November 28, 2001

Mr. Harold W. Keiser
Chief Nuclear Officer & President
PSEG Nuclear LLC-X04
Post Office Box 236
Hancocks Bridge, NJ 08038

SUBJECT: HOPE CREEK GENERATING STATION, WITHDRAWAL OF AN AMENDMENT REQUEST, OSCILLATION POWER RANGE MONITOR (TAC NO. MB0589)

Dear Mr. Keiser:

By letter dated November 29, 2000, as supplemented August 10, 2001, you applied for an amendment to the Hope Creek Generating Station (HCGS) Operating License No. NPF-57. The proposed change would have modified the HCGS technical specifications to reflect the enabling of the Oscillation Power Range Monitor (OPRM) reactor protection system (RPS) trip function. The OPRM is designed to detect the onset of reactor core power oscillations resulting from thermal-hydraulic instability and suppress them by initiating a reactor scram via the RPS trip logic. Subsequently, by letter dated October 19, 2001, you withdrew the amendment request.

The withdrawal request was based on the extended time period General Electric Company (GE) is projecting to resolve a defect that was reported to the Nuclear Regulatory Commission (NRC) pursuant to Part 21 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 21). The defect pertains to GE's OPRM setpoint methodology as detailed in letters from GE to the NRC dated June 29 and August 31, 2001. The defect could result in non-conservative OPRM trip setpoints. The OPRM is currently installed at HCGS with the RPS trip function disabled. Your withdrawal letter stated that you intend to resubmit a license amendment request to enable the OPRM RPS trip function after the 10 CFR Part 21 issue is resolved and an applicable approved methodology is in place.

Enclosed is a draft Safety Evaluation (SE) that documents the completed portions of the NRC staff's review. Upon resubmittal, you may reference the draft SE in order to facilitate the subsequent review.

The Commission has filed the enclosed Notice of Withdrawal of Application for Amendment to Facility Operating License with the Office of the Federal Register for publication.

Sincerely,

/RA/

Richard B. Ennis, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-354

Enclosures: 1. Notice of Withdrawal
2. Draft SE

cc w/encls: See next page

The Commission has filed the enclosed Notice of Withdrawal of Application for Amendment to Facility Operating License with the Office of the Federal Register for publication.

Sincerely,

/RA/

Richard B. Ennis, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-354

Enclosures: 1. Notice of Withdrawal
2. Draft SE

cc w/encls: See next page

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Hope Creek Generating Station

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UNITED STATES NUCLEAR REGULATORY COMMISSION

PSEG NUCLEAR LLC

DOCKET NO. 50-354

NOTICE OF WITHDRAWAL OF APPLICATION FOR

AMENDMENT TO FACILITY OPERATING LICENSE

The U.S. Nuclear Regulatory Commission (the Commission) has granted the request of PSEG Nuclear LLC (the licensee) to withdraw its November 29, 2000, application as supplemented August 10, 2001, for proposed amendment to Facility Operating License No. NPF-57 for the Hope Creek Generating Station (HCGS), located in Salem County, New Jersey.

The proposed amendment would have modified the HCGS technical specifications to reflect the enabling of the Oscillation Power Range Monitor (OPRM) reactor protection system (RPS) trip function. The OPRM is designed to detect the onset of reactor core power oscillations resulting from thermal-hydraulic instability and suppress them by initiating a reactor scram via the RPS trip logic.

The Commission had previously issued a Notice of Consideration of Issuance of Amendment published in the FEDERAL REGISTER on December 27, 2000 (65 FR 81930). However, by letter dated October 19, 2001, the licensee withdrew the proposed change. The withdrawal request was based on the extended time period General Electric Company (GE) is projecting to resolve a defect that was reported to the Commission pursuant to Part 21 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 21). The defect pertains to GE's OPRM setpoint methodology as detailed in letters from GE to the Commission dated June 29 and August 31, 2001. The defect could result in non-conservative OPRM trip setpoints. The OPRM is currently installed at HCGS with the RPS trip function disabled.

For further details with respect to this action, see the application for amendment dated November 29, 2000, as supplemented August 10, 2001, and the licensee's letter dated October 19, 2001, which withdrew the application for license amendment. Documents may be examined, and/or copied for a fee, at the NRC's Public Document Room, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible electronically from the Agencywide Documents Access and Management Systems (ADAMS) Public Electronic Reading Room on the internet at the NRC Web site, http://www.nrc.gov/reading-rm.html. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS, should contact the NRC Public Document Room (PDR) Reference staff by telephone at 1-800-397-4209, 301-415-4737 or by email to pdr@nrc.gov.

Dated at Rockville, Maryland, this 28th day of November 2001.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Richard B. Ennis, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

DRAFT SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO FACILITY OPERATING LICENSE NO. NPF-57

PSEG NUCLEAR LLC

HOPE CREEK GENERATING STATION

DOCKET NO. 50-354

1.0 INTRODUCTION

By letter dated November 29, 2000, as supplemented on August 10, 2001, PSEG Nuclear LLC (PSEG or the licensee) submitted a request for changes to the Hope Creek Generating Station (HCGS) Technical Specifications (TSs). The requested changes would revise the TSs to reflect the enabling of the Oscillation Power Range Monitor (OPRM) reactor protection system (RPS) trip function. The OPRM is designed to detect the onset of reactor core power oscillations resulting from thermal-hydraulic (T-H) instability and suppress them by initiating a reactor scram via the RPS trip logic. The letter dated August 10, 2001, provided clarifying information that did not change the initial proposed no significant hazards consideration determination.

By letter dated October 19, 2001, the licensee withdrew the amendment request based on the extended time period General Electric Company (GE) is projecting to resolve a defect that was reported to the Nuclear Regulatory Commission (NRC) pursuant to Part 21 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 21). The defect pertains to GE's OPRM setpoint methodology as detailed in letters from GE to the NRC dated June 29 and August 31, 2001. The defect could result in non-conservative OPRM trip setpoints. The OPRM is currently installed at HCGS with the RPS trip function disabled. The licensee's withdrawal letter stated that a license amendment request would be resubmitted to enable the OPRM RPS trip function after the 10 CFR Part 21 issue is resolved and an applicable approved methodology is in place.

This draft Safety Evaluation (SE) documents the completed portions of the NRC's review prior to the withdrawal. The draft SE is being issued to facilitate the subsequent review upon the licensee's resubmittal. The conclusions stated in this draft SE are based on the review of the licensee's submittal dated November 29, 2000, as supplemented on August 10, 2001. The NRC staff will determine the validity of its review and conclusions following the licensee's resubmittal of its application for the proposed change.

2.0 BACKGROUND

2.1 Purpose and Desription of Proposed TS Changes

General Design Criteria (GDC) 10 of Appendix A to 10 CFR Part 50 requires that the reactor core and associated coolant, control, and protections systems be designed with appropriate margin to assure that specified acceptable fuel design limits will not be exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. Additionally, GDC 12 requires that the reactor core and associated coolant, control, and protection systems be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible, or can be reliably and readily detected and suppressed.

Under certain conditions, boiling water reactor (BWR) cores may exhibit T-H instabilities. These instabilities are characterized by periodic power and flow oscillations. If the oscillations become large enough, the fuel cladding integrity minimum critical power ratio (MCPR) safety limit and GDC 10 and 12 requirements may be challenged. Based on this possibility, HCGS is currently operating with certain interim corrective actions (ICAs) as described in PSEG's response to NRC Generic Letter (GL) 94-02. The ICAs include restrictions on plant operation and procedural requirements for operator action in response to instability events.

The requirements of the ICAs and existing TSs limit the probability of an instability event by restricting the duration of any entry into the regions of the power to flow map most susceptible to instability under anticipated entry conditions. Actions are also required by the ICAs when conditions consistent with the onset of T-H oscillations are observed. These actions result in the suppression of conditions required for an instability event and thereby prevent any potential challenge to the MCPR safety limit.

Implementation of the proposed TS revisions would allow the RPS trip function of the OPRM system to be enabled consistent with the Asea Brown Boveri Combustion Engineering (ABB-CE) Option III long-term solution for the T-H instability issue. The OPRM RPS trip function would provide automatic detection and suppression of conditions which might result in a T-H instability event and would allow elimination of the ICAs. As a result, the burden on the control room operators would be reduced.

The OPRM, which was installed at HCGS during the seventh refueling outage, is currently being operated in the "indicate only" mode to evaluate the systems' performance. During this test period, the existing ICAs provide an acceptable method of ensuring adequate margin to the MCPR safety limit until the OPRM RPS trip function is enabled.

The licensee's submittal proposed the following revisions to the existing TSs:

1. TS 3.4.1.1, page 3/4 4-1: Remove the word "with" from the first sentence and remove Subsections 3.4.1.1.a and 3.4.1.1.b entirely.

2. TS 3.4.1.1 Action b, page 3/4 4-2: Remove the portion of the statement, "immediately initiate action to reduce THERMAL POWER to less than or equal to the limit specified in Figure 3.4.1.1-1 within 2 hours and".

3. TS 3.4.1.1 Action c, page 3/4 4-2: Remove the entire statement for Action c.

4. TS 3.4.1.1 Action d, page 3/4 4-2: Remove the entire statement for Action d.

5. TS 4.4.1.1.1.c, page 3/4 4-2a: Remove the word "and."

6. TS 4.4.1.1.1.d, page 3/4 4-2a: Remove the entire statement for Surveillance Requirement 4.4.1.1.1.d.

7. TS 4.4.1.1.4, page 3/4 4-2a: Remove the entire statement for Surveillance Requirement 4.4.1.1.4.

8. TS Figure 3.4.1.1.1, page 3/4 4-3: Remove Figure 3.4.1.1-1.

9. TS Bases 3/4.4.1, page B 3/4 4-1: Remove the entire last two paragraphs on this page beginning with, "The objective of...." and ending with, "greater than that specified in Figure 3.4.1.1-1."

10. TS Bases 3/4.4.1, page B 3/4 4-2: Remove the entire first three paragraphs beginning with, "Plant specific calculations can be ...." and ending with, "to the power level at a given core flow."

11. TS 6.9.1.9, page 6-20: Add "3/4.3.10 Oscillation Power Range Monitor (OPRM)."

12. TS 6.9.1.9, page 6-21: Revise the first sentence to reflect the addition of a new reference.

13. Page 6-26, REFERENCES: Add the following new reference: "NEDO-32465-A, Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications, August 1996."

The licensee's submittal proposed to add the following new TS pages:

1. Page 3/4 3-109, Section 3/4.3, Instrumentation, Subsection 3/4.3.10, Oscillation Power Range Monitor

2. Pages B 3/4 3-9 through B 3/4 3-13, TS Bases 3/4.3.10, Oscillation Power Range Monitor

2.2 System Description

The function of the OPRM is to detect core power oscillations and trip (scram) the plant if the magnitude of the oscillations exceeds the setpoint. The OPRM system consists of four OPRM channels and each OPRM channel consists of two OPRM modules that provide inputs to its associated RPS channel. Each OPRM channel contains more than 30 cells and each cell represents a combination of 4 local power range monitors (LPRMs) in adjacent areas of the core. Cells using a smaller group of LPRMs to monitor instantaneous flux provide a better resolution for detecting local oscillations than average power range monitors (APRMs) alone. The LPRM signals are grouped together so that the resulting OPRM response provides adequate coverage of anticipated oscillation modes. On detecting conditions consistent with the local oscillations in core power leading to a T-H instability, the OPRM initiates a reactor scram through the existing RPS trip logic. This capability of the OPRM ensures protection of the MCPR safety limit during all anticipated core-wide and regional T-H instability events. The

OPRM system logic configuration conforms to the existing 1 out of 2 taken twice logic configuration of the RPS. Each module executes the algorithms on the LPRM signals and based on cell configuration for that channel, generates alarms and trips. The assigned locations of modules are consistent with the RPS and Neutron Monitoring system separation requirements. The system design accounts for isolator accuracy, instrument and system response times, system performance requirements, and addresses redundancy, diversity, separation, and electrical isolation requirements.

The OPRM trip function is enabled when APRM power is greater than or equal to 30% of rated thermal power and the recirculation drive flow is less than or equal to the value corresponding to approximately 60% of rated core flow. The OPRM provides annunciation to alert the operator when the system is enabled and also provides a pre-trip alarm upon detection of imminent onset of local core power oscillations. The purpose of this alarm is to alert the plant operator to the plant condition in time for compensatory actions to be taken for those conditions for which instability may be anticipated. Each OPRM module uses three separate algorithms to detect and mitigate core power oscillations. The three algorithms are the period-based algorithm (PBA), the amplitude-based algorithm (ABA), and the growth-rate algorithm (GRA). The PBA algorithm actuates the RPS trip on detecting oscillations of a certain period and amplitude, and is the only algorithm that is credited in the analysis of capability of the OPRM system to protect the MCPR limit. The remaining two algorithms provide defense-in-depth and additional protection for T-H instability events.

3.0 EVALUATION

The design and effectiveness of the OPRM system in meeting the regulatory requirement to detect and suppress conditions that could lead to T-H instability is documented in the following NRC-approved topical reports: (1) NEDO-32645-A, “BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications,” August 1996; (2) NEDO-31960-A, “BWROG Long-Term Stability Solutions Licensing Methodology,” November 1995; (3) NEDO-31960-A, Supplement 1, “BWROG Long Term Stability Solutions Licensing Methodology,” November 1995; and (4) CENPD-400-P-A, Revision 1, “Generic Topical Report for the ABB Option III Oscillation Power Range Monitor (OPRM),” May 1995.

The staff safety evaluation report (SER) approving CENPD-400-P-A requires each licensee to address the following six issues in their plant-specific submittals for implementing the ABB-CE Option III OPRM system as a permanent long-term solution for the T-H instability issue, and to identify and justify any deviations from the CENPD-400-P-A and associated SER:

1. Confirm the applicability of CENPD-400-P, including clarifications and reconciled differences between the specific plant design and the topical report design descriptions.

   In its submittal the licensee stated that the HCGS installation and implementation of OPRM is consistent with CENPD-400-P and the associated SER and there are no deviations. Based on our review of the licensee’s application, the staff concludes that CENPD-400-P is applicable to the HCGS OPRM design.

2. Confirm the applicability of BWROG topical reports that address the OPRM and associated instability function, setpoints, and margins.

The BWROG topical reports which address the OPRM and associated instability functions, setpoints and margins are NEDO-31960 and its supplement NEDO-32465. In its submittal the licensee included the following information to confirm applicability of NEDO-31960 and its supplement NEDO-32465 for implementation of the Option III OPRM system at HCGS:

a. All three algorithms described in NEDO-31960 and its supplement are used.

b. The validity of the selected scram setpoints has been confirmed using the initial application and reload review methodology described in NEDO-32465.

c. The selected bypass region outside of which the detect and suppress action of OPRM is deactivated is defined in the proposed TS revision.

d. The automatic protective function of the OPRM trip will be a full reactor scram.

e. The LPRM groupings proposed to be implemented at HCGS conforms with LPRM assignments shown in Appendix D of NEDO-32465 and is consistent with accepted NRC position.

For the proposed TS changes, the period-based algorithm of the OPRM system actuates the RPS trip on detecting oscillations of a certain period and amplitude, and is the only algorithm that is credited in the analysis of capability of the OPRM system to protect the MCPR limit. NEDO-32465 describes the confirmation setpoints of the period-based algorithm and established a specific range of values for the period tolerance to allow the OPRM system to be tuned for plant-specific LPRM noise characteristics. But the period tolerance setpoint proposed for implementation of Option III at HCGS is out of the range established by NEDO-32465.

In its submittal, the licensee stated that based on testing performed for the HCGS plant-specific conditions during cycle 8, a period tolerance of 50 milliseconds was determined to be needed to preclude spurious trips and alarms of the OPRM system. The licensee further added that in an October 21, 1997, letter to NRC, the Southern Nuclear Company informed the staff that, the capability of the Option III firmware as prescribed in NEDO-31960 and its supplement has been verified considering a period tolerance of 50 milliseconds, using instability data from the Swiss Plant KKL. The proposed setting does not compromise the ability of the OPRM to detect T-H instabilities and initiate an automatic reactor scram prior to violating the MCPR safety limit. Although the proposed setpoint for period tolerance is out of the range established by NEDO-32465, it is consistent with the range identified in Section 6.2 of Supplement 1 to NEDO-31960 and, therefore, is acceptable to the staff.

As discussed in Section 1.0 of this SE, GE has identified a defect in their OPRM setpoint methodology that could result in non-conservative OPRM trip setpoints. The non-conservatism relates to the methodology described in NEDO-32465 and could result in setpoints that do not provide MCPR safety limit protection. Until this 10 CFR Part 21 issue is resolved and a revised NRC-approved methodology is put into place,

the NRC staff concludes that the basis for the proposed HCGS OPRM trip setpoints is not valid. Therefore, the staff cannot complete its evaluation of the proposed change to the HCGS TSs to reflect the enabling of the OPRM RPS trip function.

3. Provide a plant-specific TS for the OPRM functions consistent with CENPD-400-P, Appendix A.

In its submittal the licensee stated that the proposed TSs are consistent with CENPD-400-P, Appendix A with one exception. Appendix A to CENPD-400-P specifies two required actions in the event OPRM trip is inoperable. The first action requires initiation of an alternate method to detect and suppress T-H instability oscillations with a completion time of 12 hours, and the second action requires restoration of the OPRM trip capability within 120 days. In its submittal the licensee stated that the proposed TS revision includes only the first action and does not include the second action. In a justification for not including the second specified action in the TS, the licensee stated that the proposed OPRM system is a safety system and, therefore, requirements of Section XVI, "Corrective Action" of 10 CFR Part 50 Appendix B for timely corrective action to ensure operability of a failed, malfunctioning, deficient, defective, or non-conforming equipment, is applicable to it. Explicit specification of a required action to restore the inoperable OPRM trip capability is appropriate only if such action within a specific completion time is required to ensure detection and suppression of a T-H instability event. The licensee believes that because an alternate method would adequately ensure detection and suppression of T-H instability, the specification of an additional action to restore OPRM trip capability within a specific completion time is not necessary. The licensee further added that at HCGS, the current methods for detecting and suppressing T-H instability oscillations have been in place for more than 5 years.

Based on our review of the licensee's application, the staff concludes that: (1) in the future, when the proposed OPRM trip is not available, the licensee intends to use the current methods (which have been in place for more than 5 years) as an alternate method to detect and suppress T-H instability event, (2) the current method is equally good as compared to the proposed OPRM trip (considering its sensitivity, response time and setpoint) for performing the intended design function(s) of the OPRM trip, and (3) after implementation of the proposed OPRM trip, the licensee will maintain the current methods in accordance with the quality requirements of Appendix B to 10 CFR Part 50. Therefore, excluding the second action (described in Appendix A to CENPD-400-P) which requires the restoration of the inoperable OPRM trip within 120 days, from the proposed TS revision is acceptable to the staff.

4. Confirm that the plant-specific environmental (temperature, humidity, radiation, electromagnetic, and seismic) conditions are enveloped by the OPRM equipment environmental qualification values.

In its submittal the licensee stated that installation of the OPRM at HCGS is consistent with the Equipment Qualification requirements described in the staff's SER. At HCGS, the OPRM equipment is installed in the main control room and is qualified to perform its intended design function(s) continuously in the control room environment. The system is designed to provide a high degree of immunity from electro-magnetic interference/radio frequency interference (EMI/RFI). In response to the staff's request

for additional information dated July 12, 2001, the licensee stated in a letter dated August 10, 2001, that equipment for the proposed OPRM trip has been qualified for EMI and RFI susceptibility based on the generic levels identified by EPRI TR-102323 Revision 1. These tests met the frequency limits specified in the EMI susceptibility guide (Appendix B to EPRI TR-102323), with the exception of the radiated susceptibility test which was conducted for the frequency range of 14 kHz to 1 GHz instead 10 kHz to 1GHz. The licensee further stated that sources which could generate strong magnetic fields in a frequency range of 10kHz to 14kHz are absent from the installed area of the OPRM equipment. Since the sources of magnetic fields for frequencies lower than 14 kHz are not present at the installed location of the OPRM equipment, the staff finds EMI/RFI qualification test with the above exception, acceptable. The OPRM equipment is seismically qualified in accordance with the requirements of HCGS Design-Basis Earthquake.

Based on our review of the licensee's application, the staff concludes that the HCGS OPRM is designed for the plant-specific environmental conditions.

5. Confirm that administrative controls are provided for manually bypassing OPRM channels or protective functions, and for controlling access to the OPRM functions.

   In its submittal the licensee stated that the OPRM implementation at HCGS is consistent with the staff's SER. The plant procedures provide administrative control for placing individual OPRM modules in bypass and automatically enable its pre-trip and trip alarm outputs upon entry into the high power and low-core flow region of the power/flow operating map. Main control room overhead annunciator is activated if the OPRM has been manually bypassed or deliberately rendered inoperative.

   Based on our review of the licensee's application, the staff concludes that adequate administrative controls are provided for operation of the HCGS OPRM.

6. Confirm that any changes to the plant operator's main control room panel have received human factor reviews per plant-specific procedures.

   In its submittal the licensee stated that for OPRM implementation, human factor engineering principles consistent with the HCGS Annunciator study have been applied in selecting annunciator locations and groupings. The OPRM has an operator interface with the CRIDS computer, control room annunciators (that signal system status and/or problems), and the OPRM front panel LEDs. In addition OPRM modules are provided with local LED indications for ALARM, TROUBLE, INOP, TRIP, TRIP ENABLED, and READY modes of the OPRM system. LED indications for ALARM, TRIP, and TROUBLE modes are latched off until reset locally. Procedural requirements control placing an OPRM module in bypass and verifying restoration. Key lock access is necessary to manually bypass an OPRM module.

   Based on our review of the licensee's application, the staff concludes that adequate human factors reviews have been performed for the changes associated with implementation of the HCGS OPRM.

Based on the above evaluation, the staff finds that the HCGS OPRM implementation and associated proposed TS changes are consistent with the staff's SER approving topical report CENPD-400-P-A. However, until the GE 10 CFR Part 21 issue is resolved and a revised NRC-approved methodology is put into place, the NRC staff concludes that the basis for the proposed HCGS OPRM trip setpoints is not valid. Therefore, the proposed amendment is not acceptable at this time.

Principal Contributors: S. V. Athavale
R. B. Ennis

Date: November 28, 2001