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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, D. C. 20555-0001

Donald C. Cook Nuclear Plant Unit 2
Unit 2 Cycle 16 End of Life Moderator Temperature Coefficient Limit Report

Reference: Letter from J. N. Jensen, Indiana Michigan Power Company, to U. S. Nuclear Regulatory Commission Document Control Desk, "Supplement to License Amendment Request on the Conditional Exemption from Measurement of End of Life Moderator Temperature Coefficient," AEP:NRC:5132-01, dated June 2, 2005 (ML051650282).

Indiana Michigan Power Company, the licensee for the Donald C. Cook Nuclear Plant (CNP), made a commitment in the referenced letter to submit the following information for the first three uses of the WCAP-13749-P-A methodology for each unit at CNP as a condition for approval of the conditional exemption of the most negative end of life moderator temperature coefficient measurement technical specification change:

1. A summary of the plant data used to confirm that the Benchmark Criteria of Table 3-2 of WCAP-13749-P-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," have been met; and,

2. The Most Negative Moderator Temperature Coefficient Limit Report (as found in Appendix D of WCAP-13749-P-A).

The information is attached. This transmittal is the second of the three submittals for Unit 2. There are no new commitments made in this submittal.

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NRR

Should you have any questions, please contact Ms. Susan D. Simpson, Regulatory Affairs Manager, at (269) 466-2428.

Sincerely,

Mark A. Peifer
Site Support Services Vice President

KS/rdw

Attachments:

1. Plant Data Used to Confirm Benchmark Requirements
2. Most Negative End of Life Moderator Temperature Coefficient Limit Report for Donald C. Cook Nuclear Plant Unit 2, Cycle 16

c: J. L. Caldwell, NRC Region III
K. D. Curry, Ft. Wayne AEP, w/o attachments
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Attachment 1 to AEP:NRC:7132

PLANT DATA USED TO CONFIRM BENCHMARK REQUIREMENTS

Plant Data Used to Confirm Benchmark Requirements

To facilitate the review of this information, a list of abbreviations used in this attachment is provided.

°F	degrees Fahrenheit
%	percent
BOL	beginning of life
CNP	Donald C. Cook Nuclear Plant
EOL	end of life
HZP	hot zero power
ITC	isothermal temperature coefficient
M	measured
MTC	moderator temperature coefficient
MTU	metric tons of uranium
MWD	megawatt-day
NRC	Nuclear Regulatory Commission
pcm	percent-millirho
P	predicted

This attachment presents a comparison of the CNP Unit 2 Cycle 16 core characteristics with the requirements for use of the Conditional Exemption of the Most Negative EOL MTC Measurement methodology and presents plant data demonstrating that the Benchmark Criteria presented in WCAP-13749-P-A are met.

The Conditional Exemption of the Most Negative EOL MTC Measurement methodology is described in WCAP-13749-P-A. This report was approved by the NRC with two requirements:

- only PHOENIX/ANC calculation methods are used for the individual plant analyses relevant to determinations for the EOL MTC plant methodology, and
- the predictive correction is reexamined if changes in core fuel designs or continued MTC calculation/measurement data show significant effect on the predictive correction.

The PHOENIX/ANC calculation methods were used for the CNP Unit 2 Cycle 16 core design and relevant analyses. Also, the Unit 2 Cycle 16 core design does not represent a major change in core fuel design and the MTC calculation-to-measurement physics database shows no significant effect on the predictive correction. Therefore, the predictive correction of -3 pcm/°F remains valid for this cycle. The Unit 2 Cycle 16 core meets both of the above requirements.

The following reference is applicable to this attachment:

Letter from J. D. Peralta, NRC, to J. A. Gresham, Westinghouse Electric Company, "NRC Staff Interpretation of WCAP-16260-P-A with Respect to Two Previously Approved Topical Reports WCAP-8846-A, WCAP-13749-P-A and Their Associated Safety Evaluations," dated May 23, 2006 (ML061420313).

The following data tables are provided in support of the benchmark criteria:

- Table 1 - Benchmark Criteria for Application of the 300 ppm MTC Conditional Exemption Methodology (per WCAP-13749-P-A)
- Table 2 - Flux Map Data: Assembly Powers
- Table 3 - Flux Map Data: Core Tilt Criteria
- Table 4 - Core Reactivity Balance Data
- Table 5 - Low Power Physics Test Data (BOL, HZP): ITC
- Table 6 - Low Power Physics Test Data (BOL, HZP): Total Control Bank Worth

Table 1

Benchmark Criteria for Application of the 300 ppm MTC Conditional Exemption Methodology (per WCAP-13749-P-A)

Parameter	Criteria
Assembly Power (Measured Normal Reaction Rate)	± 0.1 or 10 %
Measured Incore Quadrant Power Tilt (Low Power)	± 4 %
Measured Incore Quadrant Power Tilt (Full Power)	± 2 %
Core Reactivity Difference	± 1000 pcm
BOL HZP ITC	± 2 pcm/°F
Individual Control Bank Worth	NA*
Total Control Bank Worth	± 10 %

* Not required when "The Spatially Corrected Inverse Count Rate (SCICR) Method for Subcritical Reactivity Measurement" (WCAP-16260-P-A) has been performed; see the referenced letter.

Table 2

Flux Map Data:Assembly Powers

Assembly Power Determination

Map	Date	Power (%)	(Maximum Magnitude of Relative Error)				
			Measured Power	Predicted Power	|Predicted - Measured|	10% of Predicted	Acceptable
216-01	5/7/2006	27.82	1.254	1.364	0.110	0.136	YES
216-02	5/7/2006	44.74	0.322	0.297	0.025	0.030	YES
216-03	5/9/2006	85.38	0.326	0.306	0.020	0.031	YES
216-04	5/12/2006	99.89	0.392	0.363	0.029	0.036	YES
216-05	6/5/2006	99.91	0.394	0.362	0.032	0.036	YES
216-06	7/10/2006	99.88	0.403	0.367	0.036	0.037	YES
216-07	8/7/2006	99.83	0.413	0.376	0.037	0.038	YES
216-08	8/30/2006	99.85	0.327	0.306	0.021	0.031	YES
216-09	9/18/2006	99.85	0.426	0.396	0.030	0.040	YES
216-10	10/9/2006	99.91	0.434	0.407	0.027	0.041	YES
216-11	11/6/2006	99.87	0.445	0.422	0.023	0.042	YES
216-12	12/4/2006	99.86	0.464	0.436	0.028	0.044	YES
216-13	1/8/2007	99.96	0.480	0.451	0.029	0.045	YES
216-14	2/5/2007	99.86	0.492	0.463	0.029	0.046	YES
216-15	3/5/2007	99.87	0.503	0.473	0.030	0.047	YES
216-16	4/9/2007	99.84	0.514	0.484	0.030	0.048	YES
216-17	5/7/2007	99.88	0.525	0.493	0.032	0.049	YES
216-18	6/4/2007	99.88	0.531	0.500	0.031	0.050	YES

Acceptance Criterion: ± 0.1 or 10%.

Table 3

Flux Map Data: Core Tilt Criteria

Top Half Incore Quadrant Power Tilt

Map #	Power (%)	Maximum Tilt	Minimum Tilt	Acceptable
216-01	27.82	1.01180	0.99005	Yes
216-02	44.74	1.00847	0.99439	Yes
216-03	85.38	1.01137	0.99214	Yes
216-04	99.89	1.01049	0.99265	Yes
216-05	99.91	1.01396	0.99181	Yes
216-06	99.88	1.01366	0.99042	Yes
216-07	99.83	1.01210	0.99170	Yes
216-08	99.85	1.00830	0.99312	Yes
216-09	99.85	1.00533	0.99535	Yes
216-10	99.91	1.00137	0.99733	Yes
216-11	99.87	1.00436	0.99740	Yes
216-12	99.86	1.00575	0.99527	Yes
216-13	99.96	1.00778	0.99397	Yes
216-14	99.86	1.00758	0.99380	Yes
216-15	99.87	1.00663	0.99517	Yes
216-16	99.84	1.00661	0.99421	Yes
216-17	99.88	1.00455	0.99620	Yes
216-18	99.88	1.00491	0.99484	Yes

Bottom Half Incore Quadrant Power Tilt

Map #	Power (%)	Maximum Tilt	Minimum Tilt	Acceptable
216-01	27.82	1.01103	0.98717	Yes
216-02	44.74	1.00781	0.99230	Yes
216-03	85.38	1.00812	0.99230	Yes
216-04	99.89	1.00769	0.99214	Yes
216-05	99.91	1.01345	0.98857	Yes
216-06	99.88	1.01772	0.98664	Yes
216-07	99.83	1.01485	0.98788	Yes
216-08	99.85	1.00919	0.98912	Yes
216-09	99.85	1.00716	0.99166	Yes
216-10	99.91	1.00560	0.99433	Yes
216-11	99.87	1.00185	0.99799	Yes
216-12	99.86	1.00431	0.99682	Yes
216-13	99.96	1.00505	0.99402	Yes
216-14	99.86	1.00618	0.99450	Yes
216-15	99.87	1.00337	0.99703	Yes
216-16	99.84	1.00455	0.99658	Yes
216-17	99.88	1.00410	0.99754	Yes
216-18	99.88	1.00188	0.99774	Yes

Acceptance Criteria: **High power maps - maximum power tilt: 1.02; minimum power tilt: 0.98**
Low power maps - maximum power tilt: 1.04; minimum power tilt: 0.96

Table 4

Core Reactivity Balance Data

Unit 2 Cycle 16 Boron Letdown Curve

Date	Burnup (MWD/MTU)	Delta Reactivity (pcm)	Acceptable
May 17, 2006	383.63	-218.0	Yes
May 20, 2006	511.65	-149.0	Yes
May 23, 2006	641.05	-86.3	Yes
May 28, 2006	854.59	-19.0	Yes
May 31, 2006	985.76	58.5	Yes
June 4, 2006	1155.42	113.0	Yes
June 7, 2006	1288.38	138.2	Yes
June 12, 2006	1502.67	164.2	Yes
July 10, 2006	2704.14	289.2	Yes
August 8, 2006	3950.28	446.5	Yes
August 30, 2006	4900.68	552.6	Yes
September 19, 2006	5742.92	601.8	Yes
October 10, 2006	6641.31	716.0	Yes
November 7, 2006	7846.16	791.3	Yes
December 5, 2006	9,049.26	781.4	Yes
January 9, 2007	10552.30	762.5	Yes
February 6, 2007	11756.10	785.4	Yes
March 6, 2007	12959.50	686.1	Yes
April 10, 2007	14462.90	596.4	Yes
May 8, 2007	15663.90	536.3	Yes
June 5, 2007	16866.30	410.5	Yes

Acceptance Criterion: ± 1000 pcm

Table 5

Low Power Physics Test Data (BOL, HZP): ITC

Measured ITC (pcm/°F)	Predicted ITC (pcm/°F)	ITC Error (M-P) (pcm/°F)	Acceptable
-1.469	-2.151	0.682	Yes

Acceptance Criterion: ITC error within ± 2 pcm/°F

Table 6

Low Power Physics Test Data (BOL, HZP): Total Control Bank Worth

	Measured Worth (pcm)	Predicted Worth (pcm)	Delta Worth (M-P) (pcm)	Worth %Error $\frac{(M-P)x100\%}{P}$	Acceptable
Total Measured Worth	5630	5704	-74.5	-1.31%	Yes

Acceptance Criterion: Total Measured Worth % error within ±10%

Attachment 2 to AEP:NRC:7132

MOST NEGATIVE END OF LIFE MODERATOR TEMPERATURE COEFFICIENT LIMIT REPORT FOR DONALD C. COOK NUCLEAR PLANT UNIT 2, CYCLE 16

Most Negative End of Life Moderator Temperature Coefficient Limit Report for Donald C. Cook Unit 2, Cycle 16

To facilitate the review of this information, a list of abbreviations used in this attachment is provided.

°F	degrees Fahrenheit
Δ	delta
%	percent
AFD	axial flux difference
ARO	all rods out
BOL	beginning of life
C_B	Reactor Coolant System boron concentration
CNP	Donald C. Cook Nuclear Plant
COLR	Core Operating Limits Report
EOL	end of life
HFP	hot full power
HZP	hot zero power
ITC	isothermal temperature coefficient
M	measured
MTC	moderator temperature coefficient
MTU	metric tons of uranium
MWD	megawatt-day
pcm	percent-millirho
ppm	parts per million
P	predicted
RCS	Reactor Coolant System
RTP	reactor thermal power

PURPOSE:

The purpose of this document is to present cycle-specific best estimate data for use in confirming the most negative EOL MTC limit in CNP Technical Specification 3.1.3. This document also summarizes the methodology used for determining if a HFP 300 ppm MTC measurement is required.

PRECAUTIONS AND LIMITATIONS:

The EOL MTC exemption data presented in this document apply to CNP Unit 2 Cycle 16 only and may not be used for other operating cycles.

The following references are applicable to this attachment:

1. WCAP-13749-P-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," March, 1997.
2. Letter from J. D. Peralta, NRC, to J. A. Gresham, Westinghouse Electric Company, "NRC Staff Interpretation of WCAP-16260-P-A with Respect to Two Previously Approved Topical Reports WCAP-8846-A, WCAP-13749-P-A and Their Associated Safety Evaluations," dated May 23, 2006 (ML061420313).

PROCEDURE:

All core performance benchmark criteria listed in Table 1 must be met for the current operating cycle. These criteria are confirmed from startup physics test results and routine HFP C_B and incore flux map surveillances performed during the cycle.

If all core performance benchmark criteria are met, then the Revised Predicted MTC may be calculated per the algorithm given in Table 2. The required cycle-specific data are provided in Tables 3 and 4, and Figure 1. This methodology is also described in Reference 1. If all core performance benchmark criteria are met and the Revised Predicted MTC is less negative than COLR Limit 2.2.2b, then a measurement is not required.

Table 1

Benchmark Criteria for Application of the 300 ppm MTC Conditional Exemption Methodology

Parameter	Criteria
Assembly Power (Measured Normal Reaction Rate)	± 0.1 or 10 %
Measured Incore Quadrant Power Tilt (Low Power)	± 4 %
Measured Incore Quadrant Power Tilt (Full Power)	± 2 %
Core Reactivity Difference	± 1000 pcm
BOL HZP ITC	± 2 pcm/°F
Individual Control Bank Worth	NA*
Total Control Bank Worth	± 10 %

* Not required when "The Spatially Corrected Inverse Count Rate (SCICR) Method for Subcritical Reactivity Measurement" (WCAP-16260-P-A) has been performed; see Reference 2.

Table 2

Algorithm for Determining the Revised Predicted Near-EOL 300 ppm MTC

The Revised Predicted MTC = Predicted MTC + AFD Correction – 3 pcm/°F

Where:

Predicted MTC is calculated from Figure 1 at the burnup corresponding to the measurement of 300 ppm at RTP conditions,

AFD Correction is the more negative value of the following:

0 pcm/°F or (ΔAFD * AFD Sensitivity)

ΔAFD is the measured AFD minus the predicted AFD from an incore flux map taken at or near the burnup corresponding to 300 ppm.

AFD Sensitivity = 0.05 pcm / °F / %ΔAFD

Predictive Correction is -3 pcm/°F, as included in the equation for the Revised Predicted MTC.

Table 3

Worksheet for Calculating the Revised Predicted Near-EOL 300 ppm MTC

Unit: 2, Cycle 16 **Date:** 6/19/2007 **Time:** 20:11

Reference for Cycle-Specific MTC Data:

CNP, Unit 2 Cycle 16, COLR

Part A. Predicted MTC

A.1	Cycle Average Burnup corresponding to the HFP ARO equilibrium xenon C_B of 300 ppm.	17488.3	MWD/MTU
A.2	Predicted HFP ARO MTC corresponding to burnup (A.1)	-24.61	pcm/°F

Part B. AFD Correction

B.1	Burnup of most recent HFP, equilibrium conditions incore flux map	16826.7	MWD/MTU
B.2	Measured HFP AFD at burnup (B.1) Reference incore flux map: Map # 216-18 Date: 6/04/07	-2.23	% AFD
B.3	Predicted HFP AFD at burnup (B.1)	-1.12	% AFD
B.4	MTC Sensitivity to AFD	0.05	pcm/°F/%ΔAFD
B.5	AFD Correction, more negative of the following: 0 pcm/°F or [B.4 *(B.2 – B.3)]	-0.06	pcm/°F

Part C. Revised Prediction

C.1	Revised Prediction (A.2 + B.5 – 3 pcm/°F)	-27.67	pcm/°F
C.2	Surveillance Limit (COLR 2.2.2b)	-32.0	pcm/°F

If C.1 is less negative than C.2, then the HFP 300 ppm MTC measurement is not required per Technical Specification Surveillance Requirement 3.1.3.2.

Table 4

Data Collection and Calculations Required to Complete the Table 3 Worksheet of the Most Negative Moderator Temperature Coefficient Limit Report

Data at the 300 ppm Boron Point

- RCS Boron at 300 ppm at 20:11 on 6/19/2007
- Burnup at 300 ppm: 17488.3 MWD/MTU **(A.1)**
- Predicted MTC: -24.61 pcm/°F **(A.2)**

Data from Last Flux Map

- Flux Map Number: 216-18 **(B.2)**
- Reactor Power (RP): 99.88% RTP
- Burnup: 16826.7 MWD/MTU **(B.1)**
- Measured Axial Flux Difference (MAFD): -2.23% **(B.2)**
  MAFD = Measured Axial Offset * RP / 100%
  = -2.232% * 99.88% / 100%
  = -2.23%

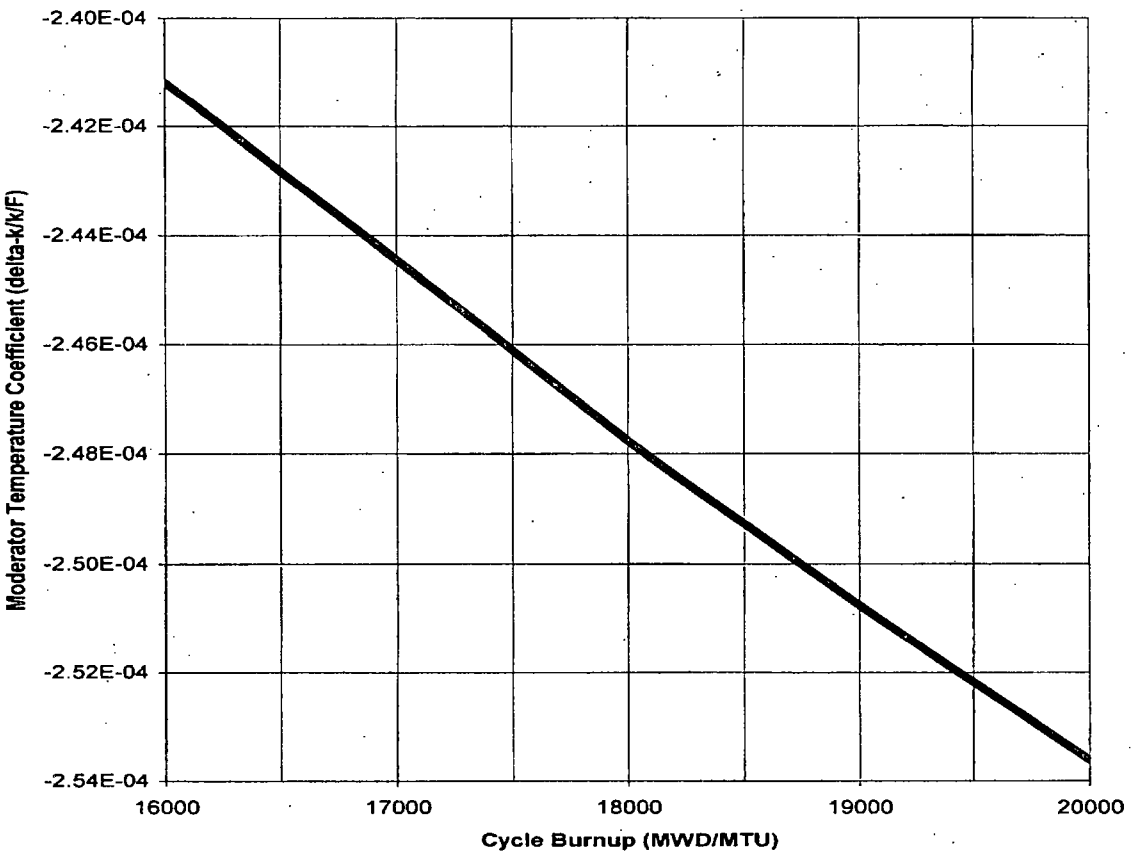
- Predicted Axial Flux Difference (PAFD): -1.12% **(B.3)**
  PAFD = Predicted Axial Offset * RP / 100%
  = -1.12% * 99.88% / 100%
  = -1.12%

Δ AFD = (MAFD-PAFD)
= (-2.23% - -1.12%)
= -1.11%

Determination of the Revised Predicted MTC
AFD Sensitivity: 0.05 pcm/°F/ %ΔAFD **(B.4)**
AFD Correction: -0.06 pcm/°F **(B.5)**
where: AFD Correction is the more negative of the following:
0 pcm/°F or (ΔAFD * AFD Sensitivity)
0 pcm/°F or (-1.11% * 0.05 pcm/°F/ %ΔAFD)
0 pcm/°F or -0.06 pcm/°F
∴-0.06 pcm/°F

Revised Predicted MTC = Predicted MTC + AFD Correction -3 pcm/°F
= -24.61 pcm/°F + -0.06 pcm/°F -3 pcm/°F
= -27.67 pcm/°F **(C.1)**

Figure 1
Unit 2 Cycle 16 Predicted HFP ARO 300 ppm MTC Versus Burnup



Burnup (MWD/MTU)	MTC (Δk/k/°F)
16000	-2.4118E-4
17000	-2.4444E-4
18000	-2.4777E-4
19000	-2.5075E-4
20000	-2.5360E-4