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)	)	February 25, 2016

NRC STAFF TESTIMONY RELATED TO JANUARY 27, 2016 ORDER
TOPIC 6: LONG-TERM ATMOSPHERIC DISPERSION FOR ROUTINE RELEASES

Q1: Please state your name, occupation, employer, and professional qualifications.

A1: (KRQ) My name is Kevin R. Quinlan. I am a Physical Scientist (Meteorologist) in the Hydrology and Meteorology Branch, Division of Site and Environmental Analysis (DSEA), Office of New Reactors (NRO), U.S. Nuclear Regulatory Commission (NRC). A statement of my professional qualifications is included in Exhibit (Ex.) NRC002.

(SEW) My name is Stephen E. Williams. I am a Health Physicist in the Radiation Protection Accident Consequences Branch, DSEA, NRO, NRC. A statement of my professional qualifications is included in Ex. NRC002.

Q2: Please describe your responsibilities with regard to the Staff's review of the PSEG Site Early Site Permit (ESP) application.

A2: (KRQ) As the lead meteorological reviewer for the Staff's Final Safety Evaluation Report (FSER) Section 2.3 "Meteorology" (Ex. NRC003), I was responsible for coordinating the review of the Site Safety Analysis Report (SSAR) Section 2.3, "Meteorology" (Ex. PSEG004B), writing the FSER for this section, and presenting to the Advisory Committee on Reactor Safeguards (ACRS).

(SEW) As the lead Health Physics reviewer for the Staff's FSER Sections 11.2 "Liquid Waste Management System," 11.3 "Gaseous Waste Management System," and 2.3.5 "Long-Term Atmospheric Dispersion Estimates for Routine Releases," (Ex. NRC003) I was responsible for the review of the Applicant's SSAR Sections 11.2.3 "Liquid Radioactive Releases" and 11.3.3 "Gaseous Radioactive Releases" (Ex. PSEG004R), and also Section 2.3.5 "Long-Term (Routine) Diffusion Estimates" (Ex. PSEG004B) on the dose relationship aspect. I was responsible for writing the FSER for Sections 11.2 and 11.3 (Ex. NRC003), and presenting to ACRS, as well as supporting the lead reviewer of Section 2.3.5 (Ex. NRC003) with the review and presentation to ACRS.

Q3: What is the purpose of your testimony?

A3: (KRQ) My testimony explains the development and review of the long-term atmospheric dispersion factors. The purpose of this testimony is to provide clarification regarding the derivations and use of these dispersion factors.

(SEW) My testimony explains the development and review of the long-term atmospheric dispersion factors and their subsequent use in the gaseous effluent dose and effluent concentration calculations.

The purpose of this testimony is to provide clarification regarding the final use of these atmospheric dispersion factors along with radiological and other plant parameters to calculate gaseous effluent doses and effluent concentrations to the public from a postulated plant at the PSEG Site.

Q4: What is the definition of atmospheric dispersion? What do χ/Q and D/Q represent?

A4: (KRQ) Atmospheric dispersion consists of two components: *Atmospheric transport* due to the mean airflow within the atmosphere and *atmospheric diffusion* due to disorganized or random air motions. Atmospheric dispersion factors are a way to estimate and quantify the effects on an effluent plume due to atmospheric turbulence, downwind distance/travel time, building wake, and other site-specific factors. Atmospheric dispersion is usually expressed in terms of a Chi/Q (χ/Q) value.

For the site suitability analysis for a nuclear power plant, long-term atmospheric dispersion estimates are calculated for routine releases: i.e., to determine the amount of airborne radioactive materials expected to reach a specific location during normal operations, as described in FSER Section 2.3.5 (Ex. NRC003). In contrast, short-term atmospheric dispersion estimates are calculated for releases in design basis accident scenarios, as described in FSER Section 2.3.4, "Short Term Diffusion (Accident) Estimates" (Ex. NRC003).

Q5: What do χ/Q and D/Q values represent?

A5: (KRQ) χ/Q values have units of seconds per meter-cubed (sec/m^3) and represent a concentration factor. These values are dependent on the combination of the receptor location (e.g., a nearby farm), the height of the release, atmospheric turbulence, and any other factors that may impact the plume. Physically, the χ/Q value is the time-average concentration at the center of a plume, where χ is the concentration and Q is the release rate.

D/Q is the normalized deposition factor. This represents the deposition rate (D) (the transfer of radionuclides and particulates from the air to the ground) divided by the release rate (Q) and has a unit of 1/m^2. Deposition can be a significant factor in long-term dose calculations due to the long decay period of some radionuclides.

χ/Q and D/Q values for long-term releases are calculated on a site-by-site basis and are used as part of the site suitability analysis to evaluate whether the radiological effluent release limits associated with normal plant operation can be met for any individual located offsite.

Q6: Please discuss the applicable regulatory requirements and Staff guidance relevant to the acceptability of long-term atmospheric dispersion estimates in the PSEG Site ESP application, and explain whether the Staff and the Applicant followed this guidance.

A6: (KRQ) The acceptance criteria (as identified in Standard Review Plan (SRP) (NUREG-0800), Section 2.3.5) for calculating atmospheric-dispersion estimates for routine releases of radiological effluents are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100. The Staff considered the following regulatory requirements in reviewing the Applicant's calculation of atmospheric dispersion estimates for routine releases of radiological effluents: (1) 10 CFR 100.20(c), as it relates to the requirement that the meteorological characteristics of the site that are necessary for safety analysis or that might have an impact on plant design be identified and characterized as part of the NRC's review of the acceptability of a site, and (2) 10 CFR 100.21(c)(1), as it relates to the requirement that site atmospheric-dispersion characteristics be evaluated and dispersion parameters established to ensure that radiological effluent release limits associated with normal operation from the type of facility to be located at the site can be met for any individual located offsite.

The Staff also followed the guidance provided in Regulatory Guide (RG) 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, as it relates to calculating offsite doses. The Applicant followed acceptance criteria from the SRP, Section 2.3.5. In the remainder of my testimony, I will discuss the Staff's and Applicant's application of this guidance in more detail.

Q7: How did the Applicant calculate the long-term atmospheric dispersion for routine releases?

A7: (KRQ) For routine releases, the Applicant determined receptor locations at points of potential maximum concentration outside the site boundary. The Applicant, following the guidance in SRP Section 2.3.5, set receptors on a radial grid of sixteen 22 ½ degree sectors out to a distance of 50 miles (80 kilometers) from the PSEG Site. The Applicant used the NRC-sponsored computer code XOQDOQ (described in NUREG/CR-2919, "XOQDOQ Computer Program for the Meteorological Evaluation of Routine Releases at Nuclear Power Stations") to estimate χ/Q and D/Q values resulting from routine releases, as described in SSAR Section 2.3.5.1, "Basis" (Ex. PSEG004B). The XOQDOQ model implements the constant mean wind direction methodology outlined in RG 1.111, Revision 1.

The XOQDOQ model is a straight-line Gaussian plume model, which means the model assumes that material released to the atmosphere will be normally distributed (characterized as a Gaussian or bell shaped curve) about the plume centerline. A straight-line model assumes that there is a straight-line, or the shortest distance, between the source (e.g., a plant vent or stack) and the receptor (e.g., a vegetable garden or milk animal). This is a conservative assumption since the straight-line between the source and the receptor would result in the highest concentration at the receptor. A Gaussian plume model assumes that the highest concentration in the plume is along the centerline (both vertically and horizontally) and that the concentration diminishes towards the edges of the plume. In predictions of χ/Q and D/Q values for long time periods (e.g., annual averages), the plume's horizontal distribution is assumed to be evenly distributed within the downwind direction sector (i.e., "sector averaging").

As an input to the XOQDOQ program, the Applicant created a joint frequency distribution (JFD) of wind speed, wind direction, and atmospheric stability based on three years of onsite meteorological data for the period of January 1, 2006, through December 31, 2008. A JFD is an NRC-approved way for computer programs to quickly summarize the frequency of wind speed, wind direction, and atmospheric stability, rather than using potentially lengthy hourly meteorological observations. In accordance with the guidance provided in SRP Section 2.3.5, the Applicant also selected the location of the nearest site boundary, nearest residence, nearest vegetable garden, and nearest meat animal for each sector and calculated the χ/Q and D/Q values for each of these receptors.

The Applicant provided the results of this analysis in SSAR Tables 2.3-34 through 2.3-37 (Ex. PSEG004C). The Applicant stated in SSAR Section 2.3.5.2, "XOQDOQ Modeling Results" (Ex. PSEG004B), that "the largest χ/Q value for the site boundary is 1.6E-05 sec/m^3 in the South direction. Note however that the limiting values for sectors SE to NW (clockwise direction) is disregarded due to the fact that the site boundary for these sectors is bordered by the Delaware River (greater than a mile radially out from new plant site center). Therefore, the only sectors that are used to obtain the limiting χ/Q value for the site boundary are between the NNW and ESE directions (clockwise direction)." The Staff included a COL Action Item (2.3-1) in FSER Section 2.3.5.4.2 (Ex. NRC003) that requires an applicant for a COL or a construction permit referencing this ESP to verify specific release point characteristics and specific locations of receptors of interest used to generate the long-term atmospheric dispersion site characteristics. This COL Action Item is meant to ensure that if any receptors in sectors SE to NW (clockwise direction) were to change when a final facility design is selected, then those previously disregarded χ/Q and D/Q values will be considered.

Q8: How did the Staff confirm the Applicant's analysis and results, and what were the Staff's conclusions?

A8: (KRQ) The Staff reviewed SSAR Section 2.3.5 (Ex. PSEG004B) to ensure that the ESP application represents the complete scope of information relating to this review topic. The Staff's review confirmed that the application addresses the required information relating to long-term atmospheric dispersion estimates. The Staff began the review by completing a quality assurance (QA) review of the onsite meteorological dataset used by the applicant, as discussed in FSER Section 2.3.3, "Onsite Meteorological Measurement Program" (Ex. NRC003). This QA review included a detailed analysis of the 3-year onsite meteorological dataset to ensure that the data was of high enough quality to be used as the basis of the atmospheric dispersion modeling. This review not only included detailed analysis of the hourly meteorological data, but of the calibration and accuracy of the instruments and tower used to collect the data. Based on its QA review, the Staff concluded that the 3-year onsite meteorological dataset was suitable for use in the atmospheric dispersion models.

The Staff independently created a JFD of wind speed, wind direction, and atmospheric stability based on the 3-year onsite meteorological dataset, which the Applicant provided to the Staff in accordance with the format recommendations of RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants." The Staff used this JFD to independently create an XOQDOQ input file for use in the atmospheric dispersion model. The Applicant chose to implement the diffusion parameter assumptions outlined in RG 1.111, Revision 1, as a function of atmospheric stability, for its XOQDOQ model runs as stated in SSAR Section 2.3.5.1 (Ex. PSEG003). The Staff evaluated the applicability of the XOQDOQ diffusion parameters and concluded that no unique topographic features preclude the use of the XOQDOQ model for the PSEG Site. Therefore, the Staff found the Applicant's use of diffusion parameter assumptions (as outlined in RG 1.111, Revision 1) acceptable.

Using the information provided by the Applicant as a basis for a confirmatory analysis, the Staff confirmed the applicant's χ/Q and D/Q values by running the XOQDOQ computer code and obtaining very similar results (i.e., values on average within about 1-percent). Based on the reasoning provided in FSER Section 2.3.5 (Ex. NRC003), the Staff found the long-term χ/Q and D/Q values provided by the applicant acceptable.

Q9: How were the long-term atmospheric dispersion estimates calculated in SSAR Section 2.3 used in the Staff's subsequent dose and effluent concentration analysis?

A9: (SEW) In order to develop an estimate of the gaseous effluent radiological doses and effluent concentrations to the public, the Applicant considered the long-term atmospheric values derived, as described above, from its meteorological analysis in combination with routine gaseous effluent release parameters. Routine gaseous effluent release parameters include volumes, flow rates, filtration factors, radiation monitor estimated readings, estimated duration of each release, and radiological sample results. The Applicant compared its calculated doses and effluent concentrations with the permissible design basis limits (in 10 CFR 50, Appendix I and 10 CFR 20, Appendix B concentration limits) to ensure their acceptability. The Applicant followed this methodology in accordance with the guidance in RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," and RG 1.109, "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."

For its independent review, the Staff reviewed all of the Applicant's gaseous effluent release parameters to ensure that they are appropriate and were used correctly in the SSAR analysis. The

Staff independently evaluated the Applicant's process used to combine the meteorological data and the gaseous effluent release data and, as described in FSER Sections 11.3 and 2.3.5 (Ex. NRC003), determined that this process was acceptable. The doses and effluent concentrations independently calculated by the Staff were within 10 CFR 50, Appendix I and 10 CFR 20 Appendix B regulatory limits and similar to the values calculated by the Applicant. Therefore, the Staff's analysis confirmed the acceptability of the Applicant's calculated doses and effluent concentrations to the public.

Q10: Does this conclude your testimony?

A10: (KRQ, SEW) Yes.

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AFFIDAVIT OF KEVIN R. QUINLAN

I, Kevin R. Quinlan, do hereby declare under penalty of perjury that my statements in the foregoing testimony and my statement of professional qualifications (Ex. NRC002) are true and correct to the best of my knowledge and belief. I attest to the accuracy of my testimony and endorse its inclusion into the record of this proceeding.

Executed in Accord with 10 CFR § 2.304(d)

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Executed at Rockville, Maryland
This 25th day of February, 2016

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AFFIDAVIT OF STEPHEN E. WILLIAMS

I, Stephen E. Williams, do hereby declare under penalty of perjury that my statements in the foregoing testimony and my statement of professional qualifications (Ex. NRC002) are true and correct to the best of my knowledge and belief. I attest to the accuracy of my testimony and endorse its inclusion into the record of this proceeding.

Executed in Accord with 10 CFR § 2.304(d)

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Executed at Rockville, Maryland
This 25th day of February, 2016