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**: Second Supplemental Brief of Amicus Curiae Robert A. Garcia Cooper in Response to LUMA Energy's Motion Submitting Testimony Adoption, Filed May 5, 2026, and in Further Support of Quantitative Assessment of Ratepayer Outage Cost Burden

SECOND 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 Second Supplemental Brief in connection with the above-captioned proceeding.

On March 30, 2026, the petitioner filed a Petition to Appear as Amicus Curiae and Accompanying Brief, which was accepted by the Energy Bureau. That brief identified three structural limitations in the 2025 IRP: (1) the Present Value Revenue Requirement metric excludes ratepayer outage costs by design; (2) the PLEXOS production cost and capacity expansion modeling framework is structurally incapable of capturing those costs; and (3) Puerto Rico-specific tools, namely the CESIC methodology and the Lawrence Berkeley National Laboratory's ICE Calculator PR model, now exist to quantify the excluded costs, making their continued exclusion a regulatory choice rather than a methodological constraint. The original brief further argued that the 29% capacity-weighted average forced outage rate is embedded in the PLEXOS model as a fixed external condition rather than treated as a cost variable attributable to the existing resource mix.

On April 19, 2026, the petitioner filed a Supplemental Brief documenting that LUMA's responses to the Third Set of Post-Filing Requests for Information confirmed in LUMA's own words the structural gaps identified in the original brief. Those confirmations are already in the record of this proceeding and are not repeated here.

On May 5, 2026, LUMA filed a Motion Submitting Testimony Adoption substituting Mr. Pedro A. Melendez-Melendez, Chief Capital Programs and Grid Transformation Officer, as the sponsoring witness for the pre-filed testimony supporting the Transmission and Distribution Plan and the T&D implications of the Preferred Resource Plan. The motion states the substance of the testimony remains unchanged. The petitioner submits this Second Supplemental Brief to address that new filing and to introduce three additional dimensions of the structural omission already documented in this proceeding, each grounded in the record or in peer-reviewed literature available to the Commission.

I. THE MELENDEZ ADOPTION PLACES A PARALLEL STRUCTURAL OMISSION ON THE T&D SIDE OF THE RECORD

The petitioner's original brief and Supplemental Brief documented the generation-side structural gap: PLEXOS excludes ratepayer outage cost by architectural design, confirmed by LUMA's own RFI responses. The Melendez adoption now places a parallel structural omission on the T&D side.

In response to Question 37 of the adopted testimony, Mr. Melendez states: "LUMA did not complete a comprehensive analysis of the implications of the PRP on the distribution system. The inclusion of distributed photovoltaic and electric vehicle charging installations in the PRP reflects forecasts of customer choices for these installations, which are not under LUMA's control and are driven solely by customer choice. LUMA has requested the Energy Bureau to waive the requirement of completing the distribution analysis of the PRP." Direct Testimony of Pedro A. Melendez-Melendez, Exhibit 1 to Motion Submitting Testimony Adoption, Case No. NEPR-AP-2023-0004, filed May 5, 2026 (hereinafter "Melendez Testimony"), Q.37/A, pp. 25-26.

This admission is operative and current. Mr. Melendez is a sitting Chief Officer of LUMA. The motion expressly states the substance is unchanged, converting this into a statement attributable to current LUMA leadership rather than a departed employee.

The structural pattern is identical on both sides of the resource plan. The generation-side PLEXOS model excludes ratepayer outage cost by design, confirmed by RFIs 1c, 1h, 5a, 5b, 5c, and 5d. The T&D distribution analysis of the PRP was not performed and a waiver was requested, confirmed by Melendez Testimony Q.37/A. The Commission evaluated resource plan alternatives without ratepayer burden quantification on the generation side and without distribution impact analysis on the T&D side simultaneously. Neither omission is a data constraint. Both are documented choices.

The stated basis for the waiver, that DPV and EV locations are customer-driven and cannot be forecast with location-specific detail, cannot be reconciled with LUMA's own hosting capacity methodology as disclosed in the 2025 IRP. That methodology defines and employs a stochastic hosting capacity method that by design randomly assigns PV generation locations without requiring known DER placement. 2025 IRP, Case No. NEPR-AP-2023-0004, filed October 17, 2025, Glossary, pp. 90-91. A methodology that functions without known DER locations was already in use at the time LUMA requested a waiver on the basis that DER locations were unknown.

The testimony documents the current condition of the distribution system. Distribution circuit analysis identified approximately 304 of 1,127 circuits with notable voltage violations and 164 circuits with thermal overloads. Melendez Testimony, Q.31/A, pp. 21-22. DER-related violations affect 660 of 771 studied feeders, split into 285 voltage issues and 638 thermal issues, including service transformer overloads and primary circuit conductors across the island. Melendez Testimony, Q.32/A, pp. 22-23. The testimony further acknowledges that the proliferation of inverter-based resources is reducing conventional short-circuit levels, distorting conventional protection schemes, and increasing the potential for missed fault detection. Melendez Testimony, Q.32/A, pp. 22-23.

The testimony identifies 660 feeders with active violations but provides no per-unit voltage magnitudes, no ampacity values, no Short Circuit Ratio assessment, and no named hosting capacity methodology standard for the distribution analysis underlying those findings.

Peer-reviewed research evaluating six real Puerto Rico distribution feeders using OpenDSS time-series simulation documents that feeders operating at 8.32 kV and 4.16 kV, which are the dominant voltage levels across the majority of LUMA's 1,127 distribution circuits, experience simultaneous voltage and thermal violations at PV penetration levels approaching the system-wide average of 49 percent disclosed in the IRP, Section 6.2, p. 63. Huaman-Rivera, A., Irizarry-Rivera, A., Calloquispe-Huallpa, R., "Increasing photovoltaic hosting capacity in distribution networks in Puerto Rico: Seasonal and technical characteristics analysis and solutions," Energy Reports, Vol. 14 (2025), pp. 867-885, DOI: 10.1016/j.egyr.2025.06.034 (hereinafter "Huaman-Rivera 2025"). The applicable voltage standard is ANSI C84.1, which establishes the voltage level upper limit at 1.05 pu. Huaman-Rivera 2025, Section 2.3.1, p. 869.

This research was conducted at the University of Puerto Rico at Mayaguez under DOE Grant DE-SC0020281. The underlying thesis on which this peer-reviewed publication is based was filed in Case No. NEPR-MI-2019-0009 on April 12, 2024 by Kenan D. Davila of Sargent and Lundy, a firm cited in the 2025 IRP for technical analyses supporting LUMA's generation resource planning, including feasibility studies and capital cost assessments. Exhibit N. The peer-reviewed journal publication predates the IRP filing by three months. The 2025 IRP does not cite this research and does not report per-unit voltage magnitudes for its violation findings. The research itself concludes that the current 15 percent PV penetration cap in Puerto Rico is conservative and that higher

integration levels are technically feasible with appropriate mitigation strategies. Huaman-Rivera 2025, p. 884.

Published research on grid strength under uncertain renewable generation further demonstrates that at 60 percent PV penetration, the Effective Site-Dependent Short Circuit Ratio falls to a median of 1.31, which is below 2 and classified as very weak, meaning voltage is sensitive to active and reactive power disturbances and grid reliability is at significant risk. Maharjan, M. et al., "Evaluating grid strength under uncertain renewable generation," International Journal of Electrical Power and Energy Systems, Vol. 146 (2023), Article 108737 (hereinafter "Maharjan 2023"), Table 6, p. 8. Puerto Rico's current average distribution circuit penetration is 49 percent as of August 2025, with the feeders driving the 660-violation figure already above that average. 2025 IRP, Section 6.2, p. 63. The IRP does not mention Short Circuit Ratio assessment at any circuit, substation, or system level, despite LUMA's own witness testimony acknowledging that inverter proliferation is reducing short-circuit levels and increasing the potential for missed fault detection.

The Volt-VAR smart inverter function, as implemented per IEEE Std 1547-2018, reduces or eliminates voltage violations on Puerto Rico distribution feeders without requiring energy storage. Huaman-Rivera 2025, p. 883, Fig. 30. The combination of battery energy storage and Volt-VAR increases hosting capacity by 20 to 90 percent depending on feeder characteristics. Huaman-Rivera 2025, p. 882. The Melendez testimony states that LUMA's recommended smart inverter settings require PREB action to implement. Melendez Testimony, Q.37/A, pp. 25-26. Puerto Rico-specific feeder research documenting what those settings accomplish has been available in Case No. NEPR-MI-2019-0009 since April 2024. The regulatory framework for requiring their deployment is within the Commission's authority under the smart inverter proceeding already open before this Bureau. The PRP incorporates distributed photovoltaic and electric vehicle adoption forecasts as part of its resource plan inputs without subjecting those adoption trajectories to distribution impact analysis, as LUMA's own witness confirms. Melendez Testimony, Q.37/A, pp. 25-26.

II. THE RELIABILITY METRICS LUMA REPORTS UNDER IEEE STD 1366-2022 CONCEAL TWO INDEPENDENT AND COMPOUNDING LAYERS OF CUSTOMER BURDEN THAT ARE INVISIBLE TO THE IRP'S PLANNING FRAMEWORK

LUMA invokes IEEE Std 1366-2022, Guide for Electric Power Distribution Reliability Indices, as the authority for its reliability reporting. That same standard contains two requirements LUMA does not fulfill and permits a methodology whose application to Puerto Rico systematically conceals the actual reliability burden ratepayers experience. These are not the same issue. They operate independently and compound each other.

A. The Major Event Day Methodology Renders up to 45.9 Percent of Annual Duration Burden Invisible to the IRP's Planning Framework

IEEE Std 1366-2022, Section 4.5, p. 20, establishes the Major Event Day classification methodology. A MED threshold is computed as MED-T = e raised to (alpha plus 2.5 times beta), where alpha is the log-mean and beta is the log-standard deviation of the system's historical daily SAIDI values. Any day on which daily system SAIDI exceeds MED-T is classified as a Major Event Day and excluded from reported SAIDI, SAIFI, and CAIDI. Section 4.5 states the purpose of the classification directly: its purpose is to allow major events to be studied separately from daily operation, and in the process, to better reveal trends in daily operation that would be hidden by the large statistical effect of major events. IEEE Std 1366-2022, Section 4.5, p. 20.

IEEE Std 1366-2022, Section 4.5.1, pp. 22-23, illustrates the MED methodology through a worked example that explicitly calculates reliability indices under two conditions: all events included, and MEDs removed. Page 23 of the standard states: "indices should be calculated for two conditions: 1) All events included 2) MEDs removed." Section 4.5, p. 20, further states that "activities that occur on days classified as MEDs should be separately analyzed and reported." In IEEE standards, "should" denotes a recommended practice rather than a mandatory requirement. The distinction matters here because LUMA cites IEEE Std 1366-2022 as the authority for its reliability reporting while departing from the dual-condition methodology the standard's own worked example demonstrates as the intended application of the MED classification. Reporting exclusively the MED-excluded figure, without the all-events figure the standard recommends alongside it, presents a partial picture of a methodology whose stated purpose is to reveal trends in daily operation that would be hidden by major events, not to render those events invisible to regulatory oversight.

The petitioner computed SAIDI, SAIFI, CAIDI, and MAIFI from the raw outage event data produced by LUMA in Fernando Tormos-Aponte v. LUMA Energy, LLC, Case No. SJ2024CV04490, covering January 2021 through May 2024, transmitted to the petitioner by Dr. Marcel J. Castro Sitiriche with written authorization from Dr. Fernando Tormos-Aponte as documented in Exhibit J of the petitioner's Supplemental Brief filed April 19, 2026 (hereinafter "Tormos Dataset"), using a rolling cumulative window MED threshold methodology consistent with IEEE Std 1366-2022, Section 4.5. Because the dataset covers 47 months rather than the standard's recommended five-year baseline, the MED threshold was calculated using all available data from June 2021 through the end of each measurement year, as the standard expressly permits when fewer than five years of historical data are available. IEEE Std 1366-2022, Section 4.5, p. 20: "If fewer than five years of historical data are available, use all available historical data until five years of historical data are available." The parameters derived from the full available dataset are: alpha equals 1.5481, beta equals 0.9072, yielding MED-T of 45.43 customer-minutes per day. Under this threshold, 15 Major Event Days were identified across the 47-month study period. These figures are presented as a sensitivity analysis rather than a formal five-year IEEE Std 1366-2022 MED determination, which requires a complete five-year history.

All calculations follow IEEE Std 1366-2022 methodology. The five-minute threshold separating sustained interruptions from momentary interruptions is established by definition in IEEE Std 1366-2022, Section 3, p. 13: "sustained interruption: An interruption that lasts more than five minutes," and "momentary interruption event: An interruption of duration limited to the period of time required to restore service. Note 1: Such switching operations must be completed within a specified time of five minutes or less."

The comparison of full burden SAIDI against MED-excluded SAIDI across four years of the study period reveals the following:

2021: Full burden SAIDI 38.2 hours;

2021: MED-excluded SAIDI 28.6 hours.

MED methodology renders 25.1 percent of annual duration burden invisible to the reporting record.

2022: Full burden SAIDI 55.6 hours;

MED-excluded SAIDI 30.1 hours.

MED methodology renders 45.9 percent of annual duration burden invisible to the reporting record.

2023: Full burden SAIDI 34.8 hours;

MED-excluded SAIDI 34.2 hours.

Difference 1.7 percent.

2024: Full burden SAIDI 34.6 hours;

MED-excluded SAIDI 33.1 hours.

Difference 4.3 percent.

The 2022 figure warrants specific attention because it is documented through the Tormos Dataset already in this record. A utility applying IEEE Std 1366-2022 MED methodology could report 30.1 hours of SAIDI for 2022 and be fully compliant with the standard. The actual ratepayer

experience was 55.6 hours, approximately 85 percent higher. The IRP's resource plan alternatives were evaluated against the reported baseline, not the full burden baseline.

The petitioner notes that CAIDI, the Customer Average Interruption Duration Index, which equals SAIDI divided by SAIFI per IEEE Std 1366-2022, Section 4.2.3, remained relatively stable across the four-year study period at approximately 2.1 to 2.2 hours. This stability does not indicate system reliability. It is a mathematical consequence of SAIDI and SAIFI moving in similar proportions. In the MED-excluded scenario, SAIFI rose from 13.59 in 2021 to 15.45 in 2023, a 13.7 percent increase in chronic baseline interruption frequency. CAIDI by construction cannot distinguish a system that is failing more frequently from one that is being restored more slowly. A resource plan evaluation that cites flat CAIDI as evidence of reliability stability while chronic SAIFI is rising and MAIFI goes entirely unreported is presenting a metric that cannot, by itself, convey what ratepayers are actually experiencing.

IEEE Std 1366-2022, Section 6.3, explicitly acknowledges this limitation and defers to regulators and utilities to determine appropriate treatment for systems where catastrophic days are structurally recurrent rather than statistically rare. The Commission is in a position to evaluate whether a system averaging one Major Event Day every 94 days across the study period falls within the conditions Section 6.3 contemplates.

The petitioner notes that as of June 1, 2026, LUMA Energy will have completed five full years of independent operations under its current operational structure. To the extent that five continuous years of daily SAIDI data under LUMA's operational period are available, this milestone would enable the first formally calculated IEEE Std 1366-2022 five-year MED threshold for the post-transition period. The Commission may wish to address this threshold calculation in its next performance reporting directive.

B. MAIFI Is a Required Index Under IEEE Std 1366-2022 and Is Absent From Every LUMA Reliability Submission in the Record

IEEE Std 1366-2022, Section 4.4.1, p. 19, defines the Momentary Average Interruption Frequency Index and establishes its formula: MAIFI equals the sum of (momentary interruptions per event times customers interrupted per event), divided by total customers served. Equation (24). The same standard defines in Section 3, p. 13, that momentary interruptions are events of five minutes or less. MAIFI is a defined index of the standard that LUMA cites as its reliability reporting authority. LUMA does not report MAIFI in any reliability submission in the record of this proceeding. The 2025 IRP does not reference MAIFI at any point in its reliability analysis, resource plan evaluation, or performance benchmarking sections.

The petitioner's computation from the Tormos Dataset yields the following system-level MAIFI values across the four-year study period:

Full burden MAIFI:

16.91 (2021),

17.74 (2022),

17.53 (2023),

16.50 (2024).

MED-excluded MAIFI:

16.48 (2021),

17.29 (2022),

17.32 (2023),

16.00 (2024).

The MED-excluded scenario is the more analytically precise comparison because it isolates chronic structural behavior from major event distortion. In that scenario:

2021: SAIFI 13.59 vs. MAIFI 16.48.

Momentary interruptions represent 54.8 percent of total interruptions experienced by Puerto Rico customers.

2022: SAIFI 13.93 vs. MAIFI 17.29.

Momentary interruptions represent 55.4 percent of total interruptions.

2023: SAIFI 15.45 vs. MAIFI 17.32.

Momentary interruptions represent 52.8 percent of total interruptions.

2024: SAIFI 15.00 vs. MAIFI 16.00.

Momentary interruptions represent 51.6 percent of total interruptions.

This finding reflects a system where the automatic protection coordination that should clear momentary faults before they develop into sustained outages is functioning with decreasing effectiveness. Two independent causes are consistent with this data. First, LUMA's own testimony acknowledges that inverter proliferation is reducing conventional short-circuit levels and distorting conventional protection schemes, degrading the fault detection. Melendez Testimony, Q.32/A, pp. 22-23. Second, the four-year MAIFI trend in the MED-excluded scenario is 16.48 in 2021, 17.29 in 2022, 17.32 in 2023, and 16.00 in 2024, which is flat across the full study period. High MAIFI relative to SAIFI may be an indicator of unmanaged vegetation contact with distribution lines in systems where automatic reclosing is functioning. A branch touching an energized conductor triggers the recloser, power interrupts briefly, and if the branch clears, service restores within seconds as a momentary event that never enters the SAIDI or SAIFI record. If vegetation management is actively reducing that contact, MAIFI falls. It has not fallen. The absence of any measurable improvement in MAIFI over four years during which LUMA claims to have cleared vegetation from over 6,491 miles of powerlines, Melendez Testimony, Q.16/A, p. 13, raises a direct question about whether that vegetation management program produced the reliability improvement it implies. The Commission cannot evaluate that question from LUMA's regulatory submissions because MAIFI is not reported in any of them.

This absence has a compounding effect on the ratepayer cost analysis at the core of this proceeding that goes beyond the missing metric itself. Out of the four methods provided as part of the CESIC methodology, peer-reviewed and submitted as an exhibit in the petitioner's original filing, two methods use SAIDI and SAIFI as primary reliability inputs to estimate annual household outage costs. Garcia Cooper, R.A. et al., "True Cost of Electric Service: What Reliability Metrics Alone Fail to Communicate," The Electricity Journal, Vol. 37, 2024, Article 107386, pp. 11-12, submitted as an exhibit in this proceeding. When those inputs are themselves understated, because MED methodology removes up to 45.9 percent of annual SAIDI burden and because SAIFI counts only sustained interruptions while MAIFI goes unreported, any CESIC estimate derived from reported reliability metrics is a floor, not an accurate measure of actual household burden. The true annual outage cost per Puerto Rico household exceeds what any CESIC calculation grounded in LUMA's reported reliability figures would produce.

The True Cost paper states directly that in Puerto Rico, reliability metrics alone have not conveyed a sufficient message to regulators and policymakers. Garcia Cooper et al., 2024, p. 16. That finding was documented using the reported metrics available at the time of publication. The data now before this Commission, through the Tormos Dataset, shows that the reported metrics themselves understate the actual burden by two independent mechanisms simultaneously. The regulatory message those metrics have failed to convey is quieter than the actual signal in the data.

Momentary interruptions carry a distinct economic consequence that the CESIC intersection probability framework is expressly designed to address. The CESIC methodology applies to any outage duration from zero to 24 hours through Equation (5) of the published methodology, which

computes the sum probability of household service replacement events intersecting with the outage event across the full duration range. Garcia Cooper et al., 2024, p. 9. At momentary durations below five minutes, the intersection probability P(j) = j/24 is very low, the CDC four-hour refrigeration threshold is not triggered, and the per-event cost is accordingly small, consistent with the shortest observed outage types documented in Table 7 of that paper. However, with 16 to 17 momentary interruptions per customer per year across the four-year study period, the annual cumulative CESIC attributable to momentary events is not zero. That calculation cannot be performed because the underlying event data, specifically the frequency, timing, and customer counts for each momentary interruption, is entirely absent from LUMA's regulatory submissions. MAIFI is not reported. The event-level momentary interruption record does not exist in this regulatory docket. The CESIC framework exists to perform the quantification. The data necessary to apply it to momentary interruptions is invisible by regulatory choice, not by methodological limitation.

Additionally, momentary interruptions are specifically identified in IEEE engineering standards as a primary driver of household equipment damage independent of the CESIC duration framework. IEEE Std 1250-2018, IEEE Guide for Identifying and Improving Voltage Quality in Power Systems, Section 3.4.2, p. 29, notes that momentary disturbances can be more consequential than sustained interruptions precisely because they occur much more frequently. Section 4.2, p. 39, documents malfunction in digital clocks, microwave ovens, computers, and consumer electronics at durations well within the five-minute threshold. This represents a category of household economic burden that is separate from and additional to the CESIC-quantifiable outage cost, and for which no analysis has been performed in this record.

The Commission is evaluating a 20-year resource plan whose ratepayer cost picture is incomplete in two reinforcing directions. First, the CESIC inputs derived from reported reliability metrics understate actual sustained outage burden because MED methodology suppresses SAIDI and because SAIFI omits the momentary interruption frequency that CESIC's intersection framework would otherwise incorporate. Second, the equipment damage burden from momentary interruptions, separately documented in IEEE Std 1250-2018, cannot be quantified from this record because the event-level data for those interruptions does not appear in any LUMA regulatory submission. Both gaps originate in the same selective application of the standard LUMA cites as its authority. Together they mean the total unquantified ratepayer burden before this Commission is larger than any single measure in the record reflects.

III. THE 29 PERCENT FORCED OUTAGE RATE EMBEDDED IN THE IRP AS A FIXED PLANNING PARAMETER REFLECTS A DOCUMENTED MULTI-DECADE INSTITUTIONAL DISINVESTMENT TRAJECTORY

The petitioner's original brief identified that the 2025 IRP applies a capacity-weighted average forced outage rate of 29 percent across the legacy generation fleet and holds that rate constant as a static assumption throughout the 20-year planning horizon. The petitioner's Supplemental Brief documented that LUMA's response to RFI 5b confirmed that forced outage rate assumptions were based on a May 2025 update reflecting historical unit performance only, without incorporating actual unserved energy events from the operational record. The argument presented here adds a further dimension to that record.

The IRP treats the 29 percent forced outage rate as an exogenous property of the legacy thermal fleet. Peer-reviewed research already submitted as an exhibit in this proceeding documents that this characterization cannot be sustained against the available evidence. It is apparent that PREPA sacrificed resilience and reliability by reducing O&M expenses, personnel, and inventory to be able to comply with its contractual obligations, of which principal and interest bond payments made up 95% of these obligations on average. Garcia Cooper et al., The Electricity Journal, 2024, Article 107386, p. 16, submitted as an exhibit in this proceeding. Figure 1 of that paper documents the correlation between PREPA's rising contractual obligations, declining employee headcount from over 9,000 in 2008 to 5,321 by 2021, reduced capital improvements, declining warehouse inventory, and rising minutes per interruption from 124 in 2008 to 489 by 2021. The petitioner notes that minutes per interruption represents a CAIDI-equivalent metric for the pre-transition period and is subject to the same interpretive limitation noted in Section II of this brief: a rising value could reflect longer individual restoration times, increasing interruption frequency, or both, and the metric alone cannot distinguish between them. The directional finding, that customer-experienced reliability burden worsened substantially across the disinvestment period, remains valid. The specific mechanism would require SAIDI and SAIFI disaggregation from PREPA's pre-2021 operational data, which is not within the scope of this proceeding.

A further analytical limitation of the 29 percent forced outage rate as presented warrants the Commission's attention. Under the North American Electric Reliability Corporation's Generating Availability Data System framework, which governs generating unit performance tracking for conventional thermal generation across North American electric utilities and which the IRP's own resource adequacy analysis draws upon through NERC planning criteria, forced outage events are classified by cause code. Those cause categories distinguish unit-internal failures, including boiler tube failures, turbine mechanical failures, auxiliary equipment breakdowns, and electrical faults within the generating unit itself, from externally induced trips, including transmission system disturbances, voltage and frequency excursions, and protective relay operations triggered by grid-side conditions at the interconnection between the generating unit and the transmission system. Puerto Rico generating units have operational records documenting each trip event, including the logbooks, known as bitácoras as termed in Spanish by PREPA's Generation division personnel, maintained by unit operators and the logs maintained by electrical control operators responsible for the interconnection between each plant and the T&D system. Those records document what happened, which protective relay operated when applicable, whether the initiating condition was

internal to the unit or external, and the sequence of events. The operational records necessary to support cause code disaggregation should exist in each power plant control room log, as well as in the records of the Transmission System Operator. The 29 percent capacity-weighted average forced outage rate embedded in the PLEXOS model was computed without cause code disaggregation from those operational records. As a consequence, the Commission cannot determine from the record before it how much of that 29 percent reflects unit-internal failures attributable to deferred maintenance and equipment wear, how much reflects externally induced trips attributable to the T&D system conditions that the Melendez Testimony confirms exist across 304 voltage-violating circuits and 164 thermally overloaded circuits, and how much reflects operator-related events attributable to workforce capacity conditions. The T&D degradation documented in Section I of this brief and confirmed by LUMA's own witness exists in the same system whose disturbances trip generating units through protective relay action. A generating unit that trips in response to a transmission-side voltage excursion is not failing. It is responding correctly to a grid condition that would not exist if the T&D system were in adequate condition. Embedding the resulting trip in the unit's forced outage rate and then treating that rate as a fixed property of the generation asset, rather than as a partial consequence of T&D system conditions, conflates two distinct failure modes into a single parameter and projects both forward unchanged across a 20-year planning horizon. The Commission is being asked to evaluate a 20-year resource plan whose least-cost determination rests in part on a reliability parameter whose root cause composition has not been analyzed, disaggregated, or disclosed.

Event-level operational data from the Tormos Dataset for the first year of the study period, June 2021 through May 2022, provides independent context for this finding. Although forced outage rate is a unit-level generation availability metric not directly comparable to distribution-level outage event counts, the distribution of customer burden in the Tormos Dataset is consistent with a generation fleet operating at significantly degraded availability. Generation and transmission events, including load shedding events triggered by generation and transmission shortfalls, combined represent only 11.4 percent of all outage events in the study year but account for 54.9 percent of total customer-hours of lost electric service. Within that figure, generation-related events account for 5.5 percent of customer-hour burden, load shedding events triggered by generation and transmission shortfalls account for 19.3 percent, and transmission events account for 30.1 percent. Distribution events represent 88.6 percent of all events but 45.1 percent of customer-hour burden. This pattern is consistent with systemic infrastructure degradation across both the generation fleet and the transmission system, producing low-frequency, high-consequence outage events that dominate customer burden disproportionate to their event count. The disproportionate customer-hour burden attributable to transmission events in particular, 30.1 percent of total burden from only 4.8 percent of events, is consistent with the T&D system conditions documented in Section I of this brief and further underscores that the forced outage rate embedded in the IRP cannot be treated as a generation-only parameter when the grid conditions in which those generating units operate contribute to their recorded unavailability.

The forced outage rate assumptions used in the 2025 IRP were finalized as of May 2025, based exclusively on post-June 2021 operational data. That period follows the workforce transition documented in the petitioner's published research. A forced outage rate measured from a fleet operated under those conditions, during a period that follows a documented multi-decade disinvestment trajectory, is not an immutable property of the physical generation assets. It is the measured output of specific institutional choices that the IRP's planning framework now perpetuates as a fixed baseline.

In a modeling framework that treats the 29 percent FOR as exogenous, the economic disadvantage of continued reliance on legacy thermal generation is systematically understated relative to resource alternatives with lower inherent failure rates. The Commission should consider whether the PVRR advantage attributed to resource plan alternatives with continued reliance on legacy thermal generation would persist if the chronic unreliability cost of those alternatives, documented in the record through the CESIC methodology and confirmed as quantifiable through the ICE Calculator PR model, were incorporated into the cost comparison.

IV. THE COMMISSION IS EVALUATING A 20-YEAR RESOURCE PLAN UNDER CONDITIONS WHERE SIX PARALLEL STRUCTURAL OMISSIONS OPERATE SIMULTANEOUSLY

The following six structural omissions have each been documented in this record through LUMA's own filings, confirmed RFI responses, peer-reviewed research in the record, or peer-reviewed research publicly available to the Commission. None of them is a data constraint. All of them are documented choices.

First: The PLEXOS generation model excludes ratepayer outage cost by architectural design. Confirmed by LUMA's responses to RFIs 1c, 1h, 5a, 5b, 5c, and 5d, filed April 16, 2026.

Second: The T&D distribution analysis of the PRP was not performed and a waiver was requested, based on a stated impossibility that is internally inconsistent with the stochastic hosting capacity methodology LUMA already employs. Confirmed by Melendez Testimony, Q.37/A, pp. 25-26, filed May 5, 2026.

Third: MAIFI is absent from four years of reliability reporting despite being a defined index of IEEE Std 1366-2022, the standard LUMA cites as its reliability reporting authority. In the MED-excluded chronic baseline scenario, more than half of all customer interruptions are momentary events invisible to the regulatory record, and the event-level data necessary to apply the CESIC intersection probability framework to those interruptions does not exist in any LUMA regulatory submission. Computed by petitioner from the Tormos Dataset per IEEE Std 1366-2022 methodology.

Fourth: MED methodology has been applied without the dual-condition reporting that IEEE Std 1366-2022, Section 4.5.1, recommends in its own worked example, rendering up to 45.9 percent of annual SAIDI burden invisible in documented years. The standard states that "indices should be calculated for two conditions: 1) All events included 2) MEDs removed," and that "activities that occur on days classified as MEDs should be separately analyzed and reported." IEEE Std 1366-2022, Section 4.5, p. 20; Section 4.5.1, pp. 22-23. Section 6.3 of the same standard acknowledges its own limitation for chronically unreliable systems and expressly defers to regulators and utilities to make the appropriate determination for systems where catastrophic days are structurally recurrent rather than statistically rare.

Fifth: The 29 percent forced outage rate is embedded as a fixed PLEXOS parameter despite peer-reviewed research already in this record documenting that it reflects a specific multi-decade institutional disinvestment trajectory rather than immutable system characteristics, and despite the absence from this record of any cause code disaggregation that would allow the Commission to determine how much of that rate reflects unit-internal failures, T&D-induced trips, or operator-related events. Garcia Cooper et al., 2024, p. 15, submitted as an exhibit in the petitioner's original filing.

Sixth: The stated impossibility underlying the distribution analysis waiver is contradicted by DOE-funded peer-reviewed research on six actual Puerto Rico distribution feeders conducted at UPRM, available in a related NEPR docket since April 2024 and published in a peer-reviewed journal three months before the IRP was filed, in a proceeding where research from the same institution was submitted by personnel of a firm cited in the 2025 IRP for technical analyses supporting LUMA's resource planning. Huaman-Rivera 2025; Exhibit N; Case No. NEPR-MI-2019-0009.

The Commission is evaluating a 20-year Preferred Resource Plan using a cost comparison framework that is simultaneously blind to ratepayer economic burden on the generation side, the T&D impact side, the momentary interruption side, and the chronic duration burden side, while treating a FOR that reflects documented disinvestment and undisclosed cause composition as a fixed condition and accepting a waiver contradicted by its own published body of evidence. These are not isolated analytical limitations. They are a compounding series of documented choices that this proceeding is positioned to correct.

V. RENEWED REQUEST FOR RELIEF

The petitioner renews the request made in the original brief and the Supplemental Brief: that the Commission acknowledge the structural limitations identified in this and prior filings explicitly in any final order on the 2025 IRP, and direct that future IRP submissions include a quantitative assessment of outage cost burden to ratepayers under each resource plan alternative evaluated.

The record now contains: LUMA's confirmed disclosure that actual unserved energy was 17,566 MWh in 2024 and 12,946 MWh in 2025; LUMA's confirmed disclosure that actual load shed events were not incorporated into PLEXOS model inputs; LUMA's confirmed disclosure that a binary availability structure with no derating was applied throughout; 168,304 lines of event-level outage data publicly filed by LUMA in SJ2024CV04490 more than sixteen months before the IRP was filed; a second broader production of event-level data by LUMA covering January 2021 through May 2024, produced fifteen months before the IRP was filed; the explicit written authorization of Dr. Fernando Tormos-Aponte to use that data; peer-reviewed CESIC methodology and the LBNL ICE Calculator PR model as available tools for translating sustained outage costs into household economic costs, with the intersection probability framework available to extend that quantification to momentary interruption durations once MAIFI event-level data enters the regulatory record; the documented structural gap inherited from the PR100 modeling lineage; LUMA's confirmation that it did not complete a comprehensive distribution analysis of the PRP and has requested a waiver; four years of computed MAIFI data showing that over half of all customer interruptions are invisible in regulatory reporting; documented evidence that the 29 percent FOR reflects institutional disinvestment rather than immutable system characteristics and has not been disaggregated by cause code; and DOE-funded peer-reviewed Puerto Rico-specific hosting capacity research available in a related NEPR docket prior to the IRP filing and in a peer-reviewed journal three months before filing.

The exclusion of ratepayer outage costs from the IRP cost comparison is no longer a data problem or a methodological constraint. It is a compounding series of documented choices. The Commission has before it both the evidence and the means. The petitioner respectfully urges the Commission to act on that basis.

VI. DECLARATION

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

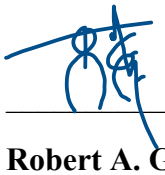
A) No party or lawyer in this proceeding assisted in drafting this second supplemental brief.

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

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

Respectfully submitted,

In San Juan, Puerto Rico, on May 7, 2026.



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EXHIBITS

The petitioner incorporates by reference Exhibits A through K as filed with the Supplemental Brief of Amicus Curiae Robert A. Garcia Cooper, submitted April 19, 2026, in this proceeding.

Exhibit L: Huaman-Rivera, A., Irizarry-Rivera, A., Calloquispe-Huallpa, R., "Increasing photovoltaic hosting capacity in distribution networks in Puerto Rico: Seasonal and technical characteristics analysis and solutions," Energy Reports, Vol. 14 (2025), pp. 867-885, DOI: 10.1016/j.egyr.2025.06.034. Open access, CC BY-NC-ND license.

Exhibit M: Maharjan, M., Ekic, A., Beedle, M., Tan, J., Wu, D., "Evaluating grid strength under uncertain renewable generation," International Journal of Electrical Power and Energy Systems, Vol. 146 (2023), Article 108737, DOI: 10.1016/j.ijepes.2022.108737.

Exhibit N: Date-stamped first page of thesis filing, Case No. NEPR-MI-2019-0009, Puerto Rico Energy Bureau. Huaman-Rivera, A., Irizarry-Rivera, A., "Increasing Hosting Capacity of Distribution Feeders Through Energy Storage and Smart Inverter Functions," University of Puerto Rico Mayaguez, 2022, filed April 12, 2024 by Kenan D. Davila, Sargent and Lundy. Full document available at: https://energia.pr.gov/wp-content/uploads/sites/7/2024/04/20240412-MI20190009-Tesis-Anny-Huaman-Rivera.pdf

CERTIFICATE OF SERVICE

I hereby certify that on May 7, 2026, a copy of this Second 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