PSEG Nuclear LLC
P.O. Box 236, Hancocks Bridge, New Jersey 08038-0236

PSEG
Nuclear LLC

DEC 0 2 2004
LR-N04-0524
LCR H04-03

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUPPLEMENT TO REQUEST FOR CHANGE TO TECHNICAL SPECIFICATIONS
SAFETY LIMIT MINIMUM CRITICAL POWER RATIO
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

Reference:
1. LR-N04-0183, "Request for Change to Technical Specifications: Safety Limit Minimum Critical Power Ratio," dated April 27, 2004.
2. GE Nuclear Energy letter MFN-04-081, "Part 21 Reportable Condition and 60-Day Interim Report Notification: Non-conservative SLMCPR," dated August 24, 2004.
3. LR-N04-0375, "Response to Request for Additional Information: Request for Change to Technical Specifications: Safety Limit Minimum Critical Power Ratio," dated September 9, 2004

This letter provides updated information regarding the Safety Limit Critical Power Ratio (SLMCPR) evaluation for Hope Creek Cycle 13. In accordance with 10CFR50.91(b)(1), a copy of this submittal has been sent to the State of New Jersey.

By the Reference 1 letter, PSEG Nuclear LLC (PSEG) requested a revision to the Technical Specifications (TS) for the Hope Creek Generating Station to revise the Safety Limit Minimum Critical Power Ratio (SLMCPR) values for two recirculation loop and one recirculation loop operation. The proposed SLMCPR values were based on evaluations performed by Global Nuclear Fuel (GNF) using NRC approved methodology and uncertainties. Recent changes to the reference loading pattern for Hope Creek Cycle 13 made it necessary to reperform the cycle specific SLMCPR evaluation. The previous reference loading pattern described in the Reference 1 letter was revised to account for the earlier than planned shutdown at the end of Cycle 12. The reference

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This letter forwards proprietary information in accordance with 10CFR 2.390. The balance of this letter may be considered non-proprietary upon removal of Attachments 1 and 3.

loading pattern was also revised to accommodate the removal of two fuel defects that were confirmed during core offload.

By the Reference 2 letter, GNF and GE Nuclear Energy (GENE) notified the NRC that the current GNF process for determination of the SLMCPR can result in a non-conservative value. Limiting control rod patterns for rated power/lower flow conditions can produce a more limiting SLMCPR value than the rated power/rated flow condition.

Attachment 1 to this letter provides a summary of the relevant input parameters and results of the SLMCPR evaluations for the revised reference loading pattern for Cycle 13. Attachment 1 replaces Attachment 3 in the Reference 1 letter. In addition to the rated power/rated flow evaluation point, an SLMCPR calculation was performed at a reduced flow condition. The SLMCPR results at the reduced flow condition are equivalent to or bound the SLMCPR results for the minimum flow point for rated power conditions in the current licensed operating domain. PSEG is not seeking NRC approval for a change in the operating domain as part of this License Change Request.

There are no changes to the proposed Technical Specifications provided in the Reference 1 letter resulting from the revised SLMCPR evaluations. PSEG has determined that the information contained in this letter does not alter the conclusions reached in the 10CFR50.92 no significant hazards analysis previously submitted.

Attachment 1 contains information that GNF considers to be proprietary. GNF requests that the proprietary information in Attachment 1 be withheld from public disclosure in accordance with 10 CFR 2.390. An affidavit in support of this request is included with Attachment 1. A non-proprietary version of the GNF document is provided in Attachment 2, which replaces Attachment 4 in the Reference 1 letter.

The Reference 3 letter provided additional information in response to requests from the NRC staff. In Attachment 3 to this letter, PSEG is updating the response to Request for Additional Information (RAI) No. 3 to describe the effects of the changes in core design and core flow rate on expected SLMCPR values. The updated response to RAI No. 3 also provides the quantitative basis for concluding that the SLMCPR results at the reduced flow condition are equivalent to or bound the SLMCPR results for the minimum flow point for rated power conditions in the current licensed operating domain. The responses to RAI Nos. 1, 2, 4 and 5 are not changed, but are repeated in Attachment 3 for convenience.

Attachment 3 contains information that GNF considers to be proprietary. GNF requests that the proprietary information in Attachment 3 be withheld from public disclosure in accordance with 10 CFR 2.390. An affidavit in support of this request is included with Attachment 3. A non-proprietary version is provided in Attachment 4.

PSEG requests approval of the proposed License Amendment by December 17, 2004 to permit sufficient time for implementation before restart from the current refueling outage.

If you have any questions or require additional information, please contact Mr. Paul Duke at (856) 339-1466.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 12/2/2004
(date)

Michael H. Brothers
Vice President - Site Operations

Attachments (4)

This letter forwards proprietary information in accordance with 10CFR 2.390. The balance of this letter may be considered non-proprietary upon removal of Attachments 1 and 3.

C: Mr. S. Collins, Administrator – Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. D. Collins, Project Manager - Salem & Hope Creek
U. S. Nuclear Regulatory Commission
Mail Stop 08C2
Washington, DC 20555

USNRC Senior Resident Inspector – Hope Creek (X24)

Mr. K. Tosch, Manager IV (without Attachments 1 and 3)
Bureau of Nuclear Engineering
PO Box 415
Trenton, New Jersey 08625

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

Additional Information Regarding the Cycle Specific SLMCPR for Hope Creek Cycle 13 (Non-proprietary version)

Additional Information Regarding the Cycle Specific SLMCPR for Hope Creek Cycle 13 22 November 2004

Proprietary Information Notice

This document is the GNF non-proprietary version of the GNF proprietary report. From the GNF proprietary version, the information denoted as GNF proprietary (enclosed in double brackets) was deleted to generate this version.

References

[1] Letter, Frank Akstulewicz (NRC) to Glen A. Watford (GE), "Acceptance for Referencing of Licensing Topical Reports NEDC-32601P, Methodology and Uncertainties for Safety Limit MCPR Evaluations; NEDC-32694P, Power Distribution Uncertainties for Safety Limit MCPR Evaluation; and Amendment 25 to NEDE-24011-P-A on Cycle Specific Safety Limit MCPR," (TAC Nos. M97490, M99069 and M97491), March 11, 1999.

[2] Letter, Thomas H. Essig (NRC) to Glen A. Watford (GE), "Acceptance for Referencing of Licensing Topical Report NEDC-32505P, Revision 1, R-Factor Calculation Method for GE11, GE12 and GE13 Fuel," (TAC Nos. M99070 and M95081), January 11, 1999.

[3] General Electric BWR Thermal Analysis Basis (GETAB): Data, Correlation and Design Application, NEDO-10958-A, January 1977.

[4] 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.

[5] 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

[6] Letter, Jason S. Post (GE Energy) to U.S. Nuclear Regulatory Commission Document Control Desk, "Part 21 Reportable Condition and 60-Day Interim Report Notification: Non-conservative SLMCPR", MFN-04-081, August 24, 2004.

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

[8] GEXL80 Correlation for SVEA96+ Fuel, NEDC-33107P Revision 0, Class III, September 2003.

[9] "Additional Information Regarding the Cycle Specific SLMCPR for Hope Creek Cycle 13", 19 April 2004.

Additional Information Regarding the Cycle Specific SLMCPR for Hope Creek Cycle 13

22 November 2004

Discussion

The Safety Limit Minimum Critical Power Ratio (SLMCPR) evaluations for the Hope Creek Cycle 13 were performed using NRC approved methodology and uncertainties [1]. Table 1 summarizes the relevant input parameters and results for Cycle 13. Additional information is provided in response to NRC questions related to similar submittals regarding changes in Technical Specification values of SLMCPR. NRC questions pertaining to how GE14 applications satisfy the conditions of the NRC SER[1] have been addressed in Reference [4]. Other generically applicable questions related to application of the GEXL14 correlation, and to the applicable range for the R-factor methodology, are addressed in Reference [5]. Items that require a plant/cycle specific response are presented below.

Previously, the SLMCPR was calculated on the upper boundary of the power/flow operating map only at 100% flow / 100% power (rated flow/rated power) with limiting control blade patterns developed at the rated flow/rated power point. This approach had been shown in NEDC-32601P-A to result in conservative SLMCPR evaluation values. As reported in Reference [6], recent SLMCPR evaluations performed by GNF have shown that limiting control blade patterns developed for less than rated flow at the rated power condition sometimes yield more limiting bundle-by-bundle MCPR distributions and/or more limiting bundle axial power shapes than the limiting control blade patterns developed at the rated flow/rated power evaluation point. Consequently, in addition to the rated flow/rated power evaluation point, an SLMCPR calculation has been performed for Hope Creek at a lower flow/rated power evaluation point. The current Hope Creek licensing basis minimum allowable core flow at rated power is 87% rated flow. However, to account for future operation at lower flow/rated power conditions, SLMCPR evaluations were performed at a reduced core flow rate of 76.6% rated flow at the rated power condition for the same exposure points that were previously calculated for the rated flow/rated power evaluations. The SLMCPR results for Hope Creek Cycle 13 at the 76.6% rated flow condition are equivalent to or bound the SLMCPR results calculated at the rated flow condition and the 87% flow condition.

The core loading information for Hope Creek Cycle 13 is provided in Figure 1. The differences in core loading shown in Figure 1 from the core loading provided in Reference [9] are the result of an earlier than planned shutdown at the end of Cycle 12, and the removal of two fuel defects found during core offload.

In general, the calculated safety limit is dominated by two key parameters: (1) flatness of the core bundle-by-bundle MCPR distributions, and (2) flatness of the bundle pin-by-pin power/R-factor distributions. Greater flatness in either parameter yields more rods susceptible to boiling transition and thus a higher calculated SLMCPR. The value of these parameters for Hope Creek Cycle 13 is summarized in Table 1 as the MIP (MCPR Importance Parameter) and the RIP (R-factor Importance Parameter), respectively.

The impact of the fuel loading pattern differences on the calculated SLMCPR is correlated to the values of MIP and RIP. The calculated MIP value for the Hope Creek Cycle 13 core at EOR using a limiting rod pattern is [[{3}]]

Pin-by-pin power distributions are characterized in terms of R-factors using the NRC approved methodology [2]. For the Hope Creek Cycle 13 limiting case analyzed at EOR, the weighted RIP value, considering the participation of the contributing bundles, was calculated to be [[{3}]]

The revised power distribution methodology was used for the Hope Creek Cycle 13 analysis. This methodology has been justified, reviewed and approved by the NRC (reference NEDC-32601P-A). When applying the revised model to calculate a lower SLMCPR, the conservatism that remains was reviewed, approved and documented by the USNRC. It was noted on page A-24 of NEDC-32601P-A [[

{3}]]

The SLMCPR was calculated for Hope Creek Cycle 13 using the reduced power distribution uncertainties described in Reference [1].

Table 1 summarizes the relevant input parameters and results of Cycle 13 evaluated at the condition of 76.6% rated flow/rated power. The SLMCPR values were calculated for Hope Creek using uncertainties that have been previously reviewed and approved by the NRC as listed in Table 2a and described in Reference [1] and where warranted, higher plant-cycle-specific uncertainties as listed in Table 2b. A [[

{3}]] consistent with current GNF fuel operation. For the Hope Creek Cycle 13 lower flow evaluations, the Core Flow Rate and Random effective TIP reading uncertainties were [[

{3}]]

These calculations use the GEXL14 correlation for GE14 fuel and GEXL80 correlation for SVEA96+ fuel (Reference [8]). [[

{3}]]

The Two Loop and SLO SLMCPR values calculated for Hope Creek Cycle 13 are shown in Table 1.

Summary

The calculated 1.06 SLMCPR and 1.08 SLO SLMCPR for Hope Creek Cycle 13 are consistent with expectations given the ratios for MIP and RIP that have been calculated and the use of the reduced uncertainties described in Reference [1]. Correlations of MIP and RIP directly to the calculated SLMCPR have been performed for this plant/cycle which show that these values are appropriate when the approved methodology and the reduced uncertainties given in NEDC-32601P-A and NEDC-32694P-A are used.

Based on all of the information and discussion presented above, it is concluded that the calculated 1.06 SLMCPR and 1.08 SLO SLMCPR for the Hope Creek Cycle 13 core are appropriate.

Table 1
Hope Creek Cycle 13 SLMCPR

QUANTITY, DESCRIPTION	Hope Creek Cycle 13
Number of Bundles in Core	764
Limiting Cycle Exposure Point	EOR[1]
Cycle Exposure at Limiting Point (MWd/MT)	10472 (EOR-1467)
Core Flow, % Rated	76.6
Reload Fuel Type	GE14
Latest Reload Batch Fraction, %	21.5
Latest Reload Average Batch Weight % Enrichment	4.02
Core Average Weight % Enrichment	3.63
Core MCPR (for limiting rod pattern)	1.38
Batch Fraction for GE14	21.5%
Batch Fraction for SVEA	78.5%
MCPR Importance Parameter, MIP	[[{3}]]
R-factor Importance Parameter, RIP	[[{3}]]
MIPRIP	[[{3}]]
Power distribution methodology	Revised NEDC-32601P-A
Power distribution uncertainty	Reduced NEDC-32694P-A
Non-power distribution uncertainty	Revised NEDC-32601P-A
Calculated Safety Limit MCPR (Two Loop)	**1.06**
Calculated Safety Limit MCPR (SLO)	**1.08**

[1] End of Rated (EOR) is defined as end-of-cycle all rods out, 100% power / 100% flow and normal feedwater temperature. The actual analysis is performed prior to EOR in order to have sufficient control rod density to force some bundles near to the OLMCPR.

Table 2a

Standard Uncertainties

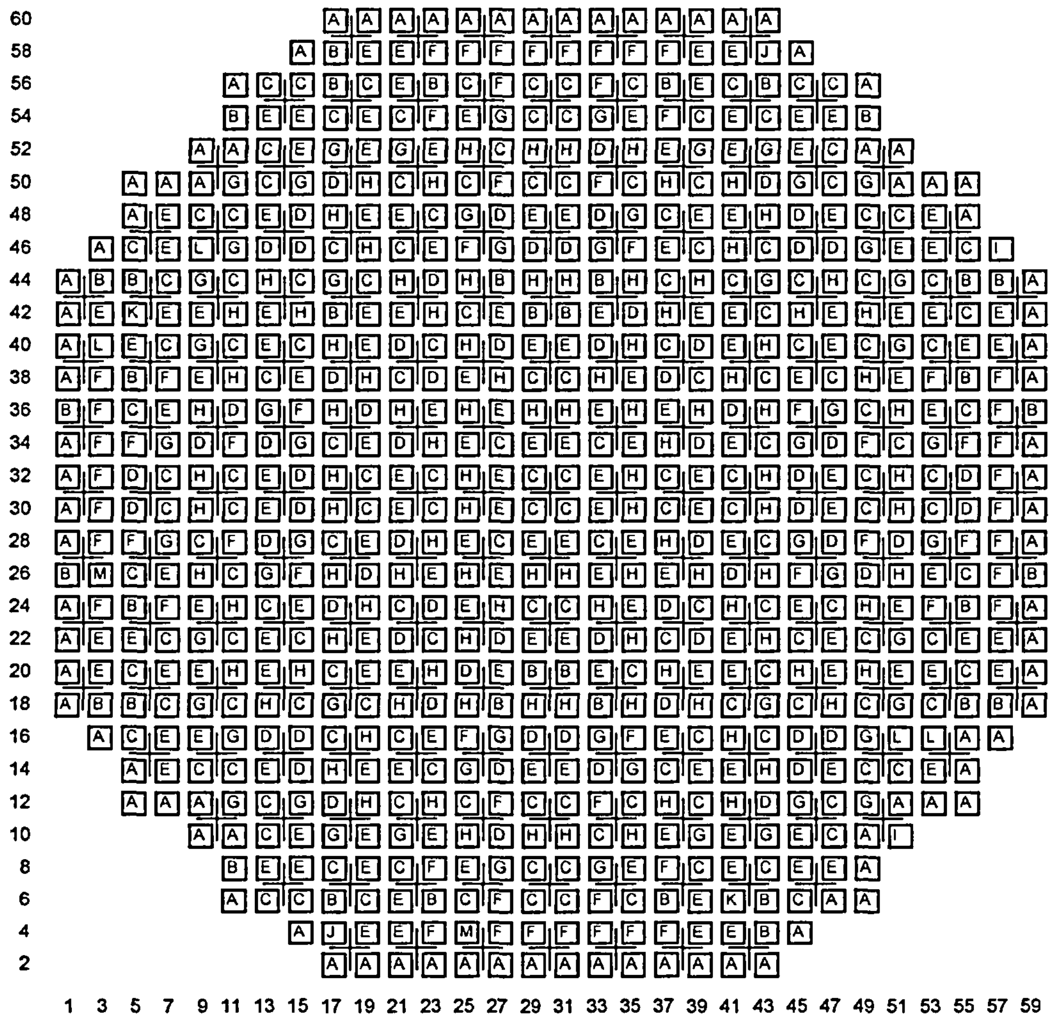
DESCRIPTION	Hope Creek Cycle 13
Non-power Distribution Uncertainties	Revised NEDC-32601P-A
Core flow rate (derived from pressure drop)	2.5 Two Loop 6.0 SLO
Individual channel flow area	[[{3}]]
Individual channel friction factor	5.0
Friction factor multiplier	[[{3}]]
Reactor pressure	[[{3}]]
Core inlet temperature	0.2
Feedwater temperature	[[{3}]]
Feedwater flow rate	[[{3}]]
Power Distribution Uncertainties	Reduced NEDC-32694P-A
GEXL R-factor	[[{3}]]
Random effective TIP reading	1.2 Two Loop 2.85 SLO
Systematic effective TIP reading	[[{3}]]
Integrated effective TIP reading	[[{3}]]
Bundle power	[[{3}]]
Effective total bundle power uncertainty	[[{3}]]

Table 2b

Exceptions to the Standard Uncertainties Used in Hope Creek Cycle 13

Reactor pressure	2.04
Core flow rate (Two Loop 76.6% core flow analysis only)	[[{3}]]
Random effective TIP reading (Two Loop 76.6% core flow analysis only)	[[{3}]]
GEXL R-factor	[[{3}]]

Figure 1
Reference Loading Pattern – Hope Creek Cycle 13



Code	Bundle Name	Number Loaded	Cycle Loaded
A	SVEA96-P10CASB326-11GZ-568U-4WR-150-T6-2654	89	10
B	SVEA96-P10CASB326-11G4.5-568U-4WR-150-T6-2655	38	10
C	SVEA96-P10CASB360-12GZ-568U-4WR-150-T6-2656	166	11
D	SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657	69	11
E	SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658	164	12
F	SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659	62	12
G	GE14-P10CNAB402-4G6.0/16G4.0-100T-150-T6-2757	56	13
H	GE14-P10CNAB402-5G6.0/14G4.0-100T-150-T6-2758	108	13
I	SVEA96-P10CASB326-11GZ-568U-4WR-150-T6-2654	2	10
J	SVEA96-P10CASB326-11G4.5-568U-4WR-150-T6-2655	2	10
K	SVEA96-P10CASB360-12G5.0-568U-4WR-150-T6-2657	2	11
L	SVEA96-P10CASB361-14GZ-568U-4WR-150-T6-2658	4	12
M	SVEA96-P10CASB360-12G5.5/2G2.5-568U-4WR-150-T6-2659	2	12

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

Responses to Draft Request for Additional Information by the Office of Nuclear Reactor Regulation Relating to Requested Amendment to License No. NPF-57 PSEG Nuclear LLC Company Hope Creek Generating Station Docket No. 50-354 (Non-proprietary version)

November 22, 2004

Responses to
DRAFT REQUEST FOR ADDITIONAL INFORMATION
BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATING TO REQUESTED AMENDMENT TO LICENSE NO. NPF-57
PSEG NUCLEAR LLC COMPANY
HOPE CREEK GENERATING STATION
DOCKET NO. 50-354

Proprietary Information Notice

This document is the GNF non-proprietary version of the GNF proprietary document. From the GNF proprietary version, the information denoted as GNF proprietary (enclosed in double brackets) was deleted to generate this version.

The staff has reviewed the April 27, 2004, Technical Specification amendment request and has identified the following questions to be addressed by the licensee in order to complete our evaluation:

Responses are provided to each RAI below. Note that the format for each response is a re-statement of the RAI followed by a written response. These responses have been verified and are documented in GNF eDRF 0000-0032-1323.

1. Describe the rationale for placing four twice burned type "C" fuel assemblies in the center of the core and twelve once burned type "E" fuel assemblies around the center core in a symmetric core loading pattern of the core design, as shown in Figure 1 of the non-proprietary version of the GNF document.

Response to RAI 1: In general, GNF core designs are quadrant symmetric. Therefore, the center cell usually consists of four bundles of the same design and operational history. Use of four twice-burnt bundles in the center cell is typical of GNF core designs for 18 month fuel cycles (such as Hope Creek Cycle 13). Four once-burnt or four fresh[1] bundles would usually be too reactive to satisfy shutdown margin and or thermal margin requirements. Use of thrice-burnt bundles is generally unnecessary in order to achieve reactivity and thermal margin design goals. The fuel surrounding the (twice-burnt) bundles in the center cell is generally fresh, once-burnt or a mixture of the two. Use of twice-burnt or thrice-burnt fuel surrounding the center cell would probably over-depress the power in the center region and thus compromise neutron economy. The bundle placement decision making process is guided by the requirement to maintain specific reactivity and thermal margin design goals while optimizing overall neutron economy.

2. Describe in detail the process of calculating the difference of the SLMCPR value between the current and the next cycle operation in terms of the multiplication of bundle-by-bundle MCPR distribution and the bundle pin-by-pin power/R-factor distribution, the constant "c", and the standard deviation "σ ". Also, justify that the equation is still valid for the mixed core from different fuel vendor, and provide the values for the constant "c" and standard deviation "σ" used in the approximation equation for Cycle 13 calculation and identify that the two parameters are constant or fuel dependent.

Response to RAI 2: The SLMCPR value that is calculated for any particular core configuration through an operational cycle is the value resulting from the GESAM evaluation that utilizes the applicable power and non-power uncertainties as inputs, as described in NEDC-32601P-A and NEDC-32694P-A. The correlation, referenced in RAI 2, that "estimates" SLMCPR values uses a combination of the bundle-by-bundle MCPR distribution and the bundle pin-by-pin power/R-factor distribution parameters as inputs. The individual values of these parameters and their combination are indicators that can be used to compare SLMCPR evaluations of different core configurations, and help explain differences. They are used to identify large differences from expected behavior that could be indicators of either an error in the evaluation or the existence of non-typical behavior that cannot be accounted for by differences in these two parameters.

The bundle-by-bundle MCPR distribution provides a measure of the number of bundles that are near the MCPR operating limit (OL) for a specific core configuration / cycle exposure point. The influence that different GEXL correlations have on the proximity of a specific bundle to the MCPR OL is implicitly considered because proximity is defined in terms of the number of GEXL standard deviations using the GEXL uncertainty appropriate for that bundle. A higher value of the MCPR distribution parameter indicates a flatter distribution. The flatter MCPR distribution tends to increase the SLMCPR. The flatter the distribution, the greater number of bundles that have the potential to participate in the SLMCPR boiling transition probability evaluation when the limiting bundle is operating at the MCPR OL.

[1] Additionally, fresh bundles are all placed in locations that will allow them to run uncontrolled throughout Cycle 13. This is part of the "control cell core" (CCC) loading strategy. The center control blade is frequently utilized in a CCC loading so no fresh is loaded into that cell.

The bundle pin-by-pin power/R-factor distribution provides a measure of the number of pins within a bundle that are near the limiting pin. A higher value of the bundle pin-by-pin power/R-factor distribution indicates a flatter distribution. The flatter the R-factor distribution, the greater number of fuel pins within a particular bundle type that have the potential to participate in the SLMCPR boiling transition probability evaluation which tends to increase the SLMCPR.

[[

[3]]]

The SLMCPR estimation correlation function has not historically depended on the bundle types contained in a core or the specific GEXL correlation used to determine their MCPR performance. This follows directly from the utilization of the two parameters combined into the quantity Z that incorporates both the effect of the bundle type specific GEXL correlation to determine the bundle MCPR distribution and also the bundle type specific pin-by-pin R-factor distribution that is used to determine the number of rods expected to be in boiling transition, for a given bundle type. See pages A-31 through A-33, NEDC-32601P-A for a discussion of this process in more detail which directly supports the conclusion that the correlation function is independent of bundle type, provided a bundle type specific GEXL correlation is employed in the SLMCPR evaluation.

Since the correlation is not dependent on bundle type, the correlation parameters c and d are constants that only depend on the selection of SLMCPR methodology and uncertainties. Therefore, it is appropriate to employ the correlation to estimate SLMCPR values for Hope Creek Generating Station Cycle 13 operation using the c and d correlation parameters that correspond to the methodology and uncertainties "set" indicated in Table 1 of Attachment 3 to PSEG Nuclear LLC letter dated April 27, 2004.

3. It appears that a higher value of the product of bundle-by-bundle MCPR distribution and the bundle pin-by-pin power/R-factor distribution would result in a higher SLMCPR, i.e., the Cycle 13 value would be larger than that of Cycle 12. Describe the impact on the results of the SLMCPR calculation due to the difference of the product of these two parameters and explain why the Cycle 13 SLMCPR value is much less than Cycle 12 value.

Response to RAI 3: Because of the changes introduced during the core redesign of Cycle 13 due to the early shutdown of Cycle 12, the removal of two fuel defects found during core offload, and the changes introduced because of the different core flow rates in which the SLMCPR calculation was performed, the statement made in question 3 is no longer applicable, i.e., the product of bundle-by-bundle MCPR distribution and the bundle pin-by-pin power/R-factor distribution has actually decreased from Cycle 12 to Cycle 13.

However, the impact on the results of the SLMCPR calculation due to changes can still be described. Different parameters contribute in different ways to the overall calculated SLMCPR, and since there are several changes to consider in the Hope Creek SLMCPR calculation (changes in core design and different core flow rate analyses), the effect of each change will be addressed separately in this response.

Tables 1 through 4 provide a breakdown of the differences between selected Cycle 12 and Cycle 13 parameters and their expected effect on calculated SLMCPR values. The expected SLMCPR effects are derived in the tables based upon power distribution changes, parameter uncertainty changes, and differences in critical power correlation statistics (mean and uncertainty). An

expected SLMCPR value can then be compared to the SLMCPR value actually calculated using GNF methodology for each Table.

The Table 1 comparison is the same as was presented in the April 2004 submittal. The information in Table 1 describes the differences between the Cycle 12 SLMCPR calculated with GNF methodology and the Cycle 13 SLMCPR. The Cycle 13 SLMCPR results are based upon the core design prior to the changes incurred due to the early Cycle 12 shutdown and the removal of two fuel defects found during core offload. This core design will be referred to as "RLP April 04". These calculations are done at the rated core flow rate.

The first difference of –0.01 is directly due to the difference of nuclear evaluation methodologies between the legacy fuel vendor and GNF. The SLMCPR value for Cycle 12, calculated by the legacy fuel vendor, for the limiting SVEA96+ fuel was 1.10. Using the GNF methodology to independently calculate the limiting SLMCPR for Cycle 12 operation yielded a limiting SLMCPR value of 1.09. No difference was observed between the Cycle 13 and Cycle 12 bundle-by-bundle MCPR distribution parameters at the respective limiting cycle evaluation points, therefore no effect is expected associated with this parameter. The bundle pin-by-pin power/R-factor distribution parameter increased slightly. The expected effect to SLMCPR was calculated to be +0.008 using the correlation as described in the response to RAI 2.

The remaining net expected decrease of 0.042 is due to differences in GEXL correlation bias and uncertainty between the GNF developed GEXL80 MCPR correlation and the GEXL14 correlation used to determine bundle-by-bundle MCPR for the Cycle 13 GE14 new reload fuel. SVEA96+ fuel is limiting for the Cycle 12 evaluation (no GE14 fuel in Cycle 12 core) while GE14 fuel is the fuel that participates in the SLMCPR evaluation at the Cycle 13 limiting condition (EOC). As is seen in the attached table, the SVEA96+ GEXL80 correlation [[{3}]]. The net difference of -0.034 between the two biases accounts for the change in limiting fuel from SVEA96+ in Cycle 12 to limiting fuel of GE14 at the limiting EOC evaluation condition. Similarly, SVEA96+ GEXL80 correlation uncertainty [[{3}]] compared to the GE14 GEXL14 uncertainty. This results in a net decrease of –0.008 due to this effect.

Summing up the expected effect of all the parameter changes between the evaluation for Cycle 12 and Cycle13 gives –0.01+0.008-0.034-0.008 = -0.044 net expected decrease in SLMCPR in going from Cycle 12 legacy vendor methodology to Cycle 13 using GNF methodology.

The observed decrease in SLMCPR of 1.10 – 1.058 = 0.042 is completely consistent with the expected decrease of 0.044, which is indicated by the expected SLMCPR of 1.056.

Table 2 describes the changes in SLMCPR related to a change in core flow rate for the SLMCPR evaluation, from rated flow to the chosen low flow rate of 76.6%. These calculations, like in Table 1, apply to the RLP April 04 core design.

There are two components contributing to a net increase in SLMCPR in Table 2: The first increase of 0.012 is due to an increase in bundle-by-bundle MCPR distribution parameters at their respective limiting control rod patterns. The second increase of 0.005 is due to changes in uncertainties associated with the core flow rate. The overall net increase in SLMCPR due to these components is +0.012+0.005=+0.017. The expected SLMCPR from this net effect is 1.056+0.017=1.073 which is 0.01 higher than the calculated SLMCPR of 1.063 for the 76.6% core flow calculation based on the RLP April 04 core design. A bias of 0.01 between expected and calculated SLMCPRs (1.073 and 1.063, respectively) is within tolerances criteria established in the GNF methodology when comparing SLMCPR correlation values to actual SLMCPR calculations. Consequently, the observed increase in the calculated SLMCPR of 1.058 + 0.005 = 1.063 is consistent with expectations.

Table 3 is constructed to capture the effects of core design changes from the early April 2004 submittal (RLP April 04) to the more recent core design necessitated by the early Cycle 12 shutdown and the removal of two fuel defects found during core offload (defined as "RLP Nov.

04"). For this purpose, the core flow rate is maintained at the low flow value of 76.6% so that only the effects on the SLMCPR due to the core redesign can be illustrated.

The contributing factors in Table 3 are due to core design changes and the associated effects on power distribution, therefore the only affected parameters are those related to the product of bundle-by-bundle MCPR distribution and bundle pin-by-pin power/R-factor distribution, resulting in a net decrease of SLMCPR of -0.026-0.001=-0.027. The expected SLMCPR from this net effect is 1.073-0.027=1.046 which is 0.01 lower than the calculated SLMCPR of 1.056 for the 76.6% core flow calculation based on the RLP Nov. 04 core design. Again, as discussed in Table 2, a bias of 0.01 between expected and calculated SLMCPRs are within GNF methodology tolerance criteria and the calculated SLMCPR value of 1.056 is therefore consistent with expectation.

Lastly, Table 4 compares the effects of the low flow 76.6% core flow rate to the currently licensed minimum allowable core flow rate of 87% at rated power. Both calculations use the core design labeled 'RLP Nov. 04'. In this table, the contributions are similar in nature to the changes shown in Table 2, but with opposite directions and different magnitudes. The first effect of 0.002 is due to a decrease in bundle-by-bundle MCPR distribution parameters at their respective limiting control rod patterns. The second decrease of 0.002 is due to changes in uncertainties associated with the core flow rate. The overall net decrease in SLMCPR due to these components is -0.002-0.002=-0.004. The expected SLMCPR from this net effect is 1.046-0.004=1.042, which is 0.008 lower than the calculated SLMCPR of 1.050 for the 87% core flow calculation. This demonstrates that the SLMCPR evaluation for the RLP Nov. 04 core design at the low flow condition of 76.6% results in an SLMCPR value that is equivalent to or will conservatively bound SLMCPR calculations performed at higher core flow rates including 87% core flow.

In conclusion, as seen from all the calculated SLMCPR cases in Tables 1 through 4, 1.06 is an appropriate value for the Two Loop SLMCPR for Cycle 13. A typical increase in SLMCPR going from a Two Loop condition value of 1.06 to Single Loop Operation (SLO) is ~ 0.01. Therefore, the requested SLO SLMCPR of 1.08, an increase of 0.02 from the Two Loop value, is an appropriate value.

4. Describe in detail the major contributors for the 0.04 reduction of the SLMCPR value with respect to the Cycle 12 value and their bases for the reduction.

Response to RAI 4: See response to RAI 3.

5. Provide a description of the power shape during the Cycle 13 operation. Also, in the SLMCPR calculation for Cycle 13 is there any penalty imposed if an upskew power shape occurs at the end of the cycle.

Response to RAI 5:

The response below addresses RAI 5 as clarified by discussion with the NRC staff during the teleconference on August 3, 2004.

The description of the power shapes considered in the SLMCPR evaluation process for Cycle 13 and any penalty imposed for upskew power shape is provided in Attachment 3 to PSEG Nuclear LLC's April 27, 2004 letter. The pertinent section of Attachment 3 is repeated below for convenience purposes.

"[[

. [3]]]"

November 22, 2004

Table 1
Two Loop (TL) SLMCPR Comparison
(Effect of Cycle 12 to Cycle 13 parameter changes)

Parameter	**EOC Cycle 12**	**EOC Cycle 13 Rated Core flow RLP April 04**	**Expected effect on SLMCPR (relative to Cycle 12 SLMCPR values)**
SLMCPR TL: GNF - Legacy vendor value	1.09 – 1.10	N/A	-0.01
MCPR distribution	[[	[3]]]	0.00
Pin-by-pin power/R-factor distribution	[[	[3]]]	+0.008
GEXL correlation bias	[[(GEXL80)	[3]]] (GEXL14)	-0.034
GEXL correlation uncertainty	[[	[3]]]	-0.008
TL Core Flow Rate Uncertainty	2.50	2.50	0.00
TL Random Effective TIP Reading Uncertainty	1.20	1.20	0.00
Expected SLMCPR	N/A	1.056	-0.044
Calculated TL SLMCPR	1.10	1.058	

Table 2
Cycle 13 Two Loop (TL) SLMCPR Comparison
(Effect of flow rate parameter changes)

Parameter	EOC Cycle 13 Rated Core flow RLP April 04	EOC Cycle 13 76.6% Core flow RLP April 04	Expected effect on SLMCPR (Relative to Rated Core Flow Values)
SLMCPR TL: GNF - Legacy vendor value	N/A	N/A	N/A
MCPR distribution	[[	{3)]]	+0.012
Pin-by-pin power/R-factor distribution	[[	{3)]]	0.00
GEXL14 correlation bias	[[	{3)]]	0.00
GEXL correlation uncertainty	[[	{3)]]	0.00
TL Core Flow Rate Uncertainty	2.50	[[{3)]]	+0.005
TL Random Effective TIP Reading Uncertainty	1.20	[[{3)]]	
Expected SLMCPR	1.056	1.073	+0.017
Calculated TL SLMCPR	1.058	1.063	

Table 3
Cycle 13 Two Loop (TL) SLMCPR Comparison
(Effect of core design parameter changes)

Parameter	EOC Cycle 13 76.6% Core flow RLP April 04	EOC Cycle 13 76.6% Core flow RLP Nov 04	Expected effect on SLMCPR (Relative to RLP April 04)
SLMCPR TL: GNF - Legacy vendor value	N/A	N/A	N/A
MCPR distribution	[[	{3}]]	-0.026
Pin-by-pin power/R-factor distribution	[[	{3}]]	-0.001
GEXL14 correlation bias	[[	{3}]]	0.00
GEXL correlation uncertainty	[[	{3}]]	0.00
TL Core Flow Rate Uncertainty	[[	{3}]]	0.00
TL Random Effective TIP Reading Uncertainty	[[	{3}]]	
Expected SLMCPR	1.073	1.046	-0.027
Calculated TL SLMCPR	1.063	1.056	

November 22, 2004

Table 4
Cycle 13 Two Loop (TL) SLMCPR Comparison
(Effect of flow rate parameter changes)

Parameter	EOC Cycle 13 76.6% Core flow RLP Nov 04	EOC Cycle 13 87% Core flow RLP Nov 04	Expected effect on SLMCPR (Relative to 76.6% Core flow)
SLMCPR TL: GNF - Legacy vendor value	N/A	N/A	N/A
MCPR distribution	[[	(3)]]	-0.002
Pin-by-pin power/R-factor distribution	[[	(3)]]	0.00
GEXL14 correlation bias	[[	(3)]]	0.00
GEXL correlation uncertainty	[[	(3)]]	0.00
TL Core Flow Rate Uncertainty	[[	(3)]]	-0.002
TL Random Effective TIP Reading Uncertainty	[[	(3)]]	
Expected SLMCPR	1.046	1.042	-0.004
Calculated TL SLMCPR	1.056	1.050	