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September 7, 2018

RE: Comments of Exelon Generation in Response to the "*Strength and Weakness Analysis of Implementing Zero Emission Credits or Procurement Support for Nuclear Power*" Prepared by the Maryland Power Plant Research Program—August 23, 2018

Contained within this document are edits and comments, in the form of a redlines, on the draft "Strength and Weakness Analysis of Implementing Zero Emission Credits or Procurement Support for Nuclear Power" ("SWOT Analysis"). We hope you will find these recommendations useful in guiding your analysis for the interim RPS report due on December 1 of this year.

Strength and Weakness Analysis of Implementing Zero Emission Credits or Procurement Support for Nuclear Power

Draft – August 23, 2018

The United States has 61 nuclear power plants, consisting of 99 separate reactors, in operation as of August 2017.[1] This number is declining, with six nuclear reactors closing since 2013 and another 13 reactors scheduled to shut down through 2025.[2] A recent Bloomberg New Energy Finance analysis determined that more than half of America's nuclear reactors are no longer profitable, incurring losses totaling approximately $2.9 billion annually.[3] Within PJM, five nuclear plants with a combined capacity of approximately 5,300 MW are slated to close by 2021~~.~~[4] which would wipe out the equivalent zero emission energy produced by all the renewable energy built in PJM over the past 25 years. [5]

While nuclear power ~~still~~ provides 20 percent of electricity generation and more than 650 percent of the zero-carbon generation in the U.S., ~~some~~ most nuclear plants are ~~struggling to adapt to~~financially challenged due to reduced wholesale electricity prices~~, and,~~ low growth in electricity demand~~,~~.[6] the failure of state, federal, and regional market rules to reflect the fuel security, resilience, and environmental benefits, as well due to the fact that ~~and because~~ polluting plants are not appropriately charged for the cost of the pollution they emit. In PJM, energy prices have dropped by more than 40 percent since 2014, falling from $53.14/MWh to $30.99/MWh in 2017.[7] Additionally, in May 2018~~, a quarter~~ over 30 percent of the nuclear capacity in PJM, representing 10,643 MW, failed to clear the PJM Base Residual Auction (BRA) for delivery year 2021/2022.[8]

These unfavorable market conditions and flawed market designs have drawn the attention of state policymakers, with some enacting legislation or regulations to ~~support~~ preserve nuclear plants that are otherwise not economically viable in today's electricity market by fairly compensating nuclear

generation for its zero-carbon emissions attributes. New York, Illinois, and New Jersey have all implemented Zero Emissions Credits/Certificate (ZECs) initiatives, as part of comprehensive clean energy legislative and regulatory efforts, which require utilities or load-serving entities (LSEs) to maintain or procure a certain number or percentage of ZECs. Each ZEC represents the carbon emissions-free attribute of one MWh of generation from a nuclear power plant. Connecticut has also passed legislation that allows nuclear plants to enter into long-term PPAs guaranteeing a fixed level of revenue. See the Appendix for an additional overview of these four states' policies. Both the Illinois and New York ZECs programs initiatives have been challenged in federal district court by fossil fuel interests and after the appeals were dismissed by the lower court, they are pending at the U.S. Court of Appeals.

This matter is of importance to Maryland, as the State's only nuclear power plant, Calvert Cliffs, accounted for 44 percent of the State's net electricity generation and 84 percent of its emission-free electricity in 2017.[9] The plant, which consists of two reactors, has a combined capacity of 1,708 756 MW and has a 99 percent capacity factor over the last three years.[10] In addition, Calvert Cliffs employs 900 workers and pays $22 million annually in state and local taxes.[11] The facility is jointly owned by Exelon Corporation and Électricité de France and is operated by Exelon Corporation.

Proponents of nuclear subsidies and related supportspreservation cite environmental, resilience, national security, and economic benefits of maintaining zero-emission nuclear power and retaining affected in-state generators. Opponents cite concerns regarding interstate commerce, the negative impact on electric power markets, and the costs imposed by the subsidiesto retain the plants. This analysis briefly summarizes the strengths and weaknesses of adding state-level subsidies that support for nuclear power either separately or as part of the Maryland RPS. Important considerations include:

- Impact on the Maryland RPS overall if nuclear power is added as an eligible technology;
- How such a decision impacts Maryland's ability and costs to achieve greenhouse gas reductions;
- Policy design (adding nuclear power as a separate tier or carve-out, or adding nuclear power as an eligible technology to the Maryland RPS);
- Determination of the amount of subsidy support and how that amount is determined;
- Defining ratepayer protections and/or cost caps;
- Potential impacts on competitive electric power markets;
- Potential impacts on land use;
- Possible changes to the PJM RPM that may affect policy support or subsidies to renewables or other specific technologies;
- The opportunity to transition Maryland toward a clean energy standard; and
- Ensuring flexibility in case market conditions change.

Range of Policy Measures

Zero emission credit programs in other states are helping transition those states to a low carbon future without reversing all the reductions in greenhouse gas emissions they have made by their

investments in renewable energy and energy efficiency. Those programs are discussed below. We note they are just one set among a number of policy or market design measures that could accomplish the same objectives – for example a price on carbon emissions, a Clean Energy Standard, a separate tier within a Renewable Portfolio Standard, or long term power purchase arrangements are others.

ZECs and State Procurement for Nuclear Power	
Strengths	**Weaknesses**
▪ **Flexibility** – Payments to nuclear facilities from ZEC programs can be reduced if market prices increase, or if the federal government enacts subsidies or other policy support for nuclear power plants. ▪ **Avoided Costs** – Maintaining nuclear power plants in operation may help avoid the costs of building new generation to replace these facilities and avoids dispatch of higher cost electricity. New York's ZEC is estimated to save customers $1.7 billion per year in related avoided costs. Connecticut's Millstone Nuclear Power Station PPA is estimated to save ratepayers $5.5 billion. ▪ **Protection for Ratepayers** – Customer protection features are built into state nuclear support programs. ~~Provisions in the proposed ZECs programs use financial records and projections to determine whether nuclear power plants require ZECs to avoid early retirement.~~ Connecticut requires a state examination of ~~Millpoint's~~ Millstone's financial situation prior to its participation in the program. In New Jersey the amount that a nuclear plant receives will be reduced if the plant is receiving compensation under any other state or federal program for the same environmental attributes. Illinois directly caps rate increases, and the New York program reduces ZEC prices by any energy and capacity price increases above a reference amount. ▪ **Retention of Economic Benefits, including Local Jobs** – Nuclear generation provides sizeable tax revenue for states with nuclear power plants. U.S. nuclear power plants employ 475,000 workers in full-time jobs. ▪ **Carbon-free Generation and No Air Pollution** – The existing nuclear fleet provides 20 percent of U.S. electricity	▪ ~~**Increased Ratepayer**~~**ZEC Costs** – The gross cost of the New York ZEC program ~~will cost ratepayers~~ is $7.6 billion over 12 years~~, net of benefits~~. The gross cost of the Illinois ZEC~~s~~ program ~~will cost ratepayers~~is an estimated $235 million annually over ten years. The gross cost of the New Jersey ZEC~~s~~ program ~~will cost ratepayers~~is approximately $300 million per year for an estimated seven to ten years. ▪ ~~**Complexity**~~ **Time-consuming** – ZEC ~~requirements are complicated to administer and implement,~~ programs require procurements similar to those conducted for wind and solar. They may additionally ~~requiring~~ require detailed filings and reviews of plant costs to ensure customers are paying the minimum amount necessary to preserve existing nuclear power plants. ▪ **Court Challenges and Dormant Commerce Clause Concerns** – New York and Illinois have faced challenges in federal court regarding ZEC programs ~~and similar legal action may occur for New Jersey~~. Sometimes ZECs are only offered to a limited number of in-state nuclear facilities, disadvantaging out-of-state nuclear plants. This raises concerns about state discrimination, as well as issues related to interstate commerce. Courts to date have rejected these complaints and upheld the states' authority to institute payments for carbon reduction attributes.[14] ▪ **Safety Concerns** – Although U.S. nuclear plants have operated safely for decades, past nuclear power accidents at Three Mile Island, Chernobyl, and Fukushima have raised public concerns regarding whether nuclear power is safe, and opposition to nuclear power more generally. ▪ **Long-term Waste Disposal** – No ~~permanent~~ long-term ~~solution~~ consolidated facility to store radioactive waste from nuclear power

generation and more than 50 percent of zero-emissions generation, including no sulfur- or nitrogen-oxides. This helps to avoid at least 400 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) of emissions annually. Retiring nuclear would likely be replaced with carbon-emitting sources, which ~~.~~would also result in increased NOx, SO2 and PM emissions that would lead to health issues and make existing Maryland non-attainment pollution zones fall further behind compliance targets.

- **Avoid Undoing Years of Renewable Investments –** Retirement of four nuclear plants announced in Ohio and Pennsylvania, (states that do not provide ZECs,) will mean that even at double its current renewable growth rates PJM will not regain 2017 zero-emission levels until 2034 (with higher emissions in intervening years).[12]

- **Helps Maintain Fuel Diversity** – A diverse power portfolio hedges against higher fossil fuel prices should they occur.
- **Fuel Security and Resiliency—**Nuclear generation has on-site fuel for its entire fuel cycle unlike gas and other fossil resources that depend on fuel delivery infrastructure. Nuclear generation is unaffected by potential fuel infrastructure interruption, which is a risk in Eastern PJM. Retiring Calvert Cliffs would increase dependence on gas which would increase Maryland's dependence on fuel delivery infrastructure.
- **National Security—**The Department of Energy and other former federal officials have noted that the loss of nuclear puts domestic military facilities at risk and cedes leadership on nuclear issues to potentially hostile nations.[13]

plants ~~exists~~has been licensed. ~~Fourteen states prohibit building new nuclear plants until the issue of a long-term storage solution for the 78,000 metric tons of nuclear waste currently stored at U.S. nuclear plants is resolved.~~The Nuclear Regulatory Commission (NRC) regulates waste storage and the U.S. Department of Energy (DOE) is responsible by law for its long term storage.

▪ **Bridge for Maryland to reach 80% GHG reduction by 2050—**Loss of nuclear would set back State's efforts to reach GHG reduction goals. States like NY, IL and NJ recognize that preserving nuclear and investing in other zero emission resources supports achievement of state goals at the least cost to customers. ▪ **Require that an eligible plant makes a positive and quantifiable environmental impact in Maryland**—In order for a plant to qualify in New Jersey, a plant must prove that ~~they~~it makes a significant contribution to New Jersey's air quality by reducing harmful emissions and that without the plant, the state ~~what~~would have a significantly more difficult time meeting its State air emissions reduction requirements. A similar approach could be implemented in Maryland.	

Appendix

Examples of Recently Enacted State Policies in Support of Nuclear Power

New York

In August 2016, New York became the first state to adopt a ZEC requirement. Load serving entities ("LSEs") must purchase ZECs from the New York State Energy Research Development Authority (NYSERDA) annually, based on the LSE's percentage of load served in New York. ZEC payments will be made to qualifying facilities that meet public necessity criteria, which is determined by the New York Public Service Commission on a plant-by-plant basis using specific financial and emissions criteria. A price of $17.48/ MWh was set for the ZECs for the first of six (6) two-year periods and was calculated using the social cost of carbon (SCC), minus the fixed baseline portion of that cost that is captured through the Regional Greenhouse Gas Initiative (RGGI), a carbon trading market in which ten states including NY participate, over the same period. The New York Public Service Commission (PSC) estimates the gross costs of the New York ZEC program ~~is estimated to cost~~ in those two years is ~~ratepayers $7.6 billion~~$965 million ~~over 12 years.~~, achieving a carbon-alone benefit of $1.4 billion. The PSC studied numerous options including whether it would be feasible to replace all the nuclear output by renewable resources and if so, how quickly. Under ~~the~~New York's Renewable Energy Standard, the Commission is pursuing new renewable resources at an ambitious pace. Ultimately ~~they~~the PSC found "it is not realistic to assume that sufficient additional renewable resources at a reasonable price or perhaps any price could be identified and implemented in sufficient time to offset the 27.6 million MWh

of zero-emissions nuclear power per year. For example, replacing all the 27.6 Million MWh of zero-emission energy with renewable resources would require 9,000 MW of onshore wind or 22,000 MW of solar deployment. It is virtually impossible to deploy this magnitude of resources in the short-term."[15] Because of the ZEC program, 2,600 talented men and women have high-paying jobs at three New York state nuclear plants producing reliable and affordable emission-free electricity for New York state families and businesses. The closure of those nuclear plants would have erased all of the progress – times four – that New York has made through billions of dollars of investments in renewable energy.[16]

Illinois

In December 2016, Illinois enacted the Future Energy Jobs Act (FEJA), which, among many other things, established a Zero Emissions Standard (ZES). Utilities are allocated ZECs equal to 16 percent of the megawatt-hours the utility sold in 2014, and the Illinois Power Authority purchases ZECs on utilities' behalf through a "Zero Emissions Procurement Plan." The ZES went into effect in June 2017 and will expire on May 31, 2027. The winning suppliers of ZECs will be based upon public interest criteria, like New York, that calculate~~s~~ the price of the ZEC payment using the SCC. The initial base price for the ZECs is $16.50/MWh and increases $1.00/MWh annually commencing with the 2023/2024 delivery year. ZEC prices would be reduced if electricity market prices increase. Furthermore, if the cost of ZECs would cause electricity rates to increase by more than 1.65 percent, then the number of ZECs would be reduced in order to comply with the rate cap. Overall, the gross costs of the Illinois ZEC ~~initiative is expected to cost ratepayers~~are expected to be $235 million per year. Cumulatively, due to avoided air pollution from renewable energy, energy efficiency, and nuclear power, the provisions in ~~According to the Natural Resources Defense Council, comparedCompared to with a a scenario without the combined energy efficiency, renewable energy and nuclear energy provisions of the Future Energy Jobs ActFEJA, between 2018 and 2030 "cumulatively between 2018 and 2030 – as the clean energy standards strengthen over time and benefits accelerate – the~~FEJA ~~plan will helps~~will help- prevent ~~up to 132,960~~tens of thousands of -lost work days and ~~, 17,890~~ asthma attacks, more than a thousand ~~1,100~~ asthma emergency department visits~~,~~ and ~~780 hospital admissions, 1,650~~ heart attacks, and up to 2,800 premature deaths ~~in total~~between 2018 and 2030. It will reduce annual carbon pollution by up to 32 million tons ~~in~~annually by 2030~~. . . This reduction from business as usual translates to about 13 million tons below 2014 levels, accelerating Illinois's transition to a low-carbon economy."~~[17] ~~.~~

New Jersey

In April 2018, New Jersey became the third state to enact ZEC legislation ~~to help support the Hope Creek and Salem nuclear plants~~ at a ~~cost to ratepayers~~gross cost of an estimated $300 million per year. A ranking system, measuring the contribution each plant makes to minimizing air pollution emissions and the degree to which the plant is unable to cover its costs, determines the eligibility of a nuclear plant to receive ZECs. The New Jersey Board of Public Utilities (NJBPU) will then select eligible plants to receive ZECs according to their ranking, capped at 40 percent of the electricity the nuclear plant produced (MWh) in the energy year prior to the date of enactment. Each public utility will be required to purchase ZECs from the qualifying nuclear plants at the amount determined by the NJBPU ~~Board of Public Utilities (BPU)~~, but will be allowed to recover costs of ZEC purchases from ratepayers at a rate of $0.004/kWh starting 90 days after enactment. This rate reflects the emissions avoidance benefits associated with the continued operation of the selected nuclear power plants.

Connecticut

Connecticut took a different approach by implementing a competitive procurement process for nuclear and other zero-emission electricity sources, provided it is deemed to be in the best interest of ratepayers. The Millstone plant, Connecticut's only nuclear power plant, must undergo an assessment that evaluates the current and projected economics of the facility, as well as the impact on air emissions, the economy, and the electric power markets if Millstone retires. The evaluation will take place prior to the competitive procurement process for new and existing zero carbon generation and will be conducted by the Connecticut Department of Energy and Environmental Protection (DEEP) and the Public Utilities Regulatory Authority (PURA). If Millstone is successful in the auction, it will receive a PPA contract ranging from three to ten years in length. Millstone supports almost 4,800 jobs in Connecticut and more in the rest of New England. Emission-free electricity from Millstone prevents the release of 8.3 million metric tons of carbon dioxide annually.[18] ~~more than~~

RPS

Few states have directly incorporated nuclear power as an eligible technology for its RPS. New York added a Tier 3 for nuclear power to its Clean Energy Standard. The Indiana voluntary RPS includes nuclear generation as an eligible technology, but utilities are not required to comply. Likewise, in Ohio, nuclear generation technology is included in the Alternative Energy Portfolio Standard (AEPS), but only in the portion of the RPS that is not subject to alternative compliance payments (ACPs) or technology minimums. Arizona is the only state currently considering the implementation of an RPS that fully integrates nuclear generation into its mandate and applying corresponding incentives and penalties. The proposed legislation would include the existing Palo Verde Nuclear Power State in the state's "Clean Resource Energy Standard and Tariff," which would require that 80 percent of the state's electricity come from carbon-free sources, including nuclear, by 2050. There is, however, competing legislation that would not include nuclear in the proposed increase in RPS to 50 percent renewables by 2030.

Sources:

[1] Energy Information Administration. "How many nuclear power plants are in the United States, and where are they located?" EIA.gov. https://www.eia.gov/tools/faqs/faq.php?id=207&t=3 (accessed August 21, 2018);
Nuclear Energy Institute. "Nuclear Plants in Regulated and Deregulated States." NEI.org. https://www.nei.org/resources/statistics/nuclear-plants-in-regulated-and-deregulated-states (accessed August 21, 2018).

[2] Energy Information Administration. "Fort Calhoun becomes fifth U.S. nuclear plant to retire in past five years." EIA.gov. https://www.eia.gov/todayinenergy/detail.php?id=28572 (accessed August 22, 2018).

[3] Polson, J. "More Than Half of America's Nuclear Reactors Are Losing Money." Bloomberg New Energy Finance. https://www.bloomberg.com/news/articles/2017-06-14/half-of-america-s-nuclear-power-plants-seen-as-money-losers (accessed August 21, 2018).

[4] Planned closures include: Exelon Corporation's (Exelon's) 615-MW Oyster Creek plant, located in New Jersey, by September 2018; Exelon's 805-MW Three Mile Island plant, located in Pennsylvania, by September 2019; FirstEnergy Solutions' (FES's) 894-MW David-Besse plant, located in Ohio, by May 2020; FES's 1,240-MW Perry plant, located in Ohio, by May 2021; and FES's 1,777-MW Beaver Valley plant, located in Pennsylvania and consisting of two reactors, by October 2021. Sources referenced include: Scott, M. "Nuclear Power Outlook." EIA.gov. https://www.eia.gov/outlooks/aeo/npo.php (accessed August 21, 2018); Walton, R. "FirstEnergy Solutions Reluctantly files First Steps to Shutting down Nuclear Plants." Power Engineering. https://www.power-eng.com/articles/2018/08/firstenergy-solutions-reluctantly-files-first-steps-to-shutting-down-nuclear-plants.html (accessed August 21, 2018).

[5] Electricity generation of announced nuclear plant retirements Beaver Valley, Davis-Besse, Oyster Creek, Perry and Three Mile Island was 45.3 billion kWh in 2017 (https://www.eia.gov/nuclear/generation/xls/usreact17.xlsx). Electricity generation in PJM from wind, run of river and other hydroelectric, solar, geothermal, and pumped storage, was 36 billion kWh in 2017 (http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2017/2017-som-pjm-sec3.pdf, Table 3-10). Wind and solar together were 22.2 billion kWh.

[6] Energy Information Administration. "What is U.S. electricity generation by energy source." EIA.gov. https://www.eia.gov/tools/faqs/faq.php?id=427&t=3 (accessed August 22, 2018).

[7] Monitoring Analytics. "PJM State of the Market Report 2017". Table 1-10.

[8] The BRA is the first auction PJM holds as part of its capacity market, known as the Reliability Pricing Model (RPM). Under the RPM, PJM holds auctions to procure capacity to meet expected electricity demand requirements three years into the future. Winning bidders in these auctions are provided capacity payments but also have to meet various PJM performance requirements; Exelon "Exelon Announces Outcomes of 2021-2022 PJM Capacity Auction" ExelonCorp.com http://www.exeloncorp.com/newsroom/exelon-announces-outcome-of-2021-2022-pjm-capacity-auction (accessed August 22, 2018)

[9] Nuclear Energy Institute. "Fact sheet – Maryland and Nuclear Energy" NEI.org (accessed August 21, 2018) https://www.nei.org/CorporateSite/media/filefolder/resources/fact-sheets/state-fact-sheets/Maryland-State-Fact-Sheet.pdf

[10] Ibid.

[11] Ibid.

[12] The Brattle Group "Impacts of Announced Nuclear Retirements in Ohio and Pennsylvania" April 2018.

[13] https://www.nei.org/CorporateSite/media/filefolder/resources/letters-filings-comments/letter-secretary-energy-rick-perry-nuclear-national-security-20180626.pdf

[14] See also Maryland PSC, Request for Rehearing at the FERC, Docket No. EL16-49-000, at 5 "decisions concerning fuel type, such as resource portfolio standards, have always laid squarely within the states' authority under the FPA." At 10 "State payments for renewable energy (or zero-emission nuclear energy) compensate those generators for the clean energy attributes of the energy and not the energy itself." At 12 "RECS therefore represent a state-authorized premium for emissions-free generation . . . Their purpose is not to interfere with or suppress the Commission's wholesale prices, but rather to compensate the provision of valuable attributes that are uncompensated in PJM markets."

[15] p. 127, NY PSC, 8/1/2016, *Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard*

[16] The New York PSC's Raj Addepalli said, "if one plant, like, Ginna, for example, retires, it's equal to replacing it with almost like, 2,000 megawatts of [UNINTEL] ~~[UNINTEL]~~ resources to get the same amount of clean energy. And to put that in context, over the last decade the whole RPS program produced close to 2,000 megawatts of renewable resources. As we move to 50 percent renewables by 2030, a CES goal, we need a bridge to ensure that

the nuclear units are available in the meantime to help not increase the carbon emissions." Tr., Technical Conference on Clean Energy Standard, at 10 (March 9, 2016).

[17] NRDC, "The Health Benefits of the Illinois Future Energy Jobs Act" (April 2017)

[18] NEI, "Economic Impacts of the Millstone Power Station" (January 2017)