WOLF CREEK
NUCLEAR OPERATING CORPORATION

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

Reference: 1) Letter ET 05-0004, dated May 4, 2005, from T. J. Garrett, WCNOC, to USNRC

2) Letter ET 06-0016, dated April 14, 2006, from T. J. Garrett, WCNOC, to USNRC

Subject: Docket No. 50-482: Response to Request for Additional Information Concerning the Results of the Thirteenth Steam Generator Tube Inservice Inspection

Gentlemen:

Reference 1 provided information regarding the number of tubes plugged in each steam generator following the completion of the inservice inspection of steam generator tubes during Refuel 14. Reference 2 provided the results of Wolf Creek Generating Station's (WCGS) thirteenth steam generator tube inservice inspection conducted during Refueling Outage 14. On September 6, 2006, the Nuclear Regulatory Commission (NRC) provided a request for additional information (RAI) via electronic mail based on a review of References 1 and 2. Attachment I provides a response to the questions.

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This letter contains no commitments. If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Kevin Moles at (620) 364-4126.

Very truly yours,

Terry J. Garrett

TJG/

Attachment

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Reference 1 provided information regarding the number of tubes plugged in each steam generator following the completion of the inservice inspection of steam generator tubes during Refuel 14. Reference 2 provided the results of Wolf Creek Generating Station's (WCGS) thirteenth steam generator tube inservice inspection conducted during Refueling Outage 14. On September 6, 2006, the Nuclear Regulatory Commission (NRC) provided a request for additional information (RAI) via electronic mail based on a review of References 1 and 2. This Attachment provides Wolf Creek Nuclear Operating Corporation's (WCNOC) response to the NRC RAI.

1. Describe the inspections performed on the secondary side of the steam generators, including any significant findings. With respect to loose parts, page 36 of Attachment 1 to the April 14, 2006, letter has a statement that "wear due to loose parts was observed." Discuss also the degradation that was attributed to loose parts wear and the evidence for it (e.g., eddy current testing, secondary-side visual inspection). If any loose parts were found, describe the parts and discuss whether they were removed. If any loose parts were left in service, explain what prevented removal of the loose parts, and provide the results of any evaluations performed to ensure these parts will not result in a loss of tube integrity during the period between inspections.

Response:

Visual inspections on the secondary side of Steam Generators "B" and "C" were performed in Refuel 14 as follows with no significant findings noted:

- Top of tubesheet cleanliness inspection
- Top of tubesheet in-bundle inspection
- Upper bundle in-bundle inspection
- Upper steam drum inspection, including general condition of the components (J-nozzles, moisture separators, etc.) and drop down visual inspection of the top of the tube bundle, some Anti-Vibration Bars and peripheral view of the uppermost support plate.
- Foreign object search and retrieval (FOSAR)

Documented below is the discussion concerning degradation that was attributed to loose parts wear and the evidence for it (e.g., eddy current testing, secondary-side visual inspection):

Wear at Tube Support Plates

In Steam Generator "B", two tubes were reported through eddy current testing with wear indications at tube support plates (reference Table 1) which was attributed to foreign object wear. None were reported in Steam Generator "C". The location of the indications is at the lower edge of the respective support plates, consistent with wear that may occur from a small, transient foreign object. Rotating Pancake Coil (RPC) examination concluded these indications were wear. Review of the Refuel 12 eddy current data (previous eddy current inspection of Steam Generator "B") showed that the signal in R17C5 is unchanged. In tube R36C110, no signal was present when last eddy current tested in Refuel 12. These indications were sized using eddy current Examination Technique Specification Sheet (ETSS) #21998.1.

The conservative structural limit for wear, based on a uniform thinning assumption is 65% through-wall depth. Since the indication depth plus the sizing uncertainty is significantly less than the structural limit, the requirements for condition monitoring were met for these indications.

No growth was observed in the indication that was previously reported in Refuel 12. For the indication first observed at Refuel 14, no possible loose part (foreign object) was identified at the location of the tube; thus, no growth is anticipated. Since no growth is expected in these indications and they are below the plugging limit of 40% through-wall depth, the tubes were left in service.

Table 1 - WCGS Refuel 14 - Tube Support Wear

SG	Row	Col	Location	Indication	RF12 %TWD	RF14 %TWD
B	17	5	2C-0.43	WAR	26	27
B	36	110	7C-0.62	WAR	NDD	29
C			None			

WAR – Wear
NDD – No Detectable Degradation
TWD – Through-wall Depth

Volumetric Indications at the Top of the Tubesheet

Table 2 summarizes the tubes with volumetric indications at the top of the tubesheet (TTS). In Steam Generator "B", one tube was reported during the TTS +point RPC program with a small volumetric, wear-like indication at the TTS hot leg. This indication was originally attributed in Refuel 12 (previous eddy current inspection) to wear due to a foreign object that was no longer resident at this location. The indication was sized using the qualified eddy current technique of ETSS #21998.1, with a resulting depth of 24% through-wall. This indication has not grown since Refuel 12.

In Steam Generator "C", 11 volumetric indications were reported in close proximity to the top of the tubesheet that were sized using the qualified technique of ETSS #21998.1. All of the indications were previously reported in Refuel 12 (previous eddy current inspection), and no growth was observed on any of the indications. These indications were judged to be the result of wear with foreign objects that are currently no longer resident at these locations. None of the indications were associated with a possible loose part indication, indicating that no foreign object currently resides at the location of these tubes.

Table 2 - WCGS Refuel 14 - Volumetric Indications at the TTS

SG	Row	Col	Location	Bundle Location	Ind	RF12 %TWD	RF14 %TWD
B	30	24	TSH+0.22	Interior	VOL	25	24
C	12	121	TSH+0.49	Peripheral	VOL	9	6
	42	102	TSH+0.27	Peripheral	VOL	13	16
	41	102	TSH+0.40	Peripheral	VOL	24	26
	41	101	TSH+0.27	Peripheral	VOL	15	17
	8	92	TSH+1.46	Stayrod	VOL	17	15
	1	87	TSH+3.17	Tube Lane	VOL	22	18
	32	63	TSH+0.49	Interior	VOL	14	11
	46	58	TSH+0.38	Interior	VOL	14	15
	56	51	TSH+0.03	Peripheral	VOL	17	18
	43	37	TSH+0.42	Interior	VOL	23	22
	16	5	TSH+0.31	Peripheral	VOL	8	8

TSH – Tubesheet Hot Leg
VOL – Volumetric
TWD – Through-wall Depth

With the exceptions of R1C87 and R8C92 in Steam Generator "C", all of the indications are within 0.5 inches above the TTS. The indication in R1C87 is approximately 3.17 inches above the TTS, and the indication on R8C92 is approximately 1.46 inches above the TTS. The distribution of positions is typical of positions where foreign objects can interact with the tubes, although those locations in the interior of the bundle would require relatively small and mobile foreign objects.

The largest indication depth was 26% through-wall (see Table 2). The structural limit for wear, conservatively based on a uniform thinning assumption and the use of lower tolerant limit material properties, is 65% through-wall. Since the largest indication is much less than the conservative structural limit, the criteria for condition monitoring are met for TTS volumetric indications. In addition, since the indication sizes are less than the plugging limit of 40% through-wall depth and have not changed since the prior inspection, the affected tubes were retained in service.

Foreign Object Search and Retrieval (FOSAR)

WCNOC performed FOSAR activities during Refuel 14 after the eddy current examination was complete including the accessible areas where possible loose parts signals were reported. Several small objects were located but not removed (see Table 3) because of their insignificant potential for damage to the steam generator tubes. Further, a small foreign object, which was determined to be "fixed in place" in Refuel 12, was dislodged during the Advanced Scale Conditioning Agent/Pressure Pulse Cleaning process performed during Refuel 14, and could not be located during the FOSAR activities.

No wear was detected that was associated with a known foreign object. The objects discovered during Refuel 14 that remained in the steam generators were analyzed to predict their potential for damage to the tubes. The analysis assumed that the objects are located at the most critical elevation and in the highest flow field in the steam generator. Further, it was assumed that the objects would remain in place, that only the tubes would wear, and that the tubes were worn to 20% through-wall depth at time zero of the calculation. Based on these very conservative assumptions, an operating cycle of at least 4.35 years was predicted before

the local wear would progress to 70% through-wall depth. Similar to the structural limit for Anti-Vibration Bar wear, also a local effect, the appropriate structural limit is 75% through-wall depth. Therefore, since the maximum wear depth is less than the structural limit, the performance criteria are met for continued operation until, at least, the next inspection of the steam generators.

Table 3 – WCGS Refuel 14 – Loose Parts Left in SG "B" and "C"

Steam Generator	Object Type	Object Description
C	Wire	¾" long by 1/32-1/64" in diameter
C	Metal Strip	½" long by 1/8" wide
C	Wire	Wire 3/8" long by 1/32" in diameter
C	Wire	1" X 1/32" in diameter
B	Wire	1 ½" long and 1/32" in diameter
B	Wire	¾" in length and 1/32" in diameter
B	Wire	1" in length by 1/32" in diameter
B	Planetary Gear	Maximum Size 7/16 inch

2. The list of indications reported from the 2005 inspection includes indications in Row 1 between approximately 15 and 16 inches above the tubesheet on the cold leg in Steam Generators (SGs) B and C. Attachment 1 to the April 14, 2006, letter, "Summary of Tube Integrity Assessment," page 36 of 37, states that these indications (1) were created by pressure-pulse cleaning during Refuel 7, (2) have been tracked by comparing eddy current signals from every subsequent inspection, and (3) have not grown, according to the eddy current signals.

   This group of Row 1 indications includes 30 indications in SG C from Column 4 to Column 20. The reported through-wall depth of these indications is between 1 percent and 28 percent. Since the report for the 2005 inspection states that these Row 1 indications in SG B and SG C are not new and have been evaluated in the past to determine the rate of propagation, discuss why the indications in SG C were not listed in the report for the previous inspection of SG C in 2003.

   In addition, clarify the meaning of the following sentence on page 37 of 37, last sentence of the first paragraph, of Attachment 1 to the April 14, 2006, letter, that addresses these indications: "Since there is no growth of these indications, as shown by tracking them since Refuel 8, the operational performance requirements are met for continued operation."

Response:

During Refuel 7 (1994), pressure pulse cleaning was first implemented at WCGS. Following this pressure pulse cleaning application, eddy current testing during Refuel 8 (1996) established that the pressure pulse nozzle tool damaged some tubes in row 1 of Steam Generators "B" and "C". There are four tubes in Steam Generator "B" cold leg and fifteen tubes in Steam Generator "C" cold leg, all in Row 1, each located at approximately 15 inches above the tubesheet, corresponding to the elevation of the pressure pulse cleaning nozzle.

If an indication is found to be acceptable when first reported and attributed to a source unrelated to steam generator operation, industry practice is to review the indication at subsequent inspections to determine if the signal characteristics have changed. If no signal change is observed, the indication is assigned the code FSH (Freespan Signal History reviewed) and entered into the inspection reports as such. Since an unchanged, acceptable signal is benign from the perspective of tube integrity, no special mention is made of it during subsequent reports. However, as new inspection techniques are qualified, it becomes necessary to re-establish a baseline using the new techniques. The availability of the technique of ETSS 21998.1 represents such a case. As noted below, these specific indications carried along in the database as FSH codes were re-evaluated with the new technique and the numerical results were reported.

During Refuel 8, these indications were sized with the available methods at the time. All depths measured during Refuel 8 utilizing this technique were reported less than 40% through-wall depth. Subsequent inspections compared the then-current signals with those from Refuel 8, noting no change in the signals, and continuing to keep the tubes in service. A comparison of all bobbin signals for these indications was made between Refuel 8 and Refuel 14 and it was determined that there was no significant change in shape or size of these signals.

Current practice for measuring these types of wear indications is to use the eddy current technique of ETSS #21998.1, which utilizes the RPC +point probe and a volumetric standard. A note on the ETSS indicates that the results from sizing a significant wear indication are very conservative. Nevertheless, ETSS #21998.1 is the industry qualified technique; therefore, plugging decisions are made based on this technique. However, since this technique is considered very conservative in measuring percent through-wall depth, the indications in Steam Generators "B" and "C" were also sized using the alternate technique based on the ASME flat-bottom hole standard.

Table 4 summarizes the indications in Steam Generators "B" and "C", notes the eddy current report from Refuel 12, and provides the sizing results from ETSS #21998.1 and the alternate technique. Four indications in Steam Generator "B" exceeded 40% through-wall depth and were mechanically plugged. The largest indication among the 15 indications in Steam Generator "C" was sized at 28% through-wall depth. Since the signals characteristics have not changed over time (only the techniques have changed), the indications sized at less than 40% with the current qualified techniques were retained in service.

The following explains the meaning of the statement: *"Since there is no growth of these indications, as shown by tracking them since Refuel 8, the operational performance requirements are met for continued operation."* When a signal is evaluated once using a qualified technique and found acceptable for continued service, it is only necessary to compare the signal over time to assure that it is not changing. If the signal does not change, it is not necessary to evaluate (size) it at every inspection, since the use of the same technique will give the same result.

The two largest indications among the pressure pulse cleaning nozzle wear indications in Steam Generator "B" were evaluated for in-situ pressure testing according to the "Steam Generator In Situ Pressure Test Guidelines," Revision 2, September 2003. Neither of the indications were found to require in-situ pressure testing. In addition, an analysis of the limiting flaw concluded that the flaw meets the performance requirements for condition monitoring, e.g., a burst capability greater than the 3 times Normal Operating Pressure Differential for WCGS conditions. The analysis utilizes the local normal operating conditions of temperature and differential pressure at the location of the flaw at R1C106, TSC+15.95" which are 550°F and

1227 pounds per square inch - differential. The actual material properties for the material heat for tube R1C106 were determined from manufacturing records. The analysis is based on burst test data for elliptical wear on tubing quite similar to the WCGS flaws. The model is conservative for WCGS application since the length of the actual flaw is much less than those in the test data. The shorter length of the actual flaw provides additional structural reinforcement compared to the flaws from the tests.

The other two Steam Generators "A" and "D" were checked to see if these bobbin type signals existed, and the evaluation concluded that there were no signals of this type in these steam generators; thus there is no concern with continuing operation of these steam generators.

Table 4 - Wolf Creek RF14 Freespan Tooling Contact Wear

SG	Row	Col	Location	Indication	RF12	RF14 (1)
B	1	105	TSC+16.0	WAR	FSH	49/28
	1	106	TSC+15.95	WAR	FSH	71/62
	1	107	TSC+16.14	WAR	FSH	57/40
	1	108	TSC+16.01	WAR	FSH	48/26
C	1	20	TSC+15.29	WAR	FSH	19/8
	1	19	TSC+15.26	WAR	FSH	16/8
	1	18	TSC+15.24	WAR	FSH	28/13
	1	17	TSC+15.26	WAR	FSH	22/10
	1	16	TSC+15.10	WAR	FSH	25/10
	1	15	TSC+15.22	WAR	FSH	23/10
	1	14	TSC+15.16	WAR	FSH	21/11
	1	13	TSC+15.19	WAR	FSH	21/8
	1	12	TSC+15.19	WAR	FSH	19/8
	1	11	TSC+15.16	WAR	FSH	18/8
	1	10	TSC+15.18	WAR	FSH	24/11
	1	9	TSC+15.15	WAR	FSH	16/9
	1	8	TSC+15.22	WAR	FSH	10/5
	1	6	TSC+15.26	WAR	FSH	19/8
	1	4	TSC+15.21	WAR	NDD	4/1

(1) Values shown are % through-wall depth. The first value is based on sizing using the technique of ETSS 21998.1; the second value is based on an alternate sizing technique provided in Appendix E of the RF14 Degradation Assessment.

TSC – Tubesheet cold leg

3. On page 2 of 37 of Attachment 1 to the April 14, 2006, letter, the "Test Extent" for the number and extent of SG tubes inspected for SGs B and C has "RPC Hot Leg Top of Tubesheet (+/- 3 inches)" listed in two places. In one case, the number of tests was about 3200 in each SG, while in the other the number of tests was about 700 in each SG. The NRC staff assumes that the smaller group of tests was performed on the cold leg. Confirm that this is correct, or discuss the difference between these two sets of tests.

Response:

The NRC staff assumption that the small group of tests was performed on the cold leg is correct. The information provided on page 2 of 37 in Reference 2 included a typographical error as noted below.

Test Extent	Steam Generator B	Steam Generator C
* RPC Hot Leg Top of Tubesheet (+/- 3 inches)	3204	3165
RPC ~~Hot~~ Cold Leg Top of Tubesheet (+/- 3 inches)	698	702

The cold leg peripheral tubes (698 tubes in S/G B and 702 tubes in S/G C) were examined with the RPC probe (+/-3 inches).

References:

1. WCNOC letter ET 05-0004, "Steam Generator Tube Plugging Report," May 4, 2005.

2. WCNOC letter ET 06-0016, "Results of the Thirteenth Steam Generator Tube Inservice Inspection," April 14, 2006.