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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Subject: Duke Energy Carolinas, LLC (Duke Energy)
McGuire Nuclear Station, Unit 2
Docket No. 50-370
Relief Request 15-MN-003
Limited Weld Examinations
Response to Request For Additional Information

By letter dated July 9, 2015, Duke Energy submitted the subject Relief Request to the U. S. Nuclear Regulatory Commission (NRC) for approval. By letter dated November 25, 2015, the NRC requested additional information. The enclosed document provides the requested information.

This submittal contains no regulatory commitments.

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

Sincerely,

Jimmy Hess
for

Steven D. Capps

Enclosure

A047
NRR

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Relief Request 15-MN-003

Request for Additional Information

ENCLOSURE

REQUEST FOR ADDITIONAL INFORMATION

RELIEF REQUEST 15-MN-003, SECTIONS 3.0 ISI AND 4.0 ISI, REGARDING WELD

EXAMINATION COVERAGE

DUKE ENERGYCAROLINAS, LLC

MCGUIRE NUCLEAR STATION, UNIT 2

DOCKET NUMBER 50-370

By letter dated July 9, 2015 (Accession Number ML15202A126), Duke Energy Carolinas, LLC (Duke) requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code). Relief request 15-MN-003, Section 3.0 ISI and Section 4.0 ISI pertain to the examination coverage of the ASME Code Class 1 piping welds (Weld Number 2NC2FW39-1 and 2NC2FW45-5) at the McGuire Nuclear Station, Unit 2.

To complete its review, the NRC staff requested additional information. Each request followed by the Duke Energy response is provided below:

NRC RAI Question 1:

1. The NRC staff notes that the third 10-year ISI interval started on March 1, 2004, and ended on July 14, 2014. It appears that the third 10-year ISI interval was greater than ten calendar years. Clarify whether IWA-2430 was invoked to extend the third 10-year ISI interval by a few month not exceeding one year, and that all applicable requirements in IWA-2430 have been met.

Duke Energy Response to RAI Question 1:

The McGuire Unit 2 Third 10-Year ISI Interval was extended to July 14, 2014, per the ASME Section XI Code, 1998 Edition with 2000 Addenda, Section IWA-2430. All applicable requirements in IWA-2430 have been met.

NRC RAI Question 2:

2. For Weld Numbers 2NC2FW39-1 and 2NC2FW45-5, (a) Discuss the inservice inspection (ISI) history (e.g., inspection years and disposition of detected flaws); (b) Discuss whether the licensee identified any indication(s) during construction and preservice inspections (i.e., radiographic testing or surface examination, or both) on the volume not covered by UT; and (c) Discuss disposition of identified flaws.

Duke Energy Response to RAI Question 2 (a):

Weld 2NC2FW45-5 received a surface examination on September 13, 2003, during the second ISI interval per ASME XI 1989 Edition under Item No. B9.21 of Table IWB-2500-1. The examination result was acceptable with no coverage limitation reported. This weld was a High Safety Significant weld in the RI-ISI program in the third ISI interval and received a volumetric examination on April 1, 2014. The volumetric examination located a circumferential linear indication adjacent to the downstream side of the weld and an axial indication approximately 0.8 inch in length. This weld was then repaired, and the preservice inspection was performed with limited coverage. Request for relief from the coverage limitation was submitted under RR 15-MN-003.

Weld 2NC2FW39-1 received a surface examination on April 9, 1996, in the second ISI interval per ASME XI 1989 Edition under Item No. B9.21 of Table IWB-2500-1. The examination result was acceptable with no coverage limitation reported. This weld also received Ultrasonic Testing (UT) examination as part of the extent of the condition activities following the discovery of the indication in weld 2NC2FW45-5 in the third interval. The examination result was acceptable. Examination coverage was limited, and a relief request for the limited coverage was submitted under RR 15-MN-003.

Duke Energy Response to RAI Question 2 (b):

There were no indications recorded by surface examination or radiographic testing during construction and preservice inspections on the area/volume that was not covered by UT for weld 2NC2FW39-1.

No crack-like or geometric reflector type indications were detected for weld 2NC2FW45-5 during construction and preservice inspections. One rounded tungsten indication with a dimension of 0.039 inch was recorded by radiography in the area not covered by UT and dispositioned as a tungsten inclusion from the welding process.

Duke Energy Response to RAI Question 2 (c):

See response to RAI question 2 (b).

NRC RAI Question 3:

3. Discuss any walkdowns (e.g., under Boric Acid Corrosion Control program or normal operator round) usually performed to monitor and identify leakage in the event of a through wall leak.

Duke Energy Response to RAI Question 3:

2NC2FW39-1 and 2NC2FW45-5 are the first nozzle weld of the A-Loop and D-Loop Reactor Coolant System (RCS) primary Cold Legs connecting to the 1.5" diameter Safety Injection lines, respectively. The location of these welds is inaccessible during normal power operation and only becomes available for walkdown and/or inspection during outage periods.

During outage periods, these locations are within the general inspection areas covered by formal Mode 3 power-down walkdown and Mode 3 power-up walkdown as committed to for the Boric Acid Corrosion Control Program. Through-wall leakage resulting in boric acid accumulation would be detected through these walkdowns. Additionally, these areas are also inspected for evidence of boric acid leakage during other outage walkdowns such as Mode 5 engineering walkdown.

During online periods, leakage monitoring is achieved through RCS leakage detection and ventilation drain tank accumulations as discussed in response to question 4 of this RAI.

NRC RAI Question 4:

4. In the event of a potential through wall flaw and leakage, discuss significance of the leak and potential for structural failure of the subject welds.

Duke Energy Response to RAI Question 4:

Should water leak out of either of these weld locations, it will immediately partially flash to steam. Some portion of the leakage is expected to remain in the liquid phase and possibly undergo some secondary boiling due to surrounding temperatures, but the percentage of primary flashing and secondary boiling will vary based upon the local site leakage conditions. A portion of the leakage would be directed to the lower containment ventilation units drain tank (VUCDT), and the rest would accumulate on the containment floor and eventually go to a Containment Floor and Equipment Sump. If the leak is significant, the VUCDT and Containment Floor and Equipment Sump would indicate a significant increase. Furthermore, the increased leakage would be identified through the daily primary system leakage calculation.

Leakage from these welds would be considered a pressure boundary leak. Per Technical Specification (TS) 3.4.13, no pressure boundary leakage is allowed. If leakage is identified to be from this source, the Unit is required to be in Mode 3 in six hours and Mode 5 in 36 hours. Furthermore, if this leakage cannot be identified as pressure boundary leakage, it would be seen as unidentified leakage. If the unidentified leakage rate increases to greater than 1 gpm, the plant would be required to be in Mode 3 in six hours and Mode 5 in 36 hours as denoted in TS 3.4.13.

For a leakage rate of less than 1 gpm, adequate makeup through the use of the Volume Control Tank is available. The impact to the RCS is minimal and the effect on accident analysis is minimal. Should leakage increase to greater than 1 gpm, a required shut down would be in order. In addition, the primary system leakage detection capability would identify a leak early enough so actions could be taken prior to the leak propagating to failure. This, therefore, provides reasonable assurance that the weld integrity would be maintained.

In summary, the consequences from a leakage magnitude less than 1 gpm can be mitigated. However, once the leakage is identified as coming from one of these locations, it would be determined to be Pressure Boundary leakage and shutdown to Mode 3 within 6 hours is required. Unidentified leakage of greater than 1 gpm would also require shutdown to Mode 3 within 6 hours.

NRC RAI Question 5:

5. (a) Discuss any industry or plant-specific operating experience regarding potential degradation (e.g., stress corrosion cracking and fatigue) and potential severe loading (e.g., vibration, water hammer, and overloading) for Weld Number 2NC2FW39-1 and 2NC2FW45-5.

(b) The NRC staff notes that due to recent operating experience regarding thermal fatigue cracking in some plants, the Electric Power Research Institute (EPRI) issued an interim guidance "EPRI-MRP Interim Guidance for Management of Thermal Fatigue

(Accession Number ML15189A100)" that supplemented the existing industry thermal fatigue guidelines (e.g., MRP-146 and MRP-192) to better manage thermal fatigue cracking. Discuss whether Duke will take any compensatory measures to better manage thermal fatigue cracking in the subject welds to ensure structural integrity and leak tightness since essentially 100 coverage was not achieved by the UT.

<u>Duke Energy Response to RAI Question 5 (a):</u>
An industry search for operating experience (OE) was performed using the INPO ICES database. The following events were reviewed in detail:

- LER 390-06005 - Reactor Coolant System Pressure Boundary Leak - Watts Bar Unit 1.
- LER 425-06002 - Forced normal Rx shutdown due to failure of weld in Reactor Coolant System (PWR) pipe 21201PIPE. - Vogtle Unit 2.
- OE2324 - Fatigue Caused By Thermal Cycling Causes Cracked Weld Joint In Cold Leg Safety Injection Line - Farley Unit 2.
- #159552 -Safety Injection System Pipe Flaw - Sequoyah Unit 2.
- #165143 - Unisolable Reactor Coolant System Leak at Cold Leg High Pressure Injection Nozzle - Oconee Unit 2.
- #203360 - Cracked Attachment Weld Found on Primary System Thermal Sleeve - North Anna Unit 1.
- LER 361-06001 Both trains of Shutdown Cooling Declared Inoperable Due to the Discovery of a Through Wall Pipe Crack in Common Header - San Onofre Unit 2.
- #313099 - Reactor Coolant System Safety Injection Line Ultrasonic Testing Indicated Thermal Fatigue Cracks - McGuire Unit 1.
- #310440 - McGuire Unit 2 - Reactor Coolant System Safety Injection Line Ultrasonic Testing Indicated Thermal Fatigue Cracks.

<u>Conclusion</u>
A review of the applicable OE above reveals that welds on similar piping are susceptible to cracking given the right conditions (thermal cycling, vibration, time, etc). None of the OE referenced here describes failures related to severe loading due to water hammer. In the majority of circumstances, the condition of thermal cycling or vibration was determined to be the root cause of the failures. The Industry OE also reveals that all of the failures and subsequent events were managed safely based on guidelines and requirements of the code and technical specifications limiting conditions of operation. Site specific OE for the welds in question shows failures only related to thermally induced fatigue.

<u>Duke Energy Response to RAI Question 5 (b):</u>
<u>Weld 2NC2FW39-1:</u> McGuire has increased the inspection volume coverage to include the pipe to nozzle butt weld and the vertical pipe base metal up to two pipe diameters per EPRI Interim Guidance MRP 2015-025 2.3.1 ("UH" configuration). This is inspected every RFO and completed 2EOC23 (Fall 2015) with no indications. Due to nozzle configuration, similar coverage limitations as obtained in 2EOC22 (Aggregate coverage 50% due to taper configuration of nozzle) were encountered. Thermocouples were

installed upstream of the weld to monitor temperatures every RFO at full temperature and pressure. All readings during 2EOC23 were within tolerance.

Weld 2NC2FW45-5: This weld is inspected every RFO per MRP-146 ("H" configuration) and completed 2EOC23 (Fall 2015) with no indications. Due to nozzle configuration, similar coverage limitations as obtained in 2EOC22 (Aggregate coverage 50% due to taper configuration of nozzle) were encountered. Valve 2NI-3 has been removed, which will prevent in leakage through this upstream valve. Thermocouples were also installed upstream of the weld to monitor temperatures every RFO at full temperature and pressure. All readings during 2EOC23 were within tolerance.

Note: This weld had a recordable flaw discovered during 2EOC22 (along with base metal and nozzle) and the pipe, weld, and nozzle were replaced/repaired during 2EOC22.

In addition, Duke Energy's non-destructive examination procedures have been revised to ensure specified volume sketches are provided to examiners, coverage volumes are calculated, and <100% coverage volumes are dispositioned by the Responsible Engineer (per EPRI Interim Guidance MRP 2015-025 2.4.1, 2.4.2, and 2.4.3).

NRC RAI Question 6:

6. Discuss whether Duke has inspected similar welds in comparable environments subject to similar degradation mechanism (i.e., thermal fatigue cracking) and achieved the ASME Code required coverage in the current or previous 10-year ISI intervals.

Duke Energy Response to RAI Question 6:

Similar welds located in similar environments that were subject to similar degradation have been examined in both McGuire Units 1 and 2. The results of these examinations are shown below:

McGuire Unit 1

Weld ID No. 1NC1F-1492(M1.R01.011.0015) Examined 1EOC16 100% Coverage
Weld ID No. 1NC1F-1493(M1.R1.11.0002) Examined 1EOC21 37.50% Coverage
Weld ID No. 1NC1F-1613(M1.R1.11.0004) Examined 1EOC21 37.50% Coverage
Weld ID No. 1NC1F-1615(M1.R1.11.0003) Examined 1EOC21 37.50% Coverage

McGuire Unit 2

Weld ID No. 2NC2FW40-11(M2.R1.11.0049) Examined 2EOC17 37.50% Coverage
Weld ID No. 2NC2FW40-11(M2.R1.11.0049) Examined 2EOC19 37.50% Coverage
Weld ID No. 2NC2FW43-1(M2.R1.11.0050) Examined 2EOC17 37.50% Coverage
Weld ID No. 2NC2FW43-1(M2.R1.11.0050) Examined 2EOC19 37.50% Coverage