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

August 20, 2012

Mr. K. Henderson
Site Vice President
Catawba Nuclear Station
Duke Energy Carolinas, LLC
4800 Concord Road
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2, PROPOSED RELIEF REQUEST 11-CN-001 FOR THE THIRD 10-YEAR INSERVICE INSPECTION INTERVAL (TAC NOS. ME7277, ME7278, ME7279, ME7280, ME7281, ME7282, AND ME7283)

Dear Mr. Henderson:

By letter dated September 28, 2011, as supplemented by letter dated May 3, 2012, Duke Energy Carolinas, LLC (the licensee) submitted a relief request (RR) 11-CN-001, to the Nuclear Regulatory Commission (NRC) for the use of alternatives to certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, related to inservice inspection (ISI) of welds. RR 11-CN-001 was requested for the remainder of Catawba Nuclear Station, Units 1 and 2 (Catawba 1 and 2), third 10-year ISI interval. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(6)(i), the licensee requested to use alternatives on the basis that complying with the specified requirement is impractical.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the proposed alternatives for weld ISI would provide reasonable assurance of leak-tightness and structural integrity of the piping and component segments identified in RR 11-CN-001, and that complying with the specified ASME Code, Section XI, requirements is impractical. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), the NRC staff authorizes the licensee's proposed alternatives as described in RR 11-CN-001, Sections 2.0 through 10.0 for the duration of the Catawba 1 third ISI interval, currently scheduled to end on July 15, 2014. The NRC staff also authorizes the licensee's proposed alternatives as described in Sections 11.0 and 12.0 for the duration of the Catawba 2 third ISI interval, currently scheduled to end on August 19, 2016.

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 In-service Inspector.

If you have any questions, please contact the Project Manager, Jon H. Thompson at 301-415-1119 or via e-mail at Jon.Thompson@nrc.gov.

Sincerely,

John Boska

John Boska, Acting Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

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

RELIEF REQUEST NO. 11-CN-001 REGARDING ALTERNATIVE REQUIREMENTS FOR LIMIT WELD EXAMINATIONS OF ASME CODE CLASS 1 COMPONENTS

DUKE ENERGY CAROLINAS, LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

1.0 INTRODUCTION

By letter dated September 28, 2011, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11278A184), as supplemented by letter dated May 3, 2012 (ADAMS Accession No. ML12125A297), Duke Energy Carolinas, LLC. (Duke, the licensee) submitted relief request (RR) 11-CN-001 to the U.S. Nuclear Regulatory Commission (NRC) staff for review and approval. RR 11-CN-001 requested the use of alternatives to certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI. Specifically, the licensee has requested relief from ASME Code requirements pursuant to the regulation at Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(6)(i). The RR requests relief for several welds where the licensee was not able to achieve essentially 100% inspection coverage due to limitations of design, geometry, and materials of construction of the components.

The ASME Code of record for the third 10-year inservice inspection interval (ISI) program for both Catawba 1 and 2 is the ASME Code, Section XI, 1998 Edition through the 2000 Addenda. The third 10-year ISI for Catawba 1 started on June 29, 2005, and is currently scheduled to end July 15, 2014. The third 10-year ISI for Catawba 2 started on October 15, 2005, and is scheduled to end on August 19, 2016.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) "must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions and addenda of the ASME [Boiler and Pressure Vessel] B&PV Code ... to the extent practical within the limitations of design, geometry, and materials of construction of the components."

Enclosure

The regulation at 10 CFR 50.55a(g)(5)(iii), states that "If the licensee has determined that conformance with a code requirement is impractical for its facility, the licensee shall notify the NRC and submit, as specified in § 50.4, information to support the determinations. Determinations of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the code requirements during the inservice inspection interval for which the request is being submitted. Requests for relief made in accordance with this section must be submitted to the NRC no later than 12 months after the expiration of the initial or subsequent 120-month inspection interval for which relief is sought."

The regulation at 10 CFR 50.55a(g)(6)(i), states that "The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility."

3.0 TECHNICAL EVALUATION

The information provided by the licensee in support of RR 11-CN-001 for relief from ASME Code requirements has been evaluated and the bases for disposition are documented below. For clarity, the licensee's requests have been evaluated according to ASME Code Examination Category and the corresponding section of RR 11-CN-001.

3.1 Sections 2.0 and 3.0 of RR 11-CN-001, Examination Category B-D, Item 3.110

ASME Code Components

Catawba 1 Pressurizer (PZR) Spray Nozzle-to-Upper Head Weld, Weld #1PZR-W2, Summary Number C1.B3.110.0002.

Catawba 1 PZR Safety/Relief Nozzle-to-Upper Head Weld, Weld #1PZR-W3, Summary Number C1.B3.110.0003.

ASME Code Requirement for Section 2.0 and 3.0 of RR 11-CN-001

ASME Code, Section XI, Examination Category B-D, Item B3.110, requires 100% volumetric examination, as defined by ASME Code, Section XI, Figures IWB-2500-7 (b), as applicable, of full penetration ASME Code, Class 1, nozzle-to-vessel welds on the PZR. ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1," was approved for use by the NRC in Regulatory Guide (RG) 1.147, Revision 16, "Inspection Code Case Acceptability, ASME Section XI, Division 1" (RG 1.147, Revision 16). ASME Code Case N-460, states that "... when the entire examination volume or area cannot be examined due to interference by another component or part geometry, a reduction in examination coverage on any Class 1 or Class 2 weld may be accepted provided the reduction in coverage for that weld is less than 10%" (i.e. greater than 90% examination coverage is obtained).

Licensee's Request for ASME Code Relief in Sections 2.0 and 3.0 of RR 11-CN-001

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination of ASME Code, Class 1 PZR Spray Nozzle-to-Upper Head Welds, #1 PZR-W2 and #1 PZR-W3.

Licensee's Analysis of RR 11-CN-001 Section 2 (as stated, in part):

Impracticality of Compliance

- Surface 1: Upper Head - Carbon steel
- Surface 2: Spray nozzle - Carbon steel
- Diameter: 12.750 in.
- Thickness: 3.000 in.

The ultrasonic [(UT)] examination of this weld obtained 81.7% coverage of the required examination volume. Because of the weld configuration, the requirements of ASME [Code,] Section V, Article 4, T-441.1.2(a), T-441.1.3, T-441.1.4, T-441.1.5, and T-441.1.6 could not be met. The aggregate coverage was calculated from the following base and weld metal scan results:

- Weld coverage using 35°& 45° shear waves for axial scans (S1, S2), and 35° & 45° shear waves for circ. scans ([clock wise] CW, [counter clock wise] CCW) obtained 91.9% coverage.
- Base material coverage using 35°, 45°& 60° shear wave for axial scans (S1) and 35°& 45° shear waves for circ. scans (CW, CCW) obtained 77.5% coverage.
- 0° scan coverage obtained 75.6% coverage.
- The aggregate coverage was calculated to be (91.9% + 77.5% +75.6%)/3 = 81.7%.

The limitation was caused by the weld taper configuration created by the attachment of the spray nozzle to the upper head not allowing scanning from Surface 2. In order to scan all of the required volume for this weld, the upper head to spray nozzle attachment weld would have to be redesigned to allow scanning from both sides of the weld, which would place a significant burden on the licensee.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage. The achieved coverage did not meet the acceptance criteria of this Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1.B3.110.0002 [(Weld #1PZR-W2)] was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code] Section XI, 1998 Edition with the 2000 Addenda.

The system leakage test performed each refueling outage in accordance with [ASME Code, Section XI] Table IWB-2500-1; Examination Category B-P requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric and pressure test), Reactor Building Normal Sump monitoring and other [Reactor Coolant System] RCS leakage detection systems provide additional assurance that, in the event that leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the pressure testing (VT-2 [visual]) examinations required by [ASME Code,] Section XI, and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met.

Licensee's Analysis of RR 11-CN-001, Section 3.0

Impracticality of Compliance

- Surface 1: Upper Head - Carbon steel
- Surface 2: Safety/Relief nozzle - Carbon steel
- Diameter: 15.000 in.
- Thickness: 3.000 in.

The ultrasonic examination of this weld obtained 81.2% coverage of the required examination volume. Because of the weld configuration, the requirements of ASME [Code,] Section V, Article 4, T-441.1.2(a), T-441.1.3, T-441.1.4, T-441.1.5 and T-441.1.6 could not be met. The aggregate coverage was calculated from the following base and weld metal scan results:

- Weld coverage using 35° & 45° shear waves for axial scans (S1, S2), and 35° & 45° shear waves for circ. scans (CW, CCW) obtained 93.0% coverage.
- Base material coverage using 35°, 45°& 60° shear wave for axial scans (S1) and 35° & 45° shear waves for circ. scans (CW, CCW) obtained 76.2% coverage.
- 0° scan coverage obtained 74.3% coverage.
- The aggregate coverage was calculated to be (93.0% + 76.2% + 74.3% /3 = 81.2%.

The limitation was caused by the weld taper configuration created by the attachment of the safety/relief nozzle to the upper head not allowing scanning from Surface 2. In order to scan all of the required volume for this weld, the upper head to safety/relief nozzle attachment weld would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage. The achieved coverage did not meet the acceptance criteria of this Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1.63.110.0003 [(Weld #1PZRW3)] was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

The system leakage test performed each refueling outage in accordance with [ASME Code, Section XI,] Table IWB-2500-1; Examination Category B-P requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric and pressure test), Reactor Building Normal Sump monitoring and other RCS leakage detection systems provide additional assurance that, in the event that leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the pressure testing (VT-2 [visual]) examinations required by [ASME Code,] Section XI, and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Sections 2.0 and 3.0 (as stated):

Radiography (RT) is not a desired option because there is no access for film placement.

No other substitution alternative for this weld is available which would provide better coverage.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Section 2.0 and 3.0

The ASME Code requires 100% volumetric examination of ASME Code, Class 1 PZR nozzle-to-vessel welds. Both welds are carbon steel welds that join carbon steel components. In addition, the ASME Code requires that the volumetric examination be conducted from both sides of these pressure-retaining welds. However, the design configurations of the subject nozzle-to-vessel welds limit access for UT scanning primarily to the vessel side of the welds.

The subject PZR Spray Nozzle-to-Upper Head Weld #1 PZR-W2, and PZR Safety/Relief Nozzle-to-Upper Head Weld #1 PZR-W3 are constructed of carbon steel material, with stainless steel inside diameter (ID) cladding. The welds extend the full thickness of the PZR vessel. The subject nozzles have a weld taper configuration created by the attachment of the spray nozzle to the upper head or attachment of the safety/relief nozzle to the upper head, not allowing

scanning from either the PZR Spray Nozzle or Safety/Relief nozzle respectively. This design geometry limits ASME Code-required UT angle beam examinations to be performed primarily from the vessel side of the welds. In order to effectively increase the examination coverage, the subject nozzles would require design modifications or replacement.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject nozzle-to-vessel welds have been completed to the extent practical with aggregate coverage of 81.7% and 81.2%, respectively. Welds 1PZR-W2 and 1PZR-W3 were examined prior to the performance demonstration requirements outlined in ASME Code, Section XI, Appendix VIII. Therefore these examinations were conducted using ASME Code-required technical guidance at the time of the examinations. The subject welds were examined in accordance to ASME Code, Section V, Article 4.

For the Spray Nozzle-to-Upper Head Weld #1 PZR-W2 coverage was obtained using 35-degree and 45-degree shear waves for axial scans, and 35-degree & 45-degree shear waves for circular scans (CW, CCW) obtained 81.7% coverage. For Weld #1 PZR-W2 base material examinations using 35-degree, 45-degree and 60-degree shear wave for axial scans and 35-degree and 45-degree shear waves for circular scans (CW, CCW) obtained 77.5% coverage. When using a zero degree scan 75.6% coverage was obtained. These scans resulted in an aggregate coverage of 81.7% coverage for Weld #1 PZR-W2.

For PZR Safety/Relief Nozzle-to-Upper Head Weld #1 PZR-W3 coverage was obtained using 35-degree and 45-degree shear waves for axial scans and 35-degree and 45-degree shear waves for circular scans (CW, CCW) obtained 93.0% coverage. For Weld #1 PZR-W3 base material examinations using 35-degree, 45-degree, and 60-degree shear wave for axial scans and 35-degree and 45-degree shear waves for circular scans (CW, CCW) obtained 76.2% coverage. When using a 0-degree scan 74.3% coverage was obtained. These scans resulted in an aggregate coverage of 81.2% of Weld #1 PZR-W3.

The examination volumes included the weld and base materials near the inside surface of the weld joint, which are typically the highest regions of stress and where one would expect degradation sources to be manifested should they occur. No flaw indications were recorded during these examinations. Although UT scans were primarily limited to the vessel side only, recent studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment[1]. Therefore, due to the fine-grained carbon steel microstructures, it is expected that the UT techniques employed would have detected structurally significant flaws that may have occurred on either side of the subject welds.

Based on above, the NRC staff has determined that the licensee has shown that it is impractical to meet the ASME Code-required 100% volumetric examination coverage for the subject PZR nozzle-to-vessel welds due to the nozzle designs. The NRC staff has further determined that to require the licensee to modify the subject nozzle welds in order to perform the ASME Code-required 100% examination coverage would be impractical. In addition, based on the volumetric coverage obtained for the subject welds, and considering the licensee's performance of UT

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1 P. G. Heasler and S. R. Doctor, 1996. Piping Inspection Round Robin, NUREG/CR-5068, PNNL-10475, U.S. Nuclear Regulatory Commission, Washington, DC.

techniques employed to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. The NRC staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. Thus, the NRC staff has determined that criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality have been met for welds #1 PZR-W2 and #1 PZR-W3.

3.2 Sections 4.0 and 5.0 of RR 11-CN-001, Examination Category C-A, Item C1.20

ASME Code Components

Catawba 1 Heat Exchanger Head to Flange Weld, Weld #1 ELDHX-HD-FLG, Summary Number C1.C1.20.0003.

Catawba 1 Tank Lower Head to Shell Weld, Weld #1 VCT-LH-SH, Summary Number C1.C1.20.0019.

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-A, Item Number C1. 20, requires essentially 100% volumetric examination, as defined by ASME Code, Section XI, Figures IWC-2500-1 of these two welds, the Let Down Heat Exchanger (LDHX) Head-to-Flange Weld #1 ELDHX-HD-FLG, Summary Number C1.C1.20.0003, and Chemical and Volume Control System (CVCS) Tank Lower Head-to-Shell Weld #1 VCT-LH-SH, Summary Number C1.C1.20.0019. "Essentially 100 percent", as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's Request for ASME Code Relief in Sections 4.0 and 5.0 of RR 11-CN-001

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination Catawba 1 Heat LDHX Head-to-Flange Weld #1 ELDHX-HD-FLG, Summary Number C1.C1.20.0003 and CVCS Tank Lower Head-to-Shell Weld, Weld #1 VCT-LH-SH, Summary Number C1.C1.20.0019.

Licensee's Analysis of RR 11-CN-001, Section 4.0 (as stated, in part):

> Impracticality of Compliance
>
> Surface 1: Carbon Steel Flange
> Surface 2: Stainless Steel Head
> Diameter: 9.5 inch
> Thickness: 0.750 inch
>
> The ultrasonic examination of the Heat Exchanger head-to flange weld obtained 30.6% coverage of the required examination volume. ASME Section XI, Appendix III, III-4420 requires coverage of the examination volume in two beam path directions and

Appendix III, III-4430 requires scanning on the weld crown in two directions. Due to the presence of nozzles, the scanning was limited in each direction for 50% of the total weld length. The total aggregate percent of coverage was calculated as follows:

Axial scans
- 45° shear waves obtained 0.00% coverage at location of 4 nozzles
- 45° shear waves & 70RL waves obtained 29.7% coverage at remaining length
- Total axial coverage obtained 0.00% + 29.7% = 29.7%

Circ scans
- 45° shear waves obtained 13.2% coverage at location of 4 nozzles
- 45° shear waves obtained 18.2% coverage at remaining length
- Total axial coverage obtained 13.2% + 18.2% = 31.4%
- This aggregate coverage was calculated to be (29.7% + 31.4%) = 61.1%/2 = 30.6 %

The limitations were caused by the four physical scanning limitations, all located on the S2 head side. In order to scan all of the required volume for this weld, the heat exchanger would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage of examination A-B-C-D. The achieved coverage did not meet the acceptance criteria of this [ASME] Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the C1.C1.20.0003 was conducted was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

In addition to the above [ASME] Code required volumetric examination, Reactor Building Normal Sump monitoring provides additional assurance that, in the event that leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Analysis of RR 11-CN-001, Section 5.0 (as stated, in part):

Impracticality of Compliance

Surface 1: Stainless Steel Shell
Surface 2: Stainless Steel Lower Head
Diameter: 90.00 inch
Thickness: 0.250 inch

The ultrasonic examination of the lower head-to-shell weld obtained 89.4% coverage of the required examination volume. ASME [Code] Section XI, Appendix III, III-4420 requires coverage of the examination volume in two beam path directions and Appendix III, III-4430 requires scanning on the weld crown in two directions. Due to the presence four support legs, scanning was limited in each direction for 10.6% of the total weld length. The total aggregate percent of coverage was calculated as follows:

- 45° shear waves obtained 89.4% coverage in one axial direction (S1 - shell)
- 45° shear waves obtained 89.4% coverage in one axial direction (S2 - head)
- 45° shear waves obtained 89.4% coverage in one circ. direction (S3 - CW)
- 45° shear waves obtained 89.4% coverage in one circ. direction (S4 - CCW)
- This aggregate coverage was calculated to be
  (89.4% + 89.4% + 89.4% + 89.4%)/4 = 89.4%

The limitations were caused by the four support leg scanning limitations. In order to scan all of the required volume for this weld, the volume control tank would have to be redesigned to allow scanning in each required direction, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage of examination A-B-C-D. The achieved coverage did not meet the acceptance criteria of this [ASME] Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1.C1.20.0019 was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code] Section XI, 1998 Edition with the 2000 Addenda.

The system leakage test performed each period in accordance with [ASME Code, Section XI,] Table IWC-2500-1; Examination Category C-H requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 [visual] examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric and pressure test), periodic visual inspections performed by plant operators provide additional assurance that in the event leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the pressure testing (VT-2) examinations required by [ASME Code], Section XI, and the continuing periodic leakage inspections it is Duke's position that the combination of examinations provides a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Sections 4.0 and 5.0

The licensee considered RT and was determined not to be a desired option because there is no access for film placement and there was no other substitution alternative for this weld is available which would provide better coverage. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Section 4.0 and 5.0

The ASME Code requires essentially 100% volumetric examination of circumferential head welds on selected ASME Code, Class 2, pressure vessels. However, for the LDHX Head-to-Flange Weld #1 ELDHX-HD-FLG and CVCS Tank Lower Head-to-Shell Weld #1 VCT-LH-SH, complete examinations are limited due to the design configuration of these components. In order to achieve greater volumetric coverage, the subject components or the adjacent components would have to be redesigned and modified. This would place a burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the LDHX Head-to-Flange Weld #1 ELDHX-HD-FLG have been performed to the extent practical, with the licensee obtaining approximately 30.6% of the required ASME Code examination volume. The examinations are limited due to the presence of two 2-inch diameter and two ¾-inch diameter nozzles in close proximity to, and on one side of, the 9-1/2 inch diameter heat exchanger head-to-flange weld. The nozzle welds completely covered the adjacent base material on the lower head up to the toe of the weld for a total length of 15 inches of the total weld length of 30 inches. In order to scan all of the required volume for this weld, the heat exchanger would have to be redesigned to allow scanning from both sides of the weld, which would place a significant burden on the licensee.

The LDHX head is fabricated of stainless steel and the flange is fabricated of carbon steel. The licensee examined these welds completely from the head side using 45-degree shear waves to achieve full circumferential and axial coverage along the weld length. The licensee performed an additional 70-degree refracted longitudinal wave (L-wave) scan from the head to maximize coverage and obtained 59.4% coverage. L-wave techniques have been shown to provide enhanced detection on the far-side of stainless steel welds[2,3]. While the licensee has only taken credit for obtaining volumetric coverage of 30.6% from primarily one side of the subject weld, the techniques employed would have provided coverage beyond the near-side of the weld. Limited scanning was performed on the head side with a 45-degree shear wave due to proximity of nozzles on the heat exchanger head. No recordable flaw indications were observed. In addition the licensee performed VT-2 visual examinations on the subject component.

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2 F.V. Ammirato, X. Edelmann, and S.M. Walker, *Examination of Dissimilar Metal Welds in BWR Nozzle-to-Safe End Joints*, 8th International Conference on NDE in the Nuclear Industry, ASM International, 1987.
3 P. Lemaitre, T.D. Koble, and S.R. Doctor, *PISC III Capability Study on Wrought-to-Wrought Austenitic Steel Welds: Evaluation at the Level of Procedures and Techniques, Effectiveness of Nondestructive Examination Systems and Performance Demonstration*, PVP-Volume 317, NDE-Volume 14, ASME, 1995.

The following information was provided in the licensee's RAI response dated May 3, 2012, for the Heat Exchanger Head-to-Flange Weld #1 ELDHX-HD-FLG, Summary Number C1.C1.20.0003, regarding limitations were caused by the four physical scanning limitations, all located on the 82 head side.

> The limitations encountered on this weld were two 2 [inch] diameter and two ¾ [inch] diameter nozzles in close proximity to, and on one side of, the 9-1/2 [inch] diameter heat exchanger head-to- flange weld. The nozzle welds completely covered the adjacent base material on the Surface 2 head up to the toe of the weld for a total length of 15 inches. The total weld length, including the limited inspection areas, is 30 inches.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject weld due to the design geometry of the weld and proximity of the nozzles. However, based on the volumetric coverage of 30.6% obtained (including the non-credited 59.4% coverage obtained) and the UT techniques employed, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. In addition there has been no experience in industry of structural failure of similar components.

The NRC staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject components. Based on the above determinations, the NRC staff considers achieving essentially 100% coverage to be impractical. Thus, the NRC staff has determined that the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for LDHX Head-to-Flange Weld #1 ELDHX-HD-FLG.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the CVCS Tank Lower Head-to-Shell Weld, Weld #1 VCT LH SH have been performed to the extent practical, with the licensee obtaining approximately 89.4% of the required ASME Code examination volume. The examinations are limited due to the presence of four support legs. In order to scan all of the required volume for this weld, the volume control tank would have to be redesigned to allow scanning the entire weld, which would place a significant burden on the licensee.

The tank shell and head is fabricated of stainless steel. The licensee examined these welds completely from two directions of the weld using 45-degree shear waves to achieve full circumferential and axial coverage along the weld length. No recordable flaw indications were observed. The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject weld due to the four tank support legs. However, based on the volumetric coverage obtained, and the UT techniques employed, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. The NRC staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject components. Based on the burden associated with the required redesign and the technical assessment of the inspections performed, the NRC staff determined that achieving essentially 100% examination coverage is impractical. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for CVCS Tank Lower Head-to-Shell Weld, Weld #1 VCT-LH-SH.

3.3 Section 6.0 of RR 11-CN-001, Examination Category C-F-1, Item C5.21

ASME Code Component

Catawba 1 Piping Elbow to Tee Weld, Weld #1 NI11-9

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-1, Item C5.21, requires volumetric examination of 100% of the weld volume and surface as defined in Table IWC-2500-1 and shown in Figure IWC-2500-7(a). The licensee uses the alternative requirements of ASME Section XI, Code Case N-460, approved for use in RG 1.147, Revision 16, which allows credit for "essentially 100% coverage" of the welds provided greater than 90% of the required volume has been examined.

Licensee's Request for ASME Code Relief in Section 6.0 of RR 11-CN-001

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the 100% volumetric examination requirement for weld #1 NI11-9 contained in ASME Code, Examination Category C-F-1, Item Number C5.21. The weld designated #1 NI11-9 is an elbow-to-tee weld in piping connecting safety injection pumps 1A and 1B. The elbow and tee are stainless steel and have a nominal pipe size (NPS) of 4 inches.

Licensee's Analysis of RR 11-CN-001,Section 6.0 (as stated, in part):

Impracticality of Compliance

Component configuration:

- Surface 1: Stainless steel elbow
- Surface 2: Stainless steel tee
- Diameter: NPS 4.0 in.
- Thickness: 0.531 in.

Scanning requirements are described in 10CFR.50.55a (b)(2)(xv)(A)(1). The aggregate coverage was calculated from the following:

- 60° shear waves obtained an aggregate coverage of 64.8% in one axial direction (S1-elbow)
- 60° shear waves obtained an aggregate coverage of 50.8% in one axial direction (S2-tee)
- 45° shear waves obtained 92.2% coverage in two circ directions on the elbow side (S1).
- 45° shear waves obtained 100% coverage in two circ directions on the tee side (S2).
- The aggregate coverage was calculated to be (64.8% + 50.8% + 92.2% + 100%)/4 = 77.0%.

The limitation was caused by the tee configuration, as well as a pipe running adjacent to the tee side of the weld. In order to scan all of the required volume for this weld, the valve would have to be redesigned, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage. Therefore, the available coverage will not meet the acceptance criteria of this Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1.C5.21.0002 was conducted using personnel, equipment, and procedures qualified in accordance with ASME Section XI, 1998 Edition with the 2000 Addenda.

In addition to the volumetric examination with limited coverage, Duke performed a surface examination ([ASME Code-required]) on this [ASME Code Item C5.21] and achieved 100% coverage. The result from the surface examination was acceptable.

The system leakage test performed each period in accordance with [ASME Code] Table IWC-2500-1; Examination Category C-H requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric, surface, and pressure test), Reactor Building Normal Sump monitoring provide additional assurance that, in the event that leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the acceptable results of the surface examinations performed during this outage, the pressure testing (VT-2) examinations required by Section XI, and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Section 6.0 (as stated):

This weld was examined using procedures, equipment, and personnel qualified in accordance with ASME [Code,] Section XI, Appendix VIII. No alternative examinations are planned for the weld during the current inspection period. Radiography (RT) is not a desired option because RT is limited in the ability to detect service induced flaws. Additionally, radiography has not been qualified through performance demonstration.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Section 6.0

Weld #1 NI11-9 is a stainless steel weld that joins a stainless steel elbow to a stainless steel tee in the piping from the safety injection pumps 1A to 1B. The ASME Code requires 100%

volumetric and surface examination for selected ASME Code, Class 2, pressure-retaining welds in austenitic stainless steel or high alloy circumferential piping. The volumetric examination must be applied from both sides of the weld to maximize coverage. However, volumetric examinations are limited by the geometry of the welds and the associated piping configurations, which restrict scanning to one side only. To gain access for examination, the welds and piping would require design modifications. Imposition of this requirement would create a burden on the licensee.

The licensee's UT techniques included 45- and 60-degree shear waves on the subject weld. Weld #1 NI11-9 has a coverage value of 77%, with the limitations caused by weld geometry and a nearby pipe that prevents scanning around the entire circumference of the pipe.

Although the ASME Code-required coverage could not be obtained, the UT techniques employed would have provided full volumetric coverage for the near-side of the welds and limited volumetric coverage for the weld fusion zone and base materials on the opposite side of the welds. There is no known active degradation mechanism for the stainless steel weld, and the only form of cracking that is expected to occur is thermal fatigue. Thermal fatigue cracking would progress relatively slowly through the weld. Considering the coverage obtained, one would expect that axial cracking would likely be detected and circumferential cracking near the weld root should also be detected. Based on the aggregate coverage obtained for the subject welds, the lack of an active degradation mechanism, and considering the licensee's performance of UT techniques used to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected. Based on these considerations, the NRC staff determined that the examinations performed provide reasonable assurance of structural integrity of the subject components. Therefore, considering the burden on the licensee, the ASME Code-required 100% volumetric examination from both sides of #1 NI11-9 is considered impractical. Thus, the NRC staff has determined that the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for subject piping welds.

3.4 Sections 7.0 and 8.0 of RR 11-CN-001, Category C-A, Item C1.30

ASME Code Components

Catawba 1 Heat Exchanger Tubesheet to Shell Weld, Weld #1 BNSHX-2B-51C, Summary Number C1.C1.30.0008.

Catawba 1 Heat Exchanger Tubesheet-to-Shell Weld, Weld #1 BNSHX-2A-50, Summary Number C1.C1.30.0009.

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-A, Item Number C1.30, requires essentially 100% volumetric examination, as defined by ASME Code, Section XI, Figure IWC-2500-2, of Catawba 1 Heat Exchanger Tubesheet-to-Shell Weld #1 BNSHX-2B-51C, Summary Number C1 .C1.30.0008, and Heat Exchanger Tubesheet-to-Shell Weld #1 BNSHX-2A-50, Summary Number C1.C1.30.0009. "Essentially 100 percent", as

clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's Request for ASME Code Relief in Sections 7.0 and 8.0 of RR 11-CN-001

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination Catawba 1 Containment Spray (NS) Heat Exchanger Tubesheet-to-Shell Weld #1 BNSHX-2B-51C, Summary Number C1 C1.30.0008, and NS Heat Exchanger Tubesheet-to-Shell Weld #1 BNSHX-2A-50, Summary Number C1.C1.30.0009.

Licensee's Analysis of RR 11-CN-001, Sections 7.0 (as stated, in part):

Impracticality of Compliance

Surface 1: Stainless Steel Tubesheet
Surface 2: Stainless Steel Shell
Diameter: 49.0 inch
Thickness: 0.50 inch

ASME Section XI, Appendix III, III-4420, requires coverage of the examination volume in two beam path directions and Appendix III, III-4430, requires scanning on the weld crown in two directions. The total aggregate percent of coverage was calculated as follows.

- 60° shear waves obtained 0% coverage in one axial direction (S1-tubesheet)
- 60° shear waves obtained 20.694% coverage in one axial direction (S2 - shell)
- 60° shear and longitudinal waves obtained 45.739% coverage in one circ. direction (S3 - CW)
- 60° shear and longitudinal waves obtained 45.739% coverage in one circ. direction (S4 - CCW)

- The aggregate coverage was calculated to be (0% + 20.694% + 45.739% + 45.739%)/4 = 28.043%

The limitations were caused by the tubesheet configuration, as well as one nozzle within the weld length. In order to obtain full coverage, the component would have to be redesigned, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage of examination volume A-B-C-D. The achieved coverage did not meet the acceptance criteria of this Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1 .C1.30.0008 was conducted using personnel, equipment, and procedures qualified in accordance with ASME Section XI, 1998 Edition with the 2000 Addenda.

The system leakage test performed each period in accordance with [ASME Code, Section XI,] Table IWC-2500-1, Examination Category C-H, requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code-required examinations (volumetric and pressure test), periodic visual inspections performed by plant operators provide additional assurance that in the event leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the pressure testing (VT-2 [visual]) examinations required by [the ASME Code] Section XI, and the continuing periodic leakage inspections, it is Duke's position that the combination of examinations provides a reasonable assurance of quality and safety.

Licensee's Analysis of RR 11-CN-001, Section 8.0 (as stated, in part):

Impracticality of Compliance

Surface 1: Stainless Steel Shell
Surface 2: Stainless Steel Tubesheet
Diameter: 49.0 inch
Thickness: 0.625 inch

ASME [Code,] Section XI, Appendix III, III-4420, requires coverage of the examination volume in two beam path directions and Appendix III, III-4430, requires scanning on the weld crown in two directions. The total aggregate percent of coverage was calculated as follows.

- 60° shear waves obtained 12.498% coverage in one axial direction (S1 -shell)
- 60° shear waves obtained 0% coverage in one axial direction (S2 - shell)
- 60° shear and longitudinal waves obtained 49.569% coverage in one circ. direction (S3 - CW)
- 60° shear and longitudinal waves obtained 49.569% coverage in one circ. direction (S4 - CCW)
- The aggregate coverage was calculated to be (12.498% + 0% + 49.569% + 49.569%/4 = 27.909%

Actual length of weld measured @ 159.3 in. Description of limitations as follows:

- S1: 4 Support lugs and 2 lugs limited scanning to 49.05% of total weld length
- S2: Tubesheet configuration limited scanning 100% of total weld length (no scan)
- S3: 2 Nozzles limited scanning to 93.00% of total weld length
- S4: 2 Nozzles limited scanning to 93.00% of total weld length

The Catawba [1 and 2] Inservice Inspection Plan allows the use of Code Case N-460, which requires greater than 90% volumetric coverage of examination volume A-B-C-D. The achieved coverage did not meet the acceptance criteria of this Code Case

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1.C1.30.0009 was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

The system leakage test performed each period in accordance with [ASME Code, Section XI,] Table IWC-2500-1; Examination Category C-H requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric and pressure test), periodic visual inspections performed by plant operators provide additional assurance that in the event leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the pressure testing (VT-2) examinations required by [ASME Code,] Section XI, and the continuing periodic leakage inspections, it is Duke's position that the combination of examinations provides a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Sections 7.0 and 8.0 (as stated):

Radiograph (RT) is not a desired option because there is no access for film placement.

No other substitution alternative for this weld is available which would provide better coverage.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Sections 7.0 and 8.0

The ASME Code requires essentially 100% volumetric examination of pressure retaining welds on selected ASME Code, Class 2, pressure vessels. However, for the 2 welds, Heat Exchanger Tubesheet-to-Shell Weld #1 BNSHX-2B-51C and Tubesheet-to-Shell Weld #1 BNSHX-2A-50, complete examinations are limited due to the design configuration of these components. In order to achieve greater volumetric coverage, the subject components would have to be redesigned and modified. This would place a burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the Heat Exchanger Tubesheet-to-Shell Weld #1 BNSHX-2B-51C and Tubesheet-to-Shell Weld #1 BNSHX-2A-50 have been performed to the extent practical, with the licensee obtaining approximately 28.043% and 27.909%, respectively, of the required ASME Code examination volumes. The examinations are limited due to the configuration of the

tubesheet configuration, as well as one nozzle within the weld length and support lugs in the case of Tubesheet-to-Shell Weld #1 BNSHX-2A-50. Although the licensee was only able to obtain an aggregate coverage of 27.909% of the Tubesheet-to-Shell Weld #1 BNSHX-2A-50 volume, it was for certain types of scans over 49.05% and 93% of the weld length.

The heat exchanger and tubesheet is fabricated of stainless steel. The licensee examined these welds from the shell side and tubesheet side using 60-degree shear waves to achieve full circumferential coverage and axial coverage along the weld length. There were no recordable flaw indications detected. The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to the design geometry of the components. Based on the volumetric coverage obtained and the UT techniques employed, in addition to the VT-2 visual examinations, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. In addition there has been no experience in industry of structural failure of similar components. The NRC staff has determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds. The NRC staff has also determined that the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality have been met for welds #1 BNSHX-2B-51C and #1 BNSHX-2A-50

3.5 Sections 9.0 and 10.0 of RR 11-CN-001, Examination Category C-F-1, Item C5.11

ASME Code Components

Catawba 1 Nozzle to Transition Ring Weld, Weld #1 SGD-W261,
Summary Number C1.C5.11.0001

Catawba 1 Transition Ring to Elbow Weld, Weld #1 CA66-35,
Summary Number C1.C5.11.0002

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-1, Item Number C5.11, requires 100% volumetric or surface examination, as applicable, as defined by ASME Code, Section XI, Figure IWB-2500-7(a), for Catawba 1 Nozzle to Transition Ring Weld #1 SGD-W261 and Nozzle to Transition Ring-to-Elbow Weld #1 CA66-35. The licensee uses the alternative requirements of ASME Section XI, Code Case N-460, approved for use in RG 1.147, Revision 16, which allows credit for essentially 100% coverage of the welds provided greater than 90% of the required volume has been examined.

Licensee's Request for ASME Code Relief in Sections 9.0 and 10.0 of RR 11-CN-001

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the 100% ASME Code-required volumetric examination coverage for Nozzle to Transition Ring Weld #1 SGD-W261, Item Number C1.C5.11.0001, and Transition Ring to Elbow Weld #1 CA66-35, Item Number C1.C5.11.0002.

Licensee's Analysis of RR 11-CN-001, Section 9.0 (as stated, in part):

Impracticality of Compliance

- Surface 1: Inconel Transition Ring
- Surface 2: Carbon Steel Nozzle
- Diameter: 7.5 in.
- Thickness: 1.12 in.

Scanning requirements are described in 10 CFR.50.55a (b)(2)(xv)(A)(1). The aggregate coverage was calculated from the following:

- 45° & 60° refracted longitudinal waves obtained 100% coverage in one axial direction (S1 – transition ring)
- 42° refracted longitudinal waves obtained 37.14% coverage in two circ. directions.
- The aggregate coverage was calculated to be (100% + 37.14%)/2 = 68.57%.

The limitation was caused by the nozzle taper configuration, which limited coverage in the circ directions only, as [ASME Code] Appendix VIII, Supplement 10 demonstrations are qualified for single sided coverage in one axial direction. In order to scan all of the required volume for this weld, the nozzle would have to be redesigned, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of [ASME] Code Case N-460, which requires greater than 90% volumetric coverage. Therefore, the available coverage will not meet the acceptance criteria of this [ASME] Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1 .C5.11.0001 was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

In addition to the volumetric examination with limited coverage, Duke performed a surface examination (code required) on this [ASME Code, Section XI, Category C-F-1,] C5.11 item and achieved 100% coverage. The result from the surface examination was acceptable.

The system leakage test performed each period in accordance with [ASME Code, Section XI,] Table IWC-2500-1; Examination Category C-H requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 [visual] examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric, surface and pressure test), there are other activities which provide confidence that, in the event that

leakage did occur through this weld, it would be detected and proper action taken. Reactor Building Normal Sump rate monitoring provide additional assurance that any leakage would be detected prior to gross failure of the component.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the acceptable results of the surface examinations performed during this outage, the pressure testing (VT-2) examinations required by [ASME Code,] Section XI, and the leakage monitoring it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Analysis of RR 11-CN-001, Section 10.0 (as stated, in part):

Impracticality of Compliance

- Surface 1: Inconel Transition Ring
- Surface 2: Carbon Steel Elbow
- Diameter: 6.0 in.
- Thickness: 0.71 in.

Scanning requirements are described in 10 CFR.50.55a (b)(2)(xv)(A)(1). The aggregate coverage was calculated from the following:

- 45° & 60° refracted longitudinal waves obtained 100% coverage in two axial direction (S1 - nozzle, S2 - elbow)
- 42° refracted longitudinal waves obtained 54.24% coverage in two circ. directions.
- The aggregate coverage was calculated to be (100% + 54.24%)/2 = 77.12%.

The limitation was caused by the nozzle taper configuration, which limited coverage in the circ directions only. In order to scan all of the required volume for this weld, the nozzle would have to be redesigned, which is impractical.

The Catawba Inservice Inspection Plan allows the use of [ASME] Code Case N-460, which requires greater than 90% volumetric coverage. Therefore, the available coverage will not meet the acceptance criteria of this [ASME] Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C1.C5.11.0002 was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

In addition to the volumetric examination with limited coverage, Duke performed a surface examination (code required) on this [ASME Code, Section XI, Category C-F-1, Item C5.11] and achieved 100% coverage. The result from the surface examination was acceptable.

The system leakage test performed each period in accordance with [ASME Code, Section XI,] Table IWC-2500-1; Examination Category C-H requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 [visual] examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric, surface and pressure test), there are other activities which provide confidence that, in the event that leakage did occur through this weld, it would be detected and proper action taken. Reactor Building Normal Sump rate monitoring provide additional assurance that any leakage would be detected prior to gross failure of the component.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the acceptable results of the surface examinations performed during this outage, the pressure testing (VT-2) examinations required by [ASME Code,] Section XI, and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Sections 9.0 and 10.0 (as stated):

This weld was examined using procedures, equipment, and personnel qualified in accordance with ASME [Code,] Section XI, Appendix VIII. No alternative examinations are planned for the weld during the current inspection period. Radiography (RT) is not a desired option because RT is limited in the ability to detect service induced flaws. Additionally, radiography has not been qualified through performance demonstration.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Sections 9.0 and 10.0

Weld #1 SGD-W261 is an alloy 82/182 weld that joins the Steam Generator (SG) 1D Auxiliary Feedwater Nozzle to transition Ring dissimilar metal weld with an NPS of 7.5.
Weld #1 CA66-35 is alloy 82/182 weld joining Piping to the SG 1A Auxiliary Feedwater nozzle dissimilar metal weld with an NPS of 6. Both welds have nickel alloy transition rings and carbon steel piping. The ASME Code requires essentially 100% volumetric and surface examinations for the ASME Code, Section XI, Examination Category C-F-1, Item Number C5.11. Complete volumetric examinations were restricted by weld geometry. These conditions, described by the licensee in RR 11-CN-001, prevented the licensee obtaining full volumetric examination. The licensee was able to obtain 68.57% coverage for weld #1 SGD-W261 and 77.12% coverage for weld #1 CA66-35. Based on the drawings provided by the licensee, improved access to the welds would require design modifications or removal and replacement of components.

For the subject pipe welds, volumetric examinations were conducted using manual techniques qualified in accordance with performance demonstration requirements listed in ASME Code, Section XI, Appendix VIII, using both shear and L-wave transducers. The L-wave method is capable of detecting planar inside diameter (ID) surface-breaking flaws on the far-side of wrought stainless steel welds. As shown on the sketches and technical descriptions included in the licensee's submittal, examinations of the subject welds have been performed to the extent practical.

Welds #1 SGD-W261 and #1 CA66-35, which have nickel alloy weld metal, had coverage values of 68.57% and 71.12%, respectively. Each weld received 100% axial scanning coverage for circumferential flaws, and the lack of coverage was caused by weld geometry preventing 100% circumferential scanning for axial flaws. Primary water stress corrosion cracking (PWSCC) is an active degradation mechanism in alloy 82/182 dissimilar metal welds, and scanning for circumferential flaws is particularly important. It was not possible, however, to obtain 100% coverage for axial flaws. Axial flaws in nickel alloy welds tend to span the entire width of the weld, so partial coverage of a weld would be expected to find a large axial flaw. Based on the coverage obtained, there is reasonable assurance that any significant cracking would have been detected if it was present.

The licensee has shown that it would impose a significant burden to meet the ASME Code-required volumetric and surface examination coverage for the subject welds due to the design of the welds and proximity of other components. Considering the volumetric coverage obtained and the resistant materials, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected. Based on the coverage obtained, the NRC staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. The NRC staff has also determined that the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for welds #1 SGD-W261 and #1 CA66-35.

3.6 Section 11.0 of RR 11-CN-001, Examination Category C-A, Item C1.10

ASME Code Components

Catawba 2 Steam Generator Lower Shell to Transition Cone Weld #2 SGC-04B-05, Summary Number C2.C1.10.0002

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-A, Item C1.10, requires essentially 100% volumetric examination, as defined by Figure IWC-2500-1(c), of the length of Class 2 shell circumferential welds. "Essentially 100 percent", as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC staff in RG 1.147, Revision 16.

Licensee's Request for ASME Code Relief in Section 11.0 of RR 11-CN-001

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination of the Catawba 2 Steam Generator Lower Shell to Transition Cone weld #2 SGC-04B-05, Summary Number C2.C1.10.0002

Licensee's Analysis of RR 11-CN-001, Section 11.0 (as stated, in part):

Impracticality of Compliance

Surface 1: Carbon Steel Transition Cone
Surface 2: Carbon Steel Lower Shell
Diameter: 129.0 inch
Thickness: 3.0 inch

The ultrasonic examination of the lower shell to transition cone weld obtained 46.872% coverage of the required examination volume. ASME [Code,] Section XI, Appendix III, III-4420 requires coverage of the examination volume in two beam path directions and [ASME Code, Section XI,] Appendix III, III-4430 requires scanning on the weld crown in two directions. The total aggregate percent of coverage was calculated as follows.

- The aggregate coverage from the 0° in the weld and base material obtained 39.440% coverage.
- The aggregate coverage from the 45° shear waves in the weld and base material obtained 49.183% coverage.
- The aggregate coverage from the 35°, 60° shear waves in the weld and base material obtained 52.278% coverage.

The total aggregate coverage obtained was (39.440% + 49.183% + 52.278%)/3 = 46.967%.

The limitations were caused by the upper lateral support. In order to obtain full coverage, the lateral support would have to be redesigned, which is impractical. The Catawba [1 and 2] Inservice Inspection Plan allows the use of [ASME] Code Case N-460, which requires greater than 90% volumetric coverage of examination volume A-B-C-D. The achieved coverage did not meet the acceptance criteria of this [ASME] Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C2.C1.10.0002 was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

The system leakage test performed each period in accordance with [ASME Code, Section XI,] Table IWC-2500-1; Examination Category C-H requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric and pressure test), Reactor Building Normal Sump monitoring provide additional assurance that, in the event that leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the pressure testing (VT-2) examinations required by [ASME Code,] Section XI, and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Section 11.0 (as stated):

Radiography (RT) is not a desired option because there is no access for film placement.

No other substitution alternative for this weld is available which would provide better coverage.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Section 11.0

The ASME Code requires 100% volumetric and surface examination of ASME Code, Class 2, nozzle-to-shell welds. However, for SG Lower Shell-to-Transition Cone weld #2 SGC-04B-05, complete examination is limited due to an upper lateral support. In order to obtain full coverage, the upper lateral support would have to be redesigned. This would place a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittal, examination of the SG Lower Shell-to-Transition Cone weld #2 SGC-04B-05 was performed to the extent practical, with the licensee obtaining approximately 46.967% of the required examination volume, including 0-degree in the weld and base metal material, and 45-degree, 35-degree, 60-degree shear wave in the weld and base material. No flaw indications were noted during the volumetric examinations.

The licensee has shown that it is impractical to meet the ASME Code-required 100% volumetric examination coverage for the subject weld due to the upper lateral support. Based on the volumetric coverage obtained, it is reasonable to conclude that, if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations performed. The NRC staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. The NRC staff has determined, therefore, that the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for Shell-to-Transition Cone Weld, weld #2 SGC-04B-05.

3.7 Section 12.0 of RR 11-CN-001, Examination Category B-J, Item B9.11

ASME Code Components

Catawba 2 Pipe to Valve 2NI175 Weld #2 NI70-4,
Summary Number C2.B9.11.0106

ASME Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-J, Items B9.11, requires essentially 100% volumetric and surface examination of weld length of the circumferential welds of NPS 4-inch or larger in accordance to ASME Code, Section XI, Figure IWB-2500-8(c). The licensee uses the alternative requirements of ASME Section XI, Code Case N-460, approved for use in RG 1.147, Revision 16, which allows credit for essentially 100% coverage of the welds provided greater than 90% of the required volume has been examined.

Licensee's Request for ASME Code Relief in Section 12.0 of RR 11-CN-001

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100% volumetric examinations for Catawba 2 Pipe-to-Valve 2NI175 Weld #2 NI70-4, which is ASME Code, Section XI, Examination Category B-J, Item Number B9.11.

Licensee's Analysis of RR 11-CN-001, Section 12.0 (as stated, in part):

Impracticality of Compliance

Component configuration:

- Surface 1: Stainless Steel Pipe
- Surface 2: Forged Stainless Steel Valve
- NPS: 6.00 in.
- Thickness: 0.719 in.

Scanning requirements are described in 10 CFR.50.55a (b)(2)(xv)(A)(1). The aggregate coverage was calculated from the following:

- 60° shear waves obtained 50% coverage in one axial direction (S1 - pipe)
- 60° shear waves obtained 0% coverage in one axial direction (S2 - valve)
- 60° shear waves obtained 50% coverage in one circ. direction (CW).
- 60° shear waves obtained 50% coverage in one circ. direction (CCW).
- The aggregate coverage was calculated to be (50% + 0% + 50% + 50%)/4 = 37.5%.

The component limitation was caused by the taper configuration of the valve, which did not allow access for scanning. In order to scan all of the required volume for this weld, the component would have to be redesigned, which is impractical.

The Catawba [1 and 2] Inservice Inspection Plan allows the use of [ASME] Code Case N-460, which requires greater than 90% volumetric coverage. Therefore, the available coverage will not meet the acceptance criteria of this ASME Code Case.

Justification for Granting Relief

Ultrasonic examination of the weld for the item number C2.B9.11.0106 was conducted using personnel, equipment, and procedures qualified in accordance with ASME [Code,] Section XI, 1998 Edition with the 2000 Addenda.

In addition to the volumetric examination with limited coverage, Duke performed a surface examination ([ASME Code] required) on this [ASME Code, Section XI, Category B-J,] B9.11 item and achieved 100% coverage. The result from the surface examination was acceptable.

The system leakage test performed each refueling outage in accordance with [ASME Code,] Table IWB-2500-1; Examination Category B-P requires a VT-2 visual examination to detect evidence of leakage. This test and VT-2 examination provide additional assurance of pressure boundary integrity.

In addition to the above [ASME] Code required examinations (volumetric, surface, and pressure test), Reactor Building Normal Sump monitoring and other RCS leakage detection systems provide additional assurance that, in the event that leakage did occur through this weld, it would be detected and proper action taken.

Duke has examined the weld/component to the maximum extent possible utilizing approved examination techniques and equipment. Based on the acceptable results for the coverage completed by the volumetric examination, the acceptable results of the surface examinations performed during this outage, the pressure testing (VT-2) examinations required by [ASME Code,] Section XI, and the leakage monitoring, it is Duke's position that the combination of examinations provide a reasonable assurance of quality and safety.

Licensee's Proposed Alternative in RR 11-CN-001, Sections 12.0 (as stated):

This weld was examined using procedures, equipment, and personnel qualified in accordance with ASME Section XI, Appendix VIII. No alternative examinations are planned for the weld during the current inspection interval. Radiography (RT) is not a desired option because RT is limited in the ability to detect service induced flaws. Additionally, radiography has not been qualified through performance demonstration.

NRC Staff Evaluation Proposed Alternative in RR 11-CN-001, Section 12.0

Weld #2 NI70-4 is a stainless steel weld that joins a stainless steel pipe to a stainless steel valve in the NI and has an NPS of 6. The ASME Code requires essentially 100% volumetric and surface examinations for the ASME Code, Section XI, Examination Category B-J, Item Number B9.11. However, complete volumetric examinations were restricted by weld geometry. These conditions prevented the licensee from obtaining full volumetric examination. The weld geometry preventing the full examination coverage of the weld was shown in the letter dated September 28, 2011. To gain access for improved examination the weld would require design modifications or removal and replacement of components. Imposition of the ASME Code-required 100% volumetric examination of weld #2 NI70-4 would place a significant burden on the licensee.

For weld #2 NI70-4, volumetric examinations were conducted using manual techniques qualified in accordance with performance demonstration requirements listed in ASME Code, Section XI, Appendix VIII, using both shear- and L-wave transducers. The L-wave method is capable of detecting planar ID surface-breaking flaws on the far-side of wrought stainless steel welds. As

shown on the sketches and technical descriptions included in the licensee's submittal, examinations of the subject welds have been performed to the extent practical with the licensee obtaining volumetric coverage of 37.5% in the required areas.

The only known degradation mechanism for the stainless steel weld and associated components is thermal fatigue. Thermal fatigue cracks propagate relatively slowly and operational experience has not shown similar welds to be challenged by thermal fatigue. The weld received 50% coverage from the axial scan from the pipe side and 50% coverage from each of the circumferential scans. While the licensee does not take credit for the ability to detect cracks on the far side of the weld, the valve side of the weld is insonified, albeit not to code requirements. Significant circumferential cracking in this weld has a high likelihood of being found by the examinations that have been performed. Significant axial cracking would likely extend into the examined section of the weld.

The licensee has shown that it would be a burden to meet the ASME Code-required volumetric and surface examination coverage for the subject welds due to the design of the welds and proximity of other components. Considering the volumetric coverage obtained and the resistant materials, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected. The NRC staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. Thus, the NRC staff has determined that the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for weld #2 NI70-4.

4.0 CONCLUSION

As set forth above, the NRC staff has determined that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) as requested in RR 11-CN-001 is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Furthermore, the NRC staff concluded that the

proposed alternatives provide reasonable assurance of the structural integrity of the subject components and that it is impractical for the licensee to comply with the applicable ASME Code requirements.

Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and is in compliance with the ASME Code requirements. Therefore, the NRC staff authorizes the licensee's proposed alternatives as described in RR 11-CN-001, Sections 2.0 through 10.0 for the duration of the Catawba 1 third ISI interval, currently scheduled to end on July 15, 2014. The NRC staff authorizes the licensee's proposed alternatives as described in Sections 11.0 and 12.0 for the duration of the Catawba 2 third ISI interval, currently scheduled to end on August 19, 2016.

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

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Date: August 20, 2012

If you have any questions, please contact the Project Manager, Jon H. Thompson at 301-415-1119 or via e-mail at Jon.Thompson@nrc.gov.

Sincerely,

/RA/

John Boska, Acting Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

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