

**Testimony of Dr. Paul Stockton
for the
Pennsylvania General Assembly's Nuclear Energy Caucus**

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Good morning. My name is Paul Stockton, and I am the Managing Director of Sonecon, LLC, a security and economic advisory firm in Washington, DC that provides strategic advice to Exelon and other energy companies. I appreciate the opportunity to testify before you today and support the vital work of the Nuclear Energy Caucus.

This hearing could not be more timely. Threats to energy sector resilience are rapidly growing, both within Pennsylvania and across the United States. These threats pose potentially severe threats to the economy of the state and to the public health and safety of its citizens. But there is good news as well. As I will discuss today, there is growing awareness of the crucial role that nuclear power plays in providing resilient electric power and supporting U.S. national security. There are also important opportunities to leverage that awareness to help reverse the premature retirement of nuclear power plants. I want to thank you and the Caucus as a whole for your work to help nuclear power continue to benefit your constituents, and would like to offer some thoughts today on recent developments that make your efforts more valuable than ever before.

Let me summarize my testimony this morning. In the face of increasingly severe cyber and physical threats to the electric grid, PJM and other grid owners and operators are making much-needed improvements in electric infrastructure security. But this same progress may encourage adversaries to adopt an indirect means of disrupt electric service: that is, interrupting the flow of natural gas on which power generation increasingly depends. Nuclear power plants have many months of fuel stored onsite and are impervious to such enemy tactics. Nuclear plants must also meet stringent, mandatory physical and cyber security protection standards – standards that the natural gas industry utterly lacks. Moreover, at a time when the Department of Defense must spend rapidly increasing funds to deal with rising sea levels and other consequences of climate change, nuclear power can make vital contributions to reducing carbon emissions. However, we will lose all of these benefits unless we can stop the premature retirement of nuclear power generators and structure markets to reflect the value of the resilient electricity they produce.

Before addressing these issues in greater detail, let me first explain why I am so committed to sustaining and ultimately, I hope, growing the contribution of nuclear power to U.S. energy resilience. I have spent much of my career working on issues related to the protection of critical public and private infrastructure, including the Bulk Power System (BPS). From June 2009 until January 2013, I served as the Assistant Secretary of Defense for Homeland Defense and Americas' Security Affairs. In that position, I was responsible for Defense Critical Infrastructure Protection and led the creation of the Department's *Mission Assurance Strategy*. I also served as the Domestic Crisis Manager for the Department of Defense (DOD) and was responsible for Defense continuity of operations. I was the principal civilian advisor to the Secretary of Defense for providing Defense support to the Federal Emergency Management Agency, the Department of Energy (DOE) and other Federal departments in Superstorm Sandy, Hurricane Irene, and other disasters. In addition, I was responsible for developing and overseeing the implementation of DOD security policy in the Western Hemisphere, including U.S.-Canada cooperation on Defense-related issues concerning energy sector resilience. From January 2012 until January 2017, I served as a Special Government Employee for the Department of Defense, and helped conduct studies to strengthen deterrence of cyberattacks, counter insider threats, and meet other infrastructure resilience challenges. I have also written extensively about opportunities to meet these challenges, and appreciate the opportunity to discuss them with you today.¹

My testimony first examines why energy resilience is so critical for national security. Next, I summarize the emerging threats to the electric grid and fuel supplies on which power generation depends, and why nuclear generation is so resilient against attack. My testimony then recommends additional steps to bolster fuel resilience, and highlights the additional benefits that nuclear power provides for U.S. security.

¹ In 2018, I authored *Resilience for Grid Security Emergencies: Opportunities for Industry-Government Collaboration*, published by Johns Hopkins University Applied Physics Laboratory; *Electric Infrastructure Protection Handbook III*, *Black Sky Cross-Sector Coordination and Communication*, published by the Electric Infrastructure Security Council; and in 2016 co-authored the Homeland Security Advisory Council's *Final Report by the Cybersecurity Subcommittee: Incident Response*. I am also widely published on other issues of homeland security, national defense and infrastructure resilience, including *Resilience for Black Sky Days: Supplementing Reliability Metrics for Extraordinary and Hazardous Events*, prepared for the National Association of Regulatory Utility Commissioners.

The National Security Imperative for Energy Resilience

Since 9/11, homeland security and infrastructure protection priorities have traditionally revolved around threats of terrorism. Those priorities are now changing, with key implications for energy sector resilience. As Secretary of Homeland Security Kirstjen Nielsen noted on September 5, 2018, hostile nation states now pose a prime challenge to the United States. Indeed, threats to our nation from Russia, China, Iran and other foreign adversaries “are at the highest levels since the Cold War.”² The *National Defense Strategy of the United States of America* (January 2018) similarly emphasizes that the “central challenge to U.S. prosperity and security is *the re-emergence of long-term, strategic competition*” by Russia, China, and other “revisionist powers” [emphasis in the original].³ We can no longer scale our infrastructure security efforts to handle a few teams of terrorists. Instead, power generators and the fuel supplies on which they depend must now be prepared for attacks by nation states with vast resources to conduct cyber and physical strikes.

Failing to meet this challenge would leave our nation vulnerable to catastrophic damage. Secretary of Energy Richard Perry emphasizes that “America’s greatness depends on a reliable, resilient electric grid” that can power the economy, support national defense, and provide for the necessities of modern life.⁴ DOE’s *Quadrennial Energy Review* provides a detailed analysis of the grid’s foundational importance and warns that a lack of electric reliability puts national security and homeland defense functions – all of which depend on electricity to carry out their missions – at risk.⁵ That dependence is especially significant for the many military bases and supporting civilian infrastructure serving power plants and electric systems in Pennsylvania and the surrounding region.

² Kirstjen M. Nielsen, “Rethinking Homeland Security in an Age of Disruption,” *Remarks at the George Washington University Center for Cyber & Homeland Security*, September 5, 2018,

<https://www.dhs.gov/news/2018/09/05/secretary-nielsen-remarks-rethinking-homeland-security-age-disruption>.

³ U.S. Department of Defense, *Summary of the National Defense Strategy of the United States of America*, January 2018, p. 2, <https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

⁴ Secretary of Energy Richard Perry, *Letter to the Federal Energy Regulatory Commission*, September 28, 2017, <https://energy.gov/sites/prod/files/2017/09/f37/Secretary%20Rick%20Perry%27s%20Letter%20to%20the%20Federal%20Energy%20Regulatory%20Commission.pdf>.

⁵ Department of Energy, *Quadrennial Energy Review – Transforming the Nation’s Electricity System: Second Installment of the QER*, January 2017, p. 1-31.

Large-scale disruptions of electric power can jeopardize DOD's ability to carry out essential missions at home and abroad. In the face of this risk, DOD continues to make significant progress in bolstering mission assurance (MA) against a wide range of threats.⁶ DOD is working with PJM and other electric industry partners to bolster the resilience of power flows to Defense installations. However, threats to the electric grid and the fuel supplies on which gas-fired power generation depends continue to intensify.

Threats and Security Requirements: A Tale of Two Subsectors

While China, Russia, and other nations are developing increasingly sophisticated cyber weapons to attack U.S. energy infrastructure, the two key components of the energy sector are taking radically different approaches to defending against that threat. The electricity subsector must comply with increasingly stringent, mandatory standards for both cyber and physical risks. Nuclear power plants must meet especially demanding security requirements – and therefore offer extraordinary value for resilient electric service. But the Oil and Natural Gas (ONG) subsector lacks mandatory standards. Moreover, the Nuclear Regulatory Commission (NRC) provides nuclear plants with a design basis threat (DBT) to help plant owners and operators understand the scale and severity of the attacks they must be prepared to counter. Natural gas systems have no such DBT to undergird their own security efforts.

Nuclear Power Plants and the Electricity Subsector

The Department of Homeland Security (DHS) and other government agencies have highlighted the intensifying cyber threats to industrial control systems used across the energy sector, including power generators, electricity transmission systems, and natural gas infrastructure. Earlier this year, DHS identified a “multi-stage intrusion campaign by Russian government cyber actors” against energy systems and other infrastructure assets.⁷ Iran, China, and other potential adversaries are

⁶ DOD defines MA as “A process to protect or ensure the continued function and resilience of capabilities and assets - including personnel, equipment, facilities, networks, information and information systems, infrastructure, and supply chains - critical to the performance of DoD MEFs in any operating environment or condition.” See: Department of Defense, *Mission Assurance Strategy*, April 2012, http://policy.defense.gov/Portals/11/Documents/MA_Strategy_Final_7May12.pdf.

⁷ “Alert (TA18-074A): Russian Government Cyber Activity Targeting Energy and Other Critical Infrastructure Sectors,” Department of Homeland Security, last revised March 16, 2018, <https://www.us-cert.gov/ncas/alerts/TA18-074A>.

also seeking to embed malware in energy systems to “prepare the battlefield” for possible future attacks.⁸ Physical attacks also present a potentially severe risk. The 2013 attack on the Metcalf electric substation in San Jose, California, which knocked 17 of its 23 transformers out of operation, exemplifies potential physical damage that adversaries may seek to inflict.⁹ A coordinated kinetic attack on multiple substations or natural gas compression facilities could magnify such disruptive effects, especially if adversaries employed truck bombs or other means to create massive physical damage.

Nuclear power plants are heavily protected against all such cyber and physical threats. Nuclear power plants, under NRC regulation, have mandatory physical and cyber standards.¹⁰ These standards are in part derived from the NRC’s design basis threat (DBT) for nuclear power plants and related facilities.¹¹ The DBT outlines basic threats that these entities need to be able to protect themselves against, including “multiple, coordinated groups of attackers, suicide attacks and cyber threats,” as well as other potential attack vectors and natural hazards.¹² The NRC also regularly reviews and revises the DBT to keep pace with evolving threats.

The electricity subsector must also meet stringent cyber and physical security standards. NERC introduced such standards in the wake of the Metcalf attack and growing cyber threats to electric utilities. The majority of these standards are cybersecurity-oriented, though CIP-014-2 addresses physical security requirements.¹³ NERC’s Electricity Information Sharing and Analysis Center (E-

⁸ Jonathan Landay, “U.S. intel chief warns of devastating cyber threat to U.S. infrastructure,” Reuters, July 13, 2018, <https://www.reuters.com/article/us-usa-russia-cyber-coats/u-s-intel-chief-warns-of-devastating-cyber-threat-to-u-s-infrastructure-idUSKBN1K32M9>.

⁹ Norimitsu Onishi and Matthew L. Wald, “Months Later, Sniper Attack at Power Hub Still a Mystery,” The New York Times, February 5, 2014, <https://www.nytimes.com/2014/02/06/us/months-later-sniper-attack-at-power-hub-still-a-mystery.html>.

¹⁰ “Physical Protection,” Nuclear Regulatory Commission, last updated August 14, 2017, <https://www.nrc.gov/security/domestic/phys-protect.html>; “Backgrounder on Cyber Security,” Nuclear Regulatory Commission, last updated October 12, 2016, <https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/cyber-security-bg.html>.

¹¹ The NRC’s DBT provide performance-based requirements which allow each facility to develop site-specific strategies. It applies to commercial nuclear power reactors and Category I Fuel Cycle Facilities. See: “Frequently Asked Questions About NRC’s Design Basis Threat Final Rule,” Nuclear Regulatory Commission, last updated August 11, 2017, <https://www.nrc.gov/security/faq-dbtfr.html>.

¹² 10 CFR § 73.1 (2010), <https://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol2/pdf/CFR-2010-title10-vol2-sec73-1.pdf>.

¹³ “United States Mandatory Standards Subject to Enforcement,” NERC, n.d., <https://www.nerc.com/pa/stand/Pages/ReliabilityStandardsUnitedStates.aspx?jurisdiction=United%20States>.

ISAC) has also established a design basis threat to help utilities conduct risk assessment processes and enhance physical security.¹⁴ It will be important for these protection requirements to keep pace with adversarial threats. However, they face a key limitation for overall energy sector resilience: they apply only to certain components of the electricity subsector.¹⁵

Natural Gas: Critical Gaps

As the electricity subsector continues to improve its cyber and physical defenses, adversaries may instead seek to disrupt the fuel sources required for power generation. In particular, adversaries may seek to interrupt the natural gas flows on which power generation increasingly depends. Dominion Energy noted in a 2016 filing to the SEC that there “appears to be an increasing level of activity, sophistication and maturity of threat actors, in particular nation state actors, that wish to disrupt the U.S. bulk power system and the U.S. gas transmission or distribution system.”¹⁶ Cyber and physical threats to natural gas systems have continued to intensify, with potentially devastating consequences for power generation capacity.¹⁷ A successful attack on natural gas utilities in regions of the U.S. that are particularly reliant on this source of fuel would immediately hinder the electricity subsector’s ability to generate power and could cause electric outages – potentially exacerbated by physical damage to gas infrastructure.¹⁸ In contrast, nuclear power plants rely on onsite fuel for power generation and can generate electricity for many months between refueling operations.

¹⁴ NERC, *State of Reliability 2016*, May 2016, p. 7,

https://www.nerc.com/pa/rapa/pa/performance%20analysis%20dl/2016_sor_report_final_v1.pdf.

¹⁵ NERC’s standards apply generally to the Bulk Electric System (BES), though some CIP standards have tiered requirements based on the assessed criticality of a given asset. See: NERC, *CIP-002-5.1a — Cyber Security — BES Cyber System Categorization*, effective December 27, 2016,

<https://www.nerc.com/pa/Stand/Reliability%20Standards/CIP-002-5.1a.pdf>. For NERC’s definition of the BES, see: NERC, “Glossary of Terms Used in Reliability Standards,” updated July 3, 2018,

https://www.nerc.com/files/glossary_of_terms.pdf.

¹⁶ Dominion Resources, Inc., Virginia Electric, and Power Company and Dominion Gas Holdings, LLC, *Annual Report to the United States Securities and Exchange Commission Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934*, 2016, <https://investors.dominionenergy.com/node/22306/html>.

¹⁷ Blake Sobczak, Hannah Northey and Peter Behr, “Cyber raises threat against America’s energy backbone,” E&E News, May 23, 2017, <https://www.eenews.net/stories/1060054924/>; Neil Chatterjee and Richard Glick,

“Cybersecurity threats to U.S. gas pipelines call for stricter oversight,” Axios, June 11, 2018,

<https://www.axios.com/cybersecurity-threats-to-us-gas-pipelines-call-for-stricter-oversight-09fac6e5-da94-491e-9523-d08ef15237f4.html>; Paul W. Parfomak, “Pipeline Security: Recent Attacks,” Congressional Research Service,

March 21, 2017, <https://www.hsdl.org/?view&did=799950>.

¹⁸ NERC, *Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System*, November 2017, p. viii.

Natural gas explosions in Massachusetts on September 13 highlight the potential risks of adversary intrusions into natural gas system control networks.¹⁹ While there is no evidence to suggest that these explosions or the over-pressurization in pipelines that caused them were the result of malicious intervention, these actions exemplify the type of actions that adversaries could take to disrupt natural gas supplies for power generation and cause kinetic damage in the U.S. If an adversary were able to infect a natural gas utility's industrial controls they could similarly cause gas lines to over-pressurize and explode, leading to both structural damage to customers and destruction of the pipeline infrastructure that allows gas to flow to power generators.

Despite the severity of threats to the ONG subsector, no mandatory physical or cyber security standards exist for natural gas systems. As a result, natural gas pipelines risk being the “weak link” in U.S. energy sector infrastructure.²⁰ The Transportation Security Administration (TSA), which has primary responsibility for the security of the nation's pipelines, recently updated and expanded its guidelines for securing pipelines in modest but helpful ways.²¹ However, while TSA has the regulatory authority and mandate to introduce mandatory measures, these standards remain voluntary.²² Despite these guidelines and other coordinated industry and government efforts to secure U.S. pipeline infrastructure, “questions remain as to their level of commitment to those activities and how effective they have been in protecting the pipeline system.”²³

¹⁹ Senators Edward J. Markey and Elizabeth Warren, *Letter to NiSource and Columbia Gas of Massachusetts*, September 17, 2018, <https://www.markey.senate.gov/imo/media/doc/Letter%20to%20NiSource%20and%20Columbia%20Gas.pdf>. A similar (though less severe) event occurred in Beaver County, Pennsylvania only three days prior. See: “Home destroyed in gas line explosion that forced evacuations,” WPXI, last updated September 11, 2018, <https://www.wpxi.com/news/top-stories/home-destroyed-in-gas-line-explosion-that-forced-evacuations-1/830644557>.

²⁰ Paul N. Cicio on behalf of the Industrial Energy Consumers of America, *Letter to Senators Walden and Pallone*, August 29, 2018, p. 1, https://www.ieca-us.com/wp-content/uploads/08.28.18_House-TSA-Letter.pdf.

²¹ Department of Homeland Security, *Pipeline Security Guidelines*, March 2018, https://www.tsa.gov/sites/default/files/pipeline_security_guidelines.pdf. See: Peter Behr and Blake Sobczak, “TSA to expand gas pipeline cybersecurity oversight,” *E&E News*, December 22, 2017, <https://www.eenews.net/stories/1060069743>.

²² Paul W. Parfomak, *Written Statement before the House Committee on Homeland Security Subcommittee on Transportation Security*, April 19, 2016, pp. 9-10, <https://docs.house.gov/meetings/HM/HM07/20160419/104773/HHRG-114-HM07-Bio-ParfomakP-20160419.pdf>

²³ *Id.*, at p. 13.

The Importance of Fuel Diversity

Potential natural gas system vulnerabilities highlight the imperative of maintaining fuel diversity in power generation. NERC regularly underscores the importance of fuel diversity in the Nation’s electricity supply, and recommends that regulators “consider fuel diversity as they evaluate electric system plans and establish energy policy objectives.”²⁴ In particular, NERC warns that the electricity subsector’s growing reliance on natural gas “raises concerns regarding the ability to maintain BPS reliability when facing constraints on the natural gas delivery systems.”²⁵ Nuclear generating capacity will be critical to diminishing the electricity subsector’s over-reliance on natural gas and maintaining fuel diversity.

Reliance on a single fuel is especially problematic during extreme weather conditions. Pennsylvania itself has experienced severe weather events in recent years, including Superstorm Sandy in 2012, and the 2014 Polar Vortex that crippled much of the northeast. In these and other severe weather events, extended cold snaps caused spikes in the price and demand for natural gas and lead to curtailments in supplies to power generators (especially those that lack firm, higher-cost contracts).²⁶ In the Polar Vortex, however, the nuclear fleet operated at 95% capacity.²⁷ Nuclear generation would benefit from a similar advantage in adversary-induced disruptions of the natural gas system.

Creating a Fuel-Resilient Electric Grid

The most important way that the United States can bolster fuel resilience for the power grid is to prevent the premature retirement of nuclear power plants in Pennsylvania and the rest of the country. However, given the fact that gas-fired generation is the predominant source of power in a growing number of U.S. regions, we should also help gas system owners and operators strengthen

²⁴ “*Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System*” The North American Electric Reliability Corporation, November 2017.

²⁵ North American Electric Reliability Corporation, *Short-Term Special Assessment: Operational Risk Assessment with High Penetration of Natural Gas-Fired Generation*, May 2016, p. 12.

²⁶ Electric Infrastructure Security (EIS) Council, *E-PRO Handbook II: Volume 1 – Fuel* (Washington, D.C.: EIS Council, 2016), p. 213.

²⁷ James Conca, “Polar Vortex - Nuclear Saves The Day,” *Forbes*, January 12, 2014, <https://www.forbes.com/sites/jamesconca/2014/01/12/polar-vortex-nuclear-saves-the-day/>.

the security of their critical assets. Establishing a design basis threat for cyber and physical threats to the ONG subsector could be especially valuable.

Retaining Nuclear Power for Grid Resilience

Nuclear power generation, today, offers a resilient source of electricity with no fuel supply concerns. Secretary Perry recently noted that nuclear generation is “not interruptible” because power plants have extensive supplies of onsite fuel.²⁸ A December NERC 2017 report similarly emphasizes the resilience value of nuclear power and other generation assets that have stored, onsite fuel. The report urges that additional consideration be given to “the reliability and resilience attributes provided by coal and nuclear generation to ensure that the generation resource mix continues evolving in a manner that maintains a reliable and resilient BPS.”²⁹

However, nuclear generators are facing a much different type of threat: undervaluation. A recent MIT study asked, rhetorically, whether investments in nuclear power were fully remunerated for the value of the electricity they supply – “At present, the answer is clearly ‘no.’”³⁰ In particular, nuclear generators are not being compensated for the resilience benefits they provide. In-service nuclear plants are being shuttered before their current licenses expire and future investments in nuclear power are receiving little-to-no consideration.

This is already occurring in Pennsylvania. The state currently has a robust nuclear generation capacity which can help mitigate potential fuel disruptions.³¹ However, Pennsylvania’s natural gas sector is increasingly mounting economic challenges to the prevalence of nuclear generation in the state’s energy mix and has already contributed to the planned shutdown of one reactor in 2019.³² Without immediate action, others could soon follow.

²⁸ Blake Sobczak, Sam Mintz and Peter Behr, “Agencies play tug of war over pipeline protection,” E&E News, August 23, 2018, <https://www.eenews.net/stories/1060094769>.

²⁹ 2017 *Long-Term Reliability Assessment*, The North American Electric Reliability Corporation, December 2017, p. 6

³⁰ Massachusetts Institute of Technology, *The Future of Nuclear Energy in a Carbon-Constrained World*, September 2018, p. 95, <https://energy.mit.edu/wp-content/uploads/2018/09/The-Future-of-Nuclear-Energy-in-a-Carbon-Constrained-World.pdf> (“The Future of Nuclear Energy”).

³¹ “Pennsylvania State Profile and Energy Estimates,” U.S. Energy Information Administration, n.d., <https://www.eia.gov/state/?sid=PA>

³² Sam Mintz, “Pa. braces for impact as Three Mile Island nears closure,” E&E News, August 2, 2018, <https://www.eenews.net/stories/1060091883>.

This trend has potential consequences for the resilience of the grid that serves Pennsylvania, as well as national security more broadly. Secretary Perry continues to emphasize that it is “important to keep coal and nuclear plants online” due to the potential for cyberattacks on gas pipelines and other sources of fuel.³³ I recommend maintaining the diverse and environmentally-beneficial mix of energy generation on which Pennsylvania has historically relied, including taking action to strengthen at-risk nuclear generation. Regulators and their industry and government partners will need to find a way to assign a dollar value to the resilience benefits that nuclear power provides and compensate plant owners accordingly.

Mandatory Protections for the Oil and Natural Gas (ONG) Subsector

Cyber and physical protections in the ONG subsector remain voluntary despite repeated pressures to introduce mandatory standards. Both TSA and the pipeline industry defend this voluntary approach by arguing that many companies currently exceed the voluntary guidelines, and that setting general standards would create requirements less stringent than what is common practice across much of the subsector.³⁴ Others suggest that government-issued standards, by nature, cannot keep pace with the evolving threat.³⁵ This rationale may no longer be sufficient for a threat landscape in which the consequences of a lapse in security could cascade across multiple critical infrastructure sectors, nationwide. Mandatory standards – paired with an effective enforcement mechanism and sufficient TSA resources to ensure compliance – could bolster the defenses of companies who do not currently meet the voluntary measures. Moreover, companies who already exceed current voluntary guidelines clearly see a business case for doing so and would not likely scale back defenses because new mandatory standards set a lower bar. TSA could also consider developing performance-based standards to minimize compliance costs for utilities that go above and beyond the voluntary guidelines, i.e. if a company can show that its specific measures exceed similar (but not exactly the same) requirements, they will be counted as compliant.

³³ Mike Lee, “Perry says cyberthreats to gas justify help for coal, nuclear,” August 6, 2018, E&E News Energywire, <https://www.eenews.net/energywire/stories/1060092775/>.

³⁴ *Id.*, at p. 10.

³⁵ Blake Sobczak, Sam Mintz and Peter Behr, “Agencies play tug of war over pipeline protection,” E&E News, August 23, 2018, <https://www.eenews.net/stories/1060094769>.

Calls for mandatory standards are mounting as threats to the subsector intensify. The Industrial Energy Consumers of America recently urged the House Committee on Energy and Commerce to conduct hearings on whether such mandatory standards are needed, and “take appropriate action to ensure that Congress has done all that is reasonable and cost-effective to ensure the security of natural gas pipelines.”³⁶ Legislative, executive, and oversight bodies have also previously suggested that the industry would benefit from implementing mandatory standards, though stopped short of requiring them.³⁷ Discussions are still ongoing between industry, government, and other subsector stakeholders on how best to protect natural gas facilities from adversary attacks.

No matter the outcome of those discussions, the ONG subsector should create a DBT similar to the one in use by NRC for nuclear facilities. Doing so will help ONG utilities understand the risks and threats they face, identify gaps in protective measures, and develop options to mitigate them. My previous testimony to FERC outlines the benefits such a DBT can also provide to electric utilities who may be woefully unprepared for significant disruptions of natural gas supplies.³⁸ Even with a DBT however, it is clear that any path forward for the ONG subsector and its partners will entail a significant catch-up period for many utilities to ensure overall subsector resilience.

Beyond Fuel Resilience: the Benefits of a Strong Nuclear Power Industry for National Security

On June 26, 2018, I had the honor of joining senior leaders in the energy sector and other former Pentagon officials in sending a letter to Secretary of Energy Perry which underscores these points. The letter called on the Secretary to take concrete steps to ensure the national security attributes of American nuclear power plants are properly valued in U.S. electricity markets, recognized by policymakers, and considered in deliberations about the importance of nuclear power to grid resilience that are occurring at the local, state, and Federal level. The letter also emphasized the value of nuclear power generation due to the resilience of nuclear plants against natural and

³⁶ Paul N. Cicio on behalf of the Industrial Energy Consumers of America, *Letter to Senators Walden and Pallone*, August 29, 2018, p. 1, https://www.ieca-us.com/wp-content/uploads/08.28.18_House-TSA-Letter.pdf.

³⁷ Paul W. Parfomak, *Written Statement before the House Committee on Homeland Security Subcommittee on Transportation Security*, April 19, 2016, p. 10.

³⁸ Paul Stockton, *Prepared Direct Testimony on Grid Reliability and Resilience Pricing* (Docket No. RM18-1-000), November 7, 2017.

manmade hazards and interruptions of fuel supply, the importance of this generation to DOD and a breadth of other nuclear security organizations, and the environmental value of emissions-free generation that nuclear sources provide.³⁹

Maintaining a strong nuclear generation fleet can also provide benefits for national security more broadly. This testimony has emphasized the importance of nuclear generation to overall grid resilience, and the importance of the grid to DOD mission assurance and homeland defense. However, nuclear generation can also contribute to national security by reducing carbon emissions that are intensifying the effects of climate change and improve American engagements and partnerships abroad.

Environmental Benefits to National Defense

Climate change is producing major challenges for DOD and other U.S. national security organizations. A recent DOD study found that climate change directly affects a large portion of its facilities and could have an “unacceptable impact” on the Department’s ability to fully execute its mission essential functions.⁴⁰ In written answers to questions for his confirmation hearing, Defense Secretary Jim Mattis also acknowledged that climate change is a driver of instability that could affect DOD installations around the world.⁴¹

Rising sea levels that threaten naval bases are particularly problematic. The rate of flooding will continue to increase as climate change intensifies, and a growing number of major bases could be fully submerged in the decades to come.⁴² DOD is already investing heavily to combat this threat. Most recently, the FY 2019 NDAA authorized the use of funds to explicitly pay for repairs or pre-emptive mitigations at a facility for “recurrent flooding and sea level fluctuation” if the Secretary

³⁹ Paul Stockton et al., *Letter to Secretary Perry*, June 26, 2018, <https://www.nei.org/CorporateSite/media/filefolder/resources/letters-filings-comments/letter-secretary-energy-rick-perry-nuclear-national-security-20180626.pdf>.

⁴⁰ Department of Defense, *Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report*, January 2018, p. 1 and 7.

⁴¹ Andrew Revkin, “Trump’s Defense Secretary Cites Climate Change as National Security Challenge,” ProPublica, March 14, 2017, <https://www.propublica.org/article/trumps-defense-secretary-cites-climate-change-national-security-challenge>.

⁴² Meghann Myers, “Rising oceans threaten to submerge 128 military bases: report,” NavyTimes, July 29, 2016, <https://www.navytimes.com/news/your-navy/2016/07/29/rising-oceans-threaten-to-submerge-128-military-bases-report>.

determines that continued access to that facility has been impacted by flooding and rising sea levels.⁴³ Such costs are likely to only increase going forward.

The need to combat these climate change risks to national security makes it all the more important to retain the nuclear fleet. In the short term, a meaningful reduction in emissions will be near impossible without maintaining – if not increasing – current levels of nuclear generation. Indeed, a recent MIT study found that “the majority of existing nuclear plants provide a vital social benefit by delivering low-carbon electricity in a reasonably cost-efficient way,” but these plants are facing premature shutdowns and cannot attract investment because they are not remunerated by the market for the full value (including social value) they provide.⁴⁴ The same study argues that nuclear plant closures “threaten the ability to achieve future, deeper decarbonization targets” in the U.S. and that current energy policies “disregard the social value of nuclear energy’s contribution to climate change mitigation.”⁴⁵

I recommend that you take steps to halt the premature retirement of nuclear power plants and ensure that energy market prices compensate nuclear plants for the resilience and environmental benefits they bring to customers – and value for national security they provide as a result. I believe that regulators need to immediately update their pricing rules to reflect these considerations, as current public policies that encourage low-carbon generation tend to discriminate against nuclear energy and fail to properly price its climate benefits.⁴⁶

U.S. Engagement Abroad

One additional consideration deserves your attention: the commercial nuclear industry and its international role. There are currently 56 nuclear reactors under construction worldwide, largely backed by Russia and China.⁴⁷ This provides our near-peer adversaries with significant

⁴³ *National Defense Authorization Act for Fiscal Year 2019*, Public Law 115-232, H.R. 5515 (2018): 650, <https://www.congress.gov/115/bills/hr5515/BILLS-115hr5515enr.pdf>.

⁴⁴ “The Future of Nuclear Energy,” p. 98.

⁴⁵ *Id.* at p. 96 and 101.

⁴⁶ *Id.* at pp. 98-99.

⁴⁷ Paul Stockton et al., *Letter to Secretary Perry*, June 26, 2018, pp. 1-2, <https://www.nei.org/CorporateSite/media/filefolder/resources/letters-filings-comments/letter-secretary-energy-rick-perry-nuclear-national-security-20180626.pdf>.

international economic ventures and an opportunity to increase their global influence through investment. Despite the decades-long history of American leadership in developing and maintaining the commercial nuclear industry, the growing trend away from nuclear generation threatens that leadership role and our international competitiveness – both of which rely on a strong domestic nuclear program. A strong civil nuclear sector will also benefit domestic national security organizations including the Navy and components of DOE outside of the electricity portfolio.⁴⁸

Conclusion

Maintaining diversity across the electric generation fleet will help mitigate the substantial risks of natural and man-made disruption to the electric system that I have described. Our country cannot afford to lose clean, resilient power while we wait for a proper valuation. It is time to roll up our sleeves and get to work on properly valuing the vital attributes offered by clean baseload nuclear power in Pennsylvania. Maintaining Pennsylvania's nuclear power presents a unique opportunity to preserve significant amounts of zero-emission generation that also helps make Pennsylvania and the nation more energy secure. Thank you for the opportunity to provide this testimony.

⁴⁸ *Id.*