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

October 18, 2016

Mr. Steven D. Capps
Vice President
McGuire Nuclear Station
Duke Energy Carolinas, LLC
12700 Hagers Ferry Road
Huntersville, NC 28078

SUBJECT: MCGUIRE NUCLEAR STATION, UNIT 1 – PROPOSED RELIEF REQUEST SERIAL #16-MN-003 FOR ALTERNATE REPAIR OF NUCLEAR SERVICE WATER SYSTEM PIPING (CAC NO. MF8269)

Dear Mr. Capps:

By letter dated August 10, 2016, as supplemented by letter dated August 18, 2016, Duke Energy Carolinas, LLC (the licensee) submitted Relief Request (RR) Serial #16-MN-003, which requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4420. The licensee requested relief pursuant to Title 10 of the *Code of Federal Regulations* 50.55a(z)(2). The request was on the basis that compliance with the specified ASME requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety at the McGuire Nuclear Station (MNS), Unit 1, and provides an alternative for the temporary repair of degraded nuclear service water system piping.

On August 29, 2016, the U.S. Nuclear Regulatory Commission (NRC) staff verbally authorized the use of RR 16-MN-003 for the MNS, Unit 1, until the next refueling outage, which is scheduled for fall 2017. The enclosed safety evaluation documents the technical basis of the temporary verbal authorization. The NRC staff has reviewed the subject request and concludes, as set forth in the safety evaluation, that inspections performed by the licensee provide reasonable assurance of structural integrity or leak-tightness of the subject welds. Therefore, the NRC staff authorizes the proposed alternative in RR 16-MN-003 for MNS, Unit 1, until the next refueling outage, which is scheduled for fall 2017.

All other ASME Code, Section XI, requirements, for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the project managers, V. Sreenivas, at 301-415-2597 or V.Sreenivas@nrc.gov, or G. Edward Miller at 301-415-2481 or Ed.Miller@nrc.gov.

Sincerely,

Shawn Williams for

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-369

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST SERIAL #16-MN-003 FOR ALTERNATE REPAIR OF

NUCLEAR SERVICE WATER SYSTEM PIPING

MCGUIRE NUCLEAR STATION, UNIT 1

DUKE ENERGY

DOCKET NO. 50-369

1.0 INTRODUCTION

By letters dated August 10, 2016 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML16224A806), as supplemented by letter dated August 18, 2016 (ADAMS Package Accession No. ML16244A057), Duke Energy (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4420, at the McGuire Nuclear Station (MNS), Unit 1.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the alternative in Relief Request (RR) Serial #16-MN-003 on the basis that compliance with the specified ASME requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. RR 16-MN-003 provides an alternative for the temporary repair of degraded nuclear service water (NSW) system piping.

On August 29, 2016 (ADAMS Accession No. ML16244A038), the U.S. Nuclear Regulatory Commission (NRC) staff verbally authorized the use of RR 16-MN-003 for MNS, Unit 1, until the next refueling outage, which is scheduled for fall 2017. This safety evaluation documents the technical basis of the NRC staff's verbal authorization.

2.0 REGULATORY EVALUATION

The licensee requested authorization of an alternative to the requirements of ASME Code, Section XI, Article IWA-4400, pursuant to 10 CFR 50.55a(z)(2).

Section 50.55a(g)(4) of 10 CFR states, in part, that ASME Code Class 1, 2, and 3, components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

Enclosure

Section 50.55a(z) of 10 CFR states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if the licensee demonstrates that

(1) the proposed alternatives would provide an acceptable level of quality and safety or
(2) compliance with the specified requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request, and the NRC staff to grant, the relief requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

The affected NSW system ASME Class 3 components are listed below:

- The 3-inch drain piping between valve 1RN-883 and its associated 8-inch diameter header.

  This piping is a low point system drain on the supply side of the '1B' Diesel Generator Cooling Water Heat Exchanger. The associated 8-inch header ties into the 30-inch diameter '1B' Essential Supply Header.

- The 3-inch drain piping between valve 1RN-884 and its associated 8-inch diameter header.

  This piping is a low point system drain on the discharge side of the '1B' Diesel Generator Cooling Water Heat Exchanger. The associated 8-inch header ties into the 36-inch diameter '1B' Essential Discharge Header.

- Nominal Wall Thickness: 0.216 inches
  Design Pressure: 135 pounds per square inch gauge (psig)
  Design Temperature: 102 degrees Fahrenheit (°F) at 1RN-883; 150 °F at 1RN-884
  Material of Construction: Carbon Steel, SA-106, Grade B
  Internal Coatings: None

3.2 Applicable Code Edition and Addenda

The original construction code is American National Standards Institute (ANSI) B31.7, Class III, 1969 Edition, including Addenda a, b, and c. The repairs, replacements, and modifications performed under the ASME Code, Section XI, shall be made in accordance with the ASME Code, Section III, Subsection ND, 1971 Edition, with Winter 1971 Addenda. The code of record is the ASME Code, Section XI, 2007 Edition, with the 2008 Addenda.

3.3 Applicable Code Requirements

ASME Code, Section XI, IWA-4400, specifies requirements for welding, brazing, metal removal, fabrication, and installation. IWA-4420 specifies requirements for defect removal, evaluation, and examination. The licensee requested relief from the requirements of IWA-4400, which

requires that defective portions of components be removed prior to performing a repair/replacement activity by welding.

3.4 Reason for Request

MNS, Unit 1, completed a refueling outage in April 2016. On May 25, 2016, the licensee detected a weeping through-wall leak in a 3-inch NWS drain line upstream of valve 1RN-884 in the Auxiliary Feedwater Pump Room. The leak was in the carbon steel pipe directly adjacent to the toe of the weld to a stainless steel valve. The licensee ultrasonically inspected the entire length of the pipe between the header and the isolation valve. The licensee continued operating the unit based on the requirements of ASME Code Case N-513-3. The licensee found that the area of excessive thinning was located at the carbon steel to stainless steel interface indicative of galvanic corrosion. The licensee continued to inspect the affected area by ultrasonically testing (UT) monthly as part of Code Case N-513-3 requirements. The UT data dated July 18, 2016, indicated the rate of wall thinning apparently accelerated to a point where the valve and its associated piping would not remain functional until the next refueling outage.

The licensee stated, in part, in its letter dated August 10, 2016, that:

> The amount of degradation (approximately 0.001 inches per day) experienced is unforeseen and unprecedented at McGuire Nuclear Station (MNS). Based on the data collected on 7/18/2016, the corrosion rate predictions were: 1) a localized pit below the thickness for hoop stress values as soon as 15 days and 2) average wall thinning below structural stress values in 66 days. Subsequent UT measurements indicate the corrosion rate is stabilizing; however, Duke Energy believes the wall thickness margin is at risk should aggressive corrosion resume.

The licensee increased the frequency of UT thickness measurement to twice weekly to ensure any changes in corrosion rates are quickly identified.

As part of the extent of condition inspections required by Code Case N-513-3, the licensee inspected the comparable 3-inch NWS drain line upstream of valve 1RN-883. Although some thinning was noted in the original inspection, the licensee stated that the pipe associated with 1RN-883 met all code requirements. When the accelerated corrosion rate was noted at valve 1RN-884, the area at 1RN-883 was reinspected by UT examination. The licensee noted that although not as degraded as the area at 1RN-884, predicted rate of corrosion was such that 1RN-883 would not remain functional until the next refueling outage. The licensee continues to collect data at the 1RN-883 location weekly to ensure any changes in corrosion rates are quickly identified.

Based on the observed thinning behavior to date, the licensee found that it is desirable to perform repairs at both of these locations at the earliest opportunity, commensurate with plant maintenance system rotation windows. Performing these activities during a '1B' Train week allows the plant to be in the safest configuration to perform maintenance.

3.5 Proposed Alternative and Basis for Use

In lieu of the requirement of the ASME Code, Section XI, IWA-4400, to remove the defective portion of the component prior to performing repair/replacement activities by welding, the licensee proposed to use the modified "Type B" full structural sleeve repair method in ASME Code Case N-786-2 as an alternative. The exact requirements for the proposed alternative are specified in the RR and in the licensee's response to NRC staff's request for additional information dated August 18, 2016. The key requirements of the proposed alternative are summarized as follows.

General Requirements

The proposed alternative will follow all paragraphs of Section 1, "General Requirements," of N-786-2, except paragraph 1(f), which prohibits the use of a sleeve repair on valves.

The defective area shall be encapsulated with a section of split section of carbon steel (SA-106 Grade B) pipe to form a sleeve similar to a Type B configuration in Code Case N-786-2. The sleeve material shall comply with the Construction Code and owner's requirements. The lengthwise cut shall be symmetrical along the long axis to provide two pieces for clam-shell type installation.

Encapsulation of the defective or locally thinned area(s) at each location shall be performed only once.

Initial Evaluation

The proposed alternative will follow Section 2, "Initial Evaluation," of N-786-2 to perform pre-installation evaluation of degraded areas of the subject pipe. Prior to installation of a sleeve, the licensee performed ultrasonic examinations to characterize the defective and locally thinned areas and to confirm the continued absence of cracks or crack-like indications.

Design

The proposed alternative will follow Section 3, "Design," of N-786-2, except paragraphs 3.1(a), 3.1(b)(2), 3.2(h), 3.2(l), 3.2(n), 3.2(o), 3.3, 3.4(c), and 3.4(d). These paragraphs are not applicable to the proposed sleeve repair and will not be used.

The licensee ultrasonically examined the 3-inch piping near the 8-inch header, which has demonstrated that the existing pipe wall thickness is both sufficient for welding and will retain sufficient thickness for the predicted life of the repair. The licensee calculated the required wall thickness in accordance with Section 3.2(k) of Code Case N-786-2.

In addition, in lieu of the required 4-inch sleeve length in paragraph 3.2(c), the length of the proposed sleeve will be less than 4 inches. In lieu of required partial penetration welds in paragraph 3.4(e), the proposed alternative will use fillet welds at both ends of the sleeve.

The piping system will no longer rely on the encapsulated parts for structural integrity or leak-tightness.

Water-Backed Application

The proposed alternative will follow all requirements of Section 4, "Water-Backed Application," of N-786-2.

Installation

The proposed alternative will follow all requirements of Section 5, "Installation," of N-786-2. In addition, the licensee proposed the following:

- A coupling shall be shop welded to one side of the sleeve to allow for purging of any weld gasses and leak testing in accordance with IWA-4540.

- Backing strips may be utilized along the longitudinal welds to prevent burn-through. If required, sleeves will be machined to allow for backing material as shown in Code Case N-786-2.

- The longitudinal welds shall be full penetration on both sides and shall be performed prior to performing circumferential welds.

- Appropriate gasket material or sealant may be used between sleeve and base piping to prevent welding on wet surfaces. Any residual moisture shall then be removed by heating prior to welding.

- Welds of carbon steel to carbon steel components shall be performed with ER70S-2/E7018-H4R.

- Welds between carbon steel and stainless steel components shall be performed with ER309L/E309L-16.

Following completion of system leakage testing, appropriate sealant compatible for use with raw water will be injected. Upon completion of sealant injection, a cap shall be installed in the coupling and shall be seal welded.

Acceptance Examination

The proposed alternative will follow all requirements of Section 6, "Examination," of N-786-2, except paragraph 6(b), which is not applicable. In addition, in lieu of paragraphs 6(d) and 6(e), the licensee will visually and ultrasonically examine longitudinal welds. The licensee will also examine the fillet welds visually and by the liquid penetrant method.

Pressure Testing

The proposed alternative will follow all requirements of Section 7, "Pressure Testing," of N-786-2.

Inservice Examination

The proposed alternative will take exceptions and propose modifications to the requirements of Section 8, "Inservice Examination," of N-786-2. In its August 18, 2016, letter, the licensee stated that it will visually monitor the repaired pipe daily during operator rounds and perform UT at least once every 2 weeks.

3.6 Hardship Justification

The licensee stated that removal of defective portions of the subject piping would require isolation of the supply and return essential headers, which would remove a complete train of safety-related equipment from service (including its associated emergency diesel generator), resulting in a high probabilistic risk configuration affecting multiple accident scenarios. Compensatory measures required for the mitigation of all of the impacted scenarios would be a significant burden.

The licensee believes that it would be a challenge to isolate the supply and return '1B' essential headers, complete the required repairs, and return the affected train to service within the limits of Technical Specification 3.7.7, "Nuclear Service Water System (NSWS)," Condition A.

The licensee noted that installation of a mechanical line stop in the 3-inch piping to isolate the affected components is not possible since there is only approximately 3-inches of pipe length between the 8-inch pipe and the valves in both configurations.

According to the licensee, installation of mechanical line stops in the 8 inch piping is not practical due to various interferences with other structures and components. This is also not desirable because this activity could result in metal shavings or the removed portion of the pipe wall dislodging, entering the system, and becoming debris that could hinder system operation and make it difficult to retrieve the loose material.

Installation of mechanical line stops in the 30 and 36 inch piping to isolate the affected components might be possible. However, the licensee believes that it would be a challenge to perform these modifications, perform the temporary repair, and return the affected train to service within the limits of Technical Specification 3.7.7, Condition A. Additionally, it is not desirable because this activity could result in metal shavings or the removed portion of the pipe wall dislodging, entering the system, and becoming debris that could hinder system operation and make it difficult to retrieve the loose material.

Use of a freeze seal to isolate the 3-inch pipe is not possible due to the short length of drain piping, and use of a freeze seal to isolate the 8-inch pipe is not practical due to the pipe location where significant quantities of gas storage cylinders would be required to be maintained.

3.7 Duration of Proposed Alternative

The proposed alternative is requested until the next Unit 1 refueling outage in fall 2017 (designated as 1EOC25).

4.0 NRC Staff Evaluation

The NRC staff evaluated the proposed alternative in terms of the following aspects of the repair: general requirements, initial evaluation, design, water-backed application, installation, acceptance examination, pressure testing, and inservice examination. The NRC staff concludes that the licensee can use the requirements of N-786-2 as part of its proposed alternative as permitted under 10 CFR 50.55a(z)(2), even though the NRC has not approved N-786-2. The NRC staff evaluated the proposed alternative as follows.

General Requirements

The NRC staff notes that the proposed alternative will follow paragraphs 1(a) and 1(b) of N-786-2, which require that the reinforcing sleeve be installed in accordance with a repair/replacement plan satisfying the requirements of ASME Code, Section XI, IWA-4150. The design, materials, and installation shall meet the requirements of the Construction Code and IWA-4000, except as stated in the Code case.

The licensee also stated in its August 10, 2016, letter that:

> The defective area [of the pipe] shall be encapsulated with a section of split section of carbon steel (SA-106 Grade B) pipe to form a sleeve similar to a Type B configuration in Code Case N-786-2. The sleeve material shall comply with the Construction Code and Owner's requirements.

The NRC staff finds it acceptable that the design and installation of the sleeve are performed in accordance with the Construction Code and ASME Code, Section XI.

The licensee stated that the wall thinning is occurring in the pipe, not on the valve. The sleeve will repair the pipe and only extends onto the valve body to the extent necessary to create a fully qualified structural weld. The new sleeve is a full structural replacement of the thinned pipe, not a repair to the valve. The NRC staff finds that although the proposed sleeve will be extended onto the valve body, the extension is not to repair the valve but to facilitate the welding. Therefore, the NRC staff finds it acceptable that the proposed alternative takes exception to paragraph 1(f), which prohibits the use of a sleeve repair on valves.

The NRC staff noted that encapsulation of the defective or locally thinned area(s) at each pipe location will be performed only once. The NRC staff finds this limitation acceptable because it will prohibit the re-use of sleeve repairing the same defective area more than once.

Initial Evaluation

The licensee has performed UT of the 3-inch piping near the 8-inch header and demonstrated that the existing pipe wall thickness is both sufficient for welding and will retain sufficient thickness for the predicted life of the repair. In addition, the licensee has performed the necessary extent of condition inspections of NSW system piping prior to sleeve installation. The NRC staff finds that the licensee has performed the required pre-installation examinations, including the extent of condition inspections. Therefore, the licensee has satisfied the initial evaluation requirements.

Design

The NRC staff finds that paragraphs 3.1(a), 3.1(b)(2), 3.2(h), 3.2(l), 3.2(n) to (o), 3.3, 3.4(d), and 3.4(d) of N-786-2 are not applicable to the proposed alternative. Therefore, it is acceptable that the licensee will not use these paragraphs.

The licensee stated that it cannot meet the 4-inch requirement of paragraph 3.2(c) of N-786-2 because the physical configuration of the pipe branch is only 3.6875 inches long. The NRC staff finds it acceptable that the proposed sleeve is less than 4 inches. The affected piping is a short cantilevered configuration and, as such, has low stresses for all design loadings (i.e., deadweight, thermal expansion, and seismic). The licensee stated that there are no vibrational issues associated with this piping, and the relatively low design pressure (135 psig) results in low pressure stresses. The licensee stated that its analysis has demonstrated the pipe stresses to be low in the repaired area and the sleeve to be structurally adequate.

In lieu of partial penetration welds required in paragraph 3.4(e), the proposed alternative will use fillet welds at both ends of the sleeve. The configuration of the piping and the proposed alternative does not allow room for a partial penetration weld between the end of the sleeve and the pipe being encapsulated. The licensee stated that the sleeve meets the valve body such that a fillet weld is possible at this location. The location is on structurally sound valve body material. The licensee believes the use of a partial penetration weld as required in Section 3.4(e) of Code Case N-786-2 might add significant heat to the area that might damage the integrity of the valve and seal material. The licensee stated that analysis shows the loading conditions at this location are sufficiently low such that fillet welds will provide adequate structural integrity to withstand all design piping loads.

Based on the above evaluation, the NRC staff finds it acceptable that the proposed alternative modifies the requirements of paragraphs 3.2(c) and 3.4(e).

The NRC staff finds that after sleeve installation, the piping system will no longer rely on the original pipe for structural integrity or leak-tightness. The NRC staff finds that the sleeve is capable of supporting the operating loads because the sleeve is designed in accordance with the Construction Code and ASME Code, Section XI, and paragraph 3.2(k) of N-786-2.

The NRC staff finds that the design of the sleeve is acceptable because (1) it follows the Construction Code and the ASME Code, Section XI, IWA-4000, and (2) the sleeve will support the necessary loadings.

Water-Backed Application

The NRC staff finds that the proposed alternative will follow all requirements of Section 4 of N-786-2 and will implement necessary precaution in welding the sleeve to water-backed pipe to minimize cracking in the welds. Therefore, the proposed water-backed application procedures are acceptable.

Installation

The NRC staff notes that the proposed alternative will follow all requirements of Section 5 of N-786-2. In addition, the NRC staff finds that the licensee's proposed alternative includes certain procedures beyond the requirements in Section 5 of N-786-2, such as using backing strips while applying the longitudinal welds to install the sleeve. This minimizes damage to the pipe base metal while welding the sleeve.

The NRC staff finds that proposed installation considers necessary procedures to minimize weld cracking and damage to the subject pipe; therefore, the proposed installation requirements are acceptable.

Acceptance Examination

After the sleeve is installed, the licensee will (1) visually and liquid penetrant examine the fillet welds, (2) visually and ultrasonically examine the longitudinal welds, and (3) perform a baseline UT inspection of the sleeve for thickness monitoring. The examination results will satisfy either the Construction Code or the ASME Code, Section III. The NRC staff finds the proposed acceptance examination acceptable because (1) the examination includes visual testing, ultrasonic testing, and liquid penetrant testing methods; and (2) the acceptance criteria are based on the Construction Code or the ASME Code, Section III.

Pressure Testing

The licensee will perform a system leakage test of repaired pipe in accordance with the ASME Code, Section XI, IWA-5000, prior to, or as part of, returning to service. This is consistent with the requirements of repair/replacement activities in accordance with ASME Code, Section XI, IWA-4000. The NRC staff finds this acceptable.

Inservice Examination

In its August 18, 2016, letter, the licensee stated that for inservice examination, it will visually monitor the repaired pipe daily during operator rounds and perform ultrasonic testing at least once every 2 weeks. The NRC staff finds that the proposed inservice examination regiment is more frequent and, therefore, more stringent than that of Section 8 of N-786-2. The proposed shorter inspection intervals will enhance the licensee's ability to detect leakage early, if it occurs. The early leakage detection will permit the licensee to take corrective actions earlier. In addition, the licensee has erected a platform at the affected pipe location to allow access for individuals performing both visual and UT inspections. Therefore, the NRC staff finds that the proposed inservice examinations are acceptable.

Hardship Justification

The NRC staff finds that the licensee has considered various options to perform an ASME Code repair to meet the NRC regulations. The licensee has identified the hardship and unusual difficulty associated with each of the ASME Code repair options. The NRC staff finds that considering the proposed temporary repair will provide reasonable assurance of the structural integrity of the subject pipe, requiring the licensee to perform the ASME Code repair on the pipe would result in a hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

5.0 CONCLUSION

The NRC staff has determined that complying with the ASME Code requirements would result in a hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Furthermore, the NRC staff has determined that the proposed RR 16-MN-003 provides reasonable assurance of structural integrity and leak-tightness of the repaired piping. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) and, therefore, authorizes the proposed alternative in RR 16-MN-003 for MNS, Unit 1, until the next refueling outage, which is scheduled for fall 2017.

This authorization is for the requested relief and repair at MNS, Unit 1, and does not imply or infer the NRC staff's approval of ASME Code Case N-786-2.

All other requirements of the ASME Code, Section XI, for which relief was not specifically requested and authorized by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: J. Tsao

Date: October 18, 2016

If you have any questions, please contact the project managers, V. Sreenivas, at 301-415-2597 or V.Sreenivas@nrc.gov, or G. Edward Miller at 301-415-2481 or Ed.Miller@nrc.gov.

Sincerely,

/RA/

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-369

Enclosure:
Safety Evaluation

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OFFICE	DORL/LPL2-1/PM	DORL/LPL2-1/LA	DE/EPNB/BC*	DORL/LPL2-1/BC (w/comments)	DORL/LPL2-1/PM
NAME	VSreenivas	LRonewicz	DAlley	MMarkley (SWilliams for)	VSreenivas
DATE	10/6/16	10/18/16	09/18/16	10/14/16	10/18/16

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