WOLF CREEK
NUCLEAR OPERATING CORPORATION

Otto L. Maynard
Vice President Plant Operations

April 5, 1996
WO 96-0058

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Docket 50-482: Response to NRC Bulletin 96-01, "Control Rod Insertion Problems"

Gentlemen:

On March 8, 1996, the NRC issued NRC Bulletin 96-01 concerning recent control rod insertion problems at three Westinghouse-designed plants, including the Wolf Creek Generating Station (WCGS). NRC Bulletin 96-01 requested all Licensees of Westinghouse-designed plants to provide, within 30 days, a written response to the bulletin, pursuant to Section 182a, the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f). Attached is WCNOC's response to that request.

If you have any questions concerning this matter, please contact me at (316) 364-8831, extension 4450, or Mr. Richard D. Flannigan at extension 4500.

Very truly yours,

Otto L. Maynard

OLM/jra

Attachment

cc: L. J. Callan (NRC), w/a
W. D. Johnson (NRC), w/a
J. F. Ringwald (NRC), w/a
J. C. Stone (NRC), w/a

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STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Otto L. Maynard, of lawful age, being first duly sworn upon oath says that he is Vice President Plant Operations of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the content thereof; that he has executed that 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 Otto L. Maynard
Otto L. Maynard
Vice President
Plant Operations

SUBSCRIBED and sworn to before me this 5 day of April, 1996.

Diana S. Clarkson
Notary Public

Expiration Date 12-15-1999

DIANA S. CLARKSON
Notary Public - State of Kansas
My Appt. Expires 12-15-99

RESPONSE TO NRC BULLETIN 96-01, "CONTROL ROD INSERTION PROBLEMS"

A. Requested Actions and Required Information

NRC Bulletin 96-01 requested each Licensee to take the following actions:

(1) Promptly inform operators of recent events (reactor trips and testing) in which control rods did not fully insert and subsequently provide necessary training, including simulator drills, utilizing the required procedures for responding to an event in which the control rods do not fully insert upon reactor trip (e.g., boration of a pre-specified amount).

(2) Promptly determine the continued operability of control rods based on current information. As new information becomes available from plant rod drop tests and trips, licensees should consider this new information together with data already available from Wolf Creek, South Texas, North Anna, and other industry experience, and make a prompt determination of control rod operability.

(3) Measure and evaluate at each outage of sufficient duration during calendar year 1996 (end of cycle, maintenance, etc.), the control rod drop times and rod recoil data for all control rods. If appropriate plant conditions exist where the vessel head is removed, measure and evaluate drag forces for all rodded fuel assemblies.

   a. Rods failing to meet the rod drop time in the technical specifications shall be deemed inoperable.

   b. Rods failing to bottom or exhibiting high drag forces shall require prompt corrective action in accordance with Appendix B to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR Part 50).

(4) For each reactor trip during calendar year 1996, verify that all control rods have promptly fully inserted (bottomed) and obtain other available information to assess the operability and any performance trend of the rods. In the event that all rods do not fully insert promptly, conduct tests to measure and evaluate rod drop times and rod recoil.

In addition to the above requested actions, NRC Bulletin 96-01 also requires, per 10 CFR 50.54(f), the following written information be submitted under oath or affirmation:

(1) Within 30 days of the date of this bulletin, a report certifying that control rods are determined to be operable; actions taken for Requested Actions (1) and (2) above; and the plans for implementing Requested Actions (3) and (4).

(2) Within 30 days of the date of this bulletin, a core map of rodded fuel assemblies indicating fuel type (materials, grids, spacers, guide tube inner diameter) and current and projected end of cycle burnup of each rodded assembly for the current cycle; when available, provide the same information for the next cycle.

(3) Within 30 days after completing Requested Action (3) for each outage, a report that summarizes the data and that documents the results obtained; this is also applicable to Requested Action (4) when any abnormal rod behavior is observed.

B. RESPONSES TO REQUIRED RESPONSE ITEMS

ITEM 1

Wolf Creek Nuclear Operating Corporation (WCNOC) has determined that for Cycle 9, all control rods are considered operable based on (1) the redesign of the Cycle 9 core loading pattern preventing control rods from being located in high burnup fuel, and (2) extensive testing of control rods in their Cycle 9 locations.

An inspection program was undertaken by WCNOC and Westinghouse to address the incomplete Rod Cluster Control Assembly (RCCA) insertion that occurred at Wolf Creek Generating Station (WCGS) near the end of Cycle 8. These activities included the preparation, review and implementation of a test plan and the formation of a root cause team. A summary of the tests and examinations performed is provided below:

1. Rod Drop testing at 195 °F. This test was performed to determine RCCA behavior in a simulated reactor trip.
2. Drag testing in vessel with upper internals in place. This test was performed to determine the impact of the upper internals on the RCCA drag.
3. Drag testing in the spent fuel pool. RCCA's were tested in their host assembly and in a new reference assembly.
4. Eddy current testing of selected RCCAs.
5. Drag testing using a short RCCA (13" long rodlets) to determine if the top of the fuel assembly was the location of the interference.
6. Fuel assembly length measurements.
7. Fuel assembly bow measurements.
8. Boroscope inspection of thimble tubes of selected assemblies.
9. Single tube probe testing of thimble tubes.

A root cause team was organized with representatives of WCNOC, Houston Lighting and Power Company, and several Westinghouse divisions. The root cause analysis determined that the incomplete RCCA insertion was caused by problems in the fuel assemblies. The fuel assemblies affected were thrice burned assemblies with burnup exceeding 49,000 Megawatt-Days per Metric Ton Uranium (MWD/MTU). (NOTE: A complete report on the testing and analysis of the incomplete RCCA insertions was submitted to the NRC in Letter WO 96-0051, dated March 20, 1996, from Otto L. Maynard to the NRC).

Following the January 30, 1996 reactor trip, WCGS entered the eighth refueling outage. As a result of the conclusions of the root cause team, the Cycle 9 core loading pattern was revised with the express intent of lowering the burnup of assemblies in control rod locations. Fuel in rodded locations in the Cycle 9 core is in its first or second cycle of operation. The projected assembly burnup for the 53 control rod locations at the end of Cycle 9 is:

Number of Control Rods	Burnup Range (MWD/MTU)
44	18,000 to 30,000
1	30,000 to 34,000
8	40,000 to 41,000

The redesigned Cycle 9 core loading pattern should eliminate the possibility of a re-occurrence of incomplete control rod insertion during Cycle 9.

At the time this response was written WCNOC was working to complete the eighth refueling outage including rod drop testing per Surveillance Requirement 4.1.3.1.3. The results of the rod drop testing for Cycle 9 will be reviewed for control rod operability.

Drag testing was performed on the control rods in their Cycle 9 locations. No excessive drag was observed in any assembly.

The Technical Specification requirement to maintain 1300 pcm shutdown margin was analyzed for the redesigned Cycle 9 loading pattern. This calculation was performed as part of the normal reload design process. The placement of fuel assemblies with reduced burnup, relative to previous WCGS cycle designs, yields increased trippable rod worth. As a result the redesigned Cycle 9 loading pattern has increased excess shutdown margin relative to recent cycles. In fact, the WCGS cycle 9 design has 584 pcm excess shutdown margin to the 1300 pcm requirement at the most restrictive time in core life.

Actions taken for Requested Action 1

On March 20, 1996, the Manager Operations provided key Operations personnel with a copy of NRC Bulletin 96-01 and a written summary of the North Anna event described in the bulletin.

In addition, a review of NRC Bulletin 96-01 will be presented to WCNOC Licensed Operators in licensed operator requalification cycle 96-3. This cycle will be held from June 10 through July 19, 1996. Simulator training on control rod insertion problems will be presented to the Licensed Operators during this same requalification cycle. This training will include an event in which the control rods do not fully insert upon a reactor trip and in which the required procedures for such an event will need to be utilized.

Actions taken for Requested Action 2

Based on the discussion provided above, WCNOC considers the control rods to be operable. As new industry information becomes available, WCNOC will consider this new information in conjunction with current data to make continued determination of control rod operability.

Plans for Implementing Requested Action (3)

For any outage occurring during 1996 which allows time to properly setup and test the control rods by established plant procedures without restraining the plant restart, WCNOC will measure and evaluate the control rod drop times and recoil data for control rods in fuel assembly locations in their second cycle of operation and having high burnups greater than 25,000 MWD/MTU. This minimum burnup was established after reviewing the performance of control rods during the previous cycle and the examinations performed during the eighth refueling outage.

A reactor trip occurred during Cycle 8 with second cycle fuel assemblies in rodded locations at burnups between 26,400 and 30,100 MWD/MTU. All control rods fully inserted during this trip. The end of Cycle 8 performance for one-cycle assemblies with a burnup of 15,000 MWD/MTU and two-cycle assemblies with burnups in the range of 39,000 to 44,000 MWD/MTU was normal. The rod drop times for these assemblies were much less than the Technical Specification requirement, even though the tests were conducted at cold temperatures. The decrease in the number of recoils observed in the twice-burned assemblies correlated with a slightly higher drag force measurement in the dashpot of these assemblies. The Cycle 9 startup tests of drag forces with assembly burnups up to 17,570 MWD/MTU indicates acceptable performance of all rodded locations. Therefore, excluding fuel in their first cycle of operation is supported by the performance and examination data at WCGS. Limiting the testing of second cycle fuel to burnups greater than 25,000 MWD/MTU will provide data to assess the operability and performance trend of the control rods.

Once this data has been collected, it will be repeated during an outage of sufficient duration only after an additional 2500 MWD/MTU burnup has been achieved on those rodded locations. For the same conditions as described above, drag forces will be measured and evaluated for outages when the vessel head is removed.

Plans for Implementing Requested Action (4)

For each reactor trip during calendar year 1996, WCNOC will verify that all control rods have promptly, fully inserted. For any control rods that do not fully insert, control rod drop tests will be performed and the results evaluated.

WCNOC plans to meet the intent of Requested Actions 3) and 4) from NRC Bulletin 96-01. This will be accomplished by following the actions described above until such time as Westinghouse and the Westinghouse Owners Group (WOG) have identified the appropriate data required to support a root cause determination. WCNOC will provide an update of our Bulletin 96-01 response if our plans for implementing Requested Actions 3) and 4) are modified to support the collection of appropriate data for the root cause determination.

ITEM 2

WCGS is currently in the eighth refueling outage. As such the current core configuration with current burnups are reflected in Figure 2. Figure 1 shows the WCGS Cycle 9 loading pattern. Of the 53 RCCAs, 36 are located in new Region L assemblies, 16 in once-burned Region K assemblies, and 1 in a once-burned Region A assembly. Design information for the fuel assembly types is shown in the following table.

Table 1
Fuel Assembly Design Information

	Region A fuel	Region K and L fuel
Fuel Type	17x17 Standard	17x17 Vantage5H
Fuel Cladding Material	Zircaloy-4	Improved Zircaloy-4
Guide Tube Inside Diameter (in.)	0.450	0.442
Dashpot Inside Diameter (in.)	0.397	0.397
Guide Tube Material	Zircaloy-4	Improved Zircaloy-4
Top Grid	Inconel	Inconel
IFM Grids	None	Improved Zircaloy-4
Middle Grids	Inconel	Improved Zircaloy-4
Bottom Grid	Inconel	Inconel
Protective Grid	None	Inconel

Figure 2 shows the burnup for the rodded locations at the beginning of Cycle 9. Figure 3 shows the projected burnup for the rodded locations at the end of Cycle 9. The maximum projected burnup in a rodded location is 40,883 MWD/MTU.

FIGURE 1
CYCLE 9 CORE LOADING PATTERN

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
A					A27	A47	A36	K13	A51	A43	A32					A
B			K59	K62 RS34	L06	L82 RS11	L66	L23 RS30	L61	L77 RS20	L01	K73 RS49	K52			B
C		K53	K10	L74	L14 RS02	K42	L28 RS36	L60	L48 RS52	K11	L09 RS05	L69	K48	K72		C
D		K59 RS17	L72	K20 RS47	L34	K43	K49	K37 RS51	K71	K44	L46	K15 RS53	L71	K56 RS16		D
E	A64	L04	L12 RS08	L40	L53	K17	L25	K23	L37	K09	L54	L27	L11 RS54	L03	A53	E
F	A17	L80 RS32	K33	K27	K36	L59 RS42	K64	L24 RS31	K76	L56 RS29	K35	K26	K08	L79 RS22	A15	F
G	A50	L64	L29 RS37	K60	L21	K68	L86	K45	L88	K77	L22	K50	L30 RS15	L63	A52	G
H	K05	L19 RS33	L50	K34 RS07	K12	L35 RS41	K21	A55 RS14	K02	L36 RS35	K41	K06 RS01	L55	L44 RS46	K38	H
J	A12	L62	L26 RS23	K54	L47	K67	L85	K31	L87	K74	L42	K51	L41 RS45	L68	A14	J
K	A44	L78 RS03	K19	K32	K07	L58 RS44	K65	L38 RS39	K79	L51 RS09	K01	K39	K28	L84 RS21	A46	K
L	A56	L02	L10 RS06	L39	L52	K03	L32	K29	L43	K04	L57	L20	L16 RS25	L08	A63	L
M		K61 RS27	L70	K22 RS12	L18	K40	K80	K46 RS40	K66	K25	L33	K18 RS26	L76	K57 RS48		M
N		K75	K30	L73	L13 RS38	K47	L31 RS10	L49	L45 RS04	K24	L15 RS19	L75	K14	K63		N
P			K78	K58 RS24	L05	L81 RS18	L65	L17 RS28	L67	L83 RS13	L07	K70 RS50	K55			P
R					A20	A07	A59	K16	A21	A03	A23					R
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

FIGURE 2
PROJECTED EXPOSURE AT BEGINNING OF CYCLE 9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
A					A27	A47	A36	K13	A51	A43	A32					A
B			K69	K82 12,927	L06	L82 0	L66	L23 0	L61	L77 0	L01	K73 12,936	K52			B
C		K53	K10	L74	L14 0	K42	L28 0	L60	L48 0	K11	L09 0	L69	K48	K72		C
D		K59 12,936	L72	K20 15,372	L34	K43	K49	K37 15,379	K71	K44	L46	K15 15,372	L71	K56 12,927		D
E	A64	L04	L12 0	L40	L53	K17	L25	K23	L37	K09	L54	L27	L11 0	L03	A63	E
F	A17	L80 0	K33	K27	K36	L59 0	K64	L24 0	K76	L56 0	K35	K26	K08	L79 0	A15	F
G	A50	L64	L29 0	K60	L21	K68	L86	K45	L88	K77	L22	K50	L30 0	L63	A52	G
H	K05	L19 0	L50	K34 15,379	K12	L35 0	K21	A55 17,570	K02	L36 0	K41	K06 15,379	L55	L44 0	K38	H
J	A12	L62	L26 0	K54	L47	K67	L85	K31	L87	K74	L42	K51	L41 0	L68	A14	J
K	A44	L78 0	K19	K32	K07	L58 0	K65	L38 0	K79	L51 0	K01	K39	K28	L84 0	A46	K
L	A56	L02	L10 0	L39	L52	K03	L32	K29	L43	K04	L57	L20	L16 0	L08	A63	L
M		K61 12,927	L70	K22 15,372	L18	K40	K80	K46 15,379	K66	K25	L33	K18 15,372	L76	K57 12,936		M
N		K75	K30	L73	L13 0	K47	L31 0	L49	L45 0	K24	L15 0	L75	K14	K63		N
P			K78	K58 12,936	L05	L81 0	L65	L17 0	L67	L83 0	L07	K70 12,927	K55			P
R					A20	A07	A59	K16	A21	A03	A23					R
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

FIGURE 3
PROJECTED EXPOSURE AT END OF CYCLE 9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
A					A27	A47	A36	K13	A51	A43	A32					A
B			K69	K62 28,536	L06	L82 23,274	L66	L23 24,682	L61	L77 23,279	L01	K73 28,552	K52			B
C		K53	K10	L74	L14 27,420	K42	L28 27,733	L60	L48 27,697	K11	L09 27,447	L69	K48	K72		C
D		K59 28,552	L72	K20 40,883	L34	K43	K49	K37 40,036	K71	K44	L46	K15 40,883	L71	K56 28,536		D
E	A64	L04	L12 27,447	L40	L53	K17	L25	K23	L37	K09	L54	L27	L11 27,420	L03	A53	E
F	A17	L80 23,279	K33	K27	K36	L59 27,609	K64	L24 27,535	K76	L56 27,609	K35	K26	K08	L79 23,274	A15	F
G	A50	L64	L29 27,697	K60	L21	K68	L86	K45	L88	K77	L22	K50	L30 27,733	L63	A52	G
H	K05	L19 24,682	L50	K34 40,036	K12	L35 27,535	K21	A55 33,416	K02	L36 27,535	K41	K06 40,036	L55	L44 24,682	K38	H
J	A12	L62	L26 27,733	K54	L47	K67	L85	K31	L87	K74	L42	K51	L41 27,697	L68	A14	J
K	A44	L78 23,274	K19	K32	K07	L58 27,609	K65	L38 27,535	K79	L51 27,609	K01	K39	K28	L84 23,279	A46	K
L	A56	L02	L10 27,420	L39	L52	K03	L32	K29	L43	K04	L57	L20	L16 27,447	L08	A63	L
M		K61 28,536	L70	K22 40,883	L18	K40	K80	K46 40,036	K66	K25	L33	K18 40,883	L76	K57 28,552		M
N		K75	K30	L73	L13 27,447	K47	L31 27,697	L49	L45 27,733	K24	L15 27,420	L75	K14	K63		N
P			K78	K58 28,552	L05	L81 23,279	L65	L17 24,682	L67	L83 23,274	L07	K70 28,536	K55			P
R					A20	A07	A59	K16	A21	A03	A23					R
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	