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

IN RE: REVIEW OF THE PUERTO RICO ELECTRIC POWER AUTHORITY INTEGRATED RESOURCE PLAN	**CASE NO.:** NEPR-AP-2023-0004 **SUBJECT**: Motion Requesting the Continuance of the Deadline for the 2024 IRP Filing

MOTION REQUESTING THE CONTINUANCE OF THE DEADLINE FOR THE 2024 IRP FILING

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 and request the following:

I. Introduction

1. On March 13, 2024, the Puerto Rico Energy Bureau (“Energy Bureau”) entered a Resolution and Order confirming that LUMA can continue modeling the six (6) Core Scenarios for its proposed Integrated Resource Plan (“2024 IRP”) filing scheduled for June 28, 2024, as requested in LUMA’s *Motion Submitting Revised 2024 Integrated Resource Plan Scenarios and Characteristics* (“March 13th Order”). The Energy Bureau also ordered LUMA to submit the applicable evaluation and analysis concerning the four (4) Supplemental Scenarios included in said Motion on or before August 1, 2024.

2. As operator of the Puerto Rico Transmission and Distribution System (“T&D”), LUMA is responsible for developing an IRP that maps out the transformation of Puerto Rico’s energy resources over the next two decades. LUMA recognizes the significant responsibility of

creating a realistic and pragmatic 2024 IRP built upon accurate data and analyses that meet public policy goals and regulations.

3. Among the milestones completed by LUMA for the 2024 IRP are: (i) completing a demand and energy forecast study; (ii) completing a demand response study; (iii) completing a baseline transmission transfer capability analysis; (iv) completing and updating the distributed solar forecast; (v) completing and updating the study of Combined Heat and Power (CHP) generation; (vi) completing high-level estimates of transmission upgrade costs; (vii) completing a distribution hosting capacity analysis; (viii) completing modifications to the PR100 EV forecast; (ix) completing a study of historical wind and solar energy resources study; (x) completing a fuel forecast including costs for biodiesel and renewable diesel in addition to the legacy fuels; and (xi) refining the strategy and plans for the T&D system.

4. As discussed extensively below, LUMA has encountered difficulties with the modeling software that have extended the completion of the base case study beyond what was expected. Those difficulties and delays will be explained in detail in the upcoming paragraphs and *Exhibit 1*. It is important to note that the difficulties encountered were not foreseeable and affected the set timeline for completing the 2024 IRP.

5. LUMA anticipates having a base case scenario in the upcoming days. Still, in the interest of timely notice, LUMA respectfully requests a continuance of the 2024 IRP Filing. LUMA will be able to provide an updated schedule of the 2024 IRP no later than June 28, 2024, after the base case resource plan is defined and validated.

II. Procedural Background

6. On July 12, 2023, the Energy Bureau issued a Resolution and Order whereby it initiated the instant administrative proceeding for the review of the proposed 2024 IRP to be filed

by LUMA as the agent for the Puerto Rico Electric Power Authority ("PREPA") ("July 12th Order").

7. Moreover, in the July 12th Order, the Energy Bureau took notice of LUMA's *Motion Submitting Update on IRP Technical Consultant Contracting Process, Request for Modification of Procedural Timeline and Request for Confidential Treatment* filed on March 31, 2023, in Case No. NEPR-MI-2020-0012, *In re: Implementation of the Puerto Rico Electric Power Authority Integrated Resource Plan and Modified Action Plan* (the "March 31st Motion"), through which LUMA informed the Energy Bureau of certain delays impacting the contracting of the IRP Technical Consultant.

8. In addition, the Energy Bureau granted LUMA's request in the March 31st Motion to schedule the initial Prefiling Technical Conference regarding the review of the 2024 IRP to no earlier than May 2023 to provide sufficient time for LUMA to be able to complete the technical consultant contracting process before the technical conference. Accordingly, the Energy Bureau scheduled the 2024 IRP Prefiling Initial Technical Conference for August 8, 2023, pursuant to the *Regulation on Integrated Resource Plan for the Puerto Rico Electric Power Authority,* Regulation No. 9021, dated April 20, 2018.

9. During the Technical Conference held on August 8, 2023, LUMA anticipated the possibility of modifying the 2024 IRP submission date to account for the delays in the contracting process of its technical consultant.

10. On August 30, 2023, LUMA filed a *Motion Submitting Revised Version of Exhibit I of Final Contract for Technical Consultant and Related Documents, Request for Approval of Final Contract, and Request for Confidential Treatment* whereby, in what is pertinent, it submitted

a revised Exhibit I in the terms discussed during the Technical Conference and requested that the Energy Bureau approve the revised version of Exhibit I of the technical consultant contract.

11. On September 7, 2023, the Energy Bureau issued a Resolution and Order approving the revised technical contract between LUMA and the technical contractor and scheduled a second IRP prefiling conference for October 31, 2023.

12. The second pre-filing Technical Conference was held on October 31, 2023. During the same, LUMA discussed the Presentation and answered the questions posed by the members of the Energy Bureau. LUMA also had the opportunity to introduce its technical consultant for the 2024 IRP filing.

13. During the second pre-filing Technical Conference, LUMA proposed the revised IRP filing date of June 28, 2024. LUMA explained that once the technical consultant was onboarded, LUMA and the IRP Technical Consultant worked diligently to develop a revised schedule that takes into account the considerable work entailed by the 2024 IRP submission, the interrelation of the LUMA and the IRP Technical Consultant tasks for the 2024 IRP and the sequential nature of those tasks. At the closing of the technical conference, this Energy Bureau directed LUMA to submit its request in writing for its consideration.

14. On November 14, 2023, LUMA filed a *Request for Modification of Timeline for 2024 IRP Filing*. LUMA included the revised timeline with a summary of the explanations supporting LUMA's request. LUMA respectfully set forth that, per its discussion with the IRP Technical Consultant and based on the technical consultant's vast experience, the normal scope of a regular IRP will typically require approximately nine (9) to twelve (12) months to complete. Also, LUMA explained that complexities in the planned scope of work for the 2024 IRP, which includes eight separate planning areas as opposed to the more common single planning area,

integrated transmission modeling, and distributed energy resource modeling, as well as the transmission and distribution areas and additional sensitivities that will be considered, required extra time to develop and file the 2024 IRP.

15. On December 20, 2023, the Energy Bureau issued a Resolution and Order approving LUMA's request for an extension to file the 2024 IRP to June 28, 2024. Further, the Energy Bureau scheduled a third technical conference for January 30, 2024, for LUMA to present information on certain parts of the transmission sections of Regulation No. 9021.

16. On March 11, 2024, LUMA filed a *Motion Submitting Revised 2024 Integrated Resource Plan Scenarios and Characteristics*. Therein, LUMA submitted its *LUMA 2024 IRP, Revised Scenarios and Characteristics,* including the six (6) scenarios ("Core Scenarios") that will form a key part of its 2024 IRP modeling analysis, which will be filed as part of LUMA's IRP submission on June 28, 2024. It also included four (4) scenarios ("Supplemental Scenarios") that would be filed in a Supplemental Filing after June 28, 2024. LUMA also explained that the exercise of revising the scenarios caused a temporary halt in the modeling of the base case scenario.

17. In the March 13th Order, the Energy Bureau confirmed that LUMA could continue modeling the six (6) Core Scenarios for its IRP filing scheduled for June 28, 2024. It also ordered LUMA to submit the applicable evaluation and analysis concerning the Supplemental Scenarios on or before August 1, 2024.

III. Request for Continuance of the 2024 IRP Filing

A. Simulation Software

18. To model the scenarios ordered by the Energy Bureau, the IRP Technical Consultant utilizes simulation software. The software is a platform with modeling capabilities across electric, gas, and water systems, allowing for the optimization of interdependent energy

markets. Specifically, it allows unifying all data streams – in any granularity – into a unified energy modeling and forecasting platform. Its simulation engine analyses zonal and nodal energy models ranging from long-term investment planning to medium-term operational planning and down to short-term, hourly, and intra-hourly market simulations. Thus, the software can be configured with a limitless collection of scenarios, customized constraints, conditional variables, physical elements, simulation horizons, durations of the simulation period, phases in the integration, and model resolution.

19. The simulations for the 2024 IRP will develop a recommended IRP portfolio that defines the lowest-cost resources that meet the goals of providing reliable, clean, efficient, resilient, and affordable energy for Puerto Rico.

B. Issues with the Results for the 2024 IRP

20. Since March 2024, even while LUMA was awaiting the Energy Bureau's determination on the revised scenarios presented on March 11, 2024, B&V resumed working on the base case modeling to avoid further delays. At the time, LUMA and B&V expected, in good faith, to complete the modeling required of the 2024 IRP in time to file by June 28, 2024.

21. For reasons totally outside LUMA's control, the modeling results for the 2024 IRP have been delayed for several reasons. While LUMA and B&V have resolved the issues with the model, the impact on the schedule has been significant, and additional time for the modeling period is necessary. These issues are explained in greater detail in *Exhibit 1* to this Motion.

C. Remedial Actions

22. At the time when LUMA proposed the June 28th date to file the 2024 IRP, neither LUMA nor the IRP Technical Consultant could foresee the issues that would arise in connection with modeling the proposed scenarios. As this was the first time both companies encountered

issues that are more fully explained in *Exhibit 1*, it was difficult to identify correctly and rapidly the issues to be resolved.

D. Continuance of the 2024 IRP Filing

23. At present, the IRP Technical Consultant is close to reaching a reasonable result for the base case scenario. However, not having a base case scenario in early June 2024 has rendered impossible the current filing date for the 2024 IRP of June 28, 2024, established by the Energy Bureau in the March 13th Order.

24. The 2024 IRP filing schedule approved by the Energy Bureau in the March 13th Order was aggressive but feasible The June 28th file date was intended to finalize the 2024 IRP in the shortest possible time and did not incorporate sufficient contingency to address the unexpected model issues that were outside LUMA's control. Based on the IRP Technical Consultant's experience, an IRP with a simple or typical scope requires approximately nine (9) twelve (12) months to complete the modeling phase alone. However, any changes in the requirements, inputs, regulations, or model issues, such as those confronted by LUMA and the IRP Technical Consultant, would typically lengthen the schedule.

25. In the March 13th Order, the Energy Bureau recognized the importance of allowing LUMA sufficient time to develop the 2024 IRP. LUMA has strictly adhered to the schedule mandated by the Energy Bureau to complete the 2024 IRP Filing. Together with the IRP Technical Consultant, LUMA has worked untiringly to address the above-described issues most efficiently and rapidly as they arose. LUMA and the IRP technical Consultant were expecting to confront typical delays and complications during the development of the 2024 IRP. However, it was not expected to find software model issues, and these issues would delay the completion of the base case until early June. Building a model for any utility system is a lengthy and intricate process

that takes time to adjust and perfect according to the unique characteristics and requirements of the electric system being examined.

26. As discussed, software modeling program issues were addressed, and LUMA is now adjusting and refining the model's resulting preliminary portfolios. While this is a normal part of the process, it demands significant time and effort to refine the model outputs correctly. LUMA anticipates having a base case scenario in the upcoming days. Still, in the interest of timely notice, LUMA formally requests a continuance of the deadline to submit the 2024 IRP to the Energy Bureau. LUMA will be able to provide an updated schedule of the 2024 IRP Filing no later than June 28, 2024, provided the base case resource plan has been completed.

27. LUMA and the IRP Technical Consultant expect to have a final and validated base case in the next couple of days and then continue to model the remaining scenarios and subsequent scheduled tasks. In order to allow adequate time to complete the remaining tasks, LUMA requests that the Energy Bureau continue the June 28th deadline. This enables LUMA and the IRP Technical Consultant more time to resolve the current issues and complete an efficient and precise modeling of Puerto Rico's system.

28. Once the base case modeling is complete, LUMA will submit a revised schedule considering the required time to model the remaining scenarios and complete subsequent tasks. Thus, LUMA will be able to provide an updated schedule no later than June 28, 2024, after the base case resource plan is defined and validated.

WHEREFORE, LUMA respectfully requests the Energy Bureau to **take notice** of the foregoing and **grant** LUMA's request for continuance of the 2024 IRP filing date. LUMA will be able to provide an updated schedule no later than June 28, 2024, after the base case resource plan is defined and validated.

RESPECTFULLY SUBMITTED.

I HEREBY CERTIFY that this Motion was filed using the electronic filing system of this Energy Bureau and that electronic copies of this Motion will be notified to the Puerto Rico Electric Power Authority: lionel.santa@prepa.pr.gov and through its attorneys of record González & Martínez, Mirelis Valle-Cancel, mvalle@gmlex.net; and Alexis G. Rivera Medina, arivera@gmlex.net; and Genera PR, LLC: brannen@genera-services.com; kbolanos@genera-pr.com; regulatory@genera-pr.com; lrn@roman-negron.com.

RESPECTFULLY SUBMITTED.

In San Juan, Puerto Rico, on June 7, 2024.

DLA Piper (Puerto Rico) LLC
Calle de la Tanca #500, Suite 401
San Juan, PR 00901-1969
Tel. 787.945.9132
Fax 939.697.6102

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

/s/ Yahaira De la Rosa Algarín
Yahaira De la Rosa Algarín
PR Bar No. 18,061
yahaira.delarosa@us.dlapiper.com

Exhibit 1

Exhibit 1- Request for Continuance of the Deadline for the 2024 IRP Filing

NEPR-AP-2023-0004

JUNE 7, 2024

Exhibit 1

Contents

Exhibit 1

1.0 Executive Summary

LUMA is committed to supporting and advancing the transformation of Puerto Rico's energy system into one that is more resilient, cleaner, and sustainable for everyone. Since assuming operation and maintenance responsibilities over Puerto Rico's Transmission and Distribution System ("T&D System"), LUMA has focused on critical priorities, consistent with the System Remediation Plan ("SRP") and approved budgets, to make real and sustainable progress toward achieving a better electric service for our customers. In nearly three years, LUMA has:

- Installed over 8,200 automatic devices that use innovative technology to reduce the size and impact of outages.
- Replaced more than 12,500 utility poles with new infrastructure that can withstand 160+ mph winds to strengthen reliability and system resiliency in severe weather.
- Cleared vegetation from over 4,500 miles of powerlines to improve public safety and reduce outages for customers.
- Reduced large-scale substation outages by more than 60% through LUMA's Substation Modernization Initiative to improve overall reliability.
- Installed over 106,000 streetlights, making communities safer and more energy efficient as part of LUMA's Community Streetlight Initiative.
- Helped connect over 91,000 customers to rooftop solar, representing more than 585 MW of renewable energy added to the grid.
- Submitted 346 detailed scopes of work (DSOWs) to FEMA, representing an estimated $9.8 billion in federal funding to help rebuild and modernize Puerto Rico's electric system.

All these achievements are relevant and beneficial to another of LUMA's core system planning responsibilities as Operator of the T&D System: the development and proposal of an Integrated Resource Plan ("IRP"). Since the beginning of 2022, LUMA has been working tirelessly and diligently to develop a realistic and pragmatic IRP (the "2024 IRP") that is built upon accurate and comprehensive data and analyses and reflects the needs and priorities of our customers, while reliably and cost effectively progressing towards a more reliable, resilient and cleaner energy system. Notably, in developing the 2024 IRP, LUMA has prioritized stakeholder engagement through the *Soluciones Energéticas para Transformar a Puerto Rico* ("SETPR") initiative, a collaborative process designed to engage with customers and stakeholders and gain their input regarding Puerto Rico's energy future and help ensure that LUMA receives a diverse set of viewpoints from customers across the Island.

As acknowledged during the October 31, 2023 Technical Conference, and as reaffirmed in LUMA's November 14, 2023 Motion,[1] LUMA developed and proposed a schedule that, based on the status of activities and the information available at that point in time, would enable the filing of the proposed 2024 IRP by June 28, 2024. Although, when compared to IRP development schedules in comparable jurisdictions, the schedule proposed on November 14, 2023 was aggressive, LUMA, in good faith,

[1] *See* November 14, 2023, LUMA's Motion to Request for Modification of Timeline of 2024 IRP Filing at: https://energia.pr.gov/wp-content/uploads/sites/7/2023/11/20231114-Request-for-Modification-of-Timeline-to-File-2024-IRP-Filing.pdf

Exhibit 1

believed all relevant modeling and validation activities, as well as the development of materials in support of LUMA's 2024 IRP filing, would be completed by June 28, 2024.

Unfortunately, once scenario modeling began in earnest, LUMA and LUMA's IRP Technical Consultant confronted challenges in the modeling results that required extensive work to diagnose and identify the necessary actions to remediate before productive modeling activities could resume.

Although LUMA and LUMA's IRP Technical Consultant have resolved the challenges encountered, the time invested in doing so has led to a delay in the modeling of the base case resource plan for the 2024 IRP, which, in turn, has delayed the multiple activities and tasks that are dependent on completion of a base case resource plan.

LUMA and its IRP Technical Consultant are currently in the final phases of development and validation of the resource plan resulting from the base case scenario and expect to complete this task in the coming weeks. Until this activity is complete, and a base case resource plan has been completed and properly validated, LUMA cannot determine the extent to which subsequent activities and tasks have been impacted and, therefore, the time that would now be required to complete a robust and comprehensive IRP analysis that meets the Energy Bureau's requirements and provides a pragmatic and reliable roadmap towards the transformation of Puerto Rico's energy system in line with energy public policy objectives.

Based on the above, and for the reasons that are further explained in this Exhibit, LUMA is requesting the Energy Bureau continue the June 28, 2024 filing deadline for the 2024 IRP and grant LUMA until said date to complete and properly validate the base case resource plan. Furthermore, LUMA requests the Energy Bureau to grant LUMA until June 28, 2024 to develop and propose a revised schedule that accounts for the effects of the delays to the base case resource plan described in this Exhibit on all other remaining tasks and activities and provides the best opportunity for LUMA to submit a compliant and comprehensive 2024 IRP. In this Exhibit LUMA is providing transparency on the reasons for the need for the extended timeframe for completion. Although, as mentioned above, the development of this revised schedule is dependent on the completion and validation of the base case resource plan, to the extent LUMA is able to provide such an updated schedule to the Energy Bureau prior to June 28, 2024, LUMA is committed to doing so. Cognizant of the importance of the IRP to the transformation of Puerto Rico's energy sector, LUMA is committed to providing transparency on challenges and solutions to creation of the base case scenario and portfolio. LUMA remains steadfast in producing a quality plan for robust discussion with stakeholders and subsequent submittal to the Energy Bureau for review.

Exhibit 1

2.0 2024 IRP Development and Progress

Development of an IRP is a complex, years-long, iterative, multi-step and resource-intensive process requiring the execution and coordination of activities across multiple groups of stakeholders. The development of an IRP includes preparatory activities such as (i) conducting stakeholder engagements and collecting input and recommendations; (ii) defining preliminary study parameters; (iii) identifying and analyzing data and information needs; (iv) identifying assumptions, forecasts, and existing resources and (v) defining objectives and scenarios.

After these preparatory activities have been completed and the modeling parameters have been defined, the IRP development team proceeds to populate the simulation model with the required data, forecasts and assumptions and then assesses and validates the initial results of the model output, making adjustments as needed. The modeling activities then move to the process of defining a pragmatic, and cost-efficient set of resource plans (i.e., portfolios) that are optimized based on the future conditions defined in each scenario. The process of defining a separate resource plan for each of the scenarios requires an iterative process of adjusting the model inputs and constraint parameters, sequentially running the multiple modules of the model, assessing the modeling results, then adjusting as necessary to ensure the reliability, accuracy, and practicality of the resulting supply plan. The resulting set of optional supply plans then undergoes a multi-step process to assess their individual performance across a range of futures described by the full set of scenarios and sensitivity analyses. Once all modeling exercises have concluded, based on the results of such activities, a preferred resource plan is identified, principally driven by the previously defined IRP objectives. After the preferred resource plan has been defined, the utility then proceeds to conclude the development of a final integrated resource plan report, along with the relevant supporting documentation and materials, and proceeds with its submission to the regulator for final review in an adjudicatory proceeding.

In keeping with industry best practices, LUMA has shown continuous progress since the beginning of the 2024 IRP development process, including successfully completing many of the activities outlined above. Understanding the significance of the 2024 IRP in defining a roadmap towards meeting our customer's needs, LUMA launched the *Soluciones Energéticas para Transformar a Puerto Rico* ("SETPR") initiative, a collaborative customer and stakeholder engagement process whereby LUMA's customers and stakeholders could provide their input on Puerto Rico's energy future. SETPR provided LUMA with valuable insight into the diverse nature of customer needs and priorities and used that information to define the objectives, scenarios and resource portfolios to be used for the 2024 IRP. This process is ongoing and LUMA has intended for it to continue until a proposed 2024 IRP is submitted to the Energy Bureau.

Other activities that LUMA has successfully completed in connection with the development of the 2024 IRP include:

- Completing the energy and demand forecast study, and underlying studies to support key energy and demand drivers such as Combined Heat and Power, distributed generation and demand response;
- Completing transmission and distribution analysis to support the incorporation of grid constraints and plans as an integral part of the study; and

Exhibit 1

- Completing several studies to provide stronger data for resource inputs including comprehensive fuel forecasts and improved granularity and specificity of solar radiation and production.

Table 1 below provides further details completed activities, as well as other activities that remain ongoing.

Table 1: Ongoing and completed activities.

ITEM	DESCRIPTION	DATE
1	Implemented the SETPR initiative to obtain direct input and feedback from stakeholders throughout the development of the 2024 IRP.	
	Conducted a total of 22 SETPR workshops across Puerto Rico with 174 participants. Participants shared their concerns and expectations on the future of Puerto Rico's energy system. LUMA incorporated the input received from stakeholders into the selected scenarios and objectives of the 2024 IRP and then reviewed the scenarios and objectives with the stakeholders.	Ongoing effort since October 2023
2	During March 2024, LUMA revised the original scenarios to incorporate the Energy Bureau's expectations.	
3	Completed input assumptions and forecasts required for the 2024 IRP study.	
	Completed LUMA's IRP energy and demand study.	Completed
	Completed LUMA's first demand response forecast study.	
	Completed update to the distributed solar forecast.	
	Completed an update to the contributions from customer owned combined heat and power generation (CHP).	
	Completed baseline transmission transfer capability analysis.	
	Completed estimates of generic transmission upgrade costs for use in the IRP modeling.	
	Completed adjustments to the PR100 Light Duty Vehicle (LDV) Electric Vehicle (EV) charging forecast.	
	Completed a distribution hosting capacity analysis.	
4	Worked with the Department of Energy (DOE) to review the results of the PR100 study and incorporate lessons learned and adopted select elements of the PR100 results as assumptions and input for the 2024 IRP.	October 2022 to March 2024
5	Continued progress toward the transmission and distribution plans for the 2024 IRP.	Ongoing effort

Exhibit 1

3.0 Scenario Modeling Challenges

LUMA and the IRP Technical Consultant began modeling activities during the month of January 2024. In a January 30, 2024, Technical Conference[2], the Energy Bureau identified several items related to the eight IRP scenarios proposed by LUMA (the "Original IRP Scenarios") that warranted further discussion and directed its consultants to engage LUMA informally to gain a better understanding of the underlying assumptions and characteristics of the Original IRP Scenarios. Based on the feedback provided by the Energy Bureau's consultants, LUMA made various revisions to its proposed scenarios, increasing the number of scenarios to be modeled to ten, six of which would be referred to as the Core Scenarios, and would be filed on June 28, 2024, with the remaining four Supplemental Scenarios to be filed later (the "Revised IRP Scenarios").

LUMA submitted the Revised IRP Scenarios to the Energy Bureau on March 11, 2024.[3] Although defining the Revised IRP Scenarios caused a temporary halt in modeling the base case resource plan, LUMA informed that the modeling exercises related to the base case resource plan had resumed. Notwithstanding, LUMA highlighted the need for the Energy Bureau to confirm its agreement with the Revised IRP Scenarios for LUMA and the IRP Technical Consultant to fully resume modeling exercises. On March 13, 2024[4], the Energy Bureau confirmed its agreement with the Revised IRP Scenarios.

3.1 Unforeseen Modeling Challenges

On March 1, 2024, the IRP Technical Consultant resumed working on modeling the base case resource plan, with the aim of completing the modeling of all Core Scenarios in time for the June 28, 2024 filing deadline. The planned June 28, 2024 filing date was aggressive, but it anticipated normal issues associated with validating results, identifying inaccuracies, identifying solutions and running the model again as part of the ordinary modeling process required in the modeling for an IRP. However, the revised schedule did not anticipate the unexpected model issues LUMA has experienced nor the prolonged process it has taken to diagnose and resolve those model issues. To mitigate delays related to modeling the initial scenario, LUMA and the IRP Technical Consultant worked diligently to identify actions that could be taken or activities that could be compressed or reassessed in order to meet the June 28, 2024 filing deadline.

However, upon resuming development and modeling of the base case resource plan, LUMA and the IRP Technical Consultant discovered multiple instances of illogical results from the model, including among others:

[2] See January 30, 2024, Technical Conference Presentation at: https://energia.pr.gov/wp-content/uploads/sites/7/2024/02/20240201-Motion-Submitting-Amended-Presentation-for-Third-In-Person-Pre-Filling-Technical-Canference.pdf

[3] See March 11, 2024, LUMA Motion submitting 2024 IRP Revised Scenarios and Characteristics at: https://energia.pr.gov/wp-content/uploads/sites/7/2024/03/20240311-AP20230004-Motion-Submitting-Revised-2024-Integrated-Resource-Plan-Scenarios-and-Characteristics.pdf

[4] See March 13, 2024, Resolution and Order at: https://energia.pr.gov/wp-content/uploads/sites/7/2024/03/20240313-AP20230004-Resolution-and-Order.pdf

- Adding new combined cycle generation that then, never operated at capacity factors that would justify the added costs of a combined cycle over a less expensive simple cycle unit;
- Operating less efficient, existing generation units at high-capacity factors and not operating newer units with better efficiencies, even when units were using the same fuel and had no transmission constraints that impacted their dispatch; and
- Large fluctuations in the unserved energy values between different model runs that did logically align with the differences that would be expected from differences in the input parameters of the runs.

Over the next two months, LUMA and the IRP Technical Consultant worked to diagnose each issue and identify the actions and solutions necessary to remediate and enable the development of a reliable base case resource plan. The three (3) primary modeling software issues identified by LUMA and the IRP Technical Consultant, in consultation with the modeling program's vendor, are:

- The use of Loss of Load Probability (LOLP[5]) as a planning objective input;
- Obtaining accurate fuel burn rate results; and
- Extended processing time to complete each model run.

The illogical results emanating from these three issues intertwined to make their diagnosis more complex and time consuming. Each of these issues is related to problems encountered with the model's functional capabilities and required considerable, unanticipated time for the LUMA, LUMA's IRP Technical Consultant and the modeling program's vendor to diagnose and resolve. The modeling software issues are further explained in the Explanation Memo prepared by the IRP Technical Consultant which is included in Attachment 1.

3.2 Steps Taken to Resolve the Modeling Software Issues

LUMA and the IRP Technical Consultant identified and applied the following solutions to address challenges outlined above and resume the development of a base case resource plan and the 2024 IRP:

- **LOLP Calibration**

  The LOLP (Loss of Load Probability) target input is used in the model to estimate resource adequacy, determining the capacity needed to meet system reliability criteria. Initially, there were discrepancies between the LOLP numbers in the expansion plan module and the more detailed production costing module. By ultimately understanding how model used the LOLP input in its program logic, LUMA and the IRP Technical Consultant made adjustments, resulting in consistent outputs between the capacity expansion and production cost modules.

- **Data Inputs to the Model**

  The incremental burn rates measure the change in burn rates per MW output. The software's default settings allow for non-convex marginal heat rate function to be used as an input method,

[5] Note that 0.1 days/year was selected as the target Loss of Load Expectation (LOLE) as the resource adequacy indicator for the 2024 IRP. The IRP Technical Consultant identified that LOLE is not supported as an input planning target in the modeling software. However, the software was represented as supporting LOLP as an input planning target and the use of LOLP was determined to provide an acceptable alternative input planning criteria to achieve resource adequacy results equivalent to the desired LOLE target.

but the IRP Technical Consultant's analysis revealed inaccuracies in the model generated burn rate curves. To correct this, LUMA and the IRP Technical Consultant simplified the burn rate formulas, which served to align the long-term generation expansion and short-term production costing module outputs.

- **Heat Rate Error Method**

  The default Production Heat Rate Error Method was set to only warn about non-convexity, adjusting the marginal heat rate function to make it convex. However, the model inaccurately estimated burn rates, showing decreasing rates before increasing. The LUMA and the IRP Technical Consultant corrected this by determining convex burn rate coefficients externally and inputting them into the model, ensuring accurate fuel consumption rates and better alignment between module outputs.

- **Complexity of Puerto Rico's Model**

  The model must meet multiple objectives, including RPS goals, system reliability of 0.1 day per year, and least cost. Due to software issues, achieving all objectives while maintaining expected system performance was challenging and required several weeks to resolve. To manage risks associated with adding or retiring many units in a single year, LUMA and the IRP Technical Consultant manually adjusted schedules, spreading out capacity changes to achieve economical retirements and additions based on model outputs.

The remediation solutions for the issues described above have resulted in increased time required for the pre and post processing of individual model and many more iterations of the model runs to achieve acceptable results. While LUMA and the IRP Technical Consultant have found solutions to the know model issues, the solutions require additional time to complete the modeling activities.

4.0 Conclusion and Revision to the 2024 IRP Schedule

Having identified and applied solutions to resolve the modeling challenges discussed above, LUMA and the IRP Technical Consultants are currently in the final phases of development and validation of the resource plan resulting from the base case scenario and expect to complete this task in the coming weeks. However, the challenges confronted in developing the base case resource plan and the time required to diagnose and resolve them, along with the incremental time required to utilize the defined solutions to each modeling run, have unavoidably delayed both the time required to achieve a final base case resource plan, as well as the completion of all subsequent tasks and activities that are dependent on a final base case resource plan. Therefore, despite LUMA's best efforts, the 2024 IRP can no longer be submitted to the Energy Bureau by June 28, 2024, as originally intended. Based on the above, LUMA is requesting the Energy Bureau suspend the June 28, 2024 filing deadline.

The extent to which these subsequent tasks and activities have been impacted cannot be determined until a base case resource plan is finalized. Therefore, LUMA requests the Energy Bureau grant until June 28, 2024, to complete and properly validate the base case resource plan. Doing so would allow LUMA to provide a reasonable and accurate estimate of the time that would now be required to complete a robust

Exhibit 1

and comprehensive IRP analysis that meets the Energy Bureau's requirements and provides a pragmatic and reliable roadmap towards the transformation of Puerto Rico's energy system in line with energy public policy objectives.

To the extent LUMA is able to provide an updated schedule to the Energy Bureau prior to June 28, 2024, LUMA is committed to doing so.

June 4, 2024

LUMA
María Giovanna Dessy, Manage, Integrated Resource Plan
P.O. Box 364267
San Juan PR 00936-4267

RE: Software Modeling Issues on the 2024 IRP

Dear Giovanna:

As requested by LUMA, the Black & Veatch team has developed an explanation of IRP modeling issues that have arisen and have negatively impacted the schedule for the completion of the production costing and expansion planning runs developed to identify the preferred resource additions and retirements for Puerto Rico.

Note that in the discussion of issues below, the planning model components are often referred to, and these primary components include the long-term expansion plan module, which determines the combination of future resources additions (and economic retirements), and the short-term hourly chronological production cost module, which dispatches available units on a merit order basis to serve load.

Loss of Load Probability (LOLP) Calculation

- The largest cause of delay involves certain issues related to the computer model utilized that have been problematic in this modeling assignment. Foremost is the methodology the planning model uses to determine the loss of load probability (LOLP) calculation in the expansion planning module. The desire was to use the LOLP to track progress toward the 0.1 day per year reliability target and to avoid using a reserve margin criterion. The reason that building to LOLP targets is preferred is because, for systems with high penetrations of non-dispatchable renewable generation capacity, contributions to capacity reserve margins requirements are less suited to provide an accurate determination of system reliability than the LOLP measure. The same reason applies to the use of a reserve margin when units are highly unreliable and have high forced outaged rates, as in the case for Puerto Rico.

  However, initial run results and discussions with the software developers has revealed that the target LOLP input does not cause the model to necessarily achieve the target LOLP input when making build decisions in the optimization module. After much study and discussion with the software vendor, it was realized/acknowledged that the LOLP target input is used in the model as a proxy to estimate reserve margin criteria in determining the amount of capacity that needs to be added to the system based on the installed capacity of the generator to meet the system reliability criteria. This partly accounted for the problematic results that were being seen; namely, the LOLP numbers seen in the expansion plan module were much better than was was being seen out of the more detailed production costing module. Understanding the details behind the calculation of LOLP in the model allowed us to make appropriate adjustments so that consistent results are now being seen between the capacity expansion module and the production cost module of the software.

Differences Between the Build Retire Module and Production Cost Module Results

- Another modelling software design problem that has significantly impacted the schedule has been the difference between generator energy production outputs from the expansion plan build/retire module and the hourly chronological production cost module. For example, in determining the lowest cost expansion build plans, the capacity expansion module was showing the capacity factor of new combined cycle combustion turbines, added by the model to average over 63 percent and at that average annual capacity factor, the model was adding the combined cycle as a component of the lowest cost plan. A 63 percent capacity factor is a utilization level that is reasonable to economically justify building combined cycles. However, when simulating the plan that was recommended by the capacity planning module in the production costing module, the combined cycle units were running at an annual average capacity factor of less than two percent. Based on industry experiences, it was judged that building combined cycle units that operate at less than a two percent capacity factor is not a lowest cost alternative. Building simple cycle combustion turbines would be a lower cost alternative. This difference required a deep dive on the part of Black & Veatch to resolve. Through discussions with the model vendor and through internal diagnostics, the root of the problem was eventually identified and the issues was fixed. To summarize the problem discovered, the long-term expansion module uses a simplified chronological production cost method to evaluate all the alternatives to meet future needs and to control run times to manageable durations. By design, the simplifications uses reduced runtimes but still adequately compares the relative merits of one alternatives plan to another. Subsequently, the production costing module algorithm is used to get a more accurate estimate of the best plan's overall production costs. This algorithm and costing caculation is more data intensive and uses a much higher requirement for computational resources. This increase in resources significanly increases the total amount of time to run scenarios as opposed to hourly chronological simulation algorithmic techniques.

Data Inputs to the Model:

The inputs that define the burn rate characteristics for the large 1x1 combined cycle generator alternatives were input as Load Point/Heat Rate pairs and are shown in the table below:

Load Point, MW	Heat Rate, Btu/kWh
193.9	7,592
399.6	6,531
525.5	6,400
550.9	6,492

The modeling software allows alternative methods to input the burn rate information and the modeling software documentation indicates that to the extent possible without introducing unacceptable misrepresentations to burn rate functions, the marginal heat rates should be monotonically non-decreasing at increasing generator output levels. (Note: what is commonly referred to in the industry as marginal heat rates are actually incremental or marginal burn rates. The incremental burn rates are the first order derivative of the burn rates equation. If the burn rates units are in MMBtu/hr and the generator output units are in MW, the incremental burn rates are a measure of change in burn rates in MMBtu/hr per change in MW output of the generator. This results in the units for the incremental burn rate to be MMBtu/hr per MW. The units can be rearranged to MMBtu/hr/MW and condensed to MMBtu/MWh, which happen to be the same units as heat rates so the incremental burn rates have become commonly referred to in the industry as marginal heat rates.)

As an alternative to entering Load Point/Heat Rate pairs, the software does have the capacity for users to enter burn rate equations coefficients directly. As a perceived time saving measure, it was decided to enter, for this engagement, the Load Point/Heat Rate pairs directly rather than to take the time to calculate the burn rate equations coefficients and enter them since the software documentation indicted that it had the capability. The software documentation states that when the burn rate function is not monotonically non-decreasing the burn rate function is referred to as being 'non-convex'.

When the burn rate function is non-convex, the simulator allows the switch to a variation of the approximation that includes additional constraints that ensures that the tranches are used in order. Because this version requires integer variables and additional constraints, it is not enabled by default, however, the documentation states that warnings from the simulator will indicate when this integer approximation might be needed by issuing a warning whenever the marginal heat rate step function, computed after the fitting of the polynomial, have values that decrease with higher tranche numbers.

The documentation states that a switch to the integer approximation can be specified globally by setting the Production Heat Rate Error Method to "Allow Non-convex" and/or by setting Generator Formulate Non-convex for individual Generator objects. With this option enabled there is no restriction on the 'convexity' of the marginal heat rate function, which allows modelling of marginal heat rate functions of practically any shape.

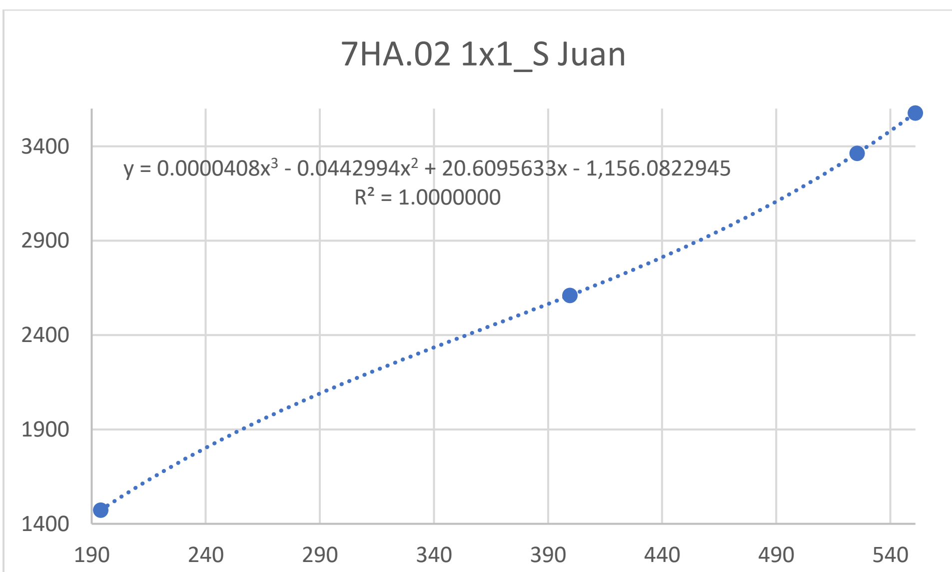
Testing the Production Heat Rate Error Method

By default, the Production Heat Rate Error Method is set to only warn about the non-convexity and "adjust" the marginal heat rate function to make it convex. The simulations performed for this analysis used the default settings. No warning messages were output indicating that the burn rate function that the software determined were non-convex.

The software has the option to turn on heat rate diagnostics. To test this option the BV team used the 7HA.02 1x1_S Juan combined cycle unit. This option was turned on for one of the simulations to learn the coefficients that the model was determining from the Load Point/Heat Rate pairs for the H-class 1x1 combined cycle. The burn rate equation coefficients are shown in the table below.

Name	Pmin	Pmax	A	b	c	d
7HA.02 1x1_S Juan	188	550.882	-1156.08	20.6096	-0.044299	4.08E-05

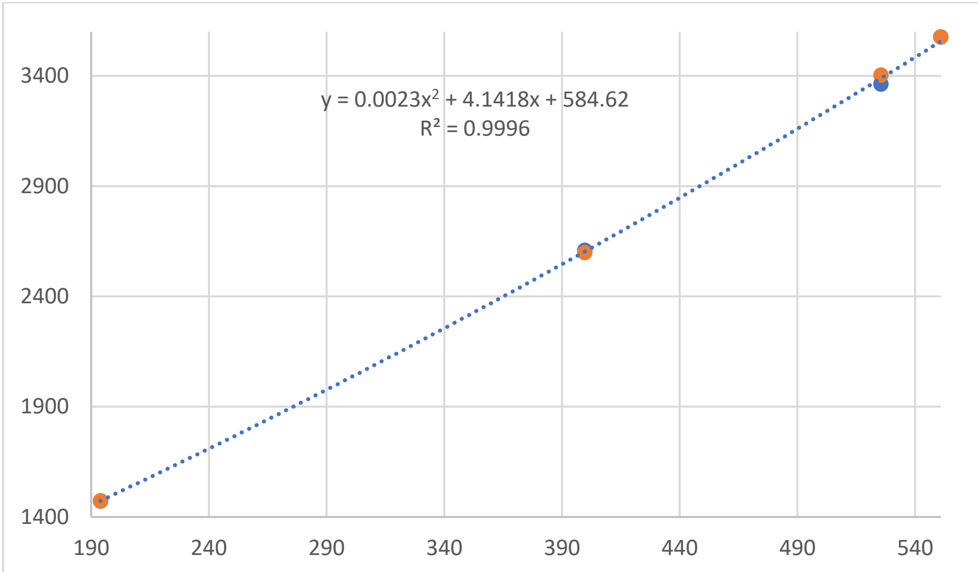
These coefficients determined by the model fan approximation method resulted in a non-convex burn rates function as can be seen in the figure below, created by using the coefficients that the model determined. Notice that the burn rate curve's slope is decreasing between the minimum and the next pair. The model apparently was not aware of the curve being non-convex because contrary to the documentation, the coefficients that the model determined resulted in a burn rate curve that was not monotonically non-decreasing.



The coefficients result in the incremental burn rates shown in the table below obtained from the model output (and can be obtained directly using the burn rate coefficients determined and used by the model). This information obtained from the model's Heat Rate diagnostics shows that the incremental burn rates, as estimated by the model, are decreasing through the sixth tranche before increasing thereafter. It is quickly apparent that the model burn rate shown in the table below is inaccurate given that the fuel input decreases as the load increases for much of the MW range. Based on the production cost model solution report, this deficiency clearly caused the model to incorrectly commit and dispatch the unit.

Point	MW	MMBtu/hr
1	188	13.72367297
2	228.3202569	7.488407246
3	268.6405139	6.17025396
4	308.9607708	5.250176507
5	349.2810278	4.728174887
6	389.6012847	4.604249099
7	429.9215417	4.878399145
8	470.2417986	5.550625024
9	510.5620556	6.620926735
10	550.8823125	8.08930428

To resolve this issue, the burn rate coefficients were determined external to the model, enforcing convexity, and input as burn rate coefficients to approximate the fuel consumption rates associated with the unit. Having input correct burn rate coefficients, the long-term generation expansion module and the short-term production costing module outputs more closely match. Other units in the model had similar issues regarding the burn rate coefficients determined by the model and fixes were implemented.



Although it was not excessively time consuming to fix the apparent deficiency in the modeling software, it was time consuming to find the cause of the differences in capacity factors between the two modules. It was initially believed, based on the model documentation, that the model would warn and adjust non-convex burn rates. It is now apparent that the model version (the latest release as of this writing) being used for this engagement does not correctly convert the inputted Load Point/Heat Rate pairs to convex burn rate curves nor does it recognize and warn that the burn rate curves are non-convex and therefore uses a inappropriate solution method to commit and dispatch the generators in the production cost simulations.

Working to resolve the above issues greatly increased the number of simulations as the problem was being diagnosed and corrected. B&V is comfortable with the work around arrived at, but this was only after a few weeks of exploring the issue.

- When diagnosing the model issues described above, it was thought that perhaps an extended sampling would reduce some of the discrepancies between the capacity expansion module results and the production costing results. Thus, model settings were changed to allow more detailed sampling in the production costing module. This increased the run time of the short term module to as much as 30 – 32 hours per run, not including post-run processing time. Since the resolution of the issues, the production costing module settings have again been relaxed and run times are now on the order of 8 hours or less, which is what would be expected for a system of this size.

Complexity of Puerto Rico's Model

The two model programming issues just described were especially difficult to identify due to the other complexities involved with the model established for the Puerto Rico IRP. These complexities required additional time to develop and run the model. In addition, some of the complexities added to the time required to isolate some of the underlying programming issues described above that impacted initial results being generated. (For example, the first characteristic described below involving the transmission service areas can cause out of order dispatch once transmission transfer capabilities are reached. Thus, it was at first not clear if the unexpected ranking of capacity factors between combustion turbine units and combined cycle units was due to transmission limitiations of the system.)

- The model established for the 2024 Puerto Rico IRP utilizes eight transmission planning areas, rather than one single area. This provides for a more accurate representation of the actual systems as it accounts for flows between areas and accounts for transmission constraints between areas. The time required to input data for these eight transmission service areas is more than the time requirements for a single service area for several key input areas. For example, regarding the cost and performance characteristics inputs for the expansion plan candidate units, for each candidate unit type an input of cost and performance characteristics needs to be entered into the dataset eight times, one for each of the eight transmission planning areas. In addition, the expansion planning process needs to consider a multiple of each candidate unit type increasing modelling run times. Demand forecast information is also entered for each transmission area. Also, area to area transmission inputs were required that would not have been needed in a single area model.

- The modeling solution must achieve multiple objectives. These objectives include meeting the target RPS goals for the system, the targeted system reliability of 0.1 day per year and achieving these targets in the least cost manner. While it is not unusual to have multiple objectives in an IRP study, due to the issues with the modeling software described above, finding a solution to meet all objectives while also following expected patterns of system performance (such as economic dispatch) became problematic and required several weeks to identify all underlying modeling software issues that needed to be addressed before arriving at a workable base case.

- Adding to the complexity of multiple objectives is the high forced outage rates and unreliability of existing units, which are allowed to retire during the planning horizon and the capacity replaced with new unit additions. To reduce the risks associated with adding or retiring many units in any one year (even if it would be lower cost to do so), adjustments to schedules for retirements and new additions are manually performed spreadout any large capacity changes to achieve the most economical retirements and additions that can be prudently achieved based on the output decisions from the model. This added to the time required to fine-tune model runs.

- In February, additional scenarios were specified through discussions with the PREB consultant. This required time to agree on the scenarios and is taking additional modeling time to make the runs and to document results.

Very truly yours,
Oscar E. Falcon

Managing Director Latin America