UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Grid Reliability and Resiliency Pricing	**)** **)** **)**	**Docket No. RM18-1-000**

RULEMAKING COMMENTS OF THE NUCLEAR ENERGY INSTITUTE

In accordance with the Federal Energy Regulatory Commission's ("FERC" or the "Commission") October 2, 2017 notice and the Commission Staff's October 4, 2017 notice, the Nuclear Energy Institute ("NEI") provides its initial comments on the Secretary of Energy's ("Secretary") September 28, 2017 proposed rulemaking (the "Proposed Rule").[1]

I. EXECUTIVE SUMMARY

NEI supports the Secretary's goal of ensuring that the reliability and resilience attributes of nuclear generation resources are appropriately valued, and is grateful to the Department of Energy ("DOE") and the Commission for their leadership on this critical issue. NEI supports the framework in the Proposed Rule to provide cost-of-service compensation for nuclear generation units, at least until other market structures are put in place that appropriately value the resiliency attributes that nuclear generation units provide. In enacting this reform, NEI also urges the Commission to respect established and future initiatives by states exercising their traditional powers to support nuclear generation. NEI also supports the Commission pressing forward with broader price formation reform.

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[1] U.S. Department of Energy, Grid Resiliency Pricing Rule, Docket No. RM18-1 (Sept. 28, 2017) (*hereinafter* "Proposed Rule"). Given NEI's diverse membership and that not every NEI member is affected by the Proposed Rule, these comments do not represent the views of all NEI members on all issues. We note that members may submit separate comments representing their company's individual views.

Current market structures and conditions have led to the premature retirement of several nuclear plants. These retirements are likely irreversible. Additional units are scheduled for premature retirement and others remain at risk. While the Commission has conducted extensive analysis of potential price formation reforms to date, current market conditions have exposed a critical gap in our market and regulatory structures that must be addressed now. Wholesale power markets have optimized short-term prices, but they were not designed to solve long-term concerns like resource diversity and grid resiliency. We should not allow short-term prices to dictate significant changes in our generation fleet that will reduce the nation's resource diversity and grid resiliency. Such changes would run counter to the federal government's efforts to make resiliency a key component of its national security strategy for more than 20 years.[2]

The Proposed Rule recognizes that organized markets need immediate reform to ensure the electric system will be able to continue delivering value to consumers for years to come. While there are divergent views about the best solution to this problem, that debate should not detract from the need to quickly put rules in place to stem the premature retirement of nuclear electric generating resources.

Nuclear electric generating units have played an important role in our nation's electric grid since the first commercial generation of nuclear power in the United States in 1957. In addition to their ability to generate large amounts of power without emitting carbon dioxide, nuclear plants operate efficiently for 18 to 24 months between refueling cycles. As a result, nuclear electric generating units are not exposed to short-term fuel cost fluctuations (which directly impact market-clearing prices) or fuel supply shortages and interruptions. Nuclear generation units provide valuable price stability and fuel supply certainty, which together

[2] *See* Declaration of Caitlin Durkovich, attached hereto as Exhibit A.

mitigate the impacts of natural and man-made disasters. Nuclear generation units also have the highest capacity factors of all resource types—*i.e.*, they generate power more consistently and reliably than any other resource. In addition, nuclear electric generators are a significant source of energy and ancillary services. Because of these attributes, nuclear power plants provide reliable baseload generation that stabilizes the grid and moderates price volatility.

DOE correctly concluded in the August 2017 Staff Report[3] and the Proposed Rule that current organized market design requires immediate reform because market conditions are placing critical merchant nuclear plants at risk for premature retirement. As we discuss below, nuclear plants that retire prematurely will not return to service (*i.e.*, they cannot simply be mothballed), thus permanently eliminating this source of resilient electricity for consumers.

Energy and capacity markets currently are blind to certain critical non-price factors, such as resiliency, fuel diversity, and environmental performance. In the Proposed Rule, the Secretary effectively asks whether we should continue to be blind to these factors, or whether we should update our system in a way that will, in the long-term, protect consumers by preserving much-needed fuel diversity and resiliency. NEI agrees with the Secretary that we must begin to recognize additional important non-price factors. Markets should use competition to lower prices, *within the constraints of these important non-price factors*. These non-price factors (such as resiliency and fuel diversity) provide a societal benefit to the consumers of that energy, and maintaining the plants that provide them is entirely consistent with FERC's obligation to establish "just and reasonable" rates.

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[3] U.S. Dept. of Energy, Staff Report to the Secretary on Electricity Markets and Reliability (August 2017), *available at* https://energy.gov/sites/prod/files/2017/08/f36/Staff%20Report%20on%20Electricity%20Markets%20and%20Reliability_0.pdf (*hereinafter* DOE Staff Report).

To be sure, our energy markets today do accommodate many non-price factors that the nation has decided are important, even if they do not produce lowest-cost power. State and federal emissions and other environmental limits on fossil generation often limit the relative contribution of coal plants in our supply portfolio. Federal tax credits and state renewable portfolio standards are non-market forces that have led to a dramatic increase in renewable production over the last decade.[4] Meanwhile, the siting of power plants and transmission facilities routinely accounts for, or even gives way to, prevailing environmental and other policy considerations that may lead to higher costs. And that is our point: the U.S. bulk power system ("BPS") does not operate in a price-only vacuum, free of these important public interest considerations. Directing the Commission to step in to stem the premature loss of power plants that provide attributes that directly contribute to resiliency is similarly justified.

Indeed, properly valuing resource diversity and resiliency in order to preserve them is squarely within the Commission's legal authority and purview.[5] The Commission has an independent statutory duty to ensure both just and reasonable wholesale prices and that the grid remains resilient in the long-run, not just tomorrow or next week. Short-term prices should not prevail over the long-run price stability and the national security benefits that come from a

[4] The federal government has also encouraged new nuclear construction through production tax credits and loan guarantees.

[5] FERC's duty to maintain just and reasonable rates is not confined to short-term rates. Courts have noted that "FERC's rate-making authority confers ***broad power*** **'to act in the public interest**.'" *New England Power Generation Association v. FERC*, 757 F.3d 283, 291 (D.C. Cir. 2014) (*quoting Miss. Indus. v. FERC*, 808 F.2d 1525, 1549 (D.C. Cir.1987) (internal citations omitted)) (emphasis added). Federal Power Act section 202(a) identifies a primary goal of the Act as being: "assuring an abundant supply of electric energy throughout the United States." 16 U.S.C. § 824a(a) (2012). As stated by the Supreme Court, FERC is "charge[d] to promote the orderly production of plentiful supplies of electric energy and natural gas at just and reasonable rates." *NAACP v. FPC*, 96 S. Ct. 1806, 1812 (1976). The D.C. Circuit has also noted that setting wholesale power rates to address "reasonable concerns about system adequacy" is "within the heartland" of the Commission's jurisdiction. *Connecticut Department of Public Utilities Control v. FERC*, 569 F.3d 477, 483 (D.C. Cir. 2009).

resource-diverse and resilient grid.[6] Regional transmission organization ("RTO") markets must evolve to consider these long-run effects.

Specifically, the Commission should amend its regulations to implement a cost-of-service mechanism for merchant nuclear units, at least until further sustainable market-based structures are put in place that appropriately value the resiliency attributes that nuclear generation units provide. The Commission should also take steps, including potentially the initiation of new proceedings, to require as necessary, RTOs to reform their tariffs to revise price formation based on these important attributes.[7]

II. ABOUT NEI

NEI is the Washington, D.C.-based policy organization of the nuclear technologies industry. NEI's mission is to foster the beneficial uses of nuclear technology and to communicate accurate information about the importance of nuclear energy and technology. NEI is responsible for developing industry positions and advocating on legal, regulatory, and policy matters affecting the nuclear energy industry. NEI has more than 300 members, spread across 17 countries, and its membership includes all the companies licensed to operate commercial nuclear power plants in the United States, as well as nuclear plant designers, major architectural and engineering firms, entities that process nuclear fuel, and other organizations involved in the nuclear industry.

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[6] Those that may suggest there is no immediate reliability problem that justifies action in this proceeding miss the point. Degrading resource diversity and resiliency impacts reliability in the long run, by making the country too reliant on a single non-intermittent fuel source. We may not see the impact of a less resilient grid until the next Polar Vortex-type emergency, when units that responded in 2014 are no longer there.

[7] *See* Testimony of Maria G. Korsnick, President and Chief Executive Officer of NEI, Subcommittee on Energy, House Energy and Commerce Committee (Oct. 3, 2017) *available at* http://docs.house.gov/meetings/IF/IF03/20171003/106457/HHRG-115-IF03-Wstate-KorsnickM-20171003-U3.pdf.

In the United States, there are currently 99 nuclear reactors, at 60 distinct sites, spread across 30 states. (Of these 99 reactors, 65 reactors at 42 sites sit in Commission-jurisdictional RTO markets, and of these, 43 reactors at 28 sites are merchant nuclear plants.) The domestic nuclear fleet represents approximately 98,672 MW of baseload generating capacity. In 2016, nuclear energy produced 20 percent of U.S. electricity supply (805.3 billion kilowatt-hours), and prevented 554 million metric tons of carbon dioxide emissions.[8] 2016 also saw U.S. reactors continue to set a record capacity factor of over 92 percent.

Nuclear energy accounted for 60 percent of America's carbon-free electricity in 2016—three times more than hydropower and three times more than wind energy. The amount of carbon dioxide emissions avoided by U.S. nuclear energy facilities is equal to the carbon dioxide emissions produced from 118 million passenger cars—essentially the equivalent of removing the operation of all the passenger cars in the United States. Without nuclear power plants operating in 30 states, carbon emissions from the U.S. electric sector would be approximately 30 percent higher.

In addition, nuclear energy contributes approximately $60 billion annually to the gross domestic product of the United States, accounts for approximately 475,000 full time jobs (direct and secondary), and provides nearly $10 billion annually in federal tax revenues and $2.2 billion in state tax revenues.[9]

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[8] NEI, *US Nuclear Power Plants, General U.S. Nuclear Info*, https://www.nei.org/Knowledge-Center/Nuclear-Statistics/US-Nuclear-Power-Plants; NEI, *Environment: Emissions Prevented*, https://www.nei.org/Knowledge-Center/Nuclear-Statistics/Environment-Emissions-Prevented.

[9] The Brattle Group, *The Nuclear Industry's Contribution to the U.S. Economy* (July 7, 2015), *available at* https://d3n8a8pro7vhmx.cloudfront.net/nuclearmatters/pages/204/attachments/original/1494335354/July-Nuclear-Matters-Report_Value-of-Nuclear.pdf?1494335354.

III. COMMENTS

NEI supports the goal of the Proposed Rule: to ensure that the resiliency and diversity attributes of fuel-secure generation are appropriately valued. NEI urges the Commission to act on the proposal within 60 days, while allowing for other solutions to be developed.[10] Specifically, the Commission should allow for cost-of-service compensation for eligible units at least until sustainable market structures can be reformed to properly value key attributes of resource diversity and resiliency.

A. Yes, There is a Problem and it Requires Immediate Action

The Proposed Rule is designed to address two interrelated issues: (1) the premature retirement of power plants that contribute substantially to the resiliency of the electric grid; and (2) the failure of current market pricing rules to adequately value the resiliency attributes that these power plants provide.[11] Continuing to ignore these issues will quickly lead to irreversible, long-run, detrimental impacts on both our nation's resource portfolio and the electric grid that hundreds of millions of Americans rely on daily.

1. Merchant Nuclear Plants are Retiring Prematurely at an Alarming Rate

As an initial matter, NEI stresses that there is indeed a problem because of the number of vital nuclear plants that are planning to retire prematurely in the near future.[12] These retirements

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[10] While NEI will focus on several important themes in the Proposed Rule, we will also endeavor to answer as many of FERC Staff's enumerated questions as possible.

[11] Proposed Rule at 2.

[12] As noted in the Proposed Rule, the premature retirement of both nuclear and coal-fired power plants is not a new concern. Rather, it has been recognized and analyzed within the power industry for several years. For instance, the North American Electric Reliability Corporation ("NERC") raised concerns in the 2013 Long-Term Reliability Assessment on becoming increasingly dependent on natural gas for electric power. NERC, *2013 Long-Term Reliability* Assessment 35 (Dec. 2013) *available at* http://www.nerc.com/pa/RAPA/ra/Reliability%20 Assessments%20DL/2013_LTRA_FINAL.pdf. Similarly, the Commission too recognized the potential effects of a changing mix of generating resources in 2013, and held a technical conference to "consider how current centralized

threaten to degrade much-needed fuel diversity and grid resiliency. More than 11,000 megawatts of nuclear capacity have retired in recent years or plan to shut down prematurely, with additional facilities at risk.[13] While there are many factors that contribute to these closures, a key factor for several of premature retirements is the failure of RTO markets to value attributes of nuclear power.[14] Since 2016 alone 7,167 MW of nuclear capacity—which represents nearly 10 percent of current U.S. capacity—has been scheduled to retire.[15]

As an example of the consequential and long-standing impacts these retirements have, three years ago an IHS Study, entitled *The Value of US Power Supply Diversity*,[16] used the Kewaunee nuclear station in Wisconsin to illustrate how lower market prices pushed out a merchant nuclear plant:

> The Kewaunee nuclear plant in Wisconsin is an example of a power plant retirement due to the missing money problem. Wholesale day-ahead power prices average about $30 per MWh in the Midwest power marketplace. This market does not have a supply surplus, and recently the Midwest Independent System Operator (MISO), the institution that manages the wholesale market, announced that it expects to be 7,500 MW short of generating capacity in 2016. The current

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capacity market rules and structures are supporting the procurement and retention of resources necessary to meet future reliability and operational needs. *Centralized Capacity Markets in Regional Transmission Organizations and Independent Systems Operators*, Notice of Technical Conference, Docket No. AD13-7-000, 1 (June 17, 2013).

[13] *See* NEI, *Nuclear Energy Institute Comments on the Department of Energy's Quadrennial Energy Review* at 24 (July 1, 2016), *available at* https://www.eenews.net/assets/2016/07/08/document_pm_01.pdf; U.S. Energy Information Administration, *Three Mile Island is the Latest Nuclear Power Plant to Announce Retirement Plans* (June 13, 2017), https://www.eia.gov/todayinenergy/detail.php?id=31612#. A comprehensive chart of the latest retirements can be found in the DOE Staff Report. *See* DOE Staff Report at 31, tbl 3-2.

[14] Other factors include sustained low natural gas prices, low load growth, renewable generation mandates and incentives, and transmission constraints. *Id*. at 11-14; *id*. at 31 tbl. 3-2 (listing the nuclear plant retirements planned and averted and their reason); NEI, *Nuclear Costs in Context* 5-6 (Aug. 2017), *available at* https://www.nei.org/CorporateSite/media/filefolder/Policy/Papers/Nuclear-Costs-in-Context.pdf?ext=.pdf; *infra* Part III. D (discussing the failure of RTO markets to value resilience or resource diversity). As noted in the DOE Staff Report, several nuclear units have faced mechanical or other regulatory challenges that have also contributed to their early retirement.

[15] DOE Staff Report at 29. Separately, eight additional nuclear reactors that were previously planned for retirement were averted through state action. *Id*. at 30.

[16] IHS Energy, *The Value of US Power Supply Diversity* (July 2014), *available at* https://www.globalenergyinstitute.org/sites/default/files/USPowerSupplyDiversityStudy.pdf (*hereinafter* 2014 IHS Study).

> market-clearing power price must almost double to send an efficient price signal that supports development of a natural gas-fired combined-cycle power plant. The Kewaunee power plant needs much less than the cost of a new plant, about $54 per MWh, to cover the costs of continued operation. Kewaunee's installed capacity was 574 MW, and the plant demonstrated effective performance since it began operation in 1974. The plant received Nuclear Regulatory Commission approval for life extension through 2033. Nevertheless, the persistent gap between market prices and new supply costs led Dominion Energy, the power plant's owner, to the October 2012 decision to close the plant because of "low gas prices and large volumes of wind without a capacity market."[17]

In addition, when a plant closes, many other societal benefits provided by merchant nuclear power are lost, including thousands of highly skilled and high paying jobs, as well as the air emissions-free generation[18] and electricity prices nuclear power provides.[19]

There is little doubt that there is an industry-wide systemic economic and financial challenge to operating merchant nuclear power plants in RTO markets. Evidence shows that the retirement of nuclear plants before their operating licenses expire is caused primarily by lower revenues as opposed to higher operating costs, as wholesale electricity prices have precipitously fallen over the last several years.[20] Indeed, more nuclear power plants will be retired prematurely if changes are not made to properly value the multiple benefits nuclear power provides.[21]

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[17] *Id*. at 29.

[18] For instance, with the loss of Vermont Yankee nuclear station in Vernon, Vermont, carbon emissions in New England increased by nearly three percent alone, the first such increase in emissions in a decade. ISO New England, *2015 ISO New England Electric Generator Air Emissions Report* 2, Tbl 1-1; 20, Fig. 5-2 (Jan. 2017), *available at* https://www.iso-ne.com/static-assets/documents/2017/01/2015_emissions_report.pdf.

[19] For example, California electricity customers paid $350 million more for electricity in the year following San Onofre's closure. Lucas Davis & Catherine Hausman, Energy Institute at Haas, University of California at Berkeley, *Market Impacts of a Nuclear Power Plant Closure* 3 (May 2015), *available at* https://ei.haas.berkeley.edu/research/papers/WP248.pdf.

[20] DOE Staff Report at 29 (citing Ronaldo Szilard, Phil Sharpe, Edward Kee, Edward Davis, and Eugene Grencheck, Economic and Market Challenges Facing the U.S. Nuclear Commercial Fleet Energy (Idaho National Laboratory and Center for Advanced Energy Studies September 2016), https://gain.inl.gov/Shared%20Documents/Economics-Nuclear-Fleet.pdf).

[21] *Id*.

2. Unlike Other Power Plants, the Retirement of Nuclear Power Plants, and their Associated Losses, Are Permanent

In addition to the negative impacts described above, the premature retirement of a nuclear power plant is particularly costly, as each merchant nuclear facility that shuts down results in a *permanent* loss of a reliable source of baseload generation.[22] As described in the attached declaration of Rodney McCullum, NEI Senior Director, Fuel and Decommissioning Programs,[23] decommissioning a nuclear unit is a pain-staking process that, once complete, is permanent (*i.e.*, they cannot be mothballed). As described by Mr. McCullum, "[o]nce a licensee has lost its authority to operate the reactor, there is no established regulatory process to reverse that decision."[24]

3. The Polar Vortex Was an Example of the Need for Resilience

As nuclear and coal power plants began to retire prematurely in recent years, the power industry recognized the negative impact these retirements could have on the resiliency and diversity of the electric grid—a vulnerability that could be devastating during an emergency or disaster.[25] As underscored in the Proposed Rule, the 2014 Polar Vortex exposed this weakness. FERC Staff asked in its notice if the Polar Vortex represented a valid case study of the resiliency issue. The answer is yes for multiple reasons.

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[22] For legal and technical reasons, nuclear units cannot be mothballed and repowered. *See, e.g.*, 10 C.F.R. § 50.82(a)(2) ("Upon docketing of the certifications for permanent cessation of operations and permanent removal of fuel from the reactor vessel . . . the 10 CFR part 50 license no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel.").

[23] The McCullum Declaration is attached hereto as Exhibit B.

[24] *Id*.

[25] *See generally* NERC, *Polar Vortex Review* (Sept. 2014), http://www.nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final. Pdf (*hereinafter* NERC Polar Vortex Review).

Before addressing the specifics of the Polar Vortex, we suggest that whether and how gas units performed during that event is not the important question. Rather, the Polar Vortex is important because it exposed a weakness that could be significantly exacerbated if nuclear units are lost to early retirement. As memorialized in reports regarding the gas price spikes, gas supply disruptions, large amounts of non-responsive combustion turbines, and frozen coal piles, the Polar Vortex is a valuable case study for the need for fuel diversity and resilience.[26]

First, during the Polar Vortex, the effects of the weather system on the electric grid were significant: 35,000 MW of generation capacity was lost,[27] including 22 percent of generating capacity being placed in forced outage in PJM.[28] Several gas-fired power plants in the Northeast region were unable to run after the natural gas froze in the fuel injectors feeding the turbines.[29] Meanwhile in Texas, freezing temperatures led to shutdowns in pipelines used to transport gas to the Southwest.[30] Because of these supply constraints natural gas prices spiked across much of the country.[31] Separately, some coal plants could not operate due to conveyor belts and coal piles freezing.[32] And as reported by PJM, even power plants with generation units with dual-fuel

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[26] *See* Federal Energy Regulatory Commission, *Winter 2013–2014 Operations and Market Performance in RTOs and ISOs*, AD14-8-000, 8 (April 1, 2014), https://www.ferc.gov/legal/staff-reports/2014/04-01-14.pdf (*hereinafter* FERC Winter 2013-2014 Report).

[27] NERC Polar Vortex Review at 4.

[28] PJM Interconnection, *Analysis of Operational Events and Market Impacts During the January 2014 Cold Weather Events* 9 (May 8, 2014), http://www.pjm.com/~/media/library/reports-notices/weather-related/20140509-analysis-of-operational-events-and-market-impacts-during-the-jan-2014-cold-weather-events.ashx (*hereinafter* PJM Polar Vortex Analysis).

[29] NERC, Polar Vortex Review at 8.

[30] *See* FERC Winter 2013-2014 Report at 12.

[31] The National Coal Council, *Coal = Reliable Energy* 6 (2015), *available at* http://www.nationalcoalcouncil.org/Documents/Energy-Education/4-Coal-Reliable-Energy-Final.pdf.

[32] FERC Winter 2013-2014 Report at 8.

capability encountered issues, including run-time limits related to permit-defined environmental restrictions, re-supply challenges, and increased failure rates for unit startup.[33]

Second, the Polar Vortex was a prime example of the value that resilient and reliable power plants—including nuclear units—offer to the electric grid, particularly when fuel supply is disrupted during disasters and disturbances. In order to compensate for these various supply issues, operators relied on older generating plants nearing the end of their useful lives.[34] By comparison, because nuclear facilities have onsite fuel and hardened facilities, they typically operate continuously in extreme weather conditions, including during the Polar Vortex where nuclear generators performed better than all other forms of generation—operating with an average capacity factor of 95 percent.[35]

Third, the conclusions drawn in the aftermath of the Polar Vortex further highlight the need to promote fuel diversity and ensure a reliable and resilient electric grid. Most notably, NERC concluded that "increased reliance on natural gas during the [Polar Vortex] exposed the industry to various challenges with fuel supply and delivery."[36]

Fourth, while the Polar Vortex exposed the resiliency and fuel diversity issue on a national scale, it is just one type of case study. On its own, the Polar Vortex demonstrates the need to immediately address the issues raised in the Proposed Rule, but beyond that event the power industry has faced the destruction caused by Superstorm Sandy and Hurricanes Harvey,

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[33] In some cases, oil suppliers began to run low on inventory or deliveries were slow because increased demand was unexpected and available delivery trucks were limited. There was approximately 2,000-3,000 MW of generation affected by oil supply and delivery issues. PJM, Polar Vortex Analysis at 39-40.

[34] As noted in the Proposed Rule, several utilities used power plants previously scheduled for retirement to meet customer demand. The National Coal Council, *Reliable & Resilient, The Value of Our Existing Coal Fleet: An Assessment of Measures to Improve Reliability and Efficiency While Reducing Emissions* 14 (May 2014), *available at* http://www.nationalcoalcouncil.org/reports/1407/NCCValueExistingCoalFleet.pdf.

[35] DOE Staff Report at 95.

[36] NERC, *Polar Vortex Review* at 17.

Irma, and Maria all within the last five years.[37] NERC also recently recognized the risk of natural gas storage outages and pipeline leaks during non-extreme weather conditions, which pose additional threats to the electric grid.[38] If anything, these disasters and disturbances appear to be occurring with greater frequency, further accelerating the need for a more resilient electric grid and to properly value those resiliency attributes.

While the RTOs and the Commission took steps to address several issues presented by the Polar Vortex, those actions do not address the risks of long-term loss of fuel diversity and the possible degradation of grid resiliency. For example, PJM's capacity performance program creates a pay for performance scheme to incentivize generators to perform well in extreme weather conditions. Although that program sought to remedy the perceived lack of firm fuel supply and improve performance of existing generators, it would not protect against, for example, a large-scale disruption to the gas supply system. The value of resource diversity is the ability to rely on a different fuel source when one or another source becomes limited due to market conditions or physical disruptions from natural or man-made (*e.g.* terrorist) events.

B. RTO Markets Fail to Value Resilience or Resource Diversity, So the Commission Must Step In and Ensure They Do

While organized markets have succeeded in many ways, these markets are based on market-clearing algorithms that simply do not take into account long-term impact and consequences for fuel diversity, and, by extension, resiliency.

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[37] Despite Hurricane Harvey's devastating impact on the region, the two South Texas Project nuclear energy generating units in Matagorda County continued operating at 100 percent during the storm, providing much needed electricity to those customers whose power lines remained intact. Rod Adams, *Texas Nuke Plant Stays Online Amid Harvey. Give Credit To Resilient Operators, Robust Design And A Plan*, FORBES, (Aug. 30, 2017) https://www.forbes.com/sites/rodadams/2017/08/30/nuke-plant-could-close-but-didnt-give-credit-to-resilient-operators-robust-design-and-a-plan/#414295096f87.

[38] *See* NERC, 2017 *State of Reliability*, 8-9 (June 2017), *available at* http://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/SOR_2017_MASTER_20170613.pdf.

Commission Staff first asks, "[h]ow are reliability and resilience valued, or not valued, inside RTOs/ISOs?" The answer is they are not valued. Staff also asks, "[d]o RTO/ISO energy and/or capacity markets properly value reliability and resilience?" The answer is unequivocally no with respect to resilience. Indeed, the flaw that current market conditions have exposed, and that the Commission should remedy, is that these markets simply were not designed to consider non-price factors like resiliency, fuel and technology diversity, and long-term rate stability. They place too much emphasis on low cost and efficiency, without appropriately balancing other goals. For instance, PJM acknowledges it "does not analyze market or economic impacts of fuel diversity" and does not fully capture "additional risks, such as gas deliverability during polar vortex-type conditions and uncertainties associated with economics and public policy."[39] Merchant nuclear plants should not be forced into early retirement because the RTO markets are providing insufficient short-term revenues despite the vital role the plants play in supporting electric grid.

1. RTO Energy Markets are Inherently Short-Term Markets

All RTOs operate day-ahead and real-time energy markets. Several started as regional power pools, but evolved to become more sophisticated organizations that more efficiently dispatched generation based on automated security-constrained economic dispatch. When these markets were conceived, all they did was dispatch energy hour-to-hour. Eventually they would include day-ahead unit commitment processes.

These very short-run markets were not developed to dictate long-term resource procurement decisions. Their only job was to look at the constraints on the system in any

[39] PJM Interconnection, *PJM's Evolving Resource Mix and System Reliability* at 5 (Mar. 30, 2017), *available at* http://www.pjm.com/~/media/library/reports-notices/special-reports/20170330-pjms-evolving-resource-mix-and-system-reliability.ashx.

particular interval and come up with the most efficient dispatch scenario to serve load. While proponents of these energy-only markets have previously argued that they could lead to long-term resource adequacy, at this point markets do not account for fuel diversity and resiliency.

2. Capacity Markets Were Not Designed to Make Fuel Diversity Decisions

While they have taken on greater roles in recent years, capacity markets were no more conceived to dictate long-term resource diversity than the energy markets. Of the RTOs, only PJM and ISO-New England operate full forward capacity markets, while NYISO operates what has been described as a spot capacity market.[40]

The capacity markets were conceived to solve what was referred to as "the missing money" problem.[41] The missing money problem describes the fact that *energy* market prices may be sufficient to compensate generators for their marginal cost of production, but they may not sufficiently cover the fixed costs of the generation plant, thus threatening its economic viability and, in turn, the system's resource adequacy. Therefore, a separate product—capacity—was introduced by the RTOs to ensure that units that cleared the market would receive their operating costs from the capacity market notwithstanding price pressures from the energy market.

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[40] MISO, CAISO, and SPP have requirements that their load-serving entities meet certain "resource adequacy" requirements. These requirements ensure that each load-serving entity has enough capacity under ownership or contract that there will be enough resources in the energy market to serve load. MISO operates a *voluntary* capacity auction mechanism that load-serving entities can use to satisfy their resource adequacy requirements if they so choose.

[41] *See* William Hogan, *On An "Energy Only" Electricity Market Design For Resource Adequacy* 1 (September 23, 2005) *available at* https://sites.hks.harvard.edu/fs/whogan/Hogan_Energy_Only_092305.pdf ("The missing money problem arises when occasional market price increases are limited by administrative actions such as price caps. By preventing prices from reaching high levels during times of relative scarcity, these administrative actions reduce the payments that could be applied towards the fixed operating costs of existing generation plants and the investment costs of new plants. The resulting missing money reduces the incentives to maintain plant or build new generation facilities. In the presence of a significant missing-money problem, alternative means appear necessary to complement the market and provide the payments deemed necessary to support an appropriate level of resource adequacy.").

While designed to provide longer term signals to address resource adequacy (*i.e.*, total megawatts only), capacity markets still only lead to short-term purchases. In NYISO, capacity can be procured in six-month strips through auctions that are held only six months ahead of time. In PJM and ISO-New England, capacity is a one-year product procured three years ahead of time through capacity auctions. These markets are designed to provide a revenue stream that supplements energy market revenues. The corresponding auction processes run on a least cost basis with some consideration of location—*i.e.*, capacity is procured zonally in many instances in order to ensure that capacity resources are deliverable to load when needed the most. But capacity markets do not seek to determine what types of resources clear the market. Aside from location, they do not consider the overall generation composition.

3. In Organized Markets, Important Questions of Fuel Diversity, Resiliency, and Reliability are Not Being Asked

In non-RTO regions of the country, many state commissions still engage in integrated resource planning. This type of resource planning analyzes a host of questions including those related to important non-price factors such as fuel diversity, fuel price exposure, and environmental considerations. RTO markets simply do not ask these questions.[42] While we are not suggesting a wholesale return to integrated resource planning in lieu of organized markets,[43]

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[42] *See* 2014 IHS Study at 8 (concluding that the increasing cost of ensuring power system resilience is exposing the problem that wholesale market price formation rules often do not fully compensate generating resources for providing the desired power system supply resiliency).

[43] Indeed, judicial opinions of recent years confirmed that states in RTO regions may not engage in that type of planning to the extent that it interferes with this Commission's exclusive jurisdiction over wholesale markets. *Hughes v. Talen Energy Mktg., LLC*, 136 S. Ct. 1288 (2016). More recent decisions suggest that states may value non-price attributes, like the zero-emission credit programs in Illinois and New York. *Village of Old Mill Creek v. Star*, 2017 U.S. Dist. LEXIS 109368, 2017 WL 3008289 (2017) (dismissing preemption challenges) *appeal docketed*, No. 17-2445 (7th Cir. 2017); *Coalition for Competitive Elec. v. Zibelman*, 2017 U.S. Dist. LEXIS 116140, 2017 WL 3172866 (2017) (same), *appeal docketed*, No. 17-2654 (2nd Cir. 2017).

we raise this point to underscore the simple absence of a regulatory structure in organized markets that asks these critical questions.

It is thus imperative for the Commission to act now, under its broad authority as provided by the Federal Power Act to regulate the wholesale market, to remedy the deficiencies in the current market designs described above.

C. The Need for Resiliency is Real and Pressing

1. Defining Resiliency

As described in the Proposed Rule and summarized above, there is an urgent need for the markets to value resiliency. NEI supports DOE's analysis of resiliency, both the need to maintain it in a sustainable fashion and how to identify units that contribute to it. FERC Staff appropriately asks a fundamental question: what is resiliency? While this term is not yet defined in the Commission's regulations, resiliency is not a new concept and has been the subject of federal government concern at least since 1998.[44] Both the federal government and NERC have similar definitions of resilience.

NERC has adequately defined the fundamental principles of resiliency. NERC uses the infrastructure resilience definition that the Department of Homeland Security's National Infrastructure Advisory Council developed in 2010: "**Infrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient**

[44] National Security Council and National Security Council Records Management Office, Presidential Decision Directive 63: Critical Infrastructure Protection (PDD 63) (May. 22, 1998), Clinton Digital Library, *available at* https://clinton.presidentiallibraries.us/items/show/12762.

infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event."[45]

NERC has also explained how baseload resources with secure fuel sources contribute to resiliency:

> [I]t is not the economics nor the fuel type that make these resources attractive from a reliability perspective. Rather, these conventional steam-driven generation resources have low forced and maintenance outage hours traditionally and have low exposure to fuel supply chain issues. Therefore, "baseload" generation is not a requirement; however, 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 BPS. These characteristics ensure that "baseload" generation is more resilient to disruptions.[46]

NERC's description of resiliency is similar to the "defense-in-depth" approach used by the nuclear energy industry. In the industry's vernacular, defense-in-depth means "having multiple, redundant, and independent layers of safety systems or physical barriers to protect against the occurrence, as well as the consequences, of an accident."[47] Thus, defense-in-depth helps ensure the safety and resiliency of nuclear generation units because they do not wholly depend on any single element of the design, construction, maintenance, or operation of a nuclear facility. The same concept applies to the Proposed Rule's description of resiliency. That is, the Proposed Rule focuses on "power plants that can withstand major fuel supply disruptions caused by natural or man-made disasters and, in those critical times, continue to provide electric energy,

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[45] DOE Staff Report at 63 (citing NERC, *Severe Impact Resilience Task Force, Severe Impact Resilience: Considerations and Recommendations* (May 2012), *available at* http://www.nerc.com/comm/OC/SIRTF%20Related %20Files%20DL/SIRTF_Final_May_9_2012-Board_Accepted .pdf).

[46] DOE Staff Report at 5 (citations omitted).

[47] United States Nuclear Regulatory Commission, *Historical Review and Observations of Defense-in-Depth*, Office of Nuclear Regulatory Research 1-1 (April 2016), *available at* https://www.nrc.gov/docs/ML1610/ ML16104A071.pdf.

capacity, and essential grid reliability services."[48] It is a combination of both (1) hardened facilities that can absorb, adapt to, and rapidly recover from a potentially disruptive event, and (2) secure fuel assurances with minimal exposure to fuel supply chain issues that lead to the attributes of resilience described in the Proposed Rule. As such, the term resiliency is properly framed in the Proposed Rule.

As described in the attached declaration of Caitlin Durkovich, former Department of Homeland Security Assistant Secretary for Infrastructure Protection,[49] the federal government has made resiliency a key component of its national security strategy for more than 20 years. For example, in 2013 the White House issued "Presidential Policy Directive 21—Critical Infrastructure Security and Resilience."[50] That directive stated that, "[i]t is the policy of the United States to strengthen the security and resilience of its critical infrastructure against both physical and cyber threats."[51] It also defined resilience as "**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**."[52] While the concept of resiliency may have received insufficient attention in federal energy regulation, it has long been considered a vital

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[48] Proposed Rule at 2. Sandia National Laboratories has similarly emphasized, '[t]he concept of reliability must be augmented with a resiliency approach—one that looks at the grid not strictly as a flow of electrons but as a grid that services, interfaces with, and impacts people and societies.' Our current resilient and diverse portfolio serves as a hedge against price volatility and supply disruptions in any part of the portfolio, minimizing not only outages but also other societal consequences." Sandia Nat's Labs., Grid Reliance: Why Reliability Is Not Enough, http://energy.sandia.gov/energy/ssrei/gridmod/resilient-electric-infrastructures (last visited October 9, 2017) (emphasis in the original).

[49] The Durkovich Declaration is attached hereto as Exhibit A.

[50] Nat'l Archives, Archived Obama White House Website, Presidential Policy Directive 21: Critical Infrastructure Security and Resilience (PPD-21) (Feb. 12, 2013), *available at* https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil.

[51] *Id*.

[52] *Id*. (emphasis added).

component of our national security. As emphasized in the attached Durkovich Declaration, there is "an important distinction between reliability and resilience. While both are critically important, they are different concepts. Reliability minimizes the likelihood of a loss or interruption of service to customers. In contrast, the concept of resilience focuses on minimizing disruptions *and* resuming to normal operations as quickly as possible."[53]

2. Fuel Diversity is a Component of Resiliency

FERC Staff poses the question, "[i]s fuel diversity within a region or market itself important for resilience? If so, has the changing resource mix had a measurable impact on fuel diversity, or on resilience and reliability?" The answer to both questions is yes.

The U.S. currently enjoys the benefits of having a diverse electricity supply, the result of a combination of factors, including competitive forces and federal and state policy. However, we cannot take that fuel diversity for granted, and it is at risk.[54] Maintaining and promoting fuel diversity not only provides important economic benefits, but also protects the electric grid from becoming too dependent on any one fuel source—an issue that NERC has previously stressed.[55]

A diverse portfolio of fuels and technologies—nuclear, coal, natural gas, hydro, non-hydro renewables, efficiency—serves as a hedge against price volatility and supply disruptions,

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[53] Durkovich Declaration at ¶ 6. The Durkovich declaration also addresses the threats and hazards that dictate the need for, and place greater value on, diversity of resources across the critical infrastructure ecosystem, and specific to the Proposed Rule, in fuel sources and baseload resources.

[54] The closing of the San Onofre nuclear facility in California, for example, dropped nuclear energy as a percentage of California's electric generation from 18.3 percent to approximately 9.0 percent. As a result, 75 percent of the San Onofre generation was replaced with more expensive generation. The substitution of this power "increase[d] California consumers' exposure to . . . the risks of low hydroelectric generation due to Western Interconnection drought cycles." In addition, the cost of electricity to California consumers increased by approximately $350 million during the first twelve months after closure, and caused carbon emissions to increase by an amount worth $320 million. 2014 IHS Study at 30-31.

[55] NERC has voiced its concerns with the ever-increasing risks associated with single fuel dependency, particularly during extreme weather conditions. *See* NERC, 2016 *Long-Term Reliability Assessment*, vii-viii (Dec. 2016), *available at* http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2016%20Long-Term%20Reliability%20Assessment.pdf (*hereinafter* NERC, 2016 Long-Term Reliability Assessment).

while providing additional cost savings benefits to customers. For instance, a recent study concluded that maintaining the current, diversified U.S. electric supply portfolio lowers the cost of electricity production by about $114 billion per year.[56] The study also estimated that the premature retirement of existing electric generating resources and replacement with new natural gas and renewable generation would increase retail power prices by about 25 percent and net consumer costs by about $98 billion per year.[57]

The significant cost increase to consumers when nuclear power plants are retired before it is economic to do so has already been borne out in Germany. A 2014 estimate concluded that Germany's net export losses directly attributed to the electricity price differential as a result of closing nuclear power plants before it was economic to do so totaled €52 billion for the six-year period from 2008 to 2013.[58] The Commission must ensure that the same does not happen here.

Reducing fuel diversity has a measurable, well-documented adverse impact on resilience and reliability.[59] As discussed in the attached declaration of Mrs. Durkovich, resource diversity is a critical part of any resiliency program.[60] Common sense, as well as numerous reports and analyses, demonstrate that fuel diversity within a region or market is itself important for the

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56 IHS Markit, *Ensuring Resilient and Efficient Electricity Generation* (September 2017), https://www.globalenergyinstitute.org/sites/default/files/Value%20of%20the%20Current%20Diverse%20US%20Power%20Supply%20Portfolio_V3-WB.PDF (*hereinafter* 2017 IHS Study).

57 *Id*. at 37-38. Extrapolated over the next 20 years, therefore, failing to maintain the resource diversity necessary for a cost-effective power supply system by prematurely retiring nuclear (and coal) baseload units could increase electricity costs by as much as $2 trillion, which in turn would have large adverse impacts on U.S. GDP and jobs.

58 2014 IHS Study at 9-10 (citing IHS Global, *A More Competitive Energiewende: Securing Germany's Global Competitiveness in a New Energy World* (March 2014), *available at* https://www.vci.de/vci/downloads-vci/media-weitere-downloads/dokumente/2014-03-ihs-report-a-more-competitive-energiewende-english.pdf).

59 *See id.* at 31 (discussing the San Onofre example in California).

60 Durkovich Declaration at ¶¶ 10-18.

ability of the relevant electric grid to withstand and recover from stresses caused by weather, such as Western droughts, extreme cold weather or hurricanes, as well as man-made disruptions.

D. Nuclear Plants Contribute to Resiliency

Currently, nuclear generation plants contribute to a diverse fuel mix in the U.S. that not only provides flexibility to changing markets, but also offers secondary fuel options if another fuel source is otherwise limited. However, as noted above, this fuel mix cannot become dependent on any one fuel source. Any market that relies too heavily on any one fuel source is threatened by extreme price volatility and price spikes, as well as energy shortages associated with interruptions in that primary fuel.[61]

1. Benefits of On-Site Fuel

DOE recognizes on-site fuel as a key attribute of a generating unit's ability to contribute to resiliency and therefore makes "on-site fuel assurance" a key eligibility component in the Proposed Rule. The Proposed Rule, quoting NERC, states that, "[c]oal-fired and nuclear generation have the added benefits of high availability rate, low forced outages, and secured on-site fuel. Many months of on-site fuel allow these units to operate in a manner independent of supply chain disruptions."[62] The DOE Staff Report also concludes that, "[a]s NERC noted, low exposure to fuel supply issues is one of the fundamental necessities of a reliable BPS."[63]

Nuclear plants have on-site fuel security and satisfy this requirement. One of the key attributes that makes nuclear power facilities unique resources within generation portfolios is their ability to operate for long periods—typically 18 to 24 months—between scheduled refueling outages. The attached McCullum declaration describes the process of nuclear fuel

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61 NERC, 2016 Long-Term Reliability Assessment at vii-viii.

62 Proposed Rule at 6.

63 DOE Staff Report at 95.

procurement, and how it protects against fuel price volatility or supply disruptions that face other fuel sources.[64] This fuel assurance attribute avoids reliance on spot fuel deliveries. In addition, even if there is a delay in the arrival of new fuel, a nuclear reactor could continue to operate for an additional three months before reaching 70 percent capacity and two more months beyond that (for a total of five months) before decreasing to 50 percent capacity—a unique and valuable attribute during any extended disturbances.[65]

By contrast, natural gas—which is heavily used by other non-power sectors of the economy—is subject to sudden increases in price and scarcity. NERC found in its most-recent Winter Reliability Assessment that "transportation and delivery challenges may impact the ability for some natural-gas-fired generation to receive fuel to serve on-peak demand," and noted that in ISO-NE alone, "nearly 3,450 MW of capacity could be at risk when natural gas pipelines become constrained [during the 2016-2017 winter capacity period]."[66]

NERC issued an even more dire warning in its landmark 2016 Reliability Assessment, *Short Term Special Assessment—Operational Risk Assessment with High Penetration of Natural Gas-Fired Generation*,[67] which was published in the wake of the catastrophic outage of the Aliso Canyon gas storage facility in California. NERC provided a stark assessment of the threats to reliability presented by overreliance on natural gas-fired generation in the first two of its three ultimate "Key Findings:"

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64 *See* McCullum Declaration ¶¶ 9-12.

65 DOE Staff Report at 95.

66 NERC, *2016-2017 Winter Reliability Assessment of the North American Electric Reliability Corporation* at 6 (Nov. 11, 2016), *available at* http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/WRA%202016_2017_final.pdf.

67 NERC, *Short Term Special Assessment – Operational Risk Assessment with High Penetration of Natural Gas-Fired Generation* (Aug. 26, 2016), *available at* http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC%20ShortTerm%20Special%20Assessment%20Gas%20Electric_Final.pdf.

> Assessment areas with a growing reliance on natural gas-fired generation are increasingly vulnerable to issues related to gas supply unavailability. Common-mode, single contingency-type disruptions to fuel supply and deliverability in areas with a high penetration of natural gas-fired generation are reducing resource adequacy and potentially introducing localized risks to reliability.
>
> Not only can impacts to BPS reliability occur during the gas-load peaking winter season, but they can also manifest during the summer season when electric demand is high and natural gas facilities are out of service, which can lower the operational capacity and flow of the pipeline system.[68]

By maintaining ample on-site fuel, together with the hardened features of nuclear facilities, nuclear generation resources can operate through many extreme weather conditions, and can provide a crucial hedge against the reliability threats posed by generation resources that use less secure fuel source.

2. Low Fuel Cost Volatility

In addition to their contributions to reliability, nuclear power resources provide price stability. The low marginal cost of production plays an important role in energy markets based upon security-constrained economic dispatch. Unlike other power plants, where fuel costs can account for 80 to 90 percent of production costs, fuel accounts for just 31 percent of production costs in nuclear power plants.[69] For example, one uranium fuel pellet—which is about the size of a pencil eraser—produces the same energy as 17,000 cubic feet of natural gas, 1,780 pounds of coal, or 149 gallons of oil.[70]

3. Highest Capacity Factors

Nuclear energy is by far the most efficient of all generation resources, achieving capacity factors that dwarf other forms of energy production. Furthermore, the nuclear energy industry

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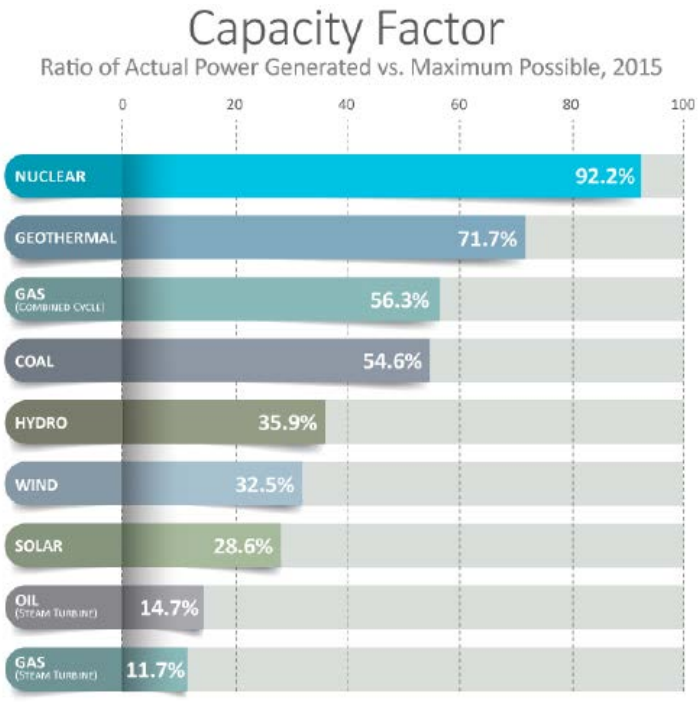
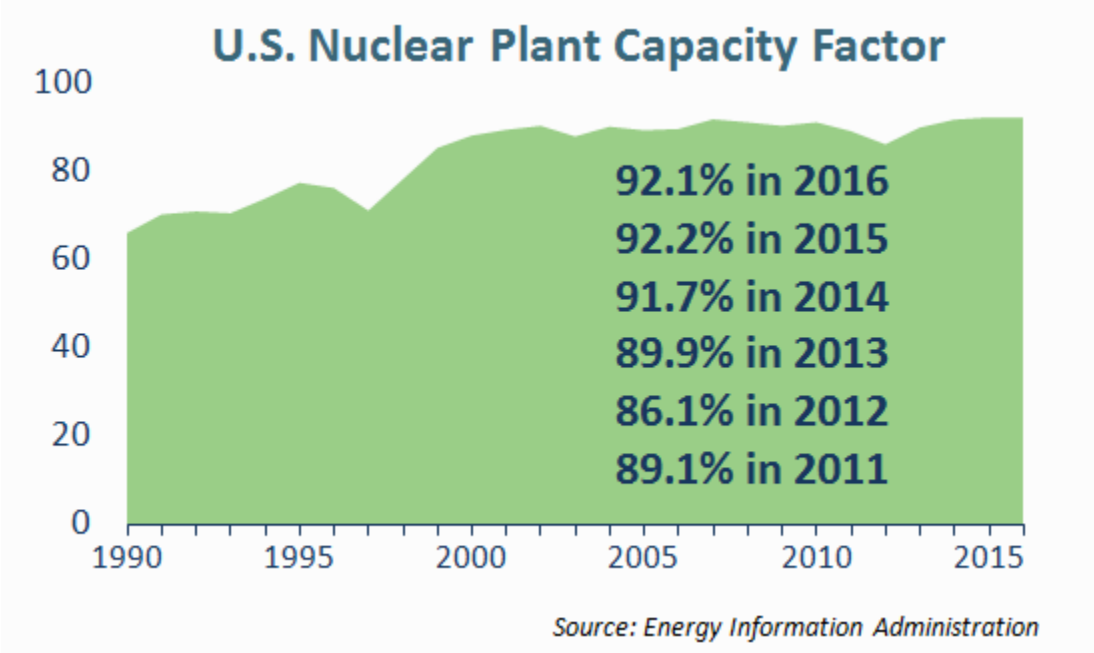
[68] *Id*. at vi.

[69] NEI, *Why Nuclear Energy?, available at* https://www.nei.org/Why-Nuclear-Energy/Reliable-Affordable-Energy/Electricity-Supply.

[70] *Id*.

continues to make consistent gains in this area over the last decade. As referenced above, 2016 saw U.S. reactors continue to set a record capacity factor of over 92 percent.





E. The Path Forward

NEI again commends the Secretary and the Commission for their leadership on this issue. While acting on the Proposed Rule within a 60-day time period may be challenging, expedited action is both warranted and feasible. NEI supports the framework in the Proposed Rule to provide cost-of-service compensation for nuclear generation units at least until other sustainable market structures are put in place that appropriately value the resiliency attributes that nuclear generation resources provide. NEI also strongly supports state action to provide support for nuclear generation. While various RTO proposals currently being considered in the stakeholder process may have significant promise to address these challenges in part—and they should be encouraged—the Commission should take expedited action.

Within the 60-day timeframe, the Commission should amend its regulations to: (1) require RTOs to provide cost-of-service compensation to eligible units; and (2) require RTOs expeditiously to enact market reforms to value resource diversity and resiliency.

1. Commission Action Should Respect State Action

State legislatures and regulatory bodies have long been critical players in establishing each state's generation mix. While the federal initiative in the Proposed Rule is both timely and necessary, certain states have already taken or will take action exercising their traditional police powers to enact public policies that support maintaining their nuclear generation resources. States are in a unique position to decide the role of nuclear generation for their citizens, and consider issues like environmental benefits, job impacts, and economic development, among others. Several states in RTO regions affected by the Proposed Rule have recently acted, or have

suggested they may act, to provide financial support for nuclear generation to ensure their viability.[71] The exercise of those police powers should remain undisturbed.

However, state actions do not obviate the need for Commission action. Ensuring the resiliency and diversity of the grid at large is ultimately this Commission's responsibility. The Commission has a duty to ensure that the interstate power markets send the appropriate signals to incentivize resiliency and resource diversity. The Commission's action in this proceeding should be respectful of those state efforts, not supplant, postpone, or delay them.

2. The Commission Should Continue to Pursue Price-Formation Reform

While the Commission has been considering price formation issues for several years, problems still persist. Price formation improvements will allow the market to better reflect the actual cost of generating the electricity we need. Furthermore, improving price formation to provide fair compensation is necessary to appropriately value all forms of generation. Accurate price signals are necessary to create efficient short-run resource allocation decisions and to provide a basis for long-term investment decisions.[72] Therefore, as recommended by the DOE Staff Report, "FERC should expedite its efforts with states, RTO/ISOs, and other stakeholders to improve energy price formation in centrally-organized wholesale electricity markets. After several years of fact finding and technical conferences, the record now supports energy price formation reform, such as the proposals laid out by PJM and others."[73]

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[71] State proposals to support nuclear generation, or value their attributes, have been either implemented or proposed in Illinois, New York, Connecticut, and Ohio.

[72] *See State Policies and Wholesale Markets Operated by ISO New England Inc., New York Independent System Operator, Inc., and PJM Interconnection, L.L.C.*, Comments of the Nuclear Energy Institute, Docket No. AD17-11-000 (June 22, 2017).

[73] DOE Staff Report at 126.

3. FERC Should Adopt a Cost-of-Service Option At Least Until Other Sustainable Market Structures Are in Place

NEI also supports the Secretary's goal of ensuring that certain resiliency and fuel diversity attributes of qualifying electric generation resources are fully valued. The Proposed Rule would require that RTOs develop a new rate for "eligible grid reliability and resiliency resources" as follows:

> Each Commission-approved independent system operator or regional transmission organization shall establish a tariff that provides a just and reasonable rate for the (A) purchase of electric energy from an eligible reliability and resiliency resource and (B) recovery of costs and a return on equity for such resource dispatched during grid operations. The just and reasonable rate shall include pricing to ensure that each eligible resource is fully compensated for the benefits and services it provides to grid operations, including reliability, resiliency, and on-site fuel assurance, and that each eligible resource recovers its fully allocated costs and a fair return on equity.

The development of market rules to properly value qualifying generation units could take some time and therefore a backstop cost-of-service relief option is needed now to prevent critical assets from retiring in the interim. At the same time, the Commission should seek broader solutions to maintain the resilience and diversity of the electric grid.

In order to provide an interim cost-of-service solution, it is crucial that the Commission quickly determine eligibility and authorize full cost recovery in this proceeding to stem the premature retirement of nuclear generating resources.

a. Unit Eligibility

DOE's criteria are generally well-supported and tailored to address the resource diversity and resilience issues described in the Proposed Rule and outlined above. The criteria target generation units that are otherwise compliant with applicable laws and capable of providing essential energy and ancillary reliability services, but that are most vulnerable to the failure of

RTO markets to value other resiliency-promoting benefits, such as fuel diversity and on-site fuel security.

A central piece of the Proposed Rule's criteria is the requirement for generation units to have the requisite fuel supply on site for power generators when they are needed most during and after emergencies, storms, and disasters that threaten and interrupt fuel supplies. Due to their unique 18- to 24-month fuel cycles, nuclear energy generators are well-positioned to not only provide hedges against price volatility, but also to deliver essential power and services during supply disruptions or other reliability problems for an extended time. NEI believes that this on-site fuel assurance requirement helps differentiate between most resources that are dependent upon receiving new fuel supplies on a consistent, short-term basis, and those unique resources that offer the resiliency needed during and after a disaster or disturbance.

The Proposed Rule also requires eligible units to be able to provide key ancillary services. The ability to provide essential energy and ancillary reliability services also constitutes an appropriate criterion. The illustrative list of energy and ancillary reliability services in the Proposed Rule, however, must not be given such a tortured interpretation so as to require that every eligible resource provide every type of conceivable energy and ancillary reliability service. While nuclear facilities may have certain operational and license-based restrictions on providing primary frequency response, nuclear facilities provide many energy and ancillary reliability services. As such, they clearly are intended to be eligible for the program as defined in the Proposed Rule. As just one example, nuclear generators provide inertial response services to stabilize frequency deviations after the sudden loss of generation from the grid.[74] Inertial

[74] *See Essential Reliability Services and the Evolving Bulk-Power System—Primary Frequency Response*, Notice of Proposed Rulemaking, 157 FERC ¶ 61,122 at P 6 (2016) ("Mitigation of frequency deviations after the

response provides value to the grid, by among other things, minimizing the need for primary frequency response and therefore the ability to provide this type of service should satisfy the criteria in the Proposed Rule.[75]

b. Cost Recovery

Under the Proposed Rule, "compensable costs shall include, but not be limited to, operating and fuel expenses, costs of capital and debt, and a fair return on equity and investment."[76] NEI supports the principle that full cost recovery should be permitted. Nuclear energy is unique in that it has very low marginal costs, which provides price stability.[77] However, due to important regulatory and other requirements, nuclear energy is also characterized by higher fixed costs.

While the Commission considers how to achieve the Secretary's goal for the long-term, a *full* cost of service recovery mechanism as an interim backstop is necessary to ensure that nuclear generation units are not prematurely retired, and their resilience benefits lost forever. The Proposed Rule recognizes that we cannot take fuel security, long-term rate stability, system resiliency, and fuel and technology diversity for granted, and that current market rules need to be revised in order to properly value those benefits. The Commission is empowered, and indeed, obligated, to remedy this problem.

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sudden loss of generation or load is driven by three primary factors: inertial response, primary frequency response, and secondary frequency response.").

[75] *Essential Reliability Services and the Evolving Bulk-Power System—Primary Frequency Response*, NEI Comments, Docket No. RM16-6-000, 5 (Apr. 22, 2016).

[76] Proposed Rule at 19.

[77] "The magnitude of the gap between operating revenues and operating costs is in the range of $5–$15 per megawatt-hour (MWh). For a 1,000 MW nuclear unit, approximately every $5/MWh of gap represents about $40 million in annual negative cash flow." DOE Staff Report at 29 (citing Ronaldo Szilard, Phil Sharpe, Edward Kee, Edward Davis, and Eugene Grencheck, Economic and Market Challenges Facing the U.S. Nuclear Commercial Fleet Energy (Idaho National Laboratory and Center for Advanced Energy Studies, September 2016), https://gain.inl.gov/Shared%20Documents/Economics-Nuclear-Fleet.pdf).

4. Market Reforms to Value Diversity and Resiliency

A cost-of-service backstop is the most effective way to stem the loss of additional merchant nuclear generation units, but it is not necessarily an end state. Rather, cost-based compensation should be used as an interim measure at least until the Commission can enact market reforms that place the appropriate economic value on resource diversity and resiliency. The Commission should determine what system risks are not being addressed by current market designs and should require RTOs to move expeditiously to propose pricing mechanisms that ensure markets will ensure system resilience, and open new proceedings as necessary.

IV. EXHIBITS

Exhibit A – Declaration of Caitlin Durkovich, Director, Toffler Associates, Inc.

Exhibit B – Declaration of Rodney McCullum, Senior Director, Fuel and Decommissioning Programs, Nuclear Energy Institute

V. CONCLUSION

For the foregoing reasons, NEI respectfully submits these comments and requests that the Commission act expeditiously to address these important issues.

Respectfully submitted,

Nuclear Energy Institute

By: /s/ Ellen C. Ginsberg

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EXHIBIT A

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Grid Reliability and Resiliency Pricing	**)**	**Docket No. RM18-1-000**

DECLARATION OF CAITLIN DURKOVICH IN SUPPORT OF RULEMAKING COMMENTS OF THE NUCLEAR ENERGY INSTITUTE

1. My name is Caitlin Durkovich. I am a Director at Toffler Associates, Inc., a future-focused strategic advisory firm. I served eight years at the Department of Homeland Security, and from May 2012 to January 2017, I had the privilege of serving as the Assistant Secretary for Infrastructure Protection, leading the national effort to secure and enhance the resilience of the nation's critical infrastructure. In this capacity, I served as the Chair of the Nuclear Government Coordinating Council and the Co-Chair of the Energy Sector Government Coordinating Council. I have nearly twenty years of experience in homeland security, developing physical and cyber risk management approaches for all-hazards, to include complex mass attacks, cyber and non-traditional aviation threats, improvised explosive devices, electric grid threats, space hazards, and climate adaptation. In my current position, I help public and private sector clients navigate the strategic challenges posed by our increasingly interconnected and interdependent global economy.

2. I have personal knowledge of the matters discussed in this Declaration.

3. My declaration addresses (1) the definition of resilience, the difference between resilience and reliability, and resources and strategies that can address resilience; and (2) the threats and hazards that dictate the need for and place greater value on diversity of resources

across the critical infrastructure ecosystem, and specific to the Department of Energy's ("DOE") September 28, 2017 proposed rulemaking (the "Proposed Rule"), in fuel sources and base load resources.

Resiliency

4. The relationship between a functioning and viable critical infrastructure and economic and national security has been a central element of Federal policy for more than twenty years. Issued in 1998, Presidential Decision Directive-63: *Critical Infrastructure Protection* established a national goal to assure the continuity and viability of critical infrastructures and mandated any interruptions or manipulations of these critical functions must be brief, infrequent, manageable, geographically isolated and minimally detrimental to the welfare of the United States.

5. In 2013, faced with increasing threats and points of vulnerability that could disrupt infrastructure and cascade across an increasingly interconnected and interdependent ecosystem, the Federal government promulgated an updated national critical infrastructure policy, Presidential Policy Directive 21, *Critical Infrastructure Security and Resilience,* advancing a national unity of effort to strengthen and maintain secure, functioning, and resilient critical infrastructure. A significant portion of this policy was the addition of the concept of resilience. The definition of resilience was debated throughout the drafting process, but when PPD-21 was published in February 2013, it clearly defined resilience as "the ability to withstand and rapidly recover from all hazards." Its implementation recognized the need for the Federal government to support critical infrastructure owners and operators in managing risks to their individual operations and assets, and to determine effective strategies to make them more secure and resilient.

6. The policy has propagated an important distinction between reliability and resilience. While both are critically important, they are different concepts. Reliability minimizes the likelihood of a loss or interruption of service to customers. In contrast, the concept of resilience focuses on minimizing disruptions *and* resuming to normal operations as quickly as possible.

7. PPD-21 identified energy and communications systems as uniquely critical due to the enabling functions they provide across all critical infrastructure sectors and, in mandating an update to the risk management framework used to strengthen the security and resilience of critical infrastructure (*The National Infrastructure Protection Plan*), instructed the Federal government to consider sector dependencies on energy and communications systems, and identify pre-event and mitigation measures or alternate capabilities during disruptions to these systems.

8. PPD-21 has informed and served as an effective framework for numerous national risk management strategies, to include the *National Space Weather Strategy and Action Plan* (October 2015) and the *Joint United States-Canada Electric Grid Security and Resilience Strategy* (December 2016). The Federal Energy Regulatory Commission ("Commission") has been an integral part of these collaborative approaches to protect today's grid, manage contingencies by enhancing response and recovery capabilities, and cultivating a more secure and resilient grid.

9. In sum, my reading of the Proposed Rule leads me to conclude that it is consistent with, and a natural extension of, these ongoing government efforts towards securing our critical infrastructure and maintaining resilience of the electric grid.

Resource Diversity is Important in An Increasingly Complex Risk Environment

10. The government-wide efforts on critical infrastructure protection I describe above segment the nation's base of critical assets into several "sectors." Each critical infrastructure sector has unique characteristics, operating models, and risk profiles that benefit from a national risk management framework that recognizes the unique attributes of each sector and subsector but takes a holistic approach to security and resilience. The energy sector is divided into three interrelated segments or subsectors—electricity, oil, and natural gas—to include the production, refining, storage, and distribution of oil, gas, and electric power—while hydroelectric and commercial nuclear power facilities are governed by the Dams and the Nuclear Sector respectively. Each sector, leveraging institutional knowledge and specialized expertise of industry and government, is required to develop a sector specific plan to help guide and integrate the sector's continuous effort to improve the security and resilience of its critical infrastructure. The Commission has played an important role in the development of these plans and other strategies designed to secure and enhance the resiliency of the sector.

11. The energy subsectors, which include asset owners and operators and the government agencies with expertise in each sector, have identified several issues as the key risks and threats to its infrastructure and/or continuity of business: Cyber and physical security threats; natural disasters and extreme weather conditions; workforce capability ("aging workforce") and human errors; equipment failure and aging infrastructure; and evolving environmental, economic, and reliability regulatory requirements. According to the 2015 Energy Sector Specific Plan, there are risks unique to each subsector (changes in the technical and operational environment, including changes in fuel supply are an identified risk to the electric subsector while volatile oil and gas prices and demands is a risk inherent to the oil and natural gas sector).

12. Equally important, is the consideration that operating environments have inherently different vulnerabilities and the consequences of threats and hazards play out differently, depending on the characteristics of the operating environment (physical and virtual) and the level of protection or defense.

13. In managing risk to any infrastructure sector, the redundancy and diversity in capabilities and services that are essential to the functioning of a critical asset is an important planning element. Redundancy and diversity are fundamental principles of continuity planning, both at the enterprise and the sector level. The communications sector, for example, relies on a principle of route diversity, which ensures communications routing between two points over more than one geographic or physical path with no common points.

14. In the energy industry, diversity of fuel source plays an important role in mitigating the threat of an attack, and recovering from such an attack. For example, if the natural gas pipeline system was threatened or disrupted by any sort of national security event, the nation would turn to power sources that were not dependent on the gas delivery system—in this case nuclear, renewables, and coal. Threats to rail cars that deliver coal may similarly require greater reliance on nuclear, gas, and renewables. Our nation's current ability to generate power from multiple fuel sources is a strategic advantage that must be protected.

15. According to the 2015 Nuclear Sector Specific Plan, nuclear facilities are among the most *physically* hardened U.S. infrastructure, using a defense in-depth security that employs independent, redundant layers of defense to guard against single-point failures. Nuclear power reactors, which generate 20 percent of the U.S. electricity, are required to protect against the design basis threat (DBT)—an assessment that identifies all adversaries and attack capabilities

that threaten a specific site—and therefore can provide critical diversity in the face of some of the more extreme threats and hazards.

16. Diversity in the energy markets is even more critical in the context of increasing geopolitical tensions and a dynamic dangerous threat environment. Our adversaries, whether Nation-State or non-State actors, understand the national strategic value of our critical infrastructure, and using increasingly asymmetric means, have developed capabilities and are targeting strategic infrastructure in an attempt to "unlevel the playing field" and "escalate to deescalate."

17. It is also my understanding that merchant nuclear plants are facing market challenges that could drive some of them to premature retirement. Implementing DOE's proposal to stem the loss of power plants that provide attributes of resilience would be one important step (potentially of many in the energy sectors) toward helping ensure the U.S. has a resilient grid. At a minimum, we should ensure the nation's market structure does not threaten fuel diversity without fully comprehending the impacts of such a loss.

18. Asymmetric threats are part of a range of existential threats that require us to continue to advance a national policy of critical infrastructure resilience. Whether Mother Nature's unyielding power, as we recently witnessed in Hurricane Maria; the increasing intent and capability of our adversaries, as evidenced by the destructive malware that targets the energy sector; or the possibility of a combined incident, where in the midst of a polar vortex or a superstorm, our adversaries may choose to exercise the footholds they have gained; we now operate with an anticipation of "when," and not "if." This reality requires that we must both anticipate disruptions to critical infrastructure and maintain and strengthen the redundant and resilient capabilities to mitigate the consequences, to withstand and rapidly recover. Simply

stated, diverse fuel sources are critical to the resilience of the electric grid. Whatever further study is necessary should be undertaken but not after further closures of facilities that now contribute to resilience and, once shuttered, will not be brought back on line.

19. In accordance with 28 U.S.C. § 1746, I state under penalty of perjury that the foregoing is true and correct.

Executed on October 23, 2017.

By: /s/ Caitlin Durkovich

Caitlin Durkovich, Director
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Reston, VA 20190

EXHIBIT B

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Grid Reliability and Resiliency Pricing	**)** **)** **)**	**Docket No. RM18-1-000**

DECLARATION OF RODNEY McCULLUM IN SUPPORT OF RULEMAKING COMMENTS OF THE NUCLEAR ENERGY INSTITUTE

1. My name is Rodney McCullum. I am Senior Director, Fuel and Decommissioning Programs, at the Nuclear Energy Institute, Inc. ("NEI"). I hold a Bachelor of Science degree in Nuclear Engineering (1980, University of Cincinnati) and a Master of Business Administration degree (2000, Lewis University). In my current position, I lead, manage, and direct NEI's efforts to develop and implement technical and regulatory programs to achieve the goals of the nuclear energy industry for safe and effective nuclear fuel management and decommissioning.

2. I have personal knowledge of the matters discussed in this Declaration.

3. NEI's members include all entities currently licensed to operate the 99 commercial nuclear power reactors in the United States. NEI's members also include entities that are decommissioning reactors that have permanently ceased operations.

4. My declaration will provide factual support on two significant issues raised in NEI's rulemaking comments. First, I will explain that once a nuclear generating unit retires before the end of its useful life, it is highly unlikely to return to service. Stated more directly, once these units are gone, they are gone. Second, I will explain the nature of a nuclear unit's on-site fuel capability, and discuss how that fuel process protects nuclear units from short-term market price volatility and supply disruption.

Nature of Nuclear Plant Retirements

5. Once nuclear plants retire, they are extremely unlikely to return to service. There is no established process to mothball and repower nuclear power plants. For a commercial nuclear power plant to operate in the United States, it first has to obtain an operating license from the U.S. Nuclear Regulatory Commission ("NRC"). The NRC is responsible for licensing and regulating the construction, operation, and decommissioning of nuclear power plants. When a nuclear power plant licensee decides to shut down the plant permanently, it is required by NRC regulations to submit a written certification of permanent cessation of operations to the NRC within 30 days. When nuclear fuel is permanently removed from the reactor vessel, the licensee must submit another written certification to the NRC. Once the NRC has docketed these two certifications, the NRC's regulations state that the licensee is no longer authorized to operate the reactor or place fuel into the reactor vessel. This fundamentally changes and limits the activities permitted by the license. Once a licensee has lost its authority to operate the reactor, there is no established regulatory process to reverse that decision.

6. Within two years after permanently ceasing operations, a licensee must submit a post-shutdown decommissioning activities report to the NRC. This report provides a description of the planned decommissioning activities, a schedule for accomplishing them, and an estimate of the expected costs. The licensee can begin major decommissioning activities 90 days after submitting the report (assuming the licensee has submitted the certifications described above). Even if a licensee plans to decommission over an extended time, it will typically take certain actions shortly after ceasing operations that significantly alter the status of the facility. For example, structures, systems, and components that are not required to support the spent fuel pool or site surveillance and security are removed from service. Once removed from service, it is

unlikely these structures, systems, and components could be reused without significant review by the NRC, up to complete relicensing of the facility, if the licensee were to attempt to regain its authorization to operate.

7. As noted above, once a licensee has lost its authority to operate the reactor, there is no established regulatory process to reverse that decision. Although we do not know exactly what such a process would look like, it might be similar to the process of applying for a new operating license. The Tennessee Valley Authority ("TVA") commenced operations of Watts Bar Nuclear Generating Station Unit 2 in October 2016, some nine years after it notified the NRC of its plans to resume construction and restart the proceeding for the operating license of this new unit. Although the process might be less time consuming and burdensome than a request for a new operating license, even a request for a license amendment and exemption from the regulation that prohibits operation upon submission of the certifications described above would be a significant endeavor.

8. No U.S. plant has ever permanently shut down and defueled due to market conditions, and subsequently returned to service. The closest situation that I am aware of is Browns Ferry Unit 1, which shut down for performance reasons in 1985, but never submitted the certifications of permanent cessation of operations and of permanent fuel removal. After an extended shutdown period and extensive restart process, Browns Ferry was authorized by the NRC to restart in 2007. According to publicly available information, the recovery effort for Browns Ferry 1 took about 5 years (from the time TVA Board decided to restart the unit in 2002) and cost approximately $1.8 billion.

Benefits of On-Site Fuel

9. Nuclear power plants do not burn any fuel. Instead, they use uranium fuel, consisting of solid ceramic pellets, to produce electricity through a process called fission. Before its use in a reactor, uranium must undergo four processing steps to convert it from an ore to solid ceramic fuel pellets. These processes are mining and milling, conversion, enrichment, and fabrication and are referred to collectively as the nuclear fuel cycle. U.S. companies supply all stages of the nuclear fuel cycle. Uranium miners use several techniques to obtain uranium: surface (open pit), underground mining, and in-situ recovery. Only 0.7 percent of natural uranium is "fissile," or capable of undergoing fission, the process by which energy is produced in a nuclear reactor. The concentration of the fissile uranium-235 isotope needs to be increased—typically to between 3.5 and 5 percent uranium-235. At a conversion facility, the uranium oxide is converted into uranium hexafluoride. At an enrichment plant, centrifuges rapidly-spin vertical tubes of gaseous uranium hexafluoride that separates the uranium into two streams, one of which is being enriched to the required level and known as low-enriched uranium. The enriched uranium hexafluoride is transported to a fuel fabrication facility, and converted into uranium dioxide powder and pressed into fuel pellets. The fabricator loads the ceramic pellets into long tubes that are grouped together into a bundle. These tubes form a fuel assembly that is shipped to the nuclear power plant. Importantly, the nuclear fuel supply chain is secure and redundant. Nuclear power plants have diverse fuel supplier options to avoid any disruption due to challenges with any one supplier.

10. Nuclear fuel prices are based on the market prices for uranium, conversion, enrichment, and fuel fabrication. New fuel for a reactor outage is dependent on many factors, but

typically can range from $40-$50 million dollars under current market prices. On average, a refueling outage last 35 days.

11. Nuclear power plants are not reliant on “just in time” fuel deliveries. Nuclear fuel is delivered only once every 18 to 24 months for planned refueling outages. The most common means of transporting uranium fuel assemblies is by truck. The required fuel load for an outage can be transported in four or five trucks. A typical truckload supplying a commercial reactor in the U.S. contains approximately 13,000 pounds of fuel. The fuel assemblies are transported in robust packages specially constructed to protect them from damage during transport in accordance with NRC and U.S. Department of Transportation regulations.

12. The companies that operate nuclear power plants schedule their refueling and maintenance outages every 18 to 24 months, typically during fall or spring when electricity demand is at its lowest. The new fuel is ordered from the fuel vendor before the reactor goes into its outage and typically arrives four to six weeks before the outage, but could arrive as early as three months prior to an outage with proper planning. Once the new fuel arrives at the facility, it is stored on site in new fuel vaults or in pools. During each refueling outage, the oldest one-third of fuel rods within the reactor are replaced with the new fuel. The fuel that is removed from the core is placed in the spent fuel pool.

13. Because nuclear power plants always have fuel on site, even if there were a delay in the arrival of new fuel, the reactor could typically continue to operate for at least an additional three months before reaching 70 percent capacity and two more months beyond that (for a total of five months) before decreasing to 50 percent capacity. In addition, spent fuel in the spent fuel pool could be placed back into the reactor core to produce electricity (although it might be difficult to operate at 100 percent capacity for an extended period).

14. In accordance with 28 U.S.C. § 1746, I state under penalty of perjury that the foregoing is true and correct.

Executed on October 23, 2017.

By: /s/ Rodney McCullum

Rodney McCullum
Senior Director, Fuel and
Decommissioning Programs
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CERTIFICATE OF SERVICE

I certify that on this 23rd day of October, 2017, I have caused a copy of the foregoing document to be served upon each person listed in the Secretary's official service list for the above-referenced proceedings.

/s/ Jonathan M. Rund
Jonathan M. Rund
Associate General Counsel
Nuclear Energy Institute