INDIANA MICHIGAN POWER
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Indiana Michigan Power
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
AEP.com

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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 1
Unit 1 Cycle 20 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.

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 first of the three submittals for Unit 1. There are no new commitments made in this submittal.

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

Sincerely,

Joseph N. Jensen
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 1, Cycle 20

c: J. L. Caldwell, NRC Region III
K. D. Curry, Ft. Wayne AEP, w/o attachments
J. T. King, MPSC
MDEQ – WHMD/RPMWS
NRC Resident Inspector
P. S. Tam, NRC Washington, DC

Attachment 1 to AEP:NRC:6132-01

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 1 Cycle 20 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 1 Cycle 20 core design and relevant analyses. Also, the Unit 1 Cycle 20 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 1 Cycle 20 core meets both of the above requirements.

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): Individual and Total Control Bank Worths

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	± 15 % or ± 100 pcm
Total Control Bank Worth	± 10 %

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
120-01	4/28/2005	47.15	1.006	1.042	0.036	0.104	Yes
120-02	4/29/2005	88.26	0.427	0.410	0.017	0.041	Yes
120-03	5/1/2005	99.90	0.463	0.442	0.021	0.044	Yes
120-04	5/5/2005	99.91	0.416	0.395	0.021	0.040	Yes
120-05	5/16/2005	99.89	0.417	0.397	0.020	0.040	Yes
120-06	6/15/2005	99.91	0.409	0.393	0.016	0.039	Yes
120-07	7/18/2005	99.90	1.147	1.106	0.041	0.111	Yes
120-08	8/15/2005	99.86	1.140	1.101	0.039	0.110	Yes
120-09	9/12/2005	99.92	1.135	1.095	0.040	0.110	Yes
120-10	10/17/2005	99.85	1.128	1.090	0.038	0.109	Yes
120-11	11/14/2005	99.94	0.341	0.329	0.012	0.033	Yes
120-12	12/12/2005	99.95	0.344	0.332	0.012	0.033	Yes
120-13	1/16/2006	99.95	1.132	1.087	0.045	0.109	Yes
120-14	2/13/2006	99.85	1.138	1.090	0.048	0.109	Yes
120-15	3/13/2006	99.87	1.146	1.094	0.052	0.109	Yes
120-16	4/17/2006	99.85	1.155	1.100	0.055	0.110	Yes
120-17	5/15/2006	99.96	1.161	1.105	0.056	0.111	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
120-01	47.15	1.01356	0.98540	Yes
120-02	88.26	1.00960	0.98957	Yes
120-03	99.90	1.00921	0.99106	Yes
120-04	99.91	1.00878	0.99196	Yes
120-05	99.89	1.00719	0.99230	Yes
120-06	99.91	1.00600	0.99641	Yes
120-07	99.90	1.00624	0.99554	Yes
120-08	99.86	1.00373	0.99673	Yes
120-09	99.92	1.00388	0.99786	Yes
120-10	99.85	1.00070	0.99864	Yes
120-11	99.94	1.00065	0.99914	Yes
120-12	99.95	1.00139	0.99796	Yes
120-13	99.95	1.00415	0.99711	Yes
120-14	99.85	1.00482	0.99577	Yes
120-15	99.87	1.00511	0.99615	Yes
120-16	99.85	1.00623	0.99606	Yes
120-17	99.96	1.00599	0.99397	Yes

Bottom Half Incore Quadrant Power Tilt

Map #	Power (%)	Maximum Tilt	Minimum Tilt	Acceptable
120-01	47.15	1.00941	0.99475	Yes
120-02	88.26	1.01173	0.99388	Yes
120-03	99.90	1.01095	0.99394	Yes
120-04	99.91	1.00930	0.99425	Yes
120-05	99.89	1.00913	0.99459	Yes
120-06	99.91	1.00660	0.99617	Yes
120-07	99.90	1.00307	0.99570	Yes
120-08	99.86	1.00255	0.99744	Yes
120-09	99.92	1.00385	0.99781	Yes
120-10	99.85	1.00480	0.99664	Yes
120-11	99.94	1.00386	0.99813	Yes
120-12	99.95	1.00301	0.99800	Yes
120-13	99.95	1.00708	0.99678	Yes
120-14	99.85	1.00768	0.99587	Yes
120-15	99.87	1.00803	0.99667	Yes
120-16	99.85	1.00906	0.99573	Yes
120-17	99.96	1.00825	0.99510	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 1 Cycle 20 Boron Letdown Curve

Date	Burnup (MWD/MTU)	Delta Reactivity (pcm)	Acceptable
4-May-05	223.6	-297.4	Yes
17-May-05	713.3	-54.0	Yes
24-May-05	976.1	72.1	Yes
31-May-05	1242.1	116.1	Yes
6-Jun-05	1467.7	167.3	Yes
15-Jun-05	1808.4	191.1	Yes
18-Jul-05	2990.7	258.2	Yes
16-Aug-05	4079.8	394.8	Yes
13-Sep-05	5135.2	528.4	Yes
18-Oct-05	6408.6	573.1	Yes
15-Nov-05	7465.4	648.5	Yes
13-Dec-05	8519.5	682.9	Yes
17-Jan-06	9835.0	706.0	Yes
14-Feb-06	10893.6	687.2	Yes
14-Mar-06	11946.6	669.6	Yes
18-Apr-06	13269.3	580.1	Yes
16-May-06	14319.7	492.6	Yes

Acceptance Criteria: ± 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
-1.42	-0.693	-0.727	Yes

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

Table 6

Low Power Physics Test Data (BOL, HZP): Individual and Total Control Bank Worths

	Measured Worth (pcm)	Predicted Worth (pcm)	Delta Worth (M-P) (pcm)	Worth %Error $\frac{(M-P)x100\%}{P}$	Acceptable
Shutdown Bank A	898.2	888.0	10.2	1.1%	Yes
Shutdown Bank B	981.5	947.7	33.8	3.6%	Yes
Shutdown Bank C	341.0	316.3	24.7	7.8%	Yes
Shutdown Bank D	308.3	321.6	-13.3	-4.1%	Yes
Control Bank A	938.9	906.0	32.9	3.6%	Yes
Control Bank B	449.9	436.7	13.2	3.0%	Yes
Control Bank C	544.5	540.8	3.7	0.7%	Yes
Control Bank D	868.9	835.2	33.7	4.0%	Yes
Total Measured Worth	5331.2	5192.3	138.9	2.7%	Yes

Acceptance Criteria: Individual bank rod worth % error within ±15%
or Delta Worth within ±100 pcm.
Acceptance Criteria: Total Measured Worth % error within ±10%

Attachment 2 to AEP:NRC:6132-01

MOST NEGATIVE END OF LIFE MODERATOR TEMPERATURE COEFFICIENT LIMIT REPORT FOR DONALD C. COOK NUCLEAR PLANT UNIT 1, CYCLE 20

Most Negative End of Life Moderator Temperature Coefficient Limit Report for Donald C. Cook Unit 1, Cycle 20

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 1 Cycle 20 only and may not be used for other operating cycles.

The following reference is applicable to this document:

WCAP-13749-P-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," March, 1997.

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 the referenced document. 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	± 15 % or ± 100 pcm
Total Control Bank Worth	± 10 %

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: 1, Cycle 20 **Date:** 6/2/2006 **Time:** 5:42

Reference for Cycle-Specific MTC Data:

CNP, Unit 1 Cycle 20, COLR

Part A. Predicted MTC

A.1	Cycle Average Burnup corresponding to the HFP ARO equilibrium xenon C_B of 300 ppm.	14953.4	MWD/MTU
A.2	Predicted HFP ARO MTC corresponding to burnup (A.1)	-20.958	pcm/°F

Part B. AFD Correction

B.1	Burnup of most recent HFP, equilibrium conditions incore flux map	14284.0	MWD/MTU
B.2	Measured HFP AFD at burnup (B.1) Reference incore flux map: Map # 120-17 Date: 5/15/06	-1.811	% AFD
B.3	Predicted HFP AFD at burnup (B.1)	-2.059	% 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)]	0.000	pcm/°F

Part C. Revised Prediction

C.1	Revised Prediction (A.2 + B.5 – 3 pcm/°F)	-23.958	pcm/°F
C.2	Surveillance Limit (COLR 2.2.2b)	-38.4	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 5:42 on 6/2/2006
- Burnup at 300 ppm: 14953.4 MWD/MTU **(A.1)**
- Predicted MTC: -20.958 pcm/°F **(A.2)**

Data from Last Flux Map:

- Flux Map Number: 120-17 **(B.2)**
- Reactor Power (RP): 99.96% RTP
- Burnup: 14284.0 MWD/MTU **(B.1)**
- Measured Axial Flux Difference (MAFD): -1.811% **(B.2)**
  MAFD = Measured Axial Offset * RP / 100%
  = -1.812% * 99.96% / 100%
  = -1.811%

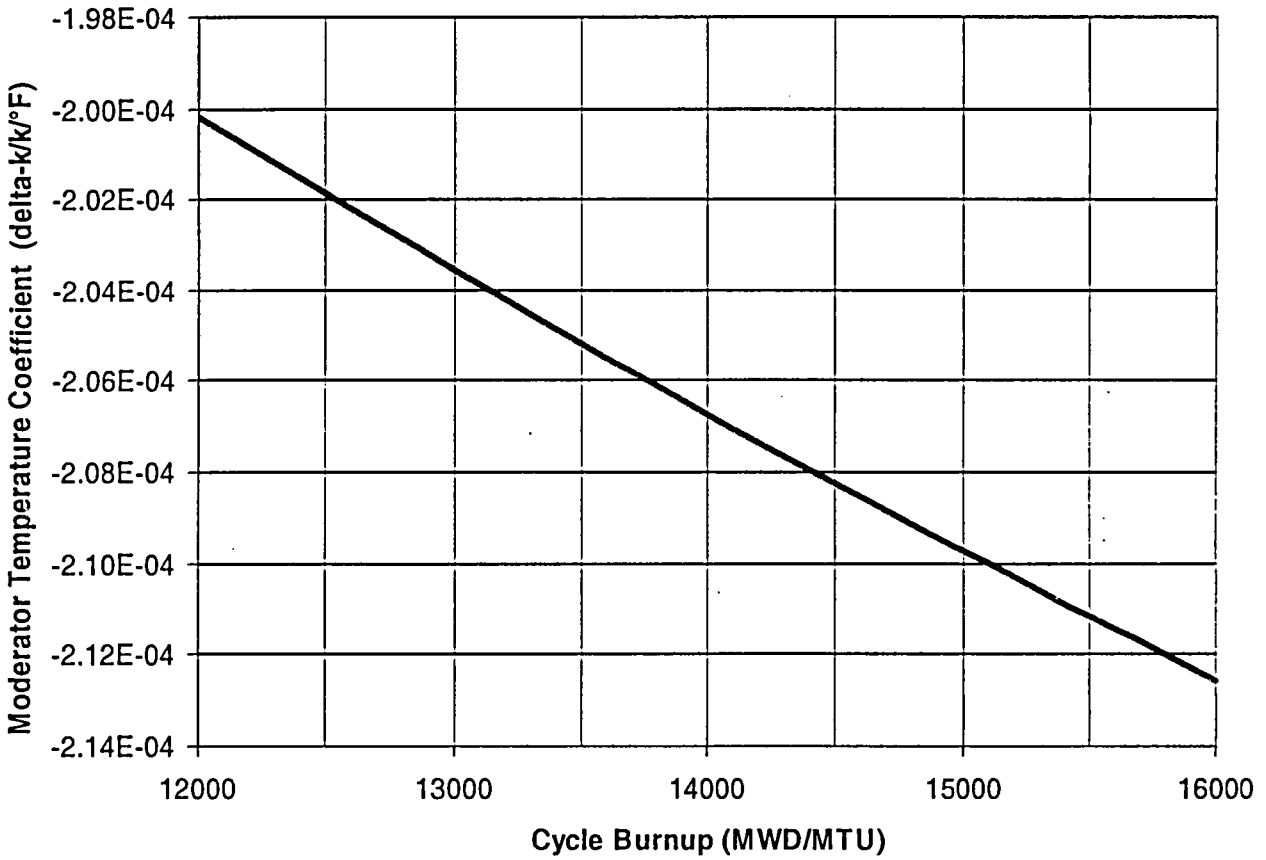
- Predicted Axial Flux Difference (PAFD): -2.059% **(B.3)**
  PAFD = Predicted Axial Offset * RP / 100%
  = -2.06% * 99.96% / 100%
  = -2.059%

Δ AFD = (MAFD-PAFD)
= (-1.811% + 2.059%)
= 0.248%

Determination of the Revised Predicted MTC
AFD Sensitivity: 0.05 pcm/°F/ %ΔAFD **(B.4)**
AFD Correction: 0.000 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 (0.248% * 0.05 pcm/°F/ %ΔAFD)
0 pcm/°F or 0.012 pcm/°F
∴0 pcm/°F

Revised Predicted MTC = Predicted MTC + AFD Correction + Predictive Correction
= -20.958 pcm/°F + 0 pcm/°F – 3 pcm/°F
= -23.958 pcm/°F **(C.1)**

Figure 1
Unit 1 Cycle 20 Predicted HFP ARO 300 ppm MTC Versus Burnup



Burnup (MWD/MTU)	MTC (Δk/k/°F)
12000	-2.0020E-4
13320	-2.0458E-4
14320	-2.0770E-4
15320	-2.1064E-4
16000	-2.1256E-4