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Brunswick Nuclear Plant
8470 River Rd SE
Southport, NC 28461

May 25, 2022
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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Brunswick Steam Electric Plant, Unit No. 1
Renewed Facility Operating License No. DPR-71
Docket No. 50-325
Unit 1 Cycle 23 MELLLA+ Eigenvalue Tracking Data

References:

1. Duke Energy Letter to NRC dated November 9, 2016, "Brunswick, Units 1 and 2 – Response to Request for Supplemental Information for License Amendment Request Regarding Core Flow Operating Range Expansion" (ADAMS Accession No. ML16330A504)
2. NRC Letter to Duke Energy, dated September 18, 2018, "Brunswick Steam Electric Plant, Units 1 and 2 – Issuance of Amendment Regarding Core Flow Operating Range Expansion (MELLLA+)" (ADAMS Accession Number ML18172A258)

Ladies and Gentlemen:

In Reference 1, Duke Energy Progress, LLC (Duke Energy), informed the NRC that it would evaluate and submit cycle-specific eigenvalue tracking data after the first full Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating cycle for each unit using AREVA methods. The enclosure provides this information for Brunswick Steam Electric Plant (BSEP), Unit 1, Cycle 23, which was completed in March 2022.

This document contains no regulatory commitments.

Please refer any questions regarding this submittal to Mr. Stephen Yodersmith, Brunswick Regulatory Affairs, at (910) 832-2568.

Sincerely,

Mark R. DeWire
Manager – Nuclear Support Services
Brunswick Steam Electric Plant

SBY/sby

Enclosure:

Brunswick Unit 1 MELLLA+ Eigenvalue Tracking Data

cc (with Enclosure):

Ms. Laura Dudes, NRC Regional Administrator, Region II
Mr. Luke Haeg, NRC Project Manager
Mr. Gale Smith, NRC Senior Resident Inspector
Chair - North Carolina Utilities Commission

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Brunswick Unit 1 MELLLA+ Eigenvalue Tracking Data

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Lambert, Brad	Approver	4/27/2022

Notes :

Brunswick Unit 1 MELLLA+ Eigenvalue Tracking

April 2022

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Approved by:	Signed Electronically	
	Brad Lambert (Manager – Brunswick/Oconee Nuclear Design)	

1. Purpose and Scope

The purpose of this letter report is to document the fulfillment of Limitation and Condition (L/C) 23 of NEDC-33173P (Reference 1). This L/C states:

> *In the first plant-specific implementation of MELLLA+, the cycle-specific eigenvalue tracking data will be evaluated and submitted to NRC to establish the performance of nuclear methods under the operation in the new operating domain. The following data will be analyzed:*
> - *Hot critical eigenvalue,*
> - *Cold critical eigenvalue,*
> - *Nodal power distribution (measured and calculated TIP comparison),*
> - *Bundle power distribution (measured and calculated TIP comparison),*
> - *Thermal margin,*
> - *Core flow and pressure drop uncertainties, and*
> - *The MIP Criterion (e.g., determine if core and fuel design selected is expected to produce a plant response outside the prior experience base).*
>
> *Provision of evaluation of the core-tracking data will provide the NRC staff with bases to establish if operation at the expanded operating domain indicates: (1) changes in the performance of nuclear methods outside the EPU experience base; (2) changes in the available thermal margins; (3) need for changes in the uncertainties and NRC-approved criterion used in the SLMCPR methodology; or (4) any anomaly that may require corrective actions.*

Based on Reference 2, the MIP Parameter will not be provided. Reference 2 states:

> *The NRC staff previously determined that submittal of the MIP was not necessary in letter to GEH dated November 20, 2015 (ADAMS Accession No. ML15292A421). That NRC staff's determination was generic and is applicable to AREVA methods as well.*

2. Comparison Approach

Brunswick Nuclear Plant Unit 1 completed its first full cycle with MELLLA+, B1C23, in March 2022. For each metric being compared, data from the previous 3 cycles (including the B1C22 partial MELLLA+ cycle) will be provided for a basis of comparison.
The eigenvalues, at cold and hot reactor conditions, are presented in the attached plots as a function of exposure. The thermal margins (MAPRAT, MFDLRX, and MFLCPR) are presented also as a function of exposure. The definitions of the thermal margin parameters are as follows:

- MAPRAT: Maximum ratio of bundle measured Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) to the appropriate limit.
- MFDLRX: Maximum fraction of limiting Linear Heat Generation Rate (LHGR) to the Fuel Design Limit (FDL)

- MFLCPR: Maximum fraction of limiting Critical Power Ratio

The ratio of on-line core monitoring system (PPX) to offline-evaluation (MCB) or "bias" is presented. The power distributions assessment uses nodal and radial Traversing In-Core Probe (TIP) statistics, consistent with Reference 3, from plant measured/calculated data as a function of exposure, core average void fractions, and power-to-flow ratio (P/F in units of MWt/Mlbm/hr). The plot of core flow and pressure drop uncertainties is presented also as a function of P/F ratio.

For convenience and better visualization, the MELLLA+ values plotted (relevant B1C22 and B1C23 data) are presented in red.

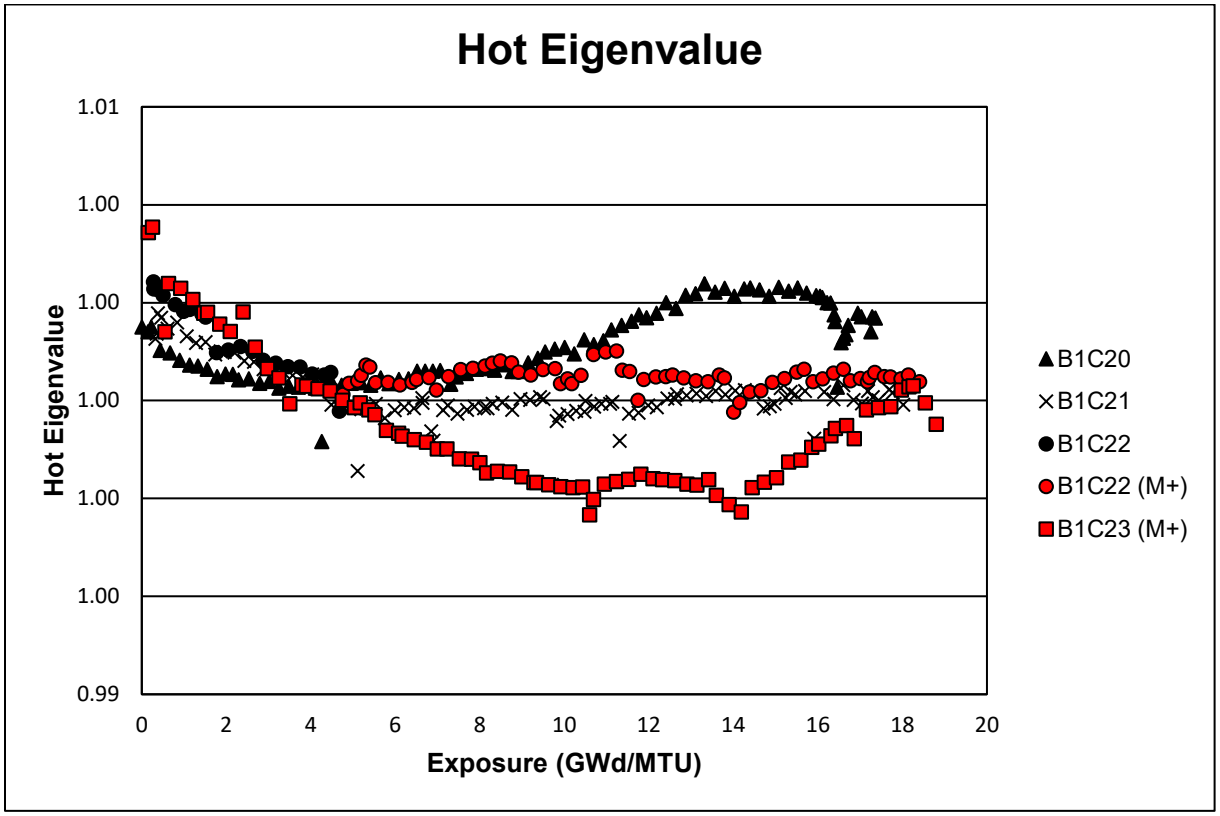
3. Conclusions

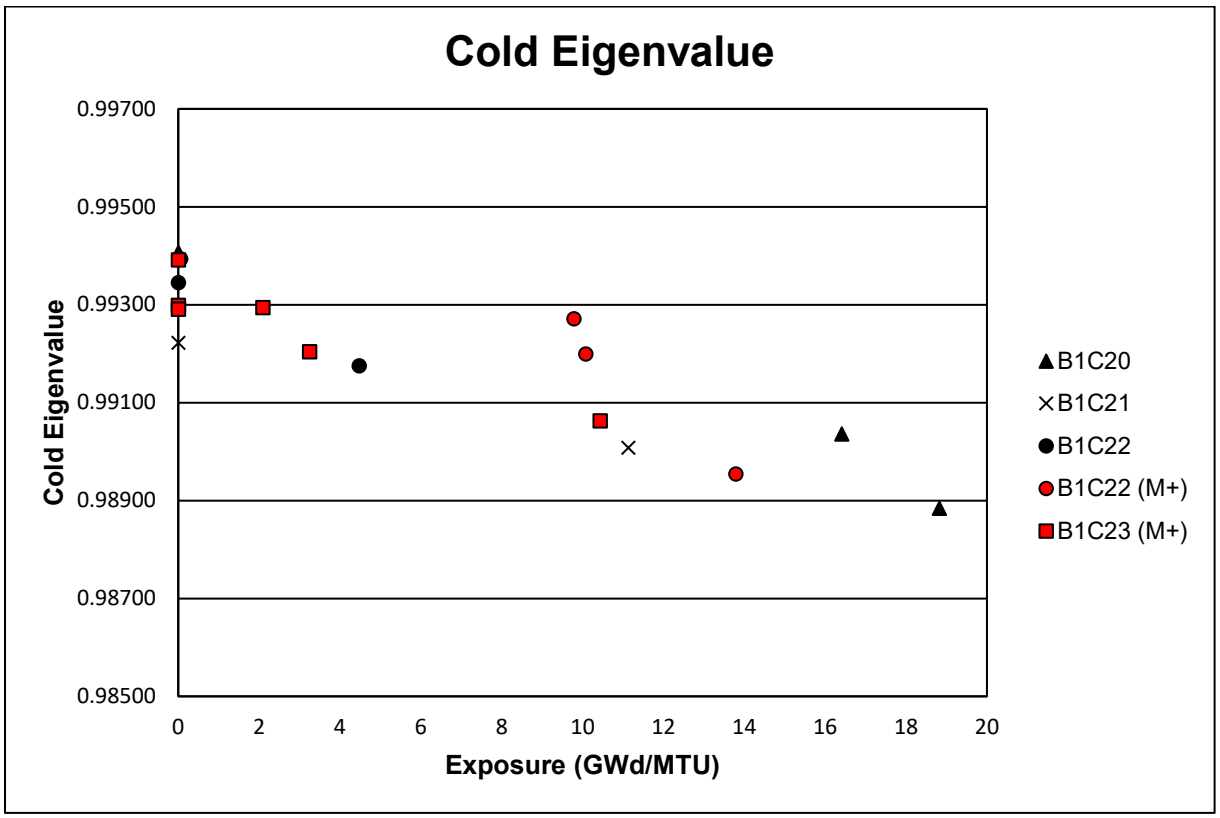
The results provided demonstrate the Methods performance in the MELLLA+ domain continues to meet expectations set by prior submittals and historical data at non-MELLLA+ conditions. Therefore, the intent of Limitation & Condition 23 has been satisfied. Similar data was provided for Unit 2 in Reference 4 and no further reporting is required.

4. References

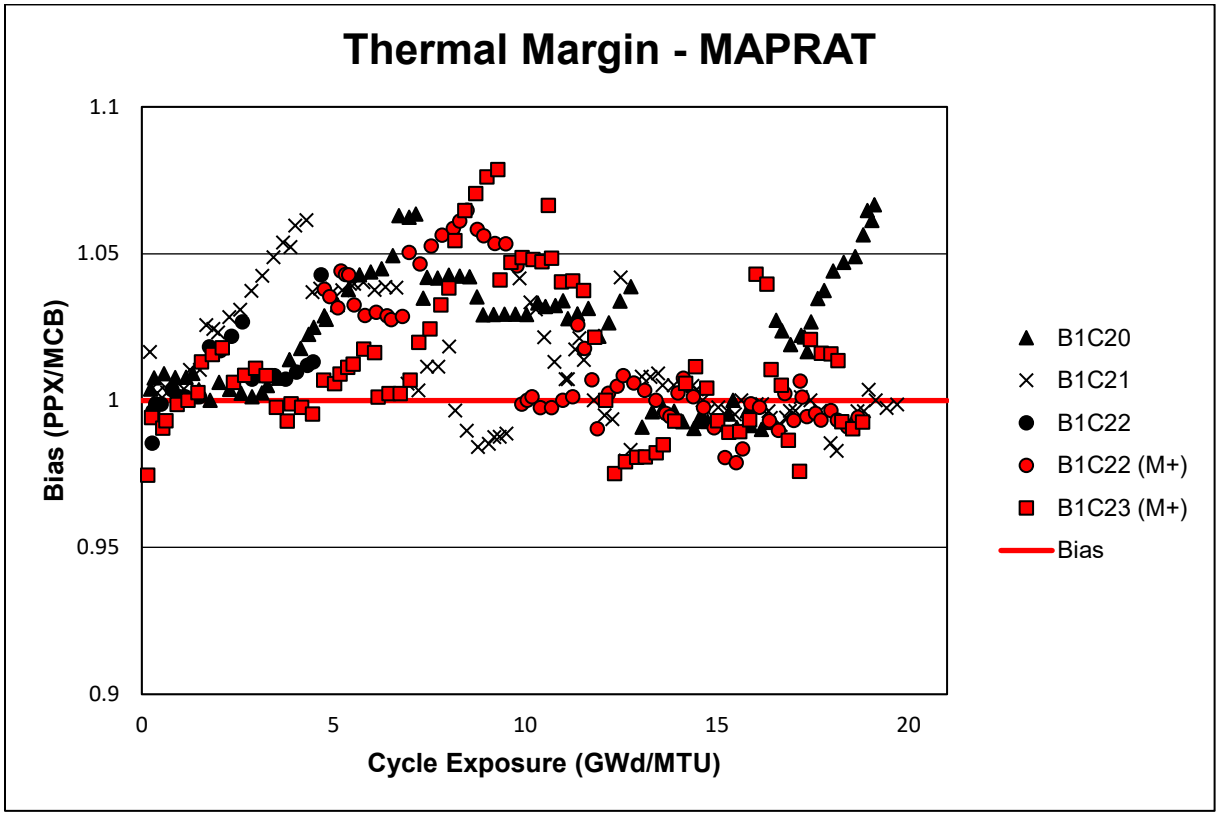
1. NEDC-33171P-A, Revision 4, "Applicability of GE Methods to Expanded Operating Domains," November 2012 (ADAMS Accession No. ML12313A107/ML12313A106 (Publicly Available/Non-publicly Available)).
2. Letter from the NRC, September 18, 2018, "Brunswick Steam Electric Plant, Units 1 and 2 – Issuance of Amendment Regarding Core Flow Operating Range Expansion (MELLLA+) (EPID L-2016-LA-0009)" (ADAMS Accession No. ML18172A258).
3. EMF-2158(P)(A), Revision 0, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2," October 1999.
4. Letter to the NRC, June 7, 2021, "Brunswick Steam Electric Plant, Unit No. 2 Renewed Facility Operating License No. DPR-62 Docket No. 50-324 Unit 2 Cycle 24 MELLLA+ Eigenvalue Tracking Data," (ADAMS Accession No. ML21158A056).

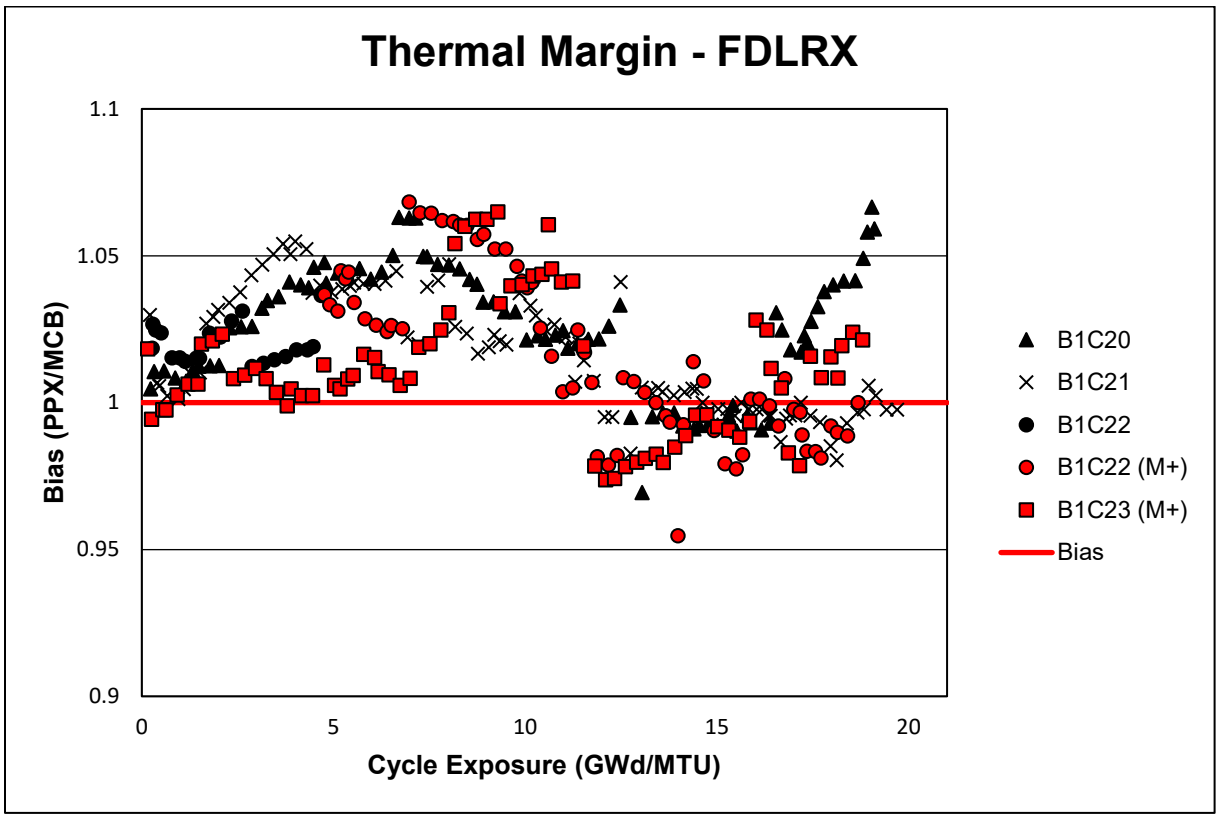
Hot and Cold Critical Eigenvalues

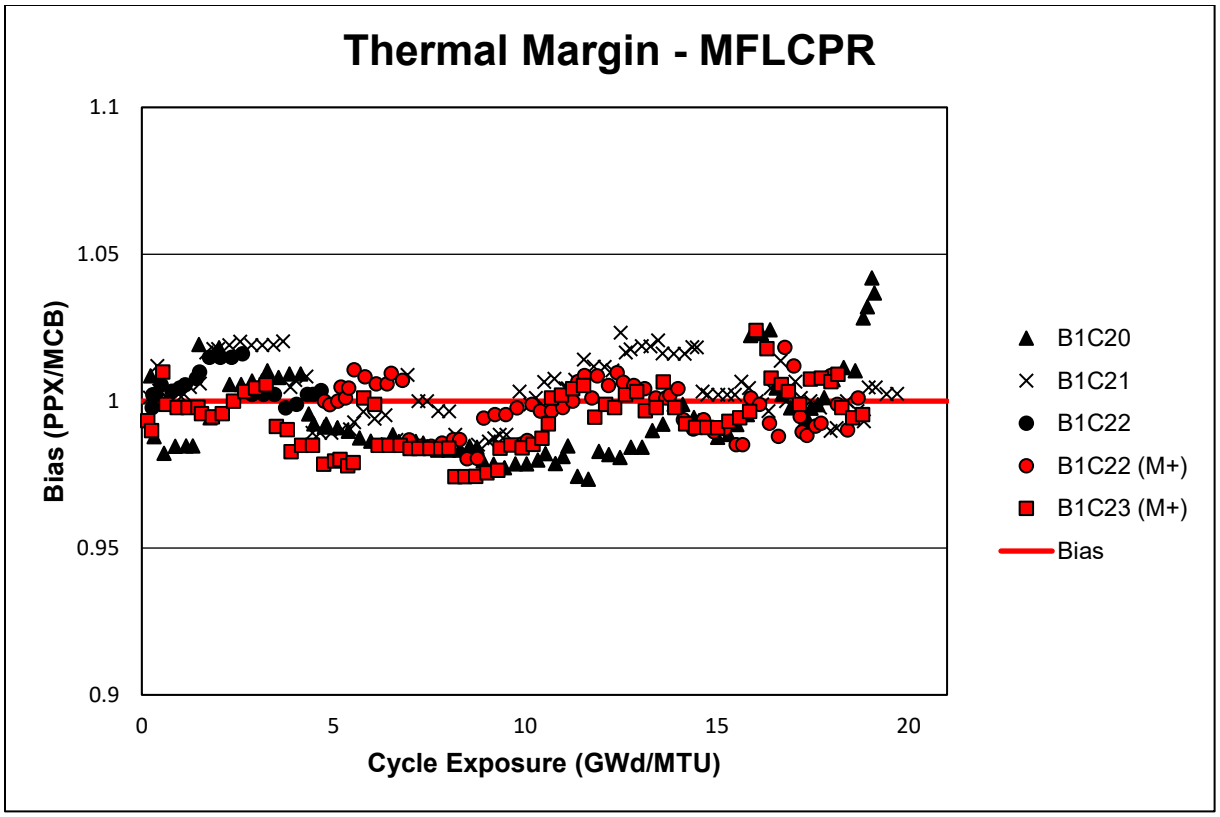




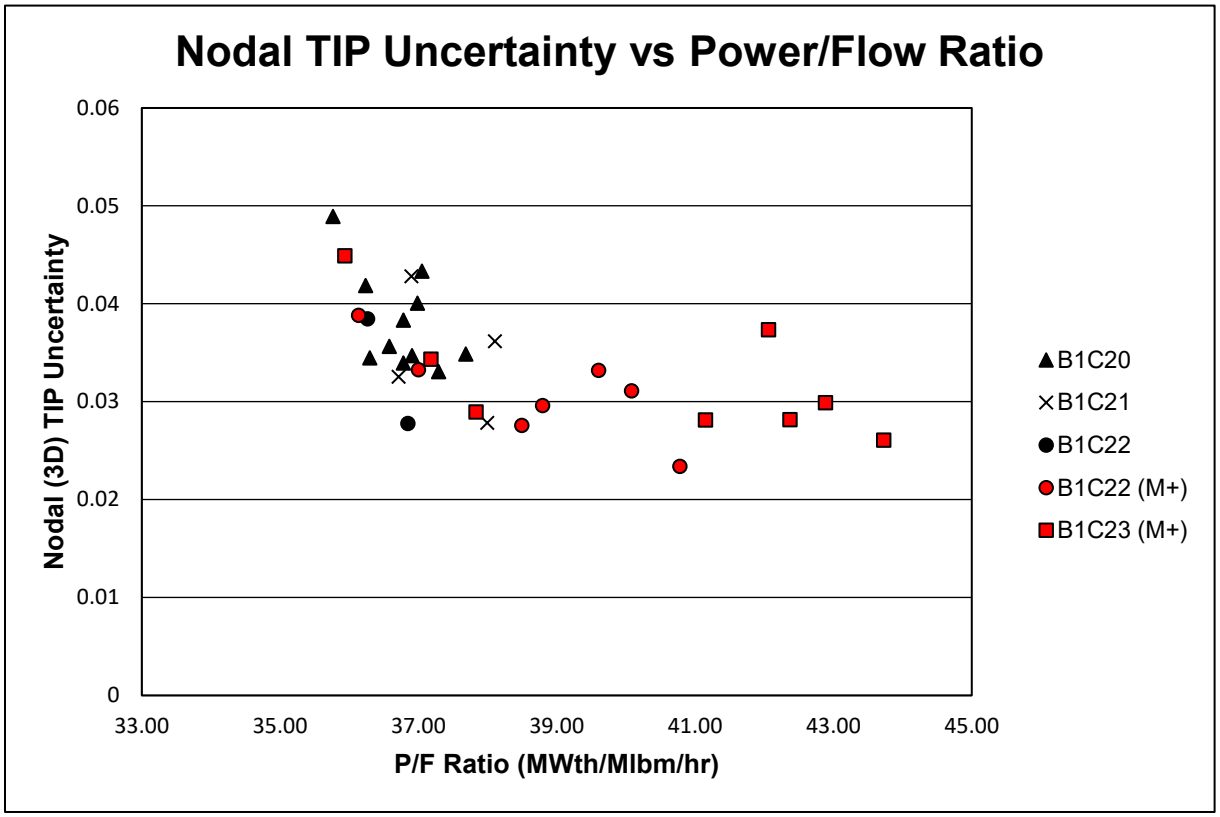
Thermal Margin

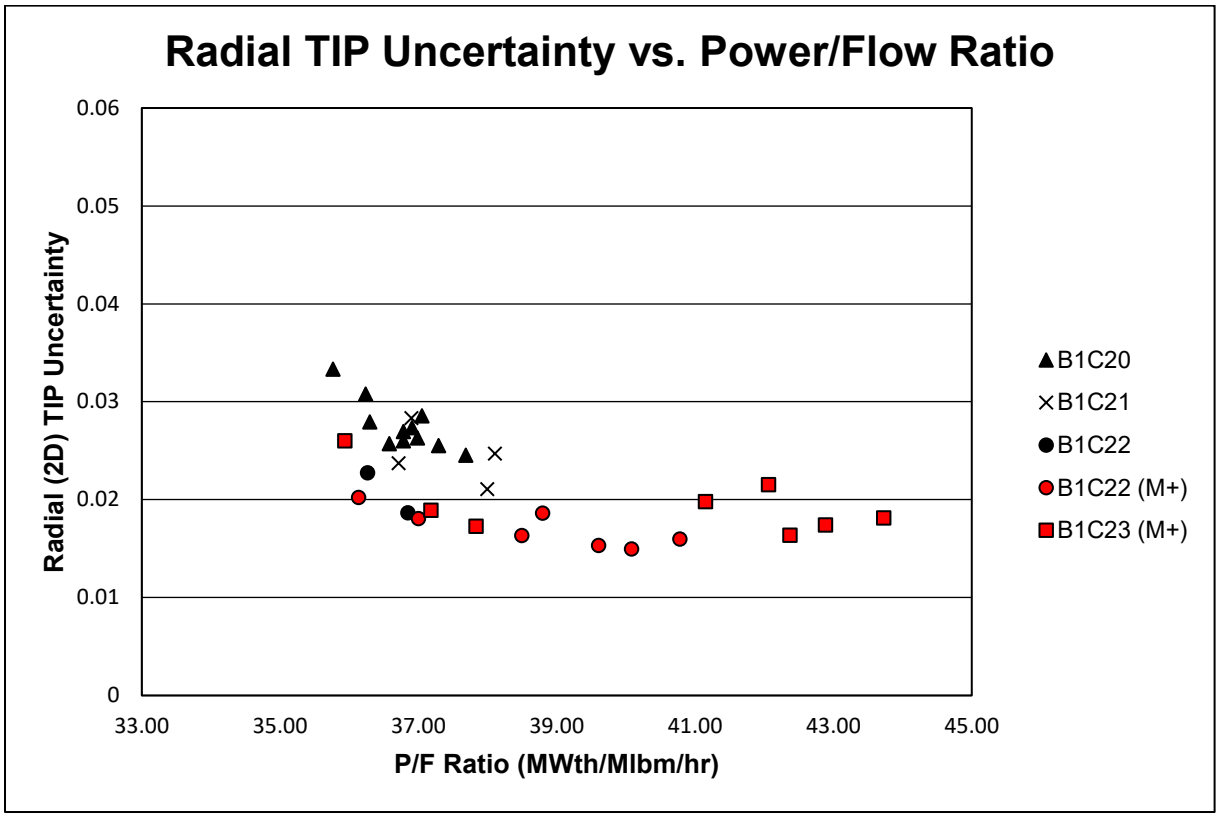


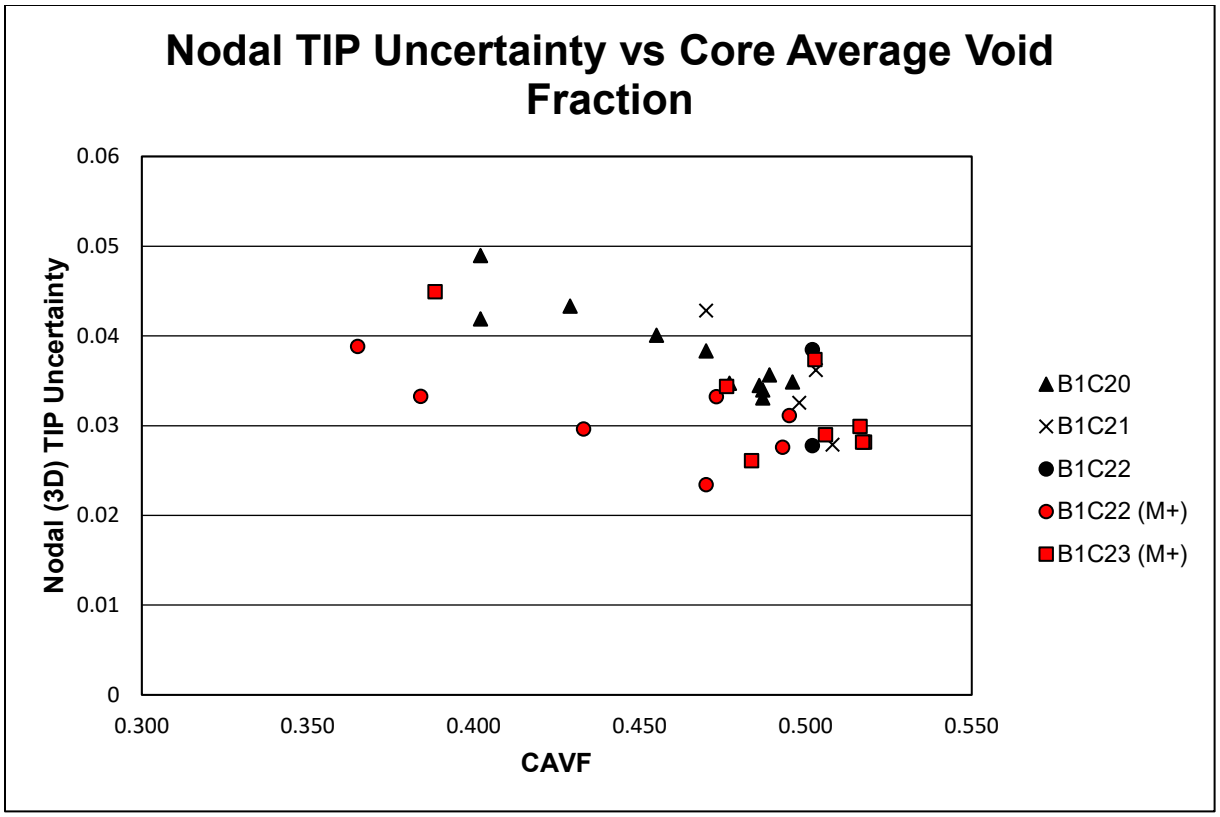


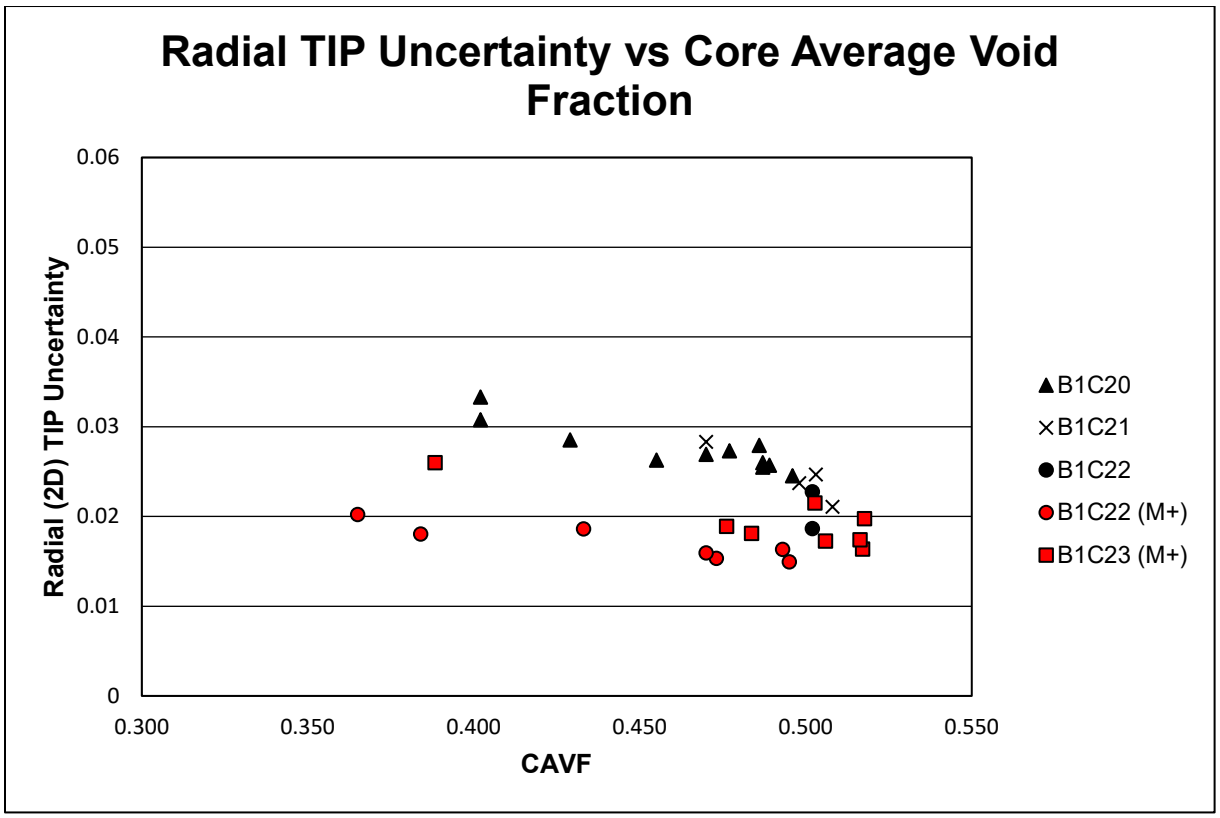

Thermal Margin - MFLCPR
Bias (PPX/MCB)
1.1
1.05
1
0.95
0.9
0
5
10
15
20
Cycle Exposure (GWd/MTU)
B1C20
B1C21
B1C22
B1C22 (M+)
B1C23 (M+)
Bias

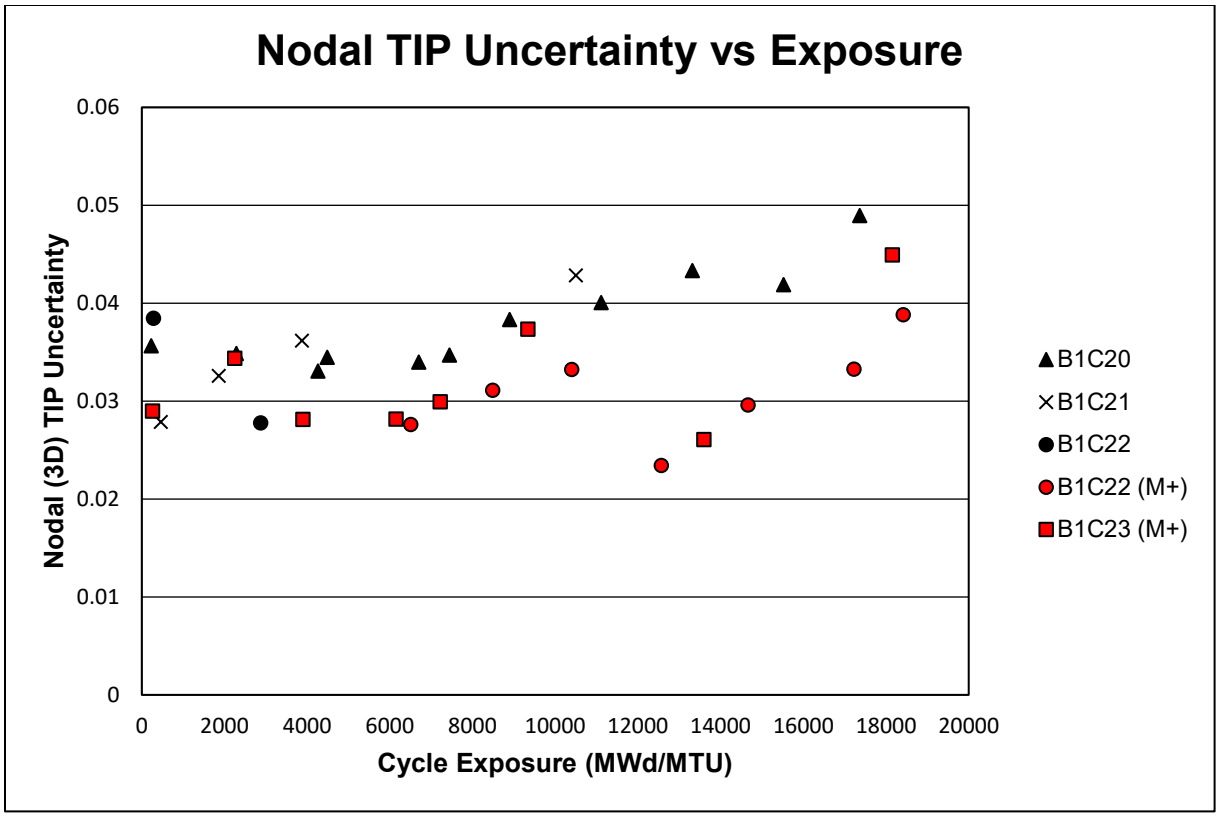
Nodal and Radial TIP Uncertainties

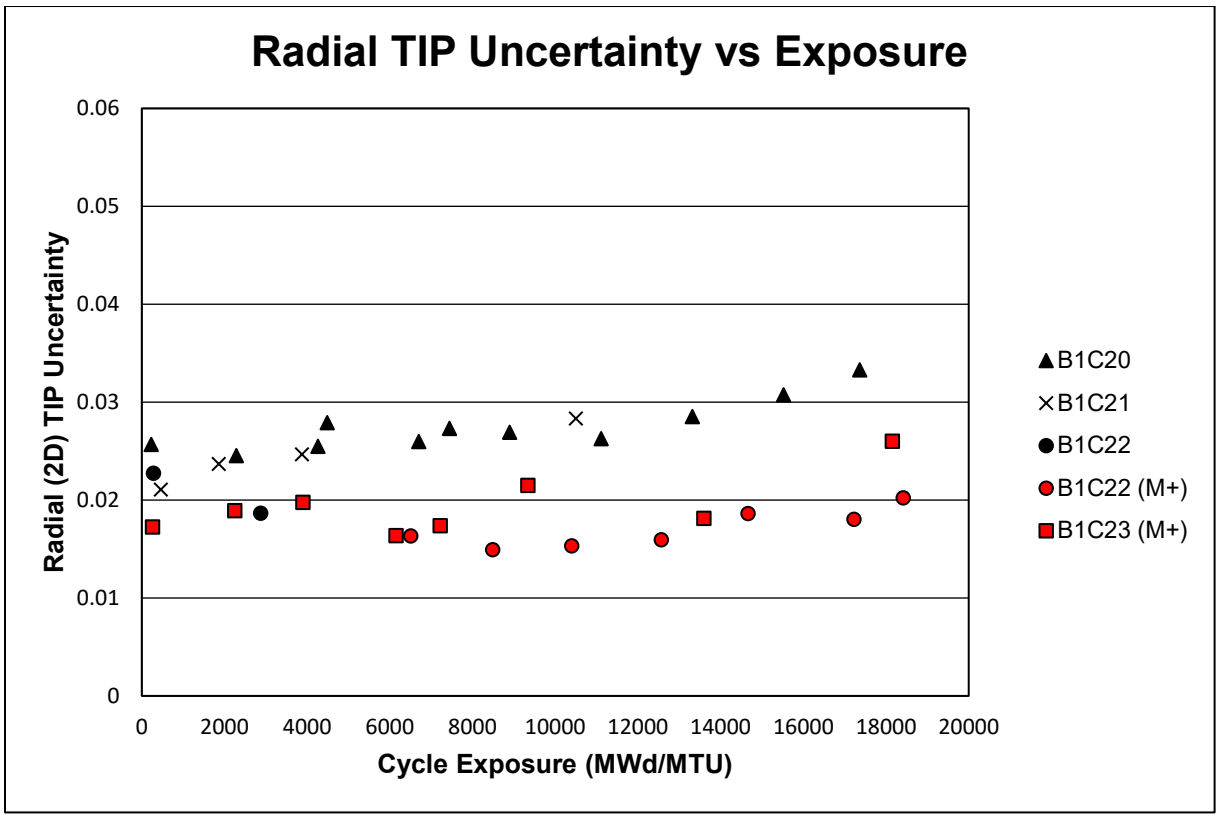





Nodal TIP Uncertainty vs Core Average Void Fraction
Nodal (3D) TIP Uncertainty
0.06
0.05
0.04
0.03
0.02
0.01
0
0.300
0.350
0.400
0.450
0.500
0.550
CAVF
B1C20
B1C21
B1C22
B1C22 (M+)
B1C23 (M+)


Radial TIP Uncertainty vs Core Average Void Fraction
Radial (2D) TIP Uncertainty
0.06
0.05
0.04
0.03
0.02
0.01
0
0.300
0.350
0.400
0.450
0.500
0.550
CAVF
B1C20
B1C21
B1C22
B1C22 (M+)
B1C23 (M+)


Nodal TIP Uncertainty vs Exposure
Nodal (3D) TIP Uncertainty
0.06
0.05
0.04
0.03
0.02
0.01
0
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Cycle Exposure (MWd/MTU)
B1C20
B1C21
B1C22
B1C22 (M+)
B1C23 (M+)


Radial TIP Uncertainty vs Exposure
Radial (2D) TIP Uncertainty
0.06
0.05
0.04
0.03
0.02
0.01
0
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Cycle Exposure (MWd/MTU)
B1C20
B1C21
B1C22
B1C22 (M+)
B1C23 (M+)

Core Flow and Pressure Drop Uncertainties