UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 11, 2018

Mr. Peter P. Sena, III
President and Chief Nuclear Officer
PSEG Nuclear LLC – N09
Hope Creek Generating Station
P.O. Box 236
Hancocks Bridge, NJ 08038

SUBJECT: HOPE CREEK GENERATING STATION - ISSUANCE OF AMENDMENT NO. 211 REGARDING SAFETY LIMIT MINIMUM CRITICAL POWER RATIO CHANGE (EPID L-2017-LLA-0387)

Dear Mr. Sena:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 211 to Renewed Facility Operating License No. NPF-57 for the Hope Creek Generating Station (HCGS). This amendment consists of changes to the Technical Specifications in response to your application dated November 9, 2017, as supplemented by letter dated January 22, 2018.

The amendment incorporates a revised safety limit minimum critical power ratio for single recirculation loop operation and two recirculation loop operation. The change results from a cycle-specific analysis performed to support the operation of HCGS in the upcoming Cycle 22.

A copy of our related safety evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

Lisa M. Regner, Senior Project Manager
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-354

Enclosures:
1. Amendment No. 211 to Renewed License No. NPF-57
2. Safety Evaluation

cc: Listserv

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PSEG NUCLEAR LLC

DOCKET NO. 50-354

HOPE CREEK GENERATING STATION

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 211
Renewed License No. NPF-57

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment filed by PSEG Nuclear LLC dated November 9, 2017, as supplemented by letter dated January 22, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-57 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 211, and the Environmental Protection Plan contained in Appendix B, are hereby incorporated into the renewed license. PSEG Nuclear LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. The license amendment is effective as of its date of issuance and shall be implemented prior to startup following the spring 2018 refueling outage.

FOR THE NUCLEAR REGULATORY COMMISSION

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility
Operating License and
Technical Specifications

Date of Issuance: April 11, 2018

ATTACHMENT TO LICENSE AMENDMENT NO. 211

HOPE CREEK GENERATING STATION

RENEWED FACILITY OPERATING LICENSE NO. NPF-57

DOCKET NO. 50-354

Replace the following page of the Renewed Facility Operating License with the revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Remove	Insert
3	3

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Remove	Insert
2-1	2-1

reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(4) PSEG Nuclear LLC, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(5) PSEG Nuclear LLC, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(6) PSEG Nuclear LLC, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility. Mechanical disassembly of the GE14i isotope test assemblies containing Cobalt-60 is not considered separation.

(7) PSEG Nuclear LLC, pursuant to the Act and 10 CFR Part 30, to intentionally produce, possess, receive, transfer, and use Cobalt-60.

C. This renewed license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

PSEG Nuclear LLC is authorized to operate the facility at reactor core power levels not in excess of 3840 megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 211, and the Environmental Protection Plan contained in Appendix B, are hereby incorporated in the renewed license. PSEG Nuclear LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

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 24% 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 24% 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 With reactor steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow:

The MINIMUM CRITICAL POWER RATIO (MCPR) shall be $\geq$ 1.09 for two recirculation loop operation and shall be $\geq$ 1.12 for single recirculation loop operation.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With reactor steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow and the MCPR below the values for the fuel stated in LCO 2.1.2, 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 reactor coolant system pressure less than or equal to 1325 psig within 2 hours and comply with the requirements of Specification 6.7.1.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 211

TO RENEWED FACILITY OPERATING LICENSE NO. NPF-57

PSEG NUCLEAR LLC

HOPE CREEK GENERATING STATION

DOCKET NO. 50-354

1.0 INTRODUCTION

By letter dated November 9, 2017, as supplemented by letter dated January 22, 2018 (Agencywide Document Access and Management System (ADAMS) Accession Nos. ML17317B320 and ML18022A374, respectively), PSEG Nuclear LLC (PSEG, or the licensee) requested changes to the Hope Creek Generating Station (HCGS) Technical Specifications (TSs). The requested changes would revise the safety limit minimum critical power ratio (SLMCPR) for single recirculation loop operation (SLO) and two recirculation loop operation (TLO). The proposed change results from a cycle-specific analysis performed to support the operation of HCGS in upcoming Cycle 22.

The supplement dated January 22, 2018, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the staff's original proposed no significant hazards determination as published in the *Federal Register* on February 6, 2018 (83 FR 5281).

2.0 REGULATORY EVALUATION

The U.S. Nuclear Regulatory Commission (NRC or the Commission) staff reviewed the proposed TS changes against the regulatory requirements and guidance listed below to ensure that there is reasonable assurance that the systems and components affected by the proposed TS changes will perform their safety functions.

2.1 Regulatory Requirements

The NRC staff identified the following regulatory requirements as applicable to the proposed amendment.

2.1.1 Applicable TS Regulations

The Commission's regulatory requirements related to the content of the TSs are set forth in Title 10 of the Code of Federal Regulations (10 CFR) Section 50.36, "Technical specifications." This regulation requires that the TSs include items in the following five specific categories:

(1) safety limits (SLs), limiting safety system settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements; (4) design features; and (5) administrative controls. The regulation does not specify the particular requirements to be included in the plant TSs.

As discussed in 10 CFR 50.36(c)(1), SLs for nuclear reactors are limits upon important process variables that protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. The fuel cladding is one of the physical barriers that separate radioactive materials from the environment. The SLMCPR is included in the TSs to ensure that fuel design limits are not exceeded. The SLMCPR limit is contained in HCGS TS 2.1.2, and the parameter on which it is based can vary from cycle to cycle.

2.1.2 General Design Criteria

General Design Criterion (GDC) 10, "Reactor design," of Appendix A to 10 CFR Part 50 states that "[t]he reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences." The purpose of the SLMCPR is to ensure that specified acceptable fuel design limits (SAFDLs) are not exceeded during steady state operation and analyzed transients.

2.2 Regulatory Guidance

Guidance for reviewers on the acceptability of the reactivity control systems, the reactor core, and the fuel system design is provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition (SRP)."

The SRP, Section 4.2, "Fuel System Design," Revision 3, March 2007 (ADAMS Accession No. ML070740002), specifies all fuel damage criteria for evaluation of whether fuel designs meet the SAFDLs.

The SRP, Section 4.4, "Thermal and Hydraulic Design," Revision 2, March 2007 (ADAMS Accession No. ML070550060) provides guidance on the review of thermal-hydraulic design in meeting the requirement of GDC 10 and the fuel design criteria established in SRP Section 4.2. It states that the critical power ratio (CPR) is to be established such that at least 99.9 percent of fuel rods in the core would not be expected to experience departure from nucleate boiling or boiling transition during normal operation or anticipated operational occurrences.

2.3 Proposed Changes

For Operating Cycle 22, the HCGS calculated SLMCPR would change from greater than or equal to (≥) 1.11 to ≥ 1.12 for SLO and from ≥ 1.08 to ≥ 1.09 for TLO. Accordingly, the licensee proposes to revise HCGS TS 2.1.2 to read as follows (changes in **bold**):

> 2.1.2 With reactor steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow:
>
> The MINIMUM CRITICAL POWER RATIO (MCPR) shall be ≥ **1.09** for two recirculation loop operation and shall be ≥ **1.12** for single recirculation loop operation.

Proposed changes to the HCGS TS Bases were provided for information only. The TS Bases are controlled by TS Bases Control Program (HCGS TS 6.15), and any changes to the TS Bases will be made in accordance with the program.

3.0 TECHNICAL EVALUATION

3.1 Background

Fuel design limits can be exceeded if the core exceeds critical power. Critical power is a term used for the power at which the fuel departs from nucleate boiling and enters a transition to film boiling. For boiling-water reactors, the critical power is predicted using a correlation known as the General Electric (GE) critical quality boiling length correlation, better known as the GEXL correlation. Due to core-wide and operational variations, the margin to boiling transition is most easily described in terms of a CPR, which is defined as the rod critical power, as calculated by GEXL, divided by the actual rod power. The greater a CPR value exceeds 1.0, the greater the margin is to boiling transition. The SLMCPR is calculated using a statistical process that takes into account operating parameters and uncertainties. The operating limit minimum critical power ratio (OLMCPR) is equal to the SLMCPR plus a CPR margin for transients. At the OLMCPR, at least 99.9 percent of the rods avoid boiling transition during steady-state operation and transients caused by a single operator error or equipment malfunction. The OLMCPR is required to be established and documented in the core operating limits report for each reload cycle.

3.2 Cycle 22 Core

The absolute value of SLMCPR tends to vary cycle-to-cycle, typically due to the introduction of improved fuel bundle types, changes in fuel vendors or applicable computer codes, and changes in core loading pattern. Fresh fuel bundles generally dominate the SLMCPR calculation. Following the determination of the cycle-specific SLMCPR values, the OLMCPR values are derived. This license amendment request supports the core design for the upcoming HCGS Cycle 22, which will start after the spring 2018 refueling outage.

3.3 Methodology

Global Nuclear Fuel (GNF) performed the HCGS Cycle 22 SLMCPR calculation using the following NRC-approved methodologies and uncertainties:

- NEDO-24011-A, Revision 24, "General Electric Standard Application for Reactor Fuel (GESTAR II)," March 2017 (ADAMS Accession Nos. ML17075A322 and ML17075A323).

- NEDO-32601-A, Revision 0, "Methodology and Uncertainties for Safety Limit MCPR Evaluations," August 1999 (ADAMS Accession No. ML14093A216).

- NEDC-32694-A, "Power Distribution Uncertainties for Safety Limit MCPR Evaluations," August 1999 ("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," dated March 11, 1999 (ADAMS Accession No. ML993140059)).

- NEDO-32505-A, Revision 1, "R-Factor Calculation Method for GE11, GE12 and GE13 Fuel," July 1999 (ADAMS Accession No. ML060520636).

These methodologies were used for the HCGS Cycle 21 and the Cycle 22 SLMCPR calculations. The NRC staff reviewed the proposed change to ensure that the generic methods were appropriately applied to HCGS. The HCGS Cycle 22 core consists of 412 GNF2 and 352 GE14 legacy fuel assemblies. No plant hardware or operational changes are required with this proposed change.

The R-Factor is an input into the GEXL correlation used to describe the local pin-by-pin power distribution and the fuel assembly and channel geometry on the fuel assembly critical power. The R-Factor uncertainty analysis includes an allowance for power peaking modeling uncertainty, manufacturing uncertainty, and channel bow uncertainty. The NEDO-32505-A report is the generic R-Factor methodology report that describes the changed methodology that was adopted after part length rods were introduced. The NRC staff's safety evaluation for NEDC-32505P-A (the proprietary version of NEDO-32505-A) has a requirement that the applicability of the R-Factor methodology is confirmed when a new fuel type is introduced. By letter dated March 14, 2017, GNF submitted FLN-2007-011, "GNF2 Advantage Generic Compliance with NEDE-24011P-A (GESTAR II), NEDC-33270P, March 2007, and GEXL17 Correlation for GNF2 Fuel, NEDC-33292P, March 2007" (ADAMS Accession No. ML070780335). This letter confirmed that the R-factor methodology of NEDC-32505P-A is applicable to GNF2, and that all of the criteria defined in NEDE-24011-P-A have been met for the GNF2 fuel design. As part of an NRC audit related to this report, the GNF2 fuel design was verified to have been evaluated in accordance with the NRC-approved methodologies listed above. This was documented in an audit report dated September 25, 2008 (ADAMS Accession No. ML082690382).

The current cycle core design has produced similar results to the previous cycle core design. The change in the calculated SLMCPR can be attributed to cycle-to-cycle variation. A key component of this variation is both the bundle-by-bundle MCPR distribution as well as the pin-by-pin power/R-Factor distribution. The only effect the increase in power level has is a difference in the flow uncertainty, which decreases due to the increase in the minimum core flow.

For the limiting TLO case, the current fresh fuel pin-by-pin power/R-Factor distribution is flatter than the previous cycle fresh fuel pin-by-pin power/R-Factor distribution while the core bundle-by-bundle MCPR distribution is slightly more peaked than the previous cycle. While the current cycle core bundle-by-bundle MCPR distribution is slightly more peaked, the change in the fresh fuel pin-by-pin power/R-Factor is more significant, thus the combination of the two distributions produces a flatter core power distribution. The overall core power distribution flatness along with the cycle-to-cycle variation in the core loading tends to produce an increase in the calculated SLMCPR.

The current cycle's change in the Monte Carlo SLO SLMCPR from the previous cycle is consistent with the Monte Carlo TLO SLMCPR change between the two cycles. The SLO values are greater than the TLO values as expected due to the increase in uncertainties used for the SLO case.

On the basis of the analysis performed by GNF using the NRC-approved methodologies described above, the licensee has proposed to amend the HCGS TS Section 2.1.2 to revise the SLMCPR for the Operating Cycle 22. The information regarding requested changes to the HCGS TS SLMCPR is based on the core rated power of 3,902 megawatt, and at minimum core

flow of 97.1 percent at rated power. For Cycle 22, the minimum core flow SLMCPR calculation performed at 97.1 percent core flow and rated core power condition was limiting as compared to the rated core flow and rated core power condition.

The current required SLMCPR values in HCGS TS are ≥ 1.08 for TLO and ≥ 1.11 for SLO. Calculations performed by GNF for HCGS Cycle 22 resulted in a minimum calculated value of SLMCPR to be ≥ 1.09 for TLO and ≥ 1.12 for SLO. GNF's calculation of the revised plant-specific SLMCPR numeric values for HCGS Cycle 22 was performed as part of the reload licensing analysis for HCGS Cycle 22, and is based upon NRC-approved methods, therefore it is acceptable. No departures from NRC-approved methodologies, or deviations from NRC-approved calculational uncertainties, were identified in the HCGS, Cycle 22, SLMCPR calculations. All calculated uncertainties for HCGS, Cycle 22, SLMCPR calculations were conservative relative to NRC-approved values.

The license amendment request dated November 9, 2017, was supplemented by letter dated January 22, 2018, in which the licensee stated that GE Hitachi Nuclear Energy determined that the GESAM02 engineering computer program used to calculate the SLMCPR contained an error in its pseudo-random number generator. No change to the proposed HCGS Cycle 22 SLMCPR values were required due to this error. However, PSEG submitted a revised GNF Report as part of the January 22, 2018, letter. The NRC staff reviewed the revised calculation and the results provided in the supplement, and verified that the proposed SLMCPR values remain unchanged.

3.4 Technical Conclusion

Based on the finding above, The NRC staff concludes that the proposed changes will continue to meet the applicable regulatory requirements and guidance, and that the analysis performed to calculate the HCGS Cycle 22 SLMCPR numeric values was based upon NRC-approved methodologies. The NRC staff concludes that the new SLMCPR values for SLO and TLO will continue to provide assurance that 99.9 percent of the fuel rods in the core will not exceed the CPR, and that fuel cladding integrity will be maintained under conditions of normal operation and with appropriate margin for anticipated operational occurrences.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the New Jersey State Official was notified of the proposed issuance of the amendment on February 27, 2018. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (83 FR 5281). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that 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.

Principal Contributor: Muhammad Razzaque, NRR

Date: April 11, 2018.

SUBJECT: HOPE CREEK GENERATING STATION - ISSUANCE OF AMENDMENT NO. 211 RE: SAFETY LIMIT MINIMUM CRITICAL POWER RATIO CHANGE (EPID L-2017-LLA-0387) DATED APRIL 11, 2018.

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ADAMS Accession No.: ML18081A044

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DATE	4/6/2018	3/28/2018	2/26/2018
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DATE	4/6/2018	4/10/2018	4/11/2018

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