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February 11, 1987

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

Subject: McGuire Nuclear Station Docket Nos. 50-369/370 Catawba Nuclear Station Docket Nos. 50-413/414 Determination of Rod Worth Using Rod Swap Methodology

Gentlemen:

By letter dated December 4, 1986, Duke submitted for information to NRC a description of the method by which bank worths are determined in startup physics testing. By letter of January 12, 1987, the Staff responded to the submittal with a request for additional information. Attached are the responses to the Staff's questions.

It is intended that the methodology described in the December 4, 1986 submittal will be used for the next reloads of Duke's Westinghouse plants; the first of which is scheduled for May 1, 1987.

Very truly yours,

Wall B. Tuskerfue

Hal B. Tucker

SAG/54/jgm

Attachment

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xc: Mr. Darl Hood, Project Director Office of Nuclear Reactor Regulation U.S. Nuclear Regulatory Commission Washington, D.C. 20555

> Dr. J. Nelson Grace, Regional Administrator U.S. Nuclear Regulatory Commission - Region II 101 Marietta Street NW - Suite 2900 Atlanta, GA 30323

Mr. W.T. Orders NRC Resident Inspector McGuire Nuclear Station

#### ATTACHMENT

- QUESTION 1: Are all the rod worth calculations done with the EPRI-NODE-P Code, including both rod swap and rod worth for shutdown margin?
- RESPONSE: Shutdown Margin calculations are performed according to the methodology approved in DPC-NF-2010A. Rod worths for both the shutdown margin calculation and the rod swap calculations are done using EPRI-NODE-P.
  - NOTE: See Section 5.4 of DPC-NF-2010A for the procedure for shutdown margin calculations.
- QUESTION 2: Section 3, "Measurement Procedure": submit detailed procedures for the measurements. Include the actual boron dilution rate and the flux level for each of the tests included in the report.
- RESPONSE: The most current procedures used in the rod swap measurements are enclosed as Attachments 1, 2, and 3.

A summary of the reactivity insertion rates and flux levels for each of the tests in the reference is presented below. Flux levels are values as measured on the reactivity computer picoammeter.

UNIT/CYCLE	REACTIVITY INSERTION RATE (PCM/HR)		TEST (AM	RA	NGE )	POINT OF ADDING NUCLEAR HEAT (AMPS)	
M1C2	450	1	Е-8 ТО	1	E-7	1.4	E-6
M1C3	460	1	Е-8 ТО	1	E-7	4.25	E-7
M1C4	420	1	Е-8 ТО	1	E-7	5.1	E-7
M2C2	480	1	Е-7 ТО	1	E-6	1.6	E-6
M2C3	720	1	Е-7 ТО	1	E-6	1.65	E-6

- QUESTION 3: Section 4, "Calculational Procedure" under 5: How many calculations are performed for each bank and at what positions.
- RESPONSE: One a is calculated for each bank (except for the reference bank) at the predicted critical height. These calculations use the results of cases performed for Sections 4.3 and 4.4 of the reference. Cases are done with the reference bank being inserted in approximately 6-step increments both by itself and in the presence of the bank being predicted.

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#### ATTACHMENT

QUESTION 4: Table 3, " " are the values given at the predicted heights?

- RESPONSE: Alpha ( $\propto$ ) is the ratio of the reference bank worth from the predicted critical height to out of the core with and without bank X in the core. Values for are given at the predicted critical heights. However, the ratio of the reference bank worth with and without bank X in the core is insensitive to variations in the predicted critical heights and will have no significant impact on the inferred worth.
- QUESTION 5: Submit a copy of Reference 2.
- RESPONSE: Reference 2: Duke Power Company McGuire Nuclear Station, "Control Rod Worth Measurement: Rod Swap Test Procedure," PT/O/A/4150/11A, April, 1984 test procedure is enclosed as Attachment 4.
- QUESTION 6: Provide data for at least 2 sets of side-by-side comparisons of boron dilution and rod swap data - predicted and measured. The data may be either for your plants or measured data from another plant and predictions by Duke.

RESPONSE: Table with requested data is provided below. All rod worths are given in units of PCM.

UNIT/ CYCLE	BANK	PREDICTED WORTH	BOR/DILUTION MEAS WORTH	% DIFF ((P-M)/M)*100)	ROD SWAP INF WORTH	% DIFF ((P-I)/I)*100	
M1C2	CD	616	566	8.8	586	5.1 4.7 4.5	
M1C3	CD	488	483	1.0	466		
M1C4	CD	581	580	0.2	556		
M2C2	CD	654	665	-1.7	664	-1.5	
M2C3	CD	591	556	6.3	530	11.5	
MEAN				2.9		4.9	
STANDAR	RD DEV	IATION		4.4		4.6	

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## ATTACHMENT

QUESTION 7: What Organization does the safety analysis for the Duke Plants? When this is not done by Duke, what is done (e.g. tests, comparisons, etc.) to show that the startup test results adequately represent the plant features and assumptions used in the safety analyses?

#### **RESPONSE:**

Cycle specific safety reviews and any safety re-analyses required for McGuire and Catawba are performed by Westinghouse, the current fuel vendor. Assuming all startup tests meet acceptance criteria, transmittal of the results to Westinghouse is formally accomplished by providing them a copy of the startup report prepared for the NRC. If any review or acceptance criteria are exceeded, the the action statements in the procedure are followed. Actions required usually include review of the test data and predicted values, assessment of impacts on safety analyses and technical specification limits, etc. Groups involved in these reviews include the Site Reactor Group, the General Office Nuclear Design Group and, as necessary, Site Compliance, G.O. Licensing, G.O. Safety Analysis, and Westinghouse.

The main safety analysis assumption verified by the rod swap procedure is that the plant will maintain adequate shutdown margin per technical specifications. One of the purposes of rod swap measurements and comparisons is to verify the accuracy of the total rod worth prediction used as an input to the shutdown margin calculation. An independent Duke Power shutdown margin is evaluated for each cycle using methods approved by the NRC in DPC-NF-2010A. The N-1 rod worth used in this prediction is reduced by 10% for conservatism. Acceptance criteria listed in the procedure indicate that the total inferred rod worth as measured in the rod swap testing must be within 10% of the total predicted worth. If the total measured rod worth is less than the predicted worth by more than 10%, a review of the shutdown margin is made to determine if the current rod insertion limits provide adequate shutdown margin. If the shutdown margin is adequate, then no revision of the limits is necessary. However, if the margin is not maintained, then Duke will notify Westinghouse, revise the rod insertion limits, and submit any necessary changes in the technical specifications to the NRC.

## Reference

McGuire Nuclear Station, Catawba Nuclear Station Rod Swap Methodology Report for Startup Physics Testing, DPC-NE-1003, Rev. 1, December 1986.