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LR-N17-0109

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

Hope Creek Generating Station
Renewed Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: Response to Final Request for Additional Information (RAI), Re: Permanently Extend Type A and Type C Leak Rate Test Frequencies (CAC No. MF8462)

Reference: NRC email to PSEG, "Hope Creek- Final Request for Additional Information Concerning ILRT (MF8462)," dated June 13, 2017 (ADAMS Accession No. ML17164A406)

In the referenced email, the Nuclear Regulatory Commission (NRC) requested PSEG Nuclear LLC (PSEG) to provide additional information in order to complete the review of the license amendment request (LAR) to permanently extend Type A and Type C leak rate test frequencies. Attachment 1 provides a detailed response to the request for additional information.

PSEG has determined that the information provided in this submittal does not alter the conclusions reached in the 10 CFR 50.92 no significant hazards determination previously submitted. In addition, the information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

There are no regulatory commitments contained in this letter.

Should you have any questions regarding this submittal, please contact Ms. Tanya Timberman at 856-339-1426.

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

Executed on 7/12/17
(Date)

Sincerely,

David J. Mannai
Senior Director – Regulatory Operations

Attachments:
1. Response to Request for Additional Information

cc: Mr. D. Dorman, Administrator, Region I, NRC
Ms. L. Regner, Project Manager, NRC
NRC Senior Resident Inspector, Hope Creek
Mr. P. Mulligan, Chief, NJBNE
Hope Creek Commitment Tracking Coordinator
Corporate Commitment Tracking Coordinator

LR-N17-0109

Attachment 1

Response to Request for Additional Information

LR-N17-0109
Attachment 1

Response to Final Request for Additional Information (RAI)
Regarding License Amendment Request (LAR) to Amend Technical Specifications (TS)
6.8.4.f for Permanent Extension of Type A and Type C Leak Rate Test Frequencies
Hope Creek Generating Station
Docket No. 50-354
(CAC No. MF8462)

In a letter dated October 7, 2016, (Agencywide Documents Access and Management System [ADAMS] Accession No. ML16281A139), as supplemented by letter dated March 27, 2017 (ADAMS Accession No. ML17086A096), PSEG requested an amendment to the facility operating license number NPF-57 for Hope Creek Generating Station (HCGS).

The Probabilistic Risk Assessment Licensing Branch (NRR/DRA/APLA) issued Requests for Additional Information (RAIs) by letter dated February 27, 2016 (ADAMS Accession No. ML17027A328) and the licensee provided responses to the RAIs in a letter dated March 27, 2017 (ADAMS Accession No. ML17086A096). The NRC staff reviewed the responses and determined that additional information is needed for the staff to complete its evaluation as follows:

In the response to RAI-1, the licensee concluded that the risk from external flooding is negligible based on the conclusions from the Individual Plant Examination for External Events (IPEEE) and the 2014 re-evaluated external flooding hazards (Accession Nos. ML080160320 and ML14071A505, respectively). The 2014 HCGS external flooding hazard re-evaluation demonstrates that several external flooding mechanisms, including substantial storm surges, are plausible for the site and may lead to flooding in excess of plant grade such that water impinges upon plant structures. Therefore, the external flooding hazard for HCGS does not appear to be negligible for the current application and may, in fact, significantly impact the risk assessment for this application. The licensee's response to RAI-1 indicates that there is no impact of external flooding on the current application due [to] the licensee's compliance with the Current Design Basis (CDB). This is not a sufficient basis for concluding that the risk from the external flood hazard is negligible for the reasons discussed below.

The HCGS IPEEE used qualitative arguments, such as the effectiveness of watertight doors and seals, to analyze and screen the risk of external flooding hazards. Operational experience has revealed possible failure of flood barriers due to degraded or missing seals and other factors (NRC Information Notice 2015-01, ADAMS Accession No. ML14279A268). Furthermore, demonstrating that the flood hazard is bounded by the CDB flood hazard does not address the frequency of exposure to floods (including those lower than the design basis flood) that may impinge upon SSCs and challenge plant safety, the impact of associated effects and the temporal characteristics of the event (e.g., the period of site inundation), and the risk associated with those floods. Additionally, both the IPEEE and the mitigating strategies assessment for flooding (ADAMS Accession No. ML16364A217) reference procedures for detecting and protecting against the effects of external flooding. However, failure estimates for such procedures and operator actions do not appear to be considered.

Provide the impact of external flooding risk on the current application with justification using a bounding quantitative assessment or a detailed qualitative assessment. Either justification should include consideration of the following factors:

- The frequency of external flooding mechanisms,
- The impact of external flooding mechanisms on plant operation and structures including the ability to cope with upset conditions,
- The operating experience associated with reliability of flood protection measures, and
- The reliability of operator actions.

PSEG Response to RAI-1

BACKGROUND

The following provides a brief discussion of relevant HCGS Flood Protection Features and the highlights of the IPEEE Screening and Re-evaluated Flood Hazard. This section then summarizes the main results from the risk calculations in the LAR.

Flood Protection Features

HCGS relies on both passive and active incorporated flood protection features to establish its design basis flood protection. Doors and penetrations in exterior walls of the Auxiliary and Reactor Buildings are protected against water inflow up to elevation 127 ft. Public Service Datum (PSD) for parts of the south exterior walls and up to elevation 121 ft. PSD of other exterior walls. Penetrations in exterior walls and slabs of the Station Service Water System intake structure are protected against water inflow up to elevation 121 ft. PSD for the north and east exterior walls and up to elevation 128.5 ft. PSD for other exterior walls and slabs. These flood protection features include the buildings themselves, penetration seals, waterproofing, and watertight doors. The HCGS flood protection features are part of the design and licensing basis of the plant and have clearly defined hydraulic capability characteristics. During HCGS's Response to Recommendation 2.3: Flooding Walkdown of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (References 1, 2, and 3), HCGS's flood protection features were reviewed and show adequate margin above design basis flood elevations. The flooding walkdown report (Reference 1) provides additional information on the flood protection features credited in the HCGS licensing basis. Performance of the walkdowns provided confirmation that flood protection features are in place, are in good condition and will perform as credited in the current licensing basis (CLB). Minor issues were identified and entered in the PSEG Corrective Action Program (CAP). No operability concerns were identified.

As shown in Table 2.1-3 of Reference 4, watertight door thresholds at HCGS are at elevation 12.2 ft. North American Vertical Datum of 1988 (NAVD88) (102.0 ft. PSD). The plant's design basis flood protection features are established to mitigate the effects of a hurricane storm surge event, with the flood protection elevations at 121 ft. PSD or higher. HCGS flood protection features do not include any temporary features that require implementation of a procedure for performance of manual/operator actions in order for the feature to perform its intended flood protection function. The watertight doors are the only active flood protection features at HCGS. The balance of the flood protection features are passive and continually maintain their full hydraulic capability.

IPEEE Screening

The HCGS IPEEE examined the probable maximum hurricane surge with a coincident ten percent exceedance high tide. This postulated condition results in a maximum wave run-up of 35.4 ft. Mean Sea Level (MSL) along the southeast face of the Reactor Building and a small corner face of the Auxiliary Building. Additionally, the Service Water Intake Structure may be subject to waves which could overtop the roof of the western portion at Elevation 39 feet MSL.

The HC IPEEE also examined the NRC Probable Maximum Precipitation (PMP) requirements associated with Generic Letter 89-22 (Reference 5) concerning plant area flood runoff depth. The requirements delineated in that letter are met and there are no new plant area flood runoff depths to evaluate.

All "other external events" identified in NUREG/CR-2300 (Reference 6) have been screened out by bounding probabilistic analyses that demonstrate a core damage frequency of less than the IPEEE screening criterion of 1E-6/yr or by compliance with the 1975 Standard Review Plan (SRP) criteria.

Performance of the walkdowns provided confirmation that flood protection features are in place, are in good condition and will perform as credited in the current licensing basis (CLB). Minor issues were identified and entered in the PSEG Corrective Action Program (CAP). No operability concerns were identified.

Re-evaluated Flood Hazard

As discussed in the Flood Hazard Reevaluation Report (FHRR Section 3, Reference 4), HCGS is susceptible to flooding above plant grade from Local Intense Precipitation (LIP) and Storm Surge based flooding events. Probable Maximum Flood events that address the effects of upstream riverine flooding only produce flood levels above plant grade when combined with storm surge events. Other NUREG/CR-7046 postulated flooding mechanisms do not produce sufficient water surface elevations in the Delaware River and Bay to cause flooding in excess of plant grade. The FHRR (Section 1.3) notes there have been no changes to the flood protection features themselves since initial licensing. Procedural actions have been enhanced to respond to potential flood threats.

Summary of Risk Results

Since the Integrated Leak Rate Test (ILRT) extension was demonstrated in the license amendment request (Reference 7, Attachment 3, Section 7.0) to have negligible impact on core damage frequency (CDF) for HCGS, the relevant criterion is large early release frequency (LERF). The increase in internal events LERF resulting from a change in the Type A ILRT test interval for the base case with corrosion included is 3.91E-08/yr (Reference 7, Attachment 3, Table 5.6-1). In using the EPRI Expert Elicitation methodology, the change is estimated as 8.52E-09/yr (Reference 7, Attachment 3, Table 6.2-2). Both of these values fall within the "very small" change region of the acceptance guidelines in Regulatory Guide (RG) 1.174 (Reference 8).

To determine the potential impact from external events, a bounding assessment from the risk associated with external events was performed utilizing available information. The total

increase in LERF due to internal events and the bounding external events assessment is 2.68E-07/yr. This value is in Region II of the RG 1.174 acceptance guidelines ("small" change in risk). The changes in dose risk was acceptable and conditional containment failure frequency also remained below the acceptance criteria of 1.0E-06/yr.

The bounding external events analysis was performed using a multiplier approach based on the IPEEE fire and seismic results. This approach screened out external flooding as having no significant quantitative contribution, based on IPEEE results.

The same bounding analysis indicates that the total LERF from both internal and external risks is 4.76E-06/yr which is less than the RG 1.174 limit of 1.0E-05/yr (Reference 9, revised values in RAI-2) given that the delta LERF is in Region II ("small" change in risk).

DETAILED QUALITATIVE ASSESSMENT

This response is structured to show that the margins between the NRC acceptance criteria still apply, based on current knowledge of external flooding risk at Hope Creek. PSEG is providing a detailed qualitative assessment that shows that the impact of external flooding risk is still very low.

Frequency of External Flooding Mechanisms

LIP and Storm Surge based flooding events that produce water levels that challenge the plant's design basis flood protection features are events with annual exceedance probabilities of 1E-6 or smaller, as discussed in Section 2.4 of Reference 4, and further in References 10, 11, and 12. The annual exceedance probability of flood levels that could exceed the watertight door thresholds did not need to be calculated for the FHRR; however, PSEG did assess these levels during the development of the FHRR (Reference 4) and subsequent activities (Reference 13).

Based on a representative analysis performed by EPRI (Reference 14), the rainfall rate used in Section 2.1 of the FHRR to evaluate the LIP event is estimated to have an annual exceedance probability between 1E-7 to 1E-9. To support development of a trigger to implement watertight door closure for a LIP event, PSEG assessed the rate of rainfall required to exceed watertight door thresholds. Based on the same conservative modeling approaches described in the FHRR (Reference 4, Section 2.1), approximately 6 inches of rain in 6 hours could challenge the threshold. Conservatively, a trigger of a predicted 6 inches of rain in the next 24 hours is now used to implement watertight door closure in advance of a heavy rainfall event (Reference 15). After the critical rainfall threshold was determined, a simplified rainfall frequency analysis was performed using historical gage data in the area to determine how often the critical threshold could be exceeded. The exercise was not intended to be a comprehensive statistical frequency analysis or exhaustive review of area rainfall records; rather, the intent of compiling rainfall data was to get a general understanding of how often the thresholds have been exceeded in the past. Five inches of rainfall was conservatively used as the threshold and the recurrence intervals were estimated to be approximately 25 years for the 24 hour storm and 50 years for the 6 hour storm.

The US Army Corps of Engineers (USACE) completed a Storm Surge Study for Federal Emergency Management Agency (FEMA) Region III, which encompasses the Delaware River

and Bay areas in 2013 (Reference 16). This study estimated still water surface elevations of 10.7 ft. NAVD and 12.1 ft. NAVD for recurrence intervals of 500 and 1000 years, respectively. These elevations equate to approximately site grade and the watertight door threshold, respectively.

Impact of External Flooding Mechanisms on Plant Operation and Structures Including the Ability to Cope with Upset Conditions

As discussed in Reference 4, the reevaluated flooding events could produce flood levels that are above the watertight door thresholds, but below the plant's minimum flood-protected elevation of 121 ft. PSD. The plant's design basis flood protection features are established to mitigate the effects of a hurricane storm surge event. Protection of safety related systems, structures, and components (SSCs) is ensured by implementing severe weather guidance document OP-AA-108-111-1001, "Severe Weather and Natural Disaster Guidelines" (Reference 17) and abnormal operating procedure HC.OP-AB.MISC-0001, "Acts of Nature," (Reference 15). Performance of the walkdowns provided confirmation that flood protection features are in place, are in good condition and will perform as credited in the current licensing basis (CLB). Minor issues were identified and entered in the PSEG Corrective Action Program (CAP). No operability concerns were identified.

The overall strategy for protecting the HCGS from a flooding event requires simple and straightforward actions. Response to a flood event begins with the Control Room Supervisor monitoring the National Weather Service for storm warnings once per shift per OP-HC-112-101-1001-F2, "Control Room Supervisor – Relief Checklist" (Reference 18). Plant safety is then ensured by implementing severe weather guidance (Reference 17) and an abnormal operating procedure (Reference 15), which instruct operators to close watertight doors. Reference 4 provides additional discussion of the temporal characteristics of these hypothetical events in Sections 2.10.6. As described later in this document, PSEG operators should execute these procedures with no particular challenge.

Operating Experience Associated with Reliability of Flood Protection Measures

Evaluation of the overall effectiveness of the HCGS flood protection features was performed and documented in the Hope Creek Generating Station Response to Recommendation 2.3: Flooding Walkdown of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Reference 1. The review of the flood protection features design and licensing documentation, and subsequent field inspection of the applicable physical flood protection features was implemented per the guidance provided within NEI 12-07 (Reference 19). PSEG has implemented ER-AA-310-101 "Condition Monitoring of Structures" (Reference 20) for condition monitoring of Maintenance Rule structures, such as with regard to the monitoring of flood control features: concrete walls and slabs, water-control structure elements, penetration seals, etc. Specific instructions regarding the inspection of HCGS penetration seals are addressed in HC.FP-SV.ZZ-0026, "Flood and Fire Barrier Penetration Seal Inspection" (Reference 21). Instruction regarding the inspection and maintenance of the HCGS watertight doors is addressed in HC.MD-PM.ZZ-0007, "Missile Resistant and Watertight Door P.M." (Reference 22).

HCGS safe shutdown SSC's are currently protected by means of permanent/passive measures and permanent active features, i.e., watertight doors. Watertight door closure can be performed

within the warning time provided by proceduralized triggers, as shown by HCGS operating experience (e.g., the flooding walkdown report in Reference 1 documents actual closure can be performed within the required period of time following exceedance of a high river water level trigger). Therefore, the manual actions required to implement the flood response strategy (i.e., watertight door closure) are feasible and the overall implementation of the strategy is adequate.

Performance of the walkdowns provided confirmation that flood protection features are in place, are in good condition and will perform as credited in the current licensing basis (CLB). Minor issues were identified and entered in the PSEG Corrective Action Program (CAP). No operability concerns were identified.

Reliability of Operator Actions

Operator actions (Reference 15) required for flood protection actions are contained in HC.OP-AB.MISC-0001, Acts of Nature. This procedure would be entered for the following conditions that could result in onsite flooding:

- A hurricane or tropical storm watch for Salem County is issued
- A hurricane or tropical storm warning for Salem County is issued
- A coastal flood warning for Salem County is issued
- Observation of severe weather conditions
- Delaware River Water Level is anticipated to reach 96 feet. (PSD)
- The National Weather Service Probabilistic Quantitative Precipitation Forecast (PQPF) predicts Local Intense Precipitation (LIP) to exceed 6 inches over the next 24 hours
- Notification of a failure of the Francis E. Walter Dam (White Haven, PA), the Cannonsville Dam (Delaware County, NY), OR the Pepacton Dam (Delaware County, NY)
- Notification of a tsunami to strike the New Jersey coast

The abnormal procedure actions direct operators to increase monitoring of river levels and perform closure of water tight doors onsite. Operators have indications available in the control room that are used to monitor river level conditions and the actions to close water tight doors are within the capability of the minimum shift complement to complete. The entry into the abnormal operating procedure under the conditions described above provides sufficient time for the operators to complete required actions such that they can be relied upon to be completed prior to water levels on site approaching the 102 ft. PSD where flooding could impact system operations. Periodic testing of the watertight doors ensures their continued flood protection capability and demonstrates operator proficiency at performing this task.

BOUNDING ANALYSIS CALCULATION

In addition to the qualitative response, PSEG is providing a rough order of magnitude estimate of the total LERF for external hazards, based on the full power internal events PRA. While quite rough, a bounding calculation indicates that total LERF is small enough that changes to the ILRT testing strategy do not have a significant effect on overall LERF.

One way to ensure that these conclusions still apply is to perform a bounding analysis using the Hope Creek full power, internal events (FPIE) PRA model. An upper bound estimate of other hazards was established assuming that external flooding events are likely to result in a loss of offsite power (LOOP). It is assumed that the frequency of these external flooding hazards is bounded by weather induced LOOP (frequency of 4.61E-3 per year in the Hope Creek PRA). While recoverable weather induced LOOPs have been observed with some frequency, unrecoverable events are rare. Thus, use of weather induced initiating event frequency to bound the non-recovered external event frequency is considered appropriate (Reference 23).

Bounding Estimate: CDF and LERF Contribution for Other External Hazards		
	CDF/yr	**LERF/yr**
SW LOOP (w/recovery)	3.45E-7	4.16E-9
SW LOOP (w/o recovery)	2.06E-6	4.99E-9

Note that the core damage frequency calculations are a significant portion of the baseline PRA core damage risk while the LERF calculations are a much smaller relative portion of baseline LERF risk. A careful review of the dominant risk contributors indicates that most of the external flooding risk is driven by the long term station blackout. Much of the postulated core damage is late, low energy core damage which will not contribute to the LERF.

The applicable risk measure to evaluate ILRT risk is LERF. From this bounding calculation, the LERF risk is clearly in the 1E-8/yr range or below. Since the Hope Creek FPIE model LERF risk used in the LAR is 8.45E-7/yr (Reference 23) and the total LERF in Table 5.7.7 is 4.76E-06/yr (Reference 9, revised values in RAI-2), changes to LERF associated with weather induced LOOPs, and thus with external floods cannot change the conclusion of the ILRT LAR.

References

1. PSEG Letter LR-N12-0369, "Hope Creek Generating Station Response to Recommendation 2.3: Flooding Walkdown of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated November 26, 2012 (ADAMS Accession No. ML12334A452).

2. NRC Letter, "Hope Creek Generating Station – Audit Report Regarding Flooding Walkdowns to Support Implementation of Near-Term Task Force Recommendation 2.3 Related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC No. MF0236)," dated November 18, 2013 (ADAMS Accession No. ML13266A297).

3. NRC Letter, "Hope Creek Generating Station – Staff Assessment of Flooding Walkdown Report Supporting Implementation of Near-Term Task Force Recommendation 2.3 Related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC No. MF0236)," dated June 16, 2014 (ADAMS Accession No. ML14042A329).

4. PSEG Letter LR-N14-0041, "PSEG Nuclear LLC's Response to Request for Information Regarding Flooding Aspects of Recommendation 2.1 of the Near Term Task Force

Review of Insights from the Fukushima Dai-ichi Accident – Hope Creek Generating Station Flood Hazard Reevaluation," dated March 12, 2014 (ADAMS Accession No. ML14071A511).

5. NRC Generic Letter No. 89-22, "Potential for Increased Roof Loads and Plant Area Flood Runoff Depth at Licensed Nuclear Power Plants due to Recent Change in Probable Maximum Precipitation Criteria Developed by the National Weather Service", dated October 19, 1989.

6. NUREG/CR-2300, "PRA Procedures Guide: A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants".

7. PSEG Letter LR-N16-0156, "License Amendment Request to Amend Technical Specifications (TS) 6.8.4.f for Permanent Extension of Type A and Type C Leak Rate Test Frequencies," dated October 07, 2016 (ADAMS Accession No. ML16281A139).

8. Regulatory Guide 1.174, Revision 2, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," dated May 2011

9. PSEG Letter LR-N17-0063, "Response to Request for Additional Information, Re: Permanently Extend Type A and Type C Leak Rate Test Frequencies (CAC No. MF8462)," dated March 27, 2017 (ADAMS Accession No. ML17086A096).

10. PSEG Letter LR-N14-0170, "PSEG Nuclear LLC's 30-day Response to Request for Additional Information Regarding Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated July 28, 2014.

11. PSEG Letter LR-N14-0207, "PSEG Nuclear LLC's 90-day Response to Request for Additional Information Regarding Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated September 23, 2014 (ADAMS Accession No. ML14268A469).

12. PSEG Letter LR-N15-0100, "Hope Creek Generating Station's Response to Request for Additional Information Regarding Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated May 7, 2015 (ADAMS Accession No. ML15128A370).

13. PSEG Letter LR-N16-0112, "Hope Creek Generating Station's Flood Hazards Mitigating Strategies Assessment (MSA) Report Submittal," dated December 29, 2016 (ADAMS Accession No. ML16364A217).

14. EPRI Report 3002004400, "Local Precipitation-Frequency Studies, Development of 1-Hour/1-Square Mile Precipitation-Frequency Relationships for Two Example Nuclear Power Plant Sites," 2014.

15. PSEG Document HC.OP-AB.MISC-0001, "Acts of Nature," Revision 30.

16. USACE Report ERDC/CHL TR-11-1, Report 5, "Coastal Storm Surge Analysis: Storm Surge Results," November 2013.

17. PSEG Document OP-AA-108-111-1001, "Severe Weather and Natural Disaster Guidelines," Revision 14.

18. PSEG Document OP-HC-112-101-1001-F2, "Control Room Supervisor – Relief Checklist," Revision 1.

19. NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," Revision 0-A dated May 2012 (ADAMS Accession No. ML12173A215).

20. PSEG Document ER-AA-310-101, "Condition Monitoring of Structures," Revision 0.

21. PSEG Document HC.FP-SV.ZZ-0026, "Flood and Fire Barrier Penetration Seal Inspection," Revision 7.

22. PSEG Document HC.MD-PM.ZZ-0007, "Missile Resistant and Watertight Doors P.M.," Revision 11.

23. HC LAR-008 – Responses to ILRT Submittal – Round 2