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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REVIEW OF THE PRESSURE TEMPERATURE LIMITS REPORT AND

METHODOLOGY FOR THE RELOCATION OF REACTOR COOLANT SYSTEM (RCS)

PRESSURE TEMPERATURE LIMIT CURVES AND LOW TEMPERATURE

OVERPRESSURE PROTECTION SYSTEM LIMITS

WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION

DOCKET NO. 50-482

1.0 INTRODUCTION

By letter dated December 29, 1998 (Reference 1), and supplemented by letters dated July 29, 1999 (Reference 2), and October 21, 1999 (Reference 3), Wolf Creek Nuclear Operating Corporation (WCNOC) requested an amendment to make changes to the technical specifications (TSs) for the Wolf Creek Generating Station (WCGS). The requested changes included (1) approving new reactor coolant system (RCS) pressure temperature (P/T) heatup and cooldown limit curves, and a low temperature overpressure protection (LTOP) system power-operated relief valve (PORV) setpoint limit curve, (2) relocating the P/T limit curves from the TS to a licensee-controlled document identified as a Pressure Temperature Limits Report (PTLR), and (3) changing the affected limiting conditions for operation and bases accordingly. These changes are made in accordance with Generic Letter (GL) 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," dated January 31, 1996 (Reference 5).

The proposed changes include an updated fluence determination based on the results of the analysis from the Wolf Creek surveillance capsule V reported in WCAP-15078, Rev. 1, (Reference 6). WCNOC also requested an exemption from the requirements of 10 CFR 50.60, "Acceptance Criteria for Fracture Prevention Measures for Lightwater Nuclear Power Reactors for Normal Operation," that allows plants to use the American Society of Mechanical Engineers (ASME) Code Case N-514. The exemption was granted on April 30, 1999. Therefore, in calculating the revised LTOP limits, the licensee used the methodology in ASME Code Case N-514. The current Wolf Creek P/T curves are valid for 13.6 effective full-power years (EFPYs). Wolf Creek has accumulated about 9.49 EFPYs through the end of Cycle 9. The new P/T curves are based on a fluence projection to 20 EFPYs of operation.

Wolf Creek is currently operating below the limit of 13.6 EFPYs and will reach this limit after the next refueling outage. The proposed revised operating limits of 20 EFPYs are based on (1) revised fluence values derived from the recently removed and tested surveillance capsule V (Reference 6); (2) more accurate instrument uncertainty calculations for the RCS temperature, pressure, and level instruments; (3) the most limiting transient of mass and heat addition; and (4) the use of Code Case N-514 in determining the proposed limits.

Approval of the methodology and establishment of the PTLR allows the licensee to change the numerical values of the P/T curves, the PORV LTOP setpoints, and the enable temperature, provided that the revisions to the numerical values are estimated using NRC approved methodologies. A detailed discussion of the PTLR requirements can be found in GL 96-03.

2.0 BACKGROUND

2.1 Neutron Fluence

The revised fluence values were derived from the data of the most recently removed and tested surveillance capsule V. They are to be estimated using the method outlined in Westinghouse Topical Report WCAP-14040-NP-A (Reference 4).

2.2 Pressure Temperature Limits

The staff evaluates the P/T limits based on the following NRC regulations and guidance: 10 CFR Part 50, Appendix G; GL 88-11; GL 92-01, Rev. 1; GL 92-01, Rev. 1, Supplement 1; Regulatory Guide (RG) 1.99, Rev. 2; and Standard Review Plan (SRP) Section 5.3.2. GL 88-11 advised licensees that the staff would use RG 1.99, Rev. 2, to review P/T limit curves. RG 1.99, Rev. 2 contains methodologies for determining the increase in transition temperature and the decrease in upper-shelf energy (USE) resulting from neutron radiation. GL 92-01, Rev. 1, requested that licensees submit their reactor pressure vessel (RPV) data for the staff for review. GL 92-01, Rev. 1, Supplement 1, requested that licensees assess and provide data from other licensees that could affect their RPV integrity evaluations. The staff uses these data as the basis for its review of P/T limit curves and as the basis for its review of pressurized thermal shock (PTS) assessments (10 CFR 50.61 assessments). Appendix G to 10 CFR Part 50 requires that P/T limit curves for the RPV be at least as conservative as those obtained by applying the methodology of Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Appendix G. The terms used throughout this evaluation are discussed in detail in these sources.

2.3 Low Temperature Overpressure Protection System

The LTOP system mitigates overpressure transients at low temperatures so that the integrity of the reactor coolant pressure boundary is not compromised by violating 10 CFR Part 50, Appendix G. At Wolf Creek, the over-pressure is mitigated by using staggered settings of two pressurizer PORVs. The PORV pressure settings are such that both settings protect the vessel. The design basis for the Wolf Creek LTOP system considers mass as well as heat addition transients. The analysis of the mass addition transient accounts for the injection from one charging pump and/or one centrifugal charging pump with the instrument air flow control valve in the charging line failing to the fully open position and the letdown line failing closed.

The analysis for the heat addition transient accounts for the heat input from the inadvertent startup of a reactor coolant pump with a maximum of 50 degrees F mismatch between the RCS and the hotter of the steam generators.

The transient analyses take into account the pressure overshoot (calculated from the mass and heat input transients), the coolant pump seal pressure limit, the 10 CFR Part 50, Appendix G limits, and Code Case N-514. The design of the cold overpressure mitigation system (COMS) satisfies the single failure criterion. Should one of the PORVs fail, the other is able to provide adequate flow to avoid RCS overpressurization. The pressure difference from the wide range pressure transmitter to the beltline region is accounted for in the determination of the PORV setting. The actual PORV settings are less than the calculated maximum allowed pressure and less than the PORV piping limits.

3.0 EVALUATIONS

3.1 Neutron Fluence

The revised fluence values were presented in WCAP-15078. This is a capsule analysis report for the Wolf Creek capsule V, which was removed at the end of 9.5 EFPYs of operation, that is, at the end of cycle 9. The analysis methodology used cross-sections, scattering approximations, and quadrature approximation recommended by the staff and, therefore, is acceptable. Similarly, the power distribution and power generation rates were derived from core loading reports, and the power operating periods are those reported in NUREG-0020. These are acceptable practices. The flux and power distribution anomaly caused by crud (severe manifestation in Callaway) did not affect Wolf Creek in a significant way. Finally, the measured fluence values were in excellent agreement with the calculated values, therefore, the staff finds the fluence estimate for 20 EFPYs acceptable.

In this submittal, Westinghouse performed the referenced fluence evaluation using the methodology described in WCAP-14040-NP-A and the evaluation was found acceptable. The same methodology is proposed for the PTLR. The methodology satisfies the GL 96-03 requirements and the staff finds it acceptable.

3.2 Pressure Temperature Limits

The methods used by the licensee in determining the P-T curves conform, in general, to the methodology approved by the NRC in WCAP-14040-NP-A. WCNOC applied the methodology as the basis for developing the COMS setpoints and the reactor coolant pressure boundary (RCPB) heatup and cooldown limit curves.

3.2.1 Reactor Vessel Material Surveillance Program

The reactor vessel material surveillance program is designed to monitor radiation effects on reactor vessel materials under actual operating conditions. Appendix H to 10 CFR Part 50 requires that the surveillance program satisfy ASTM Standard E-185, which specifies material testing, specimen sizes, specimen quantities, and material selection. The staff verified that the surveillance program for Wolf Creek is in compliance with Appendix H to 10 CFR Part 50. The withdrawal schedule is found in Table 5.3-11 of the Wolf Creek Updated Safety Analysis

Report, which is referenced in the proposed Wolf Creek PTLR. In addition, the surveillance capsule reports WCAP-11553, -13365, and -15078, for capsules U, Y, and V, respectively, are referenced in the PTLR.

3.2.2 Adjusted Reference Temperature

WCNOC submitted adjusted reference temperature (ART) calculations and P/T limit curves valid to 20 EFPYs. The staff independently verified the accuracy of the licensee's ART calculations. In addition, the staff independently generated P/T curves for normal operations and hydrostatic test pressures effective to 20 EFPYs. The details of this evaluation are provided below.

For the Wolf Creek reactor vessel, the licensee determined that the most limiting material at the 1/4T and 3/4T locations is the lower shell plate R2508-3. This plate was fabricated using plate heat number C4935-2. The licensee calculated an ART of 90 degrees F at the 1/4T location and 80 degrees F at the 3/4T location at 20 EFPYs. The neutron fluence used in the ART calculation was 7.54×10^{18} n/cm^2 at the 1/4T location and 2.68×10^{18} n/cm^2 at the 3/4T location. The initial RT_{NDT} for the limiting plate was 40 degrees F. The margin term used in calculating the ART for the limiting plate was 17 degrees F at the 1/4T and 3/4 T locations, as permitted by Regulatory Position 2.1 of RG 1.99, Rev. 2. The licensee's limiting ART for the vessel flange, head flange, and upper shell plate and weld material is 20 degrees F.

The ART is determined using the chemistry values for each beltline material of Wolf Creek. The reactor vessel integrity database (RVID) contains chemistry values for each beltline material for all light water reactors in the U.S. The licensee provided updated chemistry data for the beltline materials of Wolf Creek in the submittal of September 25, 1998. It should be noted that the staff used the updated chemistry values in the review for Wolf Creek. In addition, the staff noted that the licensee's submittal adequately addressed all of the outstanding issues regarding the Combustion Engineering Owners Group report (CE NPSD-1039, Rev. 2, "Best Estimate Copper and Nickel Values in CE Fabricated Reactor Vessel Welds").

The staff performed an independent calculation of the ART values for the limiting material using the methodology in RG 1.99, Rev. 2. Based on these calculations, the staff verified that the licensee's limiting material for the Wolf Creek reactor vessel is the lower shell plate R2508-3, which was fabricated using plate heat number C4935-2. The staff's calculated ART values for the limiting material agreed with the licensee's calculated ART values at 20 EFPYs. Substituting the ART values for the Wolf Creek limiting plate into the equations in SRP Section 5.3.2, the staff verified that the proposed P/T limits satisfy the requirements in paragraph IV.A.2 of Appendix G to 10 CFR Part 50. The staff independently generated P/T curves for normal operations and hydrostatic test pressures effective to 20 EFPYs. In comparing the staff's generated curves to the licensee's generated curves, the staff determined that the P/T curves for Wolf Creek meet the requirements of Appendix G to Section XI of the ASME Code.

3.2.3 Fracture Mechanics Calculation

As discussed previously, the staff evaluated the Wolf Creek P/T limits based on Appendix G to 10 CFR Part 50 and SRP Section 5.3.2. Appendix G to 10 CFR Part 50 requires that P/T limits

for the reactor vessel must be at least as conservative as those obtained based on Appendix G to Section III of the ASME Code. The staff verified that Wolf Creek used linear elastic fracture mechanics in Appendix G to Section XI of the ASME Code in calculating the allowable P/T limit curves.

The staff verified that the proposed 20 EFPY limits for heatup, cooldown, criticality, and inservice hydrostatic tests in the Wolf Creek PTLR satisfy the requirements of Appendix G to 10 CFR Part 50.

3.2.4 Minimum Temperature Requirement

The staff verified that the licensee's proposed PTLR included the 20 degrees F value for the initial RT_{NDT} of the closure head flange.

3.2.5 Use of Surveillance Data

The staff verified the credibility of the surveillance data for the limiting material (lower shell plate heat number C4935-2) of Wolf Creek. WCNOC placed its surveillance data in the proposed PTLR. In addition, the licensee addressed its use of the surveillance data and submitted a complete evaluation on the credibility of the surveillance data in the proposed Wolf Creek PTLR. The staff found the licensee's evaluation of the surveillance data in the PTLR acceptable.

4.0 CONCLUSION

Based on the staff's evaluations, as discussed in Section 3.0 above, the staff concludes that the methodology proposed by WCNOC is acceptable. Therefore, it is acceptable for the licensee to relocate the P/T limit curves and LTOP setpoints from the Wolf Creek TSs to a licensee-controlled PTLR.

The staff has reviewed the implementation of the LTOP and finds that the calculations of the heatup and the cooldown curves, the LTOP enable temperature, and the associated PORV actuation pressure were performed in a manner consistent with the approved methodologies in WCAP-14040-NP-A and staff approved practices. Therefore, the staff concludes that the proposed changes are acceptable.

The staff concludes that the proposed P/T limits for the reactor coolant system for heatup, cooldown, leak test, and criticality satisfy the requirements in Appendix G to Section XI of the ASME Code and Appendix G to 10 CFR Part 50 for 20 EFPYs. The proposed P/T limits also satisfy GL 88-11 because the method in RG 1.99, Rev. 2, was used to calculate the ART.

The staff concludes that the proposed PTLR for Wolf Creek meets the criteria of GL 96-03 and is acceptable.

5.0 REFERENCES

1. Letter from C. C. Warren, Wolf Creek Nuclear Operating Corporation, to NRC, "Application for Amendment to the WCGS Technical Specifications to Incorporate Revised Heatup and Cooldown Limit Curves, and a Revised Cold Ovepressure Mitigation System (COMS) Power-Operated Relief Valve (PORV) Setpoint Limit Curve," December 29, 1998. (WO 98-0104)

2. Letter from R. A. Muench, Wolf Creek Nuclear Operating Corporation, to NRC, Document Control Desk, "Wolf Creek Nuclear Operating Corporation: Supplemental Information to Amendment Request for Revision of the Heatup, Cooldown and Cold Overpressure Mitigation System Limit Curves," July 29, 1999. (ET 99-0031)

3. Letter from R. A. Muench, Wolf Creek Nuclear Operating Corporation, to NRC, Document Control Desk, "Wolf Creek Nuclear Operating Corporation: Revision of Pressure Temperature Limits Report," October 21, 1999. (ET 99-0044)

4. WCAP-14040-NP-A, Revision 2, Westinghouse Electric Corporation, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," January 16, 1996.

5. NRC Generic Letter 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," January 31, 1996.

6. WCAP-15078, Revision 1, "Analysis of Capsule V From the Wolf Creek Nuclear Operating Corporation Wolf Creek Reactor Vessel Radiation Surveillance Program," E. Terek, et al., Westinghouse Electric Corporation, September 1998.

7. WCAP-15079 Revision 1, "Wolf Creek Heatup and Cooldown Limit Curves for Normal Operation," T.J. Laubham, Westinghouse Electric Corporation, September 1998.

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Date: December 2, 1999

safety evaluation, which is enclosed. The safety evaluation defines the basis for acceptance of the submittals. Our acceptance applies only to the matters described in the submittals.

The methodology for review relating to the P/T limit curves and the PORV setpoint curve was provided in the references listed above. WCAP-14040-NP-A contained most of the methodology used for determining the acceptance of the Wolf Creek methodology.

The methodology in WCAP-14040-NP-A, along with any supplements provided by Wolf Creek, must be used to calculate future changes to the P/T limit curves and PORV setpoint curve. Wolf Creek may generate new P/T limit curves and PORV setpoint curves in accordance with this methodology without prior approval of the staff. However, any changes to the approved methodology must first be reviewed and approved by the staff. System limits may be subject to audit by the staff through inspections as necessary.

We do not intend to repeat our review of the matters described in the submittals if the submittals appear as references in other license applications relating to your plant, except to ensure that the material in the submittals is still applicable to your plant as indicated in the conclusion section of the safety evaluation.

Should our criteria or regulations change so that our conclusions concerning the acceptability of the methodology are invalidated, licensees referencing these documents will be expected to revise and resubmit their documentation, or submit justification for the continued effective applicability of the documents without revision of their respective documentation.

Sincerely,
Original Signed By
Stuart A. Richards, Director
Project Directorate IV and Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosure: Safety Evaluation

cc w/encl: See next page

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