

Testimony of Dr. Henry Chao
Quanta Technology

Before the Senate Public Utilities Committee
Hearing on Senate Bill 128: Zero Emissions Nuclear Resource Program

January 25, 2018

Chairman Beagle, Vice Chairman LaRose, and members of the Committee: I am Henry Chao, Executive Advisor and Vice President, RTO/ISO Markets for Quanta Technology. Prior to this role, I was Vice President, System and Resource Planning for NYISO. I have a PhD in Electrical Engineering and have over 27 years of experience in system planning, operations, engineering and markets. Thank you for the opportunity to share my thoughts with you today on the region's evolving mix of electricity generating resources and the potential impacts on electric system reliability.

At Quanta Technology, we help the electric power industry by providing independent, objective, and practical solutions to the most complex generation, transmission, and distribution challenges. Our clients include energy suppliers and energy delivery companies, RTOs/ISOs, industrial organizations, regulators, and policy makers. We support our parent company, Quanta Services, a fortune 400 company that provides a comprehensive scope of oil and natural gas infrastructure services including transportation, logistics and construction.

Because Quanta Technology's business depends on a well-functioning, robust, and resilient nationwide electric grid, we appreciate the opportunity to participate in energy policy discussions such as this one. Given the large number of coal and nuclear plant retirements in PJM territory, we must all carefully consider whether the system is too quickly losing diversity in resources that currently provide reliability and price stability for the region's electricity consumers. We believe, with careful consideration, Ohio can pursue its energy goals while maintaining the high degree of reliability and resiliency consumers have come to expect.

My testimony today will provide an overview of the in-depth comments that Quanta Technology has previously provided to PJM in response to its white paper entitled “PJM’s Evolving Resource Mix and System Reliability.”¹ I have included those comments as an attachment to my testimony.

The PJM region – and the country as a whole – is at a crossroads when it comes to ensuring reliable power generation, as the DOE staff study stated “the changing nature of the electricity fuel mix [is] challenging the original policy assumptions that shaped the creation of [the wholesale energy and capacity] markets.” The current market construct has not adequately compensated various reliability attributes such as on-site fuel supply and other factors that strengthen grid resilience. Consequently, this region has witnessed the premature closure of baseload power plants.

Abundant supplies of natural gas provide many advantages to electric consumers. However, as natural gas is fundamentally changing how we generate and deliver electricity with the efficient new natural gas-fired combined cycle technology, we need to be mindful of the fact that there are no systematic reliability criteria for the planning and operation of natural gas delivery systems like those that exist for the electric power industry, which are enforced by the North American Electric Reliability Corporation (NERC). Therefore, we must carefully monitor and strategically manage this significant shift in fuel sources to avoid undermining the reliability and resilience of the electric grid.

As more gas-fired generation is added to the grid, the electric industry faces an increased “single point of disruption risk” according to NERC. To the extent that multiple gas-fired generators are dependent upon a single gas pipeline, the failure of a single pipeline can result in the failure of several generating facilities. Should infrastructure disruptions occur to the natural gas pipeline, not only would they interrupt generation in one region, but also in other regions, causing simultaneous resource shortfalls in multiple regions and curtailing reliability assistances between the regions. These types of infrastructure failures could even render gas delivered on a firm contractual basis unavailable. Compared to the natural gas system, the NERC reliability criteria for the electric

¹ <http://www.pjm.com/~media/library/reports-notice/special-reports/20170330-pjms-evolving-resource-mix-and-system-reliability.ashx>

system explicitly require redundancy built into the system so that any single contingency would not result in interruptions to customer services.

As we continue to move towards natural gas as the region's primary fuel source, our concern is that this region's diverse and resilient generating mix could be lost unless the industry takes a balanced approach that recognizes the limitation of each fuel source. There are significant benefits to retain a diverse mix of electricity generating sources. Much like a diversified stock portfolio, a diverse generating mix can help protect against price spikes and volatility associated with an overreliance on any individual fuel source. A diversified energy mix includes all generating sources – nuclear, natural gas, coal, hydro, and renewable resources. The history of the electric grid has demonstrated that a diversified generation mix with robust gas and electric transmission has provided a unique value to reliability and resilience.

While the resource mix in PJM was stable in the early 2000s, policy initiatives, technology improvements, and economics resulted in a shift from coal and nuclear to natural gas and renewable generation. Today, PJM's installed capacity consists of 19 percent of nuclear, 34 percent of coal and nuclear, 35 percent of natural gas, 5 percent of oil, and 7 percent of renewables and others. As more coal and nuclear capacity exits the market, more natural gas-fired capacity will enter the market. Evidence of this trend includes the fact that although the current system has surplus capacity, 17,248 MW of planned capacity has cleared PJM's RPM auctions², almost all of the planned capacities are natural gas fired. One of our recent studies has shown that, given the current PJM energy and capacity market prices, it is highly likely this planned capacity may not get financed and built, leaving great uncertainty to the region's reliability.

Natural gas delivery infrastructure is actually aging and inadequate in this country. Upgrading the existing infrastructure and building new capacity are costly and a lengthy process. There are often serious roadblocks in getting pipeline infrastructure put into place. State and local permitting, environmental regulations, and intrastate/interstate jurisdictional debates have all caused projects

² PJM's capacity market, called the Reliability Pricing Model, ensures long-term grid reliability by procuring the appropriate amount of power supply resources needed to meet predicted energy demand three years in the future.

to be delayed. It could easily require upwards of a billion dollars and up to 10 years to permit and build a major gas pipeline.

Further, investment in new gas pipelines usually requires that all of the capacity is committed to firm contracts. Usually, very little capacity is left for interruptible customers. When the firm contracted customers do not need their fully-contracted capacity (whether because of lower demand or for economic reasons), a certain amount of gas is released to the interruptible off-takers. The interruptible customers know that if the pipeline capacity becomes constrained, their services will be interrupted in order to ensure those with firm contracts continue to be served. To the extent that gas-fired plants rely on interruptible contracts, they may be at risk in situations in which gas capacity becomes constrained. For example, when a gas pipeline company sends out a gas alert and an Operational Flow Order (OFO) due to gas pipeline congestion, all of the generation downstream is affected. Most gas-fired plants that are served by local distribution companies (LDCs) do not have firm gas contracts and residential customers have higher priority during cold weather, which makes it difficult for gas-fired generation to procure gas. It is especially difficult to procure gas on short notice in order to react to real-time market signals during gas OFOs.

Studies have shown that it is often economically infeasible for a natural gas generator to contract firm gas service because there is no guarantee that it can recover the firm contract cost from its sales of electricity. For generators in traditional, cost-of-service, vertically-integrated utilities, the cost of firm gas pipeline capacity can be recovered through the fuel charge pass-through. For merchant generators, these costs must be recovered through the energy or capacity price. Without a guarantee of how much capacity or energy is produced in the competitive market, it is difficult for the generators to contract firm gas capacity and pay for the costly pipeline construction.

These concerns are not just theoretical – we have seen them played out during the 2014 and 2015 polar vortex events and the 2017/2018 winter cold snap. During these cold days, congested pipelines were unable to deliver natural gas to the electricity generators who needed it most to generate electricity. Gas-fired generators either had to buy extremely expensive spot gas when it was available or burn high-cost liquid fuel to generate electricity, ultimately costing consumers millions of dollars. During the Polar Vortex, PJM was forced to declare a NERC Energy

Emergency, Level 1 and 2, and to activate all available resources and load reduction measures such as public appeals, voltage reduction, load management, and interruption of non-firm contracts³. Fortunately, the 2017/2018 cold snap was 5 to 6 degrees warmer than the Polar Vortex events. With the lower demand, the resilience of the PJM system was not tested. However, PJM still had over 4,000 MW of forced outages from gas generators who were unable to obtain fuel. During the cold snap, some 14,000MW⁴ nuclear and coal capacities that were unable to clear the PJM capacity market were brought on to generate, easing the challenge in PJM system and market operations during the cold weather.

Baseload nuclear plants have long served as the stabilizing generating resources for our country's electric system. With significant on-site fuel supplies, they can operate around the clock and withstand extreme circumstances such as sustained severe weather and other catastrophic events that disrupt fuel delivery to other generation resources. Nuclear plants provide valuable economic, environmental, and reliability benefits that are incredibly challenging to replace. The DOE staff report pointed out that "overall nuclear generators performed extremely well during the Polar Vortex [events], with an average capacity factor of 95 percent."

In closing, I would like to touch on the critical link between energy security, energy independence, and ultimately, national security. As malicious man-made attacks designed to inflict maximum disruption to electric grid operations become a growing concern, a diverse electricity generating mix is more resilient to absorb, withstand, and recover from an attack on a single fuel source. We believe it is important to maintain the current resource mix while the electric utility industry, together with regulators, investigate the long-term system resiliency requirements and consequences of shifting resources to generate electricity under all conditions.

I'd like to thank you once again for having me here today. I am available to answer any questions you may have.

³ PJM Interconnection, Analysis of Operational Events and Market Impacts during the January 2014 Cold Weather events (May 8, 2014).

⁴ "Cold Weather Summary December 27, 2017 – January 7, 2018", PJM Operating Committee presentation, January 9, 2018,