



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001
October 14, 2009

Mr. Bruce H. Hamilton
Vice President
McGuire Nuclear Station
Duke Energy Carolinas, LLC
12700 Hagers Ferry Road
Huntersville, NC 28078

SUBJECT: MCGUIRE NUCLEAR STATION, UNIT 1, RELIEF 08-MN-005, FOR CONTROL
ROD DRIVE MECHANISM (CRDM) CANOPY SEAL WELDS (TAC NO. MD9875)

Dear Mr. Hamilton:

By letter dated October 7, 2008, Duke Energy Carolinas LLC (the licensee), submitted Relief Request No. 08-MN-005 to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to the weld repair requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Section XI, Article IWA-4400, during the fall 2008 refueling outage for McGuire Nuclear Station, Unit 1 (McGuire 1) and for similar repair/replacement activities that could be necessary as a result of evidence of leakage that may be detected on other Control Rod Drive Mechanism (CRDM) canopy seal welds at McGuire 1, during the remainder of the third inservice inspection (ISI) interval, currently scheduled to end on November 30, 2011. As an alternative to the requirement of IWA-4400 to remove the defect prior to performing weld repair, the licensee proposed to increase the weld thickness of the canopy seal weld by overlaying the existing weld with Alloy 52M weld filler material on CRDM canopy seals for McGuire 1.

The weld overlay buildup design is based on meeting the requirements of ASME Code, Section XI, IWB-3640 and the NRC guidance outlined in NUREG-0313, Rev. 2, "Technical report on Material Selection and Processing Guidelines for BWR [Boiling Water Reactor] Coolant Pressure Boundary Piping," for the repair of Stress Corrosion Cracking flaws and uses Alloy 52M material for the build up. In addition, guidance from ASME Code Case N-504-3, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," was used.

The NRC staff has reviewed the licensee's submittal and, based on the information provided, concludes that the proposed alternative provides an acceptable level of quality and safety. Therefore, pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(i), the NRC staff authorizes the use of the proposed alternative for the remainder of the third 10-year ISI interval for McGuire 1, which began on December 1, 2001, and ends on November 30, 2011.

All ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

B. Hamilton

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Verbal relief was authorized by the NRC staff for McGuire 1 during a teleconference with the licensee on October 24, 2008.

The enclosed Safety Evaluation contains the NRC staff's evaluation and conclusions.

If you have any questions regarding this matter, please contact Jon Thompson at 301-415-1119.

Sincerely,



Gloria Kulesa, 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
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF THIRD 10-YEAR INTERVAL INSERVICE INSPECTION

REQUEST FOR RELIEF NO. 08-MN-005

DUKE ENERGY CAROLINAS, LLC

MCGUIRE NUCLEAR STATION, UNIT 1

DOCKET NO. 50-369

1.0 INTRODUCTION

By letter dated October 7, 2008 (Agencywide Documents Access and Management System Accession No. ML082890199), Duke Energy Carolinas LLC, (the licensee) submitted Relief Request 08-MN-005 to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to the weld repair requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Section XI, Article IWA-4400, during the fall 2008 refueling outage, 1EOC19, for McGuire Nuclear Station, Unit 1 (McGuire 1), and for similar repair/replacement activities that could be necessary as a result of evidence of leakage that may be detected on other Control Rod Drive Mechanism (CRDM) canopy seal welds on McGuire 1, during the remainder of the third inservice inspection (ISI) interval, currently scheduled to end on November 30, 2011. As an alternative to the requirement of IWA-4400 to remove the defect prior to performing weld repair, the licensee proposed to increase the weld thickness of the canopy seal weld by overlaying the existing weld with Alloy 52M weld filler material on CRDM canopy seals for McGuire 1.

The weld overlay buildup design is based on meeting the requirements of ASME Code, Section XI, IWB-3640 and the NRC guidance outlined in NUREG-0313, Rev. 2, "Technical report on Material Selection and Processing Guidelines for BWR [Boiling Water Reactor] Coolant Pressure Boundary Piping," for the repair of Stress Corrosion Cracking (SCC) flaws and uses Alloy 52M material for the build up. In order to provide SCC resistance, the repair weld material was selected as Alloy 52M, which will be applied using the Gas Tungsten Arc Welding (GTAW) weld process. The overlay design also satisfied the ASME Code Section XI requirement (for structural reinforcement) that no flaw be deeper than 75 percent of the pipe wall.

The suitability of the replacement material has been evaluated, is compatible with the existing component, and will provide an acceptable leakage barrier for the remainder of the intended life of the CRDM. Therefore, as necessary, the repair of leaking seal welds would be performed using a design based on meeting the requirements described above, with additional guidance from ASME Code Case N-504-3, which establishes the acceptability of a repair by increasing the weld thickness and performing the Construction code surface examination techniques, providing final acceptance of the repaired weld.

Enclosure

2.0 REGULATORY EVALUATION

The ISI of ASME Code, Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Section 50.55a(g) of Title 10 of the *Code of Federal Regulations* (10 CFR), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (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.

Pursuant to 10 CFR 50.55a(g)(4), 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 (ISI) of Nuclear Power Plant Components," to the extent practical with 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 interval and subsequent 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 10-year interval, subject to the limitations and modifications listed therein. The Code of record for the third 10-year ISI interval at McGuire 1 is the 1998 Edition through the 2000 Addenda of Section XI of the ASME Code.

3.0 TECHNICAL EVALUATION

3.1 Applicable Code Edition and Addenda

The code of record for the third 10-year ISI interval at McGuire 1 is the ASME Code, Section XI, 1998 Edition through the 2000 addenda.

3.2 ASME Code Components for Which Relief is Requested

Reactor control rod drive mechanism (CRDM) canopy seal welds – Class 1 appurtenance to the reactor vessel.

3.3 Applicable Code Requirements

IWA-4410, 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.

Relief was requested from the requirement of IWA-4400 that the defect be removed from the CRDM canopy seal weld prior to performing a repair/replacement activity by welding.

3.4 Reason for Relief Request

During the McGuire 1 Fall 2008 refueling outage (i.e. 1EOC19), boric acid deposits were observed on the F-8 CRDM housing in the vicinity of the intermediate canopy seal weld at McGuire 1. This condition was attributed to a leak of the intermediate canopy seal weld. The CRDM canopy seal welds are located above the Reactor Vessel Closure Head, which is highly congested and subject to high radiation levels. The Code-required repair method would involve excavation of the defect and restoration to the original configuration.

The alternative repair/replacement method proposed in this request was meant to facilitate immediate repair efforts during 1EOC19 and is approved for and will facilitate future repairs of like nature that may be needed if evidence of leakage is detected on other canopy seal welds when examined during subsequent McGuire 1 refueling outages.

Due to the nature of the flaw, the excavation required to remove the defect would create a cavity that opens to the threaded region of the CRDM. Due to this weld geometry, the resulting cavity would prevent the establishment and maintenance of an adequate back-purge during the welding process and would further reduce the quality of the repaired weld.

Industry experience with failure analyses performed on leaking canopy seal welds removed from service at other plants has attributed the majority of the cases to transgranular SCC. The SCC results from exposure of a susceptible material to residual stress, which is often concentrated by weld discontinuities, and to a corrosive environment. A corrosive environment can form with water being trapped in the cavity behind the seal weld that is mixed with air initially in the cavity, resulting in a higher oxygen content than in the bulk primary coolant.

3.5 Licensee Proposed Alternative and Basis for Use

As an alternative to the requirement of IWA-4400 to remove the defect prior to performing weld repair, the licensee proposed to increase the weld thickness of the canopy seal weld by overlaying the existing weld with Alloy 52M weld filler material.

This alternative weld overlay repair/replacement activity is similar to that utilized successfully by many other plants. The weld overlay buildup is designed based on meeting the requirements of ASME Section XI, IWB-3640, and the NRC guidance outlined in NUREG-0313, Rev. 2, for the repair of SCC flaws and uses Alloy 52M material for the buildup. In order to provide SCC resistance, the repair weld material was selected as Alloy 52M, which will be applied using the machine welding GTAW process. The overlay design also satisfies the ASME Code, Section XI requirement (for structural reinforcement) that no flaw be deeper than 75 percent of the pipe wall.

Welding procedures for this alternative were qualified in accordance with ASME Code, Section XI. The licensee's welding vendor performed a mock-up at McGuire 1 in which they used their welding procedure specifications and weld traveler to exercise their welding equipment, procedures and operators. They would perform welding of the CRDM canopy seal weld following a successful mockup.

3.6 Duration of Proposed Alternative

Approval of the proposed alternative is requested for repair/replacement activities associated with the McGuire 1 CRDM intermediate canopy seal weld on reactor pressure

vessel closure head penetration no. F-8 during the current refueling outage 1EOC19, and for similar repair/replacement activities that could be necessary as a result of evidence of leakage that may be detected on other CRDM canopy seal welds on McGuire 1 during the remainder of the third inservice inspection interval, currently scheduled to end on November 30, 2011.

3.7 Evaluation Summary

The licensee has proposed to perform the repair of leaking seal welds using a weld overlay buildup design based on meeting the requirements of ASME Code, Section XI, IWB-3640, and the NRC guidance outlined in NUREG-0313, Rev. 2, for the repair of SCC flaws with additional guidance from ASME Code Case N-504-3, which establishes acceptability of a repair by increasing the weld thickness and performing the Code-required surface examination for final acceptance of the repaired weld. In order to provide adequate SCC resistance, the repair weld material Alloy 52M was selected, which is applied using the GTAW weld process. The overlay design also satisfies the ASME Code, Section XI, requirement (for structural reinforcement) that no flaw be deeper than 75 percent of the pipe wall thickness. The suitability of the replacement material has been evaluated, is compatible with the existing component, and will provide an acceptable leakage barrier for the remainder of the intended life of the CRDM.

The code case allows deposition of one or more layers of weld overlay to seal unacceptable indications in the area to be repaired without excavation. The code case further requires an analysis of the repaired weldment to assure that the existing flaw will not propagate unacceptably for the design life of the repair, considering potential flaw growth due to fatigue and SCC, the mechanism believed to have caused the flaw. Since the seal weld is neither a structural weld nor a pressure-retaining weld, the NRC staff finds the proposed alternative repair method to be acceptable. The licensee also proposed to use Alloy 52M in place of austenitic stainless steel. The NRC staff finds the use of this material to be acceptable due to its resistance to SCC.

4.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternative to the Code-required repair method of the CRDM canopy seal welds would result in an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee's proposed alternative described in Relief Request 08-MN-005, Rev. 0, for McGuire 1 is authorized for the remainder of the third 10-year ISI interval. Verbal relief was authorized by the NRC staff for McGuire 1 during a teleconference with the licensee on October 24, 2008.

All ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: J. Stang
J. Tsao

Date: October 14, 2009

B. Hamilton

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Verbal relief was authorized by the NRC staff for McGuire 1 during a teleconference with the licensee on October 24, 2008.

The enclosed Safety Evaluation contains the NRC staff's evaluation and conclusions.

If you have any questions regarding this matter, please contact Jon Thompson at 301-415-1119.

Sincerely,

/RA/

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

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Enclosure:
Safety Evaluation

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