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

November 30, 2016

Mr. Adam C. Heflin
President, Chief Executive Officer,
and Chief Nuclear Officer
Wolf Creek Nuclear Operating Corporation
Post Office Box 411
Burlington, KS 66839

SUBJECT: WOLF CREEK GENERATING STATION – REQUEST FOR RELIEF I4R-01 TO CONTINUE USE OF AN ALTERNATIVE RISK-INFORMED METHODOLOGY IN SELECTING CLASS 1 AND CLASS 2 PIPING WELDS FOR INSERVICE INSPECTION DURING THE FOURTH 10-YEAR INTERVAL (CAC NO. MF7423)

Dear Mr. Heflin:

By application dated February 23, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16061A072), the Wolf Creek Nuclear Operating Corporation (WCNOC) submitted its inservice inspection (ISI) program for the fourth 10-year interval at Wolf Creek Generating Station (WCGS). Included in the licensee's submittal (Attachment I to the application) was request for relief (RR) I4R-01 for authorization to continue applying the risk-informed inservice inspection (RI-ISI) criteria of the Electric Power Research Institute's Topical Report (TR) 112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," December 1999 (ADAMS Accession No. ML013470102), to Class 1 and Class 2 piping welds during the fourth 10-year ISI interval in lieu of the requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Tables IWB-2500-1 and IWC-2500-1.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.55a(z)(1), the licensee requested to use a proposed alternative on the basis that the proposed alternative would provide an acceptable level of quality and safety

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that WCNOC has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC authorizes the use of the alternate RI-ISI program at WCGS for the fourth 10-year ISI interval, which commenced on September 3, 2015, and will end on September 2, 2025.

All other requirements of the ASME Code for which relief has not been specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions concerning this matter, please call Mr. Balwant K. Singal of my staff at (301) 415-3016 or by electronic mail at balwant.singal@nrc.gov.

Sincerely,

Robert J. Pascarelli, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

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

FOURTH 10-YEAR INTERVAL INSERVICE INSPECTION

REQUEST FOR RELIEF I4R-01

WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION

DOCKET NO. 50-482

1.0 INTRODUCTION

By application dated February 23, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16061A072), the Wolf Creek Nuclear Operating Corporation (WCNOC, the licensee) submitted its inservice inspection (ISI) program for the fourth 10-year interval at Wolf Creek Generating Station (WCGS). Included in the licensee's submittal (Attachment I to the application) was request for relief (RR) I4R-01 for authorization to continue applying the risk-informed inservice inspection (RI-ISI) criteria of the Electric Power Research Institute's (EPRI's) Topical Report (TR) 112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," December 1999 (ADAMS Accession No. ML013470102), to Class 1 and Class 2 piping welds during the fourth 10-year ISI interval in lieu of the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Section XI, Tables IWB-2500-1 and IWC-2500-1.

The WCGS RI-ISI program was initially submitted to the U.S. Nuclear Regulatory Commission (NRC) by letter dated February 15, 2001 (ADAMS Accession No. ML010520367), and was approved by the NRC for use in the second 10-year ISI interval by letter dated December 13, 2001 (ADAMS Accession No. ML013200130). The use of the WCGS RI-ISI program was requested for the third 10-year interval by WCNOC by letter dated March 2, 2006 (ADAMS Accession No. ML060720142), and subsequently approved by the NRC staff by letter dated February 21, 2007 (ADAMS Accession No. ML070260538).

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.55a(z)(1), the licensee requested to use a proposed alternative on the basis that the proposed alternative would provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), ISI of the ASME Code, Class 1, 2, and 3, components is to be performed in accordance with the latest edition and addenda of Section XI of the ASME Code, except where specific relief has been granted by the Commission pursuant to

10 CFR 50.55a(g)(6)(i). Additionally, pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3, components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 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 conditions listed therein. The ASME Code of record for WCGS fourth 10-year ISI interval is the 2007 edition through 2008 addenda of the ASME Code, Section XI.

As stated in 10 CFR 50.55a(z), alternatives to the requirements of paragraphs (b) through (h) of this section or portions thereof may be used, when authorized by the Director, Office of Nuclear Reactor Regulation. The proposed alternate must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that: (1) the proposed alternative would provide an acceptable level of quality and safety; or (2) 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(z)(1), the licensee has requested approval to continue use of RI-ISI program as an alternative to the requirements of 10 CFR 50.55a during the fourth 10-year ISI interval at WCGS, on the basis that the proposed alternative would provide an acceptable level of quality and safety. Based on the above, and subject to the following technical evaluation, the NRC staff finds that there is regulatory basis for the licensee to request and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components

All Class 1 and Class 2 piping welds previously subject to the requirements of ASME Code Section XI, Table IWB-2500-1 (Examination Categories B-F and B-J) and Table IWC-2500-1 (Examination Categories C-F-1 and C-F-2).

3.2 Applicable ASME Code Requirements

The licensee's RR I4R-01 requests NRC authorization to continue the implementation of RI-ISI program for the fourth 10-year ISI interval at WCGS as an alternative to the ASME Code, Section XI requirements. The scope of the requested relief and the WCGS RI-ISI program is limited to the ISI of ASME Code Class 1 and 2 pressure retaining piping welds, specifically Examination Categories B-F, B-J, C-F-1, and C-F-2. The examination requirements (i.e., examination methods, acceptance, standards, extent and frequency of examinations, etc.) for these components are delineated in ASME Code, Section XI, Tables IWB-2500-1 and IWC-2500-1. The applicable Code of record for the fourth 10-year ISI interval for WCGS is the ASME Code, Section XI, 2007 Edition through the 2008 Addenda. The WCGS fourth 10-year ISI interval is defined as starting on September 3, 2015, and is currently scheduled to end on September 2, 2025.

Table IWB-2500-1, Examination Category B-F, requires volumetric and surface examinations on all applicable dissimilar metal pressure retaining welds. Table IWB-2500-1, Examination Category B-J requires volumetric and surface examinations on a sample of pressure retaining piping welds and includes all dissimilar welds not covered in Examination Category B-F. The weld population selected for inspection includes the following:

1. All terminal ends in each pipe or branch run connected to vessels.

2. All terminal ends and joints in each pipe or branch run connected to other components where the stress levels exceed either of the following limits under loads associated with specific seismic events and operational conditions:

   a. primary plus secondary stress intensity range of $2.4S_m$ [design stress intensity value] for ferritic steel and austenitic steel, and

   b. cumulative usage factor U of 0.4.

3. All dissimilar metal welds not covered under Examination Category B-F.

4. Additional piping welds so that the total number of circumferential butt welds, branch connections, or socket welds selected for examination equals 25 percent of the circumferential butt welds, branch connection, or socket welds in the reactor coolant piping system. This total does not include welds exempted by IWB-1220 or welds in Item Number B9.22. For pressurized-water reactor (PWR) plants these additional welds may be selected as follows:

   a. one hot-leg and one cold-leg in one reactor coolant piping loop,

   b. one branch, representative of an essentially symmetric piping configuration among each group of branch runs that are connected to reactor coolant loops and perform similar system functions, and

   c. each piping and branch run exclusive of the categories of loop and runs that are part of system piping of (a) and (b) above.

5. A 10 percent sample of PWR high-pressure safety injection system circumferential welds in piping greater than or equal to Nominal Pipe Size (NPS) 1½-inch and less than NPS 4-inch shall be selected for examination. This sample shall be selected from locations determined by the Owner as most likely to be subject to thermal fatigue. Thermal fatigue may be caused by conditions such as valve leakage or turbulence effects.

Table IWC-2500-1, Examination Categories C-F-1 and C-F-2, require volumetric and surface examinations on a sample of dissimilar metal, austenitic stainless steel, high alloy, carbon steel,

or low alloy steel pressure retaining piping welds. The weld population selected for inspection includes the following:

1. Welds selected for examination shall include 7.5 percent, but not less than 28 welds, of all dissimilar metal, austenitic stainless steel, or high alloy steel pressure retaining piping welds (Examination Category C-F-1) or of all carbon and low alloy steel welds (Examination Category C-F-2) not exempted by IWC-1220 (some welds not exempted by IWC-1220 are not required to be nondestructively examined per Examination Categories C-F-1 and C-F-2. These welds, however, shall be included in the total weld count to which the 7.5 percent sampling rate is applied). Examinations shall be distributed as follows:

    a. among the Class 2 systems prorated, to the degree practicable, on the number of nonexempt dissimilar metal, austenitic stainless steel, or high alloy welds (Examination Category C-F-1) or nonexempt carbon and low alloy steel welds (Examination Category C-F-2) in each system;

    b. within a system, per the applicable Examination Category, among terminal ends, dissimilar metal welds, and structural discontinuities prorated, to the degree practicable, on the number of nonexempt terminal ends, dissimilar metal welds, and structural discontinuities in that system; and

    c. within each system, between line sizes prorated to the degree practicable.

3.3 Proposed Alternative and Basis for Use

In its letter dated February 23, 2016, the licensee stated that the WCGS RI-ISI program was initially approved by the NRC for use in the second 10-year ISI interval by letter dated December 13, 2001 (ADAMS Accession No. ML013200130), and subsequently approved by the NRC staff by letter dated February 21, 2007 (ADAMS Accession No. ML070260538), for the third 10-year ISI interval.

In its RR I4R-01, WCNOC proposed to continue applying RI-ISI as an alternative to the requirements of ASME Code, Section XI, Table IWB-2500-1 for Examination Categories B-F and B-J, and Table IWC-2500-1 for Examination Categories C-F-1 and C-F-2 during the fourth 10-year interval at WCGS. The licensee stated that its fourth 10-year RI-ISI program would continue to follow the NRC staff approved methodology of RI-ISI criteria of EPRI TR-112657, Revision B-A. The same methodology was used for the prior two ISI intervals. The licensee further stated that the initial RI-ISI program included a requirement for periodic reviews and updates due to significant changes, including relevant plant or industry feedback to appropriately identify safety significant piping locations. WCNOC stated that these evaluations included consideration of plant-specific changes, examination results, probabilistic risk assessment (PRA) updates, and piping failures as well as industry piping failures.

The licensee stated that with the exception of weld locations that may have changed due to maintenance or modification activities and the addition of Alloy 600 Augmented Examination

Program, the proposed alternate RI-ISI program for WCGS's fourth 10-year interval is essentially the same as the RI-ISI for the second 10-year interval, and for the third 10-year interval. However, the licensee also stated that revision to its Consequence Evaluation multiple welds changed risk category and ranking resulted in net increase of 29 elements from the third 10-year ISI interval. As part of its submittal, WCNOC provided a summary table of welds in the proposed fourth 10-year interval RI-ISI program, along with risk, consequence, and failure potential ranking, as well as associated degradation mechanism(s).

3.4 NRC Staff Evaluation

In its review of the proposed RI-ISI program at WCGS, the NRC staff used the guidance provided in the safety evaluation report (SER) for EPRI TR-112657, along with the guidance provided in the following NRC guidance documents:

- Regulatory Guide (RG) 1.174, Revision 2, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis," May 2011 (ADAMS Accession No. ML100910006).

- RG 1.178, Revision 1, "An Approach for Plant-Specific Risk-Informed Decisionmaking for Inservice Inspection of Piping," September 2003 (ADAMS Accession No. ML032510128).

- RG 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," March 2009 (ADAMS Accession No. ML090410014).

- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), Chapter 3.9.8, "Standard Review Plan for the Review of Risk-Informed Inservice Inspection of Piping," September 2003 (ADAMS Accession No. ML032510135).

The licensee's proposed alternate RI-ISI program was developed using the methodology described in the EPRI TR-112657, Revision B-A. The NRC staff's SER approving the methodology described in the EPRI TR-112657 concluded that the methodology conforms to guidance provided in RG 1.174 and RG 1.178, and that no significant risk increase should be expected from the changes to the ISI program resulting from applying this methodology.

The NRC staff has reviewed and evaluated the licensee's proposed RI-ISI program, including those portions related to the applicable methodology and processes, based on guidance and acceptance criteria provided in RG 1.174, RG 1.178, and SRP Chapter 3.9.8. An acceptable RI-ISI program plan is expected to meet the five key principles discussed in RG 1.178, SRP Chapter 3.9.8, and EPRI TR-112657, Revision B-A, as stated below:

1. The proposed change meets the current regulations unless it is explicitly related to a requested exemption or rule change.

2. The proposed change is consistent with the defense-in-depth philosophy.

3. The proposed change maintains sufficient safety margins.

4. When proposed changes result in an increase in Core Damage Frequency (CDF) or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

5. The impact of the proposed change should be monitored by using performance measurement strategies.

Principle 1

The first principle is met in this RR because an alternative ISI program may be authorized pursuant to 10 CFR 50.55a(z)(1) and therefore an exemption request is not required.

Principles 2 and 3

The second and third principles require assurance that the alternative program is consistent with the defense-in-depth philosophy and that sufficient safety margins are maintained, respectively. Assurance that the second and third principles are met is based on the application of the approved methodology and not on the particular inspection locations selected. The licensee stated that no changes to the evaluation methodology as currently implemented under EPRI TR-112657, Revision B-A are required as part of this interval update; however, the methodology used for the calculation of the risk impact assessment for the fourth 10-year ISI interval has not changed. Since the methodology used to develop the RI-ISI program for the fourth 10-year interval is unchanged from the methodology approved for development of the prior RI-ISI programs (second and third 10-year ISI intervals), the second and third principles are met.

Principle 4

The fourth key principle requires an estimate of the change in risk consistent with the Commission's Safety Goal Policy Statement (51 FR 28044; dated August 4, 1986, as corrected by 51 FR 30028; August 21, 1986). The change in risk estimate is dependent on the location of inspections in the proposed RI-ISI program compared to the location of inspections that would be performed using the requirements of the ASME Code, Section XI. The NRC staff has previously determined that it is not necessary to develop a new deterministic ASME program for each new 10-year interval but, instead, it is acceptable to compare the new proposed RI-ISI program with the last deterministic ASME program.

The licensee summarized the aspects of its living PRA program that were evaluated as part of the ISI program update for the fourth ISI 10-year interval. These aspects included PRA updates, plant design changes, and changes in postulated physical and programmatic conditions. The licensee stated that the Consequence Evaluation was revised and several segments changed consequence rank, causing many welds to change risk category, with resultant change in risk ranking. As a result, 259 welds were revised from low to medium risk resulting in the addition of 28 elements. Additionally, a further 16 welds were revised from medium to high risk, resulting in the addition of two elements. Finally, 17 welds were revised from medium to low risk, resulting in the removal of one element. The licensee stated that a risk

comparison was performed to ensure that the changes due to the new program resulted in either a reduction in risk, or at worst a negligible increase in risk, in accordance with applicable RGs (RGs 1.174 and 1.178). The NRC staff concludes the risk evaluations performed to support the new RI-ISI program process acceptable because the PRA was updated as needed, the consequence of the segments was re-evaluated, and the change in risk was within applicable regulatory guidelines.

The fourth principle also requires demonstration of the technical adequacy of the PRA. The license referenced NRC approved TR, EPRI TR 1021467-A, "Nondestructive Evaluation: Probabilistic Risk Assessment Technical Adequacy Guidance for Risk-Informed In-Service Inspection Programs," June 2012 (ADAMS Accession No. ML12171A450)). The TR identifies the capability categories of all supporting requirements (SRs) in ASME/American Nuclear Standard (ANS) RA-Sa-2009 which, if met at that indicated capability category, need no additional evaluation. Each SR that does not meet the capability category specified in the TR should be addressed. In Enclosure II of the licensee's letter dated February 23, 2016, the licensee provided several tables relating the SRs and the capability categories assigned during reviews of its PRA to the SRs in ASME/ANS RA-Sa-2009. The licensee then evaluated these against the SR capability categories in the EPRI TR. Several SRs that do not meet the capability category in the TR are identified and discussed.

The NRC staff finds that the evaluation of the final capability category of many of the SRs are not peer review assessments but are self-assessments. However, the EPRI TR states that "all relevant peer review and other independent findings shall have been addressed" and the reported results are independent findings developed by Westinghouse as described in licensee's request. The 14 SRs that do not meet the TR's capability categories have been evaluated and determined by the licensee to adequately support the analyses required by the RR. Two SRs (the review of practices that might affect diverse systems and the lack of parametric uncertainty) were identified by the licensee as possibly affecting the results but the licensee stated that the work that was done to address these SRs was sufficient to support the RI-ISI relief request. The NRC staff determined that the approach and process used to assess the technical adequacy of the PRA by systematically updating previous peer review results to the current standard (ASME/ANS RA-Sa-2009), comparing the final result to the TR guidelines and evaluating all SRs not meeting the guidelines to be consistent with the methodology approved in the RG 1.200 and the TR is acceptable.

Principle 5

The fifth principle of risk-informed decision making requires that the impact of the proposed change be monitored by using performance measurement strategies. As described in the RR, the RI-ISI program is a living program that requires periodic updating and that as a minimum, risk ranking of piping segments will be reviewed on an ASME period basis. In its submittal, the licensee stated that as part of its ISI program update for the fourth-10 year ISI interval, it performed an RI-ISI Living Program Evaluation, using the guidance provided in Nuclear Energy Institute (NEI) 04-05, "Living Program Guidance to Maintain Risk-Informed Inservice Inspection Programs for Nuclear Plant Piping Systems," April 2004 (ADAMS Accession No. ML041480432). WCNOC also stated the evaluation included consideration of plant-specific examination results, PRA updates, and piping failures, and changes, as well as industry piping failures.

As a result of these updates, for the fourth 10-year ISI interval, the number of EPRI "high" risk category weld examinations at WCGS increased by 28. The analyses and changes reported by the licensee in its submittal demonstrate that the WCGS RI-ISI program is a living program that is being periodically updated. In addition, all of the subject welds will continue to be subject to system leakage testing in accordance with ASME Code, Section XI, Table IWB-2500-1 for Examination Category B-P and Table IWC-2500-1 for Examination Category C-H. Therefore, the NRC staff concludes that the fifth key principle, which provides that risk-informed applications should include performance monitoring and feedback provisions, is met.

3.5 Results of the NRC Staff Evaluation

Based on the above discussion, the NRC staff concludes that the five key principles of risk-informed decision making are met by the licensee's proposed use of RI-ISI program described in RR I4R-01 and therefore the proposed program for the fourth 10-year ISI interval at WCGS is acceptable and provides an acceptable level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that WCNOC has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC authorizes the use of the alternate RI-ISI program at WCGS for the fourth 10-year ISI interval, which commenced on September 3, 2015, and will end on September 2, 2025.

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

Principal Contributors: Leslie Fields, NRR/DSS/APLA
Roger Kalikian, NRR/DE/EPNB

Date: November 30, 2016

If you have any questions concerning this matter, please call Mr. Balwant K. Singal of my staff at (301) 415-3016 or by electronic mail at balwant.singal@nrc.gov.

Sincerely,

/RA/

Robert J. Pascarelli, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

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Safety Evaluation

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ADAMS Accession No.: ML16320A032 ***Memo dated November 2, 2016**

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