

December 6, 2007

Mr. Bruce H. Hamilton
Vice President, Oconee Site
Duke Power Company LLC
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3, - RESPONSE TO
GENERIC LETTER 96-06 "ASSURANCE OF EQUIPMENT OPERABILITY AND
CONTAINMENT INTEGRITY DURING DESIGN-BASIS ACCIDENT
CONDITIONS" (TAC NOS. M96840, M96841, and M96842)

Dear Mr. Hamilton:

On September 30, 1996, the U. S. Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," (Agencywide Documents Access and Management System (ADAMS) Accession No. 9609250096). In GL 96-06, the NRC staff expressed concerns that cooling water systems serving the containment air coolers may (1) be exposed to the hydrodynamic effects of waterhammer during either a loss-of-coolant accident or a main steam line break or (2) experience two-phase flow conditions during these postulated accidents. The NRC staff also expressed concern that thermally-induced overpressurization of isolated water-filled piping sections in containment could jeopardize the ability of accident mitigating systems to perform their safety functions and could also lead to a breach of containment integrity via bypass leakage. The NRC staff requested that the licensees assess these concerns, take certain actions as appropriate, and provide certain information to the NRC staff within specified times.

Duke Energy, the licensee for Oconee Nuclear Station Units 1, 2, and 3 (ONS) provided responses to GL 96-06 in letters dated October 29, 1996 (Accession No. 9611040090), January 28, 1997 (Accession No. 9702110158), April 15, 1997 (Accession No. 9704210201), June 30, 1997 (Accession No. 9707090108), August 1, 1997 (Accession No. 9708070324), May 28, 1998 (Accession No. 9806020059), September 22, 1998 (Accession No. 9809290222), December 17, 1998 (Accession No. 9812240142), March 23, 1999 (Accession No. 9903300338), December 15, 1999 (ADAMS Accession No. ML993610085), July 26, 2002 (ADAMS Accession No. ML022190445), September 30, 2002 (ADAMS Accession No. ML022820013), March 24, 2003 (ADAMS Accession No. ML030920448), September 29, 2003 (ADAMS Accession No. ML032810326), May 10, 2006 (ADAMS Accession No. ML061380548), and February 14, 2007 (ADAMS Accession No. ML070610328).

During the course of evaluating the GL 96-06 waterhammer issue, the licensee also submitted Licensee Event Report (LER) 97-002 reporting waterhammer vulnerabilities that were identified. Revision 2 of the LER, dated September 14, 1998, was the final update.

Waterhammer and Two-Phase Flow

Subsequent to the issuance of GL 96-06, the Electric Power Research Institute (EPRI) developed an analytical methodology for evaluating the consequences of GL 96-06 waterhammer events as documented in EPRI Technical Reports 1003098 and 1006456 (previously EPRI Report TR-113594). The EPRI methodology was approved by the NRC in a safety evaluation dated April 3, 2002, and is included as an Appendix of the EPRI Technical Reports. Section 3.3 of the staff's safety evaluation identified additional information that licensees who choose to use the EPRI methodology were required to provide in order to: a) confirm that the EPRI methodology was properly applied and that plant-specific risk considerations were consistent with the EPRI risk perspective, b) justify any proposed exceptions to the EPRI methodology, and c) address the GL 96-06 two-phase flow issue.

The licensee indicated in letters dated May 28, 1998, March 23, 1999 and December 15, 1999, that further action to address the waterhammer and two-phase flow issues would be deferred pending completion of the EPRI initiative (referred to above). Upon completion of the EPRI initiative and as requested by NRC letter dated May 2, 2002 (ADAMS Accession No. ML0211906450), the licensee provided additional information related to using the EPRI methodology in letters dated September 30, 2002, and March 24, 2003. Based on the results of the waterhammer analyses that were completed, the licensee determined that two modifications to the low pressure service water system for ONS were warranted in order to resolve the waterhammer vulnerabilities that exist. The first modification would prevent drainage of the reactor building cooling units (RBCUs) and the reactor coolant pump (RCP) bearing oil and motor air coolers supply and discharge lines and the second modification would physically separate in containment the reactor building auxiliary cooling unit (RBACU) lines and coolers from the RBCU lines and coolers. The specific details associated with these modifications were discussed in Attachment 1 of the September 30, 2002, letter and implementation schedules were discussed in letters dated September 29, 2003, May 10, 2006, and February 14, 2007. In the May 10, 2006, letter the licensee determined that NRC review and approval was required before the drain down prevention modification could be implemented and that additional time would be required in order to allow for preparation and NRC approval of a license amendment request. The most recent letter indicated that the modifications associated with the RBACUs have been completed, and established a commitment to complete the remaining (drain down prevention) modification during the Fall 2008, Spring 2009, and Fall 2009 outages for ONS. The licensee also indicated in the September 29, 2003, letter that more detailed thermal-hydraulic analyses are being developed to ensure final resolution of the waterhammer concerns.

In addition to the waterhammer analysis that was completed, the licensee also completed a risk assessment and addressed the GL 96-06 two-phase flow issue thereby satisfying the conditions that were stipulated by the NRC for using the EPRI methodology. The plant-specific risk assessment was discussed in the licensee's September 30, 2002, and March 24, 2003, letters. The additional information requested by the NRC staff in a letter dated June 17, 1998, (Accession No. ML9806180264) for addressing the two-phase flow issue was provided in Enclosure A of the licensee's March 24, 2003, letter.

While the licensee's waterhammer evaluation was not entirely consistent with the EPRI methodology (primarily due to nonconservative closure velocity assumptions), the information that was provided in the September 30, 2002, and March 24, 2003, letters indicates that these

analyses were performed to support continued plant operation pending the implementation of plant modifications that would either prevent or significantly reduce the severity of GL 96-06 waterhammer events. In light of the risk considerations that were discussed, the licensee felt that the analyses were adequate to support interim operation while plant modifications were being completed. The NRC staff agrees that the licensee's resolution of the GL 96-06 waterhammer issue is acceptable in the interim, recognizing that: the modifications to separate the RBACUs have been completed on all three Oconee units; the licensee has established a firm commitment to complete the remaining (drain down prevention) modifications in accordance with the schedule provided in the February 14, 2007, letter; and a license amendment request (ADAMS Accession No. ML072920449) has been submitted by the licensee in order to implement the plant modifications that remain to be completed.

The licensee discussed the risk considerations that are partially credited for using the EPRI methodology in the September 30, 2002, and March 24, 2003, letters. In particular, it is the NRC staff's understanding that the licensee did not identify any inconsistencies between the plant specific risk assessment that was performed for ONS and the one that was completed by EPRI. However, the staff notes that the licensee indicated that the pipe failure probability is most likely less than the EPRI value of $1.0E-2$ based on plant-specific column closure waterhammer testing that has been completed. The NRC staff considers the licensee's risk assessment to be acceptable.

The licensee addressed the GL 96-06 two-phase flow considerations in letters dated January 28, 1997, and March 24, 2003. The licensee's analyses appeared to address primarily heat transfer considerations, but did not address fatigue and erosion concerns relative to those areas that experience two-phase flow. Because erosion and fatigue are longer term effects, the NRC staff considers the licensee's response to be acceptable in the interim pending completion of the plant modifications that remain for resolving the GL 96-06 waterhammer issue (referred to above).

Based on a review of the information that was provided and as discussed above, the NRC staff is satisfied that the licensee has adequately addressed the GL 96-06 waterhammer and two-phase flow issues for ONS for continued interim operation pending implementation of the remaining (drain down prevention) plant modifications that must be completed. This conclusion was reached recognizing that the licensee has completed the necessary RBACU separation modifications and has established a firm commitment and schedule and has submitted a license amendment request for completing the remaining plant modifications.

While the NRC staff is satisfied with the licensee's resolution of the GL 96-06 waterhammer and two-phase flow issues in the interim while plant modifications are being completed, a detailed quantitative assessment of the licensee's waterhammer and two-phase flow analyses was not performed and a review of the licensee's use and application of computer codes for performing these analyses was not performed. Consequently, these areas could be the subject of future NRC audit or inspection activities.

Thermal Overpressurization

In letters dated January 28, April 15, and June 30, 1997, and December 17, 1998, the licensee provided responses to the issue of thermally-induced pressurization of piping runs penetrating the containment.

In its response of January 28, 1997, the licensee identified 28 piping penetrations (total for all three units) and one piping segment in the decay heat drop line of each unit which were susceptible to thermally-induced pressurization. In this submittal, the licensee also determined that all of the identified penetrations and piping segments were operable. In the December 17, 1998, response, the licensee provided the necessary long-term actions and identified several additional penetrations that were susceptible to thermally-induced pressurization. For all three units, the licensee identified a total of 36 penetrations that required installation of a relief valve, 6 penetrations that required installation of leak off lines with check valves, 4 penetrations that were required to be cut, capped, and abandoned, and 3 penetrations that were required to have administrative controls to drain the lines prior to power operation. For the three decay heat drop lines, the licensee identified that administrative controls were required to partially drain the lines prior to power operation. The licensee's evaluation determined that all other piping segments penetrating containment were not susceptible to thermally-induced pressurization.

Based on this information, the NRC staff has concluded that the licensee has provided an acceptable resolution for the issue of thermally-induced pressurization of piping runs penetrating the containment for ONS.

Conclusion

Based on the information discussed above, and the licensee's License Amendment Request for Low Pressure Service Water Reactor Building Waterhammer Prevention System Modification to Mitigate Waterhammers Described in Generic Letter 96-06 and Associated Technical Specifications, submitted on October 16, 2007 (ADAMS Accession No. ML072920449), the NRC staff considers your response to GL 96-06 to be complete, subject to future NRC inspection activities as indicated above.

This completes our activity on TAC Nos. M96840, M96841, and M96842. If you have questions regarding this letter, please contact me at (301) 415-1419.

Sincerely,

/RA/

Leonard Olshan, 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

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