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May 9, 2018

VIA FERC ELECTRONIC FILING SYSTEM
Federal Energy Regulatory Commission
Attn: eFiling Department
888 First Street, NE
Washington, DC 20426

Dear Sir or Madame:

On behalf of the Microgrid Resources Coalition, enclosed please find comments in response to FERC's proceeding on Grid Resilience in Regional Transmission Organizations and Independent System Operators, initiated January 8, 2018, submitted pursuant to Rules 214 and 211 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission. The motion to intervene of the Microgrid Resources Coalition is included as a separate document.

Thank you for your attention to this matter.

Very truly yours,

C. Baird Brown
Co-Counsel for the MRC

Christopher B. Berendt
Co-Counsel for the MRC

Microgrid Resources Coalition

Motion to Intervene and Comment

Docket No. AD18-7-000

Grid Resilience in Regional Transmission Organizations and Independent System Operators

Introduction

Pursuant to Rules 214 and 211 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC" or "Commission"), the Microgrid Resources Coalition ("MRC") hereby moves to intervene and submits its comments in connection with the Grid Resilience in Regional Transmission Organizations and Independent System Operators (Docket No. AD18-7-000, the "Resilience Docket"). The MRC is a consortium of leading microgrid owners, operators, developers, suppliers, and investors formed to advance microgrids through advocacy for laws, regulations and tariffs that support their access to markets, compensate them for their services, and provide a level playing field for their deployment and operations. In pursuing this objective, the MRC intends to remain neutral as to the technology deployed in microgrids and the ownership of the assets that form a microgrid. The MRC's members are actively engaged in developing and operating advanced microgrids in many regions of the United States.[1]

[1] The MRC is actively engaged in advancing the understanding and implementation of microgrids across the country. MRC members hold significant energy assets connected to the electric grids, provide energy generation and supply services, and are exploring microgrid construction and ownership in different locations throughout the country. MRC members include: Anbaric Transmission, Commonwealth Edison, Concord Engineering Group, Eaton, ENGIE, ICETEC Energy Services, Inc., Massachusetts Institute of Technology, NRG Energy, Inc., Princeton University, Thermo Systems, University of Missouri and the University of Texas. The MRC is affiliated with the International District Energy Association ("IDEA"), which connects members from all over the country operating

The MRC strongly supports the Commission's decisions to terminate consideration of the Department of Energy's proposed rule relating to Grid Reliability and Resilience Pricing (Docket No. RM18-1-000), and to open a new proceeding to examine holistically the resilience of the bulk power system. We encourage the Commission to use this opportunity to expand its inquiry into the sources of resilience. In particular:

- We urge the Commission to broaden its definition of "resilience" to acknowledge that resilience must be measured by the ability to sustain the health, security and economic activity of local communities.
- We believe that microgrids represent a class of uniquely resilient resources that employ hybrid generation, intelligent load management, and sophisticated controls to safeguard and manage included load and provide sophisticated services to the grid.
- We believe that distribution utilities can achieve grid resilience by using microgrids and other flexible, visible "grid edge"[2] resources as building blocks and by investing in distributed communication and controls that allow the reconfiguration of the distribution system in response to disturbances so that microgrids can support one another and the larger grid. The transmission system must respond to this evolution.
- The Commission has a continuing role to play in eliminating barriers to microgrid formation and participation in markets, encouraging the evolution of markets outside of RTOs and ISOs, and assuring just and reasonable compensation for the services that microgrids and other grid edge resources provide.

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combined heat and power plants and microgrids. This filing reflects the position of the MRC as an organization and should not be construed to reflect on the positions of any individual member.

[2] See discussion below at notes 10 and 55.

- The Commission should continue this proceeding to investigate new metrics and products that recognize contributions to resilience and can serve as the basis for expansion of power markets to support grid resilience.

As detailed below, we propose that the Commission collaborate with state and local authorities to ensure that resilience manifests locally where it matters most. We propose that the Commission address the emergence of more intelligent grid architecture, including advanced distribution systems as well as highly flexible and dispatchable grid edge resources in pursuit of a resilient power system.

Summary

The Commission's proposed definition of resilience: "the ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event"[3] is generally consistent with the proposal made by the MRC in the prior docket.[4] However, we believe it is important that the definition recognize that resilience for our society manifests in our communities. A holistic view of the bulk power system's resilience must recognize that powering the infrastructure necessary to maintain critical services to our communities is the ultimate measure of performance.

We support the calls for a working definition and suggest the following additions to the Commission's proposed definition of resilience (*italics*): "The ability to withstand and reduce the

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[3] Docket No. AD18-7-000, *Grid Resilience in Regional Transmission Organizations and Independent System Operators*, 162 FERC ¶ 61,012, issued January 8, 2018.

[4] The MRC previously proposed that "Resiliency" should be defined as "the ability to preserve critical infrastructure and functions for communities and customers, adapt the grid rapidly to disruptions, and promptly restore service that is lost." *See* Docket No. RM18-1-000, *Comments of the Microgrid Resource Coalitio*n, filed October 23, 2017.

magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover *the functioning of critical infrastructure to sustain essential services for communities during and* following such an event." We recognize the multi-jurisdictional aspects of these additions. As discussed below, we do not believe that jurisdictional issues present undue barriers to open markets, and we encourage state public utility commissions as well as other state, county, municipal and local authorities to adopt the same foundational definition.

Communities and customers are the best judges of where resilience matters most. They understand their critical needs for health, safety, and the preservation of economic activity. Reliability analysis of the bulk power system treats all local uses alike – no distinction is made between cooling a movie theater, a critical care nursing facility or refrigerated research specimens – and collective measures such as aggregate loss of load or average outage duration do not capture resilience where it matters. The need for resilience cannot be addressed in the limited context of the bulk power system, and does not stop at the boundaries of ISOs and RTOs. The goal of traditional reliability planning is to protect the bulk power system, the goal of resilience planning must be to ensure that the entire grid system works to protect our communities. Communities, customers, and state and local authorities must be involved in planning and implementing resilience solutions.

Thinking from the community up will result in the evolution of grid architecture.[5] Microgrids and other secure, flexible and dispatchable local resources are the fundamental

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[5] The commission has acknowledged the importance of this evolution in its recent Notice of a Technical Conference in Docket Nos. RM18-9-000 and AD18-10-000. See discussion at note 55.

building blocks of a resilient system, together with local storage, not only of electric energy, but also of thermal energy and fuel.[6] Distribution utilities will implement distributed energy resource management systems that can reconfigure the distribution system in response to disruption and allow local resources to support critical substations and circuits. The ability of the distribution system to act as a first line of defense in disruptions by incorporating local generation and storage, intelligent emergency load shedding by customers and communities, and local, temporary reconfiguration of the grid will both protect the transmission system and ultimately determine the nature of the transmission system we need.

The Commission's jurisdiction includes not only the transmission system but also the entire range of resources providing wholesale energy, capacity and ancillary services required by grid operators and the reliability of the system as a whole. We concur with PJM Interconnection, L.L.C. ("PJM") that the Commission should anchor its process in the wide array of jurisdictional authorities it possesses.[7] To help achieve resilience, Commission approved tariffs must include and value wholesale services provided by resilient resources operated primarily by or for the benefit of customers, whether behind the customer's meter or serving groups of local retail customers, either in a microgrid, through a virtual metering arrangement, or through another form of community aggregation.[8] These "grid edge" resources directly serve retail load[9] but are

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[6] Local storage can be part of the unified aggregation of resources that makes up a microgrid or a separate resource that may be networked with local microgrids.

[7] PJM Interconnection, L.L.C., *Initial Comments*, Docket No. AD18-7-000, at 5 (Mar. 9, 2018) ("PJM Comments"). The MRC commends PJM for its thoroughgoing response to the Commission and will reference several points made in its filing below.

[8] Customer aggregations may be formed either in the states that allow community choice aggregation, or through special purpose entities permitted under the laws of various states, such as a licensed retail electric supplier serving a local industrial campus or community.

[9] This definition does not include independent power producers who are interconnected at the distribution level, whose primary purpose is to make wholesale, merchant sales and are not contracted in direct support of retail load.

also capable of providing wholesale services directly or through aggregations. Such services can be provided directly to an ISO/RTO, distribution utility, retail electricity supplier, or any combination of the three.[10] Any overlap between markets in support of the transmission system and those in support of the distribution system can be addressed with metering and standard restrictions on incompatible commitments of physical resource capacity across markets. Grid edge resources can make crucial contributions to resilience by serving critical loads and supporting essential services at the source, independent of the distribution or transmission grid, and can also support the grid at all levels in times of stress.

Access to markets for grid edge resources is a beginning. It will encourage investment in resources that directly support critical community infrastructure, while making existing markets more competitive. The MRC suggests that the Commission must go further – because of the overlapping jurisdictional issues affecting these multifunctional resources, the Commission should work with state and local authorities to address resilience and work to identify metrics that can serve as the basis for new products and services (whether state or federally regulated, or both) intended to more directly address resilience.

Microgrids

Microgrids[11] represent some of the grid's most resilient resources. Every day, microgrids make their communities more resilient by providing efficient, high performance

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The MRC has no objection to such resources, but they present different investment incentives, generally face few barriers to participation in markets, and raise different jurisdictional issues.

[10] See discussion of double counting below at notes 55 and 56.

[11] The MRC defines a microgrid as "a local electric system or combined electric and thermal system that: (1) includes retail load and the ability to provide energy and energy management services needed to meet a significant proportion of the included load on a non-emergency basis; (2) is capable of operating either in parallel or in isolation from the electrical grid; and (3) when operating in parallel, can provide some combination of energy, capacity,

energy services to local customers, utilities and wholesale markets while ensuring that critical infrastructure remains powered.

As integrated aggregations of demand and supply resources that can be managed as a unified resource, microgrids are inherently resilient. By operating as micro-control areas islandable from the grid, microgrids provide intelligent load shedding, preserve the functionality of critical infrastructure and aid in grid restoration. In so doing, they project their resilience onto their communities and the larger grid.[12] Microgrids often include distributed generation, storage and advanced building controls that can provide rapid substitution for (or reduction in demand for) grid supplied electricity, and they may also include a wide array of other capabilities such as the ability to transfer heating or cooling load from electric to thermal resources and back, the ability to use buildings themselves as thermal storage, the integration of electric vehicle batteries, and the ability to alter the time of use for many different types of loads.

These combined capabilities are typically managed by sophisticated controls that permit the microgrid operator substantial ability to control its load/generation profile in detail, across a variety of factors relevant to the grid operator. The multiple energy delivery sources and secure, direct connection of generation to localized demand allow the microgrid to provide highly efficient, reliable, and adaptable energy services.[13] In addition, microgrids have the unique capability to serve their customers and critical infrastructure, but also assist the grid operator in

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ancillary or related services to the grid." This language captures microgrids' ability to sell services to the larger grid and the opportunity for substantial efficiencies achieved through co-management of electric and thermal loads.

[12] Microgrids may include multiple metered loads and be served by more than one substation in normal operation, but are able to act as a single islanded micro control area. They are almost always served by a single transmission node.

[13] See Appendix A for a brief description of Princeton University's microgrid capabilities.

restoration, by becoming an island in an emergency and by resuming parallel operation in concert with and at the convenience of the grid operator to help stabilize the restart of the system.

For example, when widespread power outages during and after Hurricane Sandy caused significant damage to local infrastructure, Princeton University's microgrid continued to function and provide electricity to the campus. This allowed Princeton to provide hot meals, hot showers and cell phone charging to first responders. In addition to the Princeton microgrid, other distributed energy resources in the region, such as the NYU downtown campus cogeneration facility and interconnected buildings and the NRG Princeton Medical Center microgrid, were able to remain online throughout Sandy. In contrast, the power failure and eventual closing of the NYU Langone Medical Center in midtown Manhattan drew national attention and initiated a review of the center's energy infrastructure. The NYU Langone Medical Center has since built and installed an islandable cogeneration-based microgrid, along with additional back-up systems, which will allow the complex to be self-sufficient in the event of a utility power interruption.[14]

Microgrids can be developed and operated by a variety of parties. Princeton is a single electric customer that owns its microgrid. The nearby Princeton Medical Center has a microgrid operated for its benefit, which is owned and operated by NRG. In certain jurisdictions, it can be very difficult to organize an efficient aggregation of customers to support a multicustomer microgrid or other distribution level resource because of limitations on retail sales of electricity.[15] Nevertheless, special purpose entities formed as retail electric suppliers, co-

[14] See Appendix B for further examples of microgrid resilience in action.
[15] Docket No. ER16-1085, Microgrid Resources Coalition, *Motion to Intervene and Comments on California Independent System Operator Corporation's ("CAISO") Distributed Energy Resource Provider Initiative*, filed March 25, 2016.

operatives or owners associations can either develop and own or contract with third parties to own and/or operate a microgrid for multiple customers.[16] A microgrid can be developed as a utility-private partnership, in which the distribution utility owns the wires and meters the retail customers, but generation and other operating services are provided by customers or third parties, as is being done in the Hudson Yards project.[17] In Borrego Springs, California, San Diego Gas & Electric has created a microgrid to improve the resilience of the local community. It owns the wires and storage resources, while customers supply included generation.[18] These creative solutions adapt to regulatory complexity, but call for cross-jurisdictional co-operation to improve resilience.

Grid Architecture

While microgrids and other advanced grid edge resources can support the resilience of the grid, the grid must evolve to support and make use of them. The MRC believes that the development of a resilient grid will rely on a partnership between ISOs/RTOs, utilities and local resources, where utilities act as a platform for smart, flexible resources on the distribution system, such as microgrids. In this partnership, the grid operators will act as the conductor of the grid edge orchestra, queuing, amplifying or diminishing, and blending the performance of grid

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[16] See discussions of regulatory structures and utility partnerships in District of Columbia Public Service Commission, Formal Case No. 1130, *Comments of the Microgrid Resource Coalition on Formal Case No. 1130 Modernizing the Energy Delivery System for Increased Sustainability*, filed April 15, 2016.
[17] *See, e.g.*, Robert Walton, *ConEd's Hybrid Service Model for Large Microgrid Could Become Standard*, UTILITYDIVE, Feb. 21, 2018, https://www.utilitydive.com/news/coneds-hybrid-service-model-for-large-microgrid-could-become-standard/517413/; Discussions of utility private partnerships in Maryland Public Service Commission, ML#199669, *Microgrid Resources Coalition, Comments in Response to Notice of Public Conference In the Matter of Transforming Maryland's Electric Distribution Systems to Ensure that Electric Service is Customer-Centered, Affordable, Reliable, and Environmentally Sustainable in Maryland* ("PC44"), filed October 29, 2016; Formal Case No. 1130, *Comments of the Microgrid Resource Coalition on Formal Case No. 1130 Modernizing the Energy Delivery System for Increased Sustainability*, filed April 15, 2016.
[18] Berkeley Lab, *Micrograms at Berkeley Lab: Borrego Springs*, available at https://building-microgrid.lbl.gov/borrego-springs

edge resources to respond to disruptions and preserve community health, safety, and daily activity.[19] As discussed below, utilities need to make substantial investment in the networking, reconfiguration and improvement of distribution systems to develop the capacity to conduct the grid edge orchestra. This is a challenge *and* an opportunity for a new utility business model that supports resilient grid architecture.

The importance of developing resilient grid architecture is highlighted in the 2017 report prepared by the National Academy of Science, Engineering and Medicine: Enhancing the Resilience of the Nation's Electricity System (the "NAS Report").[20] The NAS Report concludes that the grid of the future will achieve resilience by incorporating increasing quantities of local generation, linked by flexible and adaptable, networked distribution, and coupled with intelligent load shedding to ride through emergencies. The NAS Report highlights strategies that will help move us toward the resilient grid of the future:

- Distribution systems resilience achieved through a networked system, smart metering and fiber optic communication.[21]
- Utility scale battery storage.[22]
- Strategically placed distributed energy resources that are visible and controllable.[23]
- Improved inverter standards that allow renewable resources to provide ancillary services.[24]

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[19] They would do this via distribution support service agreements that take advantage of resource flexibility and dispatchability that enable different demand and supply, and service profiles.
[20] National Academy of Science, Engineering and Medicine: Enhancing the Resilience of the Nation's Electricity System, 2017, available at https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system. (hereinafter "NAS Report").
[21] NAS Report at 74.
[22] NAS Report at 75.
[23] NAS Report at 76.
[24] NAS Report at 76-77; *See also*, UtilityDive, *California Solar Pilot Shows How Renewables Can Provide Grid Services*, October 16, 2017, *available at* http://www.utilitydive.com/news/california-solar-pilot-shows-how-

- System architecture that reduces the criticality of individual components needed to maintain grid functionality.[25]
- Intelligent load shedding that permits reductions in load customer by customer [and internally for individual customers] rather than radial by radial while preserving essential functioning.[26]
- Adaptive islanding that permits individual microgrids and grid sub-regions to operate independently to reduce the impact of outages.[27]

Networked distribution systems with smart metering and local resource controls are more resilient. They can substantially reduce system restoration costs,[28] and reducing the size of critical components can realize savings on the costs of reserves. Intelligent load shedding (achievable in multiple ways by unified resource aggregations such as microgrids), and islanding can substantially reduce the costs of disruptions for both the system and for customers.

Achieving networked distribution grid architecture will require a collaboration between distribution utilities, customers and communities on their systems. That collaboration must begin with the Commission including state and local authorities in resilience planning. The MRC suggests that modernization planning pursue a mutually reinforcing combination of (1) open market signals to communities and customers at all levels to invest in flexible, dispatchable, local resources, coupled with (2) the reconfiguration and improvement of the distribution grid to accommodate and intelligently manage those resources.

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renewables-can-provide-grid-services/506762/. The Primary Frequency / Reactive Power FERC Order creates a floor upon which other ancillary services are easier to provide (assuming storage or ramping capability) and the new FERC Storage order takes the next step to effectively opening up ancillary service markets for renewable energy.

[25] NAS Report at 80.

[26] NAS Report at 81.

[27] NAS Report at 81-82.

[28] NAS Report at 73-75.

The MRC anticipates a future where, technology, cost and customer empowerment trends will push our grid architecture to be smarter, self-healing, flexible, competitive, efficient, visible and resilient. As we have commented to numerous state commissions, prudent investment in a reconfigured and intelligent grid by distribution grid operators on behalf of ratepayers will support progress toward a more resilient future. Utility investment, in turn, will support investment by customers in microgrids and other grid edge resources that that deliver resilience to our communities.[29]

Open Access to Markets

Customers have many incentives to install and maintain microgrids and other grid edge resources ranging from direct cost savings arising from co-management of thermal and electric load, to individual resilience, and carbon emissions reduction. As a result, they will invest in resources that can often provide benefits to the grid at lower costs than single purpose resources can provide them. Revenues from providing services to the grid provide an additional incentive, which can prove financially critical in some instances. The Commission's successful efforts to promote open access to the transmission system gave independent power producers access to markets.[30] However, grid edge resources often encounter barriers to providing services to the grid, and to being fairly compensated for services when provided. Reducing barriers and

[29] Docket No. RM18-1-000, FERC Request for Comments, *Need for Reform*, p. 1-2.

[30] *See Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities: Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, Order No. 888, FERC Stats. & Regs. ¶31,036 (1996), *order on reh'g,* Order No. 888-A, FERC Stats. & Regs. ¶31,048, *order on reh'g*, Order No. 888-B, 81 FERC ¶61,248 (1997), *order on reh'g*, Order No. 888-C, 82 FERC ¶61,046 (1998), *aff'd in relevant part sub nom. Transmission Access Policy Study Group v. FERC,* 225 F.3d 667 (D.C. Cir. 2000), *aff'd sub nom. New York v. FERC*, 535 U.S. 1 (2002) ("Order 888").

ensuring fair compensation – providing open access to markets – are critical to the evolution of a new, resilient grid architecture.[31]

ISO/RTO Markets

The MRC commends the Commission for its ongoing efforts to include all resources in the RTO/ISO wholesale markets,[32] but work remains to be done. Following the Supreme Court's ruling in EPSA, grid edge resources clearly are entitled to access to the wholesale market.[33] However, the MRC shares the Commission's concern that resources may also be excluded by lack of a participation model that takes account of the particular characteristics of the resource.[34]

For example, we believe that the demand response participation model – particularly as implemented in some ISOs and RTOs, based on a rigid baseline – fails to take advantage of, and compensate microgrids for their multifaceted performance capabilities. In its recent Order No. 841[35] the Commission excluded from its rules for storage resources behind-the-meter resources

[31] *See* PJM Comments at 74. "Focusing on physical infrastructure is clearly important for the reasons addressed earlier in PJM's responses, but without a compensation mechanism that properly values the attributes that any particular resource brings to the grid; we will inevitably frustrate many of the initiatives seeking to integrate emerging technologies such as microgrids, advanced storage and DER to mitigate resilience challenges on the BES. Further, without a proper compensation mechanism, we will fail to properly attract the funding this capital-intensive industry needs to make some of these critical investments, particularly those needed to ensure a resilient generation fleet. That being the case, resilience efforts warrant a review and refinement [of] market-based constructs, operating procedures, industry collaboration and planning processes."
[32] *See* 125 FERC ¶ 61,071, Order No. 719: Wholesale Competition in Regions with Organized Electric Markets, issued October 17, 2008; 134 FERC ¶ 61,187, Order No. 745: Demand Response Compensation in Organized Wholesale Energy Markets, issued March 15, 2011; 137 FERC ¶ 61,064, Order No. 755: Frequency Regulation Compensation in the Organized Wholesale Power Markets, issued October 20, 2011; 162 FERC ¶ 61,127, Order No. 841: Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, issued February 15, 2018, errata issued February 28, 2018.
[33] *Federal Energy Regulatory Commission v. Electric Power Supply Association (EPSA*) 136 S. Ct. 760 (2016).
[34] Federal Energy Regulatory Commission, *Notice of Proposed Rulemaking: Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 81 Fed. Reg. 86522, proposed Nov. 30, 2016.
[35] Federal Energy Regulatory Commission, *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 841, 162 FERC ¶ 61,127 (2018).

that do not make net exports, and suggested that they participate as demand response. The inclusion of storage resources in microgrids only gives them additional flexibility and makes the current participation model less applicable.[36] We believe that the solution is to require each resource to specify by bid or contract a non-overlapping (mutually exclusive) committed capacity range for each potentially overlapping product or service that it offers.[37] Each should be responsible for not double committing its capacity across markets, and a grid operator (at any level) can assure itself that there is no conflict as a condition of market participation. A 100 MW power plant can bid 70 MW for energy and 30 MW for spinning reserve in day-ahead ISO/RTO markets, but its bid in both markets cannot be greater than its total capacity. Similarly, a Customer with a 30 MW average load and a 20 MW behind-the-meter generator can elect to reserve 15 MW of self-generation capacity for its own use as it decides, and make a 10 MW demand response bid by reserving 5 MW of generation capacity and confirming that the building management systems on campus are ready to shed 5 MW of load across non-critical functions. It cannot use the last 5 MW of generation capacity to serve its own load unless called by the system operator. A customer with behind-the-meter battery storage, likewise, could only use its capability to discharge stored energy to the grid that is committed by bid to the system operator when called by the system operator.[38] Flexible grid edge resources should be permitted the same flexibility to structure their bids as other resources on the system.

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[36] This may, in part, be solved by aggregation rules. It is important to look at the aggregator as the market participant. Some of the confusion surrounding Order 745 arose from treating the demand response resource as the participant and focusing on the marginal cost of the customer rather than the aggregator.

[37] Overlap must be parsed carefully, providing capacity doesn't overlap with offering reserves or energy in a day ahead market, and being called to run and provide energy when selected for reserves does not create an overlap. Having the same tranche of capacity committed for both reserves and energy is overlap. See discussion of double counting below at note 55 and 56.

[38] Further, a customer could bid 5 MW of demand response and satisfy that obligation with generation, storage, load shedding, or a combination so long as it has the collective capability to meet all its bid obligations.

Non-ISO/RTO Wholesale Markets

Fully realizing a resilient grid architecture will require development of markets for a wider range of services from grid edge resources. Markets for ancillary services in support of the transmission system are poorly developed outside of ISOs/RTOs, and there are, at best, early stirrings of markets at the distribution utility level. Both kinds of markets should be developed, but need not take the same form as current ISO/RTO markets. As an example of a market in support of the distribution system, where local resources can improve the stability of a substation or decrease pressure on a radial circuit, or support essential community and distribution grid control services, the MRC has suggested that the distribution utility run a Request for Proposals for resources that can provide "distribution support services" on a mid- to long-term contracted basis as a more resilient alternative to the distribution utility implementing a traditional physical system capacity upgrade (often called a "wires solution").[39] The California Public Utilities Commission has taken the lead in requiring that distribution utilities identify the locations on their system where distributed energy resources can make a contribution, and is exploring how to compensate distribution utilities so that they are indifferent between the distribution support service solution and the wires solution.[40] The Potomac Electric Power Company's filing with the Maryland Public Service Commission for public purpose microgrids, proposes to acquire

[39] Docket No. RM16-23-000, *Comments of the Microgrid Resource Coalition*, filed January 30, 2017; Microgrid Resources Coalition, *Comments to the Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, New York Public Service Commission Case 14-M-0101, filed September 22, 2014. Note that we address "wires solutions" to mean traditional substation and line capacity upgrades.

[40] *California Independent System Operator Corporation's Distributed Energy Resource Provider Initiative*, 155 FERC ¶ 61,229 (June 2, 2016).

generation resources for the microgrids through RFPs and to treat the contracts for microgrid generation services as regulatory assets.[41] The MRC supports these approaches.

The existence of markets for services or products that support the transmission system on the one hand, and the distribution system on the other hand, raises issues similar to the issues raised by incompatible commitments of physical capacity in federally regulated markets. The MRC suggests that the regulatory response should be similar: no resource can commit the same capacity to two overlapping markets. Only one system operator is responsible for dispatching the increment of capacity that is committed to its market. The resource can only be compensated for that increment of capacity in the market to which it is committed and in which it is dispatched. If a grid edge resource has a long-term contract for distribution support services, it can't make an inconsistent commitment in an ISO/RTO day-ahead market. If it does, it is subject to penalties for non-performance.[42] Careful design of markets at all levels on a collaborative basis to avoid conflicts is prudent. The MRC believes that the metering and communications technology to avoid conflicts and keep markets separate is available and that its cost is falling. Indeed, it is part of the investment that is required for the emerging resilient grid architecture.

The Jurisdictional Tangle

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[41] Potomac Electric Power Company, *Updated Proposal for a Pilot Program to Create and Evaluate Public Purpose Microgrids*, Maryland Public Service Commission Case No. 9361, February 15, 2018.

[42] *Federal Energy Regulatory Commission v. Electric Power Supply Association (EPSA*) 136 S. Ct. 760, 764 (2016)(stating that transactions occurring at the wholesale level have "natural consequences" on the retail level and not seeing interference or problematic cross-price impacts between services at different market layers). Wholesale market access for behind-the-meter resources is natural, but inconsistent commitments for the same increment of a resource's (or an aggregation's) capacity is not. Unified resource aggregations such as microgrids are able to fulfill commitments using combinations of generation, load and storage resources. *See also*, Federal Energy Regulatory Commission, *Order 719: Wholesale Competition in Regions with Organized Electric Markets*, 125 FERC ¶ 61,071, issued October 17, 2008.

Markets for ancillary services that support the operation of the transmission system of utilities outside of ISOs/RTOs are clearly subject to Commission jurisdiction.[43] The Commission can encourage transmission utilities to purchase ancillary services directly from grid edge resources, in the context of its review of utility revenue requirements under their transmission tariffs. Markets for services that take advantage of the capabilities of grid edge resources at the distribution level, however, can be hampered by tangled, overlapping jurisdictional boundaries. On one hand, *sales* of electric power for resale or *wholesale sales* of any other power market product to a distribution utility / transmission provider are subject to Commission jurisdiction.[44] Grid edge resources are likely to be eligible for market-based rates when making sales of wholesale services (whether distribution support services in support of the distribution system[45] or ancillary services in support of the transmission system), but in certain jurisdictions the exercise of centralized purchasing power on the part of a utility is essentially unavoidable and will affect whether market-based prices paid to grid edge resources can be just and reasonable for procurements. [46] On the other hand, *purchases* of (and recovery for)

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[43] *See Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities: Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, Order No. 888, FERC Stats. & Regs. ¶31,036 (1996), *order on reh'g,* Order No. 888-A, FERC Stats. & Regs. ¶31,048, *order on reh'g*, Order No. 888-B, 81 FERC ¶61,248 (1997), *order on reh'g*, Order No. 888-C, 82 FERC ¶61,046 (1998), *aff'd in relevant part sub nom. Transmission Access Policy Study Group v. FERC,* 225 F.3d 667 (D.C. Cir. 2000), *aff'd sub nom. New York v. FERC*, 535 U.S. 1 (2002) ("Order 888") and *Hughes v. Talen Energy Market LLC et al*, 136 S.Ct. 1288 (2016).

[44] *See Federal Energy Regulatory Commission v. Electric Power Supply Association (EPSA*) 136 S. Ct. 760 (2016) *supra* note 42. Regarding wholesale demand response as a power market product, absent the physical export of power from the resource to the grid.

[45] Many distribution support services will involve payments for delivery of electric energy for resale at specific times and under specific conditions (e.g. prior to or during grid restoration, such as holding in island mode, then exporting to a local substation; the ability to profile the entire unified aggregation's presentation to the grid system offers great customizability), although the payment may not be structured solely on a per KWh basis for these custom services.

[46] Docket No. ER16-1085, Microgrid Resources Coalition, *Motion to Intervene and Comments on California Independent System Operator Corporation's ("CAISO") Distributed Energy Resource Provider Initiative*, filed March 25, 2016.

distribution support-related products and services from the same grid edge resources, by a distribution utility is clearly subject to state commission jurisdiction.

The MRC believes that ongoing collaborative efforts can manage these issues.[47] Excluding resources from one set of markets or another will only reduce competition in the markets from which resources are excluded (which harms all customers) and prevent grid edge resources from receiving competitive prices (which reduces market support for resilience).[48] We suggest, as an example, that the Commission, in consultation with state regulators, consider establishing advisory guidelines for best practices for non-ISO/RTO wholesale markets for procurement of services from grid edge resources to support the expansion of those markets. Those guidelines should be based on the principles that the Commission has articulated in its orders recognizing and compensating resource performance and providing market access for the competitive provision of services.

Just Compensation

The MRC is on record supporting the ability of grid edge resources to receive fair compensation for services to the grid.[49] The MRC believes that this is best accomplished by

[47] We do not, for example, advocate changes to the Federal Power Act. We feel the Commission and state commissions have a good track record of managing such issues; we are suggesting strategies, not changes to jurisdictional lines.

[48] The requests for rehearing of FERC's order on energy storage that advocate services to both markets are suggesting lines of argument that would result in a distribution system that is more resilient not less. Docket RM16-23-000, *Request for Rehearing of Xcel Energy Services Inc.*, filed March 19, 2018.

[49] *See, e.g.*, Docket No. RM16-23-000, *Comments of the Microgrid Resource Coalition*, filed January 30, 2017; Docket No. RM18-1-000, *Comments of the Microgrid Resource Coalitio*n, filed October 23, 2017. These and additional filings of the Microgrid Resources Coalition are available through the "Advocacy" section of the Microgrid Resources Coalition website at http://www.microgridresources.com/resources/advocacy. Further, we note that Customers have many incentives to install and maintain microgrids and other grid edge resources – ranging from cost savings arising from co-management of thermal and electric load, to individual resilience, to carbon emissions reduction – and will invest in resources that provide benefits to the grid at lower costs than if there were solely a merchant value proposition.

true, transparent market mechanisms, whether short term auctions or longer term competitive procurements, both at the distribution utility and ISO/RTO levels.[50] We believe that the presence of both will be required to ensure resilience. Further, while state regulated or mandated purchases by distribution utilities cannot directly infringe on the operation of RTO or ISO markets, the Supreme Court's narrow ruling in Talen v. Hughes[51] does not generally restrict any wholesale resource (including grid edge resources) from selling energy or other services to other eligible purchasers including distribution utilities.

Where there are organized power markets, a microgrid or other grid edge resource should be entitled to sell its capabilities to the highest bidder like any grid-tied resource. A sale of energy, capacity, ancillary services or distribution support services should not face barriers because it is made to the distribution utility, an aggregator, a retailer, to the ISO/RTO or to another third party purchaser.[52] If distribution support services are more valuable to a distribution utility's customers during an emergency than the local Locational Marginal Price, the distribution utility can be expected to offer a higher price. The ability of a grid edge resource to receive a just price depends on its ability to receive a fully competitive price. The ability to receive a fully competitive price is dependent on open, non-discriminatory access to all markets and buyers.

In this regard, the MRC has been skeptical of net metering,[53] and has not supported "value of resource" approaches that seek to blend direct services to the grid with environmental

[50] Or for a vertically integrated, fully regulated and bundled utility.
[51] *Hughes v. Talen Energy Market LLC et al*, 136 S.Ct. 1288 (2016).
[52] Assuming in each case that the resource meets the technical requirements for participation.
[53] Net metering may be appropriate for simple, residential scale distributed energy resource, however it presents difficulty for advanced, flexible and dispatchable grid edge resources such as microgrids. Time-of-use rate structures will also be important.

or other benefits.[54] These approaches can both blur jurisdictional boundaries and make it more difficult to avoid double counting. In its recent Notice of Technical Conference relating to the participation of Distributed Energy Resource Aggregations in markets operated Regional Transmission Organizations and Independent System Operators, the Commission has raised concerns about double counting and has suggested exclusion of net-metered resources from aggregations.[55] As discussed above, the MRC believes that metering and submetering of hybrid resources and making them transparent to the grid operators at all levels is economically and technically feasible. Again, we believe that double counting can be eliminated by good measurements coupled with requirements for grid edge resource operators to commit particular capacity to particular markets whether by auction bid or longer-term contract.[56] A resource that commits capacity to a grid operator in one market must reserve that capacity until called and only run if called. It puts that specified capacity in the control of the grid operator and cannot run to serve other markets or purposes.[57] If those markets or contracts have appropriate, market-

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[54] These environmental and social benefits are better addressed in separate markets for environmental commodities or by the imposition of pollution taxes that lie beyond the Commission's jurisdiction. These approaches have the added benefits of limiting distortion of RTO and ISO markets and allowing for environmental attributes to stay distinct from the underlying electrons and grid operations.

[55] Dockets No. RM18-9-000 and AD18-10-000, *Notice of Technical Conference*, issued February 15, 2018, p. 6-7.

[56] *See* PJM Comments at 50. "…emerging technologies such as microgrids, advanced storage and DER could also help to mitigate resilience challenges on the BES. Based on the NERC Distributed Energy Resource Task Force recommendations, there are several ways DER and microgrids can be better integrated with transmission systems to gain a resilience benefit, including:

- Requiring data sharing across the transmission-distribution interface;
- Requiring DER owners to provide real-time data for modeling;
- Coordination between distribution and transmission providers for DER capabilities such as inverter settings; and
- Improved ability to model DER in system planning studies.

However, the penetration of these technologies is not significant enough today to have any meaningful impact on system resilience. As these technologies continue to be deployed, PJM may be able to utilize them to enhance resilience, provided they are observable and able to be controlled on a regional scale similar to existing transmission and generation infrastructure, and coordinate with distribution system operators to leverage these technologies to enhance the overall resilience of the integrated system."

[57] This principle applies to any competing use of the resource. If particular capacity is committed to an RTO, it can't be used to optimize the customer's system. If it is committed to the distribution utility, it can't respond to a

based damages for failure to deliver, double counting can be avoided. We believe that the aggregation rule approved by the Commission for distributed generation aggregation in California Independent System Operator is a good example of this approach.[58]

Expanded Markets for Resilience Services

The MRC recommends that the Commission consider expanding existing ISO / RTO markets (and recommending new markets for transmission utilities outside of ISOs / RTOs and collaborating with state commissions on markets for distribution support services) based on metrics and products that reward resources with attributes and impacts that contribute to resilience. We concur with PJM's call for continuing proceedings to identify tariff amendments and market reforms that will contribute to improving grid resilience.[59] These ongoing reforms would aim at recognizing, compensating and strengthening the ability of grid edge resources to support critical services, such as emergency responders, hospitals, and critical food and medical supplies, under a variety of conditions, and to support the larger grid when it is stressed, damaged, or failing. While state jurisdictional purchases of distribution support services that further resilience are distinct, customized and provided by grid edge resources to distribution

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call by the RTO operator. A resource operator is responsible for understanding the rules relating to each product market, and avoiding overlapping commitments of capacity, and a grid operator can require demonstration of unfettered capacity as a condition of market participation. If operation in response to grid operator direction also reduces a customer's retail purchases, that should not be viewed as double counting.

[58] *California Independent System Operator Corporation's Distributed Energy Resource Provider Initiative*, 155 FERC ¶ 61,229 (June 2, 2016). This tariff permits the aggregator to meet its market bid by achieving a net contribution to CAISO even if different resources within the aggregation are ramping in different directions. Appropriate metering and communications makes this possible. Market damages for failure to perform would apply to the aggregator. The aggregator's recourse against members of the aggregation would in turn be determined by contract terms between the resources and the aggregator.

[59] Several of the ISO/RTOs have suggested that FERC call a technical conference to discuss such matters. The MRC supports the concept of a technical conference, although we would emphasize, like PJM, that any technical conference should be part of a larger and ongoing process. *See, e.g.* PJM Comments at 6; Midcontinent Independent Service Operator, *Responses of the Midcontinent Independent Service Operator*, Docket No. AD18-7-000 at 7-8 (March 9, 2018); New York Independent Service Operator, *Responses of the New York Independent Service Operator*, Docket No. AD18-7-000 at 5 (March 9, 2018).

utilities, the standardized wholesale products provided by those same resources should also reflect their resilient attributes and capabilities. The metrics around those attributes and capabilities tie to resiliency benefits at all market levels. The MRC offers the following preliminary suggestions for metrics and attributes that capture contributions to resilience:

- *Islanding capability.* When supply resources and the critical infrastructure they are serving have the ability to island from the main grid system in an emergency allowing those resources to continue to support delivery of essential services to the community even in the event of a complete outage of the larger grid. This also permits the grid operator to shed load in emergencies without loss of critical services.
- *Ability of a supply resource to support critical demand-side infrastructure*. Supply resources located near critical infrastructure with secure distribution channels (either direct or through distribution utility channels that can be isolated) can minimize social disruption. Local planning processes should identify that infrastructure.
- *Hybrid generation*. A resource that has multiple different units and/or generation types, can operate as an aggregation (especially with hybrid generation), and which is inherently more robust and less at risk from a single point of failure.
- *Local Storage.* Local energy storage, whether electric or thermal can preserve the ability of critical loads to continue to function. Local fuel storage including gaseous and liquid (e.g. CNG storage at the local gas distribution company network level or at the local level adjacent to gas-fired generation resources) allows local generation to operate in supply emergencies.[60]

[60] We support PJM's suggestions for co-ordination with pipelines and gas supply but believe that on site fuel reserves or resources (i.e. renewable energy) and dual- or multi-fuel capacity can take the pressure off those arrangements. *See* PJM Comments at 7.

- *Fast start and black start capabilities*. If local generation serving critical infrastructure is able to fast start and black start it allows the supply resource to quickly respond to grid signals and conditions in order to support the critical infrastructure. It can also provide support for system restart.
- *Fast Emergency Load Shedding as Operating Reserves* If microgrids and other retail customers identify loads that are non-essential in emergency situations and enable rapid internal load shedding either in response to a dispatch signal or on an automated basis it can provide the grid operators with a means to shed load without resorting to indiscriminate load shedding feeder by feeder.

The MRC encourages the Commission to consider using the resilience performance measures above in developing products and markets (such as resilient capacity products) that reward the resources that actually make our communities more resilient and the grid more adaptable.

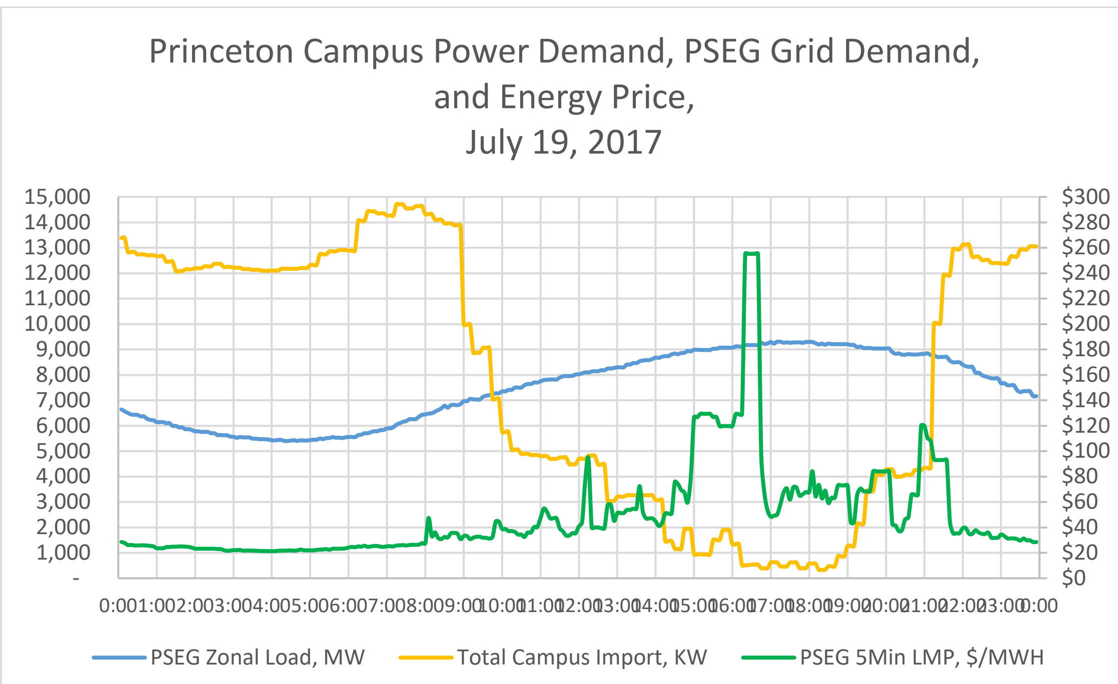
Conclusion

The MRC respectfully urges the Commission to pursue its investigation into resilience but to expand its inquiry (and its definition) to focus on how resilience must manifest to be meaningful – in the maintenance of critical community services. The evolution to a networked and locally supported grid architecture will increase the resilience of the grid and of our communities in the face of many different threats. Whether equipment failure results from a storm, a terrorist attack, or old age, a self-healing, networked grid with dynamic and flexible resources whose resilience attributes are compensated by wholesale markets and agreements for distribution support services will be equipped to respond. We suggest that the Commission carefully review and define its jurisdiction and collaborate with state and local authorities to secure the needed results. The Commission should eliminate barriers to the evolution of grid architecture giving as much latitude as possible to equal competition that avoids exclusion or prescription of technologies. It should examine new metrics, products and markets that support resilience. The Commission should commit itself to the real work of achieving resilience by recognizing and compensating the resources that help sustain essential services for our communities when they are needed most.

Appendix A

The Princeton University campus is served by a microgrid that includes 15 MW of gas cogeneration, 4.5 MW of solar generation, 40 MWh equivalent of thermal storage, advanced building controls, and an advanced interface with the grid. Figure 1. shows wholesale market energy consumption and price for the Public Service Electric and Gas (the electric utility serving Princeton) service territory and the Princeton Campus energy purchases from the grid, all plotted against the time of day. The data is for July 19, 2017, one of the days when the entire regional grid operated by PJM Interconnection, LLC ("PJM") was near system peak capacity.[61]

Figure 1.



[61] Figure 1 – PSEG Zone Load – Campus in a peak period. Image courtesy of Edward T. Borer, Energy Plant Manager, Princeton University.

Note that system load and campus imports use the same left margin scale, but system load is in MW and campus imports are in kW.

The chart shows that Princeton purchased a substantial amount of electric energy in the early morning to charge its thermal storage – chilled water in an insulated tank. It then purchased almost no electric power at the time of peak usage and peak pricing on the PJM system. This result at peak was achieved by 15 MW of cogeneration and 3.75 MW of solar. Normal campus load of around 26 MW was reduced to around 19 MW through use of steam chillers supplied by heat from the cogeneration plant and discharge of chilled water from the thermal storage tank. Princeton avoided purchasing high priced power (the prices reached $255.00). Princeton paid a weighted average of $34.06 per MWh for power that day compared to a system average price of $50.17 per MWh. On more ordinary days, Princeton may dedicate a portion of its generating capacity to providing regulation, an ancillary service that provides balancing energy to the PJM system in under ten seconds following a signal from the grid operator. Collective control of multiple grid edge resources allows Princeton to manage for efficiency, price, and reduced carbon.[62]

[62] Data on the Princeton system supplied by Edward T. Borer, Energy Plant Manager, Princeton University.

Appendix B

For further illustrations of how microgrids can support the resilience of the grid, the MRC directs FERC to the following examples compiled by the International District Energy Association ("IDEA") in its comments on Docket No. RM18-1-000, Grid Reliability and Resilience Pricing, filed October 23, 2017.[63]

Co-op City is a residential development home to roughly 50,000 people in the east corner of the Bronx. After the 2003 blackout, Co-op City invested in a microgrid served by a 40 MW CHP facility. During Superstorm Sandy, Co-op City was able to reliably provide electricity, heat, and hot water to its 50,000 residents without interruption.[64] In the aftermath of Sandy, Co-op City helped restore the grid by providing black start services to Consolidated Edison.[65]

Nassau Energy has a microgrid supported by a 57 MW CHP facility. During Superstorm Sandy, Nassau Energy provided power to the Long Island Power Authority, helping with restoration efforts. Furthermore, Nassau Energy provided thermal energy to the Nassau University Medical Center and the Nassau Community College during Superstorm Sandy. In part because of Nassau Energy's services, the Medical Center was able to attend to several patients displaced from nursing homes during the storm, and the Community College

[63] IDEA Comments at 10-11.
[64] Environmental Defense Fund Report: Sandy Success Stories at 67-68 (Jun. 2013) (EDF Report) *available at* https://www.edf.org/sites/default/files/sites/default/files/content/SandySuccessStories_June2013.pdf.
[65] IDEA briefing jointly with the Microgrid Resources Coalition and the Environmental and Energy Study Institute on microgrid policy guidance (Dec. 6, 2016) (IDEA Briefing) *available at* http://www.eesi.org/briefings/view/120616idea.

served as an emergency shelter that provided services to over 1,000 people displaced by the storm for over one month.[66]

The College of New Jersey has a microgrid supported by a 5.2 MW CHP facility. The College operated in island mode during Superstorm Sandy and maintained electric service despite grid disruptions. In the aftermath of the storm, the College was able to use its equipment to back-feed one of PSE&G's power lines to bring it back to service.[67]

The Danbury Hospital (Danbury, CT) has a microgrid supported by a 4.5 CHP unit that provides the buildings at this 371 bed hospital with electric power and heat. The Danbury Hospital was able to withstand Superstorm Sandy due to its ability to operate in isolation from the microgrid during the storm and continued to admit patients from other sites that were forced to close due to the storm.[68]

The South Oaks Hospital (Amityville, NY) has a microgrid supported by a 1.25 MW CHP facility. During Superstorm Sandy, the Hospital isolated itself from the grid and was able to provide critical services for two weeks relying solely on its CHP system. The hospital admitted patients from other sites that had been displaced by the storm, and offered refrigeration of vital medicines to those who had lost power and had no other means of keeping their medicines refrigerated.[69]

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[66] ICF International Report, Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities at 25 (Mar. 2013) (hereinafter "ICF Report") *available at* https://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_critical_facilities.pdf.

[67] *Id*. at 18.

[68] *See* Dhanya Skariachan, *Hospitals battled to protect patients as Sandy raged*, Reuters, Oct. 30, 2012, http://www.reuters.com/article/us-storm-sandy-hospitals/hospitals-battled-to-protect-patients-as-sandy-raged-idUSBRE89T1NV20121030.

[69] ICF Report at 13.

New York University (New York, NY) has a microgrid supported by a 14.4 MW CHP facility. During Superstorm Sandy, the NYU microgrid provided uninterrupted electric service, heating, and cooling to the campus, which served as a command post for New York City officials during the storm and served area residents that had been forced to evacuate their homes.[70]

The Louisiana State University ("LSU") (Baton Rouge, LA) has a microgrid supported by two CHP facilities totaling approximately 24 MW of nameplate capacity. LSU stayed online and never lost power during Hurricane Katrina in 2005, and again during Hurricane Gustav in 2008, allowing the campus to be used as shelter for many employees that had been displaced by the hurricanes.[71]

[70] *Id.* at 29.
[71] *Id.* at 24.