ADDENDUM

I. Overview[1]

The Nation's electricity grid has operated with a high level of reliability historically and continues to do so today. However, in light of the current threat environment and the evolving nature of the electricity system, reliability in the conventional sense is not sufficient. The grid also must be resilient and secure. The Nation's security and defensive capabilities, as well as critical infrastructure, depend on an electric grid that can withstand and recover from a major disruption, whether from an adversarial attack or a natural disaster. That ability to recover, known as the grid's resilience, in turn depends on the availability of robust and secure electric generation resources and their supportive supply chains.

In particular, resources that have a secure on-site fuel supply, including nuclear and coal-fired power plants, as well as oil-fired and dual-fuel units with adequate storage, are essential to support the Nation's defense facilities, critical energy infrastructure, and other critical infrastructure. Our national security also relies on a robust U.S. domestic industrial base, of which the coal, nuclear, and oil and natural gas industries are critical strategic components, as well as on a robust civilian nuclear power industry to support the entire U.S. nuclear enterprise and U.S. nuclear leadership abroad. A robust and secure network of natural gas pipeline infrastructure is also indispensable to the security of the Nation's electricity system.

Increasingly, however, due largely to regulatory and economic factors, too many of these fuel-secure plants have retired prematurely and many more have recently announced retirement. Although the lost megawatts of power often are replaced by new generation from natural gas and renewable energy sources, this transition comes at the expense of fuel security and resilience. As the North American Electric Reliability Corporation (NERC) states, "Premature retirements of fuel secure baseload generating stations reduces resilience to fuel supply disruptions."[2] Because the causes of this crisis primarily are regulatory and economic, prompt action by federal and state regulatory bodies and the private sector is required to achieve a lasting solution that meets the needs of both national security and the efficient operation of energy markets.

Under the [FAST Act], as part of its responsibilities as the Sector Specific Agency (SSA) for energy, the Department of Energy (DOE or the Department) is required to designate Critical Defense Facilities served by Defense Critical Electric Infrastructure (DCEI). To identify DCEI facilities, additional analysis will be required to gain a more detailed understanding of location-specific security vulnerabilities in our energy delivery systems, including the interdependencies associated with electric generation and transmission, and natural gas and petroleum pipelines, as well as their supply chains. DOE has begun the necessary analysis working with five National Labs. This analysis, which has never previously been undertaken, will take at least twenty-four months due to the complexity and inextricable dependency upon Canadian and Mexican system

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[1] This Addendum is not an exhaustive statement of the analysis and reasons in support of the Department of Energy's action.

[2] North American Electric Reliability Corporation, *Synopsis of NERC Reliability Assessments: The Changing Resource Mix and the Impacts of Conventional Generation Retirements*, at 3 (May 2017) [hereinafter NERC Reliability Synopsis].

components of the interconnected North American grid. In the meantime, DOE's Order (the Order or Directive) provides a temporary stop-gap measure to prevent the further permanent loss of the fuel-secure electric generation capacity for the grid upon which our national security depends, much like the interstate highway system.

As the Sector-Specific Agency for Energy under Presidential Policy Directive-21 (PPD-21),[3] DOE has determined the following:

- Electricity generation capacity is increasingly dependent on natural gas pipelines, which represent a major point of vulnerability in our critical energy infrastructure due to the limits of protection available to thousands of miles of pipeline networks.

- Although the United States electricity system operates at a high level of "reliability" according to conventional reliability standards and metrics, it is widely recognized that the security and resilience of the system in the face of major disruptions goes well beyond reliability and requires a fundamentally different analysis.

- Growing threats of multi-point attacks, including cyber-attacks, or other disruptions to the energy sector, including the electricity grid and the natural gas pipeline system, are increasing the risk of high-impact events that could result in significant harm to human life, the economy, the environment, and national security.

  In addition to transmission capacity and other critical components of the bulk power system (BPS), fuel-secure electric generation capacity constitutes critical electric infrastructure within the meaning of the FAST Act.

- While intermittent resources (wind and solar) provide value at various times during the day, during times of peak demand when there is the greatest strain on the electricity grid, many major electricity markets are and will continue to be heavily dependent on fossil and nuclear electric generation resources.

- Recent and announced retirements of fuel-secure electric generation capacity across the continental United States are undermining the security of the electric power system because the system's resilience depends on those resources.

- Although additional analysis of location-specific impacts is needed, due to the interconnected nature of the electricity system it is necessary to maintain fuel-secure generating stations across each interconnection within the continental United States to ensure adequate system-wide resilience in the event of major disruptions.

- The entire U.S. nuclear enterprise—weapons, naval propulsion, non-proliferation, enrichment, fuel services, and negotiations with international partners—depends on a robust civilian nuclear industry. Without a strong domestic nuclear power industry, the

[3] *See* Presidential Policy Directive 21– Critical Infrastructure Security and Resilience, at 11 (Feb. 12, 2013), *available at* https://www.dhs.gov/sites/default/files/publications/PPD-21-Critical-Infrastructure-and-Resilience-508.pdf.

U.S. will not only lose the energy security and grid resilience benefits, but will also lose its workforce technical expertise, supply chain, and position of clean energy leadership.

- Nuclear power, coal infrastructure, and pipeline infrastructure are all basic components of the Nation's domestic industrial base, which is necessary for national defense and furthers the National Security Strategy's priority goals of energy security through diverse supply and energy abundance.

To promote the national defense and maximize domestic energy supplies, federal action is necessary to stop the further premature retirements of fuel-secure generation capacity while DOE, in collaboration with other federal agencies, the States, and private industry, further evaluates national security needs and additional measures to safeguard the Nation's electric grid and natural gas pipeline infrastructure from current threats. To that end, as described below, it is necessary and appropriate for the Department to: (1) issue orders pursuant to its authority under the Defense Production Act of 1950 (DPA) and the Federal Power Act (FPA) to temporarily delay retirements of fuel-secure electric generation resources, while we (2) continue our analysis of, and take prompt action to address, the comprehensive resilience needs of our electric generation system, including specific actions to support defense critical energy infrastructure in the event of attack.

The Department is exercising its DPA and FPA authority by directing System Operators (as defined in the Directive), for a period of twenty-four (24) months, to purchase or arrange the purchase of electric energy or electric generation capacity from a designated list of Subject Generation Facilities (SGFs) sufficient to forestall any further actions toward retirement, decommissioning, or deactivation of such facilities during the pendency of DOE's Order. DOE also is directing SGFs outside of the RTO/ISO territories to continue generation and delivery of electric energy according to their existing or recent contractual arrangements with Load-Serving Entities. DOE's Order establishes a Strategic Electric Generation Reserve (SEGR) to promote the national defense and maximize domestic energy supplies. This prudent stop-gap measure will allow the Department further to address the Nation's grid security challenges while the Order remains in force.

II. Grid Resilience and National Security Threats

A. Resilience is Different from Reliability

It is widely agreed that the U.S. electric system operates at a high level of reliability.[4] It is also understood that most outages *to date* have been caused by distribution and transmission interruptions triggered by weather (including lightning strikes and hurricanes), lack of adequate vegetation management, and similar causes.[5] The Federal Energy Regulatory Commission (FERC), NERC, and other regulatory bodies, as well as utilities, have well-developed systems and metrics to evaluate and prepare for such events. Increasingly, however, it is also widely recognized

[4] *See e.g.*, National Academies of Sciences, Engineering, and Medicine, *Enhancing the Resilience of the Nation's Electricity System*, at 9 (2017) [hereinafter NASEM Study] ("The bulk power system achieves a relatively high degree of reliability across the United States as a whole.") .

[5] Department of Energy, *Quadrennial Energy Review: Transforming the Nation's Electricity System: The Second Installment of the QER*, at 4-28, 4-29 (Jan. 2017) [hereinafter QER]; see also NASEM at 56, 64.

that the security and resilience of the grid in the face of high-impact events caused by state actors, terrorists, or natural disasters go well beyond the conventional bounds of reliability.[6] Section 215 of the Federal Power Act provides for the establishment and enforcement of reliability standards by a FERC-approved Electric Reliability Organization (ERO). NERC currently serves as the ERO. Section 215 provides that the ERO establish standards for an "adequate level of reliability."

The statute does not specify "adequate" reliability, but does define "reliable operation" in terms that could be broad enough to encompass national security concerns.[7] Historically, however, NERC (with FERC's approval) has found it sufficient to set standards to ensure that the grid can operate in certain "credible contingencies"—*i.e.*, events that are expected and whose consequences are well understood. In NERC's narrow approach, credible contingencies involve the loss of a single system component. Under such contingencies, system operators are further required to plan for certain additional losses of system components, but not for the loss of a large number of components as would be likely in the event of a major attack or other disruption.[8] NERC's activity has developed to take into account a wider scope of likely events and includes certain planning requirements for "extreme" events.[9] NERC's own reliability assessments typically point to risks and threats that go well beyond its current standard.[10] Nevertheless, its current standards and metrics for reliability still do not adequately account for national security requirements. As Joseph McClelland, Director of FERC's Office of Infrastructure Security has testified,

> Section 215 of the Federal Power Act provides a statutory foundation for the ERO to develop reliability standards for the bulk power system. However, the nature of

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[6] *See e.g., id.* at 4-33, 4-34.

[7] Section 215 defines "reliable operation" to mean "operating the elements of the bulk-power system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements." [215(a)(4)]

[8] A recent FERC Staff Reliability Primer explains that, under current NERC standards, "[the] system must be operated at all times to ensure that it will remain in a secure condition (generally within emergency ratings for current and voltage and within established stability limits) following the unexpected loss of the most important generator or transmission facility (a 'single largest contingency'). This is called the 'N-1 criterion.' In other words, because a generator or line trip can occur at any time, the power system must be operated in a preventive mode. Use of the N-1 criterion means that the loss of the most important generator or transmission facility does not jeopardize the remaining facilities in the system by causing them to exceed their emergency ratings or stability limits, which could lead to a cascading outage." [RP at 22] Beyond N-1 events, "When a contingency does occur, system operators are required to identify and plan for the next contingencies based on the changed conditions.... Generally, the system must be restored to normal limits as soon as practical but within no more than 30 minutes, and to a condition where it can again withstand the next-worst single contingency.... Most areas of the grid are operated to withstand the concurrent loss of two or more facilities (i.e., 'N-2' or 'N-3'). This may be done, for example, as an added safety measure to protect a densely populated metropolitan area or when lines share a common structure and could be affected by the same event (e.g., a single lighting strike)." [RP at 22].

[99] [NERC has adopted standards for blackstart, cybersecurity, physical security and GMD, which have been criticized for being inadequate to the threats. But not EMP. Cite FRS, Woolsey, etc.]

[10] As discussed below, even while maintaining that the grid is currently "reliable," NERC identifies both cybersecurity and the loss of fuel-secure generation as "higher risk, higher likelihood" "risks."

> a national security threat by entities intent on attacking the U.S. by exploiting vulnerabilities in its electric grid using physical or cyber means stands in stark contrast to other major reliability events that have caused regional blackouts and reliability failures in the past, such as events caused by tree trimming practices. Widespread disruption of electric service can quickly undermine the U.S. government, its military, and the economy, as well as endanger the health and safety of millions of citizens. Given the national security dimension to this threat, there may be a need to act quickly to protect the grid in a manner where action is mandatory rather than voluntary while protecting certain sensitive information from public disclosure.[11]

In summary, as the National Academies of Sciences, Engineering, and Medicine Study concludes, "[a]lthough NERC standards have largely been effective in addressing credible contingencies and have been recently expanded to include consideration of extreme events, designing the grid to ride through catastrophic events such as major storms and cyber-attacks pushes their limit."[12]

The issue before the Department, then, is not whether our Nation's electric system has operated or is currently operating at a high level of *reliability*. Rather, it is whether the Nation's electric power system is adequately prepared and resourced to withstand a high-impact electricity system disruption caused by an attack, natural disaster, or other incident. This ability to withstand high-impact events is called "resilience." PPD-21 provides a general definition of resilience as it pertains to all critical infrastructures: "the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents." An adequate level of resilience for any critical infrastructure system must take into account the nature of the threats. , There is broad agreement among security experts, regulators, and energy industry experts that there is a need for greater resilience of the Nation's electric system to withstand an array of natural and intentional threats that are, in many cases, growing in frequency and scope. If the grid is not resilient to such disruptions, electric service may not be restored for a long time after a major disruption event. As NASEM states, "resilience is broader than reliability."[13] It should also be emphasized that, without resilience, there will likely be little or no reliability in the aftermath of the kinds of disruptions that are becoming ever more likely in the current threat environment.

The *resilience* of the electric power grid includes many components, and fuel security and diversity are among the most critical, as discussed below. In the fuel security context, the difference between conventional reliability metrics and a broader understanding of resilience. NERC, under FERC's oversight, regulates bulk power system electric reliability, but NERC does not have authority over natural gas pipelines and there are no mandatory reliability or security

[11] Testimony of Joseph McClelland, Director, Office of Energy Infrastructure Security, Federal Energy Regulatory Commission Before the Committee on Homeland Security and Governmental Affairs United States Senate, July 22, 2015, at 2. In the face of cyber, physical and other threats, "[t]he traditional definition of reliability—based on the frequency, duration, and extent of power outages—may be insufficient to insure system integrity and available electric power." QER at 4-4.
[12] *Id.* at 79 (citation omitted).
[13] NASEM Study, at 1.

standards for natural gas pipelines otherwise. The result is a situation in which conventional reliability standards do not adequately take into account gas pipeline vulnerabilities or related fuel security issues. In this context, market participants and other entities sometimes find themselves determining that the grid is "reliable" and, at the same time, that the grid is at serious risk from a fuel security standpoint. For example, on the same day that PJM approved a deactivation request for several nuclear generating units on the basis of its conventional reliability analysis, it issued a plan to initiate a study on "Valuing Fuel Security."[14] In this plan, PJM concluded that "**an increased reliance on any one resource type introduces potential fuel security risks not recognized under existing reliability standards**."[15] As defined by PJM,

> [F]uel security is the ability of the system's supply portfolio, given its fuel supply dependencies, to continue serving electricity demand through credible disturbance events, such as coordinated physical or cyberattacks or extreme weather that could lead to disruptions in fuel delivery systems, which would impact the availability of generation over extended periods of time."[16]

The goal of PJM's fuel security efforts is "to ensure that peak demands can be met during realistic but extreme contingency scenarios in various supply portfolios."[17]

Likewise, ISO New England has operated reliably in compliance with existing reliability standards and last fall stated that its capacity markets have accommodated retirements of coal-fired generation with "no adverse effect on regional resource adequacy or reliability of service."[18] However, only a few months later, commenting in FERC's resilience docket, ISO New England stated, "In New England, the most significant resilience challenge is fuel security—or the assurance that power plants will have or be able to obtain the fuel they need to run, particularly in winter—especially against the backdrop of coal, oil, and nuclear unit retirements, constrained fuel infrastructure, and the difficulty in permitting and operating dual-fuel generating capability."[19] As a result, in New England, "Fuel constraints and the continued loss of major non-gas-fired generation may pose a threat to keeping the lights on during future cold snaps."[20]

FERC currently has an open proceeding on grid resilience, in which a vigorous discussion is taking place about the precise definition of "resilience" (as it applies to the bulk power system) and the relationship between resilience and reliability. Regardless of how these definitional debates are resolved, DOE, as a national security agency, takes a comprehensive, Intelligence

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[14] PJM, *Valuing Fuel Security* (Apr. 30, 2018).
[15] *Id.* at 1.
[16] *Id.*
[17] *Id.* at 2.
[18] [ISO NE Comments in FERC Docket RM18-1]
[19] [ISO NE Response to Grid Resilience in RTO and ISOs (AD18-7-000), March 9, 2018, p. 1][See also ISO NE Operational Fuel Security Analysis p 4: "**Fuel-security risk**—the possibility that power plants won't have or be able to get the fuel they need to run, particularly in winter—is the **foremost challenge to a reliable power grid in New England.**]
[20] *Id.* at 11. "The retirements of coal-fired, oil-fired, and nuclear generators—resources with fuel stored on site—will have a significant impact on reliability and magnify the importance of other variables, particularly liquefied natural gas (LNG) supplies." [p4]

Community informed view of resilience within the context of national security. To be prepared to withstand major disruptions, the electricity system must not only operate reliably in the conventional sense, but it must also be resourced to withstand and recover from major disruptions caused by multi-point attacks or other increasingly likely events of unprecedented magnitude and scope.

B. Current Adversarial Threats to Critical Infrastructure

The President's National Defense Strategy states, "It is now undeniable that the *homeland is no longer a sanctuary*. America is a target . . . . During conflict, attacks against our critical defense, government, and economic infrastructure must be anticipated."[21] The threats to our critical energy infrastructure include intentional attacks by state actors and other enemies, as well as extreme weather and natural disasters. More specifically, the President's National Security Strategy states, "[t]he vulnerability of U.S. critical infrastructure to cyber, physical, and electromagnetic attacks means that adversaries could disrupt military command and control, banking and financial operations, the electrical grid, and means of communication."[22]

1. Threats to the Energy Subsector

PPD-21 identifies the Energy Sector as "uniquely critical due to the enabling functions [it] provide[s] across all critical infrastructure sectors."[23] The Nation's energy infrastructure faces a growing range of hazards, from increasingly sophisticated physical and cyber threats, to severe weather events and natural disasters, among others.[24] The evolving risk associated with mitigating cyber and physical security challenges is one of the most pressing issues for the sector. The sector has seen the occurrence of a number of each type of incident in recent years. According to NERC, "cyber and physical security threats are increasing and becoming more serious over time."[25]

A number of factors exacerbate the energy sector's cybersecurity challenge. The growing use of automated controls to operate energy systems, along with expanding knowledge and capabilities of malicious cyber actors, have increased the risks faced by both electricity and oil and natural gas facilities . The vulnerabilities of industrial control systems to cyber-attacks is one of the chief concerns for the Nation's critical infrastructure owners and operators. The use of information technology and operational technology components that share many of the same characteristics in terms of both their hardware and software also increase risks to the sector. Not only are individual components of concern, but also the interconnections between them—which can vary widely as new and old components are used together in systems.

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[21] Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge, at 3 (emphasis in original), *available at* https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

[22] National Security Strategy of the United States of America, at 12 (Dec. 2017), *available at* https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905-2.pdf.

[23] PPD-21 at 2.

[24] *See* Figure 2, below. The source is NERC, *ERO Reliability Risk Priorities: RISC Recommendations to the NERC Board of Trustees*, fig. 2.1, at 11 (Feb. 2018), *available at* https://www.nerc.com/comm/RISC/Documents/ERO-Reliability-Risk-Priorities-Report.pdf.

[25] North American Electric Reliability Corporation, *2017 Annual Report*, Feb. 2018, at 9, *available at* https://www.nerc.com/gov/Annual%20Reports/2017%20Annual%20Report.pdf.

Based on incidents reported by energy sector participants in the Department of Homeland Security's (DHS) Industrial Control Systems Cyber Emergency Response Team (ICS-CERT), the U.S. energy sector is one of the Nation's most highly targeted critical infrastructure sectors for cyber adversaries.[26] Energy sector stakeholders in both government and industry perform regular assessments, exercises, and information sharing and coordination in response to the growing cyber threat. Cyberattacks and intrusions targeting U.S. electric utilities have been reported, and the enhanced cyberattack capabilities in Russia, China, Iran, and North Korea represent a growing threat.[27] Criminal operations based abroad have recently targeted critical organizations—for instance, the Iran-based cyberattack on the Federal Energy Regulatory Commission—and such threats are likely to increase.[28] The physical security risk to the energy sector includes the potential for adversaries to inflict "intentional damage, destruction, or disruption to facilities."[29] The dispersed and exposed nature of many components of the electric grid, such as substations or transmission lines, as well as pipelines, makes infrastructure difficult to protect. Although these intrusions have not yet resulted in verified physical damage or disruption to energy infrastructure control systems in the United States, the capability of our adversaries to cause such disruptions appears to be increasing.[30]

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[26] *See* Supplement, at note ii.

[27] *See* Worldwide Threat Assessment 2018, *available at* https://www.dni.gov/files/documents/Newsroom/Testimonies/2018-ATA---Unclassified-SSCI.pdf; https://www.dni.gov/files/documents/ICA_2017_01.pdf.

[28] *See* Press Release, U.S. Dep't of Justice, Office of Public Affairs (Mar. 23, 2018) (describing indictment of nine Iranian nationals using an Iranian company to steal more than 31 terabytes of data from hundreds of universities, dozens of private sector companies, and government agencies, including FERC, mostly "on behalf of [Iran's] Islamic Revolutionary Guard Corps"), *available at* https://www.justice.gov/opa/pr/nine-iranians-charged-conducting-massive-cyber-theft-campaign-behalf-islamic-revolutionary (last visited May 14, 2018).

[29] *See* North American Electric Reliability Corporation, *ERO Reliability Risk Priorities: RISC Recommendations to the NERC Board of Trustees*, 10 (Nov. 2016).

[30] *See* Mission Support Center, *Cyber Threat and Vulnerability Analysis of the U.S. Electric Sector, Mission Support Center Analysis Report* (Idaho Falls, Idaho: Idaho National Laboratory), Aug. 2016, at 4. Recent examples of widely reported cyber incidents include: (1) VPNFilter (Reported on May 23, 2018, by Cisco Talos Intelligence Group that an unidentified hacking group has infected over 500,000 routers in 54 countries with malware that has code that overlaps with versions of the BlackEnergy malware that previously was used to sabotage the Ukrainian power grid. *See New VPNFilter malware targets at least 500K networking devices worldwide*, *available at* https://blog.talosintelligence.com/2018/05/VPNFilter.html, *see also* #7); (2) Russian Government Cyber Activity Targeting Energy and Other Critical Infrastructure (Per DHS' and the FBI's March 15, 2018 Joint Technical Alert, "Russian government cyber actors" targeted government entities and multiple U.S. critical infrastructure sectors, including the energy and nuclear sectors, by staging malware, conducting spear phishing, and gaining remote access into energy sector networks, collecting information pertaining to ICS) (*See* United States Computer Emergency Readiness Team, Alert TA18-074A, Russian Government Cyber Activity Targeting Energy and Other Critical Infrastructure Sectors (Mar. 15, 2018), available at https://www.us-cert.gov/ncas/alerts/TA18-074A); (3) attack on Eirgrid, Ireland's electricity wholesale transmission system operator Reported on August 6, 2017, that hackers installed eavesdropping software (Generic Routing Encapsulation (GRE) tunnel) on routers of Eirgrid, the state-owned company that

2. Threats to the Natural Gas Subsector

As has been widely reported, natural gas pipelines are increasingly vulnerable to cyber- and physical attacks.[31] Using a standard risk-based analysis, NERC has identified the disruption of electric generation supplied by gas pipelines as both a higher impact and higher likelihood event, due to the supply chain components required to provide adequate gas supply to electric power

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manages and operates the wholesale transmission electricity grid in Ireland and hackers were able to capture Eirgrid's encrypted communications. *See* Cathal McMahon, *Exclusive: EirGrid targeted by 'state sponsored' hackers leaving networks exposed to 'devious attack'*, The Independent, *available at* https://www.independent.ie/irish-news/news/exclusive-eirgrid-targeted-by-state-sponsored-hackers-leaving-networks-exposed-to-devious-attack-36003502.html); (4) spear phishing attack of Irish electric utility (On July 17, 2017, it was reported that senior engineers at the Electricity Supply Board, a state-owned utility which supplies electricity to Northern Ireland and the Republic of Ireland, were sent personalized emails containing malicious software "by a group linked to Russia's GRU intelligence agency." *See Hackers target Irish energy networks amid fears of further cyber attacks on UK's crucial infrastructure, available at* https://www.independent.co.uk/news/world/europe/cyber-attacks-uk-hackers-target-irish-energy-network-russia-putin-electricity-supply-board-nuclear-a7843086.html); (5) CrashOverride/Industroyer (On June 13, 2017, NERC issued a Level 1 NERC Alert to inform the electricity sector of capabilities found in malware targeting electric industry assets in Ukraine. The malware was designed to cause loss of visibility, loss of control, manipulation of control, interruption of communications, and deletion of local and networked critical configuration files. CrashOverride was associated with the cyber-attack which caused outages in the Ukrainian city of Kiev in December 2016.) (*See* North American Electric Reliability Corporation, *Industry Advisory: Modular Malware Targeting Electricity Industry Assets in Ukraine* (June 13, 2017), *available at* https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERCAlert_A-2017-06-13-01_Modular-Electric-Industry-Malware.pdf); (6) Grizzly Steppe (December 29, 2016 Joint Analysis Report by DHS and the FBI details tools used by Russian intelligence services to compromise and exploit networks and endpoints in the U.S.) (*See* Joint DHS, ODNI, FBI Statement on Russian Malicious Cyber Activity (Dec. 29, 2016), available at https://www.fbi.gov/news/pressrel/press-releases/joint-dhs-odni-fbi-statement-on-russian-malicious-cyber-activity); and (7) BlackEnergy (On December 23, 2015, Ukrainian power companies experienced unscheduled power outages impacting a large number of customers in Ukraine. Power outages were caused by remote cyber intrusions at three regional electric power distribution companies (Oblenergos) impacting approximately 225,000 customers. BlackEnergy is a Trojan malware designed to launch distributed denial-of-service (DDoS) attacks, among other tools to compromise information.) (*See* United States Computer Emergency Readiness Team, IR-ALERT-H-16-056-01, Cyber-Attack Against Ukrainian Critical Infrastructure (Feb. 25, 2016), available at https://ics-cert.us-cert.gov/alerts/IR-ALERT-H-16-056-01).

[31] See, e.g., "Cyberattack Shows Vulnerability of Gas Pipeline Network," New York Times, April 4 2018 https://www.nytimes.com/2018/04/04/business/energy-environment/pipeline-cyberattack.html. 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/; Blake Sobczak, "FERC Commissioner Sounds 'Call for Action' on Pipelines," E&E News, May 29, 2018. https://www.eenews.net/energywire/2018/05/29/stories/1060082831

generation units.[32] Specifically, the incapacitation of certain pipelines throughout the United States would have severe effects on electric generation necessary to supply critical infrastructure facilities.

Further, many natural gas and petroleum pipelines are designed to operate to provide one-way commodity flow. Thus, there is an increased susceptibility because a disruption at the "head end" of the pipeline disrupts the flow to all downstream pipeline facilities. Although there is redundancy built into the system, the present design of the system nonetheless poses significant risks associated with supplying commodity services to ensure national and economic security. Two-thirds of the lower 48 States are almost entirely dependent on the interstate pipeline system for their supplies of natural gas.

Natural gas, petroleum, and coal are all, to varying degrees, dependent upon supply chain interfaces that are each exposed to cyber and physical threat. However, this exposure is minimized where electric generation facilities are able to maintain fuel stockpiles onsite, as with coal and nuclear. From a resilience and national security risk perspective, those facilities that are able to secure key fuel commodities represent an important safeguard in this context, as discussed in more detail below.

Additional information regarding serious and sophisticated threats to the energy sector is contained in classified documents available to certain personnel of the Department and maintained by the Office of the Director of National Intelligence.

III. The Grid's Vulnerability Due to Loss of Fuel-Secure Generation Capacity

In light of these increasing and sophisticated threats to the energy sector, DOE continues to evaluate the resilience of the electric grid and the impacts of the ongoing loss of fuel-secure generation capacity.

The electric power system in the lower 48 States is comprised of three main "interconnections" spanning the lower 48 States– these are the Eastern and Western Interconnections, and the Electric Reliability Council of Texas.[33] Each of these interconnections is a single integrated machine that must operate continuously and at a high level of capacity to maintain stability. The three interconnections are electrically independent from each other (except for a few small DC ties). Although these are referred to as "the grid" or "grids," each is composed not only of high-voltage transmission wires, but also of electric generation units (power plants), substations, control centers, communications equipment, etc. The system as whole includes both

[32] *See* NERC, *ERO Reliability Risk Priorities: RISC Recommendations to the NERC Board of Trustees*, at 18 (noting that "[t]he resource mix and its delivery is transforming from large, remotely-located coal and nuclear-fired power plants, towards gas-fired . . . and other emerging technologies" and warning that "[t]hese changes in the generation resource mix and the integration of new technologies are altering the operational characteristics of the grid and will challenge system planners and operators to maintain reliability.")

[33] FERC Staff Reliability Primer at [**]. These comprise also portions of Canada and Mexico. The Quebec Interconnection is a fourth distinct interconnection. Neither Alaska, Hawaii, nor the island territories of the U.S. are connected to the lower 48 BPS.

the high-voltage interstate Bulk Power System (BPS) and local distribution systems that supply lower-voltage power to individual end-users.[34]

It is important to note that, given the physics of electricity and electron flows, events at any location on an interconnection can affect the rest of the interconnection. Abrupt changes of electricity supply or consumption in a particular location, particularly those caused by outages or loss of system components, can cause voltage instability, component failure, cascading failures across the interconnection, and, if the problem is not corrected quickly—collapse of the entire interconnection. Although location matters – some transmission lines or substations or generation units within an interconnection are in important ways more critical than others—the integrity and balance of the whole system is of critical importance. The breadth of an interconnection adds resiliency to the BPS by allowing a stressed portion of the grid to draw upon on another portions to supply additional power or transmission capacity to make up for generation or transmission outages. At the same time, however, a large grid can be vulnerable to rolling blackouts, as occurred during the August 14, 2003 blackout, which began in Ohio and cascaded through Eastern Canada, New York, and New England.

To avoid and recover from blackouts, it is essential that the system have adequate generation and transmission capacity broadly dispersed within the interconnection. Both transmission and generation are critical electric infrastructure as defined by the Federal Power Act. The Act defines CEI as "a system or asset of the [BPS], whether physical or virtual, the incapacity or destruction of which would negatively affect national security, economic security, public health or safety, or any combination of such matters."[35] Interconnections are designed to withstand the loss of a single generator or other component, generation and transmission "assets" more broadly are central to this definition. It is important to understand that the generation "fleet" within an interconnection does not operate like a fleet of vehicles. Because each Interconnection is a single machine that must maintain a critical mass of various components and resources to keep running.

A. Resilience Depends on Generation Fuel Diversity Including Fuel-Secure Electric Generation Resources

Generation fuel diversity is a critical strategy to ensure that the Nation has the resilient electric grid required to promote national defense and maximize domestic energy supplies in times of severe stress to the grid. NERC stated in its May 2017 *Synopsis of NERC Reliability Assessments* that "[h]igher reliance on natural gas exposes electric generation to fuel supply and delivery vulnerabilities" and that "[p]remature retirements of fuel secure baseload generating

[34] FPA section 215 defines BPS as "(A) facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); and (B) electric energy from generation facilities needed to maintain transmission system reliability." [CITE 215 (a)(1)] The definition expressly excludes "facilities used in the local distribution of electric energy." Id. In the Eastern Interconnection, for example, there are ___ generation units, ___ miles of high-voltage***. [OP]
[35] FPA 215A(a)(2).

stations reduces resilience to fuel supply disruptions."[36] Therefore, according to NERC, **"[m]aintaining fuel diversity** and security provides best assurance for resilience."[37] Further, NERC concluded that "having a portion of a resource fleet with high reliability characteristics, such as low forced and maintenance outage rates and low exposure to fuel supply chain issues, is one of the most fundamental necessities of a reliable [baseload power supply]."[38] In particular, "[c]oal and nuclear resources . . . have low forced and maintenance outage hours traditionally and have low exposure to fuel supply chain issues."[39] Also, traditional baseload generation can help the system withstand such an event, because "[n]uclear and coal plants typically have advantages associated with onsite fuel storage."[40]

The 2017 NASEM Study also discussed the benefits of generation diversity. NASEM noted that the January 2014 Polar Vortex "focused attention on the vulnerability associated with increasing reliance on natural gas for electricity restoration."[41] NASEM concluded that the proportion of generation provided by natural gas has grown substantially over the past few years, and that this trend:

> not only exposes the industry to potential price volatility and supply chain vulnerability, but also raises the question of how utilities could restore electricity service if a major disruption to natural gas delivery occurred (*e.g.*, one or more critical pipelines are destroyed).... [S]tudies suggest that resilience can be enhanced through a diverse fuel portfolio, where a single interruption is less likely to impact a significant number of generators that cannot be overcome by reserve assets.[42]

In its 2017 Long-Term Reliability Assessment, NERC observed, "[c]onventional generation, including coal and nuclear, have unique attributes of low outage rates, high availability rates, and on-site fuel storage that provides secure and stable capacity to the grid."[43] In addition, NERC concluded

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[36] NERC Reliability Synopsis, at 3.

[37] NERC Reliability Synopsis, at 3. (emphasis added). Similarly, NERC concluded in its 2017 Long-Term Reliability Assessment (LTRA), "[a] diverse resource mix promotes a more reliable supply of electricity, but as more areas are dependent on natural-gas-fired generators, reliability hinges on adequate arrangements for fuel and access to it." North American Electric Reliability Corporation, *2017 Long-Term Reliability Assessment*, at 30 [hereinafter NERC LTRA]. In assessing "the reliability benefits of having a diverse resource portfolio" NERC determined that "[f]uel diversity provides a fundamental benefit of increased resilience. Without this diversity, the impact of rare events impacting availability of resources on the power system increases and are more likely the result of a common-mode failure impacting multiple generation or transmission facilities." NERC Reliability Synopsis, at 4.

[38] NERC Reliability Synopsis, at 4.

[39] *Id.*

[40] *Id.* The chief advantage of on-site fuel is the "reduction in the risk that a generator will be unable to operate when needed."

[41] NASEM Study, at 76.

[42] *Id.* at 82.

[43] NERC LTRA, at 13.

> [N]uclear retirements require additional attention from system planners and policy makers related to local transmission adequacy and the potential for reduced resilience. This is because of the unique ability of nuclear resources to operate despite a variety of potential fuel supply disruptions."[44]

Because it ensures adequate generation during major disruptions, a diverse fuel portfolio, including fuel-secure resources, is critical to national security.

B. Loss of Fuel-Secure Electric Generation Resources: A Tipping Point

Historically, the U.S. electric system has had a highly diversified "portfolio" of electric generation resources, including three broad types of generation: First is fuel-secure capacity—which means each unit has many days or weeks of fuel available on site: this includes coal, nuclear, hydro power and certain kinds of liquid fuel or dual-fuel natural gas units. Second are pipeline-dependent units with little or no on-site storage, which depend on "just-in-time" supply chains. Third are intermittent resources—wind and solar. This diversity, anchored by fuel-secure baseload power, has meant that each part of the system has its own strengths. No single disruption effectively could compromise the whole generation fuel supply chain.

Over the last several years, however, the balance has shifted away from fuel-secure resources toward a growing dependence on pipeline-dependent and intermittent resources. According to the Department of Energy's January 2017 *Quadrennial Energy Review*:

> Currently, the changing electricity sector is causing the closure of many coal and nuclear plants in a shift from recent trends. From 2000 through 2009, power plant retirements were dominated by natural gas steam turbines. Over the past 6 years (2010–2015), power plant retirements were dominated by coal plants (37 GW), which accounted for over 52 percent of recently retired power plant capacity. Over the next 5 years (between 2016 and 2020), 34.4 GW of summer capacity is planned to be retired, and 79 percent of this planned retirement capacity are coal and natural gas plants (49 percent and 30 percent, respectively). The next largest set of planned retirements are nuclear plants (15 percent).[45]

Further, the DOE Staff Report discusses the large number of traditional baseload units that have retired or are scheduled to retire.[46] Between 2002 and 2016, 531 coal generating units representing approximately 59,000 MW of generation capacity retired from the U.S. generation fleet.[47] Coal-fired plants comprise more than 80 percent of the 18,000 MW of electric generating capacity that retired in 2015.[48]

Nuclear plants have also been hard-hit. No new nuclear generation unit has commenced operation since [YEAR]. Since 1990, the U.S. has lost fifteen nuclear generation units, comprising

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[44] *Id.* at 14.
[45] QER, at 3-73 (citation omitted).
[46] *See generally* U.S. Department of Energy, *Staff Report to the Secretary on Electricity Markets and Reliability*, at 15-60 (Aug. 2017) [hereinafter DOE Staff Report].
[47] *Id.* at 22.
[48] *Id.*

[CAPACITY].[49] The pace of planned nuclear retirements has recently accelerated. From 2013 to 2016, 4,666 MW of nuclear generating capacity (about 4.7 percent of the U.S. total) went offline.[50] Following the retirement of Fort Calhoun in 2016, the United States has 99 commercially operating units at 61 nuclear power plants.[51] Since 2016, another twelve nuclear units—and additional 11,119 MW—have announced retirement.[52] ."[53] Analysts have predicted that as much as half of the remaining nuclear fleet is "under water."[54]

Retirements of fuel-secure generation show no signs of slowing down, and are accelerating overall.[55] NERC's 2017 Long-Term Reliability Assessment highlights similar circumstances and reaches similar conclusions. So far, "[c]onventional generation retirements have outpaced conventional generation additions with continued additions of wind and solar."[56] In PJM alone, "if formally submitted deactivation plans materialize, more than 25,000 MW of coal-fired generation will have deactivated between 2011 and 2020."[57]

1. The Grid Remains Dependent on Fuel-Secure Baseload Generation

In its January 2017 Quadrennial Energy Review, DOE stated, "today's electricity system is highly dependent on baseload generation."[58] Historically, "baseload" generation meant fuel-secure coal, nuclear, and hydropower units, while natural gas-fired units were used for peak load at higher prices.

Even as large-capacity coal and nuclear plants are announcing retirement in considerable numbers, the organized wholesale electricity markets remain dependent on coal and nuclear generation to meet peak load demand during winter cold snaps and summer heat waves.[59] For example, coal and nuclear generation accounted for more than half of PJM's installed generation capacity in 2017 —specifically, 33 percent coal, 19 percent nuclear, and 21 percent natural gas.[60] Moreover, according to an analysis by the National Energy Technology Laboratory (NETL), during the cold snap of December 27, 2017 to January 9, 2018, when demand approached record winter peak levels, coal accounted for 39.5 percent of PJM's power generation, and nuclear for 30.2 percent—thus, a combined total of just under 70 percent of PJM's generation load was

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50 *Id.* at 29.
51 https://www.eia.gov/todayinenergy/detail.php?id=28572
52 [CITE]
53 *Id.* at 30.
54 [CITE]
55 [CITE EIA data]
56 NERC LTRA at 5.
57 *Id.* at 58.
58 QER at 1-20.
59 For a map of the organized wholesale electricity markets, see Figure 1.
60 PJM RTO, Capacity by Fuel Type 2017, *available at* http://www.pjm.com/-/media/markets-ops/ops-analysis/capacity-by-fuel-type-2017.ashx?la=en (last visited May 11, 2018).

supplied by coal and nuclear.[61] Importantly, coal use increased by 49 percent, providing 74 percent of the increased demand. Oil, another fuel-secure source of generation, increased by 455 percent, providing 22 percent of increased demand. Natural gas use increased by only 2 percent, providing 2 percent of increased demand, and renewables declined in use, showing no resilience to increased demand.[62] In the New England ISO (ISO-NE), coal accounted for 6 percent of generation, and nuclear accounted for 27 percent during the severe cold weather from December 26, 2017 to January 8, 2018.[63] And yet, within PJM, numerous coal and nuclear units are slated to retire. In PJM, coal-fired generating units with a total of 2,722.4 MW of nameplate capacity are scheduled for deactivation as of June 1, 2018,[64] along with 2,306.5 MW of nuclear generation by May 31, 2020.[65] And in ISO-NE, the scheduled retirements of Pilgrim Nuclear Power Station (677 MW, June 2019)[66] and Bridgeport Harbor Station (coal, 383 MW, 2021)[67] will also eliminate significant fuel-secure baseload capacity in a short time frame. As these resources go offline, ISO-NE's President and CEO Gordon van Welie warns that "for the foreseeable future, New England will be dependent on stored and imported fossil fuels and imported electrical energy, which includes energy from hydro generators in Canada, to ensure system reliability when gas pipelines are constrained."[68]

2. The retirement and decommissioning process is complex and must be managed to take into account national security implications.

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[61] National Energy Technology Laboratory, *Reliability, Resilience and the Oncoming Wave of Retiring Baseload Units, Vol. I: The Critical Role of Thermal Units During Extreme Weather Events*, Exhibit 1-8, at 12 (Mar. 13, 2018).

[62] *Id.*

[63] Gordon van Welie, ISO New England State of the Grid: 2018, Remarks and Slides, Slide 23, at 14 (Feb. 27, 2018), *available at* https://www.iso-ne.com/static-assets/documents/2018/02/02272018_pr_remarks_state-of-the-grid.pdf [hereinafter ISO NE State of the Grid]. Van Welie, President and CEO of ISO New England noted that "coal and oil power plants rarely run most of the year, but they are still needed during extreme weather events. Nuclear power is also a key contributor." *Id.* Further, he disagreed with persons who suggest that the power system is "fine" and "can handle extreme cold weather." *Id.* He warned, "This view misses several significant factors…. In the future, many of the resources we relied on this winter may not be around when extreme weather limits natural gas availability." *Id.*

[64] PJM Generation Deactivations webpage, *available at* http://www.pjm.com/planning/services-requests/gen-deactivations.aspx (last visited May 17, 2018). The coal units to be deactivated are Crane 1 (190 MW), Crane 2 (195 MW), Killen 2 (600 MW), Stuart 2 (580 MW), Stuart 3 (580.4 MW), and Stuart 4 (577 MW).

[65] *Id.* (last visited May 17, 2018). The nuclear units to be deactivated are Oyster Creek Nuclear Generating Station (607.7 MW, Oct. 1, 2018), Three Mile Island, Unit 1 (802.8 MW, Sept. 30, 2019), and Davis Besse, Unit 1 (896 MW, May 31, 2020).

[66] ISO-New England Inc., Grid Resilience in Regional Transmission Organizations and Independent System Operators, FERC Docket No. AD18-7, Attachment A, at 13 (Mar. 9, 2018) (attachment dated Jan. 17, 2018), https://www.iso-ne.com/static-assets/documents/2018/03/ad18-7_iso_response_to_grid_resilience.pdf.

[67] https://www.iso-ne.com/about/key-stats/resource-mix/ (last visited May 17, 2018).

[68] ISO New England State of the Grid, Slide 19, at 12.

The length, complexity, and growing inertia of closure plans requires the Department to ensure that sufficient baseload, fuel-secure power generation is available, before its effort becomes too little, too late. For units whose announced retirement dates are fast approaching, immediate action is needed to stop the units from being deactivated. For those units, however, that have announced retirements one or more years away, it is important to act now to forestall the retirement process before [additional actions are taken.] Coal and nuclear plants spend substantial time and resources in evaluating whether to close and initiating planning activities prior to public announcements. Owners must plan every aspect of the transition, including possible future use of the site, tax consequences, maintenance and repair needs, and new contractors needed to assist with the decommissioning and waste removal. Further, the plan must carefully consider the timing of decommissioning to coordinate it with any expiring environmental permits, licenses, leases, and other contracts.

Once the decision to close is made and an announcement is made public, there are immediate impacts even though the plant may not shut down for several months or years. Before shutting down, plants must coordinate with federal, state, and local regulators and others impacted by the closure (e.g., elected officials, as well as the plant's contractors, suppliers, and employees) to address concerns, ensure that legal and contractual requirements are met, and allow these entities to make other arrangements for power. RTOs/ISOs, plant employees, local communities, and other stakeholders immediately take steps to address how they will be impacted and make alternative arrangements. Insofar as plants are the source of tax revenues and jobs for local communities, this is a critical problem that must be addressed by these communities as far in advance as possible.

Additional factors can accelerate the decommissioning process, removing financial incentives to keep units online.. As the time gets closer to shutdown, even where the plant has years before its NRC operating license expires, there is less incentive to order new fuel or to renew necessary permits and contracts. No longer purchasing fuel is particularly critical for nuclear plants because plants need new fuel every 18-24 months and the process to obtain new fuel begins approximately two years in advance and costs millions of dollars.

In addition, plants work with regulatory agencies such as the Nuclear Regulatory Commission in advance to increase the likelihood of approvals and speed the process along because they can obtain much needed funding set aside for decommissioning upon shutdown and the filing of: (1) certification of permanent cessation of operations; (2) certification of permanent removal of fuel from the reactor; and (3) post-shutdown decommissioning activities report.[69] Also, upon docketing of the certifications for permanent cessation of operations and permanent removal of fuel from the reactor vessel, or when a final legally effective order to permanently cease operations has come into effect, the license no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel.[70] The license is amended to be a license for storage, eliminating the obligation to adhere to requirements needed only during reactor operation and the accompanying costs and resources necessary to meet such requirements. At that point, although systems and structural components are still intact, the plant becomes unacceptable for restart without a new license and an extensive costly and time consuming effort to reestablish

[69] 10 C.F.R. § 50.82(a)(8)(ii).
[70] 10 C.F.R. § 50.82(a)(2).

the safety and security integrity of the plant. Consequently, the point of no return for plants occurs far earlier than when systems and structural components may be removed from a site.

Once these and other fuel-secure units are retired, they will no longer be available to meet critical resilience demands, including potential multi-point attacks on the natural gas pipeline system. NERC has consistently identified "changing resource mix" as among its top "high priority risks."[71] NERC describes the "increased and accelerated rate of plant retirements, especially conventional synchronous generation, coupled with the increasing integration of renewable, distributed, and asynchronous resources," and warns that "[p]lanners and operators may not have the requisite time to reliably integrate these inputs and make necessary changes."[72] NERC describes "[i]ncreased risks with the transition from a balanced resource portfolio, addressing fuel and technology risks, to one that is predominately natural gas and variable resources."[73] Such risks include "[c]ommon mode or single points of failure, such as fuel delivery systems."[74] Importantly, NERC-wide natural-gas-fired on-peak generation has increased from 360 GW in 2009 to 432 GW today, and NERC has cautioned that "reliance on a single fuel increases vulnerabilities, particularly during extreme weather conditions."[75]

3. Causes of the loss of fuel-secure generation.

The causes of the retirements of fuel-secure units before the end of their useful life are primarily regulatory and economic. As the 2017 National Academies of Sciences, Engineering, and Medicine study *Enhancing the Resilience of the Nation's Electricity System* stated with respect to nuclear plants in particular, "[w]ith the cost pressures that nuclear plants are facing from inexpensive natural gas and subsidized renewables, and uncertainties about the cost and likelihood of life extension and relicensing, a number of plants have closed recently."[76]

These economic-regulatory issues are complex and will take additional time to resolve. Especially in light of the extensive comments filed in the Federal Energy Regulatory Commission ("FERC" or "Commission") RM18-1 proceeding in response to DOE's grid resilience proposal, DOE recognizes the complexity of the issues involved and the need for a thorough regulatory process concurrent with DOE's Directive. The Commission has taken numerous important regulatory actions to ensure that electricity markets properly value resources that contribute to the reliability and resilience of the electricity grid as part of its continuing initiative to improve price formation to support efficient investments in wholesale power markets and otherwise.

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[71] North American Electric Reliability Corporation, ERO Reliability Risk Priorities: RISC Recommendations to the NERC Board of Trustees, at 10 (Nov. 2016).
[72] *Id.* at 12, 14.
[73] *Id.*
[74] *Id.* at 14.
[75] NERC LTRA at 15. Batteries and other electricity storage technologies are important and maturing components of a resilient electricity system, both for customer-premises backup and grid-scale applications. DOE continues to study and fund research and development for such technologies as part of its Grid Modernization Initiative and other projects. [CITE] However, these technologies are not yet technologically or economically feasible as an alternative to fuel-secure baseload capacity, particularly for long-duration (multiple days or weeks) disruptions.
[76] NASEM Study, at 46.

For example, the Commission has ordered investigations of fast-start pricing practices in several areas. As the Commission stated, "without some form of fast-start pricing, some fast-start resources are ineligible to set prices, often due to inflexible operating limits. Even when fast-start resources can set prices, they may not be able to recover their commitment costs, such as start-up and no-load costs, through prices. As a result, prices may not reflect the marginal cost of serving load, muting price signals for efficient investments."[77] These orders include preliminary findings that certain current fast-start pricing practices in PJM and other organized markets are unjust and unreasonable.[78] The Commission continues to consider these issues carefully in the context of several open dockets. Despite terminating Docket No. RM18-1 initiated by the DOE NOPR,[79] FERC opened a new Docket No. AD18-7 the same day to seek and evaluate input on "the resilience of the bulk power system in the regions operated by regional transmission organizations (RTO) [*sic*] and independent system operators (ISO) [*sic*]."[80] The Commission has also taken action to improve the resilience of gas infrastructure by rapidly approving construction of pipeline infrastructure[81] and taking initial steps to address gas-electric coordination issues.[82]

DOE supports the Commission's continued efforts in this regard, but too little progress has been made while the risk of high-impact events, especially those caused by intentional attacks, continues to grow. Under these circumstances, DOE—as the SSA for Energy—must prepare for a variety of potential major events. In particular, given the need to safeguard the existence of fuel-secure generation facilities to promote our national defense and to maximize domestic energy supplies, DOE is compelled to exercise its authorities to avert a serious supply disruption in the wake of a natural disaster, an adversarial attack, or some combination of the foregoing.

4. Resulting Vulnerability of Our Grid

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[77] Federal Energy Regulatory Commission, FERC to Investigate Pricing of Fast-Start Resources by Three Grid Operators (Dec. 21, 2017), *available at* https://www.ferc.gov/media/news-releases/2017/2017-4/12-21-17-E-2.pdf.

[78] *N.Y. Indep. Sys. Op., Inc.*, FERC Docket No. EL18-33-000, 161 FERC ¶ 61,294 at P 5 (Dec. 21, 2017) ("The Commission preliminarily finds that some of NYISO's practices related to the pricing of fast-start resources are unjust and unreasonable"); *PJM Interconnection, L.L.C.*, FERC Docket No. EL18-34-000, 161 FERC ¶ 61,295 at P 9 (Dec. 21, 2017) ("The Commission preliminarily finds that some of PJM's practices related to the pricing of fast-start resources are unjust and unreasonable"); *Sw. Power Pool, Inc.*, FERC Docket No. EL18-35-000, 161 FERC ¶ 61,296 at P 6 (Dec. 21, 2017) ("The Commission preliminarily finds that some of SPP's practices related to the pricing of fast-start resources are unjust and unreasonable").

[79] Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures, 162 FERC ¶ 61,012 (Jan. 8, 2018).

[80] *Id.* at P 1.

[81] In just eleven weeks, from January 18 to April 5, 2018, the Commission approved ten (10) projects adding approximately 235 miles of pipeline and more than 3.4 Bcf/day of capacity. *See* Approved Major Pipeline Projects (2009-Present), *available at* https://www.ferc.gov/industries/gas/indus-act/pipelines/approved-projects.asp (last visited May 11, 2018).

[82] *See, e.g., Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities*, Order No. 809, FERC Stats. & Regs. ¶31,368 (cross-referenced at 151 FERC ¶ 61,049) (2015).

During the past two decades, an inextricable interdependency between natural gas and electricity generation has evolved that, along with benefits, also presents a serious vulnerability to the grid, and therefore, our national security. Importantly, NERC has warned about being too dependent on natural gas infrastructure:

> Natural gas provides "just-in-time" fuel; therefore, disruptions to the fuel supply can impact multiple generators that may be connected to the same supply chain. [S]ince natural gas does not generally have on-site storage, its supply is threatened to disruption by pipeline failure that potentially can lead to the loss of a substantial amount of capacity and threaten the adequacy of the electric system.[83]

Additionally, in its June 2017 State of Reliability Report (SOR), NERC echoed its earlier statements by warning that cyber and physical security risks "continue to increase and are becoming more serious."[84] It also noted the "increasing risk of fuel disruption impacts on generator availability from the dependency of electric generation and natural gas infrastructure as a single point of disruption," specifically, that the "increased dependence on natural-gas-fired capacity can lead to greater reliability risks due to the loss of natural gas or other fuel contingencies."[85] Confirming what NERC, DOE, and others have reported, the National Academies of Sciences, Engineering, and Medicine resilience study noted, "Constraints in natural gas infrastructure have resulted in shedding of electric load, and the growing interdependency of the two systems poses a vulnerability that could lead to a large-area, long-duration blackout."[86]

NERC's concern about natural gas pipeline risks has remained such that it issued a report on the issue in November 2017, entitled "Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System."[87] This System Reliability Assessment (SRA) notes that "[s]ome areas within North America now meet their peak electric demand with greater than 60 percent of that sourced from natural-gas-fired electric generation."[88] NERC also warns that, for example, "in New England and Southwest California-Arizona, an outage of nearly any major natural gas facility (*e.g.*, one interstate pipeline, key compressor station, or LNG terminal) during electric summer or winter peak conditions would likely lead to some level of electric generation outages."[89] Further, NERC reports that its "power flow analysis

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[83] NERC Reliability Synopsis, at 4.
[84] North American Electric Reliability Corporation, *State of Reliability 2017*, at 3 (June 2017).
[85] *Id.* at 7, 8.
[86] NASEM Study at 82.
[87] North American Electric Reliability Corporation, *Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System* (Nov. 2017) [hereinafter NERC SRA].
[88] *Id.* at vii.
[89] *Id.* at vii; *see also id.* at 2 (noting that improving electric system resilience requires "[i]dentifying natural gas single-element contingencies and how those contingencies will impact the electric infrastructure," and "although most natural-gas-side contingencies will not impact the electric grid instantaneously they can be far more severe than electric side contingencies over time . . . this is because natural gas contingencies may impact several generation facilities").

determined that many areas in North America could incur power flow and stability issues if they were to experience significant losses of natural gas infrastructure."[90] In addition, NERC notes,

> the Aliso Canyon storage facility shut-down in Southern California in the winter of 2015 underscores the significant threats that a single point of disruption can pose to the reliability of the [baseload power supply]. **The rapid increase in the growth of reliance on natural gas for electric generation necessitates that system planners and operators fully understand their exposures to a potential natural gas disruption and have contingency plans in the event of disruption.**[91]

Adequate advance planning for disruptions is critical because natural-gas-fired generation mostly relies on "just-in-time" fuel delivery from the natural gas industry. Disruptions to the fuel delivery can quickly lead to multiple electric generating units becoming unavailable, and have the potential to disrupt large areas of the Nation, placing at risk our Nation's security, especially defense critical infrastructure.[92] This is compounded where multiple plants are connected through the same natural gas infrastructure. Disruptions to the fuel delivery can result from adverse events that may occur such as line breaks, well freeze-offs, hurricanes, floods, storage facility outages, or infrastructure attacks. Similarly, the pipeline system can be impacted by events that occur on the electric system (e.g., loss of electric motor-driven compressors). For example, during the recent 2014 Polar Vortex event, extended periods of cold temperatures caused direct impacts on fuel availability, especially for natural-gas-fired generation. According to NERC, "[h]igher-than-expected forced outages and common-mode failures were observed during the polar vortex due to the following: Natural gas interruptions (including supply injection), compressor outages, and one pipeline explosion[;] Oil delivery problems[;] Frozen well heads[;] Inability to procure natural gas[; and] Fuel oil gelling."[93] These natural gas pipeline performance issues were all the result of a single weather event. A cyber or physical attack could result in more substantial disruptions.

In light of these risks, NERC has taken steps to identify by region the capacity of generation units that are "dependent on major trunk lines or are restricted to one pipeline connection in various areas."[94] For example: in New England, more than 13,000 MW of natural gas generation depends on a single connection; in the Mid-Atlantic region, the figure is more than 12,000 MW; and in the Southeast, more than 46,000 MW is dependent on a single connection.[95] Consequently, it is vital that DOE act now to "take proactive steps to manage risk and strengthen the security and resilience of the Nation's critical infrastructure, considering all hazards that could have a debilitating impact on national security, economic stability, public health and safety, or any combination thereof."[96]

IV. Additional National Security Value of Civilian Nuclear Facilities

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[90] *Id.* at 27.
[91] *Id.* at 7 (emphasis added.)
[92] NERC LTRA at 15.
[93] *Id.*
[94] NERC SRA at 7.
[95] *See Id.*
[96] PPD-21 at 2.

Nuclear energy is a critical strategic and energy security asset for the United States, and continued U.S. leadership in the global nuclear energy market has important nonproliferation and safety ramifications. Nuclear generation units have the kinds of "guns, guards, and gates" and other physical and cyber-hardening measures that would be needed in the event of a major attack. As NERC has stated, "nuclear retirements require additional attention from system planners and policy makers related to … the potential for reduced resilience. This is because of the unique ability of nuclear resources to operate despite a variety of potential fuel supply disruptions."[97]

Without a strong domestic nuclear power industry, the U.S. will not only lose these energy security and grid resilience benefits, but will also lose its technical expertise, supply chain, and ability to influence international policy. It is in the Nation's strategic interest to preserve these assets in order to maintain and enhance American leadership and influence in the global nuclear market, including in the export of commercial nuclear technologies and systems. The entire U.S. nuclear enterprise—weapons, naval propulsion, non-proliferation, enrichment, and section 123 negotiations with the Kingdom of Saudi Arabia and other countries—depends on a robust civilian nuclear industry. To maintain U.S. nuclear leadership and secure supply chains for our nuclear enterprise, we must preserve our civil nuclear capacity and expertise.

It is widely acknowledged that a strong domestic nuclear industry sustains "our [N]ation's ability to advance a number of crucial objectives, particularly with respect to nonproliferation, military strength, and energy security."[98] According to a 2017 report issued by the Energy Futures Initiative (EFI) led by former DOE Secretary Ernest Moniz, "[n]uclear power and a robust associated supply chain (equipment, services, people) are intimately connected with US leadership in global nuclear nonproliferation policy and norms and with the [N]ation's nuclear security capabilities."[99] The EFI report notes the United States' historic leadership in setting the global standard for nuclear fuel cycle development consistent with nuclear nonproliferation objectives.[100] Atomic Energy Act section 123 agreements often set nonproliferation benchmarks that go beyond

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[97] NERC LTRA, at 14.

[98] Center for Strategic & International Studies, *Restoring U.S. Leadership in Nuclear Energy, A National Security Imperative* (June 2013), at 19, *available at* https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/130614_RestoringUSLeadershipNuclearEnergy_WEB.pdf [hereinafter CSIS Restoring U.S. Leadership in Nuclear Energy]; *see also* Energy Futures Initiative, *Moniz: The National Security Imperative for U.S. Civilian Nuclear Energy* Policy, *available at* https://energyfuturesinitiative.org/news/2017/7/12/moniz-the-national-security-imperative-for-us-civilian-nuclear-energy-policy.

[99] Energy Futures Initiative, *The U.S. Nuclear Energy Enterprise: A Key National Security Enabler* (Aug. 2017), at 6, *available at* https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/59947949f43b55af66b0684b/1502902604749/EFI+nuclear+paper+17+Aug+2017.pdf [hereinafter EFI U.S. Nuclear Energy Enterprise].

[100] EFI U.S. Nuclear Energy Enterprise, at 7 ("A pillar for doing so lies with Atomic Energy Act Section 123 requirements for bilateral agreements with countries that receive nuclear technology, services and/or know-how, supplemented by export licensing programs at the Nuclear Regulatory Commission (Part 110) and at the Department of Energy (Part 810) that regulate individual transactions within the 123 framework.")

the Nuclear Nonproliferation Treaty (NPT) requirements. Without the "historically unique capabilities in U.S. technology, services and know-how," the United States would not have had the leverage to accomplish this.[101]

However, other countries with less stringent requirements have gained significant ground and are capturing a sizable market share for new reactor construction globally. This includes the Middle East, "where recent U.S. 123 negotiations with Egypt, Jordan and Saudi Arabia have been unsuccessful. All three countries have signed agreements with Russia for reactor construction and fuel supply. In addition, Russia has finished construction of Iran's operating reactor, is committed to further construction, and supplies fuel. Russia also has an agreement with Turkey."[102] Further, although India signed an agreement in 2008 to build six plants using United States technology, it reportedly is considering Russian nuclear technology, with delays in construction at least partially due to questions about the United States' long-term commitment to civilian nuclear technology. DOE has been diligently engaging with India and a Strategic Energy Partnership (SEP) announced by the Administration in June 2017 affirms the strategic importance of energy cooperation as the centerpiece of a relationship between the countries. Through this new partnership, the United States and India are working to advance the shared goals of strengthening energy security, expanding energy and innovation linkages, bolstering our strategic alignment, and facilitating increased industry and stakeholder engagement in the energy sector. DOE has SEPs with many countries around the world.

Where much of the new interest in nuclear power stems from countries and regions that may not share America's interests and priorities in the areas of nonproliferation and global security, this creates a significant national security concern. Only if U.S. companies can offer the technologies, services, and expertise these countries need to operate a successful nuclear program can the United States continue to effectively leverage to influence those nations' nuclear programs.[103]

In addition, a strong domestic nuclear industry is also critically important for military requirements.[104] Defense programs require a domestically owned, unobligated and unencumbered source for enriched uranium, and the U.S. no longer has this capability.[105] Current supplies will

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[101] *Id.*
[102] *Id.*
[103] *See* CSIS Restoring U.S. Leadership in Nuclear Energy, at xi.
[104] EFI U.S. Nuclear Energy Enterprise, at 27; *see also* CSIS Restoring U.S. Leadership in Nuclear Energy, at xii ("A healthy domestic nuclear infrastructure also serves our national security interests by supporting the nuclear propulsion program of the U.S. Navy, which operates a fleet of 83 nuclear-powered submarines and aircraft carriers. While the Navy is careful to develop sources of supply that can weather short-term ups and downs in the commercial industry, a sustained decline in the commercial industry could have a direct and negative impact on the naval program.").
[105] DOE, *Tritium and Enriched Uranium Management Plan Through 2060*, Report to Congress, Oct. 2015 at 11. [Recent/Upcoming] Congressional testimony from the NNSA's Brent Park further underscores this point: "The Nation's stockpile of Highly Enriched Uranium (HEU) material is repurposed and downblended to meet the enrichment uranium requirements listed above; however, that supply is finite and, at present,

be depleted by the mid-2030s, though technology development may deplete them sooner, and at that point, defense programs will need U.S. enrichment to have been reestablished. If the only client for an enrichment facility is defense programs, this becomes a much more expensive endeavor for the federal government. In addition to ensuring we have the expertise and infrastructure to maintain our nuclear deterrent, a significant portion of our naval fleet relies on nuclear power. The Navy has over 100 nuclear reactors in ships and submarines, and if civilian capabilities were to deteriorate further, U.S. nuclear defense capabilities (infrastructure, supply chain and expertise) will similarly suffer. Importantly, the civil nuclear industry supports the navy as a synergistic partner for personnel and supply chain. University nuclear engineering programs supply both the nuclear navy and civil nuclear industry with highly trained personnel, and the civil nuclear industry provides an attractive employment opportunity following military service. Absent a vibrant civilian industry, university programs contract or collapse. The civil nuclear industry helps support the supply chain of over 700 companies in 44 states, which are also relied upon by the nuclear navy.

In light of these facts, the civilian nuclear energy industry is a critical strategic and energy security asset for the United States. Without a strong domestic nuclear power industry, the U.S. will not only lose the energy security and grid resilience benefits, but will also lose its technical expertise, supply chain, and ability to influence international norms, all of which are imperative to the United States' national defense.[106]

V. All U.S. Critical Infrastructure Depends on Fuel-Secure Electric Generation

A. All Critical Infrastructure Sectors Depend on Energy

Beyond the electricity subsector, electric outages affect national security, the economy, and public health and safety.[107] As FERC has stated, "Modern society has come to depend on reliable electricity as an essential resource for national security, health and welfare, communications, finance, transportation, food and water supply, heating, cooling, and lighting, computers and electronics, commercial enterprise . . . in short, nearly all aspects of modern life."[108] Infrastructure sectors recognize their dependence on electricity and have invested resources in mitigating the effects of power outages. However, prolonged outages negatively impact the remaining fifteen critical infrastructure sectors and the important services they provide to the public and the

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irreplaceable." Statement of Dr. Brent Park, Deputy Administrator for Defense Nuclear Nonproliferation, National Nuclear Security Administration, U.S. Department of Energy, Before the Subcommittee on Energy, U.S. House Committee on Energy and Commerce (May 22, 2018).

[106] *See* 50 U.S.C. § 4502(a)(7) ("much of the industrial capacity that is relied upon by the United States Government for military production and other national defense purposes is deeply and directly influenced by—(A) the overall competitiveness of the industrial economy of the United States; and (B) the ability of industries in the United States, in general, to produce internationally competitive products and operate profitably while maintaining adequate research and development to preserve competitiveness with respect to military and civilian production").

[107] *See* National Research Council of the National Academies, *At the Nexus of Cybersecurity and Public Policy: Some Basic Concepts and Issues* (2012).

[108] FERC Staff, Reliability Primer at 9. [undated]

economy. The *2015 Energy Sector Specific Plan,* as required by the *National Infrastructure Protection Plan* (NIPP) (See Section 3.1.3), details a number of specific interdependencies between the energy subsectors and other critical infrastructure sectors, including communications, transportation, financial services, and water.[109] Impacts to interdependent sectors may occur at the outset of an outage or, as may be the case where backup systems are deployed, within hours or days of initial power loss as backup systems fail, battery power is diminished, or fuel supplies for generators are depleted.

For example, electricity is among the most vital of all services for the healthcare and public health sector. The loss of power impacts the delivery of healthcare services in inpatient healthcare facilities, outpatient care settings, and the homes of at-risk populations.[110] Similar to other critical infrastructure sectors, the healthcare sector has taken a number of steps to reduce its vulnerability to power disruptions, such as having backup generators onsite at healthcare facilities. During long-term power outages, healthcare facilities are likely to face limited fuel for backup generation and have difficulty sourcing new fuel supplies to supplement hospital stockpiles, which, according to one study, most often provide only enough fuel to run generators for eight hours.[111]

B. Defense Installations Depend on the Commercial Electric Power Grid

The power grid has an oversized vital role to national defense and homeland security. As defense and security capabilities have evolved, so has their reliance on electricity to operate. Across the Nation, the Department of Defense (DOD) relies on the electric grid to support military operations at home and abroad.[112] In 2008 a Defense Science Board report stated that DOD installations are 99% dependent on the commercial power grid.[113] Last year, DOD stated,

> DOD relies on commercial power to conduct missions from its installations and these commercial power supplies can be threatened by natural hazards and other events. DOD recognizes that such events could result in power outages affecting critical DOD missions involving power projection, defense of the homeland, or operations conducted at installations in the United States directly supporting warfighting missions overseas. Therefore, it is critical for installation commanders to understand the vulnerabilities and risk of power disruptions that can impact mission assurance.[114]

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[109] *See* Department of Homeland Security, *Energy Sector-Specific Plan* (2015), *available at* https://www.dhs.gov/sites/default/files/publications/nipp-ssp-energy-2015-508.pdf

[110] *See* Department of Health and Human Services, Department of Homeland Security, *Healthcare and Public Health Specific Plan*, 11 (May 2016); Lin CJ, Pierce LC, Roblin PM, Arquilla B, "Impact of Hurricane Sandy on hospital emergency and dialysis services: a retrospective survey," *Prehosp Disaster Med. 4*, 374-9 (2014), *available at* https://www.ncbi.nlm.nih.gov/pubmed/25068276.

[111] *See* Chaamala Klinger, Owen Landeg, and Virginia Murray, *Power Outages, Extreme Events and Health: A Systematic Review of the Literature from 2011–2012*, PLoS Currents Disasters 1 (2014).

[112] QER, at 1-35.

[113] *See* Supplement at note xi.

[114] Department of Defense's FY 2016 Annual Energy Management Report, at 39.

As a result of this continued dependence, in February 2017, the United States Army issued a directive requiring it to "reduce risk to critical missions by being capable of providing energy and water for a minimum of 14 days."[115] The reason cited in the directive was that "[v]ulnerabilities in the interdependent electric power grids, natural gas pipelines, and water resources supporting Army installations jeopardize mission capabilities and installation security, and the Army's ability to project power and support global operations."[116]

The Defense Science Board has noted that "DOD's key problem with electricity is that critical missions, such as national strategic awareness and national command authorities, are almost entirely dependent on the national transmission grid."[117] DOD has discussed its reliance on commercial power supplies, noting that "DOD recognizes that such events could result in power outages affecting critical DOD missions involving power projection, defense of the homeland, or operations conducted at installations in the U.S. directly supporting warfighting missions overseas."[118] As DOD pursues increasingly advanced capabilities, such as remotely piloted aircraft and precision guided munitions, its ability to execute critical missions increasingly depends upon a vast and complex network of ground-based communications networks, radars, data centers, and command-and-control nodes that rely on electricity to operate. This dependence makes electric grid resilience vitally important for national defense.

In addition, blackouts directly impact the Department of Defense insofar as it is the largest single electricity consumer in the United States.[119] The number of utility outages related to DOD use in FY 2016 was 701, the majority of which were from electricity disruptions.[120] Further, "The collective financial impact of these utility outages was approximately $500,000 per day, largely impacted by single isolated events."[121] Therefore, even minor outages have significant implications for national defense.

C. Economic Costs of the Loss of Fuel-Secure Generation

As explained above, current regulatory constructs prevent market forces from valuing the national security benefits of generation fuel diversity. It should be noted that, rather than protecting consumers, current regulatory arrangements shift the risks of diminishing fuel diversity to consumers in several ways. Specifically, consumers are increasingly required to bear the following costs: (1) the economic costs of blackouts; (2) the public health and environmental costs of blackouts; and (3) the economic costs of excessive reliance of a single fuel in electric power markets.

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[115] Secretary of the Army, Memorandum for SEE Distribution, Army Directive 2017-07 (Installation Energy and Water Security Policy) at 1.
[116] *Id.*
[117] QER, at 1-35.
[118] *Id.* (*citing* the Department of Defense's *2015 Annual Energy Management Report).*
[119] QER, at 1-35.
[120] Department of Defense Annual Energy Management Report: Fiscal Year 2016, at 39, *available at* https://www.acq.osd.mil/eie/Downloads/IE/FY%202016%20AEMR.pdf (Data includes on-base utility outages on DOD-owned infrastructure.)
[121] *Id.* at 40.

1. Economic costs of blackouts.

The cost of a major power outage due to large-scale attack would be enormous, far outweighing any potential short-term cost impacts on consumers resulting from temporary protective measures to prevent retirements of critical generation resources.[122] A National Academies of Sciences, Engineering, and Medicine resilience study found that "[l]arge-area, long-duration electricity outages that leave millions of customers without power can result in billions of dollars of economic and other damages and cause risk of injury or death."[123] Another study projected that the economic losses from a two week power outage across 15 states caused by a cyber-attack could cost $248 billion.[124] Between 2003 and 2012, power outages due to severe weather cost the economy an average of between $18 billion and $70 billion dollars each year, disrupting the lives of millions of Americans.[125] Further, in 2016, the 143 million electricity consumers in the United States consumed 3,711 billion kWh of grid-based power and paid an average retail price of 10.28 cents per kWh.[126] In comparison, for outages lasting at least 16 hours and affecting a cross-section of United States customers, studies show that cost estimates range from a high of approximately $126 per unserved kWh to a low of approximately $1.70 per unserved kWh.[127] In addition, NETL's study of the cold snap of 2017-2018 reveals that "[l]ack of sufficient natural gas pipeline infrastructure and the surge in natural gas demand for heating led to sharp increases in natural gas spot prices exceeding 300% across the Northeast and Mid-Atlantic."[128] Further, it found that "[t]he spike was particularly acute in New York with Transco Zone 6 NY spot prices rising nearly 700% from December 28 ($17.65/MMBtu) to January 5

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[122] Studies also have shown that preservation of generation diversity provided by fuel-secure resources benefits consumers. For example, IHS Markit concluded, "The current diversified US electric supply portfolio lowers the cost of electricity production by about $114 billion per year and lowers the average retail price of electricity by 27%" compared with a "less efficient diversity case" involving "no meaningful contributions from coal or nuclear resources." IHS Market, "Ensuring Resilient and Efficient Electricity Generation: The Value of the current diverse US power supply portfolio", Sept. 2017, at 4-5. Accordingly, removing nuclear and coal units from the mix of resources likely may result in increased rates and costs to consumers. Further, as the Brattle Group study noted above, if the announced retirement of four nuclear plants in PJM proceeds, it would take less than four years "to reverse the entire 149 million MWh of zero-emissions electricity cumulatively produced over the last two decades by solar and wind in PJM, **negating billions of dollars of historical customer and taxpayer investment**." The Brattle Group, at 5 (Emphasis added.)

[123] NASEM Study at 12.

[124] Lloyd's and the University of Cambridge Centre for Risk Studies. "Business Blackout: The insurance implications of a cyber-attack on the US power grid." Emerging Risk Report – 2015, at 4.

[125] Executive Office of the President, *Economic Benefits of Increasing Electric Grid Resilience to Weather Outages*, Aug. 2013, at 3, *available at* https://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf.

[126] IHS Markit, *Ensuring Resilient and Efficient Electricity Generation: The Value of the current diverse US power supply portfolio* (Sept. 2017), at 14.

[127] U.S. Dept. of Energy, *Valuation of Energy Security for the United States: Report to Congress*, Jan. 2017, at 204.

[128] National Energy Technology Laboratory, at 1.

($140.25/MMBtu)."[129] Also, NETL concluded that the increase in the cost of energy services over the two-week period from December 27 to January 9 was $288M per day, equivalent to $98 per MW, compared with costs from the preceding two-week period, and $225M per day, or $73 per MW, higher than the following two-week period that featured a short return of extreme cold.[130]

Although there is a lack of studies of the costs of regional long-duration outages due to the complex modeling required and inherent difficulty of separating economic costs from other disaster-related costs, studies of localized or shorter outages have determined billions in damage costs, even in single cities or limited regions. For example, the August 2003 outage affected 45 million people in the northeastern United States and parts of Canada, and they experienced a full outage for 16 hours, and gradually recovering to full restoration of power over 72 hours in total.[131] It was estimated to have cost the United States between $4 billion and $10 billion.[132] Anderson Economic Group (AEG) estimates that the likely total cost in the United States included $4.2 billion in lost income to workers and investors, $15 to $100 million in extra costs to government agencies (*e.g.*, due to overtime and emergency service costs), $1 to $2 billion in costs to the affected utilities, and between $380 and $940 million in costs associated with lost or spoiled commodities.[133] For Canada, gross domestic product (GDP) was down 0.7 percent the month of the disruption, 18.9 million work hours were lost, and shipments of manufacturing goods in Ontario were down about $2 billion.[134] In addition, in 2013, a study projected costs associated with power outages lasting from 24 hours to 7 weeks in downtown San Francisco, specifically for customers and tenants of customers (collectively, the "target population") served by PG&E's Embarcadero substation.[135] In total, a 24-hour outage among customers in the target population would result in an outage cost ranging from about $190 million to nearly $380 million, but as outage duration increases, the impact on the California economy was projected to become more severe.[136] At 3 weeks, the total outage cost ranges from $2.1 billion to over $4.2 billion, and if PG&E's Embarcadero substation lost power for 7 weeks, the total outage cost would range from $4.4 billion to nearly $8.8 billion.[137] Similarly, a study of a hypothetical outage in Los Angeles county for two weeks projected a total cost of $2.8 to 20.5 billion.[138]

Long duration outages affect virtually every aspect of people's lives and have a cascading effect on critical infrastructure, costs, and lives. The Sullivan study noted that foreseeable costs

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[129] *Id.*
[130] *Id. at 16.*
[131] Sullivan & Schellenberg, Downtown San Francisco Long Duration Outage Cost Study, (Mar. 27, 2013), at 99.
[132] U.S. Dept. of Energy, Valuation of Energy Security for the United States: Report to Congress, at 147.
[133] Anderson, Patrick, and Ilhan K. Geckil, *Northeast Blackout Likely to Reduce U.S. Earnings by $6.4 Billion*, Anderson Economic Group (AEG) Working Paper 2003-2 (Aug. 19, 2003), at 2-3, *available at*http://www.andersoneconomicgroup.com/Portals/0/upload/Doc544.pdf (accessed May 17, 2018).
[134] U.S. Dept. of Energy, *Valuation of Energy Security for the United States: Report to Congress*, at 147.
[135] *Id.* at 1. The substation serves over 27,000 customers. *Id.* at 108.
[136] *Id.* at 1.
[137] *Id.*
[138] Rose, A., Oladosu, G., & Liao, S.-Y. (2007). Business Interruption Impacts of a Terrorist Attack on the Electric Power System of Los Angeles: Customer Resilience to a Total Blackout. Risk Analysis, 27(3), 513-531, at 528.

based on prior blackouts include: (1) disruption related to transportation interruption, such as traffic congestion and inoperable transit and rail, inoperable gasoline pumps; (2) damages from looting and rioting and the costs of the associated government response; (3) loss of businesses and employment, especially lost wages and reduced spending, which particularly impacts small businesses; (4) cost of alternative housing for displaced residents, in addition to the significant inconvenience and economic impact of leaving the area; (5) increased public expenditures, including assistance programs and emergency services; (6) loss of tax revenue; (7) increased costs related to public goods, such as hospitals, sanitation, and water treatment, if available at all; and (7) costs related to injury or the loss of life.[139] The study notes,

> At a certain point, a long-duration outage comes to resemble a natural disaster. If an outage stretches to several days or longer, new costs are incurred: government assistance monies are spent, tourism declines, cancelled transactions result in lost taxes and so on. Alternative generation may not be possible for many facilities beyond several days; keeping hospitals and water treatment facilities operational becomes significantly more costly. Lack of working water, sanitation and HVAC [heating, ventilation, and air conditioning] makes residences difficult or impossible to live in. Continued transportation system challenges shift traffic patterns and slow delivery of goods. While costs associated with emergency services may decrease, security and public safety labor costs are likely to remain elevated. Businesses relocate on an emergency basis, or else shut down; individuals may relocate as well on a temporary basis. A torrent of litigation and insurance claims ensue. In the long run, insurance premia may rise.[140]

2. Public Health and Environmental Costs of Blackouts

Long-term outages can have detrimental environmental and public health impacts primarily through the loss of services dependent on electricity to function. This can include hospitals and other health services, as well as drinking water and wastewater facilities. For example, during the three-day August 2003 Northeast Blackout, New York City alone experienced failure of hospital generators, increased food-borne illness, and the accidental release of 500 million gallons of untreated sewage into recreational waterways.[141] The EPA has concluded,

> Inoperable pumps at a drinking water utility can make firefighting difficult and cause local health care facilities and restaurants to close. A loss in pressure can result in contamination entering the drinking water distribution system from surrounding soil and groundwater. For wastewater utilities, losing [electrically-

[139] Sullivan & Schellenberg, at 2-6, 107-08.
[140] *Id.* at 108.
[141] Mark E. Beatty, Scot Phelps, Chris Rohner, Isaac Weisfuse, "Blackout of 2003: Public Health Effects and Emergency Response," *Public Health Reports*, January-February 2006, vol. 121, pp. 36-44 at 36, 40.

driven] pumps may lead to direct discharge of untreated sewage to rivers and streams or sewage backup into homes and businesses.[142]

Further, attempts to mitigate outages can also cause local air pollution issues. Backup diesel generators have been found to increase overall NOx and ozone emissions, and potentially cause local particulate matter hotspots.[143]

Blackouts also adversely impact the health of vulnerable populations. For example, the National Institute of Health studied the impact of the August 2003 blackout in New York City (only one city out of the vast area impacted by the 16-72 hour outage) and concluded that total mortality rose 28%, resulting in approximately 90 deaths were attributed to the blackout.[144] While all ages were affected, those age 65-74 years "were particularly susceptible."[145] Most deaths were from disease-related causes, and the study noted that the blackout complicated the management of illnesses, with most food sources and pharmacies closed, which is "a serious problem for diabetics and anyone low on prescription medicines."[146] Importantly, the study determined that some power-operated home medical equipment (e.g., ventilators, oxygen conservers) could not be used, ambulances responded more slowly than usual, and, because cellular phone service failed during part of the blackout, it was difficult to contact emergency services.[147] Further, researchers noted that other studies have reported increases during power outages of accidental deaths and injuries, including carbon monoxide (CO) poisoning, food poisoning, and hypothermia, as well as increased respiratory hospitalizations.[148] Similarly, the National Hurricane Center estimated that during Hurricane Sandy "[a]bout 50 deaths were the result of extended power outages during cold weather, which led to deaths from hypothermia, falls in the dark by senior citizens, or carbon monoxide poisoning from improperly placed generators or cooking devices."[149]

In summary, any potential socioeconomic or consumer costs of temporary preventative action are far outweighed by the benefits of such action.

3. Less generation diversity leads to higher consumer costs.

In addition to the impact on grid resilience from the retirement of fuel-secure coal and nuclear resources, there are various potential negative impacts on consumers. For example, DOE

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142 EPA, *Power Resilience Guide for Water and Wastewater Utilities. Environmental Protection Agency* (Dec. 2015), at 0-1, *available at* https://www.epa.gov/sites/production/files/2016-03/documents/160212-powerresilienceguide508.pdf

143 Cornell University Energy and the Environment Research Laboratory, *Diesel Backup Generators* (2015), *available at* http://energy.mae.cornell.edu/research-areas/distributed-energy-systems-and-the-environment/diesel-bugs/

144 Anderson and Bell, *Lights out: Impact of the August 2003 power outage on mortality in New York, NY*, National Institute of Health, Mar. 1. 2013, at 3, *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3276729/pdf/nihms348988.pdf

145 *Id.*

146 *Id.*

147 *Id.*

148 *Id.* at 1.

149 Eric Blake, et al., *Tropical Cyclone Report Hurricane Sandy*, National Hurricane Center, Feb. 12, 2013, at 14

studied the effects of plant retirements resulting from environmental regulations and changing market conditions on the Eastern Interconnection, which serves eastern and mid-western states.[150] Using the fuel price and load growth assumption of the Energy Information Administration's 2015 Annual Energy Outlook, the study found that, by 2025, coal plant retirements related to the Environmental Protection Agency's Mercury and Air Toxics Standards could increase annual electricity costs by 50 percent and raise peak costs by 81 percent.[151] It also projected that substantial new capacity would be needed as early as 2020 and that the grid will be strained even with new capacity.[152]

Similarly, DOE also examined the PJM Interconnection RTO to determine infrastructure needs as coal plants retire and more natural gas-fired capacity is added, and it noted that the change in power generation "present[s] real risks of both higher energy costs – impacting the Nation's economy and the consumer – and reliability of the electric grid as natural gas becomes a more dominant fuel."[153] This study found that "new electrical generating capacity—beyond that which is currently accounted for as planned-certain—is projected to be necessary starting in 2020 in order to meet peak demand."[154] It also found that, while existing pipeline infrastructure was sufficient in 2014, the length of time required to build and obtain permits for new projects could result in increased short-term pipeline congestion.[155] DOE notes that this, in turn, could have significant negative impacts on consumer costs and national security.

DOE also has evaluated the effects, including costs, of the change in which coal-fired power plants have shifted to marginal operations rather than their historically favorable dispatch position.[156] It concluded that marginal operation will require more frequent startups, shutdowns,

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[150] *See generally* National Energy Technology Laboratory (U.S. Department of Energy, Office of Fossil Energy), *Coal Fleet Transition: Retirement Impacts in the Eastern Interconnection* (Feb. 22, 2015).
[151] *Id.* at 18.
[152] *Id.* at 41.
[153] National Energy Technology Laboratory (U.S. Department of Energy, Office of Fossil Energy), *Natural Gas and Electric Interdependencies Case Study: Near-Term Infrastructure Needs in PJM* (Feb. 12, 2015), at 3.
[154] *Id.* at 1.
[155] *Id.*
[156] National Energy Technology Laboratory (U.S. Department of Energy, Office of Fossil Energy), *Impact of Load Following on the Economics of Existing Coal-Fired Power Plant Operations* (June 3, 2015). Findings of this report focus on the changes to the O&M and fuel costs related to reducing generation through: (1) Decreasing the plant annual operating hours by increasing the number of plant shutdowns; and (2) Operating the plant below its design capacity, at a lower load factor. The scope of the report was limited to cold starts, which although there are variations in the definition of the term, it defined as "when the boiler and steam turbine have sufficiently cooled down, reaching temperatures less than 250°F. *Id.* at 1-2 & n.1. Generally speaking, this occurs after the unit has been off-line for more than 48 hours." The study noted that cold starts are expected to have a more significant impact on plant equipment per start then either warm or hot starts, but it noted that warm and hot starts "may be significant for units in which the number of these starts outnumber cold starts, and will be investigated in the future." *Id.* at 6.

and load changes, which reduce the lifespan of plant components, increase operation and maintenance costs, and decrease overall plant efficiency, resulting in a higher cost of electricity.[157]

Additionally, costs would be much higher if fuel-secure generation were not available during times of system stress. NETL specifically noted that simulating the 2017-2018 cold snap "for a future state with anticipated coal retirements is expected to produce higher energy costs (including any costs associated with loss of load)…."[158] As another example, IHS Markit noted that PJM was in a fortunate position that a surplus of installed capacity was present at the time of the polar vortex in 2014 with a reported system-wide reserve margin of 22.5% rather than the long-run reserve margin target of about 16%.[159] The study determined, however, that a projection of PJM operating under polar vortex conditions shows that as capacity reserves decline, PJM approaches the point at which further reductions in available supply would likely produce increasingly large outage costs.[160] The study found that "as additional net dependable nuclear capacity is removed from the PJM supply portfolio and replaced by equal amounts of net dependable natural gas–fired capacity, the expected consumer outage costs under polar vortex conditions rose at an increasing rate from $153 million to $6.7 billion."[161]

V. DOE's National Security Responsibilities

By statute and executive order, the Secretary of Energy is a member of the National Security Council,[162] responsible for advising the President on "policy issues that affect the national security interests of the United States."[163] Also by statute and executive order, the Department is charged with responding to energy supply disruptions and other threats to the reliability and resilience of the Nation's electric power system. The President also has delegated to the Secretary certain authorities under the Defense Production Act of 1950 with respect to energy matters. DOE's authorities include its authority under section 202(c) of the Federal Power Act (FPA) to issue emergency orders due to shortages of electric energy, facilities, or fuel and other causes, and its authorities and responsibilities under section 215A of the FPA regarding cyberattacks,

[157] *Id.* at 2.
[158] *Id.*
[159] IHS Markit, "Ensuring Resilient and Efficient Electricity Generation: The Value of the current diverse US power supply portfolio", Apr. 2018, at 11.
[160] *Id.*
[161] *Id.* at 11-12.
[162] Section 101(c)(1) of the National Security Act, as amended, 50 U.S.C. § 3021(c)(1), provides that "[the National Security] Council consists of the President, the Vice President, the Secretary of State, the Secretary of Defense, the Secretary of Energy, the Secretary of the Treasury, and such other officers of the United States Government as the President may designate." *See also* National Security Presidential Memorandum-4, § A (Apr. 4, 2017) (stating that the Secretary of Energy is to be a regular attendee of the National Security Council), available at https://www.whitehouse.gov/presidential-actions/national-security-presidential-memorandum-4/ (last visited May 17, 2018). The Secretary of Energy has been a statutory member of the Council since 2007, when section 932 of the Energy Independence and Security Act of 2007 (Pub. L. 110-140, 121 Stat. 1492) amended the National Security Act accordingly.
[163] Section B of National Security Presidential Memorandum-4 names the Secretary of Energy to the Principals Committee, which is "the Cabinet-level senior interagency forum" for consideration of Security Council issues.

electromagnetic pulse attacks, and geomagnetic disturbances. DOE also has a range of nuclear security responsibilities under the Atomic Energy Act of 1954, as amended,[164] and the National Nuclear Security Administration Act, as amended.[165]

A. DOE's Role as Sector-Specific Agency for Energy

DOE is designated as the Sector-Specific Agency (SSA) for Energy under PPD-21, which specifically addresses "Critical Infrastructure Security and Resilience," and subsequent executive orders.[166] As the SSA, it is DOE's responsibility to "take proactive steps to manage risk and strengthen the security and resilience of the Nation's critical infrastructure, considering all hazards that could have a debilitating impact on national security, economic stability, public health and safety, or any combination thereof."[167] DOE is responsible for monitoring and analyzing both natural and man-made threats to the electricity system, gas pipelines, and other critical energy infrastructure, and it has extensive capabilities in this area through its Office of Electricity; Office of Cybersecurity, Energy Security, and Emergency Response; and Office of Intelligence and Counterintelligence.

As the designated SSA for the energy sector with regard to critical infrastructure security and resilience, DOE is a national leader among government agencies in identifying risks and responsive actions. For example, DOE is the co-chair of the Energy Sector Government Coordinating Council (EGCC), which coordinates federal, state, local, and tribal authorities on energy security and resilience. Also, as a member of the National Security Council, the Secretary of Energy receives regular intelligence briefings on threats to critical energy infrastructure. Further, DOE serves as the coordinating agency for Emergency Support Function #12 - Energy (ESF-12) under the National Response Framework (NRF), which guides the Nation's response to disasters and emergencies.[168] In addition, DOE is a primary agency for the Infrastructure Systems Recovery Support Function under the National Disaster Recovery Framework (NRDF), which is a companion plan to the NRF. As the lead for ESF-12, DOE is responsible for providing critical information and analysis about energy disruptions and for helping to facilitate the restoration of damaged energy infrastructure.[169]

DOE's working relationships with energy sector leadership also support its expertise in assessing security and resilience issues facing the sector. DOE is well integrated into the functions of the industry-led Electricity Subsector Coordinating Council (ESCC) and the Oil and Natural Gas Subsector Coordinating Council (ONG-SCC), both of which focus on critical energy

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[164] 42 U.S.C. § 2011 *et seq.*
[165] Pub. L. 106-65.
[166] PPD-21 at 11.
[167] *Id.* at 2.
[168] *See* Emergency Support Function #12 – Energy Annex, at ESF #12-1 (June 2016), *available at* https://www.fema.gov/media-library-data/1470149363676-f4f9246fc46b10727523aee39e076a2a/ESF_12_Energy_Annex_20160705_508.pdf.
[169] Written Testimony of William Parks, Senior Technical Advisor, Office of Electricity, U.S. Department of Energy, Before the Subcommittee on National Security Committee on Oversight and Government Reform, U.S. House of Representatives, at 1 (Mar. 21, 2018), *available at* https://oversight.house.gov/wp-content/uploads/2018/03/Parks-DOE_Testimony_03212018.pdf.

infrastructure protection and resilience issues. In addition, to facilitate sharing of threats and prompt dissemination of actionable information with the private sector, DOE regularly briefs the Electricity Information Sharing and Analysis Center (E-ISAC),[170] the Downstream Natural Gas Information Sharing and Analysis Center (DNG-ISAC),[171] and the Oil and Natural Gas Information Sharing and Analysis Center (ONG-ISAC).[172]

DOE has additional responsibilities for energy cybersecurity matters. Under Presidential Policy Directive-41 (PPD-41), DOE works in collaboration with other agencies and private sector organizations, including the Federal government's designated lead agencies for coordinating the response to significant cyber incidents: DHS, acting through the National Cybersecurity and Communications Integration Center (NCCIC), and the Department of Justice (DOJ), acting through the Federal Bureau of Investigation (FBI), and the National Cyber Investigative Joint Task Force. A primary purpose of PPD-41 is to clarify the roles and responsibilities of federal government agencies during a "significant cyber incident," which is described as a cyber incident that is "likely to result in demonstrable harm to the national security interests, foreign relations, or economy of the United States or to the public confidence, civil liberties, or public health and safety of the American people."

Further, DOE's role in energy sector cybersecurity was codified through the Fixing America's Surface Transportation (FAST) Act[173] in 2015, which designated DOE as the lead SSA for cybersecurity for the energy sector.[174] Congress enacted several important energy cybersecurity measures in the FAST Act, notably those amending the FPA.[175] In particular, under

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[170] The E-ISAC, operated by the North American Electric Reliability Corporation (NERC), is a voluntary membership organization open to "[a]ll electricity owners and operators in North America." NERC, *E-ISAC Products and Services*, v. 1.1, at 2 (Aug. 2016), *available at* https://www.nerc.com/pa/CI/ESISAC/Documents/E-ISAC%20Brochure.pdf. The E-ISAC "gathers and analyzes security data, shares appropriate data with stakeholders, coordinates incident management, and communicates mitigation strategies with stakeholders," and also, "in collaboration with [DOE] and the Electricity Subsector Coordinating Council (ESCC), serves as the primary security communications channel for the electric industry and enhances industry's ability to prepare for and respond to cyber and physical threats, vulnerabilities, and incidents." NERC, *Electricity Information Sharing and Analysis Center*, *available at* https://www.nerc.com/pa/CI/ESISAC/Pages/default.aspx (last visited May 17, 2018).

[171] The DNG-ISAC "serves natural gas utility (distribution) and pipeline (transmission) companies by facilitating communications between participants, the federal government, and other critical infrastructures" and "promptly disseminates threat information and indicators from government and other sources and provides analysis, coordination and summarization of related industry-affecting information." *See* https://www.dngisac.com (last visited May 17, 2018). Members include "[a]ll American Gas Association Full Members" and "[a]ll Interstate Natural Gas Association of America (INGAA) members." *See* https://www.dngisac.com/Home/Participation (last visited May 17, 2018).

[172] The ONG-ISAC "was created in 2014 to provide shared intelligence on cyber incidents, threats, vulnerabilities, and associated responses present throughout [the oil and gas] industry." *See* http://ongisac.org (last visited May 17, 2018). "All oil and natural gas industry companies (private or public) and recognized trade associations with a presence in North America" may join the ONG-ISAC. *Id.*

[173] Pub. L. No. 114-94, 129 Stat. 1312 (Dec. 4, 2015).

[174] *Id.* § 61003(c)(2)(A), 129 Stat. at 1779.

[175] 16 U.S.C. § 791a *et seq.*

subsection 215A(b)(1) of the FPA, the Secretary of Energy is authorized, upon declaration by the President of a Grid Security Emergency, to issue emergency orders to protect or restore critical electric infrastructure or defense critical electric infrastructure.[176] This authority allows DOE to respond as needed to the threat of cyber and physical attacks on the grid.

B. Statutory Authorities

DOE is authorized to address energy production and supply issues under a number of statutory provisions.

1. Defense Production Act

Under DPA section 101(a), the Secretary, by presidential directive,[177] has ordered **[INSERT]**. The DPA provides that "the security of the United States is dependent on the ability of the domestic industrial base to supply materials and services for the national defense and to prepare for and respond to military conflicts, natural or man-caused disasters, or acts of terrorism within the United States."[178] The DPA further includes the finding that to ensure the "vitality" of the domestic industrial base, action is needed "to promote industrial resource preparedness."[179] National defense preparedness specifically requires action to "assure the availability of domestic energy supplies." Congress, in the DPA, also establishes a policy that DPA authorities should be used "to reduce the vulnerability of the United States to terrorist attacks"[180] and to "encourage the geographic dispersal of industrial facilities in the United States to discourage the concentration of such productive facilities within limited geographic areas that are vulnerable to attack by an enemy of the United States."[181] Under the DPA, "national defense" is defined broadly to include critical infrastructure and "energy production."[182]

Under DPA section 101(a), the Secretary, by delegation from the President,[183] "is authorized (1) to require that performance under contracts or orders . . . which he deems necessary

[176] *Id.* § 824o-1(b)(1).
[177] [cite Presidential memorandum]. Previously, by Executive Order No. 13,603 (Mar. 16, 2012), the President delegated to the Secretary of Energy, with respect to all forms of energy, the authority of the President conferred by section 101 of the Defense Production Act of 1950 (DPA) to promote the national defense over performance of any other contracts or orders, and to allocate materials, services, and facilities as deemed necessary or appropriate to promote the national defense Further, the authorities of the President under section 101(c)(1)–(2) of the Act are delegated to the Secretary of Commerce, with the exception that the authority to make findings regarding domestic energy that materials, services, and facilities are critical and essential, as described in section 101(c)(2)(A) of the Act, is delegated to the Secretary of Energy. DOE also has had delegated DPA authority dating back to 1974.
[178] DPA sec. 2(a)(2).
[179] DPA sec. 2(a)(2)(A).
[180] 2(b)(5).
[181] 2(b)(6)
[182] sec 702(14).
[183] [cite Presidential memorandum]. Previously, by Executive Order No. 13,603 (Mar. 16, 2012), the President delegated to the Secretary of Energy, with respect to all forms of energy, the authority of the President conferred by section 101 of the Defense Production Act of 1950 (DPA) to promote the national defense over performance of any other contracts or orders, and to allocate materials, services, and facilities as deemed necessary or appropriate to promote the national defense Further, the authorities of the President

or appropriate to promote the national defense shall take priority over performance under any other contract or order, and, for the purpose of assuring such priority, to require acceptance and performance of such contracts or orders in preference to other contracts or orders by any person he finds to be capable of their performance, and (2) to allocate materials, services, and facilities in such manner, upon such conditions, and to such extent as he shall deem necessary or appropriate to promote the national defense."[184] Further, "national defense" includes "programs for military and energy production or construction . . . homeland security, stockpiling . . . and any directly related activity. . . . and critical infrastructure protection and restoration."[185]

Under DPA section 101(c),[186] the Secretary of Energy, through a delegation from the President,[187] "may . . . require the allocation of, or the priority performance under contracts or orders . . . relating to, materials, equipment, and services in order to maximize domestic energy supplies" based on findings that:

> (A) such materials, services, and facilities are scarce, critical, and essential—
>
> (i) to maintain or expand exploration, production, refining, transportation;
>
> (ii) to conserve energy supplies; or
>
> (iii) to construct or maintain energy facilities; and
>
> (B) maintenance or expansion of exploration, production, refining, transportation, or conservation of energy supplies or the construction and maintenance of energy facilities cannot reasonably be accomplished without exercising [this] authority . . .

The authority under section 101(c) may be exercised "[n]otwithstanding any other provision of this Act," and is therefore not subject to the "national defense" requirement of § 101(a).[188]

In early 2001, to address the California energy crisis, which left Pacific Gas and Electric Company (PG&E) on the verge of bankruptcy, the President declared in a January 19, 2001 memorandum to the Secretary of Energy that an electric energy shortage existed in California that threatened the continued availability of natural gas to consumers in the central and northern regions of California.[189] Because continuity of supply in those regions of California was dependent on the continued ability of the natural gas distributor in those regions to acquire and transport natural gas to all consumers throughout those regions, the President found, *inter alia*, that natural gas supplies within those regions of California were scarce, critical, and essential within the meaning of the Defense Production Act of 1950, and that assuring maintenance of natural gas supplies to those regions of California could not reasonably be accomplished without use of these authorities and

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[184] 50 U.S.C. § 4511.

[185] 50 U.S.C. § 4552(14).

[186] 50 U.S.C. § 4511(c).

[187] [cite Presidential memo].

[188] 50 U.S.C. § 4511(c).

[189] Memorandum for the Secretary of Energy Re Electrical Energy Shortage in California (Jan. 19, 2001).

was necessary and appropriate to maximize domestic energy supplies (including electricity) and to promote the national defense. Accordingly, DOE was authorized and directed "to exercise as to continuity of supplies of natural gas to the central and northern regions of California all authorities under the Defense Production Act of 1950, in accordance with the findings of scarcity, essentiality, and criticality made herein, pursuant to Executive Order 11790, as continued in force by Executive Order 12919, without the prior approval of any other officer, notwithstanding any procedural provisions generally specified in regulations that ordinarily would govern the Secretary of Energy's invocation of the authorities under the Defense Production Act of 1950, including in particular those under section 101(c) thereof."[190] In response, DOE issued an order requiring natural gas sellers, pursuant to sections 101(a) and (c) of the DPA, to perform and prioritize contracts to sell gas needed for electric generation to PG&E.[191]

2. Federal Power Act Section 202(c)

Section 202(c) of the Federal Power Act (FPA) (codified at 16 U.S.C. § 824a(c)), through section 301(b) of the Department of Energy Organization Act (codified at 42 U.S.C. § 7151(b)), authorizes the Secretary of Energy, upon finding "that an emergency exists by reason of a sudden increase in the demand for electric energy, or a shortage of electric energy or of facilities for the generation or transmission of electric energy, or of fuel or water for generating facilities, or other causes," to issue an order "requir[ing]...such temporary connections of facilities and such generation, delivery, interchange, or transmission of electric energy as in [the Secretary's] judgment will best meet the emergency and serve the public interest." 16 U.S.C. § 824a(c)(1).

DOE may act either upon application or upon its own motion, and orders under this authority may take effect without prior notice or hearing.[192] Prior to the enactment of the DOE Organization Act, this provision was administered by the Federal Power Commission. Section

[190] *Id.* at 2.

[191] Department of Energy, *Temporary Emergency Natural Gas Purchase and Sale Order* (Jan. 19, 2001). Although preceding the creation of the Department, the DPA was used to bolster infrastructure construction in the mid-1970s, in conjunction with the Federal Energy Administration (whose responsibilities were later subsumed into DOE). In September 1974, to speed construction of the Trans-Alaska Pipeline System and following a determination "that undue delay incident to material shortages in the construction of the Pipeline System constitutes an unusual situation within the terms of Title I of the Defense Production Act," section 101(a) of the Defense Production Act was invoked to authorize "priorities and allocation support" for the Alyeska Pipeline Service Company. General Services Administration and Federal Energy Administration, Trans-Alaska Pipeline Priorities Assistance for Construction, 39 Fed. Reg. 34,608 (Sept. 26, 1974). The authorization was soon expanded to cover "field facilities for the production of North Slope oil resources" (40 Fed. Reg. 26 (Jan. 2, 1975)) and amended several more times over the next two years to cover particular construction materials and activities (see 40 Fed. Reg. 5409 (Feb. 5, 1975); 40 Fed. Reg. 19,238 (May 2, 1975); 41 Fed. Reg. 44,476, 44,477 (Oct. 8, 1976); 41 Fed. Reg. 53,391 (Dec. 6, 1976)).

[192] *Id.*

301(b)[193] of the Department of Energy Organization Act[194] transferred the responsibilities under section 202(c) to the Secretary of Energy.

The Secretary is authorized to determine that an emergency exists for a wide range of reasons, including a "shortage of electric energy or of facilities for the generation or transmission of electric energy, or of fuel ... for generating facilities, or other causes."[195]

DOE's regulations note that a 202(c) action is "envisioned as meeting a specific inadequate power supply situation."[196] However, for an emergency to exist within the meaning of 202(c), it is not necessary that a blackout have already taken place, or that an attack or natural disaster be imminent. The legislative history of section 202(c) shows that Congress contemplated the use of the provision not merely to react to actual disasters, but to act in a preventive manner. A variety of man-made and natural threat conditions require, as noted above, "a Federal agency ready to do all that can be done in order to prevent a breakdown in electric supply."[197] For this reason, under the Department's regulations, an emergency can result from, among other causes, "an inability to obtain adequate amounts of the necessary fuels to generate electricity, or a regulatory action which prohibits the use of certain electric power supply facilities."[198] Also, power supply shortfalls resulting from "inadequate planning or the failure to construct necessary facilities can result in an emergency as contemplated in these regulations."[199]

DOE does not rely solely upon the analysis of the entity requesting an emergency order under 202(c). Rather, DOE engages in an independent analysis to determine that an emergency exists.[200] Additionally, in order to minimize burden on entities ordered to take actions under 202(c) and to prevent conflict with environmental laws or regulations, DOE has limited its orders in scope to be tailored to the particular emergency. Finally, DOE's past orders have targeted facilities of different fuel types depending on the nature of the emergency. For instance, the orders discussed above directed continued operation of the Potomac River and Yorktown coal-fired power plants due to their proximity and ability to provide power to the areas in need.

DOE's regulations further provide guidelines for defining "inadequate fuel or energy supply capability" and specifically for determining whether a "utility system fuel inventory or energy supply" is inadequate. Factors include "fuels in stock, fuels en route, transportation time, and constraints on available storage facilities."[201] DOE's regulations expressly address coal storage at electric utilities as a factor in determining fuel inadequacy, as when "[s]ystem coal stocks are reduced to 30 days (or less) of normal burn days and a continued downward trend in stock is

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[193] 42 U.S.C. § 7151(b) ("Except as provided in title IV, there are hereby transferred to, and vested in, the Secretary the function of the Federal Power Commission, or of the members, officers, or components thereof").
[194] Pub. L. 95-91, as amended.
[195] 16 U.S.C. § 824a(c)(1).
[196] 10 C.F.R. § 205.371.
[197] S. Rep. No. 621, 74th Cong., 1st Sess., p. 49 (1935).
[198] 10 C.F.R. § 205.371.
[199] *Id.*
[200] *See e.g.,* Order No. 202-05-3, at 3
[201] 10 C.F.R. § 205.375.

projected."[202] The Federal Power Commission, which held the section 202(c) authority until 1977, first adopted a version of this provision in 1974 in response to major changes in generation portfolios resulting from the 1973 oil embargo,[203]and DOE has retained the language with minor modifications since that time.[204]

Section 202(c) authority is exercised within a context of broad policy considerations, both domestic and international. As the FPC stated in 1974:

> Foreign events and international affairs of 1973, as they continue to the present time, as well as domestic fuel supply and other considerations affecting electric utilities, impact upon state, regional, and Federal interests in the continuing supply of electric power and energy. The Commission's preparations for exercise of its 202(c) authority, if such exercise becomes necessary, is directed to meet those interests.[205]

In that order, the FPC cited factors of concern including the Arab oil embargo, labor negotiations in the coal industry, the restrictive effect of environmental laws on the use of coal and oil as electric utility fuel stocks, and related delays in construction of new nuclear and fossil-fired electric generating facilities and transmission facilities. The combined result of these factors "has been to substantially narrow the band of flexibility of fuel supply and operations, within which the electric utility industry can adjust to shortages of any of its major fuel resources, or other causes of 'emergencies,' and still meet its service obligations."[206] Considering these factors, the FPC found that "the maintenance or expansion of system or regional fuel stocks not only bear upon the maintenance of an adequate and reliable bulk power supply in the course of day-to-day operations of electric systems, but also are important factors directly relevant to the exercise of authority under Section 202(c)…."[207] In conclusion, the FPC found that "[s]uch conditions, in the words of the legislative history of section 202(c), call for 'a Federal agency ready to do all that can be done in order to prevent a breakdown in electric supply.'"[208]

Over the years, DOE (and the FPC previously) has issued section 202(c) orders responding to a variety of different types of emergencies, taking advantage of the statutory and regulatory flexibility afforded it to tailor the scope and duration of an order to the particular emergency. DOE's orders have come in a variety of contexts, including (1) during wartime to ensure continued production of essentials; (2) post-disruption, such as following a natural disaster or blackout, to

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[202] *Id.* § 205.375(1).
[203] *Fed. Power Comm'n*, Order No. 520, 52 F.P.C. 155, 1569 (Nov. 29, 1974) ("[A] system may be considered to have an inadequate fuel or energy supply capability when, [under certain circumstances,]…(a) system coal stocks are reduced to 30 days (or less) of normal burn days and a continued downward trend in stocks is projected.").
[204] Final Rule, 46 Fed. Reg. 39,984, 39,985 (Aug. 6, 1981).
[205] Order No. 520, 52 F.P.C at 1556.
[206] *Id.* at 1557.
[207] *Id.* at 1561.
[208] S. Rep. No. 621, 74th Cong., 1st Sess., p. 49 (1935).

restore and maintain reliability; and (3) preventatively to stave off issues related to anticipated spikes in demand or lack of supply.

Depending on the nature of the emergency, 202(c) orders have taken different forms. Many past orders have ordered temporary interconnections to provide power to a particular locality or region experiencing current or anticipated electricity shortages. Some of these orders have authorized interconnections for short periods, such as an order lasting one month to alleviate widespread power outages following Hurricanes Katrina and Rita.[209] Other orders have extended much longer, such as one lasting up to two years to prevent possible outages in the City of Cleveland due to insufficient energy infrastructure, while construction of a longer-term solution was completed.[210]

Other 202(c) orders have ordered the continued operation of generation facilities that otherwise would have shutdown. Some of these orders fall in the category of orders that have sought to prevent a breakdown in supply by ensuring that adequate generation remains available if needed. In 2005, for example, DOE granted a request by the District of Columbia Public Service Commission to order the Mirant Corporation to continue operations at its Potomac River Generating Station despite an inability to meet the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards, finding that a failure to operate would create a "reasonable possibility" of extended blackouts affecting a large number of important facilities in the Washington, D.C. area, thus violating reliability standards.[211] More recently, DOE granted a 202(c) request from PJM to order Dominion Energy Virginia to continue operations at its Yorktown Power Station despite an inability to meet EPA's Mercury and Air Toxics Standards, finding electric system reliability at risk due to anticipated electricity demand and peak load conditions associated with hot summer weather.[212] In both these cases, DOE's determination that an emergency existed rested upon reasonably anticipated, rather than currently existing or imminent, conditions.

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[209] *See Department of Energy*, Order No. 202-05-1 (Sept. 28, 2005).
[210] *See City of Cleveland v. Cleveland Electric Illuminating Co.*, 47 F.P.C. 1412, 1414 (1972).
[211] *See Department of Energy*, Order No. 202-05-3, at 6 (Dec. 20, 2005).
[212] *See Department of Energy*, Order No. 202-17-2, at 1-2 (June 16, 2017).
[213] *See Department of Energy*, Order No. 202-05-1 (Sept. 28, 2005).
[214] *See City of Cleveland v. Cleveland Elec. Illuminating Co.*, 47 F.P.C. 1412, 1414 (1972).

In order to minimize the burden on entities ordered to take actions under 202(c) and to prevent conflict with environmental laws or regulations, DOE has limited its orders in scope to be tailored to the particular emergency. For instance, neither of the preventative DOE orders involving Mirant and Dominion envisioned or resulted in the subject power stations being forced into continuous operation. Rather, the orders clearly stated that the generators would serve only as back-up power in the event that other existing sources of power are unavailable.[215] Finally, DOE's past orders have targeted facilities of different fuel types depending on the nature of the emergency. For instance, the orders discussed above directed continued operation of the Potomac River and Yorktown coal-fired power plants due to their proximity and ability to provide power to the areas in need. In response to the energy crisis in California in 2000-01, however, DOE ordered power supplied to California from a variety of sources without regard to fuel type.[216]

[215] *See* Order No. 202-05-3, at 8-9, 10; Order No. 202-17-2, at 2 (stating that "this Order authorizes operation…only when called upon by PJM for reliability purposes").
[216] *See Department of Energy*, Order Pursuant to Section 202(c) of the Federal Power Act (Dec. 14, 2000).