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

March 28, 2011

Mr. Regis T. Repko
Vice President
McGuire Nuclear Station
Duke Energy Carolinas, LLC
12700 Hagers Ferry Road
Huntersville, NC 28078

SUBJECT: MCGUIRE NUCLEAR STATION, UNIT 1 – RELIEF 09-MN-002, REVISION 1, FOR A PROPOSED ALTERNATIVE TO DELAY THE UPDATE TO THE CODE OF RECORD FOR THE FOURTH 10-YEAR INSERVICE INSPECTION (ISI) INTERVAL (TAC NO. ME4870)

Dear Mr. Repko:

By letter dated September 28, 2010, as supplemented by letter dated December 14, 2010, Duke Energy Carolinas LLC (the licensee), submitted relief request 09-MN-002, Revision 1, for McGuire Nuclear Station, Unit 1, (McGuire 1) related to use of an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI. The licensee plans to excavate and examine Class 3 Nuclear Service Water System buried piping in accord with the requirements of the McGuire Buried Piping Integrity Program. Should areas requiring repair be detected during these inspections, the licensee requests relief from ASME Code, Section XI, IWA 4400 requirements that defective portions of components be removed prior to performing a repair/replacement activity by welding. Revision 1 of relief request 09-MN-002 superseded relief request 09-MN-002, Revision 0, which had been submitted by letter dated September 28, 2010, as supplemented by letter dated December 14, 2010. The third 10-year ISI interval for McGuire 1 ends on November 30, 2011.

The NRC staff has reviewed the licensee's submittal and, based on the information provided in the licensee's request for relief, the NRC staff has determined that complying with the specified requirement would result in a hardship without a compensating increase in the level of quality or safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii). Therefore, the NRC staff authorizes the licensee's proposed alternative at McGuire Nuclear Station, Unit 1, until the end of the third inservice inspection interval on November 30, 2011.

All other requirements of ASME Code, Section XI for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

Gloria Kulesa, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-369

Enclosure:
As stated

cc w/encl: Distribution via Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF THIRD 10-YEAR INTERVAL INSERVICE INSPECTION

REPAIR OF BURIED SERVICE WATER PIPING

RELIEF NO. 09-MN-002, REVISION 1

DUKE ENERGY CAROLINAS, LLC

MCGUIRE NUCLEAR STATION, UNIT 1

DOCKET NO. 50-369

1.0 INTRODUCTION

By letter dated September 28, 2010 (Reference 1), as supplemented by letter dated December 14, 2010 (Reference 2), Duke Energy Carolinas, LLC (Duke, the licensee), submitted request for relief 09-MN-002, Revision 1, for the McGuire Nuclear Station, Unit 1 (McGuire 1), requesting approval of a proposed alternative to the requirements of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section XI, for McGuire 1. Request for relief 09-MN-002, Revision 1, superseded request for relief 09-MN-002, which had been submitted by letter dated May 4, 2009 (Reference 3), supplemented by letter dated February 1, 2010 (Reference 4). The licensee plans to excavate and examine Class 3 Nuclear Service Water (RN) System buried piping in accord with the requirements of the McGuire Buried Piping Integrity Program. Should areas requiring repair be detected during these inspections, the licensee requests relief from ASME Code, Section XI, IWA 4400, requirements that defective portions of components be removed prior to performing a repair/replacement activity by welding. The third 10-year Inservice Inspection (ISI) interval for McGuire 1 ends on November 30, 2011.

2.0 REGULATORY EVALUATION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, paragraph 50.55a(g)(4), "Inservice inspection requirements," ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year inspection interval and subsequent 10-year inspection intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month inspection interval, subject to the limitations and modifications listed therein.

Enclosure

Paragraph 55a(a)(3) of 10 CFR Part 50 states that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the Nuclear Regulatory Commission (NRC), if (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The NRC staff reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(a)(3)(ii).

The McGuire 1 Code of Record for the third 10-year ISI interval, which began on December 1, 2001, and is scheduled to end on November 30, 2011, is the 1998 Edition through 2000 Addenda of Section XI of the ASME Code. Use of this Code Edition and Addenda, with limitations, was authorized by the NRC in a safety evaluation dated November 17, 2004 (Reference 5).

3.0 DESCRIPTION OF PROPOSED ALTERNATIVE

3.1 Affected Systems and Components

Buried 36-inch and 42-inch Class 3 RN piping from the low level intake (LLI) at Cowans Ford Dam to the auxiliary building.

Buried 36-inch Class 3 supply and return RN piping from the standby nuclear service water pond (SNSWP) to the auxiliary building.

3.2 Applicable ASME Code Requirements

ASME Code, Section XI, IWA-4400, requires that welding, brazing, defect removal, and installation activities be performed in accordance with IWA-4420. IWA-4422 specifies requirements for defect removal and examination.

3.3 Basis for Alternative

To comply with the requirements of the McGuire Buried Piping Integrity Program, the licensee plans to excavate portions of buried RN piping and perform an external visual and ultrasonic examination. If excessive wall thinning or through-wall leakage resulting from internal or external corrosion is detected, the defective areas would require repair in accordance with IWA-4400.

The RN system LLI supply piping is a single header that is shared between McGuire 1 and 2 and is difficult to isolate, depressurize, and drain to allow the removal of a defect prior to performing a repair/replacement activity without simultaneously shutting down both units. As a shared line between both units, it is the normal water source for all nuclear service water, and butterfly isolation valve 1RN001 at the low level intake cannot be tested to determine whether it is sufficiently leak-tight to allow the pipe to be isolated and dewatered without entering Technical Specification (TS) 3.7.7, Condition A. As such, the licensee believes that the use of a hot-tapping machine would be necessary to install a line stop to completely dewater the pipe in order to perform the defect removal, or to perform the defect removal and repair during system operation. Since "A" trains of both units align to the LLI on an engineered safety features actuation, repairs would have to be completed within the TS 3.7.7, Condition A, allowed system outage time of 72 hours after which both units must be in Mode 3 within 6 hours and Mode 5 within 36 hours. The licensee believes that it would be difficult to complete the required repairs and return the affected train to service within this timeframe, and states that shutting down both units would present a hardship.

The RN system 36-inch diameter supply and return piping between the SNSWP and the auxiliary building does not contain valves. Therefore, isolation of this piping to permit depressurization and draining for repairs can only be accomplished by installing temporary blind flanges on the underwater intake and discharge piping at the SNSWP. If a line stop is used, or if a blind flange is installed at the SNSWP, one train of the RN system would be isolated, and repairs would have to be completed within the TS 3.7.7, Condition A, allowed system outage time of 72 hours after which both units must be in Mode 3 within 6 hours and Mode 5 within 36 hours. The licensee believes that it would be difficult to complete the required repairs and return the affected train to service within this timeframe, and states that shutting down both units would present a hardship.

If a hot-tapping machine is used to perform the defect removal and repair during system operation, there would be risks to system operation. The licensee states that hot-tapping the RN pipe could result in metal shavings or the removed defective portion of the pipe wall entering the system, and this foreign material could hinder system operation. In addition, the branch connection necessary for hot-tapping results in a mechanical joint being installed after the hot tap is completed. The licensee states that installation of a mechanical joint in a buried application is not desirable because it introduces a new path for potential system leakage.

The alternative proposed in this request will allow repairs to be made without removing the RN buried piping from service, and without the use of a hot-tapping machine. The licensee states that requiring removal of defective portions of this piping prior to performing repairs represents a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

3.4 Proposed Alternative (as stated)

In lieu of the requirement of IWA-4400 to remove the defective portion of the component prior to performing repair/replacement activities by welding, the following alternative is proposed:

> Unacceptable wall thickness loss or through-wall leakage caused by localized general or pitting corrosion may be repaired without removing the defective portion of the pipe wall, provided the following conditions are met:
>
> 1. The defective area shall be encapsulated on the O.D. [outside diameter] of the pipe using pressure retaining parts that comply with the Construction Code and Owner's requirements. The diameter of the encapsulation shall not exceed 10 inch NPS [nominal pipe size], and spacing of adjacent encapsulations shall comply with Construction Code design limits. A surface examination (i.e., magnetic particle, liquid penetrant) shall be performed on the weld connecting the encapsulation to the pipe.

2. For corrosion initiated on the I.D. [inside diameter] of the pipe (with or without through-wall leakage), and for corrosion initiated on the O.D. of the pipe that results in through-wall leakage, the repair/replacement activity shall be designed such that the I.D. of the encapsulation is greater than the maximum diameter of the defective area plus twice the nominal thickness of the component. In addition, the nominal thickness of the encapsulation and its connecting weld to the pipe O.D. surface shall be equal to, or greater than, the nominal wall thickness of the pipe.

3. This alternative shall not be used for defects containing cracks or crack-like indications, and ultrasonic examination shall be performed to characterize the defect and to confirm that the defect does not contain cracks or crack-like indications. Ultrasonic thickness examinations shall also be performed on all pipe exterior surfaces within an area whose diameter is at least twice that of the encapsulation to confirm the absence of any additional flaws that could adversely affect the design of the modification or integrity of the piping.

4. The encapsulation shall be pressure tested in accordance with IWA-4540 upon completion of the repair/replacement activity to confirm the leak-tight integrity of the encapsulation and its connecting welds to the pipe wall.

5. Following pressure testing, sealant shall be installed into the encapsulation to inhibit corrosion, the pressure test fitting in the encapsulation shall be sealwelded, and protective coatings shall be restored on exterior surfaces of the pipe and the encapsulation in the vicinity of the repair area.

6. A visual examination of above ground surfaces in the vicinity of the encapsulation shall be performed at least once during each Unit 1 [McGuire 1] operating cycle to confirm the absence of leakage from the modified portion of the buried piping. Leakage, if detected, shall be addressed through the McGuire Corrective Action Program.

7. Encapsulation of a defective area shall be used only once at each discrete location requiring correction by repair/replacement activity.

4.0 TECHNICAL EVALUATION

4.1 Corrosion and Unacceptable Wall Thinning

Wall thinning can result from corrosion initiating from the inside diameter (ID) or outside diameter (OD) of the pipe. The exterior of the buried piping at McGuire 1 is coated with coal tar epoxy which isolates the pipe from the corrosive influence of moisture and chemicals in the soil. OD-initiated corrosion can occur when a defect in the coating system allows moisture in the soil to contact the metallic pipe. Localized coating defects are usually the result of either defective initial coating application or mechanical damage of the coating during initial burial, such as stones in the earth backfill or other contact which mechanically disturbs the coating. Such exterior defects which have resulted in corrosion are readily detectable on the pipe exterior as blisters resulting from a voluminous corrosion product, or leakage if the pipe wall is perforated.

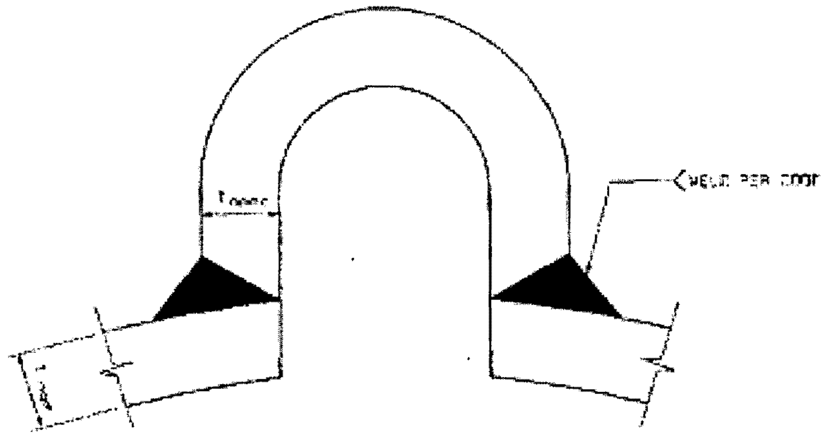
The NRC staff notes that the simple act of excavating or burying the pipe can result in the production of new defects in the pipe coating that may not be readily detectable, thus finds that excavation and burial can be detrimental to the structural integrity of the pipe and should be performed no more frequently than necessary. As noted in SECY 09-0174 (Reference 6), the structural integrity of buried piping can be readily maintained because corrosion normally occurs at localized points.

The interior of the McGuire 1 and 2 buried RN piping is not coated, thus the entire interior is exposed to the corrosive medium (water) and generalized corrosion is expected to occur throughout the pipe. Sufficient generalized corrosion may result in pipe wall thinning over large areas to the point where the structural integrity of the pipe itself could be challenged. For this reason, a corrosion allowance is applied to the pipe during initial construction. The licensee states that they have monitored the piping since 1990 with periodic inspections of pipe wall thickness at over 220 inspection locations and determined that the average general corrosion rate is 0.002 inches (2 mils) per year, with an average pitting corrosion rate of 0.004 inches (4 mils) per year. The NRC staff notes that using the larger of these two rates, 4 mils per year, would not result in perforation, nor would it result in unacceptable wall thinning of the nominal 0.5-inch pipe wall in the 29-year service life of the plant. The NRC staff finds that the licensee's extensive measurements of the corrosion rate of the RN piping are acceptable for determining the average rate of generalized and pitting corrosion, corrosion that could compromise the structural integrity of the pipe. If ID-initiated corrosion has resulted in perforation and leakage, it is most likely the result of pitting resulting from microbially induced corrosion (MIC). Since individual MIC pits are generally small in lateral extent, single pits only result in leakage and do not challenge the structural integrity of the pipe.

4.2 Hardship Evaluation

If unacceptable wall thinning is found during the course of an inspection of either the excavated RN LLI or the SNSWP piping, the licensee is required to repair the unacceptable area.* One possible configuration of a Code-compliant repair, where the defect is removed and a new pressure retaining boundary is formed, is shown in Figure 1. In order to perform such a repair, the pipe would have to be isolated, depressurized, drained and the repair would have to be performed, pressure-tested, and examined prior to returning the pipe to service. These activities would have to be performed within the 72-hour allowed outage time for TS 3.7.7, Condition A. If Condition A cannot be met within the 72-hour allowed outage time, both units would need to be in Mode 3 within 6 hours and Mode 5 within 36 hours. The NRC staff concurs with the licensee that isolation, depressurization, draining, defect removal, repair, testing and examination within the 72 hours is difficult. The NRC staff finds that a mid-cycle shutdown of one unit in order to perform a Code-compliant repair would present a hardship.

*The licensee's Code of Record, ASME Code, Section XI, 1998 Edition through the 2000 Addenda, allows the use of paragraph IWA-4340, mitigation of defects by modification, but the use of this paragraph was not authorized by the NRC staff in a safety evaluation dated November 17, 2004 (Reference 5).



t_{nom} - NOMINAL WALL THICKNESS

t_{nomc} - NOMINAL PIPE CAP WALL THICKNESS

Figure 1 (Example of Code-Compliant Repair)

The NRC staff has evaluated other repair alternatives. The RN piping is ASME Code Class 3 and meets the requirements of moderate energy piping found in Generic Letter (GL) 90-05, "Guidance For Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping" (Reference 7). Use of the provisions of GL 90-05 is inappropriate for McGuire 1 and 2 RN piping since the RN piping is shared between two units and cannot be isolated, and GL 90-05 requires performing a Code-compliant repair at the next outage exceeding 30 days. Similarly, use of Code Case N-513-3 (Reference 8) for a temporary repair also requires a Code-compliant repair be made within a time period not exceeding 26 months from the initial discovery of the condition. NRC Regulatory Guide 1.147 conditions the use of ASME Code Case N-513-3 such that the repair or replacement activity temporarily deferred under the provisions of this Code Case shall be performed during the next scheduled outage. As a result, use of either of these alternatives would require a mid-cycle shutdown of one unit that would present hardship.

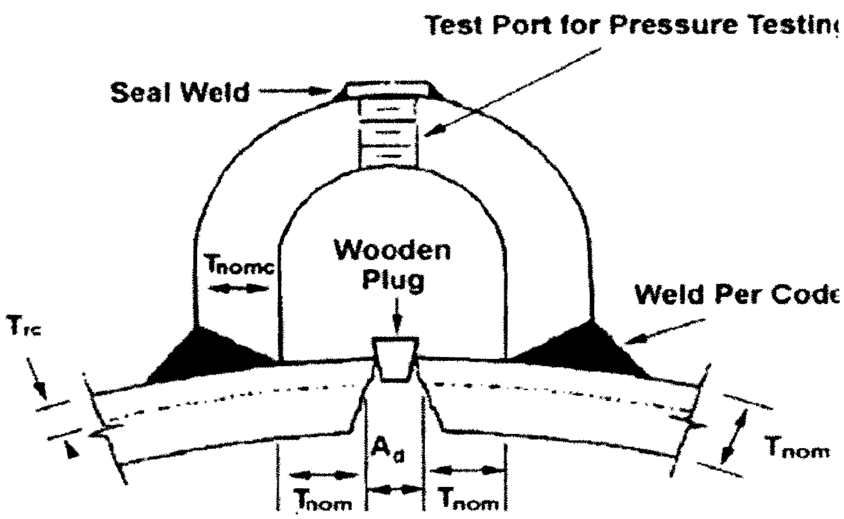
The licensee has also evaluated a method of removing a defect while the piping is in service, hot-tapping, where a branch connection would be welded to the exterior of the pipe at the defect and a special tool would remove the defect by boring a hole at the site of the defect. The tool is then removed and the pressure boundary is completed with a mechanical closure. The NRC staff concurs with the licensee's statement that there is a possibility of introducing foreign material into the RN piping system, either metal shavings or the removed defective portion of the pipe wall, that could compromise system operation. The NRC staff further concurs with the licensee's statement that the use of a mechanical closure is a potential source of leakage. Therefore, the NRC staff concludes that the use of the hot-tap technique is undesirable.

The NRC staff concludes that the above repair techniques are either undesirable or present a hardship.

4.2 Encapsulation Design and Testing

The licensee has proposed an alternative repair in which excessive localized wall thinning or through-wall leakage resulting from internal or external corrosion is repaired by encapsulation on the outside of the pipe without removing the defect (Figure 2). The encapsulation for both ID- and OD-initiated unacceptable wall thinning will utilize a pressure retaining encapsulation, not to exceed 10-inch NPS, that complies with Construction Code and the Owner's requirements, and the spacing between encapsulated defects will comply with Construction Code design limits. The licensee has set the minimum inside diameter of the encapsulation to be the maximum diameter of the defective area plus twice the nominal wall thickness. Based on the licensee's specific plant history of general corrosion and pitting corrosion rates, the NRC staff finds this dimension is adequate to provide reasonable assurance of structural integrity and leak tightness for the projected life of the repair.

Where the wall is perforated and the pipe is leaking, a temporary plug will be installed to stop the leakage. Where temporary plugs are not capable of adequately stopping leakage to perform weld repair, additional actions, such as installation of a metal plug over the defective area using a seal weld, will be taken to ensure that the encapsulation weld surfaces are dry. Since any plug or seal weld will be completely encapsulated by the final repair, structural integrity and leak tightness of the pipe does not rely on the plug or seal weld. The NRC staff finds the provisions for ensuring a dry surface for welding acceptable.



T_{nom} - Nominal Wall Thickness
T_{nomc} - Nominal Pipe Cap Wall Thickness
T_{rc} - Minimum Wall Thickness Required for Code Compliance
A_d - Defective Area

Figure 2 Example of Repair/Replacement Conforming to Proposed Alternative

The weld between the encapsulation and pipe will be an ASME Code-compliant weld. The NRC staff notes that the pipe material (P-1) and wall thickness (0.5 inches) does not require either weld preheating or post-weld heat treatment. However, the pipe wall being welded will be water backed. Welding on water-backed pipe is not addressed in Section III or Section XI of the ASME Code, and is an essential variable only for temper bead welding procedures, but could become an issue when the base material has high hardenability. In response to the NRC staff's Requests for Additional Information (RAIs) (References 2 and 4), the licensee noted that the piping is carbon steel, A-134 Grade 283C, SA-155 Grade C55, SA-285 Grade C or SA-155 Class 1 Grade KC70, and is low hardenability and not susceptible to production of a hard, brittle microstructure in the heat affected zone. Furthermore, the licensee stated that a stringer bead weld technique that is expected to produce tempering in the heat affected zone will be used. In addition, the licensee will perform a surface examination of the weld after waiting at least 48 hours to allow for the possibility of delayed cracking. The NRC staff finds that the licensee's procedures for welding on, and examination of, a weld on a water-backed surface is acceptable.

After welding, the encapsulation and weld will be pressure tested in accordance with IWA-4540 using the encapsulation test port. A sealant will then be applied to the interior of the encapsulation volume to prevent further corrosion. The NRC staff finds that the provisions to address corrosion inside the encapsulation acceptable. Finally, the pressure test port is plugged, a seal weld is made around the plug and protective coatings will be restored on the exterior surfaces of the pipe and the encapsulation in the vicinity of the repair area to prevent further OD-initiated corrosion. The NRC staff finds that these provisions for encapsulation testing and corrosion protection are acceptable.

The licensee states in Reference 2 that the RN system is designed to perform its safety function assuming a single failure and that a failure of the defect repair described in this request will result in leakage that will not compromise the function of the RN system. The NRC staff has performed a simple calculation and estimated that the failure of the maximum-sized repair by this proposed alternative will allow less than 10% of flow to be lost. The NRC staff thus accepts the licensee's conclusion that the RN system could continue to fulfill its safety function for the single failure of the type described.

The NRC staff notes the general design similarity to a Code-compliant repair, Figure 1. The NRC staff finds that the proposed design has several advantages over the Code-compliant repair of Figure 1. First, the application of corrosion protection within the encapsulation after pressure testing inhibits corrosion on the interior of the encapsulation as well as the remaining pipe wall within the bounds of the encapsulation. In addition, the remaining pipe wall material, while performing no structural function, provides an additional corrosion allowance in comparison to the design configuration of the Code-compliant repair (Figure 1). The NRC staff concludes that the proposed alternative encapsulation design is acceptable.

4.3 Measurement of Corrosion Extent

In order to ensure that the surrounding pipe wall is above ASME Code minimum requirements and has adequate structural integrity, the extent of corrosion must be determined. When the exterior of the pipe is exposed by excavation, it will be visually examined for leakage and OD-initiated corrosion. Indications of excessive wall thinning are leakage or the presence of blisters. When OD corrosion is detected, ultrasonic thickness (UT) measurements will be made to determine the thickness of the remaining pipe wall and the extent of corrosion. When unacceptable wall thickness is detected, the licensee will perform a visual examination for a distance of 5 feet from the repair area to detect other sites of OD-initiated corrosion. In addition, the licensee will perform UT pipe wall thickness measurements in a diameter that is at least twice the diameter of the proposed encapsulation diameter to determine the extent of the wall thinning. The NRC staff finds that the visual examination and the extent of wall thickness measurements are adequate to ensure that the encapsulation is welded to sound base metal and that the resulting repair can meet Construction Code and the Owner's requirements, thus is acceptable.

When unacceptable ID-initiated wall thinning is found, the licensee will perform UT pipe wall thickness measurements to determine the extent of the wall thinning and ensure that the encapsulation repair will have adequate structural integrity. The UT measurements will be made in a diameter that is at least twice the diameter of the proposed encapsulation diameter. In addition, UT wall thickness measurements will be made on a 6-inch grid for a distance of 5 feet from the repair area to ensure that the pipe is structurally sound. The NRC staff notes that the small lateral size of MIC pits makes it statistically unlikely that point-wise UT measurements will detect further MIC pitting, but the NRC staff finds that these measurements will ensure no excessive wall thinning is occurring due to general corrosion and thereby ensure the structural integrity of the pipe. Therefore, the NRC staff finds that the evaluation of the extent of condition to ensure structural integrity is acceptable.

4.4 Lifetime Estimation

The licensee addressed reinspection of the repairs through the encapsulation design, expected service life of the repair, and periodic visual inspection of ground surfaces for leakage.

4.4.1 Prediction of Corrosion Rate

In response to the NRC staff's RAI (Reference 2), the licensee states that it has performed extensive corrosion rate measurements at over 220 sites of the RN service pipe itself in the actual corrosion environment over 20 years. A general corrosion rate of 2 mils per year and a pitting corrosion rate of 4 mils per year have been determined.

For OD-initiated corrosion, the licensee estimates a lateral corrosion rate of 8 mils per year which is equal to the measured average pitting corrosion rate multiplied by a factor of 2 to account for statistical variations and uncertainties.

For OD-initiated corrosion that has resulted in through-wall leakage, the licensee estimates the through-wall corrosion rate as the measured pipe wall loss (based on nominal wall thickness or actual thickness documented in construction records) divided by the length of time that the component has been in service multiplied by a factor of 2 to account for statistical variations and uncertainties.

For ID-initiated corrosion, the licensee estimates the lateral corrosion rate as one half the diameter of the defective area, divided by the length of time that the component has been in service, multiplied by a factor of 2 to account for statistical variations and uncertainties, and the through-wall corrosion rate as the measured pipe wall loss (based on nominal wall thickness or actual thickness documented in construction records) divided by the length of time that the component has been in service multiplied by a factor of 2 to account for statistical variations and uncertainties.

The NRC staff finds that the extensive measurements of the RN piping corrosion rates in actual corrosion environment over the 20 years and the multiplicative factor of 2 to account for statistical variations and uncertainties constitute a reasonable basis for estimating future corrosion rates.

4.4.2 Repair Reinspection

For OD-initiated corrosion that has not resulted in through-wall leakage, the NRC staff notes that the encapsulation effectively isolates the defect from the corroding medium, mitigating corrosion of the pipe wall at the defect site. The pipe wall thickness at the defect area, however, has been reduced and the licensee has recognized that ID-initiated corrosion could further decrease the wall thickness. To ensure that future ID-initiated corrosion will not challenge the repair before the end of its projected service life, the projected service life is determined by lateral expansion of the defect to the encapsulation inside diameter after the ID-initiated corrosion is projected to result in a through-wall defect in the pipe. A lateral corrosion rate of 8 mils per year will be used, as discussed above. The NRC staff finds that the licensee's supporting plant-specific corrosion data is sufficient for the likely corrosion scenarios, and that the estimate of projected service life for OD-initiated corrosion without through-wall penetration provides a reasonable assurance of leak tightness for the projected lifetime of the repair.

For OD-initiated corrosion with through-wall penetration, the encapsulated area of the pipe and encapsulation itself both experience the service water corrosion environment. The service life of the repair is then determined by the lesser of: a) the time that the expected lateral growth of the defective area requires to reach the inside diameter of the encapsulation, and b) the expected time for corrosion to penetrate through the encapsulation wall. The NRC staff notes that no credit is given to the sealant which is incorporated in the interior of the encapsulation volume. The NRC staff finds the estimate of projected service life for OD-initiated corrosion with through-wall penetration to provide reasonable assurance of leak tightness for the projected lifetime of the repair.

For ID-initiated corrosion, the service life of the repair is determined by the lesser of: a) the time that the expected lateral growth of the defective area requires to reach the inside diameter of the encapsulation, and b) the expected time for corrosion to penetrate through the encapsulation wall. The NRC staff finds the estimate of projected service life for ID-initiated corrosion to provide reasonable assurance of leak tightness for the projected lifetime of the repair.

The licensee states that the low operating pressure of the RN system (≤ 35 psig) makes it unlikely that structural integrity of the pipe with the encapsulation repair would be challenged before leakage of the repair would occur, and that periodic visual inspection of ground surfaces in the repair area should detect leakage before structural integrity would be challenged. The licensee notes that any leakage that is found would be entered in the McGuire 1 and 2 corrective action program. In addition, flow balance testing and periodic visual examination of ground surfaces has been previously accepted by the NRC staff to confirm that the RN system of each unit is capable of supplying the design basis cooling water to various nuclear safety-related loads (Reference 9).

The NRC staff notes that frequent excavation and visual examination of the pipe exterior surface would also detect any leakage of the repair or any new corrosion. However, excavation of the pipe to perform the examination and subsequent burial present a risk of damage of the pipe exterior coating, increasing the risk of forming further corrosion sites.

The NRC staff acknowledges the periodic inspection of ground surfaces to inspect for leakage, but does not consider this sufficient to monitor the structural integrity of the system. However, the robustness of the repair design, coupled with the flow balance testing, provides reasonable assurance of structural integrity and continued function of the RN system, and that removal of the defect and excavation of the piping to perform direct examinations would result in hardship without a compensating increase in the level of quality or safety.

4.5 IWA-4340 Provisions

The NRC staff notes that the provisions of this relief request are similar to those of Section XI of ASME Code, IWA-4340, Mitigation of Defects by "Modification." The use of the provisions of IWA-4340 has been prohibited for Code of Record updates since November 1, 2004 (Reference 10) and was prohibited by the safety evaluation permitting McGuire 1 to use the Section XI 1998 Edition through the 2000 Addenda (Reference 5).

The provisions of this relief request satisfy the concerns about the use of IWA-4340 which were documented in the *Federal Register* on a plant-specific basis with additional actions identified; it is not the NRC staff's intention that the provisions proposed in this relief request be generically applied. The licensee has identified a significant hardship associated with dewatering the RN piping to perform defect removal and repair. Also, due to the low operating pressure of the RN system and the limited size of potential encapsulations, leakage is expected prior to the point that the structural integrity of the pipe, thus the safety function of the system, is challenged. The RN piping has not had a significant history of through-wall leakage and the NRC staff finds that the licensee's extensive measurements of the corrosion rate of the RN piping since 1990 is an acceptable method to determine the average rate of generalized and pitting corrosion. In addition, the NRC staff notes that any leakage that may occur will not contain fluids with tritium levels in excess of those in the naturally occurring water source or contain other hazardous liquids. Finally, this alternative is being requested in case degradation is discovered when the RN piping is excavated, not for leakage that has already occurred. The NRC staff concludes that these plant-specific conditions permit the mitigation of localized wall thinning by modification.

4.6 Summary

The NRC staff finds that the requirement to remove the defect prior to repair by welding would present a significant hardship due to the necessity of simultaneously shutting down both McGuire 1 and 2 to dewater the RN piping. Furthermore, when the defect is the result of local wall thinning, removal of the defect would not significantly increase the life of the repair nor increase the level of quality and safety. Finally, the NRC staff notes that any leakage that may occur will not contain hazardous liquids or fluids with tritium levels in excess of those in the naturally occurring water source. Therefore, the NRC staff finds the licensee's proposed alternative provides reasonable assurance of structural integrity of the RN piping for the projected lifetime of the repair and that removal of the defect would result in hardship without a compensating increase in the level of quality or safety

5.0 CONCLUSION

As set forth above, the NRC staff finds that complying with the specified requirement would result in a hardship without a compensating increase in the level of quality or safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii). Therefore, the NRC staff authorizes the licensee's proposed alternative at McGuire 1 until the end of the third ISI interval on November 30, 2011.

All other requirements for which relief was not specifically requested and authorized remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

6.0 REFERENCES

1. Letter from R. T. Repko, Duke, to NRC, dated September 28, 2010, "Relief Request Serial #09-MN-002, Response to Requests for Additional Information," (Agencywide Documents Access and Management System (ADAMS), Accession No. ML102790167).

2. Letter from R. T. Repko, Duke, to NRC, dated December 14, 2010, "Relief Request Serial #09-MN-002, Revision 1, Response to Request for Additional Information," (ADAMS Accession No. ML103560592).

3. Letter from B. H. Hamilton, Duke, to NRC, dated May 4, 2009, "Relief Request Serial #09-MN-002," (ADAMS Accession No. ML092170658).

4. Letter from R. T. Repko, Duke, to NRC, dated February 1, 2010, "Relief Request Serial #09-MN-002, Response to Request for Additional Information," (ADAMS Accession No. ML100480974).

5. Letter from M. J. Ross-Lee, NRC, to G. R. Peterson, Duke, dated November 17, 2004, "McGuire Nuclear Station, Unit 1 – Request for Relief for Use of a Later Edition of the ASME Section XI Code for the Remainder of the Third 10-Year Inspection Interval, RR-03-001 (TAC MC2767)," (ADAMS Accession No. ML043060231).

6. SECY-09-0174, "Staff Progress in Evaluation of Buried Piping at Nuclear Reactor Facilities," (ADAMS Accession No. ML093160004).

7. GL 90-05, "Guidance For Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," (ADAMS Accession No. ML031140590).

8. ASME Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1."

9. Letter from G. Kulesa, NRC, to R. T. Repko, Duke, dated February 18, 2010, "McGuire Nuclear Station Units 1 and 2, Relief Request 09-GO-001, Regarding Alternatives from Pressure Test Requirements for Buried Piping (TAC Nos. ME0958 and ME0959)," (ADAMS Accession No. ML100470359).

10. *Federal Register*, Volume 67, Number 187, page 60520, "Industry Codes and Standards; Amended Requirements." http://www.gpo.gov/fdsys/pkg/FR-2002-09-26/pdf/02-23811.pdf

Principal Contributor: J. Wallace, NRR

Date: March 28, 2011

All other requirements of ASME Code, Section XI for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

Gloria Kulesa, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-369

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