ATTACHMENT 3

Hope Creek Generating Station

Facility Operating License No. NPF-57
NRC Docket No. 50-354

Extended Power Uprate

GNF Hope Creek C15 SLMCPR - Non-Proprietary Letter

6/15/2007

GNF S-0000-0068-2643

GNF Additional Information Regarding the Requested Changes to the Technical Specification SLMCPR

Hope Creek (KT1) Cycle 15

Proprietary Information Notice

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1.0 Methodology

GNF performed the Hope Creek Cycle 15 Safety Limit Minimum Critical Power Ratio (SLMCPR) calculation in accordance to NEDE-24011-P-A "General Electric Standard Application for Reactor Fuel" (Revision 15) using the following NRC-approved methodologies and uncertainties:

- NEDC-32601P-A "Methodology and Uncertainties for Safety Limit MCPR Evaluations" (August 1999).
- NEDC-32694P-A "Power Distribution Uncertainties for Safety Limit MCPR Evaluations" (August 1999).
- NEDC-32505P-A "R-Factor Calculation Method for GE11, GE12 and GE13 Fuel" (Revision 1, July 1999).
- NEDO-10958-A "General Electric BWR Thermal Analysis Basis (GETAB): Data, Correlation and Design Application" (January 1977).

Table 2 identifies the actual methodologies used for the previous and current cycle SLMCPR calculations.

2.0 Discussion

In this discussion, the TLO nomenclature is used for two recirculation loops in operation, and the SLO nomenclature is used for one recirculation loop in operation. The "Previous Cycle" is Cycle 14, and the "Current Cycle" is Cycle 15.

2.1. Major Contributors to SLMCPR Change

In general, the calculated safety limit is dominated by two key parameters: (1) flatness of the core bundle-by-bundle MCPR distribution, and (2) flatness of the bundle pin-by-pin power/R-factor distribution. Greater flatness in either parameter yields more rods susceptible to boiling transition and thus a higher calculated SLMCPR. MIP (MCPR Importance Parameter) measures the core bundle-by-bundle MCPR distribution and RIP (R-factor Importance Parameter) measures the bundle pin-by-pin power/R-factor distribution. The impact of the fuel loading pattern on the calculated TLO SLMCPR using rated core power and rated core flow conditions has been correlated to the parameter MIPRIP, which combines the MIP and RIP values.

Table 3 presents the MIP and RIP parameters for the previous cycle and the current cycle along with the TLO SLMCPR estimate using the MIPRIP correlation. If the minimum core flow case is applicable, the TLO SLMCPR estimate is also provided for that case although the MIPRIP correlation is only applicable to the rated core flow case. This is done only to provide some reasonable assessment basis of the minimum core flow case trend. In addition, Table 3 presents

estimated impacts on the TLO SLMCPR due to methodology deviations, penalities, and/or uncertainties deviations from approved values. Based on the MIPRIP correlation and any impacts due to deviations from approved values, a final estimated TLO SLMCPR is determined. Table 3 also provides the actual calculated Monte Carlo SLMCPRs. Given the bias and uncertainty in the MIPRIP correlation [[{3}]] and the inherent variation in the Monte Carlo results [[{3}]], the change in the Hope Creek Cycle 15 calculated Monte Carlo TLO SLMCPR using rated core power and rated core flow conditions is consistent with the corresponding estimated TLO SLMCPR value.

2.2. Deviations in NRC-Approved Uncertainties

Tables 4 and 5 provide a list of NRC-approved uncertainties along with values actually used. A discussion of deviations from these NRC-approved values follows; all of which are conservative relative to NRC-approved values. Also, estimated impact on the SLMCPR is provided in Table 3 for each deviation.

2.2.1. R-Factor

At this time, GNF has generically increased the GEXL R-Factor uncertainty from [[{3}]] to account for an increase in channel bow due to the emerging unforeseen phenomena called control blade shadow corrosion-induced channel bow, which is not accounted for in the channel bow uncertainty component of the approved R-Factor uncertainty. The step "σ RPEAK" in Figure 4.1 from NEDC-32601P-A, which has been provided for convenience in Figure 3 of this attachment, is affected by this deviation. Reference 4 technically justifies that a GEXL R-Factor uncertainty of [[{3}]] accounts for a channel bow uncertainty of up to [[{3}]].

The Hope Creek Cycle 15 analysis has addressed the potential for shadow corrosion-induced channel bow by increasing the NRC-approved R-Factor uncertainty from [[{3}]] to [[{3}]]. Accounting for control blade shadow corrosion-induced channel bow, the Hope Creek Cycle 15 analysis shows an expected channel bow uncertainty of [[{3}]], which is bounded by a GEXL R-Factor uncertainty of [[{3}]]. Thus the use of a GEXL R-Factor uncertainty of [[{3}]] adequately accounts for control blade shadow corrosion-induced channel bow for Hope Creek Cycle 15 and subsequent cycles that exhibit channel bow uncertainty of [[{3}]].

2.2.2. Core Flow Rate and Random Effective TIP Reading

At this time, GNF has not been able to show that the NRC-approved process to calculate the SLMCPR only at the rated core power and rated core flow condition is adequately bounding relative to the SLMCPR calculated at rated core power and minimum core flow, see Reference 5. The minimum core flow condition can be more limiting due to the control rod pattern used. GNF has modified the NRC-approved process for determining the SLMCPR to include analyses at the rated core power and minimum licensed core flow point in addition to analyses at the rated core power and rated core flow point. GNF believes this modification is conservative and may in the future provide justification that the original NRC-approved process is adequately bounding.

For the TLO calculations performed at 94.8% core flow, the approved uncertainty values for the core flow rate (2.5%) and the random effective TIP reading (1.2%) are conservatively adjusted by dividing them by 94.8/100. The steps "σ CORE FLOW" and "σ TIP (INSTRUMENT)" in Figure 4.1 from NEDC-32601P-A, which has been provided for convenience in Figure 3 of this attachment) are affected by this deviation, respectively.

Historically, these values have been construed to be somewhat dependent on the core flow conditions as demonstrated by the fact that higher values have always been used when performing SLO calculations. It is for this reason that GNF determined that it is appropriate to consider an increase in these two uncertainties when the core flow is reduced. The amount of increase is determined in a conservative way. For both parameters it is assumed that the absolute uncertainty remains the same as the flow is decreased so that the percentage uncertainty increases inversely proportional to the change in core flow. This is conservative relative to the core flow uncertainty since the variability in the absolute flow is expected to decrease somewhat as the flow decreases. For the random effective TIP uncertainty, there is no reason to believe that the percentage uncertainty should increase as the core flow decreases for TLO. Nevertheless, this uncertainty is also increased as is done in the more extreme case for SLO primarily to preserve the historical precedent established by the SLO evaluation. Note that the TLO condition is different than the SLO condition because for TLO there is no expected tilting of the core radial power shape.

The treatment of the core flow and random effective TIP reading uncertainties is based on the assumption that the signal to noise ratio deteriorates as core flow is reduced. GNF believes this is conservative and may in the future provide justification that the original uncertainties (non-flow dependent) are adequately bounding.

The core flow and random TIP reading uncertainties used in the SLO minimum core flow SLMCPR analysis remain the same as in the rated core flow SLO SLMCPR analysis because these uncertainties (which are substantially larger than used in the TLO analysis) already account for the effects of operating at reduced core flow.

2.2.3. Reactor Pressure Measurement

The input for reactor pressure measurement uncertainty was changed from [[{3}]] to [[{3}]]. Hope Creek supplied this conservative value to be used in the GNF SLMCPR analysis.

2.3. Departure from NRC-Approved Methodology

No departures from NRC-approved methodologies were used in the Hope Creek Cycle 15 SLMCPR calculations.

NRC-approved methodologies or methodologies that produce a conservative result (less margin to acceptance limits) were used in the Hope Creek Cycle 15 SLMCPR calculations.

2.4. Fuel Axial Power Shape Penalty

At this time, GNF has determined that higher uncertainties and non-conservative biases in the GEXL correlations for the various types of axial power shapes (i.e., inlet, cosine, outlet and double hump) could potentially exist relative to the NRC-approved methodology values, see References 3, 6, and 7. The following table identifies, by marking with an "X", this potential for each GNF product line currently being offered:

[[

{3}]]

Axial bundle power shapes corresponding to the limiting SLMCPR control blade patterns are determined using the PANACEA 3D core simulator. These axial power shapes are classified in accordance to the following table:

[[

{3}]]

If the limiting bundles in the SLMCPR calculation exhibit an axial power shape identified by this table, GNF penalizes the GEXL critical power uncertainties to conservatively account for the impact of the axial power shape. Table 6 provides a list of the GEXL critical power uncertainties determined in accordance to the NRC-approved methodology contained in NEDE-24011-P-A along with values actually used.

For the limiting bundles, the fuel axial power shapes in the SLMCPR analysis were examined to determine the presence of axial power shapes identified in the above table. These power shapes were not found; therefore, no power shape penalties were applied to the calculated Hope Creek Cycle 15 SLMCPR values.

2.5. Methodology Restrictions

The four restrictions identified on Page 3 of NRC's Safety Evaluation relating to the General Electric Licensing Topical Reports NEDC-32601P, NEDC-32694P, and Amendment 25 to NEDE-24011-P-A (March 11, 1999) are addressed in References 1, 2, and 3.

No new GNF fuel designs are being introduced in Hope Creek Cycle 15; therefore, the NEDC-32505-P-A statement "...if new fuel is introducted, GENE must confirm that the revised R-Factor method is still valid based on new test data" is not applicable.

2.6. Minimum Core Flow Condition

For Hope Creek Cycle 15 the minimum core flow SLMCPR calculation performed at 94.8% core flow at rated core power condition was not limiting as compared to the rated core flow at rated core power condition.

2.7. Limiting Control Rod Patterns

The limiting control rod patterns used to calculate the SLMCPR reasonably assures that at least 99.9% of the fuel rods in the core would not be expected to experience boiling transition during normal operation or anticipated operational occurrences during the operation of Hope Creek Cycle 15.

2.8. Core Monitoring System

For Hope Creek Cycle 15, the 3DMONICORE system will be used as the core monitoring system.

2.9. Power/Flow Map

The utility has provided the current and previous cycle power/flow map in a separate attachment.

2.10. Core Loading Diagram

Figures 1 and 2 provide the core loading diagram for the current and previous cycle respectively, which are the Reference Loading Pattern as defined by NEDE-24011-P-A. Table 1 provides a description of the core.

2.11. Figure References

Figure 3 is Figure 4.1 from NEDC-32601-P-A. Figure 4 is Figure III.5-1 from NEDC-32601P-A. Figure 5 is Figure III.5-2 from NEDC-32601P-A.

2.12. Additional SLMCPR Licensing Conditions

Hope Creek has submitted a licensing amendment to increase rated power from 3339 MWt to 3840 MWt, which is reflected in the attached power/flow map. This uprate licensing amendment is currently being reviewed by the NRC with anticipation of approval before Hope Creek Cycle 15 starts up. Recent NRC communications for such uprates have suggested that an 0.02 adder to the SLMCPR will be a licensing condition. In anticipation that this licensing condition will be imposed on the Hope Creek uprate amendment, the SLMCPR has been established by adding 0.02 to the cycle-specific SLMCPR value calculated using the NRC-approved methodologies documented in NEDE-24011-P-A (see Table 3).

2.13. Summary

The requested changes to the Technical Specification SLMCPR values are 1.08 for TLO and 1.10 for SLO for Hope Creek Cycle 15.

3.0 References

1. Letter, Glen A. Watford (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to R. Pulsifer (NRC), "Confirmation of 10x10 Fuel Design Applicability to Improved SLMCPR, Power Distribution and R-Factor Methodologies", FLN-2001-016, September 24, 2001.

2. Letter, Glen A. Watford (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to J. Donoghue (NRC), "Confirmation of the Applicability of the GEXL14 Correlation and Associated R-Factor Methodology for Calculating SLMCPR Values in Cores Containing GE14 Fuel", FLN-2001-017, October 1, 2001.

3. Letter, Glen A. Watford (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to Joseph E. Donoghue (NRC), "Final Presentation Material for GEXL Presentation – February 11, 2002", FLN-2002-004, February 12, 2002.

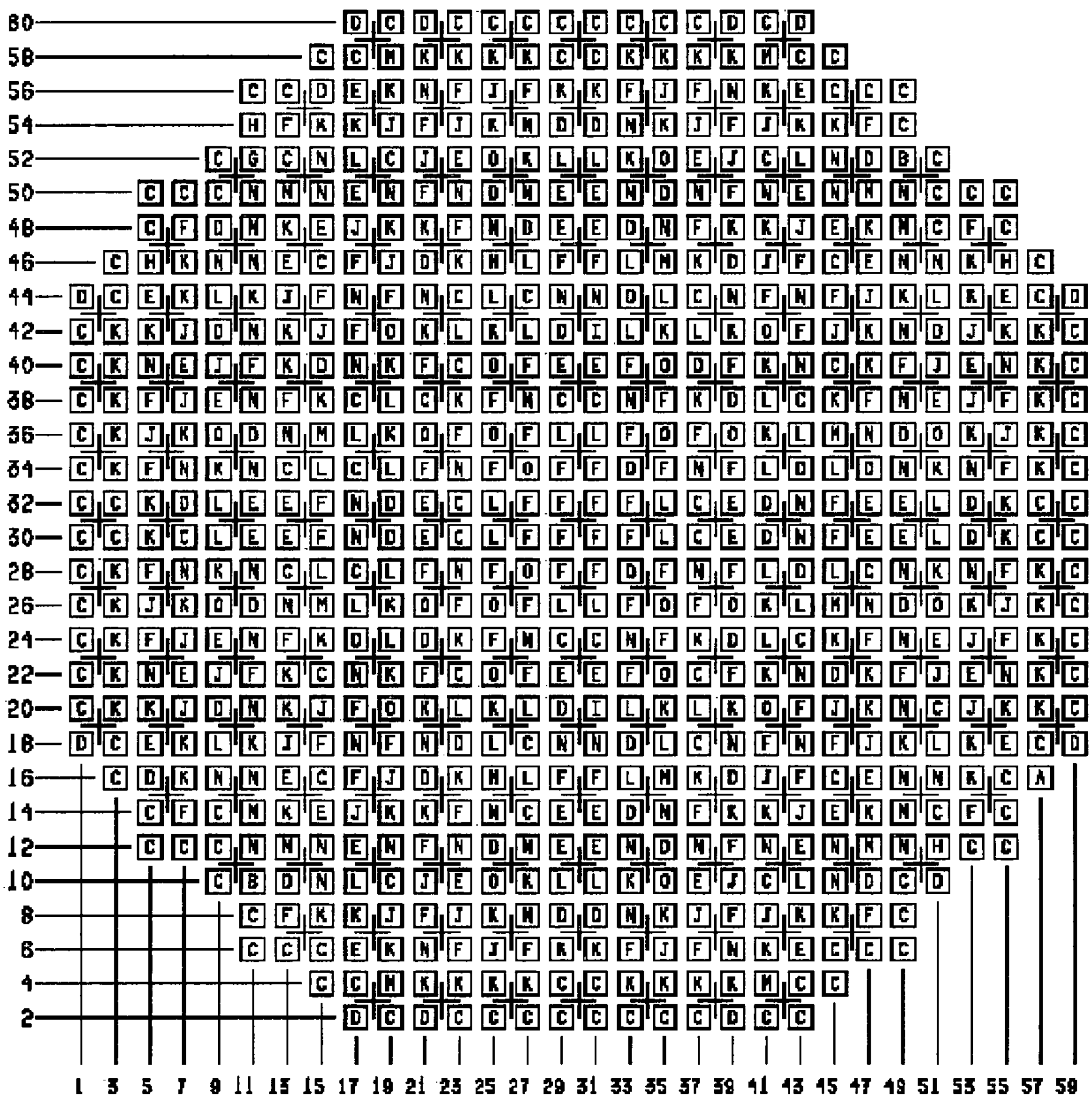
4. Letter, John F. Schardt (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to Mel B. Fields (NRC), "Shadow Corrosion Effects on SLMCPR Channel Bow Uncertainty", FLN-2004-030, November 10, 2004.

5. Letter, Jason S. Post (GENE) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to Chief, Information Management Branch, et al. (NRC), "Part 21 Final Report: Non-Conservative SLMCPR", MFN 04-108, September 29, 2004.

6. Letter, Glen A. Watford (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to Alan Wang (NRC), "NRC Technology Update – Proprietary Slides – July 31 – August 1, 2002", FLN-2002-015, October 31, 2002.

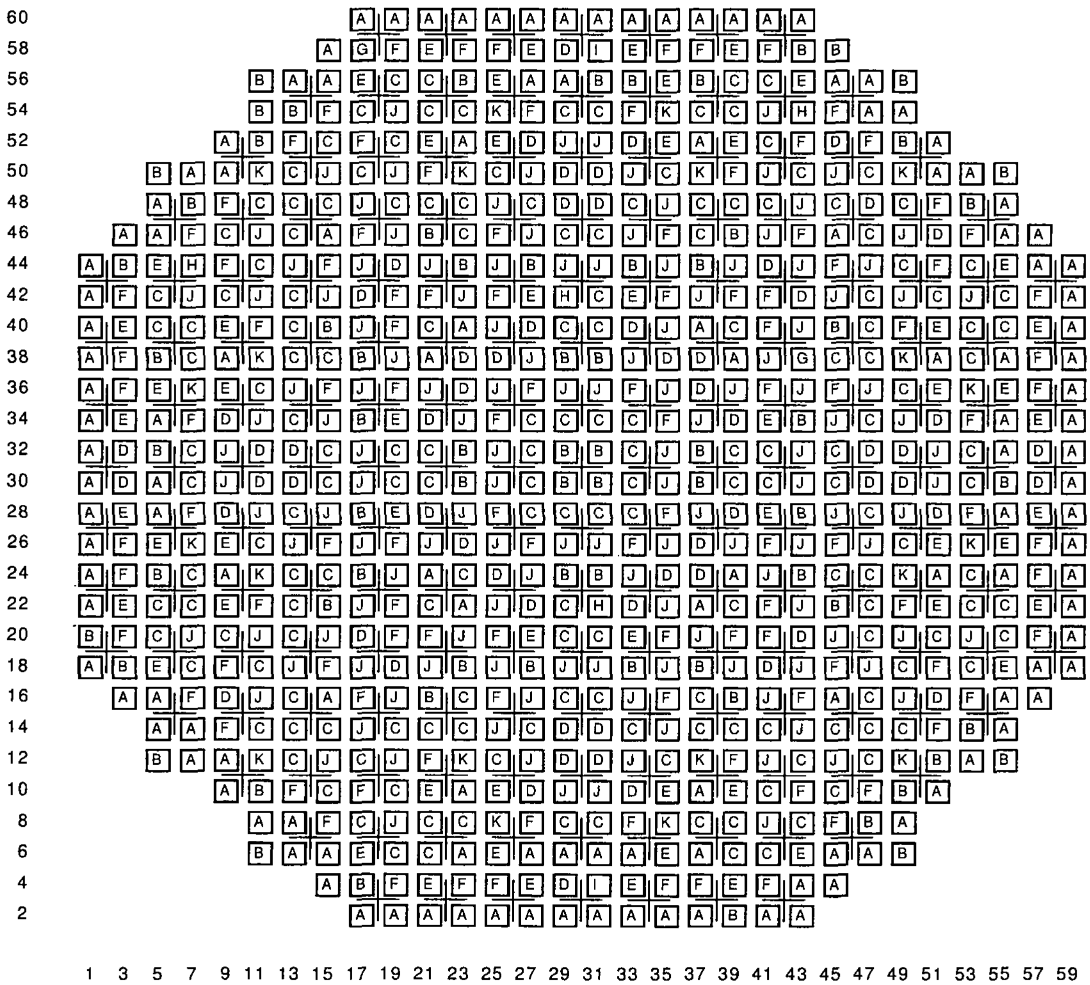
7. Letter, Jens G. Munthe Andersen (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with attention to Alan Wang (NRC), "GEXL Correlation for 10X10 Fuel", FLN-2003-005, May 31, 2003.

Figure 1. Current Cycle Core Loading Diagram



Fuel Type	
A=SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656	I= same as D
B=SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657	J=GE14-P10CNAB396-17GZ-100T-150-T6-3007
C=SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658	K=GE14-P10CNAB393-18G4.0-100T-150-T6-2885
D=SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659	L=GE14-P10CNAB405-15GZ-100T-150-T6-3009
E=GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757	M=GE14-P10CNAB393-18GZ-100T-150-T6-2884
F=GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758	N=GE14-P10CNAB398-17GZ-100T-150-T6-3008
G=SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657	O=GE14-P10CNAB400-14GZ-100T-150-T6-3006
H=SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658	

Figure 2. Previous Cycle Core Loading Diagram



Fuel Type	
A=SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656 (Cycle 11) B=SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657 (Cycle 11) C=SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658 (Cycle 12) D=SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659 (C12) E=GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757 (Cycle 13) F=GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758 (Cycle 13) G=SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657 (Cycle 11) H=SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658 (Cycle 12)	I=SVEA96-P10CASB360-12G5.5/2G2.5-568U -4WR-150-T6-2659 (Cycle 12) J=GE14-P10CNAB393-18G4.0-100T-150-T6-2885(Cycle 14) K=GE14-P10CNAB393-18GZ-100T-150-T6-2884 (Cycle 14)

Figure 3. Figure 4.1 from NEDC-32601-P-A

[[{3}]]

Figure 4. Figure III.5-1 from NEDC-32601P-A

[[{3}]]

Figure 5. Figure III.5-2 from NEDC-32601P-A

[[{3}]]

Table 1. Description of Core

Description	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case
Number of Bundles in the Core	764	764	764	764
Limiting Cycle Exposure Point (i.e. BOC/MOC/EOC)	BOC	BOC	EOC	EOC
Cycle Exposure at Limiting Point (MWd/STU)	200	200	11000	11000
% Rated Core Flow	76.6*	100	94.8*	100
Reload Fuel Type	GE14	GE14	GE14	GE14
Latest Reload Batch Fraction, %	20.4	20.4	29.8	29.8
Latest Reload Average Batch Weight % Enrichment	3.93	3.93	4.00	4.00
Core Fuel Fraction, %: GE14 SVEA96	 41.9 58.1	 41.9 58.1	 71.7 28.3	 71.7 28.3
Core Average Weight % Enrichment	3.76	3.76	3.88	3.88

* Refer to the Power/Flow map for lowest flow at rated power.

Table 2. SLMCPR Calculation Methodologies

Description	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case
Non-power Distribution Uncertainty	NEDC-32601P-A	NEDC-32601P-A	NEDC-32601P-A	NEDC-32601P-A
Power Distribution Methodology	NEDC-32694P-A	NEDC-32694P-A	NEDC-32694P-A	NEDC-32694P-A
Power Distribution Uncertainty	NEDC-32694P-A	NEDC-32694P-A	NEDC-32694P-A	NEDC-32694P-A
Core Monitoring System	3DMONICORE	3DMONICORE	3DMONICORE	3DMONICORE

Table 3. Monte Carlo Calculated SLMCPR vs. Estimate

[[

Description	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case

[3]]]

Table 4. Non-Power Distribution Uncertainties

	Nominal (NRC-Approved) Value ± σ (%)	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case
GETAB					
Feedwater Flow Measurement	1.76	N/A	N/A	N/A	N/A
Feedwater Temperature Measurement	0.76	N/A	N/A	N/A	N/A
Reactor Pressure Measurement	0.50	N/A	N/A	N/A	N/A
Core Inlet Temperature Measurement	0.20	N/A	N/A	N/A	N/A
Total Core Flow Measurement	6.0 SLO/2.5 TLO	N/A	N/A	N/A	N/A
Channel Flow Area Variation	3.0	N/A	N/A	N/A	N/A
Friction Factor Multiplier	10.0	N/A	N/A	N/A	N/A
Channel Friction Factor Multiplier	5.0	N/A	N/A	N/A	N/A

Table 4. Non-Power Distribution Uncertainties

	Nominal (NRC-Approved) Value ± σ (%)	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case
NEDC-32601-P-A					
Feedwater Flow Measurement	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Feedwater Temperature Measurement	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Reactor Pressure Measurement	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Core Inlet Temperature Measurement	0.2	0.2	0.2	0.2	0.2
Total Core Flow Measurement	2.50 (TLO) 6.00 (SLO)	2.50 (TLO) 6.00 (SLO)	2.50 (TLO) 6.00 (SLO)	2.50 (TLO) 6.00 (SLO)	2.50 (TLO) 6.00 (SLO)
Channel Flow Area Variation	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Friction Factor Multiplier	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Channel Friction Factor Multiplier	5.0	5.0	5.0	5.0	5.0

Table 5. Power Distribution Uncertainties

Description	Nominal (NRC-Approved) Value ± σ (%)	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case
GETAB/NEDC-32601-P-A					
GEXL R-Factor	[[{3}]]	N/A	N/A	N/A	N/A
Random Effective TIP Reading	2.85 SLO/1.2 TLO	N/A	N/A	N/A	N/A
Systematic Effective TIP Reading	8.6	N/A	N/A	N/A	N/A
NEDC-32694-P-A, 3DMONICORE					
GEXL R-Factor	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Random Effective TIP Reading	2.85 SLO/1.2 TLO	2.85 SLO/1.2 TLO	2.85 SLO/1.2 TLO	2.85 SLO/1.2 TLO	2.85 SLO/1.2 TLO
TIP Integral	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Four Bundle Power Distribution Surrounding TIP Location	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Contribution to Bundle Power Uncertainty Due to LPRM Update	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]

Table 5. Power Distribution Uncertainties

Description	Nominal (NRC-Approved) Value ± σ (%)	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case
Contribution to Bundle Power Due to Failed TIP	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Contribution to Bundle Power Due to Failed LPRM	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Total Uncertainty in Calculated Bundle Power	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]
Uncertainty of TIP Signal Nodal Uncertainty	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]	[[{3}]]

Table 6. Critical Power Uncertainties

[[

Description	Nominal Value ± σ (%)	Previous Cycle Minimum Core Flow Limiting Case	Previous Cycle Rated Core Flow Limiting Case	Current Cycle Minimum Core Flow Limiting Case	Current Cycle Rated Core Flow Limiting Case

{3}]]