Duke Energy®

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December 4, 2006

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

Subject: Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC (Duke)
Catawba Nuclear Station, Unit 1
Docket Number 50-413
Request for Relief Number 06-CN-004
NRC First Revised Order EA-03-009, Relaxation Request for Inspection of Reactor Pressure Vessel Heads

On February 11, 2003, the NRC issued Order EA-03-009 for interim inspection requirements for reactor pressure vessel (RPV) heads at pressurized water reactor (PWR) facilities. On February 20, 2004, the NRC issued the First Revised Order EA-03-009, which superseded Order EA-03-009. Duke agreed to comply with the revised Order in a letter dated March 9, 2004.

Pursuant to 10 CFR 50.55a(a)(3)(ii), Duke hereby requests relaxation from the requirements for nondestructive examination of one penetration nozzle for which Duke cannot obtain coverage as specified in the Order. In accordance with section IV, paragraph F of the Order, Duke requests relaxation from the requirements specified in section IV, paragraph C.(5)(b)(i) for one RPV head penetration for which nondestructive testing cannot be performed as required. The requested relaxation meets criterion IV.F.(2) of the revised Order because compliance with the revised Order for the penetration described in this request would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The details of this request are provided in the attachment.

A101

Approval of the attached request is requested by December 18, 2006 to support Catawba Unit 1 startup from the End-of-Cycle 16 refueling outage.

If you have any questions or require additional information, please contact L.J. Rudy at (803) 831-3084.

Very truly yours,

James R. Morris

LJR/s

Attachment

xc (with attachment):

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A.T. Sabisch, NRC Senior Resident Inspector
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Attachment

Relief Request 06-CN-004

Prepared by: W. O. Carraway Date: 11-28-06

Reviewed by: Rachel Doss Date: 11/28/06

Reviewed by: (Cross-Disciplinary) Date: 11/28/06

Approved by: D. L. Ward Date: 11/28/06

10 CFR 50.55a Relief Request 06-CN-004

Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(ii)

Hardship or Unusual Difficulty without a Compensating Increase in the Level of Quality and Safety

Pursuant to 10 CFR 50.55a(a)(3)(ii), Duke requests relaxation from NRC Order EA-03-009. Information is being submitted in support of this determination that compliance with the specified requirements of this order results in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

I. Component(s) Affected:

Affected Unit:	Catawba Nuclear Station Unit 1
Component number:	CN 1 NC Rx Head
Description:	RPV Head Penetration Thermocouple Nozzle
ASME Code Class:	1

II. Applicable Requirement:

NRC Order EA-03-009, Revision 1, "Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," Section IV, Paragraph C.(5)(b)(i).

NRC Order EA-03-009, Revision 1, Section IV, Paragraph C.(5)(b)(i) requires that:

> "Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material) from 2 inches above the highest point of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-1]); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level

(including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-2)…"

III. Applicable Code Requirements:

Not applicable.

IV. Reason for Request:

The Catawba Unit 1 RPV head includes five thermocouple head penetrations that are used during operation for core temperature measurement. Each of these head penetrations includes a thermocouple column welded via a J-groove weld to the internal surface of the RPV head. Below each J-groove weld, a housing guide is threaded to the bottom of the column to facilitate head replacement after refueling operations. See Figure 1.

The configuration of one of the five thermocouple head penetrations (#78) for Catawba Unit 1 does not allow a complete volumetric examination as required by the Order. The limited projected nozzle length and weld profile below the internal surface of the RPV head and the tapered tip of the thermocouple column restrict the examination of the entire volume defined by the Order for this thermocouple location as one inch below the lowest point at the toe of the J-groove weld.

For thermocouple head penetration #78, an examination of a volume with a boundary only 0.70 inch below the lowest point at the toe of the J-groove weld has been performed.

Compliance with the requirements of NRC Order EA-03-009 would result in hardship without a compensating increase in the level of quality and safety.

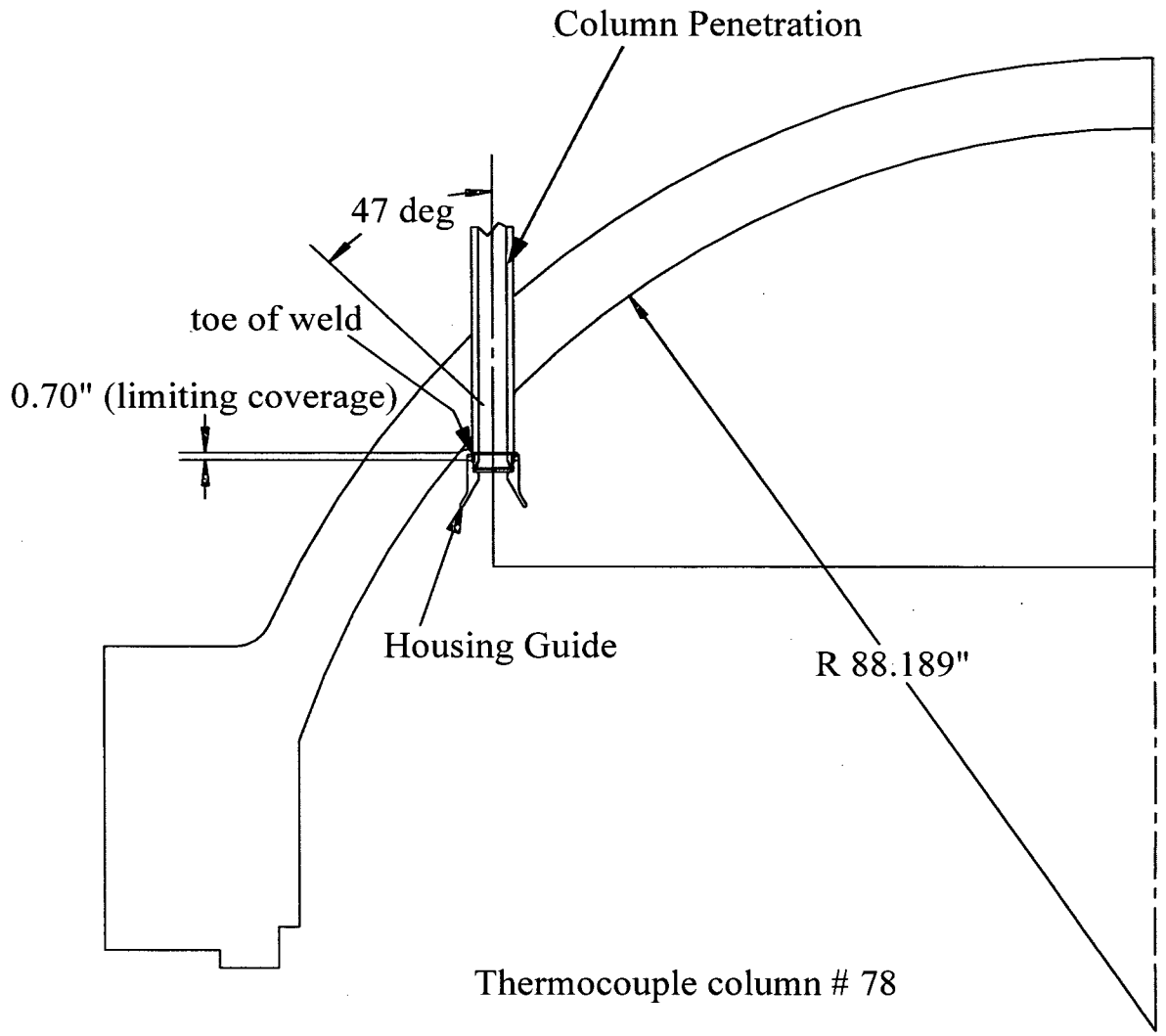

Figure 1: Illustrating Location of Thermocouple Column Penetration Relative to RPV Head

V. Background:

A structural evaluation of each control rod drive mechanism head penetration was performed as part of the non-visual RPV head inspection. The purpose of the evaluation was to develop residual and normal operating stresses in the hoop and axial directions along the vertical length of the penetration. These stresses were then used to qualify a reduced inspection region that is necessary in some cases because of examination limits associated with particular geometrical features of the penetrations. This reduction in inspection volume is allowed by the Order for all

regions 1 inch below the downhill side of the toe of the J-groove weld and where all surface tensile stresses are less than 20 ksi. The finite element analysis of the structural evaluation establishes the stress profile of the penetration nozzles. From the stress profile, the inspection zone is defined in terms of the vertical distance below the J-groove weld. The actual inspection scope is then compared with the required inspection zone to satisfy the examination requirements of the Order. In all cases (with exception of nozzle #78), the Order required inspection volume was achieved.

In addition, Duke has complied with the requirements for determining if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head. This determination was made by the ultrasonic leak path detection and the bare metal visual examination at the top of the RPV head surface that includes an inspection of 360° around the head penetration nozzles. No pressure boundary leakage at the head penetrations was identified.

VI. Proposed Relaxation:

Duke proposes to define the lower boundary of the inspection volume for RPV head penetration thermocouple nozzle #78 as: "to the top of the tapered region, which is approximately 0.70 inch below the lowest point at the toe of the J-groove weld...including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses of 20 ksi tension and greater."

VII. Justification for Granting of Relaxation:

As discussed previously, the requirement specified in NRC Order EA-03-009, that the RPV head penetration nozzle base material be ultrasonically tested 1.0 inch below the lowest point at the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension and greater, results in a significant hardship without a compensating increase in the level of quality and safety.

The design of the RPV head penetration thermocouple nozzles includes a tapered section at the bottom of the nozzles. At thermocouple nozzle #78, the dimensional configuration (see Figure 2) is such that the distance from the lowest

point at the toe of the J-groove weld to the top of the tapered region is less than the 1-inch lower boundary limit specified in section IV.C.(5)(b)(i) of the First Revised Order. Since there is limited UT coverage in the tapered region, Duke requests that the lower boundary of the UT inspection for thermocouple nozzle #78 be redefined to exclude a 10° wedge on the inside diameter of the nozzle extending 0.3 inch down from the start of the taper. This request yields a lower boundary plane defined as 0.70 inch below the lowest point at the toe of the J-groove weld. The basis for this request is:

a) The reduction in examination volume is extremely small. At the downhill side of the nozzle, the reduced inspection area is less than 0.01 in^2. The equivalent uninspectable volume is less than 0.10 in^3. Only a small portion of the circumferential component of this volume presents a concern where a radial tube crack could grow upward to the J-groove weld. The remaining circumference of the tube provides an increasing margin (axial tube length) before the J-groove weld and the reactor coolant pressure boundary are affected.
b) During the ultrasonic examination, a portion of the wall thickness in the uninspectable volume was examined. A radially oriented crack in the column penetration end was not identified during the examination. An existing crack would have been identified unless the indication was entirely contained within the small uninspectable region.
c) A visual inspection of the internal tapered surface associated with penetration #78 was performed during the current refueling outage and no cracks, indications, or other surface irregularities were identified.
d) The Catawba Unit 1 RPV is classified/ranked as a low susceptibility plant with a current EDY of 3.5 years.
e) The 77 other head penetrations, including the four other thermocouple column penetrations, were fully examined in accordance with the Order with no evidence of primary water stress corrosion cracking (PWSCC).
f) The primary concern at the thermocouple column #78 location is related to an axial crack and the potential for this crack to grow upward into the J-groove weld. In this orientation, hoop stresses are controlling for crack growth. On the downhill side of the weld, hoop stresses quickly turn compressive as the distance below the toe of the weld is increased. The hoop tensile stress diminishes below 20 ksi just 0.20 inches below the downhill side toe of the weld. As for the midplane and

uphill sides, the maximum tensile hoop stress diminishes less rapidly as the distance below the toe of the weld is increased. However, a sufficient margin in axial length at the midplane and uphill locations precludes crack growth into the critical J-groove weld.

g) A manual examination of this inspection volume would require entry into a very high radiation zone with a general area dose rate of 3 rem/hour. Furthermore, removal of the housing guide and attachment welds would be necessary to allow access for a supplemental liquid penetrant test or a manual ultrasonic examination. An entry into this radiation field for this task would involve a very large radiation exposure without a significant benefit.

h) A remote, automated examination of this minuscule inspection volume would require the specialized design and construction of robotic tooling and equipment. This would present a technical hardship, coupled with the fact that there would be limited commercial use for this type of equipment were it to be designed and constructed.

Based on the above reasons, the exclusion of this inspection volume for penetration #78 does not significantly affect the integrity of the reactor coolant system pressure boundary. Furthermore, without the proposed relaxation, a technical and radiological hardship would be incurred with no measurable benefit.

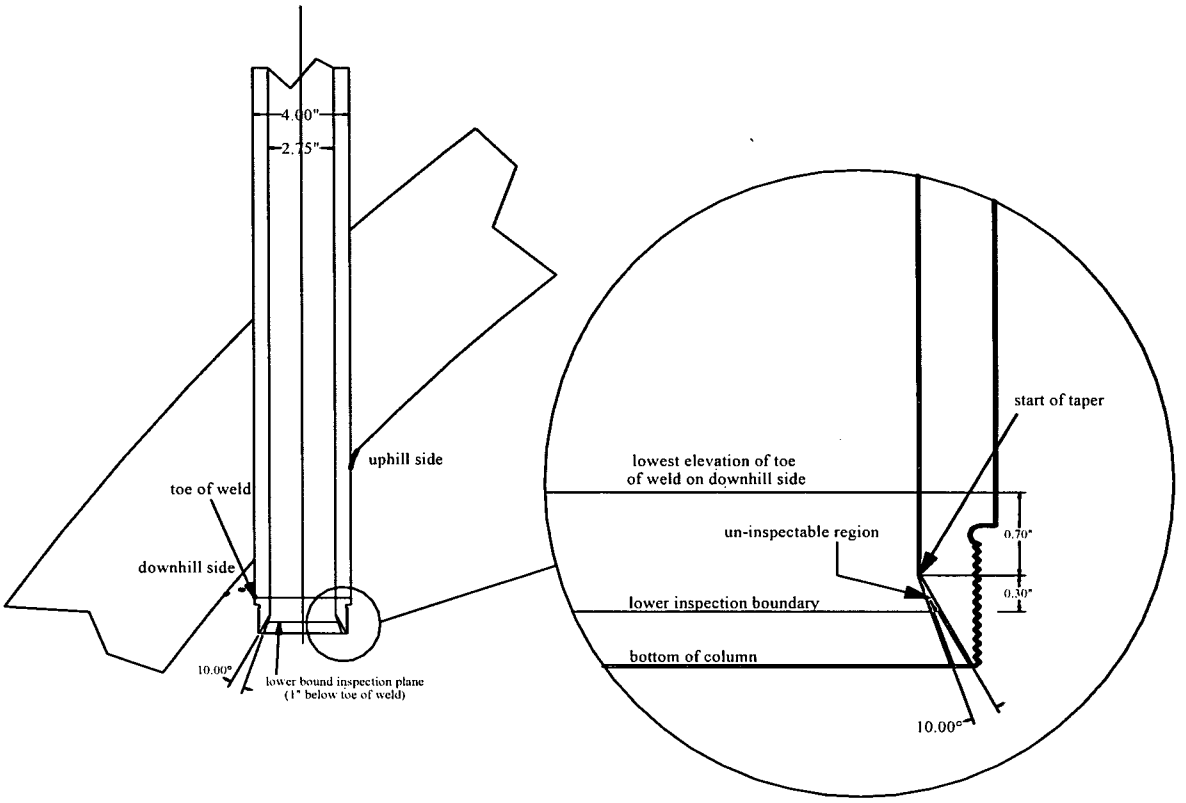

Figure 2: An Illustration of the Coverage Limitations on RPV Head Penetration Thermocouple Nozzle #78 (the red area signifies the uninspectable tapered region)

VIII. Duration of Proposed Relaxation:

This relief is requested for the duration of NRC Order EA-03-009.

An expedited NRC staff approval is requested by December 18, 2006 to support Catawba Unit 1 startup from the End-of-Cycle 16 refueling outage.

IX. Precedents:

This proposed relaxation is similar to relaxation requests submitted by other plants, including Indian Point Units 2 and 3, Seabrook Unit 1, Diablo Canyon Unit 2, Wolf Creek, Palisades, and Millstone Unit 3.

X. References:

1. NRC letter dated February 20, 2004: R. Borchardt to Holders of Licenses for Operating Pressurized Water Reactors, "Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors" (ADAMS Accession Number ML040220181).

2. Dominion Engineering, Inc. Calculation No. C-3217-00-01, "CRDM and Instrument Column Nozzle Stress Analysis for Watts Bar, McGuire 2, and Catawba 1."

3. Title 10 of the Code of Federal Regulations, Part 50, Section 55a, Codes and Standards (i.e., 10 CFR 50.55a).