November 20, 2006

Mr. Rick A. Muench
President and Chief Executive Officer
Wolf Creek Nuclear Operating Corporation
Post Office Box 411
Burlington, KS 66839

SUBJECT: WOLF CREEK GENERATING STATION - RELIEF REQUEST I2R-35 FOR THE SECOND 10-YEAR INTERVAL INSERVICE INSPECTION (TAC NO. MD0289)

Dear Mr. Muench:

By letter dated March 2, 2006 (ET 06-0011), supplemented by letter dated July 12, 2006 (ET 06-0027), Wolf Creek Nuclear Operating Corporation (the licensee) submitted Relief Request (RR) I2R-35 for its second 10-year inservice inspection (ISI) program interval at Wolf Creek Generating Station (WCGS). Included with the submittal were the following five RRs: I2R-34, I2R-35, I2R-36, I2R-37, and I2R-38. This letter only addresses RR I2R-35.

In the enclosed safety evaluation (SE), the Nuclear Regulatory Commission (NRC) staff has evaluated the information provided by the licensee for the proposed second 10-year ISI interval RR I2R-35 for WCGS. Based on the SE, the staff concludes that it is impractical for the licensee to meet the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code requirements. Therefore, granting relief pursuant to 10 CFR 50.55a(g)(6)(i) 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. The NRC staff grants relief and imposes alternative requirements in accordance with paragraph 50.55a(g)(6)(i) of Title 10 of the *Code of Federal Regulations* for the second 10-year ISI interval for WCGS. All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested, remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

***/RA/***

David Terao, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosure: Safety Evaluation

cc w/encl: See next page

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**OFFICIAL AGENCY RECORD**

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUEST I2R-35

FOR THE SECOND 10-YEAR INTERVAL INSERVICE INSPECTION

WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION

DOCKET NO. 50-482

## 1.0 INTRODUCTION

By letter dated March 2, 2006, as supplemented by letter dated July 12, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML060720056 and ML062000312, respectively), Wolf Creek Nuclear Operating Corporation (the licensee) submitted Relief Request (RR) I2R-35 for its Second 10-year inservice inspection (ISI) program interval at Wolf Creek Generating Station (WCGS). Included with the submittal were the following five RRs: I2R-34, I2R-35, I2R-36, I2R-37, and I2R-38. This safety evaluation (SE) only addresses RR I2R-35.

## 2.0 REGULATORY EVALUATION

ISI of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Class 1, 2, and 3 components is performed in accordance with applicable editions and addenda of Section XI of the ASME Code, "Rules for Inservice Inspection of Nuclear Power Plant Components," as required by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g), except where specific relief has been granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). Paragraph 10 CFR 50.55a(g)(6)(i) indicates that the NRC 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. Paragraph 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2 and 3 components (including supports) must meet the requirements, except design and access provisions and pre-service examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with

the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code of record for the WCGS second 10-year ISI interval is the 1989 Edition, with no Addenda.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Requirement

ASME Code, Section XI, 1989 Edition, with no Addenda, Figure IWB-2500-1, Examination Category B-A Full Penetration Reactor Vessel (RV) Lower Head to Shell welds, Code Item Number B1.11, requires that ultrasonic testing (UT) must be conducted on each side of the weld equal to a distance of one-half of the shell thickness adjacent to the weld for the shell side, and one-half of the head thickness adjacent to the weld for the head side. Figure IWB-2500-3 of the ASME Code, Section XI, Examination Category B-A Full Penetration RV Lower Head-to-Dollar Plate welds, Code Item Number B1.21, requires UT examination of a minimum volume of base material on each side of the weld equal to a distance of one-half of the head thickness adjacent to the weld.

3.2 Systems/component(s) for which Relief is Requested

The licensee requested relief for the following ASME Code, Section XI, Category B-A full penetration welds of RV lower head to shell and dollar plate welds:

Code Item Number B1.11 - Reactor Vessel Lower Head to Shell welds

Code Item Number B1.21 - Reactor Vessel Lower Head to Dollar Plate welds

3.3 Licensee's Proposed Alternative and Basis for Requesting Relief (as stated in the licensee's letter dated March 2, 2006)

**3. Applicable Code Requirement**

ASME Section XI, Figure IWB-2500-1 1989 Edition with no addenda requires volumetric examination of a minimum volume of base material on each side of the weld equal to a distance of 1/2t (one half of the shell thickness adjacent to the weld for the shell side, one half of the head thickness adjacent to the weld for the head side) for the vessel shell to head welds (Code Item B1.11). Figure IWB-2500-3 requires volumetric examination of a minimum volume of base material on each side of the weld equal to a distance of 1/2t (one half of the head thickness adjacent to the weld) for the vessel head welds (Code Item B1.21).

The Wolf Creek Nuclear Operating Corporation (WCNOC) second ten-year interval inservice inspection program plan also implements Code Case N-460, which is endorsed by the NRC in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI, Division 1." Code Case N-460 states in part, "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 percent."

NRC Information Notice (IN) 98-42, "Implementation of 10 CFR 50.55a(g) Inservice Inspection Requirements," termed a reduction in coverage of less than 10 percent to be "essentially 100 percent." IN 98-42 states in part, "The NRC has adopted and further refined the definition of "essentially 100 percent" to mean "greater than 90 percent"... has been applied to all examinations of welds or other areas required by ASME Section XI."

**4. Impracticality of Compliance**

The examination of the lower shell to lower head weld is limited by the proximity of the six core support lugs. During the Cycle 14 refueling outage in the spring of 2005 the subject weld was examined by remote tool (automated examination). As shown on the attached figure 1 [in the licensee's March 2, 2006, submittal], the proximity of the core support lugs to the lower shell to lower head weld limits the scan path of this component. Scanning was conducted between and below the obstructing lugs with the scan boundaries maximized by visually assisted positioning of the exam head so that scan starts and stops were as close to the support lugs as tool configuration allowed. The combined perpendicular coverage is estimated at 74.44%, the combined parallel coverage is estimated at 77.56% resulting in a combined average of 76.00%. See Table 1 [shown in this SE as an attachment] for a breakdown of the beam angle coverages.

The examination of the lower head to dollar plate weld is limited by proximity of the bottom mounted instrument (BMI) tubes. During the Cycle 14 refueling outage in the spring of 2005 the subject weld was examined by remote tool (automated examination). As shown on the attached figures 2 and 3 [in the licensee's March 2, 2006, submittal], the lower head to dollar plate weld is positioned at about the same elevation as the peripheral BMI tubes. Scanning was conducted between the obstructing penetrations with the scan boundaries maximized by visually assisted positioning of the exam head so that scan starts and stops were as close to the tubes as tool configuration allowed. The combined perpendicular coverage is estimated at 73.30%, the combined parallel coverage is estimated at 69.49% resulting in a combined average of 71.39%. See Table 2 [shown in this SE as an attachment] for a breakdown of the beam angle coverages.

Note: The coverage estimates were calculated by the vendor utilizing conservative values.

**5. Burden Caused By Compliance**

The design configuration restrictions of the subject welds at Wolf Creek Generation Station (WCGS) make the Code required examination coverage requirements impractical. Plant modifications or the replacement of components

designed to allow for complete coverage would be needed to meet the Code requirements. This would impose a considerable burden to WCNOC.

**6. Proposed Alternative and Basis for Use**

Proposed Alternative

The following alternatives are proposed in lieu of the required examination coverage of essentially 100 percent:

1. Ultrasonic Testing (UT) of the subject welds was performed to the maximum extent practical, as listed in Tables 1 and 2 [shown in this SE], due to design configuration restrictions during the second ten-year interval.

2. Visual examinations [VT-3 of the inside surface] were performed as required by Code Category B-N-1 during the second ten-year interval. No degradation was identified during this examination.

3. Pressure test VT-2 visual examinations were performed as required by Code Category B-P during the second ten-year interval. No evidence of leakage was identified for these components.

Basis for Use

The basis for use of these alternatives is that they provide the best examination coverage possible within the limitations of the current design configuration. The volumetric examination was performed using a system (procedures, personnel, and equipment) qualified in accordance with Appendix VIII, Supplements 4 and 6. The partial volumetric examinations, combined with the visual examinations provide continued assurance of weld integrity.

**7. Duration of Proposed Alternative**

The second ten-year ISI interval which began September 3, 1995, and ended September 2, 2005.

4.0 STAFF EVALUATION

ASME Code, Section XI, 1989 Edition, and no Addenda, Figure IWB-2500-1, Section XI, Examination Category B-A, Full Penetration RV Lower Head-to-Shell welds, Code Item Number B1.11, requires that UT must be conducted on each side of the weld equal to a distance of one-half of the shell thickness adjacent to the weld for the shell side, and one-half of the head thickness adjacent to the weld for the head side. Figure IWB-2500-3 of the ASME Code, Section XI, Examination Category B-A, Full Penetration RV Lower Head-to-Dollar Plate welds, Code Item Number B1.21, requires UT examination of a minimum volume of base material on each side of the weld equal to a distance of one-half of the head thickness adjacent to the weld.

As stated in its application for relief and discussed above, the licensee explained that (1) the examination of the lower shell-to-lower head weld is limited by the proximity of the six core support lugs, and (2) the examination of the lower head-to-dollar plate weld is limited by proximity of the bottom-mounted instrument (BMI) tubes. Therefore, the licensee concluded that it was impractical to meet the applicable ASME Code requirement. Based on its review of the relief requested, the NRC staff agrees with the licensee that it is impractical to meet the applicable ASME Code requirements.

To effectively evaluate the licensee's proposed alternative the staff requested that the licensee provide additional information regarding the following issues associated with the relief request:

(1) Coverage of previous UT examinations and the results.

(2) Previous industry experience associated with aging degradation of the subject welds.

(3) Type of weld metal that was used for the subject welds.

(4) State of stress that is present in the uninspected portion of the welds.

By letter dated July 12, 2006, the licensee provided responses to the staff's request for additional information (RAI). The following provides information regarding the responses from the licensee and the corresponding staff evaluation.

4.1 Coverage of Previous UT Examinations and the Results

In its response to the staff's RAI, the licensee, stated that the preservice inspection and the first 10-year ISI interval UT examinations identified no flaws which required evaluation per the ASME Code. However, complete coverage of the subject welds was not achieved during these UT examinations.

4.2 Previous Industry Experience Associated with Aging Degradation of the Subject Welds

Regarding previous industry experience, the licensee stated that, to date, there have been no reported service-induced failures or degradation of the subject welds, and with the exception of fatigue loading, these welds are not subjected to any known degradation mechanism.

4.3 Type of Weld Metal that was Used for the Subject Welds

With regard to this issue, the licensee stated that carbon/low alloy steel weld metal was used for all the subject welds.

4.4 State of Stress that is Present in the Uninspected Portion of the Welds

Finally, the licensee stated that the uninspected portion of the weld is a low-stressed region. However, the subject welds are exposed to fatigue loading. The licensee's evaluation of stress reports related to these welds indicated that the maximum fatigue usage factor of these welds is 0.007, which is considerably below the allowable value of 1.0. The volume of the subject

welds where degradation would be first expected to occur was examined to the ASME Code, Section XI, requirements. The licensee stated that these welds are subject to pressure visual testing (VT-2) during every outage and this test would detect any through wall leakage in the subject welds. In addition, VT-3 examination of the inside surface of the welds was performed during the last outage which indicated no flaws. Based on these examination results, the licensee concluded that the proposed alternative examination provides reasonable assurance of structural integrity.

The staff reviewed the licensee's responses to the RAIs and finds that the licensee's technical basis for the reduction in the examination volume is acceptable for the following reasons:

(1) The base metal and the weld metal were extensively examined during construction, preservice inspection, and prior inservice inspections. These examinations indicated no flaws which required evaluation pursuant to the ASME Code.

(2) The low-alloy steel reactor vessel lower head-to-shell and dollar-plate welds are classified as ferritic welds. Unlike stainless steel welds or nickel-alloy welds, these ferritic welds are less likely to experience aging degradation due to intergranular stress-corrosion cracking near the heat-affected zone region of the weld area.

(3) Even though the subject welds are subjected to fatigue loading, the maximum fatigue usage factor for these welds is significantly less than limiting value of 1.0. In the absence of any service-induced flaws, and with low fatigue usage factor, it can be concluded that age degradation due to fatigue loading is not a significant factor.

(4) The uninspected portion of the weld is a low stress region and, therefore, service-induced flaws are less likely to occur in the volume near the weld that was excluded from the UT examinations. The licensee conducted UT examinations on the volume of the subject welds where service-induced cracking is more likely to occur.

Since UT examinations thus far did not identify any cracking in the inspected region, the staff concludes that there is no reason to expect service-induced degradation in the uninspected regions of the subject welds. Furthermore, the licensee's pressure test VT-2 examinations during every refueling outage did not identify any through wall leakage in these welds. VT-3 examinations of the inside diameter of the welds during the last outage indicated no flaws. Therefore, the staff concludes that there is no active service-induced degradation in the subject welds.

Based on the above evaluation, the NRC staff concludes that the prior UT examinations and VT-2 and pressure tests of the subject welds did not identify any unacceptable flaws (per the ASME Code, Section XI criteria), the location of the uninspected region of the welds is a low-stressed region, and this region is less prone to service-induced cracking. Based on these conclusions, the NRC staff finds that the licensee's proposed alternative of providing the best

examination coverage possible within the limitations of the current design configuration provides reassurance that the reduced examination coverage will identify degradation in these welds so that corrective actions can be taken by the licensee to maintain the structural integrity of the subject welds. Based on this and the impracticality of meeting the applicable ASME Code requirements, the NRC staff concludes that the requested relief may be granted to the licensee for the second 10-year interval in accordance with 10 CFR 50.55a(g)(6)(i).

## 5.0 CONCLUSION

Based on the above discussion, the staff concludes that it is impractical for the licensee to meet the applicable code requirements. Therefore, granting relief pursuant to 10 CFR 50.55a(g)(6)(i) 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. The proposed RR I2R-35 is granted for the second 10-year ISI interval for WCGS. All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Attachments: Table 1 - “Beam Angle Breakdown for the Lower Shell to Lower Head Weld”
Table 2 - “Beam Angle Breakdown for the Lower Torus to Dollar Plate Weld”

Principal Contributor: Ganesh S. Cheruvenki

Date: November 20, 2006

**Table 1**
**Beam Angle Breakdown for the Lower Shell to Lower Head Weld**

| Beam Direction | 45 Shear | | 45 L Single | | 45 L Dual | | | |
|---|---|---|---|---|---|---|---|---|
| | Weld | Volume | Weld | Volume | Weld | Volume | Weld | Volume |
| Perpendicular Scan | 74.00 | 75.93 | 74.00 | 74.00 | 74.00 | 74.68 | | |
| Parallel Scan | 81.65 | 73.50 | 63.30 | 71.41 | 96.72 | 78.75 | | |
| | | | | | | | | |
| Average | 76.27 | | 58.55 | | 81.04 | | | |

The scans are limited due to the 6 Core Support Lugs located on the inside of the vessel.

Combined Perpendicular: 74.44%

Combined Parallel: 77.56%

Combined Average: 76.00%

**Table 2**
**Beam Angle Breakdown for the Lower Torus to Dollar Plate Weld**

| Beam Direction | 45 Shear | | 45 L Single | | 45 L Dual | | | |
|---|---|---|---|---|---|---|---|---|
| | Weld | Volume | Weld | Volume | Weld | Volume | Weld | Volume |
| Perpendicular Scan | 73.30 | 73.30 | 73.30 | 73.30 | 73.30 | 73.30 | | |
| Parallel Scan | 69.49 | 69.49 | 69.49 | 69.49 | 69.49 | 69.49 | | |
| | | | | | | | | |
| Average | 71.39 | | 71.39 | | 71.39 | | | |

The scans are limited due to the Bottom-Mounted Instrumentation tubing on the Bottom Head.

Combined Perpendicular: 73.30%

Combined Parallel: 69.49%

Combined Average: 71.39%