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

April 27, 2020

Mr. Cleveland Reasoner
Chief Executive Officer and Chief Nuclear Officer
Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, KS 66839

SUBJECT: WOLF CREEK GENERATING STATION, UNIT 1 – REQUEST FOR RELIEF FROM REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE CASE N-666-1 (EPID L-2019-LLR-0077)

Dear Mr. Reasoner:

By letter dated August 19, 2019, as supplemented by letter dated January 29, 2020, Wolf Creek Nuclear Operating Corporation (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) to request relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), for Wolf Creek Generating Station, Unit 1. As a result of an extent of condition resulting from a previous through-wall leak on a 2-inch socket weld on the essential service water drain line connected to the component cooling water heat exchanger system, additional socket weld connections have been identified as potential candidates for requiring weld overlay repairs before the next refueling outage. The licensee plans to use the NRC-approved ASME Code Case N-666-1, "Weld Overlay of Class 1, 2, and 3 Socket Welded Connections, Section XI, Division 1," for the temporary repair of the socket weld connections associated with the component cooling water heat exchangers.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(2), the licensee requested relief from the following requirements of ASME Code Case N-666-1, on the basis that compliance with the specified ASME Code repair would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety:

- Weld overlay carbon content requirement during water backed welding; and
- Verification requirement that the socket weld failure was a result of vibration fatigue.

As set forth in the enclosed safety evaluation, the NRC staff has reviewed the subject request and concludes that the proposed alternative provides reasonable assurance of structural integrity of the subject socket welds associated with the component cooling water heat exchanger essential service water system piping. The NRC staff concludes that complying with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in

10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of the proposed alternative for the remainder of the fourth 10-year inservice inspection interval at Wolf Creek, which is scheduled to end on September 2, 2025.

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

If you have any questions concerning this matter, please contact the Project Manager, Mr. Balwant K. Singal at 301 415-3016 or via e-mail at Balwant.Singal@nrc.gov.

Sincerely,

/RA/

Jennifer L. Dixon-Herrity, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosure
Safety Evaluation

cc: Listserv

SUBJECT: WOLF CREEK GENERATING STATION, UNIT 1 – REQUEST FOR RELIEF FROM REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE CASE N-666-1 (EPID L-2019-LLR-0077) DATED APRIL 27, 2020

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

BOILER AND PRESSURE VESSEL CODE CASE N-666-1

WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION, UNIT 1

DOCKET NO. 50-482

1.0 INTRODUCTION

By letter dated August 19, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19239A114), as supplemented by letter dated January 29, 2020 (ADAMS Accession No. ML20036C963), Wolf Creek Nuclear Operating Corporation (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) to request relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), for Wolf Creek Generating Station, Unit 1 (Wolf Creek).

As a result of an extent of condition resulting from a previous through-wall leak on a 2-inch socket weld on the essential service water (ESW) drain line connected to the component cooling water (CCW) heat exchanger (HX) documented in the NRC staff's letter dated December 12, 2018 (ADAMS Accession No. ML18334A013), additional socket welded connections have been identified as potential candidates for requiring weld overlay repairs before the next refueling outage. The licensee plans to use the NRC-approved ASME Code Case N-666-1, "Weld Overlay of Class 1, 2, and 3 Socket Welded Connections, Section XI, Division 1," for the temporary repairs of these socket welded connections.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(2), the licensee requested relief from the following requirements of ASME Code Case N-666-1, on the basis that compliance with the specified ASME Code repair would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety:

- Weld overlay carbon content requirement during water backed welding; and
- Verification requirement that the socket weld failure was a result of vibration fatigue.

The socket welded connections in question are designed to ASME Code, Section III, Class 3.

Enclosure

2.0 REGULATORY EVALUATION

Section 50.55a(g)(4) of 10 CFR, "Inservice inspection standards requirement for operating plants," requires that ASME Code Class 1, 2 and 3 components meet the inservice inspection (ISI) requirements, except the design and access provisions, set forth in Section XI of editions and addenda of the ASME Code, to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Section 50.55a(z)(2) of 10 CFR, "Hardship without a compensating increase in quality and safety," states that alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the NRC if the licensee demonstrates compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee proposed an alternative to the defect removal requirements of ASME Code, Section XI, Sub-subarticle IWA-4420 due to hardship without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Proposed Alternative

3.1.1 ASME Code Components Affected

Affected components are limited to the CCW HX socket welded connections exposed to ESW system flow. The CCW HX socket welded connections are designed and constructed to the ASME Code, Section III, Class 3. Both the piping and HX were designed and constructed to the 1974 Edition with the Summer 1975 Addenda. The specific socket welded connections are as follows:

- EGV0029, CCW HX A INTERPASS WATERBOX (WTRBX) DRAIN
- EGV0032, CCW HX A OUTLET WTRBX DRAIN
- EGV0054, CCW HX B INTERPASS WTRBX DRAIN
- EGV0057, CCW HX B ESW OUTLET WTRBX DRAIN
- EGV0028, CCW HX A ESW OUTLET PI-33 ISOLATION (ISO)
- EGV0033, CCW HX A ESW INLET PI-37 ISO
- EGV0053, CCW HX B ESW OUTLET PI-34 ISO
- EGV0058, CCW HX B ESW INLET PI-38 ISO
- EGV0026, CCW HX A INLET WTRBX VENT
- EGV0051, CCW HX B ESW INLET WTRBX VENT
- EGV0021, CCW HX A ESW INTERPASS WTRBX VENT
- EGV0046, CCW HX B INTERPASS WTRBX VENT

3.1.2 Applicable Code Edition and Addenda

The applicable ASME Code of record for the Wolf Creek fourth ISI interval is the 2007 Edition with the 2008 Addenda of ASME Code, Section XI.

3.1.3 Applicable ASME Code Requirements

ASME Code, Section XI, Sub-subarticle IWA-4420 specifies the requirements for defect removal. If a defect has an unacceptable size, the defect is required to be removed by mechanical processing, thermal methods, welding, or brazing.

3.1.4 Reason for Request

In July 2018, a leak from a through-wall flaw resulted in the submittal of the proposed alternative to use ASME Code Case N-666-1 for weld overlay repair of a socket weld on the ESW system drain line. The previous request is documented in the licensee's letter dated July 23, 2018 (ADAMS Accession No. ML18215A176), as supplemented by letter dated August 28, 2018 (ADAMS Accession No. ML18247A468). The NRC approval of this request is documented in the NRC letter dated December 12, 2018.

The previous approval for use of ASME Code Case N-666-1 allowed a weld overlay repair on the leaking socket weld without defect removal. During the leakage event, the licensee found hardship associated with isolation or draining of the ESW system, which would be necessary to perform Code-required defect removal and repair/replacement activities. Specifically, the licensee attempted to isolate Train A of the ESW system from the CCW Train A HX utilizing the isolation valves near the HX. The attempts to isolate were unsuccessful. Train B of the ESW to the CCW Train B HX has the same isolation valves and has been previously identified to have similar leak-by conditions during isolation attempts.

By draining the HX tubes, the ESW system inventory may be reduced to perform the socket weld repair/replacement activities. However, this approach would render the affected ESW train non-functional. With either train completely non-functional, Wolf Creek would be placed in an elevated, undesirable risk condition. The ESW system is the safety-related cooling medium for most safety-related systems. Therefore, making one train of the ESW system inoperable would require entry into several Wolf Creek Technical Specification (TS) action statements. It would be a significant challenge to complete the socket weld repairs and restore the ESW system to operable status within the TS completion times in order to avoid a TS-required plant shutdown.

One alternative would be to place the plant in cold shutdown (Mode 5) prior to draining the ESW system. In this approach, inherent risk is involved when maneuvering the power plant from 100 percent power to Mode 5 and then back to 100 percent. In addition, only one train of the residual heat removal system would be available for shutdown cooling if one of ESW system trains is drained. The availability of only a single train of the residual heat removal system for shutdown cooling is not desirable in terms of defense-in-depth. Therefore, establishing the condition of having the ESW system drained to complete a future/potential weld overlay would result in hardship without a compensating increase in quality and safety.

The discussion on the operating experience above supports that there is hardship associated with the implementation of Code-required repair/replacement activities. The operating experience also suggests that there would be a potential need to apply similar weld overlays on other socket welds by using the provisions of ASME Code Case N-666-1.

3.1.5 Proposed Alternative

The licensee proposed to perform a weld overlay repair without defect removal, if necessary, in accordance with the provisions of ASME Code Case N-666-1. The proposed alternative could be implemented preemptively. In using ASME Code Case N-666-1, the licensee will also implement applicable conditions to ASME Code Case N-666-1 identified in Regulatory Guide (RG) 1.147, Revision 19, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated October 2019 (ADAMS Accession No. ML19128A244).

The proposed alternative identifies two exceptions to the following paragraphs in ASME Code Case N-666-1: paragraph 1(b) requiring that the carbon content of P-No. 1 Group 2 base materials be limited to 0.30 percent maximum for water backed welding and paragraph 2(a) requiring that the Owner verify that the socket weld failure is a result of vibration fatigue. Specifically, the licensee proposed to use P-No. 1 Group 2 base materials with the maximum carbon content of 0.35 percent for water backed welding. The operating experience of the ESW system indicates that verifying the failure as a result of vibration fatigue are typically inconclusive since the flaw is initiated by localized under-deposit corrosion and vibration fatigue may contribute to the failure.

When a weld overlay is installed as an alternative to defect removal, the weld overlay will be removed from service prior to the end of the next refueling outage following the installation. The socket welded connection will be reworked or repaired to meet the requirements of the ASME Code.

3.1.6 Basis for Use of the Proposed Alternative

RG 1.147, Revision 19 approves the use of ASME Code Case N-666-1 with the condition that when ASME Code Case N-666-1 is used, a surface examination (magnetic particle or liquid penetrant) must be performed after installation of the weld overlay on Class 1 and 2 piping socket welds. As further documented in Section 3.2 of this safety evaluation, this condition is not applicable to the licensee's proposed alternative because the scope of the alternative does not include Class 1 or 2 components.

As previously discussed, the licensee requested relief from paragraph 1(b) of ASME Code Case N-666-1 requiring that the carbon content of P-No. 1 Group 2 base materials be limited to 0.30 percent maximum for water backed welding. Specifically, the licensee proposed to use P-No. 1 Group 2 base materials with the maximum carbon content of 0.35 percent for water backed welding. This maximum carbon content is based on the specification of the P-No. 1 Group 2 base materials.

With respect to the relief from paragraph 1(b), the licensee stated that the potential concerns associated with welding on the P-No. 1 Group 2 base materials with a carbon content of 0.35 percent are brittle microstructure and hydrogen induced cracking. The licensee explained that brittle microstructure is not an issue because (a) a summary of the hardness of martensite as a function of carbon content found that a shift of carbon content of 0.30 to 0.35 percent increases the peak hardness from approximately 500 to 560 Vickers, which is a relatively minor

shift; (b) welding on the coupling and drain line will not be an ideal quench as the water inside is not ambient such that a hardness level of 560 Vickers is not expected to be achieved in the actual welding process; and (c) the Code Case specifies a minimum of two layers to be deposited in the temper bead welding, which will have a tempering effect on the heat affected zone microstructure (i.e., increasing the toughness and alleviating the brittleness). In addition, the licensee stated that hydrogen induced cracking is not an issue because (a) low hydrogen consumables and practices will be used; and (b) multiple weld layers will have a tempering effect on the heat affected zone.

The licensee also requested relief from paragraph 2(a) of ASME Code Case N-666-1 requiring that the Owner verify that the socket weld failure is a result of vibration fatigue. The licensee explained that the previous operating experience of the ESW system has shown that flaw initiation may be a result of localized internal corrosion and vibration fatigue may have contributed to the eventual failure of the socket weld. The licensee also stated that verifying the failure as a result of vibration fatigue may be inconclusive. As the justification for this exception, the licensee stated that all examinations and testing are in accordance with ASME Code Case N-666-1 and that walkdowns will be performed to identify leakage after the weld overlay installation.

With respect to the hardship due to the Code-required repair/replacement activities, the licensee stated that it would be a significant challenge to complete the repairs and restore the ESW system to operable status within the TS completion times in order to avoid a TS-required plant shutdown, as discussed in Section 3.1.4 of this safety evaluation.

3.1.7 Duration of Proposed Alternative

The duration of the proposed alternative is the fourth 10-year ISI interval at Wolf Creek, which began on September 3, 2015, and is scheduled to end on September 2, 2025. Since 10 CFR 50.55a(z) specifies that NRC approval is necessary prior to implementation of a proposed alternative, the NRC staff's review of the licensee's request is focused on the use of ASME Code Case N-666-1 for the remainder of the fourth ISI interval.

3.2 NRC Staff Evaluation

As previously discussed, the latest revision of RG 1.147, Revision 19 approves the use of ASME Code Case N-666-1 with one condition. The condition specified in RG 1.147 requires that when ASME Code Case N-666-1 is used, a surface examination magnetic particle or liquid penetrant) must be performed after installation of the weld overlay on Class 1 and 2 piping socket welds.

The NRC staff notes that the condition identified for ASME Code Case N-666-1 in RG 1.147, Revision 19 (i.e., surface examination on Class 1 and 2 socket welds) is not applicable to the proposed alternative because the subject socket welds at Wolf Creek are Class 3 components. Therefore, the NRC staff finds that RG 1.147 supports the use of ASME Code Case N-666-1 for the subject socket weld connections, except for the relief from paragraphs 1(b) and 2(a) of ASME Code Case N-666-1. Accordingly, the NRC staff's evaluation was focused on the licensee's request for relief from paragraphs 1(b) and 2(a) of ASME Code Case N-666-1, as further documented below.

Paragraph 1(b) of ASME Code Case N-666-1 limits the carbon content of P-No. 1 Group 2 base materials to 0.30 percent for water-backed welding. To justify the use of ASME Code

Case N-666-1 on P-No. 1 Group 2 base materials with a carbon content up to 0.35 percent, the licensee confirmed the following: (a) a carbon content of 0.05 percent greater than the Code Case allowable (0.30 percent) will have a negligible impact on the hardness of the material, thereby eliminating the concern about the brittle microstructure and material behavior; (b) the multiple weld passes, as specified in the Code Case, will also have a tempering effect to decrease the hardness of the material and thereby reduce the potential for cracking; and (c) the use of low hydrogen electrodes and multiple weld passes will limit the potential for hydrogen induced cracking. The NRC staff finds that the relief from paragraph 1(b) of ASME Code Case N-666-1 is acceptable based on the technical basis discussed above for welding on pipe material with a carbon content up to 0.35 percent.

Paragraph 2(a) of ASME Code Case N-666-1 limits the use of the Code Case to socket weld failure as a result of vibration fatigue. To justify the use of this Code Case without verifying that the socket weld failure is a result of vibration fatigue, the licensee confirmed the following: (a) the operating experience of the ESW system demonstrates that the dominant degradation mechanism in this system is localized under-deposit corrosion (pitting); (b) the weld overlay repairs for this type of localized corrosion has a low likelihood of a leak prior to the next refueling outage, as supported by the operating experience; and (c) the temporary weld overlay repair will be monitored on walkdowns at least twice daily (once per operation shift) to identify leakage. The NRC staff finds the relief from paragraph 2(a) of ASME Code Case N-666-1 is acceptable based on the operating experience assessment results, low likelihood of a leak to occur after the repair, and frequency of the walkdowns to identify leakage.

With respect to the licensee's justification of hardship, the NRC staff notes that performing the Code-compliant repairs requires a plant shutdown, which will lead to unnecessary plant transients and additional radiation dose. The plant shutdown is undesirable in terms of plant safety because it increases loads on the systems and components. The NRC staff finds that the Code-compliant repair of the subject socket-welded connections would not significantly increase plant quality or safety. Therefore, the NRC staff finds that Code-compliant repairs would result in hardship or unusual difficulty without a compensating increase in plant quality or safety.

In summary, the NRC staff evaluated the technical basis of this request against the criteria contained in 10 CFR 50.55a(z)(2). The NRC staff concludes that the proposed alternative will provide reasonable assurance of the structural integrity of the subject socket-welded connections until the next refueling outage following the weld overlay repair when a Code-compliant repair will be implemented.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides reasonable assurance of structural integrity of the subject socket welds associated with the CCW HX ESW system piping. The NRC staff concludes that complying with the ASME Code repair requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of the proposed alternative for the remainder of the fourth 10-year ISI interval at Wolf Creek, which is scheduled to end on September 2, 2025.

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

Principal Contributors: S. Min, NRR

Date: April 27, 2020