UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

June 16, 2011

The Honorable Gregory B. Jaczko
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REPORT ON THE SAFETY ASPECTS OF THE LICENSE RENEWAL APPLICATION FOR THE HOPE CREEK GENERATING STATION

Dear Chairman Jaczko:

During the 584th meeting of the Advisory Committee on Reactor Safeguards, June 8-10, 2011, we completed our review of the license renewal application for the Hope Creek Generating Station (HCGS) and the final Safety Evaluation Report (SER) prepared by the NRC staff. During our 583rd meeting, May 12-14, 2011, we reviewed a previous version of this application and the associated staff SER. Our Plant License Renewal Subcommittee also reviewed this matter during its meeting on November 3, 2010. During these reviews, we had the benefit of discussions with representatives of the NRC staff and PSEG Nuclear, LLC (PSEG or the applicant). We also had the benefit of the documents referenced. This report fulfills the requirement of 10 CFR 54.25 that the ACRS review and report on all license renewal applications.

CONCLUSION AND RECOMMENDATION

1. The programs established and committed to by the applicant to manage age-related degradation provide reasonable assurance that HCGS can be operated in accordance with its current licensing basis (CLB) for the period of extended operation (PEO) without undue risk to the health and safety of the public.

2. The PSEG application for renewal of the operating license of HCGS should be approved.

BACKGROUND AND DISCUSSION

HCGS is a General Electric (GE) Model 4 boiling water reactor (BWR) with a Mark I containment. HCGS is located approximately 40 miles from Philadelphia, Pennsylvania, and 8 miles from Salem, New Jersey. The licensed power output of the unit is 3,840 megawatts thermal with a gross electrical output of approximately 1,268 megawatts electric. PSEG has requested renewal of the HCGS operating license for 20 years beyond the current license term, which expires on April 11, 2026.

In the final SER, the staff documented its review of the license renewal application and other information submitted by the applicant or obtained from the staff audits and inspection at the plant site. The staff reviewed the completeness of the applicant's identification of the structures,

systems, and components (SSCs) that are within the scope of license renewal; the integrated plant assessment process; the applicant's identification of the plausible aging mechanisms associated with passive, long-lived components; the adequacy of the applicants Aging Management Programs (AMPs); and the identification and assessment of time-limited aging analyses (TLAAs) requiring review.

In the HCGS license renewal application, PSEG identified the SSCs that fall within the scope of license renewal. For these SSCs, the applicant performed a comprehensive aging management review. Based on this review, the applicant will implement 47 AMPs for license renewal, of which 33 are existing programs and 14 are new programs. Fifteen of the programs are enhanced and eight programs have exceptions compared with the corresponding programs described in the Generic Aging Lessons Learned (GALL) Report. Six of the programs are plant specific programs that do not have counterparts in the GALL Report. The PSEG application either demonstrates consistency with the GALL Report or documents deviations to the approaches specified in the Report. We have reviewed the exceptions and agree with the staff that they are acceptable.

The staff conducted two license renewal audits and an inspection at HCGS. The audits verified the appropriateness of the scoping and screening methodology, aging management review, and associated AMPs. The inspection verified that the license renewal requirements are appropriately implemented. Based on the audit and inspection, the staff concluded in the final SER that the proposed activities will reasonably manage the effects of aging of SSCs identified in the application and that the intended functions of these SSCs will be maintained during the PEO. We agree with these conclusions.

Industry operating experience documents instances of corrosion on inaccessible exterior surfaces of the drywell shell of GE BWR Mark I containments. PSEG performed ultrasonic thickness (UT) measurements, for the drywell shell in 2007 and 2009. The results of these inspections showed no loss of material due to corrosion. A small reactor cavity leak was identified in 2009 during the refueling outage. The leak only occured when the reactor cavity was flooded. The probable leakage path is through a weld defect in the reactor cavity seal plate through the air gap between the drywell shell and the concrete shield wall. Some leakage exited the air gap through an instrument penetration sleeve in the concrete shield wall and formed a small puddle on the torus room floor.

Borescope inspections indicated that wetting of the concrete occurred over about a 30° azimuth span. Such leakage could collect at the base of the gap between the shell and the shield wall. There were supposed to be drain lines at the base of this gap to prevent moisture collection, but borescope examinations of each of the four drain lines showed that all of the drain lines were blocked. Probes inserted into the exit of one drain line in the torus room indicate that the line is blocked about six feet from the inner surface of the concrete shield wall. The configuration of the other three drains is not known at this time, but all of the drains are, and probably have been, nonfunctional since original construction. Thus, potential moisture from leaks could collect at the base of the drywell gap and wet a ring of the drywell shell about 1.4 feet in height before spilling out of the openings around the drywell vent lines. However, no spillage has been observed.

PSEG has made many UT measurements around the drywell shell at the base of the air gap and up the drywell shell opposite the known wetted area of the concrete. All the measured thicknesses, except for a small region at the base of the drywell air gap in the region where wetting of the concrete could be observed at higher elevations, are above the nominal

thicknesses and the design thicknesses. The minimum measured thickness is well above that assumed in the design analyses.

The AMP for the drywell shell is based on ASME Section XI, Subsection IWE. PSEG has committed to a number of enhancements beyond this program. They will continue to search for the source of the reactor cavity water leakage and repair it, if practical, before the PEO. PSEG will verify that the reactor cavity seal rupture drain lines are open. The program also commits to the establishment of drainage from the bottom of the air gap drains and provides for augmented UT examinations of the drywell shell to provide assurance of the integrity of the drywell shell.

To ensure compliance with these commitments, the staff has added two license conditions:

The first of these requires the applicant to establish drainage capability from the bottom of the drywell air gap from all four quadrants. Until drainage is established, the applicant will perform borescope examinations and UT measurements. The applicant will monitor penetration sleeve, J13, daily for water leakage when the reactor cavity is flooded and will submit a report to the staff summarizing the results from the borescope examinations, UT measurements, and leakage detected from the penetration.

The second license condition requires PSEG to submit a report to the staff when drainage has been established from the bottom of the air gap in all four quadrants. PSEG will also perform UT measurements during the next three refueling outages and submit a report to the staff summarizing the results from the UT measurements.

Based on this enhanced AMP for the drywell shell, the staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions of the primary containment will be maintained consistent with the CLB for the PEO. We concur with the staff's conclusion.

Inaccessible medium-voltage cables in certain manholes at HCGS have been exposed to significant moisture, i.e., in standing water for more than a few days. The staff has identified water in manholes as a generic, current operating plant issue in Information Notice 2002-12, “Submerged Safety-Related Electrical Cables,” dated March 21, 2002, and Generic Letter 2007-01, “Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients,” dated February 7, 2007. During the current period of operation, this issue is being addressed through the reactor oversight process, in accordance with the requirements of 10 CFR Part 50.

The problem is exacerbated at HCGS because the service water cable vaults are not easily accessible. They have 60-ton concrete blocks as covers. In addition, there are sections of in-scope cables that go in duct banks below the elevation of the manholes. Operating experience suggests that the moisture ingress is event-driven, i.e., infiltration from storms. Physical modifications have been made to the service water cable vault covers to allow more frequent inspection and dewatering. PSEG is also making repairs to try to reduce inleakage. Despite a history of water intrusion, HCGS has no history of failures of in-scope inaccessible low and medium voltage power cables.

PSEG has committed to implement a Non-EQ Inaccessible Medium-Voltage Cables Program. This program includes (1) testing of in-scope, inaccessible cables (480 volts (V); 4,160V; and 13,800V) that are exposed to significant moisture, and (2) inspection of cable vaults, including

subsequent removal of accumulated water if required, as a preventive measure to minimize the potential exposure of in-scope cables to significant moisture.

In-scope cables will be subject to electrical performance testing to ensure suitability for operation. The cables will be tested to detect deterioration of the insulation system due to wetting, using tests such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time the test is performed. PSEG currently uses Tan δ testing on in-scope medium voltage cables and insulation resistance testing on in-scope low voltage power cables. The cable test frequency will be established based on test results and industry operating experience. The maximum time between tests, however, will not exceed six years.

Manholes for in-scope cables are now being monitored on a weekly basis. PSEG has committed to perform sufficient manhole and cable vault inspections prior to the PEO so that proper inspection frequencies can be established to minimize the exposure of power cables to significant moisture during the PEO. The maximum time between inspections will be no more than one year.

The staff has determined that the Non-EQ Inaccessible Medium-Voltage Cables Program, if implemented as committed to by the applicant, will ensure that the aging affects on inaccessible power cables will be adequately managed during the PEO. We agree with this conclusion.

The Buried Piping Inspection Program provides aging management of carbon steel, ductile cast iron, and gray cast iron buried piping susceptible to general corrosion, pitting, crevice corrosion, and microbially induced corrosion. There are no in–scope buried tanks. The program relies on the visual inspection of excavated piping, including the associated coatings and wrappings. Portions of the carbon steel piping are cathodically protected. The rectifiers for the cathodic protection system are monitored on a semi-monthly basis and inspected and tested on an annual basis. For the past five years, cathodic protection availability has exceeded 90 percent.

There have been no leaks of buried in-scope piping at HCGS as a result of external piping corrosion, and inspections of coatings that have occurred during opportunistic inspections of ductile cast iron fire protection piping have also found the coatings to be in acceptable condition. All buried piping has been risk-ranked in accordance with NACE and EPRI guidelines, and PSEG is implementing the NEI Industry Initiative on Buried Piping.

The applicant has committed to perform at least one opportunistic or focused excavation and inspection on piping from each of the material types during each 10 year period, beginning 10 years prior to entry into the PEO. Reinforced concrete piping is addressed under a different program, but will be subject to the same inspection requirement. A second opportunistic or focused excavation and inspection on a carbon steel piping segment, which is not cathodically protected, will be performed during each 10 year period, beginning 10 years prior to entry into the PEO. A different segment will be inspected in each 10 year period.

The staff has concluded that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the PEO, as required by 10 CFR 54.21(a)(3). We concur with this conclusion.

The applicant identified the systems and components requiring TLAAs and reevaluated them for the PEO. The staff concluded that the applicant has provided an adequate list of TLAAs. Further, the staff concluded that the applicant has met the requirements of the License Renewal

Rule by demonstrating that the TLAAs will remain valid for the PEO, or that the TLAAs have been projected to the end of the PEO, or that the aging effects will be adequately managed for the PEO.

We agree with the staff that there are no issues related to the matters described in 10 CFR 54.29(a)(1) and (a)(2) that preclude renewal of the operating license for HCGS. The programs established and committed to by PSEG provide reasonable assurance that the HCGS can be operated in accordance with its current licensing basis for the PEO without undue risk to the health and safety of the public. The PSEG application for renewal of the operating license for HCGS should be approved.

Sincerely,

/RA/

Said Abdel-Khalik
Chairman

References:

1. NRC Safety Evaluation Report Related to the License Renewal of Hope Creek Generating Station, June 2011 (ML11158A166)

2. NRC Safety Evaluation Report Related to the License Renewal of Hope Creek Generating Station, March 2011 (ML110690244)

3. PSEG Nuclear LLC License Renewal Application for Hope Creek Generating Station, August 18, 2009, (ML092430375: Cover Latter; ML092430373: LRA Section1 thru Section 3.3; ML092430374: LRA Section 3.4 thru Appendix D)

4. Letter from P. Davison, PSEG Nuclear, LLC: Response to NRC Draft Request for Additional Information B.2.1.28-4 related to the ASME Section XI Subsection IWE Aging Management Program associated with the Hope Creek Generating Station License Renewal Application, May 19, 2011 (ML11144A016)

5. NRC Scoping and Screening Audit Summary Regarding Hope Creek Generating Station License Renewal Application, August 19, 2010 (ML102100544)

6. NRC Audit Report Regarding Hope Creek Generating Station License Renewal Application, September 3, 2010 (ML101660452)

7. NRC License Renewal Inspection Report 05000272/2010010, 05000311/2010010, 05000354/2010010, October 14, 2010 (ML102871030)

8. NRC NUREG-1800, Revision 1, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” September 2005 (ML052700171)

9. NRC NUREG-1801, Volumes 1 & 2, Revision 1, “Generic Aging Lessons Learned Report,” September 2005 (ML052700171)

10. NRC Information Notice 2002-12, “Submerged Safety-related Electrical Cables,” dated March 21, 2002 (ML020790238)

11. NRC Generic Letter 2007-01, “Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients,” dated February 7, 2007 (ML070360665)

Rule by demonstrating that the TLAAs will remain valid for the PEO, or that the TLAAs have been projected to the end of the PEO, or that the aging effects will be adequately managed for the PEO.

We agree with the staff that there are no issues related to the matters described in 10 CFR 54.29(a)(1) and (a)(2) that preclude renewal of the operating license for HCGS. The programs established and committed to by PSEG provide reasonable assurance that the HCGS can be operated in accordance with its current licensing basis for the PEO without undue risk to the health and safety of the public. The PSEG application for renewal of the operating license for HCGS should be approved.

Sincerely,
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Said Abdel-Khalik
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1. NRC Safety Evaluation Report Related to the License Renewal of Hope Creek Generating Station, June 2011 (ML11158A166)

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8. NRC NUREG-1800, Revision 1, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," September 2005 (ML052700171)

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Letter to the Honorable Gregory B Jaczko, Chairman, NRC, from Said Abdel-Khalik, Chairman, ACRS, dated June 16, 2011

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