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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**: Third Supplemental Brief of Amicus Curiae Robert A. Garcia Cooper Regarding LUMA's Fourth Set of Post-Filing RFI Responses Filed October 26, 2026

THIRD SUPPLEMENTAL BRIEF OF AMICUS CURIAE ROBERT A. GARCIA COOPER

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COMES NOW Robert A. Garcia Cooper, in his individual capacity as state-certified Engineer in Training (EIT, Certificate No. 28591), licensed Expert Electrician (Perito Electricista, License No. 10971), PhD student in electrical engineering at the University of Puerto Rico at Mayaguez, published researcher in energy systems and resilience economics, and Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), and respectfully submits this Third Supplemental Brief in response to LUMA Energy's Motion Submitting Responses to Requests for Information in Compliance with Resolution and Order of October 8, 2026, filed October 26, 2026, in the above-captioned proceeding.

I. INTRODUCTION

LUMA's response to Question 2 of the Fourth Set of Post-Filing Requests for Information, filed October 26, 2026, confirms a structural limitation that the petitioner has raised in prior filings and that the Commission's own interrogatory has now placed squarely in the record. LUMA's estimate of 17.5 GWh of actual unserved energy for 2024 is not an estimate of total customer unserved energy. It is an estimate of unserved energy attributable exclusively to generation-layer load shedding events. Transmission-layer and distribution-layer outage events, which account for the overwhelming majority of customer interruption events on the Puerto Rico system, are excluded from LUMA's figure entirely.

This omission is not incidental. LUMA disclosed in its Initial Technical Hearing Presentation, filed March 27, 2026, that the EUE results presented in the 2025 IRP "would be related to capacity" and "does not consider T&D issues in the system." Production cost modeling and capacity expansion modeling frameworks, including PLEXOS, treat transmission and distribution systems as instantaneously available conduits. In most jurisdictions where these frameworks were developed, that treatment introduces modest error. In Puerto Rico, where 90 percent of individual outage events and 59 percent of total customer-hours of lost service originate at the distribution layer, that treatment removes from the resource planning framework the dominant sources of the reliability problem the plan is supposed to solve. A resource plan optimized against a reliability metric that excludes those sources does not solve the full reliability problem. The Commission should weigh this limitation when evaluating whether the plan adequately serves Puerto Rico ratepayers under Act 57-2014 and Act 17-2019.

Separately, LUMA's response to Question 4c independently confirms a cost bias in the capacity expansion modeling that does not require outage cost methodology to identify and that warrants the Commission's attention on its own terms.

Additionally, LUMA's submission of PREB-02 on October 26, 2026, discloses generator outage rate parameters for the revised plan that reveal a categorical presentation of zero percent forced outage rates for all 104 existing generating units throughout the planning horizon. LUMA's response to RFI 5b, filed December 22, 2025, disclosed that the existing legacy generation fleet carries a capacity-weighted average forced outage rate of 29 percent. The petitioner's first filing in this proceeding identified that disclosure as a material finding warranting Commission attention. PREB-02, filed ten months later, presents a planning horizon in which that same fleet carries zero percent forced outage rates for every existing unit. LUMA's December 2025 response to RFI 6a discloses a modeling mechanism that produces zero percent forced outage rates in output files as an artifact of the Foundation Run architecture. However, PREB-02 contains unit characterization parameters of the type that serve as inputs to a production cost model, not operational output results. The appearance of zero percent forced outage rates in those unit characterization parameters raises a distinct and unresolved question: whether LUMA entered zero percent as an actual model input for the PRP' revision, or whether PREB-02 reflects values carried forward from the original foundational run under non-zero input assumptions. LUMA has not clarified this distinction in any filing before the Commission, and the foundational outage schedule for the PRP' revision has not been identified in any filing before the Commission.

II. WHAT LUMA'S 17.5 GWH FIGURE REPRESENTS

LUMA's response to Question 2c states that the unserved energy estimate is based and analyzed at the electric system level by gathering the amount of MW interrupted on each load shed event individually. Load shed events, identified in operational records as Relevos de Carga, capture the moments when the system dispatch center deliberately interrupted customer load because total generation available to the transmission system was insufficient to maintain system balance. These are generation-adequacy events. They occur at the top of the power delivery stack.

The event-level outage data already in this record through the Tormos Dataset demonstrates that Relevos de Carga de Generacion accounted for 5.83 GWh of residential sector unserved energy in 2024, and Relevos de Carga Automatico accounted for an additional 1.13 GWh, for a combined generation and automatic load shedding residential sector total of approximately 6.95 GWh [1] [2]. Scaled to all customer sectors using the residential sector's share of total system consumption, approximately 42 percent, yields a system-wide estimate of approximately 16.5 GWh, consistent with LUMA's reported figure of 17.5 GWh and confirming that LUMA's methodology was limited to load shedding events only.

III. WHAT LUMA'S FIGURE EXCLUDES

The Tormos Dataset, in this docket record through Case No. NEPR-MI-2019-0007, allows the Commission to see what that exclusion means in quantitative terms. The following table shows 2024 residential sector outage burden by event category, capturing all outage events regardless of duration and including major event day events, because this analysis measures actual customer harm rather than utility reliability reporting metrics:

	Eventos	EUE	Share of Total EUE
Total (all outage events)	77,030	67,513,308	100%
Transmission-layer events	3,386	20,117,931	30%
Generation load shedding (Relevo de Cargas - Generacion and Automatico)	4,112	6,953,261	10.3%
Distribution-layer events	69,340	40,060,772	59%
Vegetation outage events (predominantly or entirely distribution-layer)	17,992	5,693,958	8.4%

[1] Raw outage event data produced by LUMA Energy in connection with Fernando Tormos-Aponte v. LUMA Energy, LLC, Case No. SJ2024CV04490, covering January 1, 2021 through May 31, 2024

[2] Raw outage event data produced by LUMA Energy in connection with Tormos-Aponte y Castro-Sitiriche v. LUMA Energy, LLC, Case No. MZ2024CV02187, covering June 1, 2021 through April 30, 2025

Note: Distribution-layer EUE is derived as the residual after subtracting transmission-layer and Relevo de Cargas events from total residential EUE. Generation load shedding EUE is the sum of Relevo de Cargas - Generacion (5,827,904 kWh) and Relevo de Cargas Automatico (1,125,357 kWh). Vegetation outage events are predominantly or entirely distribution-layer events and are embedded within the distribution-layer row totals above. They are presented separately to identify the vegetation contact burden within the distribution layer. The vegetation outage events row is not separately additive to the distribution row.

LUMA's adopted testimony states that LUMA cleared vegetation from over 6,491 miles of powerlines since assuming operational responsibility for the T&D system. Melendez Testimony, Q.16/A, p. 13. The outage event record does not confirm that this program produced a measurable reduction in vegetation contact events. It shows the opposite. Vegetation outage events in the Tormos Dataset rose from 9,357 in 2021 to 10,293 in 2022, to 13,371 in 2023, and to 17,992 in 2024, a 92 percent increase since LUMA assumed operational responsibility for the T&D system . Residential sector EUE attributable to vegetation contact events rose from 3.85 GWh in 2021 to 5.69 GWh in 2024, a 48 percent increase. The Commission cannot reconcile LUMA's characterization of its vegetation management performance with the trajectory shown in the operational outage record.

Vegetation outage events are not a separate top-level category from the distribution burden. The available event record indicates they are predominantly or entirely distribution-layer events. All distribution-layer events, including vegetation contact within the distribution layer, fall outside what PLEXOS production cost modeling and capacity expansion modeling captures. The approximately 89 percent of 2024 customer unserved energy that does not appear in LUMA's 17.5 GWh estimate includes every vegetation contact event on the system, in a year when that burden was at its highest point in the study period.

Generation-caused load shedding accounts for 10.3 percent of residential sector EUE in 2024. That corresponds to approximately 16.5 GWh system-wide, consistent with LUMA's reported 17.5 GWh. The remaining approximately 89 percent of customer unserved energy, spanning transmission faults, distribution faults, and vegetation contact events predominantly within the distribution layer, does not inform the resource adequacy analysis, the reliability compliance determination, or the capacity expansion optimization in the 2025 IRP.

The petitioner's full-burden unserved energy estimate is derived from the VoLL methodology published in Garcia Cooper et al., The Electricity Journal (2024), DOI: 10.1016/j.tej.2024.107386, already in this record. That publication defines the Value of Lost Load as

$$VoLL = \frac{CESIC_{Annual}}{\text{Annual CHoLES x} \left(\frac{\text{Annual Consumption}}{\text{8760 hours}}\right)}$$

Or

$$VoLL = \frac{CESIC_{Annual}}{\text{EUE}}$$

Applying this methodology to the full-burden Tormos Dataset for 2024 yields a residential sector EUE of 67.5 GWh.

Scaled to all customer sectors using the residential sector's share of total system consumption, approximately 42 percent, the full-burden system-wide unserved energy estimate for 2024 is approximately 160 GWh.

The petitioner acknowledges this estimate relies on a scaling assumption and that the residential sector outage profile may differ from commercial and industrial customers in ways the available data does not resolve. The petitioner's analysis is limited to what can be derived from data available in docket NEPR-MI-2019-0007, In re: Performance of the Puerto Rico Electric Power Authority. LUMA possesses the customer-level and feeder-level data necessary to perform this calculation without the scaling assumption and was directed by the Bureau to provide a complete unserved energy accounting. LUMA's response to Question 2c demonstrates it has not done so.

LUMA's reported figure of 17.5 GWh represents approximately 11 percent of the full-burden system-wide estimate of 160 GWh. The remaining 89 percent of the customer unserved energy burden in 2024 was borne through transmission and distribution layer events that the PLEXOS capacity expansion model was never designed to capture, as LUMA itself acknowledged in its March 27, 2026 Technical Hearing Presentation.

IV. WHAT THIS MEANS FOR QUESTION 2D

The Commission asked LUMA whether the EUE inconsistency indicates that the PLEXOS capacity expansion modeling overstates the levels of EUE and resource adequacy shortfall. LUMA answered no, and within the narrow frame of generation-layer load shedding their answer is technically defensible. The model was not overstating the generation adequacy shortfall as defined by Relevos de Carga events.

But the Commission's underlying concern, which the question was designed to probe, is whether the modeling framework adequately represents the customer experience of unserved energy. On that question, the record now contains the following:

The PLEXOS model captures generation-layer events only. LUMA's own Technical Hearing Presentation confirms it does not consider T&D issues. Generation-layer events represent approximately 10 percent of the full-burden customer unserved energy in 2024. Transmission and distribution events, including vegetation contact predominantly within the distribution layer, represent the remaining 90 percent.

A resource plan selected as least-cost on the basis of a reliability metric that sees only 10 percent of the actual customer unserved energy burden is not solving for the full reliability problem. The Commission should have this context when evaluating whether the 2025 IRP's resource portfolio adequately serves the reliability interests of Puerto Rico ratepayers under Act 57-2014 and Act 17-2019.

V. THE BESS COST BIAS IN THE CAPACITY EXPANSION MODELING

LUMA's response to Question 4c independently confirms a structural issue in the capacity expansion modeling that does not require outage cost methodology to identify and that stands on its own evidentiary basis.

The generic BESS capital and O&M costs loaded into PLEXOS for capacity expansion optimization in 2028 are $40,169 per MW-month. The actual contracted costs for Tranche 1 and Tranche 2 BESS projects already under construction in Puerto Rico range from $26,632 to $30,425 per MW-month. This represents a 32 to 51 percent premium embedded in the PLEXOS cost assumptions relative to actual market prices for identical technology procured in the same jurisdiction under contracts executed between 2022 and 2025.

PLEXOS performs capacity expansion optimization by selecting resource additions that minimize PVRR. When the modeled cost of battery storage is 32 to 51 percent higher than its actual cost, the optimization systematically under selects battery storage relative to what a correctly calibrated model would recommend. Resources competing against an artificially expensive BESS alternative in the optimization will appear more cost-competitive than they actually are. The resource portfolio selected as least-cost under these assumptions may not represent the true least-cost portfolio available in the current Puerto Rico market.

LUMA acknowledges in its response to Question 4d that the generic costs are higher than the Tranche project costs and attributes this to cost increases since 2025. However, LUMA also confirms in the same response that PREPA negotiated 3 percent cost reductions in both the Salinas and Penuelas BESS projects through amendments signed in December 2024 and February 2025,

respectively, during the same period when the 2025 IRP was being developed. The modeled costs in PLEXOS were not updated to reflect these developments before the IRP was filed.

VI. THE PREB-02 SUBMISSION PRESENTS ZERO PERCENT FORCED OUTAGE RATES FOR ALL 104 EXISTING GENERATING UNITS WITH NO DISCLOSED BASIS FOR DEPARTURE FROM THE PARAMETERS ESTABLISHED IN THE ORIGINAL IRP

A. What PREB-02 Shows

In its October 26, 2026 submission, LUMA filed PREB-02, a spreadsheet disclosing generator outage rate parameters for 113 named units modeled in the revised plan. The file contains three columns of primary interest: Maintenance Rate (MR%), Forced Outage Rate (FOR%), and Combined Outage Rate (COR%) for each unit across fiscal years.

Review of this data reveals a finding of fundamental significance: every existing generating unit in the revised plan carries a Forced Outage Rate of zero percent throughout the planning horizon beginning in fiscal year 2027. This applies without exception to all units in the Thermal Gen, FEMA Gen, Peaker Gen, ASAP Phase 1, ASAP Phase 2, Biodiesel Conversion, and Landfill Gas categories.

Of the 113 named units in PREB-02, only 9 carry any non-zero forced outage rate in the visible planning years. All 9 are assets that do not currently exist: four planned combined-cycle gas turbine units (LM2500 series and 7F.05 series), three biodiesel conversion variants of those same planned units, and two Tranche 1 battery storage projects with de minimis forced outage rates of approximately 0.24 percent. No existing generating unit in the Puerto Rico fleet carries a non-zero forced outage rate anywhere in the planning horizon submitted for Commission review.

The petitioner further observes that LUMA redacted fiscal years 2024, 2025, and 2026 for all 113 units in the file, comprising 1,017 blacked-out cells. These are the only years for which actual operating data exists against which the planning parameters could be directly evaluated. The public record available to parties does not establish whether the zero percent forced outage rates assumed for 2027 and beyond bear any relationship to the actual forced outage experience of these units in the years immediately preceding the planning horizon.

B. The Input vs. Output Distinction

LUMA's December 2025 response to RFI 6a provided an explanation for why forced outage rates show as zero percent in PLEXOS output spreadsheets. LUMA explained that its Foundation Run

methodology converts non-zero forced outage rate inputs into a fixed hourly outage schedule, transfers that schedule to a "unit out" designation, and then turns off forced outage functionality in all subsequent iterations. Under this methodology, output columns reflect zero percent forced outage rates as an artifact of the locked schedule, not as a claim that the units experience zero failures.

The petitioner acknowledges this explanation as it applies to output files. PREB-02 contains per-unit forced outage rate, maintenance rate, and combined outage rate values expressed as annual percentages for each unit across fiscal years of the planning horizon. These are unit characterization parameters of the type that describe how each generating unit is represented going into a production cost model, not operational results of the type such a model produces as output, which would appear as hourly dispatch quantities, energy volumes, or reserve provision values. The appearance of zero percent forced outage rates in unit characterization parameters raises a distinct and unresolved question: whether LUMA entered zero percent as the actual characterization for these units in the PRP' revision, or whether these values reflect the Foundation Run artifact carried into the parameter submission. LUMA has not addressed this distinction in any filing before the Commission, and the foundational outage schedule for the PRP' revision has not been identified in any filing before the Commission.

C. Forced Outage Rates and Maintenance Rates Are Not Interchangeable Parameters

A forced outage rate reflects unplanned, random equipment failures. These events cannot be anticipated, scheduled, or timed to minimize system impact. In PLEXOS and equivalent production cost models, forced outage events are treated as stochastic: they can occur at any hour including peak demand periods, and the system must maintain spinning reserves precisely because such events are unforeseeable. High forced outage rates require higher reserve margins, reduce system reliability metrics, and produce greater modeled unserved energy.

A maintenance rate reflects planned, scheduled outages. These are outages the system operator plans in advance, typically spanning days, weeks, or months in duration. While PLEXOS can optimize the timing of maintenance outages across planning periods, this scheduling occurs at a coarser temporal resolution than hourly dispatch and does not carry the emergency repair costs associated with an unplanned failure of equivalent duration.

The cost consequences of this distinction extend beyond reserve requirements. When a unit fails unexpectedly, the operator incurs emergency repair costs: unplanned labor, expedited parts procurement, and overtime that are not present in a planned outage of the same duration. These costs are reflected in the variable operations and maintenance expenses associated with forced outages. A model that assigns zero percent forced outage rates to an aging fleet does not need to price in these emergency repair costs, which means the modeled operating cost of the existing fleet is lower than its realistic cost under conditions the fleet actually experiences.

The practical consequence of reclassifying outage hours from forced to maintenance is therefore double: the temporal distribution of those hours moves from random to optimization-controlled, and the associated cost burden moves from variable emergency expenses to predictable planned maintenance. Whether the reclassification from non-zero forced outage rates in the original IRP to zero percent in PREB-02 materially altered the temporal distribution of unit unavailability relative to peak demand periods is a question this record cannot answer without disclosure of the Foundation Run outage schedules under both parameter sets. The Commission should direct LUMA to provide this comparison.

D. The Foundation Run Architecture Locks These Parameters into Every Scenario

The significance of the PREB-02 parameters is amplified by a mechanism LUMA disclosed in its March 27, 2026 Initial Technical Hearing Presentation. Slide 35 of that presentation describes the Foundation Run. LUMA states in its own words: "In subsequent runs, planned and forced outage functionality is then turned off for all units included in the foundational run."

The Foundation Run does not simply inform subsequent scenario runs. It locks the outage schedule. Once the Foundation Run is complete, planned and forced outage functionality is turned off for every unit included in it. Every scenario run uses the binary outage schedule generated in the Foundation Run as fixed input. LUMA confirmed in its December 2025 response to RFI 5a that "forced outage result patterns and quantities and planned maintenance outages are reflected in the same way across all scenarios for existing legacy units."

Whether the PRP' revision ran a new Foundation Run under the parameters shown in PREB-02, or carried forward the outage schedule from the original IRP's Foundation Run, is not disclosed in any filing before the Commission. In either case, the Foundation Run architecture means that whatever outage parameters produced the foundational schedule propagate through every scenario in the revised plan without further probabilistic treatment.

E. The Breadth of the Finding

The breadth of this finding is its own illustration. Without exception, every existing generating unit in the Puerto Rico fleet, across all technology categories in PREB-02, carries a forced outage rate of zero percent throughout the planning horizon. LUMA's Foundation Run explanation, disclosed in RFI 6a and described in Section VI.B above, accounts for zero percent values appearing in PLEXOS output files as an artifact of the locked outage schedule. It does not resolve whether PREB-02 reflects that same artifact carried into a parameter submission, or whether zero percent was entered as an actual input characterization for the PRP' revision. That distinction has not been addressed in any filing before the Commission. It is the question the petitioner respectfully suggests the Commission should direct LUMA to answer.

F. The Regulatory Significance

The purpose of the IRP is to identify the least-cost, reliable path for meeting Puerto Rico's electricity needs. A planning model whose unit characterization parameters show zero forced outage rates for every existing generating unit will produce modeled reliability outcomes that do not reflect the conditions of the actual fleet. These are not marginal differences: forced outage rate assumptions are core inputs from which reserve requirements, capacity expansion decisions, storage procurement targets, and reliability compliance determinations are derived.

The Commission's authority under Act 57-2014 and Act 17-2019 encompasses the obligation to ensure that IRP assumptions reflect the actual conditions of the Puerto Rico electric system. LUMA's response to RFI 5b, filed December 22, 2025, confirmed that the existing fleet carries a 29 percent capacity-weighted average forced outage rate. PREB-02 presents a planning horizon in which that same fleet carries zero forced outage rates for every existing unit. The gap between those two representations of the same physical fleet, disclosed ten months apart by the same party, warrants direct Commission inquiry into which representation is being used to plan Puerto Rico's energy future.

VII. REQUEST FOR RELIEF

The petitioner respectfully requests that the Commission:

First, acknowledge that LUMA's 17.5 GWh unserved energy estimate captures only generation-layer load shedding events and does not represent the full customer experience of unserved energy on the Puerto Rico system, consistent with LUMA's own disclosure in its March 27, 2026 Technical Hearing Presentation that its EUE framework "does not consider T&D issues in the system."

Second, direct LUMA to provide a complete unserved energy estimate for 2024 that accounts for transmission and distribution layer outage events using the customer-level and feeder-level outage data already in LUMA's possession, which is substantially more granular than the methodology LUMA employed to derive its 17.5 GWh figure.

Third, direct LUMA to confirm whether the BESS cost inputs used in PLEXOS for capacity expansion optimization reflect the actual contracted prices for Tranche 1 and Tranche 2 projects as amended through December 2024 and February 2025, and if not, to quantify the effect of the cost differential on the capacity expansion optimization results and on the PVRR comparison between the Preferred Resource Plan and alternative resource plans.

Fourth, direct LUMA to clarify whether the zero percent forced outage rates in PREB-02 reflect actual unit characterization parameters used in the PRP' revision or artifacts of the Foundation Run methodology as described in RFI 6a, and in either case to provide the actual forced outage rate inputs used in the PRP' Foundation Run for each existing generating unit.

Fifth, direct LUMA to disclose the Foundation Run outage schedules generated under the original IRP parameters and the revised plan parameters for direct comparison, so that the Commission may evaluate whether the temporal distribution of unit unavailability relative to peak demand periods changed between the original IRP and the PRP' revision.

Sixth, direct LUMA to submit a sensitivity analysis demonstrating the effect on modeled expected unserved energy, reserve requirements, and PVRR under scenarios that retain historically documented forced outage rates for existing generating units rather than the zero percent values presented in PREB-02.

Seventh, direct LUMA to provide the unredacted fiscal year 2024, 2025, and 2026 forced outage rate, maintenance rate, and combined outage rate data for all units in PREB-02, so that the Commission may evaluate the relationship between actual recent operating parameters and the planning horizon assumptions submitted for review.

VIII. DECLARATION

In compliance with Section 7.01(B)(4) of Regulation No. 8543, the petitioner declares as follows:

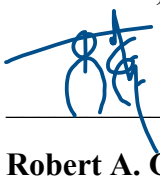
A) No party or lawyer in this proceeding assisted in drafting this brief.

B) No party or lawyer in this proceeding contributed funds or any other type of resource for the preparation or submission of this brief.

C) No person other than the petitioner contributed funds or any other type of resource for the preparation or submission of this brief.

Respectfully submitted,

In San Juan, Puerto Rico, on October 29, 2026.



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CERTIFICATE OF SERVICE

I hereby certify that on October 29, 2026, a copy of this Third Supplemental Brief was filed with the Office of the Clerk of the Puerto Rico Energy Bureau using its electronic filing system, and that electronic copies were served upon all parties of record in Case No. NEPR-AP-2023-0004 as reflected in the most recent Certificate of Service filed in this proceeding.

Robert A. Garcia Cooper