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Donald F. Schnell
Senior Vice President
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April 4, 1996

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Washington, D. C. 20555

Gentlemen: ULNRC-03360

DOCKET NUMBER 50-483
CALLAWAY PLANT
CONTROL ROD INSERTION PROBLEMS

Reference: NRC Bulletin 96-01, dated March 8, 1996

The referenced Bulletin requested all licensees of Westinghouse - designed plants to take actions to ensure that the required shutdown margin is maintained during a reactor trip.

The attachments provide Union Electric's 30-day response to NRC Bulletin 96-01. Attachments 1 and 2 address Item 1; attachments 3 and 4 address Item 2.

Should you have any questions or need additional information concerning this matter, please contact us.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

JMC/sld

Attachments

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STATE OF MISSOURI)
) S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Senior Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company 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 Donald F. Schnell
Donald F. Schnell
Senior Vice President
Nuclear

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

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BARBARA J. PFAFF
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REQUIRED RESPONSE TO NRC BULLETIN 96-01

ITEM (1), REQUESTED ACTION 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).

RESPONSE:

All Callaway reactor operators and senior reactors operators have been informed of the recent events regarding incomplete control rod insertion via the plant electronic mail system and all operators have been provided a hard copy of the bulletin. Simulator training should be completed by June 7, 1996, in conjunction with requalification schedules, for similar scenarios to ensure complete understanding of the issues and responses to the event (e.g., boration to a specified amount to ensure shutdown margin).

ITEM (1), REQUESTED ACTION 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.

RESPONSE:

Attachment 2 documents an operability evaluation in response to the initial part of the Requested Action. This evaluation has been approved by the Onsite Review Committee. Union Electric will continue to participate in the Westinghouse Owners Group (WOG) Program to ensure awareness and dissemination of updated information on plant control rod operation and tests which, coupled with our experience at Callaway Plant, will allow continued assessment of control rod operability.

ITEM (1), REQUESTED ACTIONS 3 AND 4.

Measure and evaluate at each outage of sufficient duration during calendar year 1996 (end of cycle, maintenence, 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).

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.

RESPONSE:

During calendar year 1996, the first planned outage of sufficient duration to obtain rod drop times, recoil data and drag forces will be Refuel 8, currently scheduled to commence on October 11, 1996. At that time and at any other planned outage of sufficient duration which may be experienced during the year, Union Electric will:

1. Trip the reactor manually, at low power so that rod drop time information may be obtained for all RCCAs.

2. Perform drag tests of RCCAs in high burnup fuel assemblies (>40,000 MWD/MTU) prior to core offload.

For each reactor trip during 1996, Union Electric will:

1. Verify that all control rods have fully inserted (bottomed) promptly,

2. Gather other available information to assess operability and any RCCA performance trend.

3. Conduct tests to measure and evaluate performance of RCCAs which fail to fully insert (bottom) promptly.

The actions outlined above are prompted by our current understanding of the probable causes of recent industry control rod insertion problems. As the WOG root cause analysis progresses, some of these actions may be deleted and other may be warranted. We will notify the NRC in advance of any changes to our planned actions.

On April 2, 1996 at 10:45 a.m., Callaway Plant was manually tripped due to spurious closure of the "B" Main Feedwater Isolation Valve. Control Room personnel observed closure of the isolation valve and appropriately tripped the plant. It was observed and verified that all control rods fully inserted (bottomed) promptly as expected.

Included as Attachments 3 and 4, are core maps of rodded fuel assemblies for both the current Callaway Cycle 8 and for the subsequent Cycle 9. These maps show fuel type and current and projected end of cycle burnup for each rodded assembly.

CONTROL ROD OPERABILITY EVALUATION FOR CALLAWAY NUCLEAR PLANT

Introduction

Due to recent industry problems related to incomplete control rod insertion, the NRC has requested each licensee to determine the continued operability of control rods taking into consideration current operating plant experience, to ensure that required shutdown margin is maintained during a reactor trip.

Callaway Unit 1 is a 4 loop Westinghouse PWR, which utilizes 193 Westinghouse 17X17 Vantage-5 (V-5) fuel assemblies. Callaway is currently operating in cycle 8, at an approximate cycle burnup of 12.8 GWD/MTU. The projected end of cycle burnup is 21.8 GWD/MTU.

Fifty-three (53) silver-indium-cadmium Rod Control Cluster Assemblies (RCCAs) are utilized at Callaway to provide reactivity control in conjunction with chemical shim (boric acid). The RCCAs must be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded, and adequate shutdown margin is maintained.

During operation, the shutdown rod banks are fully withdrawn. The control rod system automatically maintains a programmed average reactor temperature compensation for reactivity effects associated with scheduled and transient load changes. The shutdown rod banks, along with the control banks, are designed to shut down the reactor with adequate margin under conditions of normal operation and anticipated operational occurrences. The most restrictive period in the core life is assumed in all analyses, and the most reactive rod cluster is assumed to be stuck in the fully withdrawn position.

Operability

The operability of RCCAs at Callaway is governed by Technical Specification 3/4.1, Reactivity Control Systems/ 3/4.1.3, Movable Control Assemblies, which has the following sub-sections:

Group Height
Position Indication Systems - Operating
Shutdown Rod Insertion Limit
Control Rod Insertion Limits

The Technical Specifications provide surveillance requirements for ensuring that the applicable Limiting Conditions for Operation (LCO) are met. The following discusses the various surveillance requirements for each section noted above:

Group Height

4.1.3.1.1 The position of each full-length rod shall be determined to be within the group demand limit ($\pm$ 12 steps) by verifying the individual rod positions at least once per 12 hours except during time intervals when the rod position deviation monitor is inoperable, then verify the group positions at least once per 4 hours.

4.1.3.1.2 Each full-length rod not fully inserted in the core shall be determined to be OPERABLE (trippable) by movement of at least 10 steps in any one direction at least once per 92 days.

4.1.3.1.3 Prior to reactor criticality, the rod drop time of the individual full-length shutdown and control rods from the fully withdrawn position shall be demonstrated to be less than or equal to 2.7 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry with Tavg $\geq$ 551 degrees F and all reactor coolant pumps operating:

a. For all rods following each removal of the reactor vessel head, and

b. For specifically affected individual rods following any maintenance on or modification to the Control Rod Drive System which could affect the drop time of those specific rods.

Position Indication Systems - Operating

4.1.3.2 Each digital rod position indicator shall be determined to be OPERABLE by verifying that the Demand Position Indication System and the Digital Rod Position Indication System agree within 12 steps at least once per 12 hours except during time intervals when the rod position deviation monitor is inoperable, then compare the Demand Position Indication System and the Digital Rod Position Indication System at least once per 4 hours.

Shutdown Rod Insertion Limit

4.1.3.5 Each shutdown rod shall be determined to be within the insertion limit specified in the Core Operating Limits Report (COLR):

a. Within 15 minutes prior to withdrawal of any rods in Control Bank A, B, C, or D during an approach to reactor criticality, and

b. At least once per 12 hours thereafter.

Control Rod Insertion Limits

4.1.3.6.1 The position of each control bank shall be determined to be within the insertion limits at least once per 12 hours except during time intervals when the Rod Insertion Limit Monitor is inoperable, then verify the individual rod positions at least once per 4 hours.

4.1.3.6.2 When in MODE 2 with Keff less than 1, verify that the predicted critical control rod position is within insertion limits within 4 hours prior to achieving reactor criticality.

Evaluation

Review of the surveillance records for the above Technical Specification sections for the past four cycles indicates that there has only been one time when the Callaway RCCAs have not been OPERABLE. This was due to a relay failure for one of the step counters, and not due to an RCCA problem. During the remainder of the cycles, the control rods have at all times been:

1) Determined to be within the group demand limit of $\pm$ 12 steps,
2) Verified OPERABLE by movement of at least 10 steps,
3) Demonstrated to have a rod drop time of $\leq$ 2.7 seconds,
4) Determined to be OPERABLE by verifying that the Demand Position Indication System and the Digital Rod Position Indication System agree within $\pm$12 steps, and
5) Determined to be within the insertion limits as specified in the COLR.

Due to the nature of the control rod insertion problem, the following issues were also evaluated to ensure the continued operability of the RCCAs at Callaway:

1) Beginning of Cycle (BOC) Rod Drop Testing,
2) Performance of RCCA Stepping tests,
3) Recent reactor trip data and observations,
4) Any anomalous behavior on RCCA changeout during refueling operations,
5) Current cycle burnup in rodded locations,
6) Excess shutdown margin available for current core design, and
7) Fuel types affected (V-5 vs. V-5H).

Review of BOC rod drop testing results for the past 4 cycles indicates that all RCCAs met the Technical Specification limit of $\leq$ 2.7 seconds. There has been no anomalous behavior.

As noted above, RCCA stepping tests have only resulted in one instance that the RCCAs were not considered OPERABLE, and this was due to a relay failure, not any type of control rod malfunction.

A review of reactor trip data from the past 4 cycles (including the current cycle) indicates that all RCCAs have fully inserted after each trip. The highest rodded assembly burnup at the time of tripping was approximately 48.9 GWD/MTU, with another four (4) rodded assemblies having burnups of approximately 42.0 GWD/MTU. This trip occurred late in cycle 5 (early 1992). An end of cycle rod drop test was performed during cycle 7 to test plant computer software. The highest rodded assembly burnup for this trip was approximately 47.4 GWD/MTU, with another four (4) rodded assemblies at approximately 47.0 GWD/MTU. The majority of other plant trips since cycle 5 have been early in the cycle. Two reactor trips during the current cycle occurred at cycle burnups of approximately 1.1 GWD/MTU and 4.0 GWD/MTU. The maximum rodded assembly burnup for these trips was approximately 31.5 GWD/MTU.

The Westinghouse Owner's Group (WOG) has collected data on Westinghouse plants that have experienced trips during recent operations. The database contains information from 24 plants, which includes 501 rodded fuel assemblies with accumulated burnups greater than 40 GWD/MTU. One hundred six (106) of these fuel assemblies have attained accumulated burnups greater than 45 GWD/MTU, and a few have attained burnups greater than 50 GWD/MTU. Only the plants referenced in the NRC bulletin have reported anomalous RCCA behavior. In addition, a number of Westinghouse plants with various fuel types have tripped within the last two weeks with no anomalous RCCA behavior.

Review of Callaway refueling records reveals no anomalous behavior on RCCA changeout either during drag testing or while performing RCCA shuffles in the spent fuel pool. A review of drag testing records indicates that all drag test results have been within prescribed limits.

Currently, the Callaway Cycle 8 average burnup is approximately 12.8 GWD/MTU (3/17/96), and the highest rodded assembly burnup is 39.6 GWD/MTU (see also Attachment 3). The highest projected end of cycle rodded assembly burnup is 48 GWD/MTU. Based on the current WOG evaluation, the anomalous RCCA behavior appears to have a threshold in fuel assemblies with burnups of 40-45 GWD/MTU. However, the WOG data referenced above includes 9 plants with Westinghouse 17X17 OFA/V-5 fuel (the type in use at Callaway) including rodded assemblies with burnups greater than 50 GWD/MTU, and none of these plants have experienced RCCA anomalies.

As noted in the Westinghouse safety assessment for the Wolf Creek event, the amount of uninserted rod worth involved in postulated trip scenarios, i.e., a number of rods not fully inserted, is small relative to the design basis assumption of a worst stuck rod. The conclusion from the Wolf Creek scenarios was that the design basis shutdown margin (SDM) assessment would bound all scenarios that could reasonably be postulated to occur, and an unrealistically large number of RCCAs would have to stick at high elevations to challenge the design basis SDM assessment. The excess shutdown margin available at the end of Callaway cycle 8 is calculated to be 750 pcm above the Technical Specification shutdown margin requirement of 1300 pcm. Callaway specific calculations show that at the end of cycle 8, with all rodded high burnup assemblies (9 assemblies) stuck at 30 steps, the total change in shutdown margin would be 1 pcm.

Based on the above, we can reasonably conclude that the Callaway RCCAs are operable and will continue to be operable throughout the current operating cycle.

CALLAWAY CYCLE 8
CONTROL ROD AND BURNUP INFORMATION

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2				V-5 33.460 38.593		V-5 14.923 25.483		V-5 15.693 26.656		V-5 14.930 25.489		V-5 33.443 38.578			
3					V-5 16.297 27.648		V-5 17.232 29.293		V-5 17.238 29.299		V-5 16.304 27.655				
4		V-5 33.443 38.578		V-5 38.659 47.264				V-5 17.631 29.570				V-5 38.659 47.264		V-5 33.460 38.593	
5			V-5 16.304 27.655										V-5 16.297 27.648		
6		V-5 14.930 25.489				V-5 17.148 28.865		V-5 16.746 28.686		V-5 17.148 28.865				V-5 14.923 25.483	
7			V-5 17.238 29.299										V-5 17.232 29.293		
8		V-5 15.693 26.656		V-5 17.631 29.570		V-5 16.746 28.686		V-5 39.626 48.079		V-5 16.746 28.686		V-5 17.631 29.570		V-5 15.693 26.656	
9			V-5 17.232 25.483										V-5 17.238 29.299		
10		V-5 14.923 25.483				V-5 17.148 28.865		V-5 16.746 28.686		V-5 17.148 28.865				V-5 14.930 25.489	
11			V-5 16.297 27.648										V-5 16.304 27.655		
12		V-5 33.460 38.593		V-5 38.659 47.264				V-5 17.631 29.570				V-5 38.659 47.264		V-5 33.443 38.578	
13					V-5 16.304 27.655		V-5 17.238 29.299		V-5 17.232 29.293		V-5 16.297 27.648				
14				V-5 33.443 38.578		V-5 14.930 25.489		V-5 15.693 26.656		V-5 14.923 25.483		V-5 33.460 38.593			
15															

FUEL TYPE
CURR. BU
EOC BU

Fuel Type Information: Westinghouse 17X17 Vantage-5 (V-5), Improved Zircaloy-4 cladding, grids, and guide tubes; Guide Tube I.D. = 0.442 in.

ATTACHMENT 3

CALLAWAY CYCLE 9
CONTROL ROD AND BURNUP INFORMATION

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2				V-5 29.293 42.007		V-5 0.000 26.403		V-5 0.000 26.803		V-5 0.000 26.403		V-5 29.299 42.012			
3					V-5 0.000 28.351		V-5 0.000 28.403		V-5 0.000 28.405		V-5 0.000 28.350				
4		V-5 29.299 42.012		V-5 0.000 28.995				V-5 28.865 49.839				V-5 0.000 28.995		V-5 29.293 42.007	
5			V-5 0.000 28.350										V-5 0.000 28.351		
6		V-5 0.000 26.403				V-5 0.000 28.709		V-5 0.000 29.102		V-5 0.000 28.709				V-5 0.000 26.403	
7			V-5 0.000 28.405										V-5 0.000 28.403		
8		V-5 0.000 26.803		V-5 28.865 49.839		V-5 0.000 29.102		V-5 27.662 47.399		V-5 0.000 29.102		V-5 28.865 49.839		V-5 0.000 26.803	
9			V-5 0.000 28.403										V-5 0.000 28.405		
10		V-5 0.000 26.043				V-5 0.000 28.709		V-5 0.000 29.102		V-5 0.000 28.709				V-5 0.000 26.043	
11			V-5 0.000 28.351										V-5 0.000 28.350		
12		V-5 29.293 42.007		V-5 0.000 28.995				V-5 28.865 49.839				V-5 0.000 28.995		V-5 29.299 42.012	
13					V-5 0.000 28.350		V-5 0.000 28.405		V-5 0.000 28.403		V-5 0.000 28.351				
14				V-5 29.299 42.012		V-5 0.000 26.043		V-5 0.000 26.803		V-5 0.000 26.043		V-5 29.293 42.007			
15															

FUEL TYPE
CURR. BU
EOC BU

Fuel Type Information: Westinghouse 17X17 Vantage-5 (V-5), Improved Zircaloy-4 cladding, grids, and guide tubes; Guide Tube I.D. = 0.442 in.

ATTACHMENT 4