WOLF CREEK
NUCLEAR OPERATING CORPORATION

Terry J. Garrett
Vice President, Engineering

August 20, 2007
ET 07-0037

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Reference:
1) Letter ET 06-0038, dated September 27, 2006, from T. J. Garrett, WCNOC, to USNRC
2) Letter WM 07-0049, dated June 1, 2007, from M. W. Sunseri, WCNOC, to USNRC
3) Letter WM 07-0051, dated June 7, 2007, from M. W. Sunseri, WCNOC, to USNRC
4) Letter dated July 24, 2007, from V. Rodriguez, USNRC, to T. J. Garrett, WCNOC (ML071730352)
5) Letter ET 07-0031, dated July 26, 2007, from T. J. Garrett, WCNOC, to USNRC

Subject: Docket No. 50-482: Response to NRC Requests for Additional Information Related to Wolf Creek Generating Station License Renewal Application Time–Limited Aging Analysis Audit Question

Gentlemen:

Reference 1 provided Wolf Creek Nuclear Operating Corporation's (WCNOC) License Renewal Application (LRA) for the Wolf Creek Generating Station (WCGS). As part of the review for license renewal, the Nuclear Regulatory Commission (NRC) staff conducted three audits at WCGS. The LRA Aging Management Program audit was conducted during the week of March 26, 2007 and the LRA Aging Management Review during the week of May 7, 2007. During the course of these two audits the NRC staff also audited Time Limited Aging Analyses (TLAA). An additional TLAA audit was conducted during the week of July 9, 2007.

Based on the results of the March 26 and May 7, 2007 TLAA audits, WCNOC modified Sections 4.1 and 4.3 of the LRA. WCNOC submitted these amended sections as Amendment 1 to the WCGS LRA in Reference 2.

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A TLAA question and answer database was compiled during the audits. WCNOC submitted this database in Reference 3. Reference 4 submitted NRC Request for Additional Information (RAI) number 4.3-3, concerning the WCNOC response to audit question TLAAA002. Attachment I provides the response to RAI 4.3-3.

This letter contains new commitments. WCNOC had previously committed to a number of action items concerning metal fatigue in commitment number twenty-one of Reference 5. This commitment has been revised to include the additional action items identified in this correspondence. Attachment II provides the revised commitment number twenty-one. If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Kevin Moles at (620) 364-4126.

Sincerely,

Terry J. Garrett

TJG/rlt

Attachment I: Response to RAI 4.3-3
Attachment II: List of Commitments

cc: J. N. Donohew (NRC), w/a
V. G. Gaddy (NRC), w/a
B. S. Mallett (NRC), w/a
V. Rodriguez (NRC), w/a
Senior Resident Inspector (NRC), w/a

S TATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Terry J. Garrett, of lawful age, being first duly sworn upon oath says that he is Vice President Engineering of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By____________________
Terry J. Garrett
Vice President Engineering

SUBSCRIBED and sworn to before me this 20th day of August 2007.

Gayle Shepheard
Notary Public

GAYLE SHEPHEARD
Notary Public - State of Kansas
My Appt. Expires July 24, 2011

Expiration Date July 24, 2011

Wolf Creek Nuclear Operating Corporation (WCNOC) Response to NRC Requests for Additional Information RAI 4.3-3

RAI 4.3-3

By letter dated June 1, 2007, the applicant amended license renewal application (LRA) Section 4.3. LRA Section 4.3.1.3 states that all NUREG/CR-6260 sample locations, except for the vessel lower head to shell juncture, were projected from historical and current rates of accumulation of transient cycles and usage factors, using either the cycle-based or the stress-based method of the fatigue management program which is described in LRA Section 4.3.1. In LRA Section 4.3.4, the applicant provided an analysis of these sample locations and stated that the inlet, outlet, and hot leg nozzle predictions used the cycle-based method. The charging, safety injection, and the accumulator-residual heat removal nozzle predictions used the stress-based method.

LRA Section 4.3.1.3 states that cycle-based monitoring assumes the alternating stress range of every cycle of a transient is equal to that of the design basis, worst-case events assumed by the code fatigue analysis.

During the audit, the staff reviewed basis document FP-WOLF-304, which indicates that actual plant transient data (i.e., pressure and temperature) was used for the fatigue usage factor calculation for Period 2 (i.e., from January 13, 1996 through December 31, 2005), and that these values were used to derive backward projected initial cumulative usage factors (CUFs) for Period 1 (i.e., from 1984 through 1995), for each of the 28 locations. The projections were based solely on the ratio of heatups and cooldown cycles for most locations; however, it did not consider other significant transients. For example, the transient tracking report indicates that seven losses of offsite power cycles and two loss of load cycles occurred between 1984 and March 1992, and that these two transients did not occur again between March 1992 and December 2005. The staff believes that the validity of these CUF backward-projections using the ratio of heatups and cooldown cycles has to be further justified.

In its response to audit question TLAAA002, the applicant stated that "The basis of the conclusion that data for accumulated fatigue usage factor per heatup/cooldown during Period 2 is realistic for Period 1 is based on the methodology used for the Period 2 calculations, specifically the numbers surge line insurge/outsurge transients assumed to occur during each heatup/cooldown. The numbers of transients used in the Period 2 analyses were based on data collected during Period 1. Therefore, the calculation methodology used for Period 2 calculations were based on transients typical for Period 1. Usage for Period 1 was calculated on the basis that the incremental usage per heatup/cooldown from Period 2 analyses was applicable to Period 1."

The staff reviewed the surge line stratification evaluation report WCAP-12893 which indicates that there are 26,000 piping insurge and outsurge cycles for 200 heatups and cooldowns that should be considered if a modified operating procedure (MOP) is not implemented. Wolf Creek Generating Station implemented the MOP prior to 1995 to mitigate piping insurge and outsurge transients. However, the staff reviewed the CUF calculation of FP-WOLF-304 and found that the analyses that used actual transient data for Period 2 does not consider significant piping insurge and outsurge cycles from Period 1 to support the validity of the backward projections. On the basis of its review, the staff finds that the CUF calculations does not support the statement that Period 2 calculations are based on transients typical for Period 1.

a) Clarify the discrepancy between design basis events used as stated in LRA 4.3.1 and the actual transient data used in the basis calculation.
b) Demonstrate the validity of the baseline CUF for Period 1 using monitoring data from Period 2.

WCNOC Response RAI 4.3-3

In the following response, when referring to LRA sections or pages the reference is the text as submitted in LRA Amendment 1 (dated June 1, 2007) and LRA Amendment 2 (dated August 9, 2007).

(a) LRA Table 4.3-2 shows the 28 locations monitored by the program. Fatigue in the line 1 through 4 locations in the table is tracked with cycle-based fatigue (CBF) monitoring. Fatigue in the line 5 through 13 locations in the table is tracked with stress-based fatigue (SBF) monitoring. The methods used by the program are described in FP-WOLF-304, and use (1) actual plant cycle count data and the design basis fatigue effect of each cycle transient for CBF calculations of cumulative usage factor (CUF), or (2) actual plant cycle count data and actual plant transient profile data to calculate fatigue usage factors for locations tracked by SBF monitoring.

For the cycle-based locations (line numbers 1-4 in LRA Table 4.3-2), the Wolf Creek Generating Station (WCGS) fatigue management program uses (1) actual plant cycle count data and (2) the design basis fatigue effect of each cycle transient pair. Because all of the cycles contributing to fatigue that occurred before implementation of the fatigue monitoring program were reconstructed from reviews of historical records, all transient cycles have been accounted for since the beginning of plant life (starting from February 1984). The fatigue effect of each cycle is defined by design calculations. Thus, there are no unknown parameters needed to calculate CUF using cycle based methodology. Therefore, CUF results from cycle based monitoring represent the accurate baseline usage to date for these locations. No back-projection was necessary [FP-WOLF-304 §8.2.1].

For the remaining 24 locations (line numbers 5-13 in LRA Table 4.3-2) the WCGS fatigue management program uses the stress-based fatigue model. This model uses both (1) actual plant data for the number of cycles to date and (2) actual plant transient profile data, to calculate usage factor accumulation over the period for which the profile data are available, i.e. from January 13, 1996 through December 31, 2005. The results for this nearly-10-year period were then also used to back-calculate the usage factor accumulation for the earlier periods [FP-WOLF-304, §8] using the severities of the transients during the monitored period and evaluations of fatigue effects of various transients as discussed in (b) below.

(b) The period of operation prior to January 13, 1996, when plant transient profile data collection was started, will be defined as Period 1, and the period for which monitoring data are available (January 13, 1996 through December 31, 2005) will be defined as Period 2. The question raised in RAI 4.3-3 part b) is the validity of calculating the baseline CUF for Period 1 using monitoring data from Period 2 considering significant piping insurge and outsurge cycles.

For the purpose of making backward projections, the SBF monitored locations were separated into three groups:

Group 1: Normal and alternate Chemical Volume Control System (CVCS) charging nozzles (line 5 and 6 of Table 4.3-2).
Group 2: Hot leg surge line nozzle, pressurizer lower head, pressurizer heater penetrations, pressurizer spray nozzle, pressurizer surge line nozzle, and pressurizer surge line (lines 7, 8, 9, 11, 12, and 13 of Table 4.3-2).
Group 3: Steam generator feedwater nozzles (lines 10A, 10B, 10C, and 10D of Table 4.3-2)

It is considered that for Group 1, the charging and alternate charging nozzles, which are locations in the stress based fatigue monitoring program that are evaluated for environmental effects in accordance with NUREG/CR-6260, the Period 2 transients are typical of the Period 1 transients. For the charging nozzles, the only changes in plant operations that affect the nozzles is that the usage is to be spread evenly over the two nozzles rather than being concentrated on the normal charging nozzle. The changes in procedure to use the two nozzles more equally are conservatively accounted for in the current baseline fatigue usage calculation for the charging nozzles. Therefore, the current baseline usage calculations (backward projections) for the charging nozzles are considered to be conservative.

For the Group 2 Pressurizer locations, the current backward projection to establish baseline fatigue usage may not be conservative. Following a review of the method used to develop backward projection of accumulated fatigue usage during plant operation in Period 1, it is concluded that data collected for transients affecting the hot leg surge line nozzle (HL Surge Nozzle) during Period 2 may not be bounding for transients experienced by this nozzle during Period 1. Therefore, the baseline Period 1 fatigue usage for HL Surge Nozzle calculated by using the ratio of Period 1 heatup/cooldown events to Period 2 heatup/cooldown events times the fatigue usage for Period 2 determined by the stress based monitoring program may not be conservative.

The basis of this conclusion is the implementation of modified operating procedures (MOP) to maintain a continuous outflow from the pressurizer during heatup and cooldown. Use of MOP has resulted in a significantly reduced number of insurge/outsurge flow events during the heatup and cooldown evolutions. Because the insurge/outsurge events contribute to fatigue usage by both thermal transients on the nozzle ID surfaces and by causing fluctuations in pipe bending moments from thermal stratification, reducing the number of insurge/outsurge events during a heatup or a cooldown reduces the rate of accumulation of fatigue usage. All of Period 2 was with MOP. Part of Period 1 (prior to April 1993) was before implementation of MOP.

A conservative baseline fatigue usage for Period 1 will be calculated using the method of cycle based fatigue usage calculations. Fatigue usage by this method is calculated from the actual plant transients counted during the period of interest and the design basis transient severity assumption. For the HL Surge Nozzle, the design basis transient severity is defined in WCAP-12893, "Structural Evaluation of the Wolf Creek and Callaway Pressurizer Surge Lines, Considering the Effects of Thermal

Stratification." WCAP-12893 postulates that each heatup and cooldown evolution includes a large number of sub-transients (from insurge/outsurge). The fatigue usage for a heatup/cooldown is a summation of the usage from the postulated insurge/outsurge sub-transients combined with the fatigue usage from the system temperature and pressure changes.

The baseline fatigue usage for the HL Surge Nozzle accumulated prior to implementation of the stress based fatigue monitoring data acquisition system will be recalculated using the conservative assumption that the transients that occurred during the un-monitored period (Period 1) were as severe as the design basis assumptions. The same methodology will be used for other pressurizer locations tracked by stress based monitoring unless there is a basis for assuming that the monitored period (Period 2) is typical of the un-monitored period (Period 1) for a specific location.

The Group 3 locations are steam generator feedwater nozzle locations. None of these locations are evaluated for the environmental effects of the feedwater (i.e., none of the feedwater nozzle locations are NUREG/CR 6260 locations). Fatigue usage for these nozzles is principally accumulated during heatup and cooldown (e.g., from feedwater flow cycling during standby periods). Data for Period 2 show a fairly uniform rate of accumulation vs. time. During Period 2, the frequency of heatups and cooldowns was also reasonably constant. However, the frequency of heatups and cooldowns was greater during Period 1. There is no evidence of systematic trends in the severity of transients during the monitored period. Therefore, it was concluded that fatigue usage for Period 1 can be reasonably estimated by multiplying the usage accumulated during Period 2 by the ratio of the number of heatup/cooldown events during Period 1 to the number of those events during Period 2 (the ratio is 2.25).

LIST OF COMMITMENTS

The following table identifies those actions committed to by Wolf Creek Nuclear Operating Corporation in this document. Any other statements in this letter are provided for information purposes and are not considered regulatory commitments. Please direct questions regarding these commitments to Mr. Kevin Moles, Manager Regulatory Affairs at Wolf Creek Generating Station, (620) 364-4126.

	COMMITMENT SUBJECT	LRA, Appendix A, Section	COMMITMENT DESCRIPTION
21	Metal Fatique of Reactor Coolant Pressure Boundary (RCMS 2006-218)	A2.1	Prior to the period of extended operation, the Metal Fatigue of Reactor Coolant Pressure Boundary program will be enhanced to include: (1) Action levels to ensure that if the fatigue usage factor calculated by the code analysis is reached at any monitored location, appropriate evaluations and actions will be invoked to maintain the analytical basis of the leak-before-break (LBB) analysis and of the high-energy line break (HELB) locations, or to revise them as required, (2) Action levels to ensure that appropriate evaluations and actions will be invoked to maintain the bases of safety determinations that depend upon fatigue analyses, if the fatigue usage factor at any monitored location approaches 1.0, or if the fatigue usage factor at any monitored NUREG/CR6260 location approaches 1.0 when multiplied by the environmental effect factor F_{EN}, (3) Corrective actions, on approach to these action levels, that will determine whether the scope of the monitoring program must be enlarged to include additional affected reactor coolant pressure boundary locations in order to ensure that additional locations do not approach the code limit without an appropriate action, and to ensure that the bases of the LBB and HELB analyses are maintained, (4) 10 CFR 50 Appendix B procedural and record requirements.

		Cycle Count Action Limit and Corrective Actions An action limit will be established that requires corrective action when the cycle count for any of the critical thermal and pressure transients is projected to reach a high percentage (e.g., 90%) of the design specified number of cycles before the end of the next fuel cycle. If this action limit is reached, acceptable corrective actions include: 1. Review of fatigue usage calculations. a. To determine whether the transient in question contributes significantly to CUF b. To identify the components and analyses affected by the transient in question. c. To ensure that the analytical bases of the leak-before-break (LBB) fatigue crack propagation analysis and of the high-energy line break (HELB) locations are maintained. 2. Evaluation of remaining margins on CUF based on cycle-based or stress-based CUF calculations using the WCGS fatigue management program software. 3. Redefinition of the specified number of cycles (e.g., by reducing specified numbers of cycles for other transients and using the margin to increase the allowed number of cycles for the transient that is approaching its specified number of cycles).

		Cumulative Fatigue Usage Action Limit and Corrective Actions An action limit will be established that requires corrective action when calculated CUF (from cycle based or stress based monitoring) for any monitored location is projected to reach 1.0 within the next 2 or 3 fuel cycles. If this action limit is reached, acceptable corrective actions include: 1. Determine whether the scope of the monitoring program must be enlarged to include additional affected reactor coolant pressure boundary locations. This determination will ensure that other locations do not approach design limits without an appropriate action. 2. Enhance fatigue monitoring to confirm continued conformance to the code limit. 3. Repair the component. 4. Replace the component. 5. Perform a more rigorous analysis of the component to demonstrate that the design code limit will not be exceeded. 6. Modify plant operating practices to reduce the fatigue usage accumulation rate. 7. Perform a flaw tolerance evaluation and impose component-specific inspections, under ASME Section XI Appendices A or C (or their successors), and obtain required approvals by the NRC. • Corrective action limits for cumulative fatigue usage will be established to assure that sufficient margin is maintained to allow one cycle of the highest fatigue usage per cycle transient to occur without exceeding CUF = 1.0. (This includes consideration of environmental effects for NUREG/CR6260 locations.) This may require that corrective action is taken more than 2 or 3 fuel cycles before CUF is projected to exceed 1.0.

		This is because the projections will be based on historical experience, which is not expected to include many of the low probability design transients. The low probability design transients to be used in the evaluation will include: • Aux. Spray Actuation, Spray Water Diff.>320F • Excessive Feedwater Flow • Reactor Trip – Cooldown with no SI • COMS • Reactor Trip – No Inadvertent Cooldown with Turbine Over-speed • Reactor Trip - Cooldown with SI • Inadvertent RCS Depressurization • Accumulator Safety Injection • Operating Basis Earthquake Implementation of action limits for cumulative usage for locations monitored by stress based monitoring requires calculation of a reliable baseline cumulative usage to date, including fatigue usage accumulated prior to implementation of the fatigue monitoring system. Accumulated fatigue usage from the unmonitored period for the hot leg surge line nozzle and other pressurizer locations cannot be estimated reliably based on data from the monitored period, because improvements in operating procedures implemented prior to the beginning of stress based fatigue monitoring have reduced the severity of the transients. Therefore, conservative baseline cumulative usage for the hot leg surge line nozzle will be calculated using the assumption that the severity of transients during the unmonitored period was the same as assumed for design basis fatigue analyses. Prior to the period of extended operation, changes in available monitoring technology or in the analyses themselves may permit different action limits and action statements, or may re-define the program features and actions required to address fatigue time-limited aging analyses. (TLAAs) **Reference: ET 06-0038** **Due: March 11, 2025** **Revised ET 07-0031** **Revised ET 07-0037**