

October 6, 2022

To: Puerto Rico Energy Bureau

World Plaza Building
268 Munoz Rivera Ave,
San Juan, PR 00918

Re: Risk Assessment of the Puerto Rico Electric Grid Following Hurricane Fiona

To the Honorable Energy Bureau:

As System Operator, LUMA has the responsibility to assess Resource Adequacy and to identify Generation resource deficiencies to the PREB and to the Administrator.¹ In the immediate aftermath of Hurricane Fiona, the Puerto Rico electric grid is now operating in a condition of heightened risk of load shed which is expected to continue for several months. As identified initially in the Emergency Event Update provided on September 25, 2022, the following paragraphs briefly describe this increased risk and potential mitigation steps that PREB and the P3A Administrator to consider.

Storm damage to the electric generating facilities in Puerto Rico from Hurricane Fiona has pushed the grid to a high probability of load shed events.

Storm damage is of two types:

1. Known and observed, such as observed physical damage to the LNG handling facilities at EcoElectrica
2. Increased probability of failure from damages that cannot be fully assessed until plants are taken offline for inspection but are known, as evidenced by continued operating challenges / trips at units that have been successfully restarted. Examples include the trip of Costa Sur 6 on September 29, 2022, the controlled shut down of Palo Seco 3 and San Juan 6 on October 1 and 2, 2022 and more recently the trip of Costa Sur units 5 and 6 on October 6, 2022.

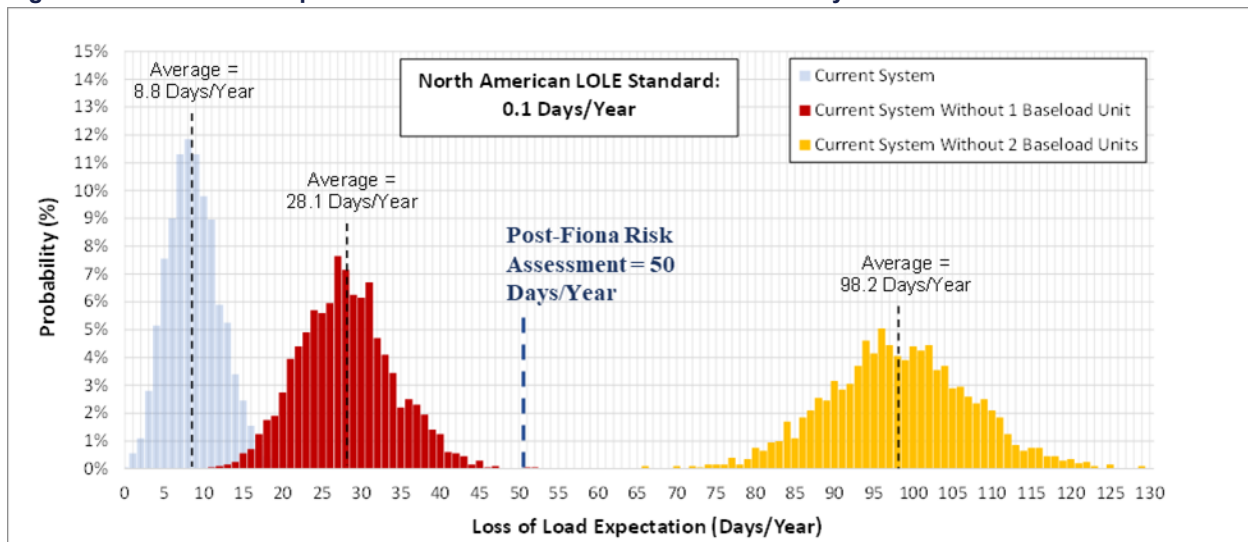
¹ Under the Puerto Rico Transmission and Distribution Operation and Maintenance Agreement (OMA) between the Puerto Rico Electric Power Authority (PREPA), the Public Private Partnerships Authority (P3 Authority), LUMA Energy, LLC and LUMA Energy ServCo (collectively, LUMA) effective June 21, 2020 (T&D OMA), LUMA carries out multiple activities as System Operator. Section 5.13 (d) of the T&D OMA states that LUMA shall prepare risk assessments and analyses in support of Resource Adequacy and Generation Project or Generation Supply Contract procurement prioritization and planning.



The storm damage has dramatically increased the risk of customers experiencing load shedding events. Prior to Hurricane Fiona, customers were 88 times more likely to have a load shed event, when compared to the average mainland electric customer. They are now approximately 500 times more likely to have a load shed event (compared to the average mainland electric customer).

The Resource Adequacy report (filed on August 30, 2022, in docket NEPR-MI-2022-0002) outlines customers' risk exposure under different scenarios. The report outlines a 'base case' scenario and a scenario where one baseload unit is out for the full year. Given the impact of Hurricane Fiona, LUMA has added a third scenario where two baseload units are out for a full year. As shown in Figure 1 below, the loss of load expectations (LOLE) increase dramatically as baseload units are not available. The first scenario, in blue, assumes that all baseload units are available, the second scenario, in red, assumes one baseload unit is out for the year and the third scenario, in yellow, assumes two baseload units out for the year. LUMA estimates that post-Hurricane Fiona the electric system likely resembles between one or two baseload units being out and a LOLE around 50 days/year.

Figure 1. Loss of Load Expectations Under Different Baseload Availability Scenarios



As an example, during calendar year 2021 there were 15 days in August and September when lack of sufficient generation capacity resulted in load shed. Further, the Puerto Rico Electric system experienced 18 load shed events from January 1, 2022, to July 31, 2022, solely attributed to generation event issues. During that same period, the electric system suffered an additional 16 events attributed to generation issues, but they did not result in load shed due to interventions from the System Operator.

SITUATION BEFORE AND AFTER FIONA

Since June 2021, the electric system has operated for extended periods with at least one major generation unit offline that was not planned. This situation dramatically impacts the ability to



take other units offline to perform overdue planned maintenance, pushes outages for planned maintenance into the peak summer months, and increase the number of forced outages on available units. It also requires the system to utilize peaking units to a higher dispatch level, increasing CO₂ emissions and the cost of generation for the customers.

For most of calendar year 2022, the entire PREPA generation portfolio has operated with approximately 52% availability. This situation is even worse than the assumptions used in the Resource Adequacy report, which is based upon planned outage schedules and derates provided by the generator. As an example, on September 16, 2022, prior to the arrival of Hurricane Fiona, the electric system was experiencing two base load unit outages with the extended outage of Aguirre unit 1 and unplanned outage of Palo Seco unit 4.

With these low levels of availability, the reserves during peak hours have been 200 MW on average. These levels are in violation of the System Operating Principles and prudent utility practices which have defined a required reserve margin of 750 MW. After the passage of Hurricane Fiona, the generation fleet suffered damages and as of October 3, 2022, the availability has been trending closer to 49% with some major units still yet to return to service. Further, in the morning of October 6, 2022, the availability rate decreased to 44% and load shed was experienced by customers following trips at Costa Sur units 5 and 6. This situation will remain highly uncertain as complete damage assessments of the generation units have not yet been completed on those units that were brought back online after Hurricane Fiona. This uncertainty increases the risk of load shed for customers.

Furthermore, typically EcoElectrica is available at full capacity. However now, as mentioned above, EcoElectrica suffered damage on its refueling line and with the current stored natural gas fuel levels, it is expected that the units can only be in operation until October 13, 2022, depending on utilization. EcoElectrica's current estimates expect the work on the refueling line to be completed by October 14, 2022, and the next fuel delivery is expected on October 26, 2022. EcoElectrica's fuel shortage is expected to increase the risk of load shed, deprive the system of reliable generation and frequency regulation, and increase costs and emissions of the generation portfolio.

Without any intervention, a Puerto Rican customer is expected to incur on average 10-12 load shed events in the next three months as a direct result of Hurricane Fiona damage to the existing generation assets.

The Value of Loss Load (VOLL) is the generally recognized metric to assign the economic cost to consumers from load shed events. The 2017 IRP used an industry consensus approach to estimate the VOLL in Puerto Rico as \$57,488/MWh. Adjusting for inflation and using an average load shed event size in Puerto Rico of 200 MW, this results in an average VOLL per load shed event of \$14 million. This will result in an economic cost to Puerto Rican customers of \$140 million - \$168 million for next 90 days or approximately \$700 million in the coming year unless



the generation shortfall is addressed. In addition to the direct economic cost of load shed, the related fragility in the power portfolio will increase the reliance on old, inefficient diesel peakers which will increase fuel costs and CO₂ emissions by approximately 7 to 9%.

MITIGATION STRATEGIES

Mitigation strategies should be employed to reduce the economic cost to Puerto Rican customers.

At this time, LUMA has investigated the limited number of alternatives to mitigate existing risks and can provide the Energy Bureau with additional detail as required. LUMA has reviewed floating and on land generation options. **Barge mounted units have greater flexibility in location and could be interconnected to the existing grid at locations where current generation facilities exist.** Other land-based options are available, which could be either mobile or semi-permanent, and can be procured with sale or lease options. Locations have been preliminarily assessed, but a full assessment will be required. Land-based generation options have limited fuel delivery access and so a southern location on the water is likely a stronger candidate.

LUMA suggests that the Energy Bureau immediately explore emergency generation options. LUMA can support through interconnection studies to identify feasible locations for emergency generation interconnections.

SUMMARY

In summary, the damages from Hurricane Fiona have put the electric grid in Puerto Rico at a significantly increased risk of incurring multiple load shed events in the coming weeks, months and years if nothing is done. This will have a significant impact beyond the electric grid. This will have a real and significant effect on the economy as residents and businesses start to build back from Hurricane Fiona. Their speed of recovery will be negatively impacted as will other economic drivers of the economy including, manufacturing processes, inventory and the quality of health care.

While LUMA continues to act with urgency to restore the grid as safely and efficiently as possible, it urges the Energy Bureau to explore generation capacity increases for the near-and-medium term to benefit the people of Puerto Rico.

Sincerely,

A Engbloom

Ashley Engbloom
Vice President, Regulatory

