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Serial No: MNS-17-012

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10 CFR 50.55a

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Duke Energy Carolinas, LLC (Duke Energy)
McGuire Nuclear Station, Unit 2
Docket No. 50-370
Relief Request 17-MN-001
Alternative for Repair of Class 1 Piping

Pursuant to 10 CFR 50.55a(z)(2), Duke Energy hereby requests U.S. Nuclear Regulatory Commission's approval for use of an alternative for the repair of Class 1 piping. This pipe is the boron injection line to 2D Reactor Coolant System Cold Leg. Repair is in progress at this time and McGuire plans to be back to Mode 4 on March 6, 2017 at approximately 09:00 hours. Duke Energy requests NRC's approval of this relief request prior to this Mode 4 date and time. The enclosure provides details regarding this relief request.

If you have any questions or require additional information, please contact P.T. Vu of Regulatory Affairs at (980) 875-4302.

Sincerely,

SDCapps

Steven D. Capps

Enclosure with attachments:

Attachment 1: Nondestructive Examination Data for Boron Injection Line to 2D RCS Cold Leg
Attachment 2: AREVA Information

A047
NRR

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Enclosure 1

Duke Energy Carolinas, LLC

McGuire Nuclear Station, Unit 2

Relief Request Serial #17-MN-001

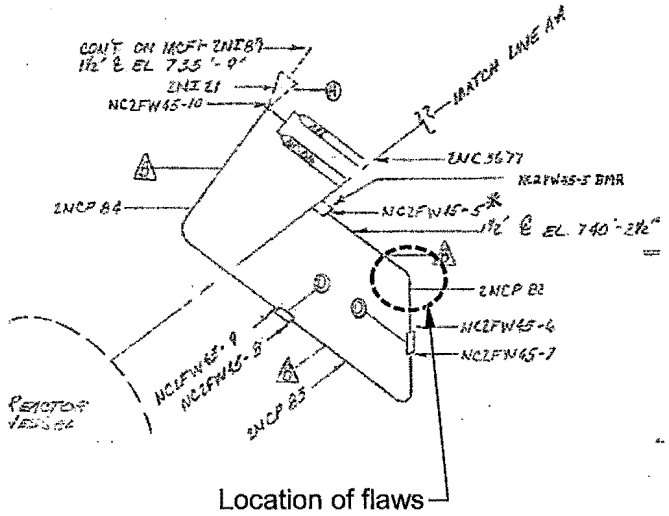
Relief Requested in Accordance with 10 CFR 50.55a(z)(2) for Weld Overlay Repair of Class 1 Piping

1.0 ASME Code Component(s) Affected

ASME Class 1 Piping, NPS 1-1/2 Schedule 160 5D bend (in piping subassembly 2NCP82) in the Boron Injection Line to 2D Reactor Coolant System Cold Leg.

The piping material is SA-376/TP304.

The specific location of the piping subassembly is shown in the following excerpt from drawing MCFI-2NC45:



2.0 Applicable Code Edition and Addenda

ASME Boiler and Pressure Vessel Code, Section XI, 2007 Edition with the 2008 Addenda

3.0 Applicable Code Requirements

3.1 The ASME Code, Section XI, IWA-4420 requires, in part, that defects be removed or mitigated in accordance with the requirements of IWA-4421(a), (b), or (c).

3.2 Relief from the defect removal requirements of IWA-4420 is requested to allow installation of a weld overlay to repair the piping identified in this request.

4.0 Reason for Request

4.1 An unisolable pressure boundary leak in the boron injection line to 2D Reactor Coolant System Cold Leg was detected during plant operation on February 23, 2017, requiring a unit shutdown to perform a repair/replacement activity. The flawed area of piping is located approximately 5.75" from the pipe to nozzle weld 2NC2FW45-5, on the intrados of the 5D elbow bend. The flaw was located approximately 45 degrees between the bottom and side of the piping circumference at a skew of approximately 45 degrees to the piping axis. Reference Attachment 1 for information on the location and orientation of the identified flaws.

4.2 Conventional angle beam UT was performed to procedure NDE-NE-ALL-6101, "Ultrasonic Examination of Small Bore Piping Welds & Base Materials for Thermal Fatigue Damage". The primary search units utilized for detection and characterization of the indications were a 38 degree search unit, which produces an approximately 60 degree impingement angle, for the circumferential scan direction and a 45 degree search unit for the axial scan direction. Sixty and seventy degree search units were also utilized for axial scans to assist with indication characterization. The full circumference of the piping base material was interrogated with UT in four scanning directions, from the pipe-to-nozzle weld down to the first upstream pipe coupling, which encompassed the entire 5D elbow bend. One inch bands of base material of the upstream socket welds 2NC2FW45-6 and 2NC2FW45-7 were also examined.

The flaw was observed to be open to the surface for a dimension of approximately 0.6" of length. The flaw was ultrasonically length sized with a combined surface and subsurface length of approximately 1.3". The flaw was further characterized as an off-axis axial flaw. Adjacent to the surface breaking flaw, two additional low amplitude indications were observed at approximately 0.1" to 0.15" below the leaking flaw and another indication of significant amplitude was observed, approximately 0.25" above the leaking flaw, with a length of approximately 0.25". A total of 4 off-axis flaws were observed.

4.3 To repair this defect, Duke Energy proposes to perform a temporary weld overlay repair using ASME Code, Section XI, Nonmandatory Appendix Q, as modified in this request. Compliance with the requirement of ASME IWA-4420 to remove the defect and perform a repair in accordance with IWA-4000 will require draining of the reactor coolant system (RCS) loops below the level necessary for operability of the Residual Heat Removal (RHR) System. This requires the reactor to be defueled. Duke Energy believes that compliance with the requirement of IWA-4420 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

5.0 Proposed Alternative and Basis for Use

5.1 In lieu of the requirement of IWA-4420, Duke Energy proposes to use ASME Section XI, Nonmandatory Appendix Q for the repair of the piping identified in this request, except as follows:

5.1.1 In lieu of the requirement of Q-3000(a)(5) that the axial length of the overlay shall cover the weldment and the heat affected zones, the axial length of the overlay shall cover the flaws and extend at least ½ in. (13 mm) beyond the ends of the observed flaws in the pipe base material. There is no weld or heat affected zone in the area requiring weld overlay, so the requirement of Q-3000(a)(5) related to the weldment and heat affected zones is not applicable.

5.1.2 In lieu of the requirement of Q-3000(b)(1) that the axial length and end slope of the weld overlay shall cover the weldment and heat affected zones on each side of the weldment, the axial length and end slope of the weld overlay shall cover the flaws identified in the pipe base material. There is no weld or heat affected zone in the area requiring weld overlay, so the requirement of Q-3000(b)(1) related to the weldment and heat affected zones is not applicable.

5.1.3 The requirement of Q-4100(c) shall be met, except that in lieu of the weld shown in Figure Q-4100-1, the overlay shall be installed over as-found flaws in the pipe base material. This exception does not change the examination volume specified in Figure Q-4100-1.

5.1.4 In lieu of the preservice examination Volume A-B-C-D shown in Figure Q-4300-1, the examination volume shall extend a minimum of ½ in. (13 mm) beyond both ends of the flaws to be overlayed. The depth of the examination volume shall extend from the O.D. surface of the weld overlay to points C and D, located at a depth of t/4, as shown in Figure Q-4300-1. There is no weld in the area requiring weld overlay, so the examination volume shown in Figure Q-4300-1 extending ½ in. (13 mm) from the toe of the weld is not applicable.

5.1.5 Preservice ultrasonic examination shall be performed in accordance with Q-4200, using ASME Section XI, Appendix VIII qualified procedure, personnel, and equipment. The examination shall be performed using procedure EPRI-WOL-PA-1, "Nondestructive Evaluation: Procedure for Manual Phased Array Ultrasonic Testing of Weld Overlays", which is qualified to accurately detect and size discontinuities within the specified examination volume from the outside diameter (OD) overlay surface. Additionally the diameter and thickness of weld overlay being examined is within the qualification Ranges of Applicability as described in the procedure. Although this procedure is intended for use in examining overlays of similar and dissimilar metal welds (and adjacent base material), the technical requirements and qualification conditions are specified and are applicable to the underlying base material. For this reason, this procedure meets the intent of ASME Section XI, Appendix VIII for the proposed examinations.

5.1.6 The requirements of Q-4300 are not applicable because Duke Energy shall remove the weld overlay during refueling outage 2EOC24.

5.1.7 All other applicable requirements of the ASME Code, Section XI, 2007 Edition with the 2008 Addenda, IWA-4000 shall be met.

5.2 Duke Energy believes that the proposed alternative is justified for the following reasons:

5.2.1 Nonmandatory Appendix Q is part of the ASME Code, Section XI, 2007 Edition with the 2008 Addenda, which has been incorporated by reference in 10 CFR 50.55a. Although Duke Energy believes that the requirements of Nonmandatory Appendix Q are suitable for use in performing a weld overlay on piping, approval is requested in accordance with 10 CFR 50.55a(z)(2) for the specific weld overlay of the as-found flaws in the piping identified in this request.

5.2.2 The proposed alternative addresses modification of the requirements of Nonmandatory Appendix Q for use in the installation of a weld overlay on piping base material flaws, in lieu of the overlay of a piping weld.

5.2.3 The design of the weld shall comply with all of the requirements of Nonmandatory Appendix Q, with exceptions noted herein.

5.2.4 The flaw characterization and evaluation requirements of Nonmandatory Appendix Q, Q-3000(a) shall be met, except as noted in 5.1.1 of this request. Crack growth, including stress corrosion cracking and fatigue crack growth, shall be evaluated using IWB-3640.

5.2.5 Preservice ultrasonic examination of the weld overlay and outer 25% of the pipe wall shall be performed in accordance with 5.1.5 of this request.

5.2.6 A system leakage test and VT-2 examination shall be performed following completion of the weld overlay, in accordance with Q-4400, IWA-4540, and IWA-5000.

5.2.7 Duke Energy shall perform a repair/replacement activity in accordance with IWA-4000 of the 2007 Edition with the 2008 Addenda during refueling outage 2EOC24 (currently scheduled to start in March, 2017). This repair/replacement activity will involve the replacement of the 5D bend and the weld overlay in the boron injection line.

5.3 Duke Energy is actively working to determine the root cause of this event, but a final, conclusive cause cannot be determined until the 5D bend containing the flaws is removed and metallurgical analysis is completed during refueling outage 2EOC24. The following preliminary findings have been provided by the Root Cause evaluation team:

5.3.1 Cracking is likely being influenced by residual stress from forming the 5D bend, applied torsional stress, or both.

5.3.2 Axial cracking near the intrados (in the "cheeks") of a pipe bend is a common location for ID-initiated axial cracks due to the residual stress patterns formed in cold-formed pipe bends. The straightness of the cracking implies a fatigue mechanism, which could be caused by either thermal and/or mechanical fatigue. The 5D bend was fabricated by a vendor using piping material supplied by Duke Energy and was installed during the 2014 refueling outage 2EOC22. The PT conducted on the 5D pipe bend prior to installation at receipt inspection did not indicate flaws.

5.3.3 Torsional stress at the nozzle area and 5D bend is suspected because of pipe interaction with a pipe rupture restraint installed near the bottom of the vertical piping segment just upstream from (below) the 5D bend. Duke Energy has determined by taking cold position measurements that the piping was misaligned with the adjacent rupture restraint, and contact between the pipe and the rupture restraint is suspected due to the anticipated thermal movement of the system. This would generate torsion stresses at the upper nozzle/pipe area and is suspected of being a contributor to the cause of the flaws. An engineering change package will modify the restraint to provide adequate clearances, prior to returning the unit to service.

5.3.4 Thermal fatigue cannot be ruled out due to the flaw being in the EPRI MRP-146 susceptible area. However, the flaw orientations are atypical of thermal fatigue cracks observed previously at McGuire.

5.3.5 Vibration data will be collected to confirm whether mechanical fatigue due to vibration has contributed to, or caused this condition. However, previously collected vibration data does not support mechanical fatigue as the likely cause.

5.3.6 Subsequent UT of the pipe after the leak occurred found no other flaws in the bent pipe and nozzle area other than at the local area near the leak.

5.3.7 Duke Energy believes that unacceptable degradation to the weld overlay repair will not occur before refueling outage 2EOC24, regardless of the cause. This is supported by the fracture mechanics evaluation performed for the weld overlay design.

5.4 For the above reasons, Duke Energy believes that compliance with the requirement of IWA-4420 to remove the defect prior to performing a repair/replacement activity in accordance with IWA-4000 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

6.0 Duration of Proposed Alternative

This alternative is requested for use during the McGuire Unit 2 fourth inservice inspection interval, which began on July 15, 2014 and is currently scheduled to end on December 14, 2024.

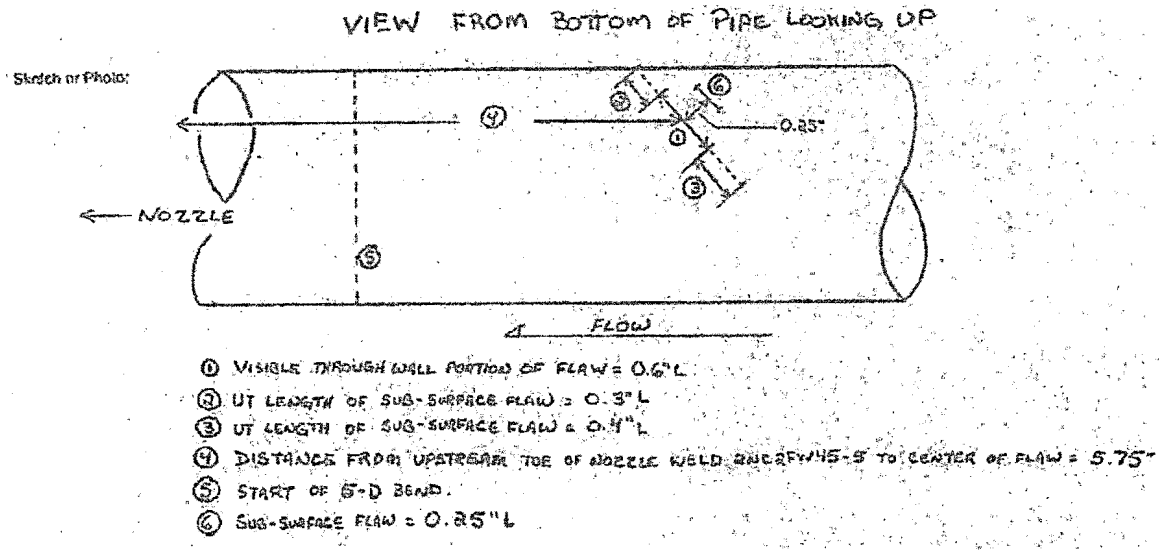
Use of the proposed alternative is requested only until refueling outage 2EOC24 (currently scheduled to begin in March, 2017), during which the affected pipe and weld overlay shall be removed and a permanent repair/replacement activity shall be performed in accordance with IWA-4000.

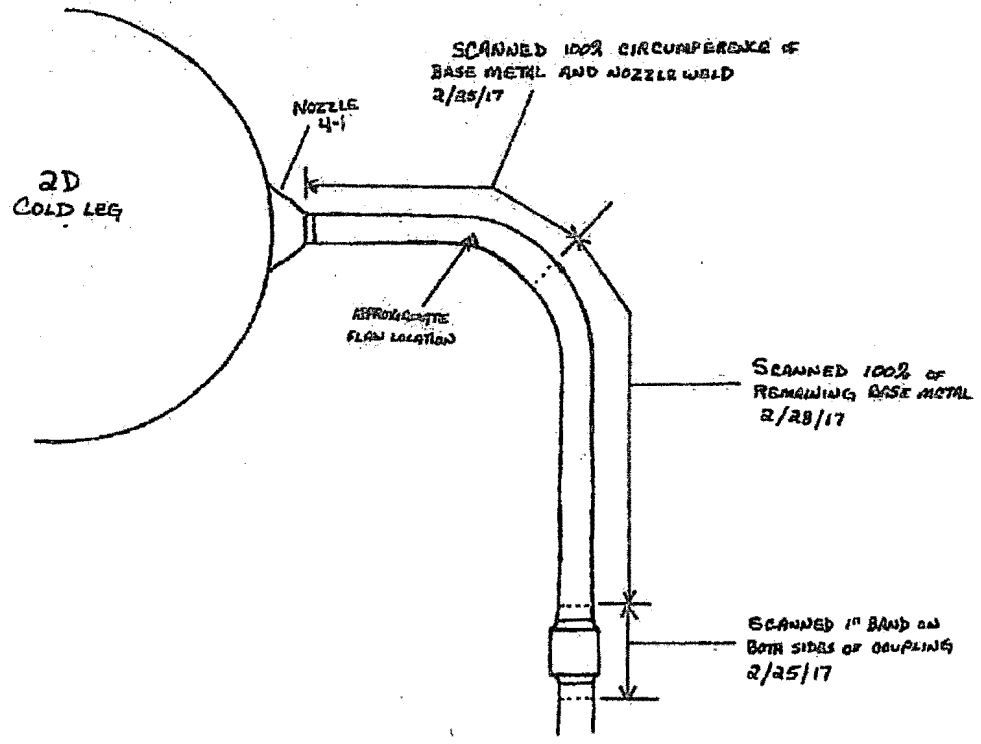
7.0 Related Industry Relief Requests

None.

Attachment 1

Nondestructive Examination Data for the NPS 1-1/2 Schedule 160 5D Bend in the Boron Injection Line to 2D Reactor Coolant System Cold Leg





Elevation View

Attachment 2 - AREVA Information

The following AREVA engineering products are in the process of owner acceptance:

1. 02-9268348 Drawing, McGuire Unit 2 Safety Injection Line Full Structural Weld Overlay Implementation

2. 08-9268347-000 McGuire Unit 2 Cold Leg 'D' Safety Injection Line Elbow Overlay

3. 51-9268389-000 McGuire Unit 2 Safety Injection Line Elbow Weld Overlay Fracture Mechanics Evaluation

4. 32-9268474-000 McGuire Unit 2 Cold Leg Safety Injection Line Elbow Sizing Calculation

5. 32-9268383 McGuire Unit 2 Cold Leg Injection Line Piping Loads for Weld Overlay