United States Nuclear Regulatory Commission Official Hearing Exhibit
In the Matter of: PSEG POWER, LLC AND PSEG NUCLEAR, LLC (Early Site Permit Application)
ASLBP #: 15-943-01-ESP-BD01
Docket #: 05200043
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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)	)	March 11, 2016

NRC STAFF TESTIMONY RELATED TO JANUARY 27, 2016 ORDER
TOPIC 3: USE OF HYDRAULIC MODELING EXPERIENCE IN STAFF REVIEW

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

A1: (JFG) My name is Joseph F. Giacinto. I am a Hydrologist 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 attached (Exhibit (Ex.) NRC002).

(HJ) My name is Henry Jones. I am a Hydrologist in the Hydrology and Meteorology Branch, DSEA, NRO, NRC. A statement of my professional qualifications is attached (Ex. NRC002).

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

A2: (JFG) As the hydrology team lead on the safety review of the PSEG Site ESP application, I was responsible for coordinating the review of all subsections of Site Safety Analysis Report (SSAR) Section 2.4, "Hydrologic Engineering," (Ex. PSEG004B) developing the Staff's Final Safety Evaluation Report (FSER) for Section 2.4 (Ex. NRC003), and coordinating, developing, and presenting to the Advisory Committee on Reactor Safeguards (ACRS) all subsections of the FSER Section 2.4 with the exception of subsections 2.4.5, "Probable Maximum Surge and Seiche Flooding," and 2.4.6, "Probable Maximum Tsunami Hazards."

(HJ) As the hydrology team lead oceanographer, I was responsible for reviewing the SSAR subsections 2.4.5, "Probable Maximum Surge and Seiche Flooding," and 2.4.6, "Probable Maximum Tsunami Hazards," (Ex. PSEG004B) developing the Staff's FSER for those subsections (Ex. NRC003), and presenting those two subsections to the ACRS.

Q3: What is the purpose of your testimony?

A3: (JFG, HJ) The purpose of our testimony is to provide statements as to the Staff's background and experience with the river model discussed in FSER Section 2.4.3, "Probable Maximum Flood on Streams and Rivers," (Ex. NRC003) and to explain the impacts of enhancing the precision of this model on the probable maximum flood (PMF) level at the PSEG Site and on the Staff's determination of the design basis flood (DBF).

Q4: What is the Staff's experience with the agency that created the river flooding model and those agencies that use the models?

A4: (JFG, HJ) The river flood model used by the Applicant in SSAR Section 2.4.3, "Probable Maximum Flood on Streams and Rivers," was developed in 1992 and continues to be maintained by the Army Corps of Engineers (USACE) (Ex. PSEG004B). This model is the industry standard for modeling riverine flows in watershed basins. Several federal agencies use the model for evaluating river flooding including the USACE, Federal Emergency Management Agency, Federal Energy Regulatory Commission, U. S. Bureau of Reclamation, and the Department of Energy. Over the past several years with these agencies, the Staff has participated in several interagency meetings, workgroups and workshops on riverine flood hazard modeling in addition to attending various training courses which include those sponsored by the USACE. The NRC has contracted with the USACE to conduct riverine flooding and dam break analysis on several sites for the Fukushima Near-Term Task Force (NTTF) Recommendation 2.1 reviews. Through these interagency relationships, the NRC has continued to enhance its understanding of the river model. As called out in Standard Review Plan (SRP) (NUREG-0800), Section 2.4.3, "Probable Maximum Flood (PMF) on Streams and Rivers," the Staff should use currently accepted runoff and flood routing methods such as those made available by the USACE in their reviews.

Q5: What is the Staff's experience with hydraulic modeling, specifically those used by the applicant?

A5: (JFG, HJ) The Staff reviewed several combined license (COL) applications that used the USACE hydraulic river flooding model, independently confirmed the results of the modeling, and had formal training in its use. Recently licensed sites where the Staff reviewed the river model used by an applicant include Vogtle, V.C. Summer, Fermi 3, and South Texas Project. In addition, the river model used by the Applicant is currently being reviewed by the Staff for several active new reactor sites (i.e., Bell Bend, Levy, North Anna, Harris, and W.S. Lee). Most recently, the Staff used the river model to evaluate several operating plants related to Fukushima NTTF Recommendation 2.1 reviews.

Q6: How does the Staff determine the DBF for an ESP or COL applicant?

A6: : (JFG, HJ) Given the site location, regional physiography, and historical record, the Staff evaluates all plausible mechanisms (e.g., PMF, dam failure, and probable maximum storm surge) that are capable of generating a severe flood at a site. In the context of site specific data, evaluations of mechanisms proceed in a progressively refined manner by adding additional details to the analysis for multiple combinations of hydro-meteorological, geoseismic, or structural failures which are evaluated within each mechanism to determine the bounding and most severe hazard to safety-related structures, systems and components. This bounding hazard is designated as the design basis flood (DBF). For sites along rivers and streams, the river flooding generally provides the DBF; however, this is not the case for the PSEG Site, which is located on a tidally influenced section of the Delaware River where marine effects dominate freshwater river flow.

Q7: What is the DBF for the PSEG Site?

A7: (JFG, HJ) The DBF for the PSEG Site is 32.1 ft consisting of a combined event composed of the probable maximum hurricane (PMH) storm and associated surge, 10 percent exceedance high tide, sea level rise, and the 25 year rainfall event applied to the area to estimate precipitation during the PMH storm event. River flow, tidal effects, and wave runup were included in the Staff's detailed two-dimensional (2D) evaluation of probable maximum storm surge in FSER Section 2.4.5 (Ex. NRC003).

Q8: How does the Staff's evaluation of the river flooding model in the context of the PMF maximum water level factor into the consideration of the river modeling precision?

A8: (JFG, HJ) The PMF maximum water level of 21.0 ft consists of the component contributions in the table below.

Component	PMF Maximum Water Level Contribution (ft)
Riverine flooding	2.1
10 percent exceedance high tide	4.5
Historical Storm surge	11.3
Wave runup	3.1

The river flooding model calculated the riverine flooding and the 10 percent exceedance high tide components; these are the only two components that were calculated by the river flooding model. The remaining components are simply added to the result of the river flooding model to arrive at the total of 21.0 ft. The coincident and conservative combinatory events of high tide, storm surge from the worst regional hurricane of record producing the highest storm surge at the site, and included wave runup contribute to the majority of the PMF maximum water level.

The river flooding model was developed based on plausible combination of extreme events that occur simultaneously including maximum rainfall in the basin, adjustment of the storm orientation to maximize rainfall volume and saturated ground prior to the storm event to maximize runoff all occurring coincident with the high tide. The relatively small contribution of simulated river flood flow to water levels near the PSEG site is consistent with tidal gage observations during severe flooding on nontidal portions of the Delaware River. Given that the river model was validated against U.S. Geological Survey (USGS) and National Oceanic and Atmospheric Administration tidal gage data, and observed changes in water levels from riverine flooding at these gages near the PSEG Site is small (a maximum of a few feet), model refinements may improve river model precision; however, the resultant changes in the PMF maximum water level would not be meaningful in that these changes would have no impact on the Staff's determination that probable maximum storm surge is the design basis flood hazard.

The river model incorporates conservative and coincident events, and by nature of its one-dimensional (1D) numerical method, tends to be conservatively high in estimating river flood levels. The 1D model predominately tracks in the direction of flow along the river channel with limited lateral dispersal of energy. In reality, river channels are rarely straight and flow energy disperses laterally traveling downstream which would tend to reduce the water level height resulting from 1D model calculations. Therefore, even though the riverine flooding level calculated by the model is likely biased high and conservative, the resulting level remains an appropriate small proportion of the PMF maximum water level.

The site location, regional physiography and the historical record have shown that storm surge and associated effects are the bounding flood hazard at the PSEG Site. The lack of topographic restrictions, and wide and open connection to the Atlantic preclude the buildup of freshwater flow near the PSEG Site. Conversely, these same physiographic features allow marine tides and storm surge to dominate water level changes at the PSEG Site. Near the PSEG Site, fresh water river flows influence tidal gage measurements only by a few feet during severe historical upstream flooding events in the non-tidal portions of the Delaware River whereas these same tidal gages measure several to tens of

feet of change due to tides and storm surge events. The Staff determined that flooding due to the probable maximum storm surge is the dominant flood hazard consistent with the historical record.

Q9: To what extent is the "experience with hydraulic modeling" upon which this decision was based documented?

A9: (JFG, HJ) As discussed in the answer to Q5 above, the Staff has carefully examined the river model used by PSEG and found it to be acceptable in several new reactor reviews, for example as documented in the SERs for recently licensed sites for Vogtle, V.C. Summer, Fermi 3 and the South Texas Project. However, for the PSEG Site, the Staff's conclusions were not dependent solely on the Staff's experience with this model; as explained in FSER Section, 2.4.3, "Probable Maximum Flood on Streams and Rivers," the Staff determined that increasing the resolution of the watershed basin river model could not change the conclusion that probable maximum storm surge is the bounding flood hazard for the PSEG ESP site, and that additional analyses or refinements were not necessary. FSER Section 2.4.1 "Hydrologic Description," describes the Staff's review of the conceptual hydraulic model formulation upon which the river model is based (Ex. NRC003). The Staff reviewed components of the river model including historical data, causal mechanisms associated with the site setting, the regional physiography, the Applicant's technical reports, USGS and USACE technical reports and finally, the river modeling files and results as described in FSER Sections 2.4.1, "Hydrologic Description," 2.4.2, "Floods," 2.4.3, "Probable Maximum Flood on Streams and Rivers," and 2.4.5, "Probable Maximum Surge and Seiche Flooding," to determine that additional precision would not alter the Staff's conclusion concerning probable maximum storm surge as the design basis flood (Ex. NRC003).

Q10: If experience based knowledge is used in the Staff's decision-making process generally, how is this experience documented?

A10: (JFG, HJ) As described in response to Q4, Q5 and Q9 above, the Staff documents experience with methods and models in Staff guidance and as appropriate, considers reviews that have been completed and issued to support other new reactor licensing decisions. With respect to the PSEG Site ESP review, the experience is documented in SER Section 2.4 (Ex. NRC003). Further supporting the Staff's review are documented public/non-public calls and meetings with the Applicant to clarify the Staff's requests for additional information (RAIs), the Applicant's understanding of those RAIs, and the applicant's intended response. The RAIs and their responses are also documented as public information. The Staff uses (and gains) experience based knowledge in working through the reviews, developing RAIs and interacting with applicants to ultimately evaluate the adequacy of the applicant's evaluations as documented in the Staff's FSER.

Q11: Does this conclude your testimony?

A11: (JFG, HJ) Yes.

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PSEG POWER, LLC AND PSEG NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	March 9, 2016

AFFIDAVIT OF JOSEPH F. GIACINTO

I, Joseph F. Giacinto, 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 9th day of March, 2016

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	)	Docket No. 52-043-ESP
PSEG POWER, LLC AND PSEG	)	
NUCLEAR, LLC	)	ASLBP No. 15-943-01-ESP-BC01
	)	
(Early Site Permit Application)	)	March 10, 2016

AFFIDAVIT OF HENRY JONES

I, Henry Jones, 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 10th day of March, 2016