs. The gap velocity and density distributions along the secondary side of selected tubes was extracted from the thermal-hydraulic output for use in the Flow Induced Vibration (FIV) analysis.

A comparison of thermal-hydraulic and FIV parameters for the Catawba Unit 1 and McGuire Units 1 and 2 RSGs at 102% power (lower RCS T-hot window case) was made to the already uprated units at 105% power. The results show that the already uprated RSG tube bundle has higher tube loadings at a higher uprated power as compared to the Catawba/McGuire RSG at 102% power. This is exemplified by the comparisons of gap velocity, dynamic pressure, void fraction, and steam quality loadings for the most critical U-bend tube in either RSG. The comparisons of maximum local void fraction and steam quality in the U-bend region are also indicative of the FIV response severity as these parameters affect gap velocities and intrinsic damping ratios for U-bend tubes. Higher void fraction or steam quality will reduce mixture density thereby increasing gap velocity while tending to reduce the overall damping ratio attributed to reduced viscous and two-phase damping components. Therefore, the FIV responses of the U-bend region of the tube bundle are expected to be higher at uprated conditions since gap velocities are higher and intrinsic damping is reduced with respect to 100% power operation.

An FIV analysis was completed for the secondary side velocities and densities that would be experienced in both a clean (start-up) and fouled RSG. For a fouled steam

generator, the circulation through the tube bundle is reduced and the velocities are adjusted by prorating the velocities and densities from the start-up condition analysis.

The FIV analysis for the Catawba Unit 1 and McGuire Unit 1 and 2 RSGs at uprated conditions was completed using an FIV computer program Version 3.3, which is an updated version of the same program that was used to perform the original FIV analysis of the RSGs.

Three FIV mechanisms were investigated for the tubes in the Catawba Unit 1 RSGs:

- Fluid Elastic Instability (FEI)
- Random Turbulence Excitation (RTE)
- Vortex Shedding (VS)

The results of the FIV analysis met the acceptance criteria, confirming that neither FEI nor excessive RTE vibration leading to detrimental tube wear are predicted.

Fatigue evaluation of the tubes was performed for uprated conditions using the primary and secondary stresses in the tubes from all ASME Code Level A and B transients. FIV stresses, originating from RTE, were added to the Level A/B alternating stress range to determine the tube fatigue usage factor. The resulting fatigue usage factor for U-tubes is less than the allowable limit.

The uprate operating conditions of the Catawba Unit 1 RSGs will be the same as those in the McGuire Units 1 and 2 RSGs and are bounded by the uprate operating conditions in the already uprated unit RSGs.

The already uprated units of similar design RSGs have been operating successfully at uprated power (5% uprate) since May of 2001 and October of 2001, respectively. Numerous inspections have been performed on these RSGs and no instance of a rapidly developing degradation mechanism has been reported. Furthermore, already uprated unit RSGs began operation at a further 1.63% MUR power uprate in February of 2014 and they appear to be operating successfully.

The RSGs at McGuire Units 1 and 2 have also been operating at uprated power (1.7%) since November of 2014 and November of 2013, respectively. They appear to be operating successfully. However, since uprate, they have not yet been subject to inspection.

In conclusion, based on the thermal-hydraulic, FIV, and structural analyses performed for the Catawba Unit 1 RSGs at uprated condition, as well as the successful operating experience at McGuire Units 1 and 2 and already uprated units' RSGs of similar design, it is reasonably expected that the inservice tubes in the Catawba Unit 1 RSGs will not experience a rapidly developing degradation mechanism that cannot be successfully managed through Catawba's steam generator program.

Additional Information Regarding Electrical Engineering Branch (EEEB) – RAI 6 and EEEB – RAI 7

In Duke Energy's January 22, 2015 letter, the following was stated with respect to the response to EEEB – RAI 6:

"Duke Energy is still evaluating the issues associated with Radiation Zones 30 and 45 (LAR Commitments 11 and 12, respectively). Duke Energy will inform the NRC Project Manager regarding the expected response date for this issue once the work scope necessary to complete this portion of the response has been determined."

The following information details the current work scope associated with this issue:

In followup reviews associated with LAR Commitments 11 and 12, Duke Energy has continued evaluations of the radiological dose values associated with Radiation Zones 30 and 45 in the Auxiliary Building. This evaluation has recently identified existing legacy dose shielding discrepancies with several Annulus penetrations located at different elevations in the Auxiliary Building. Due to the potential increase in the calculated dose levels in these areas, Catawba Condition Report (CR) C-15-00304 was entered into the Corrective Action Program.

The initial evaluation of CR C-15-00304 prompted entry into the Operability Determination Process for equipment in the Electrical Penetration and 4 KV Switchgear Rooms on Elevations 560' and 577' and the Electrical Penetration Rooms on Elevation 594' for both Unit 1 and Unit 2. In total, seventeen (17) penetrations were identified with insufficient lead shielding, with eleven (11) on Unit 1 and six (6) on Unit 2. This resulted in elevated dose values calculated for the identified areas which were higher than those currently listed in the Catawba Equipment Qualification Criteria Manual (EQCM). Locations on Elevation 560' were existing EQ HARSH zones due to the overall Total Integrated Dose (TID) with identified EQ equipment. Locations on Elevations 577' and 594' were existing EQ MILD zones that were projected to transition to EQ HARSH dose levels due to this issue. The operability evaluation for all identified locations resulted in a determination of Operable But Degraded/Non-Conforming for the equipment with respect to the Duke Energy EQ Program in CR C-15-00304. Followup corrective actions have been generated in CR C-15-00304 and will be tracked under the Corrective Action Program.

Based on the revised dose calculations and equipment evaluations, Catawba is pursuing the re-establishment of the appropriate lead shielding in the identified Annulus penetrations to restore the dose levels in the locations to values consistent with those currently listed in the Catawba EQCM. These corrective actions will resolve LAR Commitments 11 and 12 and the equipment qualification items associated with EEEB – RAI 6 and EEEB – RAI 7. The work to correct the shielding of the Annulus penetrations on Unit 1 will be completed in the Unit 1 Fall 2015 Refueling Outage. With respect to the MUR Power Uprate project, Unit 1 is the only unit being uprated. The Unit 2 Annulus penetrations will also be corrected, but the Unit 2 locations do not have any impact on the MUR Power Uprate project.