

PROPRIETARY INFORMATION – WITHHOLD UNDER 10 CFR 2.390

10 CFR 50.90

October 12, 2011

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Limerick Generating Station, Unit 1
Facility Operating License No. NPF-39
NRC Docket No. 50-352

Subject: License Amendment Request - Safety Limit Minimum Critical Power Ratio Change

In accordance with 10 CFR 50.90, Exelon Generation Company, LLC (Exelon) requests a proposed change to modify Technical Specification (TS) 2.1 ("Safety Limits"). Specifically, this change incorporates revised Safety Limit Minimum Critical Power Ratios (SLMCPRs) due to the cycle specific analysis performed by Global Nuclear Fuel for Limerick Generating Station (LGS), Unit 1, Cycle 15.

The proposed changes have been reviewed by the Limerick Generating Station Plant Operations Review Committee, and approved by the Nuclear Safety Review Board in accordance with the requirements of the Exelon Quality Assurance Program.

In order to support the upcoming refueling outage at LGS, Unit 1, Exelon requests approval of the proposed amendment by February 12, 2012. Once approved, this amendment shall be implemented within 30 days of issuance. Additionally, there are no commitments contained within this letter.

Attachment 1 contains the evaluation of the proposed changes. Attachments 2 and 3 provide the marked up TS and Bases pages and the retyped TS and Bases pages, respectively. The Bases page is being provided for information only.

Attachment 4 (letter from C. F. Lamb (Global Nuclear Fuel) to J. Tusar (Exelon Generation Company, LLC), dated September 22, 2011) specifies the new SLMCPRs for LGS, Unit 1, Cycle 15. Attachments 4, 5, and 6 contain information proprietary to Global Nuclear Fuel. Global Nuclear Fuel requests that these documents be withheld from public disclosure in accordance with 10 CFR 2.390. Attachments 7 and 8 contain non-proprietary versions of the Global Nuclear Fuel documents. Attachment 6 is proprietary in its entirety; therefore, no non-proprietary version is being supplied. An affidavit supporting this request is also contained in Attachment 9. Attachment 10 contains the power/flow map for the current Cycle 14 and expected Cycle 15.

**Attachments 4, 5, 6 transmitted herewith contain Proprietary Information.
When separated from attachments, this document is decontrolled.**

License Amendment Request
Safety Limit Minimum Critical Power Ratio Change
October 12, 2011
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In accordance with 10 CFR 50.91, Exelon is notifying the Commonwealth of Pennsylvania of this application for license amendment by transmitting a copy of this letter and its attachments to the designated State Official.

Should you have any questions concerning this letter, please contact Tom Loomis at (610) 765-5510.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 12th of October 2011.

Respectfully,



Michael D. Jesse
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

- Attachments:
- 1) Evaluation of Proposed Changes
 - 2) Markup of Technical Specifications and Bases Pages
 - 3) Retyped Technical Specifications and Bases Pages
 - 4) Proprietary Version of Global Nuclear Fuel Letter
 - 5) Proprietary Version of Supplemental Peach Bottom RAI Responses Applied to Limerick Unit 1 Cycle 15
 - 6) Proprietary Version of Fuel Application Overview
 - 7) Non-Proprietary Version of Global Nuclear Fuel Letter
 - 8) Non-Proprietary Version of Supplemental Peach Bottom RAI Responses Applied to Limerick Unit 1 Cycle 15
 - 9) Affidavit
 - 10) Power/Flow Map for the Current Cycle 14 and Expected Cycle 15

cc: USNRC Region I, Regional Administrator
USNRC Senior Resident Inspector, LGS
USNRC Project Manager, LGS
R. R. Janati, Commonwealth of Pennsylvania

ATTACHMENT 1

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SUBJECT: Safety Limit Minimum Critical Power Ratio (SLMCPR) Change

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Attachment 1

Limerick Generating Station (LGS), Unit 1

Facility Operating License No. NPF-39

Evaluation of Proposed Changes

1.0 SUMMARY DESCRIPTION

This evaluation supports a request to amend Facility Operating License No. NPF-39 for Limerick Generating Station (LGS), Unit 1.

The proposed change modifies Technical Specification (TS) 2.1 ("Safety Limits"). Specifically, this change incorporates revised Safety Limit Minimum Critical Power Ratios (SLMCPs) due to the cycle specific analysis performed by Global Nuclear Fuel for LGS, Unit 1, Cycle 15.

2.0 DETAILED DESCRIPTION

The proposed change involves revising the SLMCPs contained in TS 2.1 for two recirculation loop operation and single recirculation loop operation. The SLMCP value for two-loop operation is being changed from ≥ 1.07 to ≥ 1.09 . The SLMCP value for single-loop operation is being changed from ≥ 1.09 to ≥ 1.12 .

Marked up TS page 2-1 and Bases page B 2-1 showing the requested changes are provided in Attachment 2.

3.0 TECHNICAL EVALUATION

The proposed TS change will revise the SLMCPs contained in TS 2.1 for two recirculation loop operation and single recirculation loop operation to reflect the changes in the cycle specific analysis performed by Global Nuclear Fuel for LGS, Unit 1, Cycle 15.

The new SLMCPs are calculated using NRC-approved methodology described in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18 (Reference 1). A listing of the associated NRC-approved methodologies for calculating the SLMCPs is provided in Section 1.0 ("Methodology") of Attachment 4.

The SLMCP analysis establishes SLMCP values that will ensure that during normal operation and during abnormal operational transients, at least 99.9% of all fuel rods in the core do not experience transition boiling if the limit is not violated. The SLMCPs are calculated to include cycle specific parameters and, in general, are dominated by two key parameters: 1) flatness of the core bundle-by-bundle MCR distribution, and 2) flatness of the bundle pin-by-pin power/R-Factor distribution. Information to support the cycle specific SLMCPs is included in Attachment 4. That attachment summarizes the methodology, inputs, and results for the change in the SLMCPs. The LGS, Unit 1, Cycle 15 core will consist of GE14 and GNF2 fuel types.

Attachment 10 contains the power/flow map for the current Cycle 14 and expected Cycle 15. The power-flow map generally depicts a "natural circulation" flow line and a "maximum rod line" (MELLLA line). The Backup Stability Protection (BSP) region boundaries are calculated based on points on the natural circulation line and the maximum rod line and the BSP regions are depicted as areas between the maximum rod line, the natural circulation line and the BSP region boundaries in the high-power, low-flow region of the map. However, the natural circulation line is approximate and the core flow measurement uncertainty is larger at low flow conditions. In the past, this has resulted in operating conditions in which the indicated power-flow condition was below (to the left of) the natural circulation line on the power-flow map. To

address this situation, an operational decision was made to conservatively extend operating boundaries (e.g., maximum rod line, stability regions, etc.) back to zero flow. These operational enhancements to the power-flow map have been made to provide additional guidance for the unlikely, but possible circumstance of operating at those conditions.

As part of this package, GNF has prepared responses to questions posed during the review of the Peach Bottom Atomic Power Station, Unit 3 SLMCPR review in 2011. These responses are contained in Attachments 5 and 6.

No plant hardware or operational changes are required with this proposed change.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR 50.36, "Technical specifications," paragraph (c)(1), requires that power reactor facility TS include safety limits for process variables that protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. The fuel cladding integrity SLMCPR is established to assure that at least 99.9% of the fuel rods in the core do not experience transition boiling during normal operation and abnormal operating transients. Thus, the SLMCPR is required to be contained in TS.

4.2 Precedents

The NRC has approved similar SLMCPR changes for a number of plants:

1. Letter from C. Lyon (U.S. Nuclear Regulatory Commission) to Vice President, Operations (Entergy Operations, Inc.), "Grand Gulf Nuclear Station, Unit 1 - Issuance of Amendment RE: Change to the Minimum Critical Power Ratio Safety Limit (TAC NO. ME2474)," dated March 25, 2010
2. Letter from J. Hughey (U.S. Nuclear Regulatory Commission) to M. Pacilio (Exelon Generation Company, LLC), "Peach Bottom Atomic Power Station, Unit 2 – Issuance of Amendment RE: Safety Limit Minimum Critical Power Ratio Value Change (TAC NO. ME3994)," dated September 28, 2010
3. Letter from P. Bamford (U.S. Nuclear Regulatory Commission) to M. Pacilio (Exelon Generation Company, LLC), "Limerick Generating Station, Unit 2 – Issuance of Amendment RE: Safety Limit Minimum Critical Power Ratio Changes (TAC NO. ME5182)," dated April 5, 2011
4. Letter from J. Hughey (U.S. Nuclear Regulatory Commission) to M. Pacilio (Exelon Generation Company, LLC), "Peach Bottom Atomic Power Station, Unit 3 – Issuance of Amendment RE: Safety Limit Minimum Critical Power Ratio Value Change (TAC NO. ME6391)," dated September 30, 2011

4.3 No Significant Hazards Consideration

Exelon Generation Company, LLC (Exelon) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The derivation of the cycle specific Safety Limit Minimum Critical Power Ratios (SLMCPRs) for incorporation into the Technical Specifications (TS), and their use to determine cycle specific thermal limits, has been performed using the methodology discussed in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18.

The basis of the SLMCPR calculation is to ensure that during normal operation and during abnormal operational transients, at least 99.9% of all fuel rods in the core do not experience transition boiling if the limit is not violated. The new SLMCPRs preserve the existing margin to transition boiling.

The MCPR safety limit is reevaluated for each reload using NRC-approved methodologies. The analyses for Limerick Generating Station (LGS), Unit 1, Cycle 15 have concluded that a two loop MCPR safety limit of ≥ 1.09 , based on the application of Global Nuclear Fuel's NRC-approved MCPR safety limit methodology, will ensure that this acceptance criterion is met. For single-loop operation, a MCPR safety limit of ≥ 1.12 also ensures that this acceptance criterion is met. The MCPR operating limits are presented and controlled in accordance with the LGS, Unit 1 Core Operating Limits Report (COLR).

The requested TS changes do not involve any plant modifications or operational changes that could affect system reliability or performance or that could affect the probability of operator error. The requested changes do not affect any postulated accident precursors, do not affect any accident mitigating systems, and do not introduce any new accident initiation mechanisms. Therefore, the proposed TS changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The SLMCPR is a TS numerical value, calculated to ensure that during normal operation and during abnormal operational transients, at least 99.9% of all fuel rods in the core do not experience transition boiling if the limit is not violated. The new SLMCPRs are

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The SLMCPR is a TS numerical value, calculated to ensure that during normal operation and during abnormal operational transients, at least 99.9% of all fuel rods in the core do not experience transition boiling if the limit is not violated. The new SLMCPRs are calculated using NRC-approved methodology discussed in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18. The proposed changes do not involve any new modes of operation or any plant modifications. The proposed revised MCPR safety limits have been shown to be acceptable for Cycle 15 operation. The core operating limits will continue to be developed using NRC-approved methods. The proposed MCPR safety limits or methods for establishing the core operating limits do not result in the creation of any new precursors to an accident. Therefore, the proposed TS changes do not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No.

There is no significant reduction in the margin of safety previously approved by the NRC as a result of the proposed change to the SLMCPRs. The new SLMCPRs are calculated using methodology discussed in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18. The SLMCPRs ensure that during normal operation and during abnormal operational transients, at least 99.9% of all fuel rods in the core do not experience transition boiling if the limit is not violated, thereby preserving the fuel cladding integrity. Therefore, the proposed TS changes do not involve a significant reduction in the margin of safety previously approved by the NRC.

Based on the above, Exelon Generation Company, LLC, concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18.

calculated using NRC-approved methodology discussed in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18. The proposed changes do not involve any new modes of operation or any plant modifications. The proposed revised MCPR safety limits have been shown to be acceptable for Cycle 15 operation. The core operating limits will continue to be developed using NRC-approved methods. The proposed MCPR safety limits or methods for establishing the core operating limits do not result in the creation of any new precursors to an accident. Therefore, the proposed TS changes do not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No.

There is no significant reduction in the margin of safety previously approved by the NRC as a result of the proposed change to the SLMCPRs. The new SLMCPRs are calculated using methodology discussed in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18. The SLMCPRs ensure that during normal operation and during abnormal operational transients, at least 99.9% of all fuel rods in the core do not experience transition boiling if the limit is not violated, thereby preserving the fuel cladding integrity. Therefore, the proposed TS changes do not involve a significant reduction in the margin of safety previously approved by the NRC.

Based on the above, Exelon Generation Company, LLC, concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified.

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In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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6.0 REFERENCES

1. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," Revision 18.

ATTACHMENT 2

Markup of Technical Specifications and Bases Pages

Revised Pages

TS 2-1

Bases B 2-1

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 SAFETY LIMITS

THERMAL POWER, Low Pressure or Low Flow

2.1.1 THERMAL POWER shall not exceed 25% of RATED THERMAL POWER with the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With THERMAL POWER exceeding 25% of RATED THERMAL POWER and the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

THERMAL POWER, High Pressure and High Flow

2.1.2 The MINIMUM CRITICAL POWER RATIO (MCPR) shall not be less than ~~1.07~~ for two recirculation loop operation and shall not be less than ~~1.09~~ for single recirculation loop operation with the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With MCPR less than ~~1.07~~ for two recirculation loop operation or less than ~~1.09~~ for single recirculation loop operation and the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

REACTOR COOLANT SYSTEM PRESSURE

2.1.3 The reactor coolant system pressure, as measured in the reactor vessel steam dome, shall not exceed 1325 psig.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3, and 4.

ACTION:

With the reactor coolant system pressure, as measured in the reactor vessel steam dome, above 1325 psig, be in at least HOT SHUTDOWN with the reactor coolant system pressure less than or equal to 1325 psig within 2 hours and comply with the requirements of Specification 6.7.1.

2.1 SAFETY LIMITS

BASES

2.0 INTRODUCTION

The fuel cladding, reactor pressure vessel and primary system piping are the principal barriers to the release of radioactive materials to the environs. Safety Limits are established to protect the integrity of these barriers during normal plant operations and anticipated transients. The fuel cladding integrity Safety Limit is set such that no fuel damage is calculated to occur if the limit is not violated. Because fuel damage is not directly observable, a step-back approach is used to establish a Safety Limit such that the MCPR is not less than 1.07 for two recirculation loop operation and 1.09 for single recirculation loop operation. MCPR greater than 1.07 for two recirculation loop operation and 1.09 for single recirculation loop operation represents a conservative margin relative to the conditions required to maintain fuel cladding integrity. The fuel cladding is one of the physical barriers which separate the radioactive materials from the environs. The integrity of this cladding barrier is related to its relative freedom from perforations or cracking. Although some corrosion or use related cracking may occur during the life of the cladding, fission product migration from this source is incrementally cumulative and continuously measurable. Fuel cladding perforations, however, can result from thermal stresses which occur from reactor operation significantly above design conditions and the Limiting Safety System Settings. While fission product migration from cladding perforation is just as measurable as that from use related cracking, the thermally caused cladding perforations signal a threshold beyond which still greater thermal stresses may cause gross rather than incremental cladding deterioration. Therefore, the fuel cladding Safety Limit is defined with a margin to the conditions which would produce onset of transition boiling, MCPR of 1.0. These conditions represent a significant departure from the condition intended by design for planned operation.

2.1.1 THERMAL POWER, Low Pressure or Low Flow

The use of the (GEXL) correlation is not valid for all critical power calculations at pressures below 785 psig or core flows less than 10% of rated flow. Therefore, the fuel cladding integrity Safety Limit is established by other means. This is done by establishing a limiting condition on core THERMAL POWER with the following basis. Since the pressure drop in the bypass region is essentially all elevation head, the core pressure drop at low power and flows will always be greater than 4.5 psi. Analyses show that with a bundle flow of 28×10^3 lb/h, bundle pressure drop is nearly independent of bundle power and has a value of 3.5 psi. Thus, the bundle flow with a 4.5 psi driving head will be greater than 28×10^3 lb/h. Full scale ATLAS test data taken at pressures from 14.7 psia to 800 psia indicate that the fuel assembly critical power at this flow is approximately 3.35 MWt. With the design peaking factors, this corresponds to a THERMAL POWER of more than 50% of RATED THERMAL POWER. Thus, a THERMAL POWER limit of 25% of RATED THERMAL POWER for reactor pressure below 785 psig is conservative.

ATTACHMENT 3

Retyped Technical Specifications and Bases Pages

Revised Pages

TS 2-1
Bases B 2-1

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 SAFETY LIMITS

THERMAL POWER, Low Pressure or Low Flow

2.1.1 THERMAL POWER shall not exceed 25% of RATED THERMAL POWER with the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With THERMAL POWER exceeding 25% of RATED THERMAL POWER and the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

THERMAL POWER, High Pressure and High Flow

2.1.2 The MINIMUM CRITICAL POWER RATIO (MCPR) shall not be less than 1.09 for two recirculation loop operation and shall not be less than 1.12 for single recirculation loop operation with the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With MCPR less than 1.09 for two recirculation loop operation or less than 1.12 for single recirculation loop operation and the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

REACTOR COOLANT SYSTEM PRESSURE

2.1.3 The reactor coolant system pressure, as measured in the reactor vessel steam dome, shall not exceed 1325 psig.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3, and 4.

ACTION:

With the reactor coolant system pressure, as measured in the reactor vessel steam dome, above 1325 psig, be in at least HOT SHUTDOWN with the reactor coolant system pressure less than or equal to 1325 psig within 2 hours and comply with the requirements of Specification 6.7.1.

2.1 SAFETY LIMITS

BASES

2.0 INTRODUCTION

The fuel cladding, reactor pressure vessel and primary system piping are the principal barriers to the release of radioactive materials to the environs. Safety Limits are established to protect the integrity of these barriers during normal plant operations and anticipated transients. The fuel cladding integrity Safety Limit is set such that no fuel damage is calculated to occur if the limit is not violated. Because fuel damage is not directly observable, a step-back approach is used to establish a Safety Limit such that the MCPR is not less than 1.09 for two recirculation loop operation and 1.12 for single recirculation loop operation. MCPR greater than 1.09 for two recirculation loop operation and 1.12 for single recirculation loop operation represents a conservative margin relative to the conditions required to maintain fuel cladding integrity. The fuel cladding is one of the physical barriers which separate the radioactive materials from the environs. The integrity of this cladding barrier is related to its relative freedom from perforations or cracking. Although some corrosion or use related cracking may occur during the life of the cladding, fission product migration from this source is incrementally cumulative and continuously measurable. Fuel cladding perforations, however, can result from thermal stresses which occur from reactor operation significantly above design conditions and the Limiting Safety System Settings. While fission product migration from cladding perforation is just as measurable as that from use related cracking, the thermally caused cladding perforations signal a threshold beyond which still greater thermal stresses may cause gross rather than incremental cladding deterioration. Therefore, the fuel cladding Safety Limit is defined with a margin to the conditions which would produce onset of transition boiling, MCPR of 1.0. These conditions represent a significant departure from the condition intended by design for planned operation.

2.1.1 THERMAL POWER, Low Pressure or Low Flow

The use of the (GEXL) correlation is not valid for all critical power calculations at pressures below 785 psig or core flows less than 10% of rated flow. Therefore, the fuel cladding integrity Safety Limit is established by other means. This is done by establishing a limiting condition on core THERMAL POWER with the following basis. Since the pressure drop in the bypass region is essentially all elevation head, the core pressure drop at low power and flows will always be greater than 4.5 psi. Analyses show that with a bundle flow of 28×10^3 lb/h, bundle pressure drop is nearly independent of bundle power and has a value of 3.5 psi. Thus, the bundle flow with a 4.5 psi driving head will be greater than 28×10^3 lb/h. Full scale ATLAS test data taken at pressures from 14.7 psia to 800 psia indicate that the fuel assembly critical power at this flow is approximately 3.35 Mwt. With the design peaking factors, this corresponds to a THERMAL POWER of more than 50% of RATED THERMAL POWER. Thus, a THERMAL POWER limit of 25% of RATED THERMAL POWER for reactor pressure below 785 psig is conservative.

ATTACHMENT 7

Non-Proprietary Version of Global Nuclear Fuel Letter

ENCLOSURE 2

CFL-EXN-HH1-11-119

GNF Additional Information Regarding the Requested Changes to the
Technical Specification SLMCPR, Limerick Unit 1 Cycle 15

Non-Proprietary Information – Class I (Public)

INFORMATION NOTICE

This is a non-proprietary version of CFL-EXN-HH1-11-119 Enclosure 1, which has the proprietary information removed. Portions of the document that have been removed are indicated by white space inside an open and closed bracket as shown here [[]].

September 13, 2011

GNF-0000-0131-9304-R0-NP

eDRFSection: 0000-0131-9304 R0

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

Limerick Unit 1 Cycle 15

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Important Notice Regarding Contents of this Report Please Read Carefully

The design, engineering, and other information contained in this document is furnished for the purpose of providing information regarding the requested changes to the Technical Specification SLMCPR for Exelon Limerick Unit 1. The only undertakings of Global Nuclear Fuel - Americas, LLC (GNF-A) with respect to information in this document are contained in contracts between GNF-A and Exelon, and nothing contained in this document shall be construed as changing the contract. The use of this information by anyone other than Exelon, or for any purpose other than that for which it is intended is not authorized; and with respect to any unauthorized use, GNF-A makes no representation or warranty, express or implied, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

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1.0 Methodology

Global Nuclear Fuel (GNF) performs Safety Limit Minimum Critical Power Ratio (SLMCPR) calculations in accordance with NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel" (Revision 18) using the following Nuclear Regulatory Commission (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.

Table 2 identifies the actual methodologies used for the Limerick Unit 1 Cycle 14 and Cycle 15 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.

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 Minimum Critical Power Ratio (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 effect 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 effects on the TLO SLMCPR due to methodology deviations, penalties, and/or uncertainty deviations from approved values. Based on the MIPRIP correlation and any effects 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 [[]] and the inherent variation in the Monte Carlo results [[]], the change in the Limerick Unit 1 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.

The intent of the final estimated TLO SLMCPR is to provide an estimate to check the reasonableness of the Monte Carlo result. It is not used for any other purpose. The methodology and final SLMCPR is based on the rigorous Monte Carlo analysis.

The items in Table 3 that result in the increase of the estimated SLMCPR are discussed in Section 2.2.

Cycle 15 will be the first full reload of GNF2 for Limerick Unit 1. The critical power uncertainty for GNF2 is defined in Table 6. As seen in Table 6, the critical power uncertainty for GNF2 is higher than the previous cycle's fuel type (GE14). As such, the GEXL uncertainty of the new fuel type tends to make the final SLMCPR higher.

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, the estimated effect 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 [[]] 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 [[]] accounts for a channel bow uncertainty of up to [[]].

Limerick Unit 1 has experienced control blade shadow corrosion-induced channel bow to the extent that an increase in the NRC-approved R-Factor uncertainty of [[]] is deemed prudent to address its effect. Accounting for the control blade shadow corrosion-induced channel bow, the Limerick Unit 1 Cycle 15 analysis shows an expected channel bow uncertainty of [[]], which is bounded by a GEXL R-Factor uncertainty of [[]]. Thus, the use of a GEXL R-Factor uncertainty of [[]] adequately accounts for the expected control blade shadow corrosion-induced channel bow for Limerick Unit 1 Cycle 15.

2.2.2. Core Flow Rate and Random Effective TIP Reading

In Reference 5 GNF committed to the expansion of the state points used in the determination of the SLMCPR. Consistent with the Reference 5 commitments, GNF performs 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. The approved SLMCPR methodology is applied at each state point that is analyzed.

For the TLO calculations performed at 82.9% core flow, the approved uncertainty values for the core flow rate (2.5%) and the random effective Traversing In-Core Probe (TIP) reading (1.2%) are conservatively adjusted by dividing them by 82.9/100. 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 because 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. LPRM Update Interval and Calculated Bundle Power

To address the Local Power Range Monitor (LPRM) update/calibration interval in the Limerick Unit 1 Technical Specifications, GNF has increased the LPRM update uncertainty in the SLMCPR analysis for Limerick Unit 1 Cycle 15. The approved uncertainty values for the

contribution to bundle power uncertainty due to LPRM update [[]] and the resulting total uncertainty in calculated bundle power [[]] are conservatively increased, as shown in Table 5. The steps “ σ TIP (INSTRUMENT)” and “ σ BUNDLE (MODEL)” 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.

[[

]] The total bundle power uncertainty is a function of the LPRM update uncertainty as detailed in Section 3.3 of NEDC-32694P-A.

2.3. Departure from NRC-Approved Methodology

No departures from NRC-approved methodologies were used in the Limerick Unit 1 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 (References 3, 6, 7 and 8). The following table identifies, by marking with an “X,” this potential for each GNF product line currently being offered:

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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:

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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 effect 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 Limerick Unit 1 Cycle 15 SLMCPR values.

2.5. Methodology Restrictions

The four restrictions identified on page 3 of the 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, 3, and 9.

The four restrictions for GNF2 were determined acceptable by the NRC review of "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," NEDC-33270P, Revision 0, March 14, 2007. Specifically, in the NRC audit report ML081630579 for the said document, Section 3.4.1 (page 59) states:

"The NRC staff's SE of NEDC-32694P-A (Reference 19 of NEDC-33270P) provides four actions to follow whenever a new fuel design is introduced. These four conditions are listed in Section 3.0 of the SE. The analysis and evaluation of the GNF2 fuel design was evaluated in accordance with the limitations and conditions stated in the NRC staff's SE, and is acceptable."

GNF's position is that GNF2 is an evolutionary fuel product based on GE14. It is not considered a new fuel design as it maintains the previously established 10x10 array and 2 water rod makeup, as stated by the NRC audit report ML081630579, Section 3.4.2.2.1 (page 59):

“The NRC staff finds that the calculational methods, evaluations and applicability of the OLMCPR and SLMCPR are in accordance with existing NRC-approved methods and thus valid for use with GNF2 fuel.”

As such, no new GNF fuel designs are being introduced in Limerick Unit 1 Cycle 15; therefore, the NEDC-32505P-A statement “...if new fuel is introduced, 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 Limerick Unit 1 Cycle 15, the minimum core flow SLMCPR calculation performed at 82.9% core flow and rated core power condition was limiting as compared to the rated core flow and rated core power condition. For convenience, Figures III.5-1 and III.5-2 from NEDC-32601P-A have been provided in Figures 4 and 5, respectively, to show this minimum core flow condition relative relationship to the data on these figures. For this condition, the MIP [[

]]. Therefore, this demonstrates that the MIP criterion for determining what constitutes a reasonably bounding limiting rod pattern is still valid for this minimum core flow condition. Hence, the rod pattern used to calculate the SLMCPR at 100% rated power/82.9% rated flow 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 Limerick Unit 1 Cycle 15. Consequently, the SLMCPR value calculated from the 82.9% core flow and rated core power condition limiting MCPR distribution reasonably bounds this mode of operation for Limerick Unit 1 Cycle 15.

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 Limerick Unit 1 Cycle 15.

2.8. Core Monitoring System

For Limerick Unit 1 Cycle 15, the 3D Monicore 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-32601P-A. Figure 4 is Figure III.5-1 from NEDC-32601P-A. Figure 5 is based on Figure III.5-2 from NEDC-32601P-A, and has been updated with GE14 and GNF2 data.

2.12. Additional SLMCPR Licensing Conditions

For Limerick Unit 1 Cycle 15, no additional SLMCPR licensing conditions are included in the analysis.

2.13. 10CFR Part 21 Evaluation

There are no known 10 CFR Part 21 factors that affect the Limerick Unit 1 Cycle 15 SLMCPR calculations.

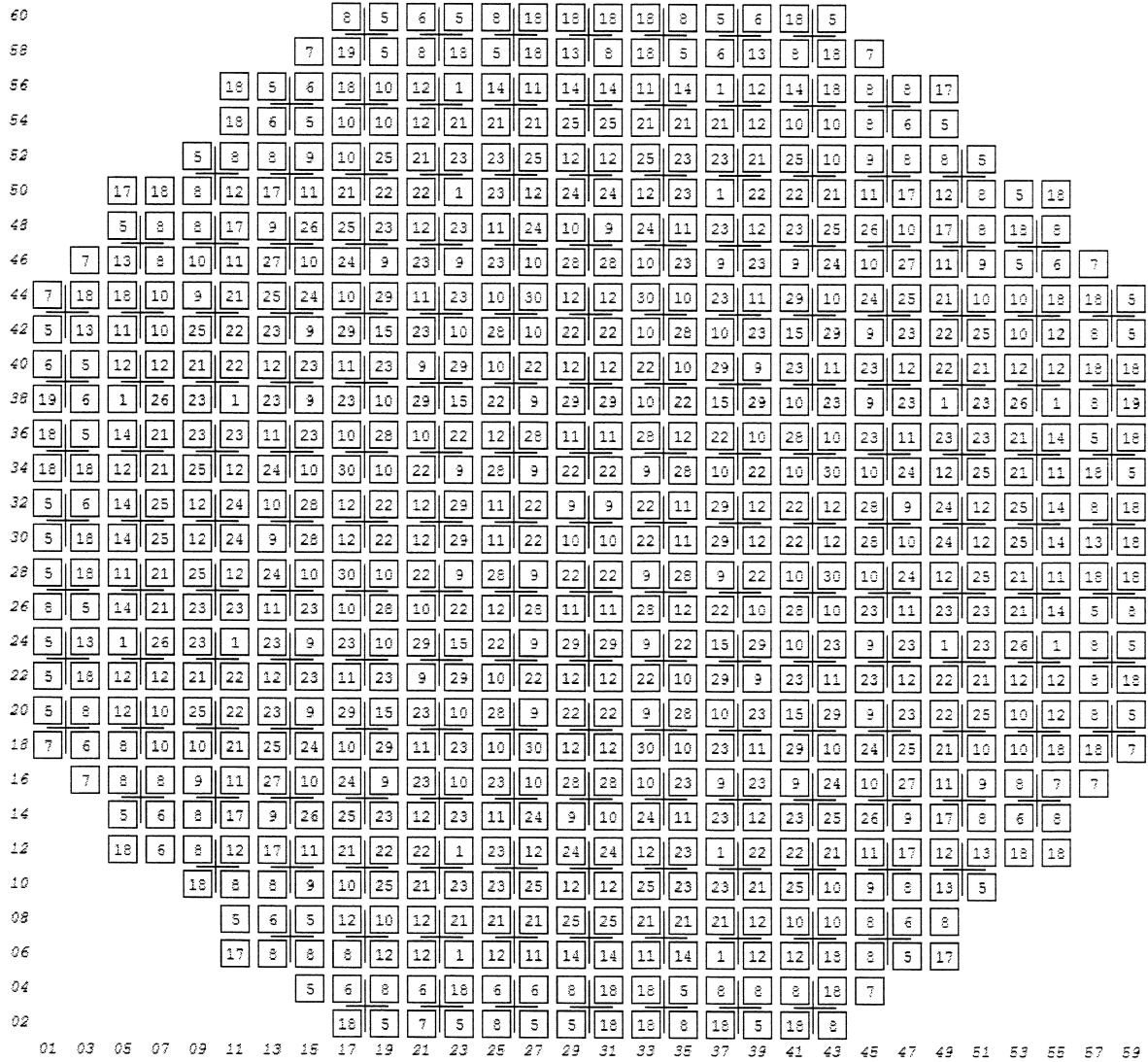
2.14. Summary

The requested changes to the Technical Specification SLMCPR values are 1.09 for TLO and 1.12 for SLO for Limerick Unit 1 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.
8. Letter, Andrew A. Lingenfelter (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with cc to MC Honcharik (NRC), "Removal of Penalty Being Applied to GE14 Critical Power Correlation for Outlet Peaked Axial Power Shapes," FLN-2007-031, September 18, 2007.
9. Letter, Andrew A. Lingenfelter (GNF-A) to U.S. Nuclear Regulatory Commission Document Control Desk with cc to SS Philpott (NRC), "Amendment 33 to NEDE-24011-P, General Electric Standard Application for Reactor Fuel (GESTAR II) and GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II), NEDC-33270P, Revision 3, March 2010," MFN 10-045, March 5, 2010.

Non-Proprietary Information - Class I (Public)



- 1 = GE14-P10CNAB394-15GZ-120T-150-T6-3272 (Cycle 14)
- 5 = GE14-P10CNAB415-15GZ-120T-150-T6-3035 (Cycle 13)
- 6 = GE14-P10CNAB415-15GZ-120T-150-T6-3035 (Cycle 13)
- 7 = GE14-P10CNAB415-15GZ-120T-150-T6-3038 (Cycle 13)
- 8 = GE14-P10CNAB415-15GZ-120T-150-T6-3041 (Cycle 13)
- 9 = GE14-P10CNAB394-15GZ-120T-150-T6-3271 (Cycle 14)
- 10 = GE14-P10CNAB394-15GZ-120T-150-T6-3271 (Cycle 14)
- 11 = GE14-P10CNAB401-13GZ-120T-150-T6-3273 (Cycle 14)
- 12 = GE14-P10CNAB402-13GZ-120T-150-T6-3274 (Cycle 14)
- 13 = GE14-P10CNAB416-15GZ-120T-150-T6-3040 (Cycle 13)
- 14 = GE14-P10CNAB398-12GZ-120T-150-T6-3275 (Cycle 14)
- 15 = GE14-P10CNAB394-15GZ-120T-150-T6-3272 (Cycle 14)
- 17 = GE14-P10CNAB415-15GZ-120T-150-T6-3042 (Cycle 13)
- 18 = GE14-P10CNAB415-15GZ-120T-150-T6-3039 (Cycle 13)
- 19 = GE14-P10CNAB415-15GZ-120T-150-T6-3039 (Cycle 13)
- 21 = GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643 (Cycle 15)
- 22 = GNF2-P10CG2B387-15GZ-120T2-150-T6-4045 (Cycle 15)
- 23 = GNF2-P10CG2B388-13GZ-120T2-150-T6-4046 (Cycle 15)
- 24 = GNF2-P10CG2B392-15GZ-120T2-150-T6-4047 (Cycle 15)
- 25 = GNF2-P10CG2B393-10G7.0/2G6.0-120T2-150-T6-4048 (Cycle 15)
- 26 = GNF2-P10CG2B404-12G6.0-100T2-150-T6-4044 (Cycle 15)
- 27 = GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643 (Cycle 15)
- 28 = GNF2-P10CG2B387-15GZ-120T2-150-T6-4045 (Cycle 15)
- 29 = GNF2-P10CG2B388-13GZ-120T2-150-T6-4046 (Cycle 15)
- 30 = GNF2-P10CG2B392-15GZ-120T2-150-T6-4047 (Cycle 15)

Figure 1. Current Cycle Core Loading Diagram

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

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

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Figure 5. Relationship Between MIP and CPR Margin

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	
Limiting Cycle Exposure Point (i.e., Beginning of Cycle (BOC)/Middle of Cycle (MOC)/End of Cycle (EOC))	EOC	EOC	EOC	EOC
Cycle Exposure at Limiting Point (MWd/STU)	14200	14200	13800	13800
% Rated Core Flow	82.9	100.0	82.9	100.0
Reload Fuel Type	GE14		GNF2	
Latest Reload Batch Fraction, %	36.6		36.6	
Latest Reload Average Batch Weight % Enrichment	3.97		3.91	
Core Fuel Fraction:				
GE14	100.0		63.4	
GNF2	0.0		36.6	
Core Average Weight % Enrichment	4.05		4.00	

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	
Power Distribution Methodology	NEDC-32601P-A		NEDC-32601P-A	
Power Distribution Uncertainty	NEDC-32694P-A		NEDC-32694P-A	
Core Monitoring System	3D Monicore		3D Monicore	
R-Factor Calculation Methodology	NEDC-32505P-A		NEDC-32505P-A	

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
[[

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

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Table 4. Non-Power Distribution Uncertainties

	Nominal (NRC-Approved) Value $\pm \sigma$ (%)	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 $\pm \sigma$ (%)	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-32601P-A					
Feedwater Flow Measurement	[[]]	[[]]	[[]]	[[]]	[[]]
Feedwater Temperature Measurement	[[]]	[[]]	[[]]	[[]]	[[]]
Reactor Pressure Measurement	[[]]	[[]]	[[]]	[[]]	[[]]
Core Inlet Temperature Measurement	0.2	0.2	0.2	0.2	0.2
Total Core Flow Measurement	6.0 SLO/2.5 TLO	6.0 SLO/3.02 TLO	6.0 SLO/2.5 TLO	6.0 SLO/3.02 TLO	6.0 SLO/2.5 TLO
Channel Flow Area Variation	[[]]	[[]]	[[]]	[[]]	[[]]
Friction Factor Multiplier	[[]]	[[]]	[[]]	[[]]	[[]]
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-32601P-A					
GEXL R-Factor	[[]]	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-32694P-A, 3DMONICORE					
GEXL R-Factor	[[]]	[[]]	[[]]	[[]]	[[]]
Random Effective TIP Reading	2.85 SLO/1.2 TLO	2.85 SLO/1.45 TLO	2.85 SLO/1.2 TLO	2.85 SLO/1.45 TLO	2.85 SLO/1.2 TLO
TIP Integral	[[]]	[[]]	[[]]	[[]]	[[]]
Four Bundle Power Distribution Surrounding TIP Location	[[]]	[[]]	[[]]	[[]]	[[]]
Contribution to Bundle Power Uncertainty Due to LPRM Update	[[]]	[[]]	[[]]	[[]]	[[]]

Table 5. Power Distribution Uncertainties

Description	Nominal (NRC-Approved) Value $\pm \sigma$ (%)	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	[[]]	[[]]	[[]]	[[]]	[[]]
Contribution to Bundle Power Due to Failed LPRM	[[]]	[[]]	[[]]	[[]]	[[]]
Total Uncertainty in Calculated Bundle Power	[[]]	[[]]	[[]]	[[]]	[[]]
Uncertainty of TIP Signal Nodal Uncertainty	[[]]	[[]]	[[]]	[[]]	[[]]

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
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ATTACHMENT 8

Non-Proprietary Version of Supplemental Peach Bottom RAI Responses Applied to Limerick
Unit 1 Cycle 15

ENCLOSURE 4

CFL-EXN-HH1-11-119

Supplemental Peach Bottom RAI Responses Applied to Limerick Unit 1
Cycle 15

Non-Proprietary Information – Class I (Public)

INFORMATION NOTICE

This is a non-proprietary version of CFL-EXN-HH1-11-119 Enclosure 3, which has the proprietary information removed. Portions of the document that have been removed are indicated by white space inside an open and closed bracket as shown here [[]].

Nuclear Regulatory Commission (NRC) Docket No. 50-278 contains Requests for Additional Information (RAIs) related to the License Amendment Request (LAR) for Technical Specification changes to the Safety Limit Minimum Critical Power Ratio (SLMCPR) values for Peach Bottom Atomic Power Station (PBAPS) Unit 3. In order to assist the review of the Limerick Generating Station (LGS) Unit 1 SLMCPR Technical Specification LAR, Global Nuclear Fuel (GNF) is including responses to these RAIs as applied to LGS Unit 1. Please note that references to “Attachment 4” in the PBAPS RAIs are equivalent to Enclosure 1 to CFL-EXN-HH1-11-119 entitled “GNF Additional Information Regarding the Requested Changes to the Technical Specification SLMCPR,” hereafter referred to as Enclosure 1.

PBAPS Unit 3 - RAI-01:

Provide the PBAPS Unit 3 cycle-specific fuel quantity for each fuel type and state when the specific fuel types are loaded in the core (i.e., fresh, once, or twice burn) as depicted in Figure 1 of Attachment 4 for the Cycle 19 core loading diagram.

GNF RESPONSE TO RAI-01.1 – Applied to LGS Unit 1:

GNF provides the following table for clarification.

**Table RAI-01-1
Figure 1 of Enclosure 1 (Cycle 15) Core Description – Fuel Type, Bundle Name,
Number of Bundles, and Cycle Loaded**

Fuel Type	Bundle Name	Number of Bundles	Cycle Loaded
	Irradiated:		
1	GE14-P10CNAB394-15GZ-120T-150-T6-3272	16	14
5	GE14-P10CNAB415-15GZ-120T-150-T6-3035	44	13
6	GE14-P10CNAB415-15GZ-120T-150-T6-3035	20	13
7	GE14-P10CNAB415-15GZ-120T-150-T6-3038	12	13
8	GE14-P10CNAB415-15GZ-120T-150-T6-3041	54	13
9	GE14-P10CNAB394-15GZ-120T-150-T6-3271	48	14
10	GE14-P10CNAB394-15GZ-120T-150-T6-3271	80	14
11	GE14-P10CNAB401-13GZ-120T-150-T6-3273	40	14
12	GE14-P10CNAB402-13GZ-120T-150-T6-3274	72	14
13	GE14-P10CNAB416-15GZ-120T-150-T6-3040	8	13
14	GE14-P10CNAB398-12GZ-120T-150-T6-3275	16	14
15	GE14-P10CNAB394-15GZ-120T-150-T6-3272	8	14
17	GE14-P10CNAB415-15GZ-120T-150-T6-3042	12	13
18	GE14-P10CNAB415-15GZ-120T-150-T6-3039	51	13
19	GE14-P10CNAB415-15GZ-120T-150-T6-3039	3	13
	Fresh:		
21	GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643	36	15
22	GNF2-P10CG2B387-15GZ-120T2-150-T6-4045	48	15
23	GNF2-P10CG2B388-13GZ-120T2-150-T6-4046	72	15
24	GNF2-P10CG2B392-15GZ-120T2-150-T6-4047	24	15
25	GNF2-P10CG2B393-10G7.0/2G6.0-120T2-150-T6-4048	32	15
26	GNF2-P10CG2B404-12G6.0-100T2-150-T6-4044	8	15
27	GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643	4	15
28	GNF2-P10CG2B387-15GZ-120T2-150-T6-4045	24	15
29	GNF2-P10CG2B388-13GZ-120T2-150-T6-4046	24	15
30	GNF2-P10CG2B392-15GZ-120T2-150-T6-4047	8	15

PBAPS Unit 3 - RAI-02:

Provide the information to obtain a final core loading pattern as shown in Figure 1 of Attachment 4 including procedures, guidelines, criteria, and approved methodologies used for this analysis.

GNF RESPONSE TO RAI-02 – Applied to LGS Unit 1:

The loading pattern is developed collaboratively by GNF and Exelon based on Exelon input. Among the inputs are:

- Cycle Energy Requirements – fuel bundle design (nuclear) and loading patterns
- Thermal Limit Margins
- Reactivity Margins – minimum shutdown margin, minimum and maximum hot excess reactivity
- Discharge Exposure Limitations and Other Limits as established by safety analysis
- Desired Control Rod Patterns – sequences and durations
- Channel Distortion Minimization

Methods used to analyze the core-loading pattern are in accordance with GESTAR II. GESTAR II is the umbrella for all procedures, guidelines, criteria, and methodologies used for this analysis. There is no change in approved methodologies. This is a SLMCPR Technical Specifications change within approved methodologies. SLMCPR is not the primary driver in developing the fuel cycle core design. The energy plan, reactivity, and thermal margins are the primary drivers.

PBAPS Unit 3 - RAI-03:

Provide the rationale for why a 35.1% reload batch fraction for GNF2 fuel caused the proposed SLMCPR to change by 0.02 for two recirculation loop operation and 0.03 for single recirculation loop operation for the proposed loading pattern in Figure 1 of Attachment 4.

GNF Response to RAI-03 – Applied to LGS Unit 1:

Section 2.1 of Enclosure 1 describes the major contributors to the SLMCPR change. In addition to the explanation provided in this section, Table 6 of Enclosure 1 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 the values actually used. LGS Unit 1 Cycle 15 is the first full reload of GNF2 and therefore applies a higher critical power uncertainty value to the SLMCPR calculation than the GE14 value used in the previous reload, which contributes to an increase in the SLMCPR.

PBAPS Unit 3 - RAI-04:

Confirm that the fuel-related coefficients and constants are the same in the approximation of the correlation for the MCPR Importance Parameter (MIP) and the R-factor Importance Parameter (RIP) for all of the fuels shown in Figure 5 of Attachment 4.

GNF Response to RAI-04 – Applied to LGS Unit 1:

All of the fuels shown in Figure 5 of Enclosure 1 use the same coefficients and constants in the approximation of the correlation for the MIP and RIP. The correlation provides an estimate to check the reasonableness of the Monte Carlo result. It is not used for any other purpose. The methodology and final SLMCPR is based on the rigorous Monte Carlo analysis. A description of the correlation used for the Two Loop Operation (TLO) SLMCPR estimate using the MIPRIP correlation is provided below.

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Background for RAI-05.1 -RAI-05.3:

Section 2.1, "Major Contributors to SLMCPR Change," states that Table 3 presents estimated impacts on the TLO SLMCPR due to methodology deviations, penalties, uncertainties and/or deviations from approved values.

PBAPS Unit 3 - RAI-05.1:

Provide calculation details and justify that the results listed in Table 3 are conservative related to methodology deviations, penalties, uncertainties and/or deviations from approved values.

GNF Response to RAI-05.1 – Applied to LGS Unit 1:

The Monte Carlo TLO and Single Loop Operation (SLO) results listed in Table 3 of Enclosure 1 are conservative related to methodology deviations, penalties, and/or uncertainties deviations from approved values. Section 2.2 of Enclosure 1 discusses the deviations from the NRC-approved values.

PBAPS Unit 3 - RAI-05.2:

Provide a qualitative explanation of the impact on the SLMCPR estimate at rated power and rated flow versus minimum core using MIPRIP correlation as described in Section 2.1 of Attachment 4.

GNF Response to RAI-05.2 – Applied to LGS Unit 1:

Section 2.1 of Enclosure 1 states that 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 cases, and that this is done only to provide some reasonable assessment basis for the minimum core flow trend. As described in Table 3 of Enclosure 1, an additional uncertainty of 0.003 is applied to the estimated SLMCPR for the low core flow case as a result.

PBAPS Unit 3 - RAI-05.3:

Provide a justification that all affected factors including any fuel-related Part 21 issues are reflected in Table 3.

GNF Response to RAI-05.3 – Applied to LGS Unit 1:

There are no known 10 CFR Part 21 factors that affect the LGS Unit 1 Cycle 15 SLMCPR calculations.

PBAPS Unit 3 - RAI-06:

Provide a reactor core map that depicts the 0.1 percent of fuel bundles that may experience boiling transition for the limiting SLMCPR case. Include information regarding the fuel bundle group, group exposure, the number of bundles, fuel type and the percent contribution to the number of fuel rods that are subjected to boiling transition.

GNF Response to RAI-06 – Applied to LGS Unit 1:

The bundle groupings for the TLO SLMCPR calculations are shown in Table RAI-06-1, along with the number of bundles in the group, their contribution to percent number of rods in boiling transition (NRSBT) and the group average exposure at the analysis point. The 2-dimensional core map of the bundle groupings is shown in Figure RAI-06-1 for the upper left hand quadrant in the core. The bundle groupings for the SLO SLMCPR calculations are shown in Table RAI-06-2, along with the number of bundles in the group, their contribution to the percent NRSBT and the group average exposure at the analysis point. [[

]]. Both the TLO and SLO are [[
]].

Table RAI-06-1
Bundle Group, Number of Bundles, Bundle Type, % Contribution to NRSBT, and
Group Exposure for TLO

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Figure RAI-06-1
Two-Dimensional Map of the Bundle Groupings for Percent Contribution to
NRSBT for TLO

Table RAI-06-2
Bundle Group, Number of Bundles, Bundle Type, % Contribution to NRSBT, and
Group Exposure for SLO

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Figure RAI-06-2
Two-Dimensional Map of the Bundle Groupings for Percent Contribution to
NRSBT for SLO

PBAPS Unit 3 - RAI-08:

Identify the sections/pages of Reference 02-1: Global Nuclear Fuel, “General Electric Standard Application for Reactor Fuel (GESTAR II),” NEDE-24011P-A-18 and NEDE-24011P-A-18-US, April 2011, that are applicable to the inputs identified in the response to RAI-02. In addition, provide a quantitative range for the referenced thermal limit margins and the reactivity margins.

GNF Response to RAI-08 – Applied to LGS Unit 1:

While GESTAR II is the umbrella regulatory document for reload activities from a safety criteria and work scope standpoint; it does not specify all design considerations or parameters. Therefore, a one-to-one correspondence with the cycle “design” considerations as listed in the RAI-02 response does not exist.

GESTAR II, NEDE-24011P-A-18, Section 3.1 (Page 3-1) includes the safety criteria to be met by the core design:

3.1.1 Reactivity Basis

The nuclear design shall meet the following basis: The core shall be capable of being made subcritical at any time or at any core condition with the highest worth control rod fully withdrawn.

3.1.2 Overpower Bases

The Technical Specification limits on Minimum Critical Power Ratio (MCPR), the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) and the Linear Heat Generation Rate (LHGR) are determined such that the fuel will not exceed required licensing limits during abnormal operational occurrences or accidents.

Table 3-1 of GESTAR II (Page 3-12) contains more details of the thermal limits applied to nuclear designs.

The design considerations as listed in the RAI-02 response relate to customer specified parameters for the cycle design. Each reload design must meet the GESTAR II safety criteria. These criteria are reflected in the plant Technical Specifications and are monitored for compliance. The design considerations do not affect the requirement to meet the safety criteria or the methodology used in the analysis.

Based on customer input, the following quantitative design values were applied to the LGS Unit 1 Cycle 15 core design:

PBAPS Unit 3 - RAI-09:

Identify the sections/pages of Reference 03-1: Global Nuclear Fuel, "General Electric Standard Application for Reactor Fuel (GESTAR II)," NEDE-24011P-A-18 and NEDE-24011P-A-18-US, April 2011, that describe the SLMCPR calculation related to GNF2 fuel assemblies as discussed in the response to RAI-03.

GNF Response to RAI-09 – Applied to LGS Unit 1: There appears to be some clarification needed in the parsing of this statement in the RAI-03 response:

"In addition to the explanation provided in this section, Table 6 of Attachment 4 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 the values actually used."

- 1st: Table 6 of Enclosure 1 includes the list of uncertainties and actual values used for the LGS Unit 1 Cycle 15 SLMCPR LAR.
- 2nd: The NRC-approved methodologies are contained in GESTAR II as well as being documented in Enclosure 1. The plant and product line specific parameters are not contained in GESTAR II.

An overview of the SLMCPR process is presented in Section 1.1.5 of GESTAR II, NEDE-24011P-A-18 (Page 1-4). Sections 4.3.1, 4.3.1.1, 4.3.1.1.1 and 4.3.1.1.2 (Pages 4-7 and 4-8) contain more details on the calculational method to derive the SLMCPR.

As described in GESTAR II Section 4.3.1.1.1, further details on the procedure are presented in Appendix IV of GESTAR II Reference 4-9 and Section 4 of GESTAR II Reference 4-36. The uncertainties used for the LGS Unit 1 cycle-specific statistical analyses are presented in GESTAR II Reference 4-37, as well as Table 4, Table 5 and Table 6 of Enclosure 1.

GESTAR II provides the approved SLMCPR process and methodology references; therefore, there is no specific mention of the GNF2 product line. The GNF2 fuel product was licensed via the provisions of GESTAR II Section 1.1, Fuel Licensing Acceptance Criteria, which culminated in the Compliance Report for GNF2, NEDC-33270P. Revision 0 of NEDC-33270P was submitted in March 2007 and was subsequently audited by the NRC. As noted in Section 2.5 of Enclosure 1, the NRC has reviewed the applicability of GNF2 to the SLMCPR process and audit report ML081630579, Section 3.4.2.2.1 page 59 states:

"The NRC staff finds that the calculational methods, evaluations and applicability of the OLMCPR and SLMCPR are in accordance with existing NRC-approved methods and thus valid for use with GNF2 fuel."

References:

- GESTAR II 4-9: General Electric BWR Thermal Analysis Basis (GETAB): Data, Correlation and Design Application, NEDE-10958-PA and NEDO-10958-A, January 1977.
- GESTAR II 4-36: Methodology and Uncertainties for Safety Limit MCPR Evaluation, NEDC-32601P-A, August 1999.
- GESTAR II 4-37: Power Distribution Uncertainties for Safety Limit MCPR Evaluations, NEDC-32694P-A, August 1999.

PBAPS Unit 3 - RAI-10:

Provide the calculation details requested in RAI-05.1 that justify the results listed in Table 3 of Attachment 4 from the June 8, 2011, submittal.

GNF Response to RAI-10 – Applied to LGS Unit 1:

Please see Enclosure 5, which contains an overview of the core design process. Note that this enclosure is a modified presentation that was provided to the NRC on August 10, 2010 in response to an NRC Audit on Fitzpatrick C20 SLMCPR Technical Specification Change letter. Slight modifications were made to the presentation in order to include data specific to the LGS Unit 1 Cycle 15 core design.

ATTACHMENT 9

Affidavit

ENCLOSURE 6

CFL-EXN-HH1-11-119

Affidavit

Global Nuclear Fuel – Americas
AFFIDAVIT

I, Andrew A. Lingenfelter, state as follows:

- (1) I am Vice President, Fuel Engineering, Global Nuclear Fuel – Americas, LLC (GNF-A), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.
- (2) The information sought to be withheld is contained in Enclosures 1 and 3 of GNF's letter, CFL-EXN-HH1-11-119, C. Lamb (GNF-A) to J. Tusar (Exelon Nuclear), entitled "GNF Additional Information for SLMCPR Technical Specification Submittal Letter for Limerick Unit 1 Cycle 15," dated September 22, 2011. GNF-A proprietary information in Enclosure 1, which is entitled "GNF Additional Information Regarding the Requested Changes to the Technical Specification SLMCPR, Limerick Unit 1 Cycle 15," and Enclosure 3, which is entitled "Supplemental Peach Bottom RAI Responses Applied to Limerick Unit 1 Cycle 15," is identified by a dotted underline inside double square brackets. [[This sentence is an example.^{3}]] A "[[" marking at the beginning of a table, figure, or paragraph closed with a "]" marking at the end of the table, figure or paragraph is used to indicate that the entire content between the double brackets is proprietary. The information in Enclosure 5, which is entitled "Fuel Application Overview," is proprietary in its entirety. The header of each page in this enclosure carries the notation "GNF Proprietary Information – Class III (Confidential)^{3}." In each case, the superscript notation ^{3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.
- (3) In making this application for withholding of proprietary information of which it is the owner or licensee, GNF-A relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975 F2d 871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F2d 1280 (DC Cir. 1983).
- (4) Some examples of categories of information which fit into the definition of proprietary information are:
 - a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GNF-A's competitors without license from GNF-A constitutes a competitive economic advantage over other companies;

- b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;
- c. Information which reveals aspects of past, present, or future GNF-A customer-funded development plans and programs, resulting in potential products to GNF-A;
- d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

- (5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GNF-A, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GNF-A, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.
- (6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GNF-A. Access to such documents within GNF-A is limited on a "need to know" basis.
- (7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GNF-A are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.
- (8) The information identified in paragraph (2) is classified as proprietary because it contains details of GNF-A's fuel design and licensing methodology. The development of this methodology, along with the testing, development and approval was achieved at a significant cost to GNF-A.

The development of the fuel design and licensing methodology along with the interpretation and application of the analytical results is derived from an extensive experience database that constitutes a major GNF-A asset.

- (9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GNF-A's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GNF-A's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical, and NRC review costs comprise a substantial investment of time and money by GNF-A.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GNF-A's competitive advantage will be lost if its competitors are able to use the results of the GNF-A experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GNF-A would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GNF-A of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 22nd day of September 2011.



Andrew A. Lingenfelter
Vice President, Fuel Engineering
Global Nuclear Fuel – Americas, LLC

ATTACHMENT 10

Power/Flow Map for the Current Cycle 14 and Expected Cycle 15

LGS, Unit 1

Current Cycle 14 and Expected Cycle 15 Power/Flow Map

