February 12, 2021

VIA EMAIL: Zec.Comments@bpu.nj.gov

Secretary of the Board of Public Utilities
44 South Clinton Avenue, 3rd Floor, Suite 314
Post Office Box 350
Trenton, New Jersey 08625-0350
Attn: Aida Camacho-Welch

RE: In The Matter Of The Application Of PSEG Nuclear, LLC And Exelon Generation Company For The Zero Emission Certificate Program - Salem Unit 1

In The Matter Of The Application Of PSEG Nuclear, LLC And Exelon Generation Company For The Zero Emission Certificate Program - Salem Unit 2

In The Matter Of The Application Of PSEG Nuclear, LLC For The Zero Emission Certificate Program – Hope Creek

BPU Docket Nos. ER20080557, ER20080558, & ER20080559

Dear Secretary Comacho-Welch,

Attached are comments for inclusion in the record in the above-captioned matters being filed pursuant to the January 15, 2020 Notice of Public Hearings issued by the New Jersey Board of Public Utilities. These comments are a slightly expanded version, with supporting footnotes, of the oral comments I delivered at the 6:00 PM session of the February 1, 2020 hearing held by Board.

Please let me know if you have any questions.

Very truly yours,

Ron Norman
Member of PA's Management Group

(expanded comments including footnotes)

Good evening. Thank you for the opportunity to speak with you today. My name is Ron Norman. I am a senior partner in the Energy & Utilities practice of PA Consulting Group.

PA was retained by PSEG to prepare an independent analysis of some of the impacts that would occur if one or more of PSEG's nuclear units were to retire. In particular, we were asked to answer two primary questions:

- How would emissions of certain air pollutants - SO_2, NOx, CO_2, mercury and particulate matter - change if one or more of the Hope Creek, Salem 1 and/or Salem 2 nuclear units were to retire?

- And would the retirement of one or more of these nuclear units affect the reliability and resiliency of the electric supply serving New Jersey residents?

Our work also provided data that ERM used in its analysis of air quality impacts in New Jersey.

The studies needed to answer these questions require large data sets and sophisticated modeling tools. The model we used, called Aurora,[1] covers the whole of the Eastern Interconnect - the interconnected electric system from Canada to Florida and from the Atlantic seaboard to as far west as parts of Montana and New Mexico. The model includes over 8,500 generation "nodes" on the transmission system, and over 46,000 nodes representing locations of customer demand.

Our modeling incorporates numerous variables -- about the demand for electricity, fuel prices, the characteristics of existing and new generators, and emission control programs like RGGI. We also incorporate into our analysis the addition of new renewable energy resources -- primarily wind and solar -- including projects that are in advanced development as well as projects that we believe will be profitable to bring online or that will be needed to meet state renewable portfolio standards in the future. This includes the consideration of New Jersey's objective to achieve 50% zero carbon generation by 2030 and other objectives set forth in the New Jersey Energy Master Plan.

We used the Aurora model to simulate the operation of all those power plants, on an hourly basis, initially with the PSEG nuclear units in operation, and then under two alternative scenarios -- one with Hope Creek removed, and a second with all three PSEG nuclear units removed. We were then able to calculate the resultant changes in the quantity of various pollutants emitted by generators and the resultant changes in the generation mix.

While we found that emissions of measured pollutants increase significantly whether one nuclear unit or all three units are retired, I will focus today on the results of the three-unit retirement analysis. In that analysis, across the three-year study period, NOx emissions in New Jersey would be expected to increase by over 2,000 tons, SO_2 emissions would be expected to increase by over 200 tons, fine particulate emissions would be expected to increase by almost 1,150 tons, and CO_2 emissions would be expected to increase by almost 8,900,000 tons. For context, 8,900,000 tons of CO_2 is roughly equivalent to the emissions from 590,000 cars driving in New Jersey, based on average usage, for three years, or roughly the equivalent of having a 300 MW coal plant in Newark operating at full output, 24 hours per day for three years.

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[1] Aurora is a product of Energy Exemplar.

In considering impacts, while ERM has focused on the analysis of the localized impacts of increased air pollution, it is also important to recognize that NOx is one of the main precursors of ozone formation, and that SO_2 and NOx are precursors of fine particulate formation. Like other air pollutants, both ozone and fine particulate matter are known to have significant negative health impacts, and studies demonstrate these negative health impacts are particularly acute in lower income and minority populations.[2] And, though CO_2 is a "global" greenhouse gas pollutant, National Oceanic and Atmospheric Administration data show that New Jersey has been one of the fastest-warming states in the US, with average temperature increases approximately double the average for the Lower 48 states over the last 125 years.[3] And, studies have already shown significant impacts of climate change in the State as well as highlighting the risks to New Jersey's coastal property if sea levels rise.[4]

On the question of fuel diversity, our analysis also found that both retirement scenarios show considerable negative impacts to fuel diversity. The electric system in the New Jersey region would become more heavily dependent on fossil fuel generation, as well as imported electricity (primarily fired by natural gas and coal plants) from elsewhere in PJM and neighboring electricity regions. Too much reliance on a particular fuel source – especially natural gas – increases the risk of experiencing outages during extreme weather events. For example, the 2014 Polar Vortex event and the 2018 Bombogenesis event remind us that natural gas supply for power generation is vulnerable to competition from higher priority heating demand. And while coal-fired generators typically have on-site fuel storage capability, even these generators are sometimes vulnerable to frozen coal piles and flooded transportation infrastructure. During the Polar Vortex, over 20% of PJM's generating capacity was out of service during the most critical period in January and over 80% of that unavailable capacity was gas- or coal-fired. In comparison, nuclear outages accounted for only 3% of the unavailable capacity. Further, had we also modeled electric transmission vulnerabilities, New Jersey's greater reliance on electricity imports could have made New Jersey more vulnerable to outages.

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[2] *See, e.g.*, American Lung Association, *State of the Air 2020*, p. 11 ("Evidence shows that people who have low incomes may face higher risk from air pollution."; "Studies have found that Hispanics, Asians, American Indians/Alaska Natives and especially African Americans experienced higher risks of harm, including premature death, from exposure to air pollution.") (https://www.stateoftheair.org/assets/SOTA-2020.pdf); Wang, Kloog, *et al.*, *Estimating Causal Effects of Long-Term PM2.5 Exposure on Mortality in New Jersey*, Environmental Health Perspectives, vol. 124, no.8 (2016), p. 1187, ("By analyzing the population of an entire state, [i.e., New Jersey] we had sufficient power to test interaction and found that the effects of $PM_{2.5}$ were greater in census tracts with a higher percentage of black residents, lower median home value, or lower median home income.") (https://doi.org/10.1289/ehp.1409671); Kioumourtzoglou, Marianthi-Anna *et al., PM2.5 and Mortality in 207 US Cities: Modification by Temperature and City Characteristics*. Epidemiology, vol. 27, no. 2 (2016), p. 221 ("[W]e observed increasing estimates [between long-term $PM_{2.5}$ exposure and mortality] with increasing obesity rates, %residents and families in poverty, %black residents and %population without a high school degree, and lower effects with increasing median household income and %white residents.") (https://pubmed.ncbi.nlm.nih.gov/26600257/); The American Lung Association, *Urban Air Pollution and Health Inequities: A Workshop Report,* Environmental Health Perspectives, June 2001, vol.109 (supp. 3), p. 363 ("Existing research specific to urban populations has clearly shown a disproportionate burden of exposure to air pollutants in low-income and racial/ethnic minority communities. These communities are also subject to higher risks of health problems associated with air pollution, at levels beyond those expected with the higher levels of exposure.") (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4977041/).

[3] *See* Mulson, Mooney et. al., *2°C BEYOND THE Limit – Extreme Climate Change has arrived in America*, Washington Post, August 13, 2019, (The Washington Post used the National Oceanic and Atmospheric Administration's Climate Divisional Database (nClimDiv), which provides monthly temperature data at the national, state and county level between 1895 and 2018 for the Lower 48 states.) (https://www.washingtonpost.com/graphics/2019/national/climate-environment/climate-change-america//)

[4] *See Id.* (discussing *inter alia* insect infestations and algae blooms in New Jersey); Union of Concerned Scientists, *Underwater Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate*, June 18, 2018 (study showing that in "intermediate" case for rise in sea levels, homes in New Jersey valued at about $9.6B would be at risk of being subject to regular flooding). https://www.ucsusa.org/global-warming/global-warming-impacts/sea-level-rise-chronic-floods-and-us-coastal-real-estate-implications; *See also*, Leslie Norton, *Wildfires, Hurricanes, and Muni Bonds*, BARRON'S, Sept. 23, 2019, at 30–31, (noting that "individual [municipal] bonds may be at risk" and referencing "climate-threatened cities like…Newark, and states like…New Jersey.")

In conclusion, in answering the two questions we were hired to evaluate, our analysis found that the retirement of any or all of PSEG's nuclear units would lead to materially higher emissions across a range of pollutants and a significant decline in fuel diversity in New Jersey.

Thank you very much.