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May 17, 2011

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC
McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370

Response to Request for Additional Information Related to Generic Letter (GL) 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems"

This letter provides the responses to the most recent request for additional information (RAI) regarding the McGuire response to GL 2008-01 dated October 13, 2008 and supplemented on February 3, 2009 and January 6, 2010. McGuire responded to the first set of GL 2008-01 RAIs on December 14, 2010. This RAI request was conveyed by the NRC staff from Jon Thompson by letter dated May 9, 2011. The NRC staff's questions and Duke Energy's responses are provided in Attachment 1.

This letter contains no regulatory commitments. Please contact Lee A. Hentz at 980-875-4187 if additional questions arise regarding these RAI responses.

Sincerely,

Regis T. Repko

Attachment

A134
NRR

cc: w/attachment

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OATH AND AFFIRMATION

Regis T. Repko affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

Regis T. Repko, Site Vice President

Subscribed and sworn to me: May 17, 2011
Date

Notary Public

My commission expires: July 1, 2012
Date

ATTACHMENT 1

REQUEST FOR ADDITIONAL INFORMATION (RAI)

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING GENERIC LETTER 2008-01. "MANAGING GAS

ACCUMULATION IN EMERGENCY CORE COOLING.

DECAY HEAT REMOVAL, AND CONTAINMENT SPRAY SYSTEMS"

MCGUIRE NUCLEAR STATION. UNITS 1 AND 2 (MCGUIRE 1 AND 2)

There have been several public meetings with Nuclear Energy Institute (NEI) and industry on the topic of GL 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems." The U.S. Nuclear Regulatory Commission (NRC) staff has continued to update its guidance to inspectors as new information becomes available; the most recent revision is Reference 2. At the June 2, 2010 public meeting (Meeting Summary at Agencywide Documents Access and Management System (ADAMS), Accession No. ML 101650201) and in Reference 3, NRC and industry agreed on various void criteria including the Froude numbers required to credit dynamic venting.

Reference 2, Section 1.4.3, states, "At $N_{FR} \leq 0.65$, some gas may be transported and if $N_{FR} \geq 2.0$, all gas will be carried out of a pipe with the flowing water. Time to clear gas from a pipe for $0.8 < N_{FR} < 2.0$ is a function of flow rate. Dynamic venting may not be assumed effective for $N_{FR} < 0.8$. Time to clear gas as a function of time will be addressed in a later revision of this document when we have received and evaluated test data that supports clearance behavior .... "

Reference 1 states, " ... dynamic venting is credited (Froude number of > 0.55 for horizontal piping runs and >1.0 for vertical piping runs)."

The NRC staff has the following questions:

1. **Please provide justification for crediting dynamic venting with Froude numbers between 0.55 and 0.8.**

   McGuire Response:

   The evaluations performed to respond to Generic Letter 2008-01 utilized guidance contained within Section 3.3.1 of WCAP-16631-NP, Volume 1. Specifically, the following criteria from the referenced document were utilized:

   > Since most of the available literature correlates air transport out of horizontal pipes on the basis of Froude number (N_{FR}), this is expected to be the primary correlating parameter. Based on the current state of knowledge, the following transport characteristics can be expected:

1. For $N_{FR} < 0.35$ no air will be transported downwards towards the pump suction.

2. For $N_{FR} > 0.55$ all of the air can be flushed out of a horizontal pipe into a plenum. The ability to transfer air through a piping system depends on the layout of piping downstream of the horizontal local high point. It is reasonable to expect that $N_{FR} = 0.55$ will not be sufficient to purge all of the air out of the local high point.

3. For $N_{FR} > 1.0$ all of the air will be transported downwards towards the pump suction.

4. For $0.35 < N_{FR} < 1.0$ at least a portion of the air can be expected to be discharged from the local high point.

5. The rate of air entrainment is expected to be a function of the Froude number (N_{FR}) in the horizontal pipe.

The above criteria was published prior to the October 2008 response date required by Generic Letter 2008-01. The criteria specified within Reference 2 were not issued until after the response date and completion of the required System evaluations. System evaluations consisted of determining Froude numbers that were applicable to each unique horizontal span and judged against WCAP-16631-NP criteria. For locations at which the potential for gas formation existed and the Froude number was not sufficient to ensure adequate flushing as defined in the WCAP, either a high point vent location was credited, subsequent UT verification was performed, or piping geometry was reviewed and determined to be effective for gas transport. As part of the initial licensee activities related to GL 2008-01 evaluations, confirmatory UT inspections were performed at numerous locations to evaluate the effectiveness of dynamic venting (piping was full at all locations checked during the response).

As ongoing validation, post-dynamic flush venting or routine venting/UTs are conducted at numerous points within the GL-addressed systems to verify dynamically flushed piping remains sufficiently filled.

As a result of this request for additional information, a review has been conducted of the evaluations to re-examine any locations where Froude numbers less than 0.80 were used to credit dynamic venting. These are evaluated below:

1. The intermediate-head Safety Injection (NI) System evaluation concluded that a Froude number of 0.62 was sufficient to ensure 8 inch suction piping was dynamically vented. The suction piping geometry contains both horizontal and upward vertical pipe segments. Effective dynamic venting of these piping segments (with the stated Froude number) has been demonstrated by subsequent UT validation.

2. The NI System evaluation further concluded that a Froude number of 0.62 was not adequate for the dynamic fill of the common (shared with the Residual Heat Removal (ND) low pressure injection) 8 inch hot leg discharge piping. Thus, initial fill and vent procedures were revised to perform local venting, subsequent to dynamic venting.

3. The Refueling Water (FW) System evaluation has a Froude number of 0.4 for post maintenance dynamic venting, but this dynamic vent is only a supplement to high point venting of the FW suction header. This dynamic vent would only be used as part of a maintenance restoration process, and the applicable procedure follows up with venting at the FW suction header high point, both Units.

4. The Containment Spray (NS) System evaluation concluded that a Froude number of 0.7 achieved during the NS pump comprehensive IST full flow test may not adequately vent the common 18 inch NS pump suction header; however, the header is self-venting to the 24 inch Refueling Water Storage Tank (FWST) suction header. Venting of the FWST is performed after completion of the comprehensive test.

2. Please clarify if an Ultrasonic Test (UT) is used at McGuire 1 and 2 to verify that dynamically flushed piping remains sufficiently full with respect to such areas as vertical U-tube heat exchangers and valve internal configurations where UT cannot be used if dynamic flushing involves these locations. If dynamic flushing is not used for these areas, then describe how they are determined to be sufficiently full.

McGuire Response:

UT is not used at McGuire in the above locations. The Residual Heat Removal (ND) Heat Exchangers (Hx) at McGuire Nuclear Station are vertical U-tube heat exchangers. The heat exchangers are dynamically vented in a ND system alignment that passes a flow rate of greater than 4000 gpm through each heat exchanger to the Reactor Coolant System (NC). After the Heat Exchanger has been flushed, the piping branches downstream of the ND Hx's are re-vented to remove any gas that may have accumulated in the non-flowing branch high points. Once the re-venting of downstream piping is complete, the ND Hx and ND system piping is considered sufficiently full. UT cannot be used to verify gas voids in the ND Heat Exchangers.

The likely gas intrusion mechanisms would be on-line maintenance or Cold Leg Accumulator (CLA) inleakage to the hot and cold leg headers. Routine monitoring (e.g. CLA parameters, and ND discharge header pressure) would provide means for early detection of potential gas accumulation, whereby supplemental venting actions could be implemented. Containment Spray (NS) Heat Exchanger discharge high points are now vented following quarterly NS pump tests, as part of the response to Generic Letter 2008-01.

With respect to valve internal configurations, it is concluded that the following general statements apply:

- Unventable volumes within valve bonnets are above the flow stream. Only a portion of the gas within tall bonnets such as those on gate valves can be displaced due to the lack of a direct flow path through the upper portion of the bonnet.
- For gate valves, discs in the open position reduce the available volume for gas to collect in the bonnet. Gate valves would typically be aligned open during the fill and vent of the systems. This minimizes the amount of gas that is present in the valves.
- For check valves, a large portion of the exposed volume is blocked from the flow path by the disc.
- For valves on the discharge of pumps, the gas volume will likely be compressed up into the bonnet, especially with the taller bonnets on gate valves.
- Globe, diaphragm and butterfly valves within the subject systems have negligible internal volumes subject to gas accumulation.
- Gate valves oriented horizontally (valve stems are horizontal) will tend to self vent with minimal gas accumulation in the bonnet.

REFERENCES

1 Harrall, T., "Duke Energy Carolinas, LLC (Duke); Oconee Nuclear Station, Units 1, 2 & 3, Docket Nos. 50-269, 50-270, 50-287; McGuire Nuclear Station, Units 1 & 2, Docket Nos. 50-369, 50-370; Catawba Nuclear Station, Units 1 & 2, Docket Nos. 50-413, 50-414; Generic Letter 2008-01, 9-Month Response," Letter to Document Control Desk, NRC, October 13, 2008 (ADAMS Accession No. ML082900490).

2 "Guidance To NRC/NRR/DSS/SRXB Reviewers for Writing TI Suggestions for the Region Inspections," December 6, 2010 (ADAMS Accession No. ML103400347).

3 Lyon, Warren, "Interim Clean Section 1 4 (3)," e-mail to James Riley, NEI, June 7, 2010, (ADAMS Accession No. ML102090074).