COMMONWEALTH OF PUERTO RICO
PUBLIC SERVICE REGULATORY BOARD
PUERTO RICO ENERGY BUREAU

IN RE: LUMA'S RESPONSE TO HURRICANE FIONA	**CASE NO. NEPR-MI-2022-0003** **SUBJECT: Submission of Supplemental Information**

MOTION SUBMITTING SUPPLEMENTAL INFORMATION IN ATTENTION TO QUESTIONS POSED IN TECHNICAL CONFERENCE OF OCTOBER 11, 2022

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COME NOW LUMA Energy, LLC ("ManagementCo"), and **LUMA Energy ServCo, LLC** ("ServCo"), (jointly referred to as "LUMA"), and respectfully state the following:

1. In a Resolution and Order of October 7, 2022 ("October 7th Order") with the subject "Baseload Generation Dispatch Status-Post Hurricane Fiona," this honorable Puerto Rico Energy Bureau ("Energy Bureau") convened a Technical Conference to discuss concerns raised by LUMA in a letter dated October 6, 2022 regarding Resource Adequacy and potential Generation resource deficiencies following Hurricane Fiona. Per the October 7th Order, the topics to be discussed at the Technical Conference were "Dispatch Status of the available Baseload Generation post Hurricane Fiona and (ii) the identified temporary emergency mitigation measures thought to address the generation deficiencies arising from Hurricane Fiona."

2. The Technical Conference was held as scheduled on October 11, 2022. During the Technical Conference, the Energy Bureau and consultants for the Energy Bureau posed questions to LUMA's representatives. For some of the subject matters that were discussed in the Technical Conference, LUMA's representatives offered to provide supplemental information,

including the topics of battery energy storage and load shed events. In Exhibit 1 to this Motion, LUMA hereby submits supplemental information in attention to the questions posed by the Energy Bureau in the Technical Conference of October 11, 2022.

WHEREFORE, LUMA respectfully requests that the honorable Bureau **take notice** of the aforementioned and **accept** the information submitted in Exhibit 1 to this Motion.

RESPECTFULLY SUBMITTED.

In San Juan, Puerto Rico, this 31st day of October, 2022.

I hereby certify that this motion was filed using the electronic filing system of this Energy Bureau. I also certify that copy of this motion will be notified to the Puerto Rico Electric Power Authority, through its attorneys of record: jmarrero@diazvaz.law and kbolanos@diazvaz.law.

DLA Piper (Puerto Rico) LLC
500 Calle de la Tanca, Suite 401
San Juan, PR 00901-1969
Tel. 787-945-9107
Fax 939-697-6147

/s/ Margarita Mercado Echegaray
Margarita Mercado Echegaray
RUA NÚM. 16,266
margarita.mercado@us.dlapiper.com

Exhibit 1

LUMA's Comments from October 11, 2022 Technical Conference

NEPR-MI-2022-0003

October 31, 2022

Contents

1.0 Introduction 3

2.0 Information on Battery Energy Storage 3

2.1 Total number of existing batteries 3

2.2 Impact of utilizing batteries currently on-island 3

3.0 Information on Load Shed Events 4

3.1 Load Shed Summary for 2022 4

3.1.1 Summary of 2022 Load Shed Events Caused by Generation 4

3.1.2 Economic Impact 5

3.1.3 Observed Trends 5

3.1.4 Details of Each Load Shed Event 6

3.2 Load Shed Analysis – including Mobile Generation 6

1.0 Introduction

LUMA appreciated the opportunity to meet with the Energy Bureau and its consultants during the Technical Conference on October 11, 2022. As system operator, it is LUMA's role to inform the Energy Bureau and other Puerto Rican Government Agencies of the risks from the Power Generation portfolio to Resource Adequacy and LUMA's ability to provide safe, reliable and affordable energy to the people of Puerto Rico. The ability to maintain open dialogue with customers, the Energy Bureau and key stakeholders to address this issue will be critical to developing and implementing a stabilization plan to protect against the risk of insufficient energy from generators to meet customer demand.

The following Sections 2.0 and 3.0, provide additional information regarding topics discussed during the Technical Conference related to battery energy storage and load shed events.

2.0 Information on Battery Energy Storage

2.1 Total number of existing batteries

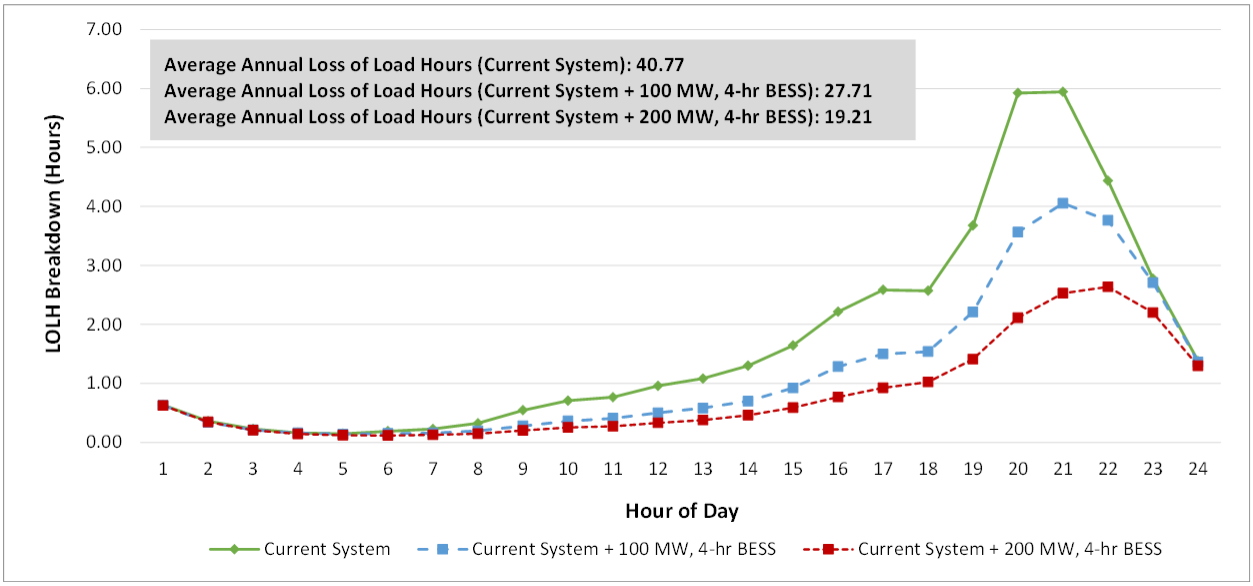
Several of the existing utility scale renewable generators have batteries installed which are used for compliance with Minimum Technical Requirements (MTR). The sum of all of the batteries represents 58 MW of capacity. The batteries are each rated for between 20-30 minutes of capacity, depending upon individual plant design. The batteries are used to regulate the frequency of the output of each facility.

2.2 Impact of utilizing batteries currently on-island

If more batteries were available, they would help LUMA deal with generator shortfalls that result in load shed. The Resource Adequacy Report for FY2023 (submitted in August 2022) quantifies the reduced risk of load shed by modeling a 100 MW (4-hour duration or 400 MWh of energy capacity) addition of batteries. The report estimates that 100 MW of 4-hour duration batteries could reduce the Loss of Load Expectation (LOLE) from 8.81 days per year down to 5.79 days per year, which is a statistically significant improvement.

For perspective, the potential improvement from a 100 MW 4-hour duration battery or a 200 MW 4-hour duration battery is shown below as expressed in Loss of Load Hours (LOLH) as they would be expected to occur over a 24-hour day. The figure below is calculated with a Monte Carlo simulation and is in Appendix 24 of the FY 2023 Resource Adequacy Report.

Figure 2-1: Comparison of Loss of Load Hours by Hour – Standalone BESS Addition



LUMA estimates the impact of 2.75 MW of 4-hour batteries would be to reduce the Loss of Load Expectation from 8.81 days per year down to 8.72. This improvement is not significant.

3.0 Information on Load Shed Events

3.1 Load Shed Summary for 2022

3.1.1 Summary of 2022 Load Shed Events Caused by Generation

In 2022, from January 1st through October 6th, there have been 20 load shed events due to generation. This number does not include load shed events caused by generation shortfall during the April outage event or during the Hurricane Fiona restoration period. The total cumulative load shed duration has been 432 minutes, with an average load shed duration of 22 minutes. The total capacity of generation that tripped and caused these 20 load shed events was 4,246 MW; with a weighted average of 240 MW of generation capacity was lost for each trip which resulted in a load shed event.

Load Shed Events	20 events	**Total Capacity Lost**	4,246 MW	**Total Load Shed Duration**	432 minutes
Estimated Customers Impacted	69,600	**Average Capacity Lost**	240 MW	**Average Load Shed Duration**	22 minutes

Each load shed event caused by a shortfall in generation has impacted approximately 69,600 customers, considering a weighted average of 87 MWh of load shed this year, and an average hourly consumption of 1.25 kWh per customer. In other words, 69,600 customers have not had electricity for a total of 432 minutes this year attributed to generation.

3.1.2 Economic Impact

As for the economic impact, the Value of Lost Load (VOLL) is an electric industry metric intended to represent the societal cost of outages in a monetary figure. A VOLL estimate was quoted in the Integrated Resource Plan of 2017, the Value of Lost Load (VOLL) equals $57,488 per MWh. Using this VOLL, the economic impact of the load shed events caused by generation shortfall in 2022 equals $100,029,120 in 2017 dollars) for all 20 events.

3.1.3 Observed Trends

Figure 3-1 below summarizes the load shed events caused by generation per month. The blue bars represent the total number of customers impacted for the load shed events during that month. The red line represents the total duration of all the load shed events that occurred during that month. Furthermore, Table 3-1 details the total number of events that occurred within that month and the power lost, represented in MW.

Figure 3.1 – Impacted Customers and Duration of Load Shed Events Caused by Generation Shortfall

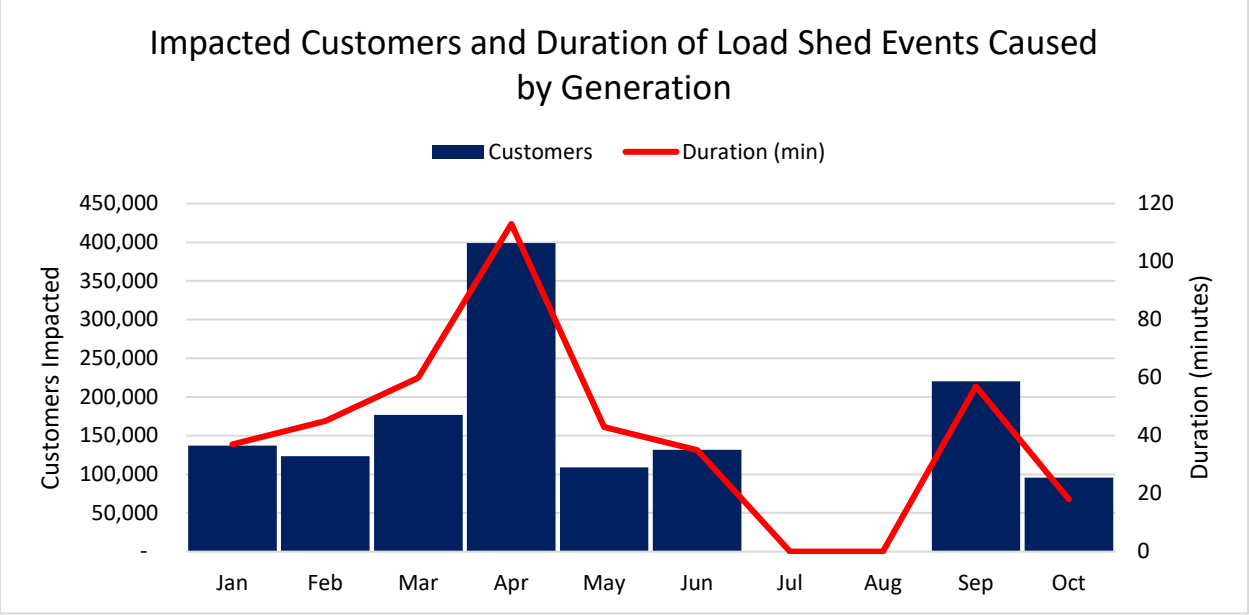


Table 3-1 – Information per Month of Load Shed Events Caused by Generation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
# Events	2	3	5	4	2	2	0	0	1	1
Capacity Lost(MW)	505	620	1186	977	380	440	0	0	290	398

It is important to note that this data and graph does not include load sheds that occurred during the April 6, 2022 outage event, nor during the Hurricane Fiona restoration period.

3.1.4 Details of Each Load Shed Event

Table 3-2 Details of Each Load Shed Event Caused by Generation, provides details on each load shed event with information regarding the start time, end time, duration, equipment that caused the load shed, the power loss, the equivalent megawatt-hours (MWh) and the equivalent number of customers impacted.

Table 3-2 – Details of Each Load Shed Event Caused by Generation

#	Start Time	End Time	Duration (min)	Equipment	Capacity Lost (MW)	MWh	Customers Impacted
1	13-Jan-22 15:31:00	13-Jan-22 15:56:00	25	Costa Sur 5	325	135	108,333
2	15-Jan-22 09:45:00	15-Jan-22 09:57:00	12	San Juan 5	180	36	28,800
3	11-Feb-22 10:46:00	11-Feb-22 11:00:00	14	EcoEléctrica CT 1	177	41	33,040
4	18-Feb-22 08:59:00	18-Feb-22 09:19:00	20	AES 2	210	70	56,000
5	19-Feb-22 06:51:00	19-Feb-22 07:02:00	11	Costa Sur 6	233	43	34,173
6	03-Mar-22 01:03:00	03-Mar-22 01:14:00	11	AES 2	210	39	30,800
7	13-Mar-22 01:40:00	13-Mar-22 01:50:00	10	Aguirre 1 & 2	500	83	66,667
8	16-Mar-22 13:40:00	16-Mar-22 14:00:00	20	Aguirre 2	136	45	36,267
9	26-Mar-22 23:16:00	26-Mar-22 23:26:00	10	Palo Seco 4	170	28	22,667
10	29-Mar-22 15:43:00	29-Mar-22 15:52:00	9	Palo Seco 3	170*	25	20,400
11	05-Apr-22 11:09:00	05-Apr-22 11:30:00	21	AES 1	227	79	63,560
12	14-Apr-22 01:14:00	14-Apr-22 01:54:00	40	San Juan CT 6 & STM 6, Aguirre 2	400	267	213,333
13	15-Apr-22 16:09:00	15-Apr-22 16:33:00	24	San Juan CT 6	160	64	51,200
14	28-Apr-22 13:15:00	28-Apr-22 13:43:00	28	EcoEléctrica CT 2	190*	89	70,933
15	14-May-22 02:37:00	14-May-22 02:50:00	13	EcoEléctrica CT 2	190	41	32,933
16	22-May-22 05:40:00	22-May-22 06:10:00	30	EcoEléctrica CT 2	190*	95	76,000
17	03-Jun-22 21:05:00	03-Jun-22 21:11:00	6	Palo Seco 3	125	13	10,000
18	12-Jun-22 05:56:00	12-Jun-22 06:25:00	29	Costa Sur 6 & 5	315	152	121,800
19	07-Sep-22 01:08:00	07-Sep-22 02:05:00	57	Costa Sur 6	290	275	220,400
20	06-Oct-22 03:51:00	06-Oct-22 04:09:00	18	Costa Sur 5 & 6	398	119	95,520

*Estimated Capacity Lost

3.2 Load Shed Analysis – including Mobile Generation

LUMA has evaluated the potential contribution that 500 MW of temporary, emergency generation would make to Resource Adequacy, as measured by the Loss of Load Expectation (LOLE) and Loss of Load Hour (LOLH) statistics.

Figure 3-2 below shows the expected LOLE for two separate scenarios. The first scenario, shown in the red shaded area, is LUMA's current "Expected Case" which represents the number of load shed events that LUMA expects based upon existing conditions and outage schedules provided by PREPA, AES, and EcoElectrica, and adjusted for estimated impact from Fiona. This scenario has a LOLE of 49.8 events with a 90% probability of between 40 and 59 events. This distribution of expected outcomes is based on a Monte Carlo simulation that ran 2,000 separate iterations of LUMA's risk analysis to simulate expected plant performance over the period from October 1, 2022 through September 30, 2023. The second scenario shown in green shaded areas, represents all the same "Expected Case" assumptions with the addition of 500 MW of temporary emergency capacity for the coming year.

Figure 3-2 : Comparison of Loss of Load Expectations With and Without Emergency Generation

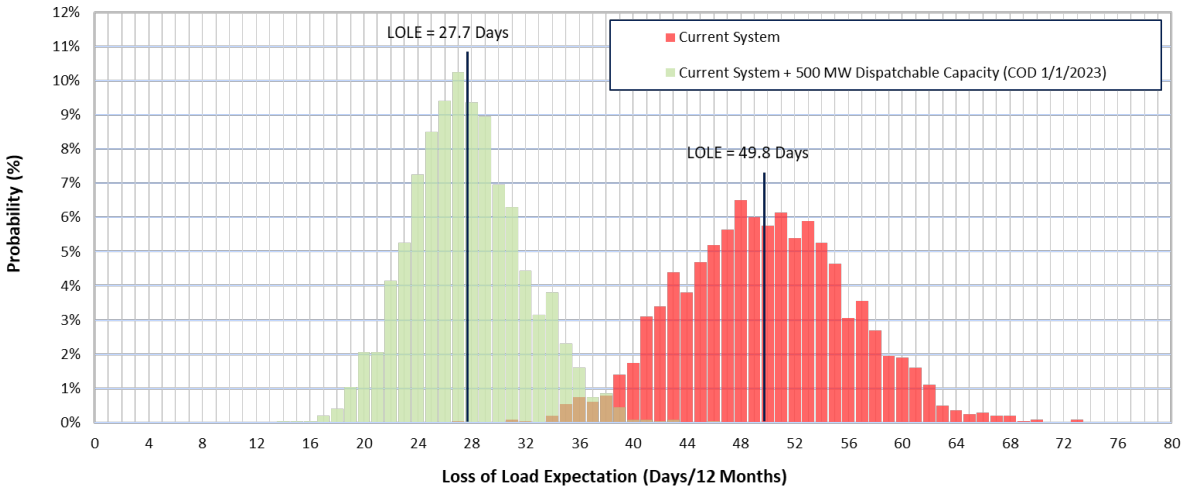
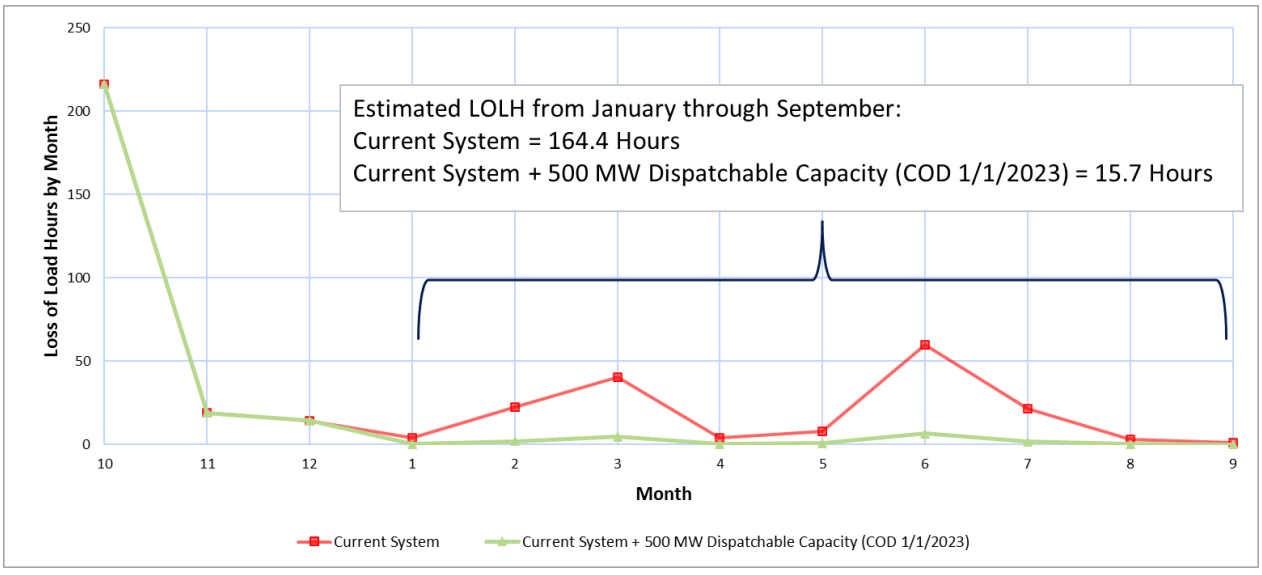


Figure 3-3 below shows the distribution of Loss of Load Hours (LOLH) over the next 12 month period for the same two scenarios. The difference between LOLH and LOLE is that the LOLE reflects that fact that under the MonteCarlo simulation, some of the lost hours could occur in the same day or could extend over two or more days. For example an eight hour outage could extend from 8 pm until 4 am in some simulations but could occur between 8 am and 4 pm in other simulations. So the same eight hour outage could result in one day with a loss of load event or two days. LOLH and LOLE are different ways to look at the same risk metric of a load shed but recognizes some outage will be longer duration and different time of day than others.

Figure 3-3: Comparison of Loss of Load Hours by Month With and Without Emergency Generation



As the chart clearly illustrates, the expected frequency of loss of load hours will be lower between January and March since the customer load is also forecasted to be lower during this winter season.

However, LOLH increases considerably during the summer of 2023. It is also important to note that outage schedules after the summer of 2023 are still highly uncertain, so the loss of load events after the summer season are likely to be even higher.

The other important observation from Figure 3-3 above is to point out that while the expected load shed events might appear to decline between January and March, it is critically important that generators are able to perform their scheduled maintenance during this period before the summer season begins. Over the past three year period , scheduled maintenance has been longer than forecast, and unscheduled forcedoutages have contributed to the need to postpone maintenance on units that are more dependable. Emergency generation will provide the reserves that are absolutely essential to allow maintenance to occur. If these maintenance schedules are not kept, than the probability of load shed will increase dramatically.