

LUMA'S ASSESSMENT ON ADDITIONAL RELIABILITY METRICS

Docket Number: NEPR-MI-2019-0007

April 2, 2026, R&O, Section IV. Addition of Reliability Metrics

The IEEE Standard 1366-2012 (IEEE Standard 1366), *Guide for Electric Power Distribution Reliability Indices*, establishes the industry-standard definitions and methodologies for calculating distribution-level reliability indices, including the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI). The standard specifies that these indices apply solely for electric distribution systems encompassing substations, circuits, and specified service regions, consistent with the scope articulated in IEEE Standard 1366, Clause 1.2.

Under IEEE Standard 1366, SAIDI and SAIFI are designed to measure sustained interruption performance at the distribution level (IEEE Standard 1366, Clause 2 “sustained interruption: Any interruption not classified as a part of a momentary event. That is, any interruption that lasts more than five minutes.”.) In contrast, interruptions of five minutes or less are classified as *momentary interruptions* and are explicitly excluded from SAIDI and SAIFI calculations; instead, they are monitored using the Momentary Average Interruption Frequency Index (MAIFI) as per IEEE Standard 1366, Clause 3.4 Other indices (momentary). This distinction is a fundamental component of the standard’s reliability reporting framework and underpins LUMA’s transmission and distribution (T&D) reliability calculations.

In evaluating the reliability metrics mandated by the Puerto Rico Energy Bureau (PREB) through its Resolution and Order on Updated Data Template for Quarterly Reporting issued on April 2, 2026 (April 2 R&O), LUMA notes that several required indices deviate from IEEE Standard 1366. The standard clearly stipulates that interruptions resulting from events outside the distribution system, including those originating in generation facilities are not included in distribution reliability indices such as SAIDI and SAIFI (IEEE Standard 1366, Clause 2, defines “interruptions caused by events outside of the distribution system: Outages that occur on generation...” and specifies that generation events are not defined under the term of an outage “This definition derives from transmission and distribution applications and does not apply to generation Outages”).

The following sections provide LUMA’s assessment of the majority metrics ordered by PREB in the April 2 R&O, including the applicability of IEEE Standard 1366 definitions to each metric, limitations imposed by the standard regarding catastrophic events, momentary events, and challenges in cross-

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domain attribution when metrics extend beyond the IEEE Standard 1366 reliability framework. Our assessment is limited to the following metrics, established via the April 2 R&O.

- **Monthly SAIDI (Generation) – System:** Calculated as the sum of total customer minutes interrupted due to load-shed events (including automatic, planned, and contingency) divided by the total number of customers served.
- **Monthly SAIFI (Generation) – System:** Calculated as the sum of total customers interrupted due to load-shed events (including automatic, planned, and contingency) divided by the total number of customers served.
- **Monthly SAIDI (T&D Unnormalized) – System:** Calculated using the same methodology as Monthly SAIDI (T&D) - System metric but includes MEDs and catastrophic events.
- **Monthly SAIFI (T&D Unnormalized) – System:** Calculated using the same methodology as Monthly SAIDI (T&D) - System metric but includes MEDs and catastrophic events.
- **Monthly SAIDI (T&D All-in) – System:** Calculated using the same methodology as Monthly SAIDI (T&D) - System metric, but includes all T&D-related outages, including MEDs, catastrophic events, planned outages, and momentary outages.
- **Monthly SAIFI (T&D All-in) – System:** Calculated using the same methodology as Monthly SAIFI (T&D) - System metric, but includes all T&D-related outages, including MEDs, catastrophic events, planned outages, and momentary outages.

1.1 [Monthly SAIDI and SAIFI \(Generation\): Generation Events](#)

As previously discussed, the IEEE Standard 1366 establishes that SAIDI and SAIFI measure the performance of the distribution system only and therefore do not incorporate generation-related outages or interruptions, which the standard classifies as events occurring outside the distribution system. At present, LUMA's SAIDI and SAIFI calculations exclude generation events and are limited to those events arising from transmission and distribution system interruptions. While LUMA can report SAIDI and SAIFI values associated with generation, expanding these metrics to include generation events, as required by PREB, presents notable challenges and limitations. One major limitation is the difficulty in accurately distinguishing interruptions caused solely by generation events from those resulting from transmission or distribution failures, in the context of multiple overlapping events in the electric system, as seen during storm events. Moreover, reporting these metrics on a monthly basis increases the risk of exclusion errors, as generation events that overlap with other system contingencies (transmission contingencies, damaged substation equipment or distribution infrastructure) or extend across multiple reporting periods may be misclassified or counted more than once. This makes it difficult to maintain consistency and comparability in these metrics, especially in systems where outages often cascade or involve complex interactions among generation, transmission, and distribution assets. Calculating generation-specific reliability metrics may lead to statistical inconsistencies, distorting the overall assessment of system reliability and complicating outage impact analysis.

Customer interruptions resulting from known generation shortfalls or load-shed events can be reported but with the following considerations.

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Reportable limitations:

- Double or triple counting of customers interrupted, under current reporting scripts, may occur when generation-related outages happen at the same time as ongoing T&D outages.
- Generation events cannot be excluded through Major Event Day (MED) rules, as they are not part of the T-MED calculation.
- Outage durations and customer counts are available only from the distribution system's perspective.

Not fully viable for reporting:

- Clean separation of T&D versus generation causes without extended investigations.
- Timely reporting on events that require root-cause analyses extending beyond quarterly reporting deadlines. If root-cause analyses are not performed before reporting, there is a risk of wrong data reporting. These analyses take time, which is dependent on the magnitude and type of event. In turn, these analyses deviate resources currently assigned to other tasks.

1.2 Monthly SAIDI and SAIFI (T&D Unnormalized): Catastrophic Events

During catastrophic events, such as storms or seismic events, utilities like LUMA transition from their standard operations to emergency operation protocols. Indices reported on an unnormalized basis include days when the energy delivery system experiences stresses that exceed those normally expected, as outlined in the IEEE Standard 1366. Statistically, days with elevated daily system SAIDI reflect periods of extraordinary system strain, such as those caused by severe weather or other unusual circumstances. Under these conditions, the primary objectives shift to public safety and rapid restoration of critical loads. This focus often precludes the more granular data-logging to differentiate primary, contributory, and sustaining causes of an outage and interruption. Historically, interruption events occurring during these periods are recorded under a “blanket cause code”, Major Storm/Earthquake (“Disturbio Atmosferico”). This is due to the cascading nature of these catastrophic events where a single customer interruption may be simultaneously caused by generation shortfalls, transmission contingencies and damage or failures to substation equipment or distribution infrastructure. An attempt to differentiate records into specific system area responsibilities is futile as, for example, a single customer outage may have multiple and concurrent causes or points of failure that would introduce significant statistical noise and potential inaccuracies. Further an attempt to do this will require manual process that will consume specialized resources already committed in restoration effort and therefore negatively impacting the restoration efforts.

It is important to emphasize that this data has significant limitations, and, in some cases, it will not be viable to report.

Reportable limitations:

- The total interruption minutes and customers interrupted under the catastrophic event cause code. Catastrophic events pose a limitation in the calculation of reliability metrics. When a catastrophic event overlaps with a MED, it becomes difficult to accurately calculate

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or segment performance data. In alignment with IEEE Standard 1366, MEDs may be included only when no catastrophic event is present in the dataset, as metrics derived during overlapping periods become unreliable and thus do not reflect real performance.

Not viable for reporting:

- Detailed segmentation by system component: generation, transmission, distribution.
- Assigning precise responsibility for each outage during catastrophic conditions.

1.3 [Monthly SAIDI and SAIFI \(T&D All-in\): Momentary Interruptions](#)

As previously stated, LUMA does not have the technology nor infrastructure to provide MAIFI, an index as defined in the IEEE Standard 1366, that indicates the frequency of momentary interruptions. Thus, the request to include momentary interruptions within an “all-in” version of SAIDI and SAIFI is not only against IEEE Standard 1366 definition as sustained interruption indices, but also not feasible currently. Momentary interruptions (interruptions of five minutes or less) are typically caused by transient faults and are automatically cleared by protective devices such as reclosers or breakers. Each recloser operation is considered a separate momentary interruption. Currently, LUMA's systems do not account for reclosing operations occurring within five minutes of the initial interruption. LUMA does not currently have the monitoring infrastructure required to calculate the MAIFI as defined by IEEE Standard 1366. Consequently, the calculation of the MAIFI is not feasible.

Reportable limitations:

- LUMA's systems cannot track reclosing operations within the five-minute window, making meaningful MAIFI values unattainable at this time.
- Hundreds of automation devices have reclosing capability, but their data is not yet connected to central systems. Extracting usable MAIFI or momentary outage data would require significant staff effort and manual analysis.
- Known momentary events for devices already in the SCADA (Supervisory Control and Data Acquisition) generating verifiable alarms, though incomplete.

Not viable for reporting:

- Use of momentary interruptions within “all-in” SAIDI or SAIFI, as these indices are explicitly defined as sustained (>5 min) by IEEE Standard 1366 and PREB references.
- Calculation of MAIFI with any statistical completeness.

1.4 [Monthly SAIDI and SAIFI \(T&D All-in\): Planned Outages](#)

Planned outages are already subject to proper coding procedures and are tracked in accordance with established reliability reporting standards, including IEEE's. However, LUMA notes that planned outages are excluded from the calculation of SAIDI and SAIFI under IEEE Standard 1366 definitions, which is the industry-standard methodology used for electric distribution reliability reporting.

Planned outages such as maintenance work, infrastructure replacements, and coordinated improvement activities are purposefully scheduled, notified to customers in advance, and executed to reduce long-term risk and improve reliability. Including these interruptions in SAIDI or SAIFI would

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introduce distortion and make the metrics no longer comparable to industry benchmarks, utility peers, or LUMA's historical performance.

The following table summarizes which reliability metrics are currently reportable and highlights any associated limitations or constraints:

Metric	Reportable?	Constraints / Non-viable Elements
SAIDI (Generation)	Yes, but not within the three-month system data reporting cadence	Not an IEEE Standard 1366 distribution metric; subject to lengthy investigations; potential overlaps and disputes.
SAIFI (Generation)	Yes, but not within the three-month system data reporting cadence	Not an IEEE Standard 1366 distribution metric; subject to lengthy investigations; potential overlaps and disputes.
SAIDI (T&D Unnormalized)	No	Catastrophic events cannot be granularly segmented.
SAIFI (T&D Unnormalized)	No	Catastrophic events cannot be granularly segmented.
SAIDI (T&D All-in)	No	Catastrophic events cannot be granularly segmented; Momentary data not feasible; violates IEEE Standard 1366 definitions.
SAIFI (T&D All-in)	No	Catastrophic events cannot be granularly segmented; Momentary data not feasible; violates IEEE Standard 1366 definitions.

It is important to emphasize that several of the PREB-ordered metrics are subject to inherent limitations. As outlined in the preceding table, LUMA cannot isolate catastrophic events at the granularity required, nor can it incorporate momentary interruptions into certain indices without contradicting IEEE Standard 1366 definitions. Consequently, metrics may not fully represent actual service performance. For example, SAIDI and SAIFI indices that cannot fully capture all event types or momentary interruptions will reflect only a partial picture of system reliability. As a result, the reported metrics may have significant limitations in their representation of actual service

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interruptions and may not fully align with industry-standard definitions. These constraints should be clearly communicated to ensure transparency regarding the accuracy, limitations, and reliability of the reported data.

For the PREB-ordered metrics that LUMA is able to report (see table above), given the expanded scope of these and the corresponding need for new analytical logic, LUMA requires additional time to develop, test, and deploy the analytical scripts. These updates entail restructuring existing data queries, building new logic pathways to incorporate PREB-ordered categories, and conducting comprehensive validation to ensure accuracy and consistency across all metrics produced. The validation process includes developing a clear definition of the new mandated metrics to create the new categories and sub-groups of events that will be considered for each metric. The current data sources must be evaluated to determine if they remain sufficient to provide the event data needed, and if not, additional data sources must be identified and included in the process. Quality checks must be completed on the data from all sources, and quality assurance processes must then be updated to consider new categorizations and data that previously would not have gone through this process. Current scripts must then be updated to produce the new metrics, and the results would then be validated through alternative manual calculations to ensure consistency for the results of the new metrics, while also ensuring that already reported metrics values match what has been reported. Once any errors or gaps are addressed, the scripts can then be deployed and used to produce the PREB-ordered metrics, while the outputs will remain under monitoring for any unexpected results, allowing for improvements as needed to the scripts. At a minimum, LUMA requires three additional months to complete the programming, testing, and quality assurance activities needed to reliably produce the requested metrics. This timeframe is essential to ensure that all values reported to the PREB are technically sound, supported by available data, and compliant with the methodological constraints outlined above.

The technical personnel available to participate in a technical conference to address the issues described through this document and in LUMA's Motion Requesting Partial Reconsideration of the April 2 Order are:

- Thor Hjartarson, Assets Management and Engineering Vice-President
- Humberto Campán Colón, Reliability and Automation Director
- Olga W Soto Pagán, Dispatch and Distribution Ops Center Director

CERTIFICATION

I, Thor Hjartarson, Assets Management and Engineering Vice-President, hereby state and certify as follows:

1. I am the Assets Management and Engineering Vice-President of LUMA Energy, LLC and am authorized to make this Certification in the above-captioned proceeding before the Puerto Rico Energy Bureau.

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2. The document titled Technical Memorandum submitted in support of LUMA's *Motion for Reconsideration of the April 2 Order* filed today, April 22, 2026, was prepared under my direction and review and reflects my professional opinions, analyses, and conclusions for purposes of this proceeding.
3. If called to testify under oath, I would provide the same responses and opinions set forth in the Technical Memorandum.
4. The facts, data, assumptions, analyses, and statements contained in the Technical Memorandum are true and correct to the best of my knowledge, information, and belief, and have been prepared in good faith using information reasonably relied upon in the ordinary course of my professional responsibilities.

Certified and signed today, April 22, 2026, in San Juan Puerto Rico.



Thor Hjartarson
Assets Management and Engineering
Vice-President