TESTIMONY OF EUGENE L. SHLATZ

BEFORE THE U.S. HOUSE COMMITTEE ON ENERGY AND COMMERCE

"UPDATE ON THE RESTORATION OF PUERTO RICO'S ELECTRIC INFRASTRUCTURE"

Summary

My name is Eugene L. Shlatz and am employed by Navigant Consulting, Inc. an independent consulting firm headquartered in Chicago, Illinois. I work as a Director in Navigant's Global Energy Practice, the largest energy management consulting firm in the industry. We collaborate with utilities, government, investors, manufacturers, oil and gas companies, and major corporations to help them thrive in the rapidly changing energy environment. I have over 35 years' experience addressing challenges facing the electric utility electric industry, including working in a senior management position for an electric utility. I have testified as an expert witness on a range of electric utility matters before state regulatory commissions and the Federal Energy Regulatory Commission.

My testimony supports findings and recommendations contained in the December 11, 2017 report titled "Build Back Better: Reimagining and Strengthening the Power Grid of Puerto Rico" that Navigant prepared on behalf of the Governors of the State of New York and Puerto Rico. My role in this undertaking was to provide subject matter expertise and help develop recommendations for many of the topics addressed in the report. Our report provides an assessment of the electric power system storm damage caused by Hurricanes Maria and Irma, and proposes redesign and rebuild recommendations to strengthen the electric grid of Puerto Rico. A copy of our report is attached as an exhibit to my testimony.

The damage caused by Irma and Maria was extensive and affected a substantial portion of Puerto Rico's electric generation and power delivery system, with a loss of electric service to over 1 million customers. The magnitude of devastation, while unprecedented, now provides an opportunity to rebuild and transform the system to one that is hardened, smarter, more efficient, cleaner, and less dependent on fossil fuel imports. The cost to rebuild the system and achieve this vision is $17.6 billion. Transforming and modernizing the Puerto Rico electric grid will not be easy. An ongoing commitment by affected stakeholders, including state and federal agencies is essential to ensure a successful outcome, as the complexity of rebuilding an island electric system requires a coordinated effort to undertake projects and initiatives that, collectively, are expected to take 10 years or more to complete.

The Navigant Team and Working Group Objectives

Navigant worked closely with a Working Group (i.e. the Puerto Rico Energy Resiliency Working Group[1]) comprised of industry experts to develop rebuild recommendations.[2] The primary goal of the Working Group's recommendations is to support the Puerto Rico Governor's Office, PREPA, interested stakeholder agencies, and the Federal Emergency Management Agency in defining first level funding requirements and electric power system rebuild recommendations. Recommendations include the use of modern technology and incorporation of lessons learned from successful rebuild efforts undertaken in other regions following natural disasters such as Hurricane Sandy in New York. Importantly, the rebuild recommendations align with the DOE's recommendations for power system hardening and resiliency.[3]

Navigant's report provides a roadmap outlining short-term, mid-term and longer-term actions to implement resiliency and hardening measures designed to increase the capability of Puerto Rico's electric power grid to withstand future storms. These measures include modernizing the Puerto Rico electric grid by leveraging proven power system technologies to better contain outages, reduce recovery times, lower operation costs. These actions will also enable the power system to accommodate greater amounts of sustainable energy resources that, in turn, will reduce reliance on imported fuel. This is an important public policy objective, as Puerto Rico currently relies heavily on fossil fuel, mostly oil, to run its generating plants.

In addition to the increased use of renewable energy resources, such as wind and solar, we recommend incorporating new distributed energy resource technologies, such as energy storage and microgrids to provide greater reliability and resiliency to future storms for critical infrastructure and facilities; for example, hospitals, water treatment facilities, police stations, emergency shelters and remote communities most susceptible to sustained interruptions.

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[1] The Working Group included the following representatives: New York Power Authority, Puerto Rico Electric Power Authority, Puerto Rico Energy Commission, Consolidated Edison Company of New York, Inc., Edison International, Electric Power Research Institute, Long Island Power Authority, Smart Electric Power Alliance , U.S. Department of Energy, Brookhaven National Laboratory, National Renewable Energy Laboratory, Grid Modernization Lab Consortium, Pacific Northwest National Lab and PSEG Long Island, an agent for and on behalf of the Long Island Lighting Company d/b/a LIPA.

[2] Navigant provided power system subject matter expertise, project management and report development as a consultant to the Working Group.

[3] *Hardening and Resiliency: U.S. Energy Industry Response to Recent Hurricane Seasons*, Infrastructure Security and Energy Restoration, Office of Electricity Delivery and Energy Reliability, US Department of Energy, 2010.

Proposed Rebuilds and Grid Enhancements

Transmission and Distribution System

The transmission and distribution lines and substations that delivery power from electric generation stations to Puerto Rico's residences and businesses suffered severe damage from hurricanes Irma and Maria, as most equipment was not designed and built to withstand hurricane-force winds and flooding. The Working Group estimates that only 15 percent of the transmission system is built to withstand Category 4 (or 5) hurricanes. Consequently, many transmission lines, including critical north-south lines traversing mountainous terrain, suffered catastrophic failure. Mudslides and unstable terrain also caused many structures and towers to topple. Electric substation equipment damage was extensive as high winds, mudslides and water intrusion into sensitive equipment and buildings containing control panels and switches. Up to 75 percent of distribution lines were damaged by high winds and flooding.

The Working Group recommends several short-term recovery objectives and longer-term design and rebuild objectives to be considered when building back the T&D system. These include rebuilding the Puerto Rico electric power system to current codes and industry best practices, hardening for greater storm resiliency, and designing for the future. To harden the transmission and distribution (T&D) infrastructure, physical and structural improvements to lines, poles, towers, substations, and supporting facilities will be needed to make them less vulnerable to the damaging effects of hurricane winds and flooding.

Specifically, he Working Group recommends that PREPA's system should be designed and constructed to withstand an upper Category 4 event (155 mph winds) and heavy flood waters. To harden and enhance the resiliency of PREPA's system, the following measures are proposed for the T&D system:

1. Reinforce existing direct-embedded poles with enhanced support such as perimeter injected concrete grout or other soil stabilization
2. Upgrade damaged poles and structures to a higher wind loading standard
3. Strengthen poles with guy wires
4. Install underground power lines in select areas prone to high wind damage

5. Modernize the T&D system via smart grid investments to make the system less susceptible to extended outages
6. Install automated distribution feeder fault sectionalizing switches to enable fault isolation and reduce outage impact
7. Deploy modern control systems to enable distributed energy resources (DER) integration and encourage their development
8. Adopt effective asset management strategies, such as the targeted inventory of critical spares
9. Institute consistent vegetation management practices, including changing tree trimming standards
10. Apply enhanced design standards for equipment and facilities damaged in the recent storms

These recommendations include relocating existing high voltage transmission lines from difficult to access and unstable mountainous terrain to new rights-of-way along existing highways, installing flood barriers or raising equipment in substations, and locating distribution lines away from transmission lines. They also include upgrading communication and control systems to limit the number of customers affected by storms and to improve system operator's ability to restore service once interruptions occur; upgrades systems and procedures also are needed to manage and integrate the distributed resources and microgrids that the Working Group recommends to enhance resiliency and reliability of electricity supply to critical facilities and infrastructure.[4]

Generating Stations

Many electric generating plants encountered significant damage, particularly along coastlines, where the storm surge and high winds resulted in the partial or complete loss of output from these stations. Inspections conducted by experienced personnel from NYPA and ConEdison indicated damage to cooling towers and unprotected or exposed turbines and boilers, and fuel handling facilities. Delivery of electricity from plants that remained on line was complicated by the loss of electric switchyards and transmission lines, including those that deliver output from generating plants located along the southern coast to major load centers in the north. One major plant, Palo Seco, experienced significant damage to such an extent that the Working Group recommends a complete upgrade or replacement of most units. Similar to T&D facilities, the full extent of damage to these stations and necessary repairs should be

[4] Enhanced communications and controls also are required for load reduction measures that the Working Group recommends to reduce electricity production from conventional generating stations during periods of high demand.

determined by a detailed engineering assessment and testing to supplement and confirm the findings obtained during initial inspections.

Many of the generating units that were damaged are older and less efficient than modern generation. These units also mostly burn oil and do not meet current Mercury and Air Toxic standards (MATS). Notably, pre-storm generating capacity, including independently-owned generation sources,[5] was almost 6,000 MW, or approximately 100 percent above the recent system peak of just above 3,000 MW. The system peak has dropped by over 15 percent from the previous peak of 3,600 MW and further decreases may occur due to post-storm migration to the mainland.

Based on the initial damage assessment and above observations, the Working Group's evaluation of Puerto Rico's generating fleet led to the following priorities and recommendations:

1. Expedite near-term restoration of power to the island
2. Identify opportunities to increase the use of DER
3. Develop new targets for renewable resources (Renewable Portfolio Standard or RPS)
4. Shift oil-fired fossil generation to mostly dual-fuel units, with primary fuel as natural gas
5. Harden the remaining generating facilities that will remain
6. Consider a reduction of the generation reserve margin to 50%

The primary modifications recommended by the Working Group was the conversion and upgrade of existing generators at Palo Seco and Aguirre to highly efficient, dual-fuel units that meet MATS requirements, with natural gas as the primary fuel source. It includes the planned Aguirre Offshore Gas Port along with marine infrastructure and pipeline to shore for gas delivery to shore would enable the conversion of the Aguirre generation plant to natural gas. These plants also would be capable of provide the operating flexibility needed to accommodate the large amount of renewable generation the Working Group anticipates will be installed in Puerto Rico over the next decade and beyond. Additional study is needed to determine the reduction in reserve margin that can be achieved while maintaining reliability of supply throughout the island.

[5] 961 MW is provided by two co-generators (EcoElectrica and AES-PR) through 20-year power purchase operating agreements (PPOAs). EcoElectrica, L.P. in the Municipality of Peñuelas (507 MW of gas-fired capacity) and AES-PR in the Municipality of Guayama (454 MW of coal-fired capacity) are the two largest sources of generation on the island

The issues noted above will require the 2015 Integrated Resource Plan (IRP) approved by state regulators to be modified to ensure all relevant factors are considered, including the potential impact of increased DER, increased renewable targets, shift of fossil generation to natural gas, and reduction of system reserve margin. The updated IRP could include a recommendation to retire generation plants where upgrades or repairs are proposed and therefore, not require the full level of estimated expenditures for rebuild or hardening outlined in my testimony.

Rebuild Cost Summary

The following table provides a breakdown of the Working Group's $17.6 billion cost estimate for the recommended power system rebuild investments. We expect these costs may vary as more detailed engineering and testing is performed, and after Each line item estimate includes a 30% scope confidence escalator. Final cost estimates require multiple engineering studies and an updated IRP the IRP is updated. Accordingly, each line item estimate includes a 30 percent scope confidence escalator.

Rebuild Recommendations	Total (Millions)
Overhead Distribution (includes 38 kV)	$5,268
Underground Distribution	$35
Transmission - Overhead	$4,299
Transmission - Underground	$601
Substations – 38 kV	$856
Substations – 115 kV & 230 kV	$812
System Operations	$482
Distributed Energy Resources	$1,455
Generation	$3,115
Fuel Infrastructure	$683
Total Estimated Cost	**$17,606**

Summary

As noted, transforming and modernizing the Puerto Rico electric grid will not be easy. An ongoing commitment by affected stakeholders, including state and federal agencies is essential to ensure a successful outcome. Further, a rebuild project of this magnitude requires the consideration of several technical and non-technical factors necessary for the success of the project including, but not limited to those listed below.

- **Management of Cash Flow** – Work that is proposed as a reimbursement from other funding sources, including federal funding, requires upfront expenditures.

- **Stafford Act Compliance** - Generally, federal funding requires the use of US-sourced material, a strict procurement process, a strong quality assurance capability, strict accounting, and an on-going audit process.
- **Supply Chain** – Competitive bidding on both equipment purchases and construction contracts is needed.
- **Labor Force** – Recommendations in this report will require development of the on-island workforce to operate the system with new technologies and methods.
- **Stewardship** – It is critical that strong asset management principles and practices are implemented with the reinstallation and replacement of power system equipment.
- **Organizational Change Management** - Our report proposes a significant amount of grid modernization and the use of new technologies, systems, and operating methods. PREPA and related stakeholder agencies will need to consider the impacts of these changes and institutionalize new business processes, systems and organizational roles and responsibilities.
- **Stakeholder Engagement** – Many of the Working Group recommendations will require extensive stakeholder engagement.
- **Project Management** - Effective project management will be required to deliver on the rebuild recommendations, optimize the use of federal funding, provide transparency and accountability, and comply with federal tracking, control and reporting requirements.

This concludes my testimony.