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LUMA's System Performance Information

March 29, 2021

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1.0 Introduction & Overview

1.1 Introduction

The following information is excerpted from the LUMA Performance Metrics Baselines filing entitled Motion Resubmitting LUMA's Comments on Performance Baselines and Metrics Based on Data Presented on January 19th, 2021 by the Energy Bureau, and Resubmitting Proposed Performance Metrics and Baselines filed with the Energy Bureau on February 5, 2021.

The current performance of PREPA is well below industry standards. Establishing a robust set of Performance Metrics will begin to enable transparency, reverse negative performance trends and will further align LUMA with public policy – critical upon LUMA's commencement of T&S Services. This will advance LUMA's key goals: Prioritize Safety; Improve Customer Satisfaction; System Rebuild and Resiliency; Operational Excellence; and Sustainable Energy Transformation. The Puerto Rico Energy Board ("PREB") has also promulgated regulation concerning Performance Metrics, including NEPR-MI-2019-0014 and NEPR-MI-2019-0007. In the latter docket, PREB, through its order issued December 23, 2020, ordered that LUMA take part in the proceedings.

This submission describes the process followed by LUMA to study and evaluate PREPA's baseline performance for selected Performance Metrics. This work forms part of the Front-End Transition Services being delivered by LUMA under the OMA. LUMA has been reporting its progress during the Front-End Transition in monthly reports provided to P3A and PREB.

LUMA's review took place before December 2020 and included dedicated teams focused on this specific effort and the active participation of experts from each functional department in the organization. The process also included discussion with key stakeholders, who provided feedback on process, regulations and other context that informed this proposal. Please refer to Sections 1.2.3 Summary of Planning Team Activity and Section 2.0 Review of Processes & Data of this document for additional details.

The work performed by the LUMA teams required continuous interaction with the corresponding groups at PREPA for information gathering on current processes and available data. As part of the assessment of current practices, LUMA has determined that there are multiple gaps between PREPA's current processes and supporting data when compared against applicable industry standards and practices for the metrics listed in Annex IX of the OMA (hereafter referred to as "Annex IX"). In this submission, LUMA compares PREPA's current practices with industry standards and practices.

Because LUMA found significant gaps in both processes and data as explained in detail herein, LUMA proposes that reporting of certain metrics and their use in Annex IX be deferred until such time as LUMA is able to provide reliable data for those metrics. In order to provide a full set of metrics, LUMA proposes the addition of some Performance Metrics in Annex IX. Determining baseline performance to enable the setting of realistic performance targets for the proposed Performance Metrics was also a challenge due to current process and data gaps as explained in detail herein.

The proposed Performance Metrics are presented with details related to each, including descriptions, calculations, and performance baselines.



It must be noted that the design of LUMA's plans will be affected in several cases by the absence and lack of quality data. LUMA's plans for improvement in the proposed Performance Metrics is reflected in our prioritization of programs and projects, and ultimately in our Initial Budgets to be submitted to PREB under a separate filing as part of LUMA's Front-End Transition Services obligations.

2.0 Review of Processes & Data

2.1 Technical

The key findings and proposals for these metrics are presented below.

TECHNICAL

In accordance with the OMA and common industry practice, there are certain event exclusions permitted in the calculation and reporting of reliability Performance Metrics. The following defines and describes those exclusions and LUMA's findings.

Annex IX of OMA states that the calculation of technical Performance Metrics (SAIFI and SAIDI) excludes:

- Interruptions associated with outage event days using the IEEE 2.5 Beta Method (defined in IEEE Std 1366[™]-2012)
- Planned interruptions
- Interruptions caused by generation events

Detailed descriptions of the stated exclusions are of special importance:

THE IEEE 2.5 BETA METHOD

As defined in IEEE Std 1366[™]-2012¹, the Beta Method "is used to identify Major Event Days (MED), provided that the natural log transformation of the data results closely resembles a Gaussian (normal) distribution.² 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."

- "An MED is a day in which the daily system SAIDI exceeds a threshold value, T_{MED}"
- "The MED identification T_{MED} value is calculated at the end of each reporting period (typically one year) for use during the next reporting period"

• $T_{MED} = e^{\alpha + 2.5\beta}$

where α is the log-average of each daily SAIDI in the data set and β is the log-standard deviation of the data set

"Five years of historical data is preferable for this method."



¹ The Institute of Electrical and Electronics Engineers, Inc., IEEE Guide for Electric Power Distribution Reliability Indices IEEE Std 1366TM-2012

PLANNED INTERRUPTIONS

As defined in IEEE Std 1366[™]-2012, "The loss of electric power to one or more customers that results from a planned outage."³ The key test to determine if an interruption should be classified as a planned or unplanned interruption is as follows: if it is possible to defer the interruption, then the interruption is a planned interruption; otherwise, the interruption is an unplanned interruption."

INTERRUPTIONS CAUSED BY GENERATION EVENTS

An examination of the PREPA data and conversations with PREPA Operations and Reliability Reporting SMEs revealed that the existing process for identification of interruptions caused by generation events is highly likely to produce unreliable data.

- Rather than selecting from a predefined drop-down list to indicate the component level of where an
 interruption originated, the system operators manually input this information in an inconsistent manner
 into a free form field which leads to errors and difficulty searching and filtering thousands of records to
 identify those interruptions caused by generation events.
- Because of the free form nature of this field and the many ways that individual operators describe what
 occurred, it is impossible to confirm that all generation events have been excluded.

After examination of many data entries, LUMA made the following assumptions:

- Where generation is mentioned without a related transmission line(s), the event is assumed to be a
 generation event
- Where generation is mentioned with a related transmission line(s), the event is assumed to be a transmission event

Note that LUMA plans to add a field in the OMS with a drop-down selection of the system component level in which the interruption occurred (G, T, or D) for operators to directly record the necessary information.

IDENTIFIED GAPS AFFECTING PREPA'S REPORTED RELIABILITY PERFORMANCE METRICS

The Major Event Day Threshold (T_{MED}) has not been calculated since 2017 and that calculation was based on 4 years of data. The current value used is derived from assumed data that is not supported by recent operational history.

The process of restoring customer service may include restoring service to small sections of the system (typically a distribution feeder) until service has been restored to all customers.⁴ According to IEEE, which



³ Ibid

⁴ The Institute of Electrical and Electronics Engineers, Inc., IEEE Guide for Electric Power Distribution Reliability Indices IEEE Std 1366[™]-2012 Section 4.3.2

sets the industry standard for collection of this performance data, each of these individual steps should be tracked to collect the start time, end time and the number of customers interrupted for each step.^{5,6}

No procedure or functionality exists in the PREPA Outage Management System (OMS) to explicitly capture and track data related to Step Restoration (i.e., Partial Restoration). Currently at PREPA, the operator keeps a daily log of events manually and updates events in the interruptions database manually with his notes about which events were restored in steps. This entails manually creating events for each restoration step related to the main event, then changing the time stamps, events numbers, and cause codes to mimic what occurred in the field. The number of customers involved in each step is based on the knowledge of the operators and crews since PREPA's OMS model functionality, and process does not support capturing this information in the OMS. PREPA's current process is prone to errors and creates a difficult challenge in accurately calculating the number of customers and duration impacted for the event.

Under the current PREPA process, many interruption events are excluded from calculations based on cause code. PREPA excludes events from their calculations that are associated with 28 of PREPA's predefined 43 cause codes. Based on industry practice, events with 25 of the 28 excluded cause codes should be included in calculations. LUMA could not identify valid reasons for excluding these 25 cause codes. Please refer to Tables 2.1 and 2.2 for information regarding PREPA's cause codes.

	PREPA	Industry Practice
Include	15	40
Exclude	28	3
Total	43	43

Table 2.4. PREPA's Interruption Cause Codes

Table 2.5. PREPA's Interruptions with Cause Code Included or Excluded from Metric Calculation

ID	CODIGO_C (Espanol)	CODE _C (English)	PREPA	Best Practice
13	REMOCION DE ASBESTO O CAJAS DE ACEITE	ASBESTOS OR OIL BOX REMOVAL	exclude	include
15	SECUNDARIA/CONDUCTOR ROTO, ABIERTO O CRU	SECONDARY / DRIVER BROKEN, OPEN OR CRU	exclude	include
16	SECUNDARIA/ESTRUCTURA AVERIADA	SECONDARY / FAILED STRUCTURE	exclude	include
17	SECUNDARIA/DESGANCHE	SECONDARY / RELEASE	exclude	include
18	POWER TRANSFORMER AVERIADO	POWER TRANSFORMER FAILED	exclude	include
19	LINEA DE TRANSMISION/MAL TIEMPO/WET ASH	TRANSMISSION LINE / BAD WEATHER / WET ASH	exclude	include
20	LINEA DE TRANSMISION/ANIMAL U OBJETO EXT	TRANSMISSION LINE / ANIMAL OR EXT OBJECT	exclude	include
21	RELEVO DE CARGA POR CONTINGENCIA	CONTINGENCY LOAD RELAY	exclude	include

⁵ The Institute of Electrical and Electronics Engineers, Inc., IEEE Guide for Electric Power Distribution Reliability Indices IEEE Std. 1366[™]-2012, May 2012, pages 2-3, 17-18.

⁶ The Institute of Electrical and Electronics Engineers, Inc., IEEE Guide for Collecting, Categorizing, and Utilizing Information Related to Electric Power Distribution Interruption Events IEEE Std. 1782[™]-2014, March 2014, pages 10 and 19.



ID	CODIGO_C (Espanol)	CODE _C (English)	PREPA	Best Practice
22	RELEVO DE CARGA PROGRAMADO	PROGRAMMED LOAD RELAY	exclude	include
23	MAL TIEMPO/RAYOS/WET ASH	BAD WEATHER / LIGHTNING / WET ASH	include	include
24	SUBIR/BAJAR TAP	UP / DOWN TAP	exclude	include
25	DISPARO DE BARRA DE TRANSMISION	TRANSMISSION BAR TRIP	exclude	include
38	LINEA DE TRANSMISION 38KV	38KV TRANSMISSION LINE	exclude	include
39	LINEA DE TRANSMISION 115KV	115KV TRANSMISSION LINE	exclude	include
48	TRANSFORMADOR AVERIADO	FAULTY TRANSFORMER	exclude	include
51	ESTRUCTURA AVERIADA	FAILED STRUCTURE	include	include
52	CONDUCTOR ROTO, ABIERTO O CRUZADO	BROKEN, OPEN OR CROSSED CONDUCTOR	include	include
53	DESGANCHE	RELEASE	include	include
54	PARARRAYOS DEFECTUOSO	DEFECTIVE LIGHTNING ROD	include	include
56	AISLADOR ROTO, PARTIDO O SAFADO	DAMAGED OR BROKEN LOOSE INSULATOR	include	include
58	EMPALME O TERMINACION SOTERRADA AVERIADA	UNDERGROUND JOINT OR TERMINATION BROKEN DOWN OR MALFUNCTING	include	include
59	CABLE SOTERRADO AVERIADO	UNDERGROUND CABLE BROKEN	include	include
63	DESCONECTIVO DEFECTUOSO	DEFECTIVE DISCONNECT	include	include
65	HERRAJE ROTO O PODRIDO	BROKEN OR ROTTED HARDWARE	include	include
66	CAJA PRIMARIA DEFECTUOSA O QUEMADA	DEFECTIVE OR BURNT PRIMARY CASE	include	include
67	UNIDAD SECCIONADORA (SWITCHING UNIT)	SWITCHING UNIT	include	include
69	OTRAS CAUSAS(CERTIFICAR)	OTHER CAUSES (CERTIFY)	exclude	include
83	FUEGO	FIRE	exclude	include
85	ERROR HUMANO	HUMAN ERROR	exclude	include
86	ANIMAL U OBJETO EXTRAÑO	ANIMAL OR STRANGE OBJECT	exclude	include
87	SOBRECARGA	OVERLOAD	include	include
88	DISTURBIO ATMOSFERICO	ATMOSPHERIC DISTURBANCE	exclude	include
89	EQUIPO DE CONTROL DEFECTUOSO	DEFECTIVE CONTROL EQUIPMENT	include	include
90	VIA LIBRE PROGRAMADA - DISTRIBUCION	FREE SCHEDULED ROUTE - DISTRIBUTION	exclude	exclude**
91	RELEVO DE CARGA AUTOMATICO	AUTOMATIC LOAD RELAY	exclude	include
92	VIA LIBRE A SOLICITUD DEL CLIENTE	FREE ROUTE AT THE CLIENT'S REQUEST	exclude	exclude**
93	LINEA DE TRANSMISION	TRANSMISSION LINE	exclude	include
94	BREAKER DEFECTUOSO O NO OPERA	BREAKER DEFECTIVE OR NOT OPERATING	exclude	include
95	VIA LIBRE PROGRAMADA - TRANSMISION	PROGRAMMED FREE ROUTE - TRANSMISSION	exclude	exclude**



ID	CODIGO_C (Espanol)	CODE _C (English)	PREPA	Best Practice
96	VIA LIBRE DE EMERGENCIA - DISTRIBUCION	EMERGENCY FREE ROUTE - DISTRIBUTION	exclude	include
97	VIA LIBRE DE EMERGENCIA - TRANSMISION	EMERGENCY FREE ROUTE - TRANSMISSION	exclude	include
98	PROTECCION DEFECTUOSA	DEFECTIVE PROTECTION	exclude	include
99	NO SE REPORTO CAUSA	NO REPORTED CAUSE	include	include

** Events with these cause codes are excluded from LUMA's Performance Metrics calculations in accordance with the OMA.

In addition to the above, transmission and substation events are excluded from PREPA's calculations. LUMA included these types of events in calculations per industry practices.

The valid data available spans the period May 2018 to August 2020 – data prior to May 2018 is either known to be faulty or not relevant to the configuration and state of today's T&D system due to destruction and emergency reconstruction after Hurricanes Irma and Maria.

ACTIONS TAKEN

Based on our assessment, PREPA has little documentation relating to why certain assumptions are made in the collection of data and calculation of reliability metrics.

As a result of this, LUMA built an interruption data analysis workbook, tested PREPA's assumptions and results, applied PREPA's practices and industry practices under various scenarios of historical data and compared the results.

The LUMA workbook was tested using sample data and results included in IEEE Std. 1366[™]-2012. PREPA's cause code exclusion list and system component level analyzed for reporting was also used to test the LUMA workbook. Initial results did not match and required many discussions with PREPA personnel, along with trial-and-error analyses. Based on these analyses, LUMA concluded that the current PREPA process excludes interruptions with three additional cause codes relative to what was indicated in PREPA's original list of exclusions (these have been included in Table 2.5). These are failed power transformer, animal or strange object, and defective protection. After excluding these cause codes, the LUMA workbook results matched PREPA's results within reason.

LUMA used the interruption data set from the period May 2018 through Dec 2019 to determine the Major Event Day (MED) Threshold (T_{MED}) as specified in the IEEE Guide for Electric Power Distribution Reliability Indices, IEEE P1366-2012. The T_{MED} calculation procedure in IEEE Std. 1366TM-2012 specifies analyzing data up through the end of the year prior to that being currently analyzed and only excluding interruptions from the T_{MED} analysis identified as Planned Interruptions and interruptions caused by generation events. The standard also specifies only excluding interruptions from the metrics analysis identified as a Planned Interruptions, Interruptions Caused by Generation Events, and Interruptions



associated with Major Event Days. These exclusions are currently the predominant practice in the US⁷ and only ones stated as exclusions in Annex IX of the OMA.⁸

SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI) AND SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIDI)

IEEE Std. 1366TM-2012 recommends using five years of historical data in the calculation of T_{MED}. However, five years of credible relative data does not exist. Only 20 months of historical data is available for use in the IEEE Std. 1366TM-2012 T_{MED} calculation procedure. The impact that using this limited period of historical data has on the resulting reliability Performance Metrics is unknown and is impractical or impossible to determine. Therefore, LUMA plans to carefully determine and evaluate T_{MED} against the previous T_{MED}s as each additional year of historical data becomes available. While proposing baselines, LUMA will monitor the data for significant changes in T_{MED} during the initial 3-year period and identify any related changes to the proposed reliability Performance Metrics that require revisiting.

CUSTOMER AVERAGE INTERRUPTION DURATION INDEX (CAIDI)

Based on growing industry concerns that CAIDI is a limited value performance metric,⁹ LUMA proposes eliminating CAIDI. Since CAIDI is the ratio between SAIDI and SAIFI, CAIDI can be misleading because it can remain the same even when the SAIDI and SAIFI values decrease. In this case, while the customer experience improves, the CAIDI metrics can remain the same, indicating that there was no improvement. Also, valuable improvements to the T&D system such as adding automation will tend to improve SAIDI and SAIFI but could also cause CAIDI to increase because automation tends to reduce less complicated interruptions to less than five minutes (IEEE definition of a sustained outage). The more complicated and time-consuming interruptions are left for field personnel to repair and restore.

CUSTOMERS EXPERIENCING MULTIPLE INTERRUPTIONS (CEMIN)

Setting a meaningful CEMI_N metric is highly dependent on accurate customer information and sufficient customer connectivity in the Outage Management System. Due to data quality issues including a lack of accurate customer information and a lack of customer connectivity in the Outage Management System, LUMA proposes deferring CEMI_N. LUMA plans to perform field inspections to increase customer connectivity in the OMS which will be reflected in the GIS. A new process to update the connectivity model will be put in place to capture the new and future updates. These field inspections will be started in year one. The new process for data connectivity will also be implemented in year one. Updates on the connectivity accuracy will be provided on an annual basis to allow for implementation of the CEMI_N metric.

MOMENTARY AVERAGE INTERRUPTION FREQUENCY INDEX (MAIFI)

Due to data availability and quality issues, LUMA recommends deferring the MAIFI metric until it can be accurately measured. Determining a meaningful MAIFI metric is highly dependent on extensive highquality monitoring infrastructure (e.g., Supervisory Control and Data Acquisition (SCADA), Advanced

⁹ Richard Brown, *Electric Power Distribution Reliability 2nd Edition*, (Boca Raton, FL: CRC Press, 2009), 58-59.



⁷ Based on discussions with industry SMEs. Also see Evaluation of Data Submitted in APPA's 2018 Distribution System Reliability & Operations Survey https://www.publicpower.org/system/files/documents/2018%20DSRO%20Report_0.pdf and CPUC Electric System Reliability Annual Reports https://www.cpuc.ca.gov/General.aspx?id=4529.

⁸ While OMA Annex IX uses some non-standard terminology, LUMA uses terminology under IEEE Std. 1366[™]-2012 as cited in the OMA.

Metering Infrastructure (AMI)) and information systems due to the short duration of a momentary interruption. Given that the extensive high-quality monitoring infrastructure (e.g., SCADA, AMI) and information systems necessary are not in place, meaningful values for this metric cannot be determined. Even utilities with extensive monitoring in place find this metric problematic to track consistently. Updates on the monitoring infrastructure to enable implementation of the MAIFI metric will be provided on an annual basis.

ADDITIONAL PERFORMANCE METRICS

DISTRIBUTION LINE INSPECTIONS & TARGETED CORRECTIONS

The Distribution Line Inspections & Targeted Corrections indicator measures the number of distribution line inspections completed, with data recorded in a database for analysis. 100% of the 1,057 three-phase, main line distribution feeders will be inspected over a four-year period, ramping up the number of inspections each year. The inspections will prioritize the worst performing feeders (based on Customer Interruptions and Customer Minutes Interrupted) and critical customers as defined by FEMA (e.g., hospitals, police stations, water treatment plants etc.). These inspections will assess the physical integrity of the poles/structure (and components such as hardware and insulators), line/conductor, guy/anchor system and grounding. The assessment will be used to provide an overall health rating which will identify issues that affect safety and reliability. Serious safety issues to either the public or workers will result in immediate attention by the utility.

PREPA does not have a documented health condition assessment of the grid assets. In recent years, PREPA has not conducted programed inspections of its assets. Inspections were conducted of a sample of the system but the condition of a majority of the grid assets is basically unknown and not documented. It is apparent to experienced LUMA utility engineers from visual observations, site visits and an asset condition sampling that the grid has widespread deficiencies. As a result, LUMA has incorporated field inspections to categorize assets according to their health condition, based on estimates of condition (likelihood of failure) and criticality (consequence of failure). The overall health asset score will be based on 0 being the worse to 4 being the best.

Asset scores of 0 and 1 will be the highest risk assets and will be given the highest priority to repair and / or replace. These will be assets (Asset Score of 0 and 1) that exhibit the following:

- High risk of failure, or already failed and likely to cause:
 - A safety impact to LUMA employees and contractors and members of the public
 - A violation of regulatory or legal requirements, including Act 17 which includes requirements related to safe (based on applicable safety standards) and prudent utility practices, or
 - An outage that will be widespread, long duration and could affect critical customers.

All deficient assets will go into a work planning process to schedule repair or replacement in order to achieve objectives.

TRANSMISSION LINE INSPECTIONS & TARGETED CORRECTIONS

The Transmission Line Inspections metric measures the number of transmission line inspections completed, with data recorded in a database for analysis. 100% of the 260 transmission 230kV, 115kV, and 38kV circuits will be inspected over a four-year period, ramping up the number of inspections each year. The 230kV and 115kV lines will take priority for inspections. These inspections will assess the



physical integrity of the structure (and components such as hardware and insulators), line/conductor, guy/anchor system, foundation and grounding. The assessment will be used to provide an overall health rating which will identify issues that affect safety and reliability. Serious safety issues to either the public or workers will result in immediate attention by LUMA.

PREPA does not have a documented health condition assessment of the grid assets. In recent years, PREPA has not conducted programed inspections of its assets. Inspections were conducted of a sample of the system but the condition of most of the grid assets is basically unknown and not documented. It is apparent to experienced LUMA utility engineers from visual observations, site visits and an asset condition sampling that the grid has widespread deficiencies. As a result, LUMA has incorporated field inspections to categorize assets according to their health condition, based on estimates of condition (likelihood of failure) and criticality (consequence of failure). The overall health asset score will be based on 0 being the worse to 4 being the best.

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- High risk of failure, or already failed and likely to cause:
 - A safety impact to LUMA employees and contractors and members of the public
 - A violation of regulatory or legal requirements, including Act 17 which includes requirements related to safe (based on applicable safety standards) and prudent utility practices, or
 - An outage that will be widespread, affecting critical customers, and long duration.

All deficient assets will go into a work planning process to schedule repair or replacement in order to achieve the objectives.

T&D SUBSTATION INSPECTIONS & TARGETED CORRECTIONS

The Distribution and Transmission Substation Inspections metric measures the number of distribution and transmission substation inspections completed with data recorded in a database for analysis. 100% of the 392 distribution and transmission substations will be inspected over a four-year period, ramping up the number of inspections each year. Substations with critical customers and/or greatest number of customers served will take priority. These inspections will assess the physical integrity of the substation components and equipment including site/fencing/grounding, structures/foundations, high voltage equipment (breakers, power transformers, switches etc.), control building, protection control and SCADA systems, AC/DC systems and telecommunications systems. The assessments will be used to provide an overall health rating which will identify issues that affect safety and reliability. Serious safety issues to either the public or employees, resulting in immediate attention from the utility.

PREPA does not have a documented health condition assessment of the grid assets. In recent years, PREPA has not conducted programed inspections of its assets. Inspections were conducted of a sample of the system but the condition of most of the grid assets is basically unknown and not documented. It is apparent to experienced LUMA utility engineers from visual observations, site visits and an asset condition sampling that the grid has widespread deficiencies. As a result, LUMA has incorporated field inspections to categorize assets according to their health condition, based on estimates of condition (likelihood of failure) and criticality (consequence of failure). The overall health asset score will be based on 0 being the worse to 4 being the best.



Asset scores of 0 and 1 will be the highest risk assets and will be given the highest priority to repair and / or replace. These will be assets (Asset Score of 0 and 1) that exhibit the following:

- High risk of failure, or already failed and likely to cause:
 - A safety impact to LUMA employees and contractors and members of the public
 - A violation of regulatory or legal requirements, including Act 17 which includes requirements related to safe (based on applicable safety standards) and prudent utility practices, or
 - An outage that will be widespread, affecting critical customers, and long duration.

All deficient assets will go into a work planning process to schedule repair or replacement in order to achieve the objectives.

IMPACT OF FUTURE PROCESS AND IT SYSTEM IMPROVEMENTS - SAIDI & SAIFI

As described in section 4.4.1 of IEEE Guide Std 1782[™]-2014, entitled "Evaluating the Impact of Outage Management Process Changes":

"Upon implementation of an automated outage management system, indexes are likely to change reflective of the differences in measuring outage events. Thus, while index levels may indicate deterioration, this is generally the result of collecting data which was not previously collected or may reflect more accuracy in the collection process. A variety of methods have been implemented to try to measure the effect of the process change."

While the above addresses moving from a manual process to an automated process, the same phenomena can occur when making any significant improvements in the outage management process or related IT systems and should be considered when comparing reliability Performance Metrics over time. Guidance from IEEE Std 1782 and IEEE Std 1366 will be considered whenever changes to the outage management process or related IT systems are contemplated and the end to end (the utility becoming aware of an interruption through its ultimate inclusion in the analysis and reporting of reliability Performance Metrics) impact evaluated and considered in the design and implementation of those changes.

TECHNICAL INTERPRETATIONS

The Institute of Electrical and Electronics Engineers, Inc. (IEEE) published standards will be used to interpret matters related to technical Performance Metrics. Where published standards do not address specific matters, IEEE standards in development and published papers and reports from IEEE committees and working groups will be used for guidance.

3.0 Baseline Performance

As introduced in Section 2, "Review of Processes and Data", LUMA relied on its subject matter experts in each of its functional teams to establish and validate performance metric baselines. These teams worked judiciously with the corresponding PREPA departments in a detailed analysis of the processes, tools and data available for each performance metric. The task included initial information gathering, followed by industry benchmarking for industry practices and a gap assessment. The teams then proceeded to calculate baselines using the available acceptable data and, when technically justifiable, used corrections or projections to seek more reasonable and consistent results.



As described in Section 2, in the evaluation process LUMA found that some of the established Performance Metrics cannot be properly baselined (mainly due to nonexistent or inadequate data) and in a few instances found doubtful results even with sufficient data. This supports the deferment of such Performance Metrics or the addition of others, at least until LUMA is able to establish the proper practices for data collection and calculation. The following describes the baseline calculations (and proposed changes) for the Performance Metrics that LUMA proposes to measure and report.

3.1 Technical

3.1.1 SAIFI, SAIDI

Description:

- System Average Interruption Frequency Index (SAIFI)
- System Average Interruption Duration Index (SAIDI)

Calculation: per IEEE Std 1366[™]-2012

Data Source: PREPA historical data (when available)

Metric baseline calculation: In the process of investigating and validating PREPA's reliability metrics, LUMA built an interruption data analysis workbook based on IEEE Std. 1366-2012 for metric validation, tested PREPA's assumptions and results, and applied industry practices using historical data. The effort included analysis and comparisons of several years of PREPA customer interruption data and reliability metrics calculations and the findings of this investigation are:

- PREPA is a worse performer when compared to other utilities in the IEEE Reliability Benchmarking Study
- Degrading Performance seen in 2020 vs 2019
- Interruption data prior to May 2018 is not valid for current use
- PREPA has not updated the Major Event Days (MED) Threshold (T_{MED}) since 2017
- PREPA uses a beginning period customer count
- PREPA does not include transmission or substation outages that result in customer interruptions
- PREPA does not include interruptions having certain cause codes (28 of 43 are excluded)
- Many reports of no lights/no power from customer telephone calls are not transferred to the Outage Management System (OMS)
- The electrical model in the GIS system that feeds into the OMS system is not accurate or up to date
- Crew findings, actions, time stamps and estimates of customers restored are predominately based on crew knowledge and experience and entered manually
- Dispatch processes are inconsistent between the different regions/districts and dispatch records are manual and handwritten
- As data and processes are improved, metrics will change even if there is no change in customer experience these changes could appear to cause improved or degraded performance
- The significant increase in construction as LUMA takes control will increase the number of human element (HE) outages due to the necessary large number of construction/commissioning activities (currently excluded)

LUMA established the following parameters for determining reliability Performance Metrics:



- Using the interruption data set from the period May 2018 through Dec 2019 for determining the Major Event Day (MED) Threshold (T_{MED})
- The T_{MED} calculation procedure in IEEE Std. 1366[™]-2012 specifies analyzing data up through the end of the year prior to that being currently analyzed
- Data for 2020 is skewed by an extremely high daily SAIFI for Jan 7, 2020 due to a magnitude 6.4 earthquake
- Only excluding interruptions from the T_{MED} and metrics analysis identified as planned interruptions or caused by generation events
- Interruptions associated with Outage Event days using the IEEE 2.5 Beta Method (defined in IEEE Std 1366[™]-2012)

Note that the exclusions stated in the previous two bullets are stated in Annex IX of the OMA as the only exclusions from the calculation of this Technical Performance Metric. This is also currently the predominant practice in the US based on discussions with industry SMEs (see also Evaluation of Data Submitted in APPA's 2018 Distribution System Reliability & Operations Survey¹⁰).

Based on this analysis LUMA proceeded with specific calculations for Performance Metrics baseline as follows:

SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI) AND SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIDI)

To develop a baseline for SAIDI & SAIFI, LUMA applied the definitions of IEEE Std. 1366-2012 and industry practices, calculating 2019 year-end results, 2019 through end-of-August results, and 2020 through end-of-August results (the latest data available at the time the calculations were made). Results through end-of-August results for both years were compared.





As the charts indicate, the 2020 performance, based on LUMA calculations using industry standards, is significantly degraded from the 2019 performance over the first 8 months of the year, demonstrating that

¹⁰ https://www.publicpower.org/system/files/documents/2018%20DSRO%20Report_0.pdf and CPUC Electric System Reliability Annual Reports https://www.cpuc.ca.gov/General.aspx?id=4529



2019 year-end results would not reflect an appropriate baseline. Therefore, LUMA annualized the 2020 through end-of-August results for SAIDI & SAIFI as follows:

SAIDI Baseline (minutes) = 871 minutes x (12 months ÷ 8 months) = 1,307 minutes

SAIFI Baseline (occurrences) = 6.5 occurrences x (12 months ÷ 8 months) = 9.8 occurrences

Note that applying the degradation factors shown in the charts would have resulted in baselines slightly higher than with the method chosen to estimate an appropriate baseline.

3.1.2 Distribution Line Inspections and Targeted Corrections, Transmission Line Inspections and Targeted Corrections, T&D Substation Inspections and Targeted Corrections

Infrastructure integrity and public/employee safety is paramount. LUMA will embark on the critical task of detailed inspection of PREPA's infrastructure and that effort is certainly a good target for measuring the performance of LUMA in the important period of reconstruction and upgrades. The Distribution Line Inspections and Targeted Corrections, Transmission Line Inspections and Targeted Corrections, and T&D Substation Inspections and Targeted Corrections metrics will assess the physical integrity of the poles, structures, components and equipment, providing data to develop an overall health rating from zero to four. With this information, LUMA will identify serious safety issues to either the public or workers, which will result in immediate priorities for the remediation process. Category 0 and Category 1 findings shall be incorporated in a plan to address within 60 days of identification.

LUMA proposes the use of the inspection effort in the mentioned categories as additional metrics.

Baselines: N/A (cannot be calculated since such tasks are not routinely performed by PREPA)

