Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

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Dr. Thomas E. Murley
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTN: DOCUMENT CONTROL DESK

Subject: Dresden Nuclear Power Station Unit 2 and 3
Quad Cities Nuclear Power Station Units 1 and 2
Revised Control Rod Sequencing Methods
NRC Docket Nos. 50-237, 249, 254, and 265

References: See Attachment A

Dr. Murley:

Commonwealth Edison Company (CECo) Boiling Water Reactors (BWRs) have previously utilized control rod sequences consistent with the Banked Position Withdrawal Sequence (BPWS) restrictions and associated reduced notch worth procedures. Attachments A and B describe a planned revision to the sequencing methods for the Dresden and Quad Cities units based on CECo studies and cycle-specific analyses by the fuel vendors (ANF and GE, respectively) of the Control Rod Drop Accident. Attachment A describes the background, basis, and benefits of the change. Attachment B provides a more detailed description of the CECo revisions to the BPWS methods, including the new control rod group definitions.

As noted in the attachments, the change would apply only to the region between 75% and 50% control rod density at Dresden and Quad Cities and is not being applied at the LaSalle units due to the constraints of the Rod Sequence Control System (RSCS).

The earliest potential applications for these enhanced sequencing methods are Dresden 2 Cycle 13 and Quad Cities 1 Cycle 12 which are currently scheduled to start-up in December, 1990 and January, 1991 respectively.

Please contact this office should further information be required.

Very truly yours,

J.A. Silady
Nuclear Licensing Administrator

Attachments (2)

cc: A.B. Davis - Regional Administrator, RIII
B.L. Siegel - Project Manager, NRR
L.N. Olshan - Project Manager, NRR
S.G. DuPont - Senior Resident Inspector, Dresden
T. Taylor = Senior Resident Inspector, Quad Cities

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ATTACHMENT A

BASIS FOR REVISED CONTROL ROD SEQUENCING

Background

Commonwealth Edison Company Boiling Water Reactors (BWRs) have utilized control rod sequences which are based on the Banked Position Withdrawal Sequence (BPWS) restrictions developed by General Electric in the 1970's as modified by a reduced notch worth procedure. CECo has studied the feasibility of modifying the BWR control rod sequencing rules required in the region from 75 to 50% Control Rod Density (CRD). The objectives were to simplify the sequence thereby improving the efficiency of reactor startups and shutdowns and reducing potential operator errors. A discussion of the resulting control rod sequencing changes is included in Attachment B. The standard BPWS rules are described in Reference 1.

Evaluation

There are two potential concerns with simplification of the control rod sequencing rules. The first of these is to assure compliance with the licensing basis. Control rod sequencing rules must be developed which ensure that the postulated Control Rod Drop Accident (CRDA) will result in an energy deposition of less than 280 cal/gm. The Quad Cities and Dresden fuel vendors, General Electric and Advanced Nuclear Fuels respectively, will utilize the revised rules to evaluate CRDA on a cycle-specific basis using NRC approved methodology, (References 2 and 3). CECo will then evaluate the fuel vendor's CRDA analysis using the 10CFR50.59 criteria as part of the reload licensing review for each cycle. It should be noted that the sequencing strategy described in Attachment B was developed based on analyses of past cycles. If the cycle-specifec CRDA analysis indicates additional banked positions are required to meet the 280 cal/gm limit, these will be included in the specified sequencing restrictions for the cycle.

The second concern with modification of the control rod sequencing rules is the possibility of short periods. Commonwealth Edison will continue to follow the single notch withdrawal requirements specified in the GE Reduced Notch Worth Procedure (Reference 4) to minimize the probability of a short period. The sequences to be used in future cycles will not increase the likelihood of short periods relative to the current BPWS rules due to the fact that fewer rods will be banked at a single rod position. The practice of banking a large percentage of the control rods forces the axial power shape to peak stronger, thereby increasing the potential for a larger reactivity insertion when these rods are withdrawn. The modified control rod sequencing rules result in a flatter axial power shape by minimizing the number of banked positions, and hence will not increase the likelihood of a short period occurrence.

Implementation Plans

The CRDA evaluation has been completed for Dresden 2 Cycle 13 by ANF, and for Quad Cities 1 Cycle 12 by GE, as part of the licensing analyses for these upcoming cycles. As expected, the vendor analyses confirmed compliance with the 280 cal/gm limit for these cycles. CECo plans to review these analyses as part of the 10CFR50.59 review for each cycle. CECo may choose to implement the new control rod sequencing rules conservatively, by requiring more banked positions than were analyzed by the vendor (but less than currently in BPWS). Additional banked positions beyond those analyzed will provide more margin to the 280 cal/gm limit and hence is in the conservative direction.

LaSalle County Station does not currently plan on revising its control rod sequencing rules, as these rules are enforced by the Rod Sequence Control System (RSCS) which would be difficult to modify.

Benefits

CECo's modification of the control rod sequencing rules will reduce the required number of bank positions. This simplification will increase the efficiency of start-ups and shutdowns, and therefore improve availability and capacity factor; while at the same time reducing the probability of control rod mispositioning errors.

References:

1. GE Document, NEDO-21231, "Banked Position Withdrawal Sequence", January 1977.

2. GE Document, NEDO-10527, "Rod Drop Accident Analysis for Large Boiling Water Reactors", March 1972.

3. ANF Document, XN-NF-80-19, "Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis", March 1983.

4. GE Service Information Letter 316, "Reduced Notch Worth Procedure", November 1979.

ATTACHMENT B

PROPOSED CONTROL ROD SEQUENCING REVISION

Based on work performed by Edison's BWR fuel vendors, GE and ANF, and confirmatory work performed in-house using the vendors' methodology, Edison developed revised control rod sequencing rules. GE and ANF will evaluate the Control Rod Drop Accident (CRDA) on a cycle-specific basis using these proposed sequences to assure adequate margin exists to the 280 cal/gm limit.

The control rod sequences from 75% to 50% control rod density (CRD) have been modified in order to reduce the banked position requirements of these rods. Emphasis was placed on the control rods being withdrawn from 75% to 50% CRD due to the fact that the first 25% of the control rods (100% to 75% CRD) are already withdrawn from Notch Position 0 to 48 without banking. Additionally, a reduction in the Rod Worth Minimizer (RWM) Low Power Setpoint is anticipated, as a result of BWROG efforts, which will reduce the amount of time after the "black-and-white" pattern (50% CRD) where low power sequencing restrictions are necessary. Therefore, it was determined that pursuing a simplified control rod sequence beyond the black-and-white pattern is not as beneficial.

To reduce the banked position requirements while maintaining adequate margin to the 280 cal/gm limit, Commonwealth Edison divided the second 25% of the control rods to be withdrawn (75% CRD to 50% CRD) into four groups and defined a specific withdrawal sequence to be enforced for these four groups. This was done by dividing the control rods in BPWS Groups 3 and 4, thereby forming four control rod groups in the range from 75% and 50% CRD as opposed to two groups in the BPWS designations. This division is consistent with typical plant practice, as current practice is to withdraw the peripheral rods of BPWS Group 3 first, followed by the interior rods. These rods are designated as Groups 3 and 4 in the modified sequencing rules. BPWS Group 4 is then withdrawn in the same manner. These rods are designated as Groups 5 and 6 in the modified sequencing rules.

The new sequence includes the withdrawal of the same rods in the same general order, but this strategy in now enforced (i.e. formally required and programmed in the upgraded RWM) and is used as an assumption into the CRDA analysis. The enforcement of this withdrawal sequence allows the elimination of most of the required banked positions for the control rods from 75 to 50% CRD due to the more even power distribution throughout the core. One of the four groups has a banked position at Position 12 for additional conservatism (new Group 4), but the remaining groups (new Groups 3, 5, and 6) may be withdrawn directly from Position 0 to 48. It should be noted that, although the extent of banking is reduced, the individual withdrawal of each rod is still performed in a notchwise manner as appropriate and as required procedurally for approaching criticality and avoidance of short periods, per the Reduced Notch Worth Procedure single notch withdrawal restrictions.

The modified control rod groups in the region from 100% CRD to 50% CRD are shown in Figure A-1 for reference purposes. No modifications are being made to the control rod sequencing rules from 50% CRD to the RWM Low Power Setpoint.

FIGURE A.1

QUAD CITIES AND DRESDEN MODIFIED CONTROL ROD GROUP ASSIGNMENTS

PRIOR TO BLACK AND WHITE

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	
15						3		5		3						15
14					1		2		2		1					14
13				3		5		4		5		3				13
12			1		2		1		1		2		1			12
11		3		6		4		6		4		6		3		11
10	1		2		1		2		2		1		2		1	10
9		5		4		6		4		6		4		5		9
8	2		1		2		1		1		2		1		2	8
7		5		4		6		4		6		4		5		7
6	1		2		1		2		2		1		2		1	6
5		3		6		4		6		4		6		3		5
4			1		2		1		1		2		1			4
3				3		5		4		5		3				3
2					1		2		2		1					2
1						3		5		3						1
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	