UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	
	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14, 2016

NRC STAFF RESPONSE TO THE LICENSING BOARD'S INITIAL QUESTIONS ISSUED DECEMBER 15, 2015

Pursuant to the Licensing Board's Memorandum and Order (Initial Board Questions and Associated Administrative Directives) of December 15, 2015 and the Initial Scheduling Order of November 16, 2015, the NRC staff (Staff) hereby responds to the Licensing Board's initial questions on the Staff's Safety Evaluation Report (SER). Consistent with these Board Orders, the Staff written responses (or, as applicable, portions of responses) identify the responding subject matter expert(s) or individual(s) and are submitted in exhibit form, under oath, so that they are suitable for receipt into evidence without the personal appearance of each expert or individual.

The Staff's filing includes three attachments. Attachment A to this filing presents the Staff's responses to the Board's questions on the SER. Attachment B presents the affidavits of the Staff reviewers identified as authors of the Staff responses. Attachment C presents the statements of professional qualifications of those Staff reviewers.

As the Board encouraged, the Staff and the Applicant coordinated development of their responses to minimize unnecessary repetition of information. Based on this coordination, the Staff is providing responses to all Board questions, and the Applicant is providing responses to some of the questions, as specified in its filing. In addition, the Staff is electing to defer its

response to question 1, consistent with the option that the Board provided the Staff in its initial questions.

Respectfully submitted,

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Dated at Jersey City, New Jersey
This 14th day of January, 2016

Attachment A

NRC STAFF RESPONSES TO THE LICENSING BOARD'S INITIAL QUESTIONS ISSUED DECEMBER 15, 2015

SER Question No. 1: Consistent with the option provided by the Board in its initial questions, the Staff elects to defer its response to question 1.

SER Question No. 2: *Were any significant calculations performed by the Applicant and documented in the SSAR for which Staff did not perform its own confirmatory calculations? If so, what were they? Why is independent verification not necessary?*

Response No. 2 (P. Chowdhury): The Staff performed independent confirmatory analysis for all subject matter areas where the Staff determined it necessary to ensure that the conclusions in the Site Safety Analysis Report (SSAR) were justified and that the Staff's regulatory findings are supported. In general, Staff performs independent calculations in safety significant areas or where there is meaningful uncertainty in the analysis. Applicants often use well-understood (and even NRC-approved) methodologies, so not every calculation needs to be reproduced by the Staff for confirmation or verification, especially those calculations where the methodology is well-established and the Staff can readily examine the reasonableness of the assumptions, inputs, and results.

Accordingly, as indicated in the example described below regarding the evacuation time estimate (ETE) analysis, for particular calculations the Staff may reasonably determine that verification of the Applicant's methodology and how it was applied provides sufficient confirmation of the appropriateness of the assumptions, inputs, and results. Consistent with its guidance, in the PSEG ESP review the Staff conducted regulatory audits of calculations and documentation for the purpose of verifying and confirming the Applicant's results and determinations with further confirmatory analysis, where appropriate. One such example is the Staff's independent sensitivity analysis in the area of flooding hazard evaluation to assess the Applicant's approach, calculations, results and conclusions (refer to Safety Evaluation Report (SER) Section 2.4.5, "Probable Maximum Surge and Seiche Flooding").

(B. Musico) With respect to the emergency planning review, the Applicant performed an ETE analysis that it documented in the ETE report entitled "PSEG Site Development of Evacuation Time Estimates," (Feb. 2012). This report is discussed in SER Section 13.3 "Emergency Planning." The ETE report describes the methods, inputs used in the analysis, and calculation results of the time to evacuate the public from the emergency planning zone. Calculating ETEs requires use of a traffic simulation model; however, as explained in Supplement 2, "Criteria for Emergency Planning in an Early Site Permit Application," to NUREG-0654/FEMA REP 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Revision 1 (NUREG-0654), the value of the ETE analysis is in the methodology required to perform the analysis, rather than in the calculated ETE. Confirmatory calculations by the Staff were not necessary because the reasonableness of the analysis can be determined through the review of the methodology and by comparison of inputs to results.

SER Question No. 3: *Identify those areas where Staff either reviewed Applicant's computer code input or performed significant analysis using the computer code. Briefly describe the reviewer's prior experience with those codes.*

Response No. 3 (Staff names - see below): The Staff's review of the Applicant's implementation of computer program or computer program inputs for the technical disciplines is presented below:

- Meteorology (K. Quinlan): As part of the review of SSAR Section 2.3, "Meteorology," the Applicant used two atmospheric dispersion codes sponsored by the NRC:

    - PAVAN (NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design-Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations")

    - XOQDOQ (described in NUREG/CR-2919, "XOQDOQ Computer Program for the Meteorological Evaluation of Routine Releases at Nuclear Power Stations")

    The Staff reviewed in detail the Applicant's input and output files related to these programs to ensure proper assumptions and data usage. The Staff also performed independent confirmatory calculations using the same programs, as described in SER Sections 2.3.4 "Short Term Diffusion (Accident) Estimates," and 2.3.5 "Long-Term Atmospheric Dispersion Estimates for Routine Releases." The Staff member has been the lead reviewer on eight combined license (COL) applications, two early site permit (ESP) applications, and one design certification (DC) application, and has considerable experience running these codes and verifying applicants' results.

- Radiation Protection (S. Williams, Z. Gran): As discussed in SER Chapter 11, the Applicant used the LADTAP II (i.e., NUREG/CR-1276) and GASPAR II (i.e., NUREG/CR-4653) computer codes. The LADTAP II and GASPAR II computer codes are approved by the NRC, as these particular codes are referenced and described in SRP (NUREG-0800) Sections 11.2 and 11.3. Regulatory Guide (RG) 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," is also referenced as the calculational basis for the evaluation of liquid and gaseous effluent doses to the environment and forms the basis for these codes design. The Staff issued requests for additional information (RAIs) for the input and output files to facilitate Staff review of the input parameters and confirmation of the parameters specified by the Applicant in the ESP application. The Staff evaluated the Applicant's parameters and performed confirmatory calculations using the same approved codes as chosen by the Applicant. The Staff confirmed the results of the Applicant's output files and the results specified in the application.

    The lead reviewer's (S. Williams) prior experience with the codes referenced above includes:

    - 16 years implementing and operating the initial radiological effluent technical specifications (RETS) program at the Three Mile Island Nuclear Unit 1 facility, for GPU Nuclear Corporation, including developing all required procedures, designing the IT process to implement the LADTAP II and GASPAR II computer codes, ensuring the Process Effluent Radiation Monitoring System was operational, installing and calibrating the effluent sample counting instrumentation, validating and verifying the calculational methodology, and designing the effluent program to provide operational NRC compliance with 10 CFR 20 and 10 CFR 50 Appendix I.

    - 8 years regulatory oversight over the 5 nuclear facilities in the state of Pennsylvania for the Department of Environmental Protection, Bureau of

Radiation Protection, concerning those facilities' implementation of the RETS Program and their use of the NRC computer codes.

- 7 years NRC regulatory oversight and Technical Reviews for 4 DC, 3 combined license (COL), and 3 ESP applications concerning Chapter 11 Radioactive Waste Systems Applicant submittals and their use of the NRC computer codes.

- Hydrology (H. Jones, J. Giacinto): For the development of SSAR Section 2.4 "Hydrologic Engineering," the Applicant used the following models to characterize surface and groundwater:

  - HEC-RAS - Hydrologic Engineering Centers River Analysis System
  - HEC-HMS - Hydrologic Engineering Centers Hydrologic Modeling System
  - 1D Bodine - Bodine One-dimensional Surge
  - SLOSH - Sea, Lake, and Overland Surges from Hurricanes
  - ADCIRC+SWAN - ADvanced CIRCulation Model coupled with Simulating WAves Nearshore
  - MOST - Method of Splitting Tsunami
  - MODFLOW - MODFLOW, Modular Three-Dimensional Finite-Difference Groundwater Flow Model

  The Staff performed detailed reviews of the Applicant's input and output files and supporting technical reports related to the models to verify proper incorporation of the Applicant's conceptualization and parameters into the simulations. The Staff members reviewing the data, models and simulations have considerable experience, with a minimum of 20 years of experience with each of the computer codes and models and were involved in the review of two ESP applications and several COL applications as either a lead reviewer or a team lead.

- SER Section 2.5.2, "Vibratory Ground Motion" (D. Seber, S. Devlin-Gill): The Staff performed its own independent confirmatory analysis using in-house codes (seismic hazard) and publically available software (site response). Further, as described in SER Section 2.5.2.4.4.2 "PSHA Calculation and Confirmatory Analysis," the Staff conducted a software audit of the Applicant's contractor to review the seismic hazard software and examine the implementation of the seismic source models described in NUREG-2115 "Central and Eastern United States Seismic Source Characterization for Nuclear Facilities". The Staff member who conducted the software audit (D. Seber) has over 20 years of experience in software development, and eight years of specific experience in seismic hazard codes.

- External Manmade Hazards (S. Tammara): The Staff completed an independent analysis using the widely available ALOHA computer code, which the Applicant used in its SSAR analysis. The Staff used its own inputs and independent assumptions to calculate the effects of explosions from hazardous chemicals and gasses and confirmed that the Applicant's approach was appropriate and conservative. The Staff reviewer has

40 years of experience in the nuclear field and approximately 20 years of experience working with ALOHA for the Department of Energy and NRC.

SER Question No. 4: *Given that three nuclear power reactors are already located adjacent to the proposed site, was Staff able to rely on any information already in its possession and thereby conserve its resources for analysis of the most important safety-related issues? Explain.*

Response No. 4 (P. Chowdhury): Because issuance of an ESP is a separate licensing action, focused on determining the suitability of the proposed ESP site, the ESP application must contain the necessary information to support the Staff's ultimate safety findings. As such, the Staff's review necessarily focused on whether the information presented in the application complies with current NRC regulations governing ESPs. The Staff recognizes that certain potentially relevant information about the site and site vicinity was available to the Applicant as it developed the safety analysis in the application. As explained further in response to Question 5, consistent with NRC regulations and guidance, some analyses in the application necessarily considered the potential interactions with other operating nuclear facilities nearby, and the Staff carefully reviewed that information in reaching its safety findings. (As an example, refer to response to Question 42).

SER Question No. 5: *Given that three nuclear power reactors are already located adjacent to the proposed site, what efforts did Staff make to focus on potential cumulative and interactive effects with respect to safety-related issues? Explain.*

Response No. 5 (Staff names – see below): Consistent with NRC regulations and guidance, as discussed below, the Staff did consider cumulative effects from the three operating units adjacent to the proposed site to inform its safety findings and conclusions in the following subject areas:

- Meteorology (K. Quinlan): The Staff considered the effects of close major structures on the Salem Generating Station (SGS) and Hope Creek Generating Station (HCGS) site on the onsite meteorological measurement system consistent with RG 1.23, “Meteorological Monitoring Programs for Nuclear Power Plants.” This discussion is provided in SER Section 2.3.3, “Onsite Meteorological Measurement Program.”

- Radiation Protection (S. Williams, Z. Gran): For SER Chapter 11, “Radioactive Waste Management - Radiological Effluent Release Dose Consequences from Normal Operations,” the Staff considered the cumulative and interactive effects of the operating SGS/HCGS units on whether a facility located at the proposed ESP site would be able to comply with applicable dose limits. Given the three existing reactors located adjacent to the proposed site, the Staff references 10 CFR 20.1301, “Dose limits for individual members of the public,” and 10 CFR 20.1302, “Compliance with dose limits for individual members of the public,” to account for the cumulative effects with respect to safety issues.

  10 CFR 20.1301, item (e) specifies the following requirement: “In addition to the requirements of this part, a licensee subject to the provisions of the Environmental Protection Agency’s generally applicable environmental radiation standards in 40 CFR part 190 shall comply with those standards.” 40 CFR 190 addresses releases from all fuel cycle facilities, including utilization and production facilities. The total release from all fuel cycle facilities includes contributions from the new unit’s liquid and gaseous

effluent doses as well as the existing unit's liquid, gaseous, and direct dose contributions.

In addition to 10 CFR 20.1301, the Applicant will follow 10 CFR 20.1302. 10 CFR 20.1302 specifies that a licensee shall demonstrate: "the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to part 20." The Staff evaluated the Applicant's analysis comparing these effluent concentration limits to the site's total effluent releases, including the total contributions from the planned new units and the existing units (one boiling water reactor and two pressurized water reactors).

- Hydrology (H. Jones, J. Giacinto): In conjunction with the review of SSAR Section 2.4 "Hydrologic Engineering," the Staff reviewed previous hydrologic studies and observations that were conducted for the operating reactors and included in the application to evaluate cumulative impacts as discussed in corresponding SER sections. The Applicant's studies and observations included data and information gathered for water supply studies and hydrologic observations related to the operating plants, and observations related to past storm events. Discussions of these studies, observations, and data are included in the Staff's assessment of the proposed site (e.g., SER Section 2.4.12 "Groundwater," describes a water supply study that was conducted for the operating reactors, and also in this section, variable groundwater pathways due to the influence of post-construction and existing features are described).

- External Manmade Hazards (S. Tammara): For the external manmade hazards analysis, all potential sources (including SGS/HCGS) within five miles of the ESP site were considered for the potential impacts due to source explosions, vapor cloud explosions, chemical releases, and potential aircraft hazards as discussed in SER Section 2.2 "Nearby Industrial, Transportation, and Military Facilities."

- Emergency Planning (B. Musico): Consistent with SRP (NUREG-0800) Section 13.3, the Staff was assisted by the fact that the PSEG Site Emergency Plan is based on the existing SGS/HCGS Emergency Plan. See Response No. 52, which addresses the relationship between the SGS/HCGS Emergency Plan and the PSEG Site Emergency Plan.

SER Question No. 6: *Throughout the SER, Staff "concludes" certain things and "finds" certain other things. Does Staff's use of either term connote a different decisional process or a different standard of proof? Or are these terms used interchangeably?*

Response No. 6 (A. Fetter): The Staff's use of the two terms does not connote a different decisional process or different standard of proof.

SER Question No. 7: *Except as already discussed the SER or in response to other, more specific questions set forth below, Staff shall identify any regulatory guides that were directly or indirectly applicable and explain how they were applied or adapted to Staff's review.*

Response No. 7 (P. Chowdhury): The Staff did not use any guidance documents in its review that are not referenced in the SER.

SER Question No. 8: *Except as otherwise discussed in response to more specific questions set forth below, identify significant issues (if any) to which Staff determined that no regulatory guide applied, and explain how Staff addressed such issues.*

Response No. 8 (P. Chowdhury): In conjunction with the PSEG Site ESP application, the Staff identified, addressed, and satisfactorily resolved all issues during the safety review. During the course of the review, the Staff followed guidance in the agency's SRP (NUREG-0800) in conducting its safety review. The Staff did not identify any review areas for which no regulatory guidance was available.

SER Question No. 9: *The Commission has stated that license conditions must be "precisely drawn so that the verification of compliance becomes a largely ministerial . . . act." Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), CLI-00-13, 52 NRC 23, 34 (2000). Does Staff contend that this standard does or does not apply to each of the nine permit conditions Staff proposes in the SER (at pp. A-2 through A-6)?*

Response No. 9 (P. Chowdhury): The Commission's *Private Fuel Storage* standard for license conditions does apply to each of the nine permit conditions the Staff proposes in the SER on pages A-2 through A-6. The Staff agrees that determining compliance with each of the permit conditions would involve only a ministerial act.

SER Section 2.1.3.4 Technical Evaluation

SER Question 10: *In the middle of the second paragraph on page 2-12, Staff states:*

> *Therefore, in RAI 32, Questions 02.01.03-5 and 02.01.03-6, the Staff requested that the Applicant analyze this information and population data and clarify based on growth rates from 2000 to 2010 U.S. Census, whether Middletown, DE, could be a future population center. If so, the Staff requested that the Applicant demonstrate compliance with population distance requirement in 10 CFR 100.21(b), such that the future growth and developments of Middletown, DE will not be closer than 11.3 km (7 mi) west of the PSEG Site, including growth into and around Odessa, DE, or discuss any changes to the current LPZ boundary.*

Does Staff contend that 10 C.F.R. § 100.21(b) requires applicants to apply siting criteria to future population estimates? If so, explain.

NRC Staff Response to SER Question 10 (S. Tammara): The regulations in 10 CFR 100.20(a) and 10 CFR 100.21(b) provide requirements for population density and distribution in determining the acceptability of a site for a stationary power reactor. The Commission has stated that population density and distribution considerations "apply only for initial siting for new plants" (61 FR 65163). The Staff conservatively considered population projections for the duration of the initial operating period, consistent with NRC guidance in RG 4.7 and the SRP (NUREG-0800) Section 2.1.3 "Population Distribution." RG 4.7 provides guidance acceptable to the Staff for meeting the requirements of 10 CFR 100.20 and 10 CFR 100.21. RG 4.7 specifies that projected changes in population within about 5 years after initial plant approval should be evaluated. Therefore, according to this applicable guidance, the population was evaluated for the year 2021. Further, consistent with the SRP (NUREG-0800) (and RG 4.7), the Applicant projected and the Staff reviewed the potential population growth for a 60-year period of plant operation and confirmed that the distance to Middletown, DE, population center would not exceed the requirements given in 10 CFR 100.20(a) and 100.21(b). The Applicant provided

census data information and available state and county future growth, zoning, and other data pertaining to growth in the Middletown, DE, area and a comprehensive discussion that conformed with NRC guidance and, therefore, met the requirements of 10 CFR 100.20(a) and 10 CFR 100.21(b).

Question 11: *On pages 2-12 & 13, Staff discusses Applicant's projected population density of 497 people per square mile in the year 2021, which is considered to be the first year of plant operation. Since plant operation by 2021 is unlikely, should there be a COL application at some point in the future, will the criterion of RG 4.7 be revisited at that time?*

NRC Staff Response to SER Question 11 (S. Tammara): Evaluation of the projected population density would have finality with the ESP and would not be revisited for the COL application, unless there were changes that met the criteria of 10 CFR 52.39(a) for changing or imposing new site characteristics, design parameters, or terms and conditions. However, as part of the Staff's review of the PSEG Site ESP application, the Staff reviewed the Applicant's projections of potential population density for the potential operational period of a site and found the Applicant's justification for the site acceptable.

The guidance provided in RG 4.7, states that at the time of initial plant approval within about 5 years thereafter, the population density, including weighted transient population, averaged over any radial distance out to 20 mi, does not exceed 500 persons per square mile. The Applicant estimated a population density of 497 people per square mile in the year 2021; in contrast, the staff's independent calculation estimated 508 people. As documented in the SER, consistent with RG 4.7, the Staff requested that the Applicant address the evaluation of alternate sites with lower population densities. Subsequently, the Applicant provided satisfactory response in a revision to SSAR Sections 2.1.3.3.2 and 2.1.3.6, and SSAR Tables 2.1-5 and 2.1-6. RG 4.7 further provides that population projections should be considered over the lifetime of the facility, and further population projections should be made by decade for a 40-year period beyond the start of power plant operation. Accordingly, the Applicant calculated the projected population to the years 2010, 2021, 2061, and 2081 (a 60-year period of potential operation) to ensure population density was evaluated for a sufficient period into the future and confirmed that the distance to a potential population center (Middletown, DE) would not exceed the requirements given in 10 CFR 100.20(a) and 100.21(b). (see also response to Question 10). As addressed in SER Section 2.1.3, the Applicant provided adequate information and justification for choosing the site. The Staff determined that the Applicant's population projection analysis as well as justification for suitability of the site given the potential population density was adequate.

SER Section 2.2.3.4.1 Explosions and Flammable Vapor Clouds

SER Question 12: *Was any consideration given to missiles that might be generated by an explosion?*

NRC Staff Response to SER Question 12 (S. Tammara): No, because the design basis explosions evaluated in the application remained below the threshold established in Staff guidance for which analysis of missiles would be warranted. Although the Staff review does consider missiles that may potentially be generated due to the impacts from potential explosions, RG 1.91 specifies that missiles only need to be considered if the blast overpressurization levels are exceeded (which RG 1.91 specifies as 1.0 psi). For the PSEG Site ESP application, the Staff confirmed that there are no design basis explosions that are capable of producing 1.0 psi overpressure. Therefore, consistent with the guidance, it was not necessary to consider potential missiles generated by explosions.

SER Section 2.3.1.4.5 Severe Weather

SER Question 13*: Has Staff compared severe weather as described in the SSAR with equivalent information in Hope Creek and Salem plant documents? If so, are there any significant differences?*

NRC Staff Response to SER Question 13 (K. Quinlan): As part of the NRC Staff's confirmatory analysis of severe weather at the PSEG Site, the Staff did not compare any severe weather hazards against information in the SGS and HCGS Updated Final Safety Analysis Reports (UFSARs). The Staff performed independent confirmatory analyses using sources and datasets suggested in NRC Regulatory Guides and NUREGs, and cited in the PSEG ESP SSAR. NRC guidance (RG 1.23, Revision 1) recommends the inclusion of a 24-month period of onsite meteorological data that is defendable, representative, and complete, but not older than 10 years from the date of the application. As discussed in SER Section 2.3.2.4.2, the Applicant included 3 years (2006-2008) of onsite meteorological data that was compared against nearby meteorological stations to verify that the Applicant identified and considered the meteorological and topographical characteristics of the site and the surrounding area. As part of this analysis, the Applicant provided a comparison of the meteorological data collected over the 32-year operating period of the onsite tower against the 3-year dataset provided as part of the ESP application. The Staff accepted the comparison between the two datasets as informational, but did not verify its accuracy because the 32-year period of record is not used in the generation of site characteristics for use as design or operational bases. As documented in SER Section 2.3.2.4.2.1, the Staff agrees that the longer period of record shows similar wind speed and direction characteristics when compared with the 3-year period of record (2006–2008).

SER Section 2.3.2.4.2.2. Atmospheric Stability

SER Question 14: *This section explains Applicant's reasons for selecting the lower altitude delta T for determining the atmosphere stability class:*

> *[T]he applicant explained that the use of the delta-temperature between the 45-m (150-ft) and 10-m (33-ft) heights is more appropriate than the use of the delta-temperature between the 91-m (300-ft) and 10-m (33-ft) levels. This is because short-term and long-term releases from each of the reactor technologies used to develop the plant parameter envelope (PPE) are considered to occur at ground level. Using this lower layer to determine the stability class is more representative of conditions that would affect a ground-level release.*

Is it reasonable or conservative to treat all releases as occurring at ground level?

NRC Staff Response to SER Question 14 (K. Quinlan): The Staff determined that it was both reasonable and conservative for the Applicant to assume a ground level release for the atmospheric dispersion analyses in the ESP application. SRP (NUREG-0800), Section 2.3.5, states, "If the exact plant configuration and location is not known at the ESP stage, the maximum χ/Q and D/Q values at specific locations of potential receptors of interest should be based on conservative assumptions (e.g., ground level releases with vent flow rates of zero)." Additionally, at the COL stage, the Applicant will be required to verify specific release point characteristics used to generate the ESP long-term (routine release) atmospheric dispersion site characteristics to ensure that they remain bounded by the selected design (e.g., a certified design).

For both the short-term (accident) diffusion estimates and the long-term (routine) diffusion estimate, the Applicant modeled one ground-level release point and did not take credit for building wake effects. Ignoring building wake effects for a ground-level release decreases the amount of atmospheric turbulence assumed to be in the vicinity of the release point, resulting in higher (more conservative) χ/Q values.

A ground-level release is generally a conservative assumption at a relatively flat terrain site, such as the PSEG Site, resulting in higher χ/Q and D/Q values when compared to a mixed-mode (i.e., part-time ground, part-time elevated) release or a 100-percent elevated release, as discussed in RG 1.111, Revision 1. The highest concentrations in a plume occur along the plume centerline. For ground level releases, the plume centerline is assumed to be at ground level. For elevated releases, the plume centerline is aloft and the plume's effluents must disperse below the plume centerline to reach the ground.

At the COL stage, when the Applicant chooses a specific reactor design, the Applicant would have to conduct analyses to demonstrate that the site characteristics remain bounded by the parameters of the reactor design. Because the Applicant has not yet chosen a reactor technology to build at the PSEG Site, the exact release paths and elevations are unknown at this time. Consequently, the Applicant chose conservative methods to result in concentrations that would likely bound any reactor design that may be selected at the COL stage. The defined site characteristic χ/Q values for the PSEG Site are lower than the corresponding site parameter χ/Q values provided by the Applicant for each of the referenced designs, as summarized in Tables 15.0.3.4.3-1 through 15.0.3.4.3-4 of the Staff's SER. If, at the COL stage, the release point characteristics or locations of receptors do not fall within those specified in the ESP, the COL applicant will need to request a variance from this element of the permit. (See 10 CFR 52.39(b) and 52.93(b); see also 10 CFR 52.79(a)(1)).

SER Question 15: *If a release occurred as a hot air plume at ground level, could not that plume rise to above the level of the lower delta T measurement?*

NRC Staff Response to SER Question 15 (K. Quinlan): Although it is possible that a hot air plume released at ground level could rise above the lower delta-T measurement level, this scenario was not considered as part of the release characteristics in any of the four designs considered in the plant parameter envelope (PPE). The potential plume rise due to buoyancy is a non-conservative scenario since it would effectively raise the plume centerline (highest area of concentration) above any ground receptors, thus lowering the potential concentration at ground level.

An independent NRC Staff comparison of stability class layers showed that the measurement layer representing ground level (45.7 m – 10.1 m) had a higher percentage of hours in the moderately stable (F) and extremely stable (G) stability classes when compared against the entire tower height (91.4 m – 10.1 m). Since the highest concentrations (χ/Q values) for ground level releases occur under low wind speed conditions and G-stability, this comparison supports the use of the ground layer as a conservative assumption.

SER Section 2.3.4.4 Technical Evaluation

SER Question 16: *On page 2-67, Staff states: "a COL or CP applicant citing this ESP will need to assess the dispersion of airborne radioactive materials to the control room at the COL or CP stage." Is this requirement captured in a COL Action Item? If not, why not?*

NRC Staff Response to SER Question 16 (K. Quinlan): No. As part of its review of a COL application, the Staff will confirm compliance with GDC 19, "Control Room," including the meteorological conditions used to evaluate the personnel exposures inside the control room during radiological and airborne hazardous material accident conditions. Therefore, there is no requirement for a COL Action Item related to the dispersion of airborne radioactive materials to the control room. The purpose of COL Action Items is to ensure that particular significant issues are tracked and considered during the review of a later application referencing any ESP that might be issued for the PSEG ESP site. The list of COL Action Items is not presented as a complete list of what a COL Applicant would need to address to comply with the Commission's regulations in Part 50 or Part 52. Where a requirement is clearly addressed in regulations applicable to COLs, the Staff may determine that a COL Action Item is not necessary to track the issue.

SER Section 2.3.4.4.4 Conservative Short-Term Atmospheric Dispersion Estimates for EAB and LPZ

SER Question 17: *On page 2-68, Staff states:*

> *The applicant modeled one ground-level release point and did not take credit for building wake effects, as described in SSAR Section 2.3.4.1. Ignoring building wake effects for a ground-level release decreases the amount of atmospheric turbulence assumed to be in the vicinity of the release point, resulting in higher (more conservative) χ/Q values. A ground-level release assumption is, therefore, acceptable to the staff.*

Staff assumes a ground-level release with no building wakes is conservative relative to a ground-level release with building wakes accounted for. However it does not address the conservatism of assuming a ground-level release for a release at a higher elevation. Why is assuming a ground-level release conservative for an above ground-level release?

NRC Staff Response to SER Question 17 (K. Quinlan): The highest concentrations in a plume occur along the plume centerline. As provided in NUREG-0800, Section 2.3.4, 10 CFR 50 (Section II.B.1 of Appendix I) requires that the calculated annual total quantity of all radioactive material above background to be released to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of prescribed limits. For elevated releases, the plume centerline is aloft and the plume's effluents must disperse below the plume centerline to reach the ground. For ground level releases, the plume centerline is assumed to be at ground level. Therefore, assuming a ground level release is conservative.

SER Section 2.4 Hydrologic Engineering

Please note: All elevations are given in NAVD88 reference, unless otherwise specified

SER Question 18: *What is the definition of the "10 percent exceedance high tide"?*

NRC Staff Response to SER Question 18 (C. Bender, H. Jones): The "10 percent exceedance high tide" is the high-tide level that is equaled or exceeded by 10 percent of the maximum monthly tides over the tidal epoch (a continuous 21-year period in most locations).

The “10 percent exceedance high tide” can be determined from the recorded tide or from the predicted astronomical tide. If astronomical tides are used, sea level anomaly should be added. Sea level anomalies (also referred to as initial rise) are departures of the water surface elevation from astronomical tides due to various meteorological and oceanographic forces. Historical and current tide observations, information on tidal datums, as well as predicted tide levels can be found on the National Oceanic and Atmospheric Administration (NOAA) Tides and Currents website. NOAA also maintains a network of tide gage stations along the U.S. shoreline, including the Great Lakes.

Reference: "Standards for Determining Design Basis Flooding at Power Reactor Sites" ANS/ANSI 2.8 (1992) Section 7.3.1.1.1.

SER Question 19: *Are the maximum rainfall, flood, surge, seiche, wave runup, tsunami, etc. for the PSEG site consistent with those for the Hope Creek and Salem plants? Explain any significant differences.*

NRC Staff Response to SER Question 19 (H. Jones): As a result of their co-location, the SGS and HCGS operating sites used similar hydrological analyses and methods as those performed for the PSEG Site ESP application as the basis for their site-specific Fukushima hydrological hazard reevaluations. These analyses included: (1) local intense precipitation (LIP); (2) probable maximum flood on streams and rivers; and, (3) seiche, surge, and tsunami runup. Therefore, the methods used to determine flooding hazard water elevations for the PSEG ESP site are consistent with the reevaluated flood hazards for SGS and HCGS operating sites. However, the values for the SGS and HCGS sites are different from the PSEG Site values because of the presence of features such as structures, slopes, flood protection, barriers, and site grade.

The final water elevations determined using these methods are highly dependent on site-specific plant design/drainage. The SGS and HCGS operating sites have site grade elevations of 9.7 feet and 11.7 feet, respectively, and rely upon multiple flood protection systems for safeguarding existing plant structures and safety systems. The PSEG ESP site has a proposed site elevation of 36.9 feet with a final plant design that will be determined at the COL stage. This proposed site grade is above all of the postulated water hazard levels that Staff analyzed, and would not necessarily require additional flood protection for safety systems or structures. Once the technology is selected at the COL stage, a detailed site grading plan and drainage system will be designed to route runoff from LIP into swales and pipes draining toward the Delaware River consistent with COL Action Item 2.4-1.

SER Section 2.4.3.4.3 Computation of Peak Water Levels

SER Question 20: *On page 2-99, Staff states:*

> *Additionally, although the overall resolution of the applicant’s basin model was somewhat coarse . . . the staff recognizes that these assumptions are needed given the large area the model encompasses and associated computational limitations.*

Was any study performed to show that the coarseness of the model did not significantly affect these calculations? How much uncertainty could there be in this calculation without affecting the design basis flood?

NRC Staff Response to SER Question 20. (H. Jones, J. Giacinto): The bounding flood hazard, which establishes the design basis flood (DBF) for the PSEG ESP site, is a storm surge from a probable maximum hurricane at 32.1 feet as described in SER Section 2.4.5 "Probable Maximum Surge and Seiche Flooding," and not from the riverine flood at 21.0 feet as described in SER Section 2.4.3 "Probable Maximum Flood on Streams and Rivers." The PSEG ESP Site grade will be 36.9 feet. While the Staff recognizes that increasing the resolution of the overall watershed basin model could improve the precision of the Applicant's river flooding model results, the Staff determined on the basis of experience with hydraulic modeling that such improvements could not change the conclusion that storm surge is the bounding flood hazard for the PSEG ESP site and additional analyses were not necessary. The DBF from storm surge was developed using the ADCIRC+SWAN model, and river discharge had negligible impact on the DBF. The ADCIRC+SWAN model is a high resolution model that incorporates river flow.

SER Section 2.4.5.4 Technical Evaluation of Probable Maximum Surge and Seiche Flooding

SER Question 21: *Staff notes that the Applicant determined parameters for the Probable Maximum Hurricane (PMH) from data reported in the 1979 National Weather Service Technical Report NWS 23. Using this reference, the Applicant chose a value of 28 nautical miles for the Radius of Maximum Winds (R) for the PMH used in their numerical models, shown on SSAR Table 2.4.5-4.*

Would a larger R for the PMH significantly affect the modeled values for maximum total water surface elevation at the PSEG site? If so, given that the Radius of Maximum Winds for Hurricane Sandy was much larger than 28 nautical miles, why is the R value selected for the PMH considered sufficiently conservative?

NRC Staff Response to SER Question 21 (C. Bender, H. Jones): In general, keeping all other storm surge parameters constant, hurricane central pressure and resultant storm intensity decreases as R (storm size) increases. Historically (1869 to present), the New England region has experienced the landfall of 41 tropical cyclones with only three reaching Category 3 (110-130 miles per hour (mph)) intensity. No storms have been recorded with greater intensity in this region. The controlling storm at the PSEG Site is a Category 4 (133.5 mph) tropical cyclone at landfall with a resultant storm surge of 32.1 feet. Given the very low central pressure applied (26.64 in. Hg (902 millibar (mb))), the R value applied is appropriate and conservative for a PMH event at the PSEG Site. In comparison, the record for storm surge in the United States is 29 feet in the Gulf of Mexico from the 2005 Hurricane Katrina (at landfall with a storm intensity of 130 mph, a radius of maximum winds of 30 miles and a central pressure of 27.17 in. of Hg (920 mb).

Hurricane Sandy was formally considered to be an extratropical cyclone at landfall due to the cold waters off the coast of New England and intrusion of cold air derived from a frontal system merging with the storm as it moved northward along the Atlantic Seaboard. Upon landing northeast of Atlantic City, New Jersey, Extratropical Cyclone Sandy had 80 mph winds (equivalent to a Category 1 hurricane) and an actual radius of maximum winds over 1000 miles with a storm surge of 12 to 15 feet at the location of landfall. Thus, a larger value for R (radius to maximum winds) does not necessarily translate to a larger storm surge at the PSEG Site. Because of this important inverse statistical relationship between storm intensity and parameter R, the Applicant's analysis is considered sufficiently conservative in the Staff's safety evaluation.

SER Section 2.4.5.4.9 Comparative Storm Surge Analyses and Design Basis Flood Level

SER Question 22: *On page 2-125, Staff states:*

> *Through independent confirmatory analysis, the staff determined that application of PMH storm parameters as input in the SLOSH model produces water surface elevations that exceed the publically available SLOSH Display Program (V. 1.61g) data for Category 4 storms in the PSEG project area.*

What is the significance of this statement? Does it mean that the code is being used outside of its range of applicability?

NRC Staff Response to SER Question 22 (C. Bender, H. Jones): Yes, the SLOSH Display Program (SDP) initially being used by the Applicant was outside of its range of applicability and was found unacceptable. The SDP analysis, as part of the initial methodology in the hierarchal hazard approach analyses performed by the Applicant, was used to provide a comparison surge value for the Bodine/HEC-RAS/Kamphuis one-dimensional model approach. Subsequently the two-dimensional ADCIRC+SWAN model approach was also applied. Thus, the Staff's statement was made to indicate a limitation in the SDP analysis conducted by the Applicant as part of the original methodology applied in the PSEG ESP analysis.

The NOAA SDP tool and SLOSH storm surge forecast model are two different programs. The SDP software was developed as a tool to aid emergency managers in visualizing storm surge vulnerability using data produced by the National Hurricane Center (NHC). The SLOSH storm forecast model is a two-dimensional storm surge model used by the NHC to forecast storm surge and model storm surge vulnerability. The Staff's statement was made to convey that the Applicant's use of the SDP results produced a weaker storm than PMH conditions at the PSEG Site and, therefore, did not provide a robust comparative value to the Bodine/HEC-RAS/Kamphuis one-dimensional model approach. The Applicant used the two dimensional ADCIRC+SWAN model for the final probable maximum storm surge (PMSS), and the Applicant's revised two dimensional ADCIRC+SWAN analysis is what the Staff ultimately relied on for its final safety findings in the SER.

SER Question 23: *What are the water surface elevations at the PSEG site that resulted from Staff's application of the SLOSH model? Why is the ADCIRC+SWAN methodology preferred to the SLOSH methodology?*

NRC Staff Response to SER Question 23 (C. Bender, H. Jones): The SLOSH storm surge forecast model was developed by NOAA in the 1980s to facilitate developing computationally fast forecasts in order to provide the public with timely operational storm surge warnings. It was also used in the 1990s by the Federal Emergency Management Agency (FEMA) for the development of flooding insurance demarcation. In order to reduce computation time, assumptions in the fundamental equations were made that limited the physics of the program code including a coarse grid (finite difference), and the exclusion of tides and rivers. The Staff's SLOSH model results showed that multiple storms could produce water surface elevations greater than 25 feet at the site with some storms producing values over 30 feet.

In contrast to SLOSH, the ADCIRC+SWAN model, which was developed by the U.S. Army Corps of Engineers (USACE) and academia, includes state-of-the art physics and allows for much higher model mesh resolution (finite element) near the site. These features allow important surge-altering topographic and bathymetric features to be included in models. Additionally, the ADCIRC+SWAN model allows for more detailed wind and pressure forcing

within the model. Within the coastal engineering community, a highly resolved ADCIRC+SWAN model is considered more appropriate for a detailed site analysis compared to the SLOSH model, which features much reduced model resolution. ADCIRC+SWAN is currently used as standard best practice by NOAA, USACE, and FEMA for research, emergency management and for determining hazards to ocean structures. The Applicant's revised two dimensional ADCIRC+SWAN analysis is what the Staff ultimately relied on for its final safety findings in the SER.

SER Question 24: *On page 2-126, Staff states:*

> *As a second step in the independent analysis, the staff confirmed the ability to reproduce the PSEG study model results near the project site for similar model settings and storm forcing. The staff executed the PSEG study Hurricane Isabel validation simulation and the PMH storm simulation. The results from the independent Hurricane Isabel and PMH storm simulations, presented in Table 2.4.5-2 below, showed nearly identical values near the project site with differences in maximum water levels on the order of 0.01 m (0.03 ft).*

This paragraph suggests that in Table 2.4.5-2 one would find Staff confirmatory calculations (right two columns of the table) showing nearly the same results as one of the PSEG calculations. However the two Staff calculations in that table do not show close agreement with any PSEG calculation. Staff shall provide the comparison between Staff and PSEG calculations that demonstrates the ability of Staff to replicate PSEG calculations. Staff shall also provide a table showing all the sensitivity calculations performed by Staff.

NRC Staff Response to SER Question 24 (C. Bender, H. Jones): There is a typographical error on page 2-126, paragraph four and SER Table 2.4.5-2 should have been referenced. The SER Table 2.4.5-2 provides a comparison of the Applicant's and the Staff's PMSS results, which are based on comparison of different synthetic storms used to determine the maximum plausible PMSS. The purpose of the Table was to show the general agreement between the PSEG PMSS analysis and the Staff's independent analysis of the PMSS. Thus, the paragraph should read: "…*The results from the independent Hurricane Isabel and PMH storm simulations showed nearly identical values near the project site with differences in maximum still water levels on the order of 0.01 m (0.03 ft*)." It should be noted that the model validation simulations for Hurricane Isabel were confirmatory in nature, to assess the adequacy of both the Applicant's and the Staff's ADCIRC+SWAN models to reproduce physical results from a historic storm, and were not used as a basis for the Staff's findings.

SER Section 2.4.5.6 Conclusion

SER Question 25: *On page 2-132, Staff states:*

> *The staff accepted the applicant's PMSS of 9.78 m (32.1 ft) as the DBF noting that it was a very conservative analysis and most realistic of the simulations with the post-addition of the 10 percent exceedance high tide.*

Table 2.4.5-2 on page 2-130 appears to show that 32.1 ft is near the low end of the calculations displayed in the table. Staff shall summarize the factors leading to the conclusion that this value is conservative.

NRC Staff Response to SER Question 25 (H. Jones): The calculation of storm surge water elevation is a result of many variables including: hurricane forward velocity, radius, central pressure, site location and bathymetry, building and other surface improvements, climate change assumptions, antecedent tide, and storm track angle. Given the entirety of the Staff's review, calculations and sensitivity runs, the Staff determined that the PSEG ESP ADCIRC+SWAN Run#2 is conservative and the most appropriate of the simulations that result in the DBF. None of the ADCIRC+SWAN runs done by the Applicant and the Staff resulted in total storm surge water elevations that exceed the PSEG Site grade of 36.9 feet.

For example, in the Hierarchical Hazard Approach (HHA), past experience has often demonstrated that parameter realism and accuracy within the analysis will reduce uncertainty and result in a lower number without changing the conservative approach. For example, the Applicant's 32.1 feet result uses sea level rise in the antecedent water level and adds the high tide post-simulation. This reflects that high tide is site-specific because adding high tide in the antecedent water level would raise the water level throughout the entire grid (e.g., Atlantic and Gulf model grids). In addition, a major factor was that the differences between the simulations was caused by the wave runup calculations. The wave values near all the infrastructure contain uncertainty due to the fact that the light detection and ranging (LIDAR) data used were for a bare earth site without structures. Therefore the calculated wind wave runup coming from the south would be conservatively larger than if structures and grading were present to cause wave dissipation. For waves coming from the west, any structure present near the coastline between open water and the safety-related infrastructure will reduce the wave heights. Finally, the total water level from wind wave runup is an intermittent value with the PMH still water level 7.5 feet lower (value without runup but including antecedent water level).

For further context, the highest storm surge of record (29.0 feet) in the U.S. was a result of Hurricane Katrina in New Orleans, Louisiana, in 2005. Further, during 2012, when Hurricane Sandy made landfall as it transitioned to an Extratropical Cyclone, approximately 75 mi northwest of the PSEG Site, it resulted in a maximum storm surge of 7.0 ft near the Oyster Creek Nuclear Generating Station (an operating nuclear facility on the New Jersey coast). While these examples are for other sites, the fact that such notable storm events produced storm surge levels lower than those assumed in the PSEG analysis helps emphasize the significant conservatism of the factors (including storm surge) considered in determining the DBF for the PSEG ESP site.

SER Section 2.4.6.4.1 Probable Maximum Tsunami

SER Question 26: *On page 2-139, Staff discusses Applicant's intention to defer some work to the COL application stage:*

> *In SSAR Section 2.5.5, the applicant stated that the analysis of slopes will be conducted at the COL stage. SSAR Section 2.5.5.1 discusses the general site slope characteristics and states that analyses will consider potential failure surfaces extending into the Delaware River. The applicant's text also states that portions of the site outside the new plant power block are relatively flat, and that there are no existing slopes on the site, either natural or manmade, that could affect the stability of the site.*

This section of the SER is evaluating the Probable Maximum Tsunami. What is the significance of site slope characterization to the potential sources of tsunamis?

NRC Staff Response to SER Question 26 (H. Jones, P. Lynett): Tsunamis generated by submarine and subaerial landslides are often the Probable Maximum Tsunami (PMT) for nuclear power plant sites throughout the U.S. The Applicant's SSAR Section 2.5.5 discusses, among other things, the potential for subaerial landslides that could affect the site. For the PSEG Site, current site topography averages between 10 and 12 feet at site grade, with relatively flat topography around the site and no existing slopes on the site. Overall, the lower Delaware Estuary-Bay region is characterized by gently sloping topography inland, transitioning to a relatively flat coastal plain along the coast, dominated by salt marshes, sandy beaches and dunes, and coastal forests. Thus, subaerial landslides are excluded as a potential tsunami generating source for the PSEG Site.

While currently there are no existing slopes on the site, natural or manmade, that could affect the site, there is the potential for structures related to the technology selected requiring the construction of slopes. As such, the Staff added COL Action Item 2.5-20 that requires PSEG to perform a slope stability analysis for the technology selected. The slope stability analysis will include the evaluation of deep slope failure surfaces that may extend into the Delaware River and various water level considerations.

SER Section 2.4.6.4.2 Historical Tsunami Record

SER Question 27: *Staff states on page 2-140 that the 1929 Mw = 7.2 submarine earthquake and associated landslide in the Grand Banks resulted in a tsunami with a runup height of 27 m on the coast of Newfoundland. Are there geological reasons why a similar combination of events could not occur off the coast of the Mid-Atlantic States?*

NRC Staff Response to SER Question 27 (H. Jones, P. Lynett): While the specific local geology has a large influence on the types of submarine landslides that might occur, the Applicant and the Staff assumed for the purpose of the PSEG application and review that the potential exists for a landslide with a volume similar to the Grand Banks event to occur offshore of the PSEG Site. However, the submarine landslide volume of 165 km^3 used for the PSEG Site hazard assessment, taken from studies of the Currituck Submarine Landslide, is much larger than the initial volume of the Grand Banks slide (20 km^3, see Nisbet and Piper, 1998). Thus, the Staff analysis conservatively uses a slide volume much larger than the Grand Banks initial volume.

The Staff's independent, calculated one dimensional tsunami elevations, which are conservative, on the open Atlantic coast from the Currituck-like source simulated, are in excess of 30 m (98.4 feet). This compares similarly to the coast of Newfoundland results referenced by the Staff in the SER on page 2-140. However, near the PSEG Site, the maximum one-dimensional Staff water elevation only reaches 8.6 m (28.2 ft) while the Staff's two dimensional simulations predict a maximum tsunami elevation of 6.0 m (19.7 ft) with the no-friction simulation and 1.0 m (3.3 ft) from the with-friction simulation. Both the Applicant's and the Staff's PMTs are taken from two-dimensional simulations with friction included. The Applicant's PMT water level (Currituck landslide) associated with maximum runup at the site is 1.72 m (+5.64 ft). These evaluations thus reinforce the conclusion that a tsunami would not constitute the DBF for the PSEG Site, and that in any event it would not exceed the PSEG ESP site grade elevation, which is 36.9 ft.

SER Section 2.4.6.4.3 Source Generator Characteristics

SER Question 28: *On page 2-143, Staff provides a brief analysis of potential tsunami sources from intra- plate earthquakes and states that the primary sources of intra-plate earthquakes suitably located to generate tsunamis are the mid-Atlantic Ridge and associated transform faults.*

Staff shall comment on the 2013 journal article by Hough, Munsey and Ward proposing that a small tsunami observed in the Delaware River near Philadelphia in 1817 was produced by a significant ("low- to mid-M7") earthquake located along a northeast trending seismic zone off the eastern coast of the United States. Does Staff agree with the conclusions presented in this paper and, if so, does the location and nature of this seismic zone have the potential to generate a significant tsunami hazard for the PSEG site?

NRC Staff Response to SER Question 28 (H. Jones, P. Lynett): The 2013 journal article by Hough, Munsey and Ward discusses that an earthquake of Mw7+ located 800-1000km off South Carolina may be responsible for the accounts of small tsunami observations near Philadelphia, Pennsylvania. The Staff considers it likely that there exists the potential for mid-Mw7 earthquakes in this off shore region. However, intra-plate earthquakes at this energy level are not capable of producing large tsunamis, such as the submarine landslide induced tsunamis discussed in the SER, because the vertical motion of the plate during such an earthquake is small. For example, the tsunami height reported in the Hough et al paper at the entrance to the Delaware Bay is 50 cm, while the tsunami height at this same location for the Staff-estimated PMT is greater than 10 m. Nevertheless, large earthquakes near the continental margin do have the potential to trigger large submarine landslides and this hazard is included in the Applicant's analysis, as well as the Staff's independent confirmatory analysis.

SER Question 29: *On page 2-145, Staff states that the Applicant commissioned an independent analysis of 26 well boring logs collected within the footprints of the proposed new power block and east of the existing operating station, but notes that due to the limited geologic information and the complicated estuarine/fluvial and artificial fill architecture of the PSEG Site, the evaluation of the boring logs in a paleotsunami deposit sense is inconclusive.*

Other than contacting representatives of the New Jersey Geological Survey, did Staff pursue any additional inquiries to identify studies indicating the presence of Quaternary age paleotsunami deposits in the region bordering Delaware Bay?

NRC Staff Response to SER Question 29 (H. Jones, P. Lynett): The Staff performed the independent analysis discussed on SER page 2-145. The Staff examined boring logs recorded by the Applicant during the site survey. There are no credible, verified (peer-reviewed publications) descriptions of tsunami deposits in Delaware Bay or anywhere along the east coast of the United States. Using conservative methodologies, the Applicant's PMT and the Staff's independent confirmatory analysis results were significantly below site grade.

SER Question 30: *On page 2-145, Staff discusses the estimated age of the Currituck landslide:*

> *Approximately 4-9 m (13 ft to 30 ft) of sediment has accumulated since the Currituck landslide (Locat, et al., 2009b) leading to an estimated age of the failure of between 25,000-50,000 ybp, based on average sedimentation rates of 5 cm/year (2 in./year) for sediment burying the scar and deposits (Locat, et al., 2009b and Lee, 2009).*

In actuality, the reference cited by Staff (Lee, 2009) states: "Deposition rates are likely about 5 cm/ky for the Holocene and about 20 cm/ky for the late Pleistocene." Staff shall confirm that

the omission of "k"—thereby increasing the deposition rate by a factor of 1,000—is merely a typographical error. Staff shall also confirm that the 25,000-50,000 year age calculation is based upon an average of the Holocene and Late Pleistocene deposition rates, and not solely upon the Holocene rate of 5 cm/ky.

NRC Staff Response to SER Question 30 (H. Jones, P. Lynett): Yes, this is a typographical error in the SER. The Holocene deposition rate is estimated as 5 cm/ky. The Staff also confirms that the 25,000-50,000 year age calculation in the SER is based upon an average of the Holocene and Late Pleistocene deposition rates.

SER Question 31: *In the discussion of the hazards posed by tsunamis generated by volcanic landslides in the Canary Islands, Staff notes that the hydrodynamic model used by Ward and Day predicts wave heights on the eastern shore of North America of 10-25 m, but goes on to state on pages 2-142 through 143 that "The hydrodynamic model used by Ward and Day (Ward and Day, 2001), however, does not include the effects of non-linear advection or wave breaking. More recent research that incorporates these effects suggests wave heights along the eastern U.S. coast from this failure would be less than 3 m (9.8 ft) (Mader, 2001) or less than 1 m (3 ft) (Gisler and Weaver, 2006)."*

Are there more recently published numerical simulations of Canary Islands sourced tsunamis that predict the maximum heights of tsunami waves on the east coast of the United States? If so, how do these simulations compare with those of the earlier studies cited in the SER?

NRC Staff Response to SER Question 31 (H. Jones, P. Lynett): There have been a number of more recent studies on the Canary Islands flank collapse and resulting tsunami impacts on the east coast of the U.S. These recent studies are consistent with the studies referenced in the Staff SER. Below are three of the more recent studies.

- Abadie, S. M., et al. "Numerical modeling of tsunami waves generated by the flank collapse of the Cumbre Vieja Volcano (La Palma, Canary Islands): tsunami source and near field effects." Journal of Geophysical Research: Oceans (1978–2012) 117.C5 (2012).

- Løvholt, F., G. Pedersen, and G. Gisler (2008), Oceanic propagation of a potential tsunami from the La Palma Island, J. Geophys. Res., 113, C09026, doi: 10.1029/2007JC004603.

Both of these studies predict tsunami wave amplitudes of 4-8m along the eastern U.S. continental shelf break, similar to those provided in the Staff analysis (peak amplitude of 8.5 m). However, neither of the more recent studies attempts to model the waves once on the shelf, where breaking and bottom dissipation can become important. Building off the efforts of Abadie et al (2012) above, the authors presented tsunami elevation predictions on the shelf in:

- Harris, Jeffrey C., et al. "Near-and far-field tsunami hazard from the potential flank collapse of the Cumbre Vieja Volcano." The Twenty-second International Offshore and Polar Engineering Conference. International Society of Offshore and Polar Engineers, 2012.

The tsunami elevation predictions in the Harris study are generally less than 3 m, which is well below the site grade for the PSEG ESP site.

SER Question 32: *Have new geological data become available or new numerical methodologies been developed that would lead Staff experts to question the results of their numerical simulation for a tsunami generated by a volcanic landslide in the Canary Islands? In other words, in light of tsunami research published since the 2011 Fukushima Dai-ichi accident, does the Staff remain confident that its assessment of the potential hazard posed by tsunamis at the PSEG site is sufficiently conservative?*

NRC Staff Response to SER Question 32 (H. Jones, P. Lynett): No new geologic data have become available, although new numerical methodologies have been developed related to landslide tsunami hazards. The most recent tsunami research highlights observations and insights that imply large, coherent landslides are unlikely realizations (e.g. Hunt et al, 2013). This implies that the landslides used in the Staff analysis – large and coherent motions – are possibly more conservative than originally thought when the SER was developed. As such, the Staff's analysis is conservatively bounding.

- J.E. Hunt, R.B. Wynn, P.J. Talling, & D.G. Masson (2013). Multistage collapse of eight western Canary Island landslides in the last 1.5 Ma: Sedimentological and geochemical evidence from subunits in submarine flow deposits Geochemistry, Geophysics, Geosystems, 14 (7), 2159-2181 DOI: 10.1002/ggge.20138

SER Section 2.4.6.4.4 Tsunami Analysis

SER Question 33: *In its discussion of the numerical simulations of tsunamis generated by a Currituck-like submarine landslide, Staff states on page 2-148 that "[o]f immediate note is the rapid attenuation of wave height through the entrance of the Delaware Bay." With regard to their simulation of a tsunami caused by a Canary Islands volcanic landslide, Staff states on page 2-150 that "Similar to Currituck, the scattering of the wave at the entrance is the primary wave height reducer." In both simulations the wave height at the PSEG site is substantially lower than the wave height at the bay entrance.*

Can Staff cite any documented examples of tsunamis that entered estuaries and experienced wave height reductions on scales similar to those indicated by the numerical simulations? In other words, do the observed behaviors of tsunamis support the Staff's conclusion based on their numerical models?

NRC Staff Response to SER Question 33 (H. Jones, P. Lynett): The wave height response in the bay or estuary will be related to the ratio of the length scales of the tsunami and bay. A tsunami that is very long with respect to the bay will have little attenuation, and vice-versa. In this particular case, the dominant wavelength of the tsunami is much less than the characteristic length scale of the Bay (considered the square root of the surface area of the Bay). Such processes have been documented in the following articles:

- Hinwood, Jon B., and Errol J. Mclean. "Effects of the March 2011 Japanese tsunami in bays and estuaries of SE Australia." Pure and Applied Geophysics 170.6-8 (2013): 1207-1227.; *see section 4.3. where strong decrease in tsunami energy is found as a function of distance into the estuary*,

- Yeh, Harry; Tolkova, Elena; Jay, David; Talke, Stefan; Fritz, Hermann; Tsunami Hydrodynamics in the Columbia River, Journal ref: Journal of Disaster Research, 7(5), 604-608. 2012; *mostly a numerical study, but describes quantitatively the process of tsunami's in estuaries*, and

- AGU Ocean Sciences Presentation: "Coastal plain estuaries as low pass filters for tsunami activity" (https://www.sgmeet.com/osm2012/viewabstract2.asp?AbstractID=11819) provided a detailed study of this process.

SER Section 2.4.11.4.2 Low Water from Drought

SER Question 34: *On page 2-173, Staff states:*

> *The applicant is a co-owner of the Merrill Creek Reservoir, which is used for low flow augmentation during times of drought to allow the applicant to continue water withdrawal from the Delaware River for power generation.*

Given that PSEG is not the sole owner of the reservoir, what assurances are there that this source of low flow augmentation will always remain available?

NRC Staff Response to SER Question 34 (J. Giacinto): The Delaware River basin planning, development and regulatory agency is the Delaware River Basin Commission (DRBC), which oversees flow management of the Delaware River. It is the Staff's understanding that Merrill Creek Reservoir releases are intended to maintain a freshwater/saltwater interface down steam of the reservoir in times of drought. At the site location, tidal flow alone is capable of providing a sufficient cooling water supply given the minimum river water surface elevation of -15.9 feet site characteristic.

SER Section 2.4.12.4.1 Groundwater System

SER Question 35: *On page 2-180, Staff states:*

> *Although the applicant indicated that the aquifer/aquitard sequence for the site includes the Kirkwood-Cohansey Formation, the New Jersey Geological Survey (Dames & Moore, 1988) has indicated that this Formation is absent from the site area. Since the applicant performed field studies and derived parameters from these studies for the interval proposed to be the Kirkwood-Cohansey Formation, the formal name for this interval had no impact on the staff's evaluations and conclusions in this report.*

Staff shall confirm that it has concluded that, because the geological and hydrological parameters of these rocks have been determined, it does not matter that the unit was misidentified by the Applicant.

NRC Staff Response to SER Question 35 (J. Giacinto): The Applicant identified the regional aquifer/aquitard sequence as including the Kirkwood-Cohansey Formation. Staff confirms that the hydrogeological parameters of the stratigraphic units specific to the site have been adequately characterized by the Applicant through cross-sections of lithologic boundaries based on over 30 geotechnical borings, which included four boreholes with downhole geophysical tests. Borehole logs included interval blow counts, detailed descriptions of lithologies and geophysical information including gamma logging through the interval of the Kirkwood Formation. Additional geophysical testing on the lithologic sequence is described in SER Section 2.5.

SER Section 2.4.13.4.1 Release Site Location

SER Question 36: *On page 2-186, Staff asserts:*

> *In a June 30, 2011, response, the applicant provided several qualitative arguments, summarized below, as to why a release toward the east side is the most conservative . . . . These arguments for the conservatism of the westerly path noted that a substantially longer easterly travel time allowed for more radionuclide decay before discharge to surface water. (Emphasis added).*

Was this simply a typographical error? Explain.

NRC Staff Response to SER Question 36 (J. Giacinto): Yes, "…east side…" should read "…west side…" with "most conservative" taken to mean the case producing the highest radionuclide concentration at the discharge point. During the Staff's interaction with the Applicant at that time, the Applicant provided its rationale for the analysis of a direct discharge of a westerly pathway towards the Delaware River. The Applicant qualitatively noted the longer easterly travel time due to a longer distance to a discharge point and radionuclides having to pass through the low conductivity hydraulic fill from the underlying Alluvium. Subsequently, the Applicant provided a quantitative analysis of the easterly pathway confirming the conservatism of the westerly pathway as described in the SER Section 2.4.13.

SER Section 2.5 Geology, Seismology, and Geotechnical Engineering

SER Question 37: *On page 2-199, Staff states:*

> *The applicant (PSEG) followed guidance in Regulatory Guide (RG) 1.208, "A Performance Based Approach to Define Site-Specific Earthquake Ground Motion," to define the following four zones around the site and conducted investigations in those zones that became progressively more detailed passing from site region to site location:*
>
> - *Site region – Area within a 320-kilometer (km) (200-mile (mi)) radius of the*
> - *site location*
> - *Site vicinity – Area within a 40-km (25-mi) radius of the site location*
> - *Site area – Area within an 8-km (5-mi) radius of the site location*
> - *Site location – Area within a 1-km (0.6-mi) radius of the proposed plant*

10 C.F.R. § 100.23(c) provides that:

> *The size of the region to be investigated and the type of data pertinent to the investigations must be determined based on the nature of the region surrounding the proposed site. (Emphasis added).*

Did the Applicant provide an assessment of "the nature of the region surrounding the proposed site" to show that the guidance of RG 1.208 was appropriate for the PSEG site? If so, did the Staff evaluate this assessment? If not, why is it appropriate for Applicant to follow the guidance of a Regulatory Guide rather than the requirements of the regulations?

NRC Staff Response to SER Question 37 (G. Stirewalt): The Applicant did not provide a distinct assessment to specifically determine the size of the region based on the nature of the region surrounding the proposed PSEG ESP site. However, the Applicant provided sufficient

information to characterize the site region acceptably. RG 1.208 provides an approach acceptable to the Staff to satisfy the seismic requirements of 10 CFR Part 100. The Applicant used the 320 km (200 mi) regional distance specified in RG 1.208 to characterize the region and meet the regulatory requirements in 10 CFR 100.23(c). In addition, the Applicant used existing information from locations farther than 320 km (200 mi) from the site to acceptably evaluate the site-specific seismic hazards.

The only geologic data that are relevant to the safety assessment beyond 320 km (200 mi) are those involving the potential for vibratory ground motion from distant earthquake sources outside the site region. Data for these potential earthquake sources were captured by the Applicant's use of the existing information in NUREG-2115, "Central and Eastern United States Seismic Source Characterization for Nuclear Facilities." As discussed in RG 1.208, in conducting the assessment of seismic hazards, as required by 10 CFR 100.23(c), the areas of investigation might need to be expanded beyond 320 km (200 mi) "in regions that include capable tectonic sources, relatively high seismicity, or complex geology, or in regions that have experienced a large, geologically recent earthquake identified in historical records or by paleoseismic data." Geological features with these characteristics do occur beyond 320 km (200 mi) from the PSEG Site. However, these features are included in the existing NUREG-2115 model. Consequently, these features did not require additional characterization by the Applicant in order to conduct a site-specific probabilistic seismic hazard assessment.

SER Section 2.5.2 Vibratory Ground Motion

SER Question 38: *This section describes the evaluation of the ground motion response spectra. Should a COL be granted at some future date and a plant be built, what parts of this evaluation (or updated version thereof) will become design basis information for that plant?*

NRC Staff Response to SER Question 38 (D. Seber, S. Devlin-Gill): The design basis information is developed by the Applicant and reviewed by the Staff. The design basis for the plant is the safe shutdown earthquake (SSE) spectra, for which certain structures, systems, and components (SSC) must remain functional. The SSE is established during the COL phase based on the ground motion response spectrum (GMRS) and other design requirements. The GMRS, which is one of the site characteristics established in an ESP, represents the ground motion levels expected at the site based on local and regional seismic sources surrounding the site. As such, the GMRS is the first step in the development of the SSE. For the PSEG ESP, SER section 2.5.2 "Vibratory Ground Motion" documents the Staff's review of the Applicant's development of the site-specific GMRS.

The steps necessary to develop the SSE are described in Chapter 3, "Design of Structures, Components, Equipment, and Systems," of the SRP (NUREG-0800), which states that a COL Applicant may use a certified design nuclear power plant. Certified designs use broad-banded, smooth response spectra, referred to as certified seismic design response spectra (CSDRS). The CSDRS are site-independent spectra to which the certified design Category I safety-related SSCs of a nuclear power plant are designed. At the COL stage, the CSDRS is evaluated against the site-dependent GMRS (after both spectra have been transferred to the foundation level of the structure) to assure that the CSDRS are adequate and account for the site-specific demand. If the CSDRS envelops the foundation-level GMRS, then the CSDRS represents the design basis ground motions for the certified portion of the design. If the foundation-level CSDRS does not envelop the foundation-level GMRS, then either additional evaluations are undertaken to demonstrate that the certified design can withstand the additional demands beyond the CSDRS, or the SSCs need to be modified. The design basis ground motions in this

case include both the CSDRS and the GMRS. For the safety-related SSCs that are not part of the certified design, or a COL not referencing a certified design, the GMRS may be used as the SSE, provided that the SSE requirements of Appendix S of 10 CFR 50 are satisfied (i.e., peak ground acceleration value is at least 0.1g and the spectral shape is appropriate).

In summary, as described above, the CSDRS and GMRS may both be part of the design basis. Both the CSDRS and the GMRS must comply with the requirements of GDC 2, 10 CFR 100.23 and Appendix S of 10 CFR 50. However, only the GMRS would be established at the ESP stage.

References

U.S. Nuclear Regulatory Commission (NRC). NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition — Design of Structures, Components, Equipment, and Systems (NUREG-0800, Chapter 3)", August 2015.

SER Section 2.5.2.2.4.1.2 Ground Motion Models

SER Question 39: *On page 2-244, Staff states that "[t]hese models were reviewed by the staff as part of prior ESP and COL applications' reviews." What prior ESP and COL applications is Staff referring to, and where is this review documented?*

NRC Staff Response to SER Question 39 (D. Seber, S. Devlin-Gill): SER Section 2.5.2.2.4.1.2 "Ground Motion Models", discusses the Applicant's use of the ground motion models developed by the Electric Power Research Institute (EPRI) in 2004 (with an update published by EPRI in 2006) in its probabilistic seismic hazard analysis. Regarding the use of the EPRI (2004, 2006) ground motion models, both RG 1.208 and NUREG-0800 (Section 2.5.2, Revision 4) state that these ground motion models are acceptable as long as an adequate investigation has been carried out to provide reasonable assurance that there are no significant updates or new models that may impact on the results of the probabilistic seismic hazard analysis. The quoted SER statement refers to the final SERs for the Clinton (ADAMS Accession No. ML061210203), Grand Gulf (ADAMS Accession No. ML061070443), and North Anna (ADAMS Accession No. ML052710305) ESP sites, which document the Staff's review of the EPRI 2004 ground motion models (referred to in these SERs as the 2003 EPRI-sponsored project). The EPRI 2006 model update made minor changes to the EPRI 2004 models by concluding there was no technical basis for truncating the ground motion distribution at a specified number of standard deviations (epsilons) below that implied by the strength of the geologic materials. The Staff first accepted the use of EPRI 2006 update in the SER for the V.C. Summer COL application (ADAMS Accession No. ML110450305), but a detailed documented evaluation of this minor update was determined to be unnecessary.

References

Electric Power Research Institute (EPRI), TR-1009684, "CEUS Ground Motion Project Final Report," 2004.

---------, TR-1014381, "Program on Technology Innovation: Truncation of the Lognormal Distribution and Value of the Standard Deviation for Ground Motion Models in the Central and Eastern United States," August 2006.

U.S. Nuclear Regulatory Commission (NRC), NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition — Site

Characteristics and Site Parameters — Vibratory Ground Motion (Section 2.5.2, Revision 4)", March 2007. ADAMS Accession No. ML070730593.

---------, NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site", September 2005. ADAMS Accession No. ML052710305.

---------, NUREG-1840, "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf ESP Site", April 2006. ADAMS Accession No. ML061070443. ADAMS Accession No.

---------, NUREG-2153, "Final Safety Evaluation Report Related to the Combined Licenses for Virgil C. Summer Nuclear Station, Units 2 and 3", August 2011. ADAMS Accession No. ML110450305.

---------, "Safety Evaluation Report for an Early Site Permit (ESP) at the Exelon Generation Company, LLC (EGC) ESP Site", May 2006. ADAMS Accession No. ML061210203.

---------, RG 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion", March 2007. ADAMS Accession No. ML070310619.

SER Question 40: *On page 2-280, Staff states:*

> *The applicant acknowledged that large portions of the site vicinity are tidal marshes and any liquefaction features developed in that environment would be relatively quickly degraded and not easily recognized during aerial or ground reconnaissance investigations.*

Given that liquefaction features would not be easily recognized, were any alternative tests considered? Explain.

NRC Staff Response to SER Question 40 (G. Stirewalt): An Applicant is expected to use multiple investigative techniques to evaluate the potential for surface tectonic deformation at a site. Some of these investigative techniques are discussed in RG 1.208. Paleoliquefaction investigations are just one means that an Applicant can use in its evaluation. The Staff found that the Applicant conducted thorough aerial and field reconnaissance investigations throughout the PSEG Site vicinity. These investigations covered areas other than the tidal marsh areas within the site vicinity, as appropriate. The Applicant identified no evidence for Quaternary seismic deformation in the site vicinity as a result of its combined field investigations and literature reviews. In addition, excavation mapping at the existing HCGS site did not reveal earthquake-induced features. The Staff determined that the scope of the Applicant's investigations, which included investigations for earthquake-induced liquefaction features, was sufficient to evaluate the potential for surface tectonic deformation at the PSEG Site. Permit Condition 3 addresses the need for geologic mapping of excavations for safety-related engineered structures and will provide further verification of the geologic and geotechnical characteristics of the geologic unit comprising foundation materials. Therefore, the Staff did not find it necessary for the Applicant to conduct any additional tests in the tidal marsh areas.

SER Question 41: *In Appendix A.1 of the SER, Staff proposed that the Commission include a license condition (Permit Condition No. 3) on an applicant for a COL or CP referencing the PSEG early site permit that requires the applicant to perform detailed geologic mapping of excavations and evaluate features discovered in those excavations. Are these excavations likely to expose undisturbed sediments and, if so, as part of this geologic evaluation, will the Applicant*

and/or Staff experts be required to carry out analyses specifically designed to identify paleotsunami deposits?

NRC Staff Response to SER Question 41 (G. Stirewalt): The purpose of geologic mapping performed in excavations for safety-related engineered structures is to confirm the presence or absence of any tectonic or non-tectonic features that could potentially result in deformation beneath the safety-significant structures. Excavation is typically performed immediately before commencing construction. For the PSEG Site, the potential excavations that would be mapped would be founded in the sedimentary rocks of the Vincentown Formation, the chosen foundation unit, which consists of shallow marine sediments that are older than 23 million years in age. Unconsolidated to poorly consolidated younger sediments that overlie the Vincentown Formation will be removed from the location of site excavations, consistent with Permit Condition 4, and as such would not be geologically mapped. If paleotsunami deposits (either undisturbed or disturbed) are present in the older excavated Vincentown Formation, these deposits would represent paleo-geologic and paleo-hydrologic conditions from so long ago that they would not be informative relative to the characteristics of potential future tsunamis at the PSEG site. Consequently, the Applicant would not be required to carry out analyses specifically designed to identify paleotsunami deposits in the Vincentown Formation, because this information would not be safety significant. The Staff's review of tsunami potential for the PSEG ESP site is in SER Section 2.4.6.

SER Section 2.5.4.4.2 Properties of Subsurface Materials

SER Question 42: *Do the subsurface materials at the PSEG site differ in any significant way from those at the Hope Creek and Salem sites?*

NRC Staff Response to SER Question 42 (F. Vega, G. Stirewalt): The PSEG Site subsurface materials do not differ significantly from those at SGS and the HCGS. As documented in the SER, in addition to reviewing the geologic and geotechnical engineering information provided in the PSEG SSAR, the Staff reviewed relevant information in the SGS and HCGS UFSAR to confirm the Applicant's assessment that there are no significant variations in the major sedimentary units across the sites. The Staff compared boring logs from the PSEG and SGS/HCGS site investigations and the subsurface material and engineering properties of the two sites based on field and laboratory test data. The Staff determined that the data show lateral continuity and geologic similarity for the site stratigraphy and that the material and engineering properties of the subsurface materials are similar at the PSEG and SGS/HCGS sites.

SER Section 2.5.4.4.10 Static Stability

SER Question 43: *On page 2-332, Staff states: "the applicant stated that it has not yet established the criteria to estimate the site-specific total and differential settlement because …." Is this something that must be evaluated at the COL stage, and if so, should there be a COL Action Item for it?*

NRC Staff Response to SER Question 43 (F. Vega, L. Candelario): Yes, settlements induced by applied loading from structures must be evaluated at the COL stage once the reactor technology has been selected. Since settlements are mostly dependent on the structure's size and weight and these characteristics have not been determined yet by the Applicant, the Staff identified COL Action Item 2.5-16 in SER Section 2.5.4.4.10 "Static

Stability," to ensure a detailed settlement evaluation is performed to analyze the stability of safety-related facilities as part of the COL application.

The COL Action Item 2.5-16 states: An applicant for a COL or CP referencing this early site permit should analyze the stability of all planned safety-related facilities, including static and dynamic bearing capacity, rebound, settlement, and differential settlements under dead loads of fills and plant facilities, as well as lateral loading conditions.

SER Section 2.5.4.6 Conclusion

SER Question 44: *On page 2-336, Staff identifies Permit Condition 4 stating, "the staff identified Permit Condition 4, which addresses the need for additional geotechnical investigations and liquefaction assessments for a COL or CP." But Permit Condition 4, as set forth on the same page, make no mention of "additional geotechnical investigations" or "liquefaction assessments." Instead it requires that Applicant "remove and replace the soil." Which is the correct representation of the Permit Condition?*

NRC Staff Response to SER Question 44 (F. Vega, L. Candelario): Permit Condition 4 is correctly stated in the SER, however, there is a typographical error in the third paragraph of SER Section 2.5.4.6 "Conclusion." The Staff intended to reference COL Action Item 2.5-14 that describes the need for additional geotechnical investigations and liquefaction assessments in the COL or CP stage, rather than Permit Condition 4.

The COL Action Item 2.5-14 states: An applicant for a COL or CP referencing this early site permit should perform additional geotechnical investigation, consistent with RG 1.132, including the performance of additional borings and a detailed liquefaction assessment to determine if zones of lower blow counts, which might indicate a potentially weak liquefiable zone, are present underneath the competent layer. If the additional borings and analyses identify areas where potential for liquefaction may be present, the applicant should remove unsuitable materials and either replace it with competent material or improve it to eliminate liquefaction potential.

Question 45: *The potential for an aircraft hazard is evaluated in SSAR section 3.5.1.6. The criteria for eliminating an aircraft from hazard consideration are cited by Staff on page 3-2 as:*

> *The site-to-airport distance (D) is between 5 and 10 statute miles and the projected annual number of operations is less than 500 D^2, or the site-to airport distance (D) is greater than 10 statute mi, and the projected annual number of operations is less than 1000 D^2.*

Table 3.5-1 of the SSAR demonstrates that each airport considered by itself meets this criteria. However by evaluating "Limited Distance/Screening Limit" for each airport it can be seen that an aggregate of the airports do not pass this screening by a factor of 2.38. How does considering each airport on its own provide adequate assurance that area airports are not a potential hazard to a new unit? Is it permissible to parse a single hazard (aircraft) into subdivisions (aircraft from different airports) to show that that possible hazard meets safety criteria?

NRC Staff Response to SER Question 45 (S. Tammara): The methodology for evaluation of aircraft hazard outlined in the Staff's SRP (NUREG-0800) includes a process for screening out certain airports from consideration based on a 10^{-7} crash probability that considers the distance from the site and the projected number of flights. The Staff aggregates the crash probabilities

for all airports that are screened in. The Staff considers this process adequate because the screening criteria of 10^{-7} is at an acceptably conservative level to ensure that the probability of a crash resulting in radiological consequences exceeding the regulatory limits would be less than 10^{-7}. However, for PSEG all the airports identified were screened out of further analysis. Even if all of the airports considered in the PSEG ESP analysis were assumed to have the maximum screening crash probability of 10^{-7} per year, the aggregated probability of all airports would be 6.0×10^{-7} per year, which is on the same order of magnitude of 10^{-7} per year, and this result is less than the upper limit criterion of 10^{-6} per year provided in SRP (NUREG-0800) Section 2.2.3. It should be noted, as shown in SSAR Table 3.5-1, the number of operations projected for year 2025 for each of the six nearby airports is considerably less than the screening criteria used. Therefore, this criteria is appropriate as a screening criteria to eliminate airports from further consideration and there was no need to aggregate the crash probabilities of all of the airports.

SER Question 46: *On page 3-4, Staff cites an acceptance criterion for airplane crash as, "The radiological consequences of 10 CFR Part 100 exposure criteria are considered met if it is demonstrated that the probability of radiological release or core damage frequency (CDF) is less than 10^{-7} per year." Where is this criterion documented?*

NRC Staff Response to SER Question 46 (S. Tammara): The design basis events are defined as those events that have a probability of occurrence on the order of magnitude of 10^{-7} per year or greater with potential consequences serious enough to affect the safety of the plant to the extent that the guidelines specified (radiological dose requirements) in 10 CFR Part 100 would be exceeded. This criterion for design basis accidents is documented in SRP (NUREG-0800) Section 2.2.3, which the Staff followed in conducting its analysis.

SER Question 47: *How many events, each having a CDF just less than 10^{-7} per year, are acceptable before the aggregate becomes a significant risk? How does the safety evaluation assure that the sum total of all risks is acceptable?*

NRC Staff Response to SER Question 47 (S. Tammara): The Staff's evaluation assures that the sum of all risks from potential aircraft impacts is acceptable by ensuring that the aggregate probability of aircraft crashes from all airports that are screened in is below 10^{-7}, consistent with SRP (NUREG-0800) Section 2.2.3.

SER Question 48: *In the third paragraph of the subsection titled "Gaseous Effluent Source Term Analysis," Staff discusses the absence of dose factors for five radionuclides. Staff states that Applicant explained that the five nuclides are short-lived daughters of long-lived parents, and that there are no dose factors for them in the dose-factor library. Because they are radionuclides, there will be a dose from their decay. Has this dose been accounted for in the dose factor for the parent radionuclides? If not, have they simply been neglected? If so, why is this an adequate treatment?*

NRC Staff Response to SER Question 48 (S. Williams, Z. Gran): The absence of explicit dose factors for these five nuclides does not reflect any inadequacy in the dose analysis, as they either contribute negligibly to dose or are accounted for in the dose factor for their parent nuclides. The five radionuclides in question are: Kr-90, Xe-139, Rh-103m, Rh-106, and Ba-137m. As discussed further below, the doses for Kr-90 and Xe-139 are not explicitly accounted for in the dose factor for the parents due to their very short half-lives and accordingly negligible contribution to dose, while the contributions for Rh-103m, Rh-106, and Ba-137m are attributed to their parents and are accounted for from their parent's contributions. Accordingly, the

referenced RG 1.109 listings for the Dose Conversion Factors (DCF) for calculation of gaseous effluents from nuclear power plants (Tables E-6 to E-10) do not include DCFs for these particular radionuclides. Also, in the referenced 10 CFR 20 Appendix B, Table 2, Column 1, these radionuclides are also not listed regarding any regulatory effluent concentration limits.

- The half-lives of Kr-90 and Xe-139 are 32.3 seconds and 39.7 seconds, respectively. These two radionuclides are not considered because with such a short half-life they would have undergone several decays before reaching a receptor, making any dose to a receptor negligible, given the expected time to the receptor in comparison to the half-life of these nuclides.

- Rh-103m, Rh-106, and Ba-137m dose contributions are attributed to their parents because these nuclides are assumed to be in secular equilibrium with their parent nuclides. Secular equilibrium is a scenario where the quantity of a radioactive isotope remains constant because its production rate is equal to the decay rate of both the parent and daughter. Secular equilibrium only occurs in a radioactive decay chain where the parent radionuclide's half-life is much larger than the half-life of the daughter. The daughter's radioactive quantity would build until the number of atoms decaying per unit time becomes equal to the rate at which the parent is producing. The daughter decays so quickly, in comparison to the parent, that its radioactive quantity is based solely on the amount the parent produces. The decay relationship between these parent radionuclides and their daughter radionuclides is as follows:

    - The parent radionuclide Ru-103, half-life 39.27 days, decays to Rh-103m, half-life 56.12 minutes.

    - The parent radionuclide Ru-106, half-life 1.02 years, decays to Rh-106, half-life 29.9 seconds.

    - The parent radionuclide Cs-137, half-life 30.07 years, decays to Ba-137m, half-life 2.552 minutes.

In the three chains described above, the half-life of the parent is much longer than that of the daughter and, therefore, they are in secular equilibrium. For these reasons, the Staff did not consider it necessary for the dose analysis to include explicit dose factors for any of the five specified nuclides.

SER Question 49: *In the subsection titled "10 CFR Part 50, Appendix I, Gaseous Dose Compliance," on page 11-9, Staff discusses Applicant's calculation of the dose to "a member of the public being located at the nearest site boundary for the full duration of the year." Figure 2.3-8 of the SER makes it appear that the nearest site boundary might be in the Delaware River. Was this the location of the calculation or was the nearest site boundary on land used?*

Staff Response to SER Question 49 (S. Williams, Z. Gran): SSAR Table 11.3-1 references the receptor locations used in the Chapter 11 analysis. The receptor location used for the analysis by the Applicant and the Staff is located in the ENE direction, at a distance of 0.24 miles. This location was chosen since it is the location of the highest χ/Q and D/Q values for a maximally exposed individual. The river's χ/Q and D/Q values were not used because of the negligible time any individual is expected to spend in this area during a one-year period. The values used by the Applicant and confirmed by the Staff reflect those doses that an individual would expect to receive from gaseous effluents from the proposed units. To ensure that the

appropriate specific release point characteristics and specific locations of receptors will be used, the Staff included COL Action Item 2.3-1, which a COL or a CP applicant must address.

SER Question 50: *On page 11-11, Staff explains the reason that the calculated total body dose is close to the limit. The reasons provided include the statement:*

> *(2) in the GASPAR computer code, when the Undecayed, Undepleted and Decayed, Undepleted X/Q values are equal, the equation GASPAR II uses to solve for decay time sets time equal to zero. Without a decay time, the shortlived gaseous radionuclides increase the total dose.*

Staff shall explain this statement in more detail.

Staff Response to SER Question 50 (S. Williams, Z. Gran): The reason that the calculated total body dose is close to the limit is due to the conservatisms in the calculations used in accordance with the Staff's guidance. Page 3.3 of NUREG/CR-4653 "GASPAR II – Technical Reference and User Guide," provides the relevant NRC approved Equation 3.1, which solves for a transit time for a radionuclide based on a ratio of the decayed (χ/Q_{dr}) to the undecayed χ/Q (χ/Q_r) data.

$$T = \frac{-\ln\left[\left(\bar{\chi}/Q'\right)_{dr} / \left(\bar{\chi}/Q'\right)_{r}\right]}{\lambda_{\chi e}} \qquad (3.1)$$

The effective transit time, T, is used to determine the time it takes for a radionuclide to travel from the release point to the exposure location. When χ/Q_{dr} and χ/Q_r are equal, the value within the natural log becomes 1. The ln(1) is equal to zero, and so the value for T equals zero over the decay constant, which would also become zero.

In this case, with the transit time set to zero, the GASPAR computer code would not account for a decay time for any parent or daughter radionuclide, already in equilibrium, and a maximum dose would be calculated. If a time for decay of short lived radionuclides had been considered, the doses shown in the SER would be lower since the short lived radionuclides would not contribute to the total dose.

SER Question 51: *Under the subheading "Population Dose Evaluation—Gaseous Effluents" on page 11-12 the following two sentences appear:*

> *"Table 11.4.2-3 of this report lists the population doses that the applicant calculated as compared to the staff's verification of the applicant's results."*
>
> *"Table 11.4.2-3 below shows the assumptions and parameters used by the applicant that resulted in the same dose for the total body and a slightly lower dose for the thyroid when compared to the staff's bounding independent assessment."*

The first of these sentences appears to reflect the content of Table 11.4.2-3. The second sentence does not. Staff shall provide clarification.

Staff Response to SER Question 51 (S. Williams, Z. Gran): The Staff's intent in the second statement was to indicate that the Applicant's own assumptions and parameters were used to

develop the results referenced in SER Table 11.4.2-3 “Comparison of Gaseous Population Doses”.

SER Section 13.3 Emergency Planning

SER Question 52: *Staff shall briefly describe any significant differences between the current site emergency plan and that which would be used if an additional reactor is built on the PSEG site.*

NRC Staff Response to SER Question 52 (B. Musico): The Staff did not identify any significant differences between the current site emergency plan and the PSEG Site Emergency Plan, which is based on the existing SGS and HCGS Emergency Plan. There are, however, various aspects of the PSEG Site Emergency Plan that will differ from the current site’s emergency plan. These are related to whichever reactor design that will be chosen at the combined license application stage. These aspects, which are unknown at this time, are addressed by permit conditions in SER Section 13.3.

SER Question 53: *On page 13-26, Staff states that its “primary focus” was to evaluate the emergency plan against NUREG-0654, Planning Standard F. On what else did Staff focus in its evaluation?*

NRC Staff Response to SER Question 53 (B. Musico): NUREG-0654 represents the consolidated guidance that applies to the 16 emergency planning standards in 10 CFR 50.47(b), and is supplemented by several additional regulations and related guidance documents (which are identified in the SER), depending upon the specific subject matter. These additional regulations and guidance documents are either referenced in NUREG-0654 or were developed after NUREG-0654 was published in November 1980. The use of the term “primary focus” merely reflects that NUREG-0654 is the Staff’s principal guidance document for emergency plan reviews, as it provides the basic, overall, emergency planning review framework, within which the Staff (as well as the FEMA) conducts its evaluation of the emergency plans.

SER Question 54: *On page 13-32, Staff states that its “primary focus” was to evaluate the emergency plan against NUREG-0654, Planning Standard H. On what else did Staff focus its evaluation?*

NRC Staff Response to SER Question 54 (B. Musico): See Response to Question 53.

SER Question 55: *On page 13-49, Staff states that its “primary focus” was to evaluate the emergency plan against NUREG-0654, Planning Standard L. On what else did Staff focus its evaluation?*

NRC Staff Response to SER Question 55 (B. Musico): See Response to Question 53.

SER Question 56: *On page 15-5, Staff states that “[t]he estimated site characteristic χ/Q values for the proposed site are lower than the corresponding site parameter χ/Q values.”*

What is the difference between a site characteristic value and a site parameter? Why do their ratios being less than 1.0 ensure satisfactory radiological consequences?

Staff Response to SER Question 56 (S. Tammara): 10 CFR 52.1 provides the following definitions:

- *Site characteristics* are the actual physical, environmental and demographic features of a site. Site characteristics are specified in an early site permit or in a final safety analysis report for a combined license.

- *Site parameters* are the postulated physical, environmental and demographic features of an assumed site. Site parameters are specified in a standard design approval, standard design certification, or manufacturing license.

Each approved reactor design shall comply with 10 CFR Part 100 dose criteria, based on the generic or design site parameter relative concentration (χ/Q) values. For each potential reactor design considered within the ESP application, the applicant must demonstrate that the site specific/site characteristic relative concentration (χ/Q) values based on site meteorological data, site exclusion area boundary and low population zone distances would be bounded by (less than) the design specific/site parameter χ/Q values. Therefore, the ratio of respective site specific/site characteristic χ/Q values to the site parameter χ/Q values should be less than 1.0. Since the radiological dose is directly proportional to the χ/Q value, the radiological dose using the site specific/site characteristic χ/Q value would be lower than that using the site parameter χ/Q value, and would ensure compliance with the regulatory requirement. Demonstrating that the site characteristic χ/Q values for the proposed site are lower than the corresponding site parameter χ/Q values assumed in a certified design shows that the site dispersion conditions are more favorable than those in the certified design, therefore demonstrating radiological consequences that comply with NRC requirements.

Attachment B

AFFIDAVITS FOR NRC STAFF RESPONSES TO THE LICENSING BOARD'S INITIAL QUESTIONS ISSUED DECEMBER 15, 2015

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF ALLEN FETTER

I, Allen Fetter, do hereby declare as follows:

1. I am a Senior Project Manager in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of New Reactor Licensing. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Allen Fetter

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF PROSANTA CHOWDHURY

I, Prosanta Chowdhury, do hereby declare as follows:

1. I am a Project Manager in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of New Reactor Licensing. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Prosanta Chowdhury

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF HENRY JONES

I, Henry Jones, do hereby declare as follows:

1. I am a Hydrologist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Henry Jones

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF JOSEPH GIACINTO

I, Joseph Giacinto, do hereby declare as follows:

1. I am a Hydrologist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Joseph Giacinto

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF FRANKIE VEGA

I, Frankie Vega, do hereby declare as follows:

1. I am a Project Manager in the Nuclear Regulatory Commission's (NRC) Office of Nuclear Reactor Regulation, Japan Lessons Learned Division. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Frankie Vega

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF KEVIN QUINLAN

I, Kevin Quinlan, do hereby declare as follows:

1. I am a Physical Scientist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Kevin Quinlan

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF BRUCE MUSICO

I, Bruce Musico, do hereby declare as follows:

1. I am a Senior Emergency Preparedness Specialist in the Nuclear Regulatory Commission's (NRC) Office of Nuclear Security and Incident Response, Division of Preparedness. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Bruce Musico

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF STEPHEN WILLIAMS

I, Stephen Williams, do hereby declare as follows:

1. I am a Health Physicist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Stephen Williams

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF ZACHARY GRAN

I, Zachary Gran, do hereby declare as follows:

1. I am a Health Physicist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Zachary Gran

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF DOGAN SEBER

I, Dogan Seber, do hereby state as follows:

1. I am a Senior Geophysicist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Dogan Seber

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF STEPHANIE DEVLIN-GILL

I, Stephanie Devlin-Gill, do hereby state as follows:

1. I am a Project Scientist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Stephanie Devlin-Gill

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF LUISSETTE CANDELARIO-QUINTANA

I, Luissette Candelario-Quintana, do hereby declare as follows:

1. I am a Geotechnical Engineer in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Luissette Candelario-Quintana

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF GERRY STIREWALT

I, Gerry Stirewalt, do hereby declare as follows:

1. I am a Senior Geologist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Gerry Stirewalt

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF SESHAGIRI TAMMARA

I, Seshagiri Tammara, do hereby declare as follows:

1. I am a Physical Scientist in the Nuclear Regulatory Commission's (NRC) Office of New Reactors, Division of Site Safety & Environmental Analysis. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Seshagiri Tammara

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF CHRISTOPHER BENDER

I, Christopher Bender, do hereby declare as follows:

1. I am a Senior Engineer In Taylor Engineering, Inc.'s Coastal Engineering Service Group. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Christopher Bender

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14 2016

AFFIDAVIT OF PATRICK LYNETT

I, Patrick Lynett, do hereby declare as follows:

1. I am a Professor in the Sonny Astani Department of Civil and Environmental Engineering at the University of Southern California (USC); a member of the USC Tsunami Research Center; and an Affiliate Coastal Engineer in Taylor Engineering, Inc.'s Coastal Engineering Service Group. A statement of my professional qualifications is attached.
2. I am responsible for the statements in the responses to Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Initial Questions Issued on December 15, 2015" for which I am listed as an author.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record for this proceeding. I declare under penalty of perjury that my statements in the foregoing responses to Board questions and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
Patrick Lynett

Attachment C

NRC STAFF STATEMENTS OF PROFESSIONAL QUALIFICATIONS FOR RESPONSES TO THE LICENSING BOARD'S INITIAL QUESTIONS ISSUED DECEMBER 15, 2015

Allen H. Fetter, Ph.D.
Statement of Professional Qualifications

Current Position

Senior Project Manager
Environmental Projects Branch
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission

Education

Ph.D., Geology, University of Kansas, Lawrence, Kansas
M.S., Geology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina
B.A, Geology, Guilford College, Greensboro, North Carolina

Professional

U.S. Nuclear Regulatory Commission Senior Project Manager
Geological Society of America, Member

Qualifications

Dr. Fetter is the U.S. Nuclear Regulatory Commission (NRC) environmental Project Manager (PM) for review of the PSEG Site Early Site Permit (ESP) application, and has about 7 years of experience as a project manager within the NRC Office of New Reactors (NRO). Since the docketing of the PSEG Site ESP application, he has planned and coordinated most aspects of the NRC staff's environmental review of the application, including the acceptance review and docketing, scoping and information gathering, site audits, and preparation of the draft and final environmental impact statements (EISs). Dr. Fetter also planned and executed public meetings for comment on the draft EIS, and interfaced effectively with other government entities and stakeholders throughout the environmental review process. In addition to the PSEG ESP application review, he has worked at NRC a total of over 11 years as a qualified technical reviewer and project manager on a variety of pre-application activities and licensing reviews pertaining to high-level waste storage and disposal, in-situ uranium recovery, complex materials sites, and other new reactor siting applications. Most of Dr. Fetter's work as a project manager at the NRC has involved coordinating and managing a number of environmental reviews, and the associated preparation of environmental assessments and environmental impact statements as part of the NRC licensing process and the agency's implementation of NEPA.

Prior to coming to NRC, Dr. Fetter spent several years in the private sector where he worked as a hydrogeologist and project manager on numerous geotechnical, geophysical and hydrological site characterizations to determine the suitability of sites for waste disposal and to assist in the development of remediation plans for contaminated industrial sites. He also spent time in academia where he utilized heavy and rare-earth isotopes to delineate the crustal framework and reconstruct the tectonic evolution of complex metamorphic Precambrian geologic domains in North and South America, Africa and Antarctica. He was invited to Universidade Estadual Paulista in São Paulo, Brazil and spent 5 years helping to design, equip and manage two state-of-the-art isotope geochemistry labs for preparation of geologic and environmental samples for analysis by mass spectroscopy, and to expand and continue his research in South America. He obtained external funding for field research and laboratory equipment, and established a revenue source through the analytical work performed in the laboratory. He taught short courses on isotope chemistry and laboratory techniques, and their application to studies of environmental monitoring, and geologic and

tectonic evolution. Dr. Fetter also advised undergraduates and graduate students with their research projects and served as a committee member for seven graduate student oral examinations and final defense examinations. He refereed journal articles for the *Journal of South American Earth Sciences* and *Gondwana Research* and evaluated the merits of research proposals for CNPq (Brazilian equivalent to NSF). While in Brazil, he developed collaborative research projects with fellow scientists in Brazil (USP –São Paulo, UNICAMP, UFC, UF-Brasília), and in the United States (UNC – Chapel Hill, University of Kansas), publishing the results in peer-reviewed journals. Dr. Fetter is the author and coauthor on 22 publications related to geology.

Prosanta Chowdhury
Statement of Professional Qualifications

CURRENT POSITION

Project Manager
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors
Nuclear Regulatory Commission

EDUCATION

M.S., Nuclear Engineering, Louisiana State University, Baton Rouge, Louisiana
M.S., Electrical Engineering, Moscow Power Engineering Institute, Moscow, Russia

PROFESSIONAL

U.S. Nuclear Regulatory Commission (NRC) Qualified Project Manager
Secretary, National Radiological Emergency Preparedness Conference, Inc. (USA)

QUALIFICATIONS

Mr. Chowdhury is the U.S. Nuclear Regulatory Commission (NRC) lead Project Manager (PM) for review of the PSEG Site Early Site Permit (ESP) application, and has about 8 years of experience as a project manager within the NRC Office of New Reactors (NRO). Since the docketing of the PSEG Site ESP application, Mr. Chowdhury coordinated all aspects of the NRC staff's review of the application that included such disciplines as Site Hazards, Meteorology, Hydrology, Geology-Seismology-Geotechnical Engineering, Aircraft Hazards, Radiological Effluent Release Dose Consequences, Emergency Planning, Physical Security, Radiological Consequences of Design Basis Accidents, Quality Assurance Program, and Fukushima Near-Term Task Force (NTTF) Recommendations. Mr. Chowdhury also coordinated staff's presentation of safety evaluations to the Advisory Committee on Reactor Safeguards (ACRS), and publication of the Final Safety Evaluation Report (FSER). In this regard, Mr. Chowdhury's experience includes timely and effective communication of issues with the applicant and coordinating the staff efforts for resolution of the issues within established schedules. As part of his responsibilities, Mr. Chowdhury coordinated and actively participated in a number of regulatory audits and site visits. Mr. Chowdhury also participated in several public outreach meetings as well as government-to-government meetings.

In the capacity of project management, Mr. Chowdhury also coordinated the review of Chapter 19 in conjunction with the U.S. EPR design certification application and the Calvert Cliffs Unit 3 combined license application (COLA). Mr. Chowdhury was also the lead PM for the Nine Mile Point Unit 3 COLA (now withdrawn), and was assigned lead PM responsibilities of the-then suspended Callaway Unit 2 COLA (now withdrawn). Prior to joining NRO, Mr. Chowdhury served from 2005 until 2008, as an emergency preparedness specialist within the Office of Nuclear Security and Incident Response (NSIR), where he drafted the safety evaluation on emergency planning associated with the South Texas Project Units 3 & 4 COLA.

Prior to joining the NRC, Mr. Chowdhury served for 18 years as a Radiation Protection Specialist and Environmental Scientist in the State of Louisiana Department of Environmental Quality. In this capacity, Mr. Chowdhury oversaw the day-to-day function of the State's emergency preparedness program involving nuclear power plants affecting the State, and also of the State's radioactive materials transportation emergency response program. Mr. Chowdhury conducted radiation protection training for State and local responders.

From 1996 until 2004, Mr. Chowdhury was periodically recruited as an emergency planning, preparedness, and response expert of the International Atomic Energy Agency (IAEA) to instruct students from various member states, and also as a technical expert to review several IAEA draft technical documents.

As his M.S. research at LSU, Mr. Chowdhury developed and validated a three-dimensional neutron flux synthesis methodology and computer code, which became his thesis and was published as NUREG/CR-4984, ORNL/TM-10503. Mr. Chowdhury also co-authored technical papers involving neutron cross-sections and nuclear reactor pressure vessel embrittlement studies.

Henry Jones, Ph.D.
Statement of Professional Qualifications

CURRENT POSITION

Hydrologist
Meteorology and Oceanography Team (RMOT)
Hydrology and Meteorology Branch (RHMB)
Division of Site Safety and Environmental Analysis (DSEA)
Office of New Reactors (NRO)
Nuclear Regulatory Commission (NRC)

EDUCATION

Ph.D., Physical Oceanography, Naval Postgraduate School
M.S., Meteorology and Physical Oceanography. Naval Postgraduate School
M.S., Systems Management (Information Systems), University of Southern California
M.A., International Relations, Salve Regina University
B.S., Oceanography, United States Naval Academy
Diploma, Strategic Studies, Naval War College

PROFESSIONAL

Tropical Cyclone Forecaster – United States Navy
Co-Chair, International Atomic Energy Agency (IAEA) Working Group on Tsunami Hazards

QUALIFICATIONS

Dr. Jones joined the U.S. Nuclear Regulatory Commission (NRC) in 2007. He is currently a hydrologist and technical reviewer in the Office of New Reactors (NRO). He continues to lead several of NRC's high priority reviews in the new and operating reactor business lines in the area of oceanography. Dr. Jones is the lead for several of the licensees' 50.54(f) responses to Recommendation 2.1, flooding hazard reevaluation including Point Beach, St. Lucie, and Salem/ Hope Creek. Dr. Jones is assigned as the surge, seiche and tsunami hazard technical reviewer for all new reactor COL or ESP applications. He is also the lead or supporting reviewer for multiple COL or ESP reviews including PSEG, Turkey Point, Calvert Cliffs, STP, Fermi, and Levy County.

Following commissioning in 1979, Dr. Jones was assigned as a division officer aboard the USS BRADLEY (FF-1041). After completing his Surface Warfare Officer qualification, he transferred to the Meteorology and Oceanography (METOC) community in 1981.

Initial assignments ashore included Typhoon Duty Officer, Naval Oceanography Command Center, Guam (1982-1984) and Officer-in-Charge, Naval Oceanography Command Detachment, Kadena, Japan (1986-1989). Dr. Jones subsequently served as Ship's Oceanographer, USS MISOURI (BB-63) during DESERT SHIELD/DESERT STORM (1989-1991). Following this tour, he served as Assistant Program Manager for the Airborne Laser Theater Missile Defense Program (ABL) in the Ballistic Missile Defense Organization (BMDO) and Naval Research Laboratory (1992-1994). From 1994-1996 Dr. Jones served as Program Manager, Navy Satellite Remote Sensing in the Office of the Oceanography of the Navy (N096).

From 1996-2000, he provided graduate instruction as an Oceanography Lecturer at the Naval Postgraduate School in Monterey, CA. Dr. Jones was selected as a Permanent Military Professor (PMP) in 1999 and returned to the U.S. Naval Academy in 2000 where he served as an Assistant Professor in the Oceanography Department until his retirement from the United States Navy in 2007.

Joseph F. Giacinto
Statement of Professional Qualifications

CURRENT POSITION

Hydrologist
Hydrology Branch
Division of Safety and Environmental Analysis
Office of Nuclear Reactor Regulation (NRR)
Nuclear Regulatory Commission (NRC)

EDUCATION

M.S., Hydrology, University of Arizona
B.S., Geology (Geophysics), San Diego State University

PROFESSIONAL

Certified Professional Geologist, Virginia License 001350, Wyoming License 2788.

QUALIFICATIONS

Mr. Giacinto has 8 years of experience as a U.S. Nuclear Regulatory Commission hydrologist participating in major, multidisciplinary safety projects for NRC within the Offices of New Reactors and the Nuclear Reactor Regulation. His experience includes the technical review of multiple combined license (COL) and early site permit (ESP) applications in the areas of hydrology and geology. Mr. Giacinto currently serves as a technical lead in the Division of Site and Environmental Analysis (DSEA) developing projects related to reviews of new reactors and combined license and early site permit applications.

As a qualified technical reviewer, Mr. Giacinto has planned, led, and coordinated activities within DSEA related to the technical review of COL and ESP applications for licensing new nuclear power plants under NRC regulations in Title 10 of the *U.S. Code of Federal Regulations* (10 CFR) Parts 50, 52, and 100. Specifically, Mr. Giacinto has reviewed Safety Analysis Reports and associated information for Section 2.4, “Hydrologic Engineering” for the Bell Bend Nuclear Power Plant, Fermi Unit 3, North Anna Power Station (Unit 3), Turkey Point Units 6&7 and William States Lee III COL applications and, North Anna Unit 3, Victoria County Station and PSEG ESP applications. In these technical review activities, Mr. Giacinto applied his hydrogeologic expertise to evaluate and perform independent and confirmatory analysis of applicant’s conclusions, analyses, and results. Mr. Giacinto has engaged in technical discussions with licensees, developed requests for additional information, participated in pre-audits and safety audits, and provided key technical input for Safety Evaluation Reports.

As a DSEA hydrologist, Mr. Giacinto routinely reviews site specific hydrologic evaluations as part of new reactor applications, and assists, plans, and provides technical oversight/support involving staff reviews and recommendations. Mr. Giacinto has also provided key support in the issuance of Staff Assessments (SAs) related to the flood hazard evaluation for over 30 operating nuclear power plants in the U.S. Mr. Giacinto regularly participates in public and non-public meetings to better inform licensees and other stakeholders regarding NRC positions and review statuses.

Frankie G. Vega
Statement of Professional Qualifications

CURRENT POSITION

Project Manager
Hazard Management Branch
Japan Lessons Learned Division (JLD)
Office of Nuclear Reactor Regulation (NRR)
Nuclear Regulatory Commission (NRC)

EDUCATION

M.E., Civil Engineering, University of Maryland, College Park
B.S., Civil Engineering, University of Puerto Rico, Mayaguez

PROFESSIONAL

Professional Engineer (PE) – Puerto Rico 09/2012, #23820

QUALIFICATIONS

Mr. Vega has 9 years of experience as an engineer and project manager participating in major, multidisciplinary safety projects for U.S. Nuclear Regulatory Commission (NRC) within the Offices of New Reactors (NRO) and the Nuclear Reactor Regulation (NRR). This experience includes the technical review of multiple combined license applications (COLAs) and Early Site Permits (ESPs) in the area of geotechnical engineering. Mr. Vega currently serves as a project manager in the Japan Lessons Learned Division (JLD) managing projects related to Near Term Task Force (NTTF) Recommendations 2.1 and 2.3 "Seismic".

As a qualified technical reviewer in NRO, Mr. Vega has planned, lead, and coordinated activities in the Division of Site and Environmental Analysis (DSEA) related to the technical review of COL and ESP applications for licensing new nuclear power plants under NRC regulations in Title 10 of the *U.S. Code of Federal Regulations* (10 CFR) Parts 50, 52, and 100. Specifically, Mr. Vega has reviewed Sections 2.5.4, "Stability of Subsurface Materials and Foundations" and Section 2.5.5, "Stability of Slopes" of the South Texas Project, Turkey Point, Comanche Peak COL applications and the PSEG ESP application. In these technical review activities, Mr. Vega applied his engineering knowledge to perform confirmatory analysis of the licensee's soil stability analyses, engaged in technical discussions with licensees, developed requests for Additional Information (RAIs), participated in safety audits and provided key technical input into Safety Evaluation Reports (SERs).

As a project manager in JLD, Mr. Vega is involved in projects related to site specific seismic hazard evaluations and seismic walkdowns performed as part of NTTF Rec. 2.1 and 2.3. Mr. Vega has coordinated, assisted, planned and provided technical oversight/support related activities involving these recommendations. Mr. Vega has provided key support in the issuance of Staff Assessments (SAs) related to the seismic hazard evaluation for over 30 operating nuclear power plants in the US, has developed key pieces of communication, and participated in public meetings to better inform licensees and other stakeholders of NRC positions and review statuses.

Kevin Quinlan
Statement of Professional Qualifications

CURRENT POSITION

Physical Scientist (Meteorologist)
Division of Site Safety & Environmental Analysis (DSEA)
Nuclear Regulatory Commission

EDUCATION

M.S. Atmospheric Science, University of Alabama in Huntsville (2008)
B.S. Meteorology, Millersville University of Pennsylvania (2006)

QUALIFICATIONS

Mr. Quinlan has been working in the Office of New Reactors at the U.S. Nuclear Regulatory Commission (NRC) since July 2008. He is, or has been, the lead NRC meteorological reviewer on eight combined license applications, two early site permit applications, and one design certification currently undergoing review by the NRC Staff. Mr. Quinlan has successfully testified in front of the Advisory Committee on Reactor Safeguards nine times and once before the Commission in a combined license mandatory hearing.

His work primarily includes the analysis of regional and local climatology to determine the most severe weather that may impact a potential reactor site or design. As part of his reviews, he inspects the meteorological instrument tower at each site to ensure that it provides accurate data for use in determining the correct atmospheric dispersion properties of the site. Since March 2013 he has been a lead reviewer on the NRC's near-term task force recommendation 2.1 reviews of Flood Hazard Reevaluation Reports.

Bruce J. Musico
Statement of Professional Qualifications

Current Position

Sr. Emergency Preparedness Specialist
Division of Preparedness and Response
Office of Nuclear Security and Incident Response
U.S. Nuclear Regulatory Commission

Education

J.D., Franklin Pierce Law Center, Concord, NH 1992
B.S., Nuclear Engineering, University of Michigan, Ann Arbor, MI 1976

Professional Affiliations

Bar Admission – Pennsylvania & Washington, D.C.

Qualifications

Mr. Musico is a nuclear engineer with over 30 years experience in the commercial nuclear power and related industries, including approximately 25 years relating to nuclear reactor emergency planning (EP). This EP experience included work in virtually all facets of reactor emergency preparedness and response, including substantial experience performing a variety of EP work for nuclear utilities, local, State and Federal governments, and Canadian & U.S. nuclear licensing work. Prior to joining the NRC in 2002, Mr. Musico had a private consulting and law practice providing counsel to governmental agencies and legislators in the area of nuclear power operation, regulation, and decommissioning.

NRC Experience

Combined Licenses (COLs) – Staff technical reviewer for the emergency planning information submitted in the Vogtle, North Anna, and Turkey Point COL applications; including testifying as an expert witness before the NRC Commission during the Vogtle COL hearings.

Early Site Permits (ESPs) – Staff technical reviewer for the emergency planning information submitted in the Vogtle, North Anna, and PSEG Site ESP applications; including testifying as an expert witness during the Vogtle NRC Atomic Safety and Licensing Board (ASLB) hearings.

Standard Review Plan (SRP) – Author of Section 13.3, "Emergency Planning," of the March 2007 update to the Standard Review Plan (NUREG-0800). Creator of the emergency planning Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) contained in SRP Section 14.3.10, "Emergency Planning – Inspections, Tests, Analyses, and Acceptance Criteria."

Regulatory Guide (RG) 1.206 – Author of Section 13.3, "Emergency Planning," and related guidance in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

ESP Review Standard (RS)-002 – Author of Section 13.3, "Emergency Planning," of NRC RS-002, "Processing Applications for Early Site Permits."

New Reactor Licensing Final Rule (10 CFR Part 52) – Principal author of various revisions to emergency planning regulations associated with new reactor licensing under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

NRC Incident Response Organization – Member of the NRC Headquarters Protective Measures Team, associated with NRC response in support of nuclear reactor emergencies. Participated in the NRC's 24-hour emergency response to the Fukushima Daiichi nuclear incident.

Non-NRC Experience

Counsel – New Hampshire Nuclear Decommissioning Financing Committee

Reactor Licensing Engineer – Ontario Power Generation, Toronto & Pickering Nuclear Station

Reactor Licensing Engineer – Commonwealth Edison Co., Zion Nuclear Station

Counsel – Maryland NRC Agreement State Nuclear Materials Licensee

Emergency Planning Consultant – Impell Corporation

Emergency Planning Manager – Illinois Department of Nuclear Safety

Radwaste System Designer – Sargent & Lundy Engineers

Reactor Startup and Operations Engineer – VEPCO, North Anna Unit 1

Publications

"Getting It Right–New Hampshire's State-of-the-Art Nuclear Decommissioning Law," *Radwaste Solutions*, Nov/Dec 2001 (http://www.ans.org/pubs/magazines/rs/docs/2001-11-12-5.pdf)

Stephen E. Williams
Statement of Professional Qualifications

CURRENT POSITION

Health Physicist
Radiation Protection and Accident Consequence (RPAC)
Division of Site and Environmental Analysis (DSEA)
Office of Nuclear Reactors (NRO)
Nuclear Regulatory Commission (NRC)

EDUCATION

M.S., Environmental Pollution Control, Penn State University, State College, Pennsylvania
B.S., Radiological Health, Duquesne University, Pittsburgh, Pennsylvania

PROFESSIONAL

Health Physics Society (HPS) – United States
Technical Reviewer Qualification, NRC, 2009

QUALIFICATIONS

Mr. Williams has 40 years of experience in various disciplines in Health Physics. Current experience as a Health Physicist for 8 years, participating in major, multidisciplinary radiological safety projects for U.S. Nuclear Regulatory Commission (NRC) within the Office of New Reactors (NRO). This experience includes the technical review of multiple (3) combined license applications (COLAs), (4) Design Certification Documents (DCD), and (3) Early Site Permits (ESPs) in the area of Radiological Environmental Technical Specifications and Radiological Protection. Mr. Williams currently serves as a project manager in Health Physics/Environmental Review for the Small Modular Reactor (SMR) Design submittal and developing the Design-Specific Review Standards (DSRS) procedures for SMR applications.

As a qualified technical reviewer in NRO, Mr. Williams has planned, lead, and coordinated activities, such as audits, in the Division of Site and Environmental Analysis (DSEA) related to the technical review of COLAs and ESP applications for licensing new nuclear power plants under NRC regulations in Title 10 of the *U.S. Code of Federal Regulations* (10 CFR) Parts 50, 52, and 100. Specifically, Mr. Williams has reviewed Sections 2.4.13, 11 and 12, “Radioactive Waste Systems” and developed Requests for Additional Information (RAIs), participated in safety audits and produced and many Safety Evaluation Reports (SERs) in support of applicant submitted projects.

As a Program Manager for the Bureau of Radiation Protection at the Pennsylvania Department of Environmental Protection (DEP) for 8 years Mr. Williams managed the X-Ray and Accelerator inspection, registration and licensing program for the State. Prior to working at DEP Mr. Williams managed the Radiological Effluent Program at Three Mile Island for 16 years without an NRC finding. For 6 years as an Industrial Radiographer, Mr. Williams inspected pipelines, station piping, and building structure. Mr. Williams also performed University/Hospital Health Physics functions for 2 years, as well as managing the radwaste and dosimetry programs at Wayne State University.

Zachary A. Gran
Statement of Professional Qualifications

CURRENT POSITION

Health Physicist
Radiation Protection and Accident Consequences Branch
Division of Site Safety and Environmental Analysis
Office of New Reactors
U.S. Nuclear Regulatory Commission

EDUCATION

M.S. Radiological Health Physics, University of Massachusetts Lowell
B.S. Physics, University of Massachusetts Lowell
A.A.S. Nuclear Engineering Technologies, Three Rivers Community College, Norwich CT

PROFESSIONAL

Technical Review Qualification, NRC, 2013

QUALIFICATIONS

Mr. Gran is a Health Physicist with five years of experience at the NRC. He has been working in Health Physics for all five years. As a technical reviewer Mr. Gran has reviewed two early site permit applications, two COL applications, and two design certification applications.

In his current position as a certified technical reviewer at the NRC, Mr. Gran is responsible for the Health Physics reviews for the Radioactive Waste Management Systems in Chapter 11. Mr. Gran is well versed in the use of the GALE, the LADTAP II, and the GASPAR II computer codes, all codes necessary to perform the Chapter 11 reviews. In his role as a technical reviewer Mr. Gran regularly performs confirmatory calculations to assess compliance with the limits of 10 CFR 20 and 10 CFR 50 Appendix I effluent releases.

Dogan Seber, Ph.D.
Statement of Professional Qualifications

CURRENT POSITION

Senior Geophysicist
Geosciences and Geotechnical Engineering Branch 1
Division of Site Safety & Environmental Analysis
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C.

EDUCATION

Ph.D. Cornell University, Seismology
M.Sc. St. Louis University - Geophysics
B.S. Istanbul Technical University – Geophysical Engineering

PROFESSIONAL

U.S. Nuclear Regulatory Commission (NRC) Qualified Reactor Technical Reviewer
American Geophysical Union, Member
Seismological Society of America, Member

QUALIFICATIONS

Dr. Seber has 30 years of professional work experience in geophysics. This experience has evolved around academia and the NRC. At the NRC, as a senior geophysicist in NRO, he has been working on a variety of science and policy issues related to nuclear regulation. He has worked on issues related to licensing new reactors under 10 CFR Part 52, re-assessment of seismic hazards of the operating nuclear power plants as required by 50.54(f) letters issued following the NTTF Fukushima recommendations, interfaced with external stakeholders through various public and non-public meetings, conducted seismic software audits, and collaborated with external experts to develop documents, participated in revisions of existing regulatory documents, and mentored junior staff. In addition, he was the NRC representative for the IAEA's seismic hazard guidance documentation development activities, provided advice and guidance to the IAEA's extra budgetary program, and worked extensively with Japanese and European counterparts to develop international nuclear safety reports and documents.

Prior to working for the NRC, in academia, he developed independent earth science research programs, obtained external funding from government organizations, initiated national-scale grass-roots efforts, developed educational programs, served as a senior advisor to many national earth science programs, and supervised work activities of undergraduate students. Dr. Seber worked as the Director of the Geoinformatics Lab and Scientist at the University of California, San Diego conducting original research in broad earth science fields and application of information technology into the geosciences. Overall responsibilities consisted of establishing externally funded research programs, supervising technical and scientific personnel, and budget preparation and administration. Specific research activities involved development of state-of-the-art information technology resources to aid geoscience research primarily in the areas of seismology, geophysics, geology, seismotectonics, and lithospheric deformation. He led the

development of a state-of-the-art, high-performance computing based, full 3-dimensional seismic wave propagation calculation environment to study the effects of seismic sources, crustal structure, and attenuation models. He also published a series of papers about the uses of advance information technology tools in geophysical and geological studies. As an education and outreach expert, he created online earth science educational materials and promoted the uses of web-based learning in high school and middle school classroom environments. He organized a variety of workshops and trained earth science researchers and students in uses of information technology resources.

Dr. Seber also worked as a Senior Research Associate at Cornell University. He conducted original geophysics and seismology research activities, developed externally funded research programs, advised Master's and PhD. students. He also led and managed the activities of the Geographic Information Systems (GIS) lab within the Institute for the Study of the Continents at Cornell University. He served as a Co-Investigator in a series of research projects that conducted research activities in the areas of geophysics, seismology and tectonics. Dr. Seber organized and participated in seismological field studies, installed broadband seismic stations, collected and interpreted data to understand seismicity, crustal structure and seismic hazard conditions in continental collision zones. He also participated as a co-investigator in a series of research activities funded by Department of Energy and Department of Defense aimed at better monitoring the Comprehensive Nuclear Test Ban Treaty using seismic networks, geophysical methods, and data and knowledge management systems.

Dr. Seber is the author and co-author on more than 100 scientific articles and reports related to geophysics and earth sciences.

Stephanie Devlin-Gill
Statement of Professional Qualifications

CURRENT POSITION

Project Scientist
Division of Site Safety & Environmental Analysis
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C.

EDUCATION

Ph.D. Cornell University, Geophysics
B.A. Rutgers, The State University of New Jersey, Physics, Computer Science minor

PROFESSIONAL

U.S. Nuclear Regulatory Commission (NRC) Qualified Reactor Technical Reviewer
Federal Acquisition Institute Qualified Contracting Officer's Representative
NRC Qualified Emergency Response Official
Geological Society of Washington, Member, Former Meeting Secretary, Former Councilor
Seismological Society of America, Member

QUALIFICATIONS

Dr. Devlin-Gill is a geophysicist with seven years of experience at the NRC with the five most recent years as a Qualified Reactor Technical Reviewer. Devlin-Gill's areas of expertise include probabilistic seismic hazard analysis, earthquake seismology, and siting of critical facilities. Devlin-Gill has reviewed numerous combined and operating license (COL), early site permit (ESP), and design certification (DC) applications, which are the Levy and William States Lee COL applications, the Advanced Power Reactor 1400 (APR1400) DC application, and now the PSEG ESP application. Additionally, Devlin-Gill has reviewed numerous existing reactor site seismic hazard reevaluations associated with the Near-Term Task Force (NTTF) seismic Recommendation 2.1 (R2.1). Further, Devlin-Gill gained experience with two roles during the NTTF R2.1 Expedited Approach review project, as both a Technical Reviewer and as Technical Coordinator for the Senior Review Board, a board that advised the review staff for the purpose of consistency across the review project. Devlin-Gill was the lead geophysicist on the 2014 update of the Standard Review Plans (SRP) 2.5.2 "Vibratory Ground Motion" and 3.7.4 "Seismic Instrumentation."

Prior to working for the NRC, Devlin-Gill was a teaching and research assistant in graduate school at Cornell University where Devlin-Gill received numerous honors and awards – the National Science Foundation Graduate Research Fellowship (2004 – 2007), the IRIS Workshop Graduate Student Fellowship Recipient (June 2005 and June 2006), and the Cornell University McMullen Fellowship (August 2002 – May 2003).

Prior to graduate school, Devlin-Gill worked as a Laboratory Technician at Princeton University's Geosciences Department. Devlin-Gill worked on studies of subsurface

geomicrobiology and bacterial transport and conducted laboratory experiments and field research in the gold mines of South Africa and at the Oyster, Virginia field site.

Devlin-Gill is the author and co-author on two peer-reviewed journal publications and was author or coauthor on nine conference publications.

Luissette Candelario-Quintana
Statement of Professional Qualifications

CURRENT POSITION

Geotechnical Engineer
Geosciences and Geotechnical Engineering Branch 2
Division of Site Safety & Environmental Analysis
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C.

EDUCATION

M.E., Civil Engineering, University of Maryland, College Park
B.S., Civil Engineering, University of Puerto Rico, Mayaguez

PROFESSIONAL

U.S. Nuclear Regulatory Commission (NRC) Qualified Reactor Technical Reviewer
Federal Acquisition Institute Qualified Contracting Officer's Representative

QUALIFICATIONS

Mrs. Candelario-Quintana has eight years of experience as an engineer participating in major, multidisciplinary safety projects for U.S. Nuclear Regulatory Commission (NRC) within the Offices of New Reactors (NRO) and Nuclear Regulatory Research (RES).

Mrs. Candelario-Quintana is a geotechnical engineer at NRO, qualified as a reactor technical reviewer, who has supported the review of numerous combined and operating license (COL), early site permit (ESP), and design certification (DC) applications. Specifically, Mrs. Candelario-Quintana has collaborated in the review of Fermi 3 and Turkey Point COL applications, the Advanced Power Reactor 1400 (APR1400) DC application, and the PSEG ESP application in the areas of Stability of Subsurface Materials and Foundations and Stability of Slopes. Additionally, Mrs. Candelario-Quintana provided support to the implementation of Near Term Task Force Recommendations (NTTF) 2.1 and 2.3. Particularly, Mrs. Candelario- Quintana served as Technical Coordinator, as well as a Technical Reviewer on the NTTF R2.1 Expedited Approach review project and NTTF R2.3 Seismic and Flooding Walkdowns. Mrs. Candelario-Quintana has supported a variety of duties associated with inspecting the engineering and operation of power reactors.

As a structural engineer in RES, Mrs. Candelario-Quintana collaborated on the creation of finite element models for the structural analyses of containment designs.

Prior to working for the NRC, Mrs. Candelario-Quintana worked as a student intern at the US Geological Survey (USGS) developing geographical information digital maps that identify mineral facilities. Mrs. Candelario- Quintana is one of the authors of the USGS publication "Mineral facilities of Africa and the Middle East", 2006.

Mrs. Candelario-Quintana has received numerous performance awards in recognition of a sustained high level performance which resulted in a significant contribution to the work of Nuclear Regulatory Commission.

Gerry L. Stirewalt, Ph.D., P.G., C.E.G.
Statement of Professional Qualifications

CURRENT POSITION

Senior Geologist
Geoscience and Geotechnical Engineering Branch 2 (RGS2)
Division of Site Safety and Environmental Analysis (DSEA)
Office of New Reactors (NRO)
U.S. Nuclear Regulatory Commission (NRC)
Rockville, MD

EDUCATION

Postdoctoral Research Studies
- Structural Geology and High-Temperature Experimental Deformation, University of British Columbia, Vancouver, British Columbia, Canada, 1971-1973
- Structural Geology and Petrofabrics, Lemont-Doherty Geological Observatory of Columbia University, Palisades, NY, 1969-1971

Ph.D. in Structural Geology from the University of North Carolina at Chapel Hill, Chapel Hill, NC, 1970
B.A. in Geology and Mathematics from Catawba College, Salisbury, NC, 1964

PROFESSIONAL

U.S. NRC Qualified Technical Reviewer for New Reactor Applications
Professional Organization Memberships
- Geological Society of America (GSA) and the following Divisions of GSA:
  - Structural Geology and Tectonics
  - Environmental and Engineering Geology
  - Geology and Society
  - History and Philosophy of Geology
- American Geophysical Union
- Association of Engineering and Environmental Geologists

Professional Registrations
- Registered Professional Geologist and Certified Engineering Geologist (Number 229 and E229) in Oregon
- Registered Professional Geologist (Number 896) in North Carolina

EXPERIENCE

Dr. Stirewalt is a structural geologist with more than 43 years of national and international experience in geoscience, including university teaching, independent consulting, and working as a contractor on site characterization of nuclear and other critical power facilities. His experience as a contractor encompassed work with an architectural engineering firm on projects in Southeast Asia and the U.S; with the Department of Energy in the high level radioactive waste (HLW) disposal program (including interface with the Canadian and Swedish site characterization programs, overview of the characterization of all potential sites for the first HLW repository, and development of the second repository program in crystalline rock locations east of the Mississippi River); with the NRC for 3D geospatial modeling of Yucca Mountain and other

non-HLW facilities; and with the NRC on Yucca Mountain at the Center for Nuclear Waste Regulatory Analyses. His primary technical specialty lies in field geologic site characterization for critical facilities. His particular interests include investigation of tectonic deformation features (faults, shear zones, and fractures) and paleoseismic features in relation to potential for surface deformation and geologic and seismic hazard, and assessment of geologic data for seismic source characterization.

Dr. Stirewalt's 43 years of experience include working as a geologist at the NRC for the past 10 years, initially with the HLW program in NMSS but also in NRO preparing Safety Evaluation Reports for COL and ESP applications (e.g., Vogtle, Summer, Levy, Lee, PSEG); participating in mandatory licensing hearings for Vogtle and Summer and a contested hearing for Levy under 10 CFR Part 52; reviewing application materials in ESP or COL applications for Calvert Cliffs, Comanche Peak, and Harris as the primary technical reviewer of Sections 2.5.1 and 2.5.3; acting as a member of the Technical Integration Team for characterization of seismic sources in the central and eastern U.S. as presented in NUREG-2115; re-assessing seismic hazard at operating nuclear power plants as required by the 50.54(f) letters that were issued following the NTTF Fukushima recommendations; interfacing with external stakeholders, including applicants and licensees, in various public and non-public meetings; and mentoring junior staff.

Dr. Stirewalt is the author or co-author of more than 56 technical publications related to the field of geoscience.

Seshagiri Tammara
Statement of Professional Qualifications

CURRENT POSITION

Physical Scientist
Radiation Protection and Accident Consequences Branch
Division of Site Safety and Environmental Analysis
Office of New Reactors
U.S. Nuclear Regulatory Commission

EDUCATION

M.S. Environmental engineering, University Maryland, 1974
M.S. Chemical Eng., and Nuclear Eng., University of Maryland, 1970
M.S. Chemical Eng., Osmania University, India, 1968

PROFESSIONAL

Technical Reviewer Qualification, NRC, 2008

QUALIFICATIONS

Mr. Tammara is a physical scientist with over 40 years of experience as a technical analyst and physical scientist. Mr. Tammara has 10 years of experience at the NRC performing reviews for new reactors and operating reactors. Mr. Tammara's reviews have been in the areas of population distributions, site characteristics/site suitability, external hazards, aircraft crash evaluations, control room habitability, design basis accident evaluations, and the environmental impact evaluations for the EIS.

Mr. Tammara has 20 years of experience performing accident assessments using the ALOHA code with the DOE and the NRC. ALOHA calculates the plume concentrations and the vapor cloud explosions for the review of external hazards and control room habitability chemical concentrations.

As a qualified technical reviewer in NRO Mr. Tammara has performed the COL reviews for 12 COL applications and has performed the ESP reviews for three ESPs. Mr. Tammara has also performed reviews for the reactor license renewal applications for current operating reactors.

Christopher J. Bender, Ph.D., P.E., D.CE
Statement of Professional Qualifications

CURRENT POSITION

Senior Engineer
Coastal Engineering Service Group
Taylor Engineering, Inc.
Jacksonville, FL

Part-time Faculty Member
Coastal and Port Engineering Program
School of Engineering
College of Computing, Engineering, and Construction
University of North Florida
Jacksonville, FL

EDUCATION

Ph.D., Coastal Engineering, University of Florida
M.S., Coastal Engineering, University of Florida
B.S., Ocean Engineering, University of Rhode Island

PROFESSIONAL

Professional Engineer (PE) – Florida 07/2006, #64736
Professional Engineer (PE) – Mississippi 05/2009, #19134
Diplomate of Coastal Engineering (D.CE) – American Society of Civil Engineers (ASCE), Academy of Coastal, Ocean, Port, and Navigation Engineers (ACOPNE), 2010

QUALIFICATIONS

Since joining Taylor Engineering in 2003, Dr. Bender has taken a leading role in the simulation and evaluation of hurricane surge, wave mechanics and loading, littoral processes, shoreline protection, and sediment transport. Dr. Bender's coastal engineering experience includes use of the following assessment tools: STWAVE, SWAN, SWAN+ADCIRC, REF/DIF-1, MIKE21, SMS, ACES, Beach-fx, GENESIS, and SBEACH as well as numerous desktop assessment techniques. He has successfully applied these models to many Atlantic and Gulf Coast locations from New York to Texas. Dr. Bender contributes to multi-disciplinary teams that significantly advance the state-of-the-art for simulation of storm surge and waves during significant storm events. Further, Dr. Bender is a subject matter expert in public hearings and at regional, national, and international conferences.

Since 2011, Dr. Bender has supported U.S. Nuclear Regulatory Commission (NRC) staff in review of storm surge hazards and development of independent storm surge levels at more than 10 nuclear sites, including review of the PSEG Early Site Permit (ESP) storm surge levels for the Salem / Hope Creek site. Dr. Bender has also supported NRC reviews of post-Fukushima Flood Hazard Reevaluation Report (FHRR) analyses of storm surge and seiche and developed independent storm surge estimates for numerous coastal nuclear sites along the Gulf of Mexico, Atlantic Coast, and Lake Erie).

Dr. Bender teaches coastal engineering courses at the University of North Florida as a part-time faculty member. Since joining Taylor Engineering, Dr. Bender has authored or co-authored six articles in peer-reviewed journals and acted as a peer-reviewer for five journals.

Patrick J. Lynett, Ph.D.
Statement of Professional Qualifications

CURRENT POSITION

Professor
Tsunami Research Center
Sonny Astani Department of Civil and Environmental Engineering
University of Southern California
Los Angeles, CA

Affiliate Coastal Engineer
Coastal Engineering Service Group
Taylor Engineering, Inc.
Jacksonville, FL

EDUCATION

Ph.D., Civil Engineering, Cornell University
M.E., Civil Engineering, Cornell University
B.S., Civil Engineering, Cornell University

PROFESSIONAL

Secretary, Coastal Engineering Research Council (CERC)
Editor, Proceedings of the International Conference on Coastal Engineering
Associate Editor, Journal of Geophysical Research-Oceans
Associate Editor, Journal of Waterway, Port, Coastal, and Ocean Engineering (ASCE)

QUALIFICATIONS

Following 9 years as a faculty member at Texas A&M University, in 2011 Dr. Lynett moved to the University of Southern California (USC), where he currently holds the Shea Chair in Civil Engineering and is a member of the USC Tsunami Research Center. His research interests are directed towards a better understanding of coastal processes, such as nearshore circulations, wave evolution from generation to the shoreline, multi-scale hydrodynamic interactions, and sediment transport. Investigations combine numerical modeling with both controlled experiments and field observations. Short time-scale coastal hazards, such as hurricanes and tsunamis, are of particular interest. Since 2002, Dr. Lynett has been a lead or co-author on 60 peer-reviewed articles in journals such as Science, Journal of Fluid Mechanics, and Proceedings of the Royal Society of London. These papers focus on ocean wave phenomena, and include numerical, analytical, experimental, and field studies.

Lynett was a member of the 2005 International Tsunami Survey Team to Sri Lanka, the 2005 Hurricane Katrina Coastal Impacts Survey Team sponsored by ASCE, the post-tsunami survey team in American Samoa in 2009, and numerous surveys throughout the Pacific after the 2011 Japan tsunami. Dr. Lynett has been the recipient of research grants from the National Science Foundation (NSF), the U.S. Army Corps of Engineers, the United States Geological Survey, the Nuclear Regulatory Commission, the NOAA Sea Grant Program, the Office of Naval Research, various California state agencies, and private industry. Since 2003, he has been a Primary Investigator (P.I.) or co-P.I. on research and equipment grants totaling $9.2 million, including four

large, collaborative NSF research grants of over $1 million each, two of which he was the lead P.I. Notable awards include the Department of the Army Commander's Award for Public Service given for Dr. Lynett's post-Katrina work, a prestigious Guggenheim Fellowship in 2010, and the Walter L Huber Civil Engineering Research Prize given by ASCE in 2013.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	January 14, 2016

CERTIFICATE OF SERVICE

I hereby certify that the "NRC STAFF RESPONSE TO THE LICENSING BOARD'S INITIAL QUESTIONS ISSUED DECEMBER 15, 2015" has been filed through the E-Filing system this 14th day of January, 2016.

/Signed (electronically) by/

Kevin C. Roach
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U.S. Nuclear Regulatory Commission
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