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

IN RE: PROCESS FOR THE ADOPTION OF REGULATION FOR DISTRIBUTION RESOURCE PLANNING	**CASE NO.:** NEPR-MI-2019-0011 **SUBJECT:** Joint motion by LUMA and PREPA submitting **corrected** work plan in compliance with Resolution and Order of December 31, 2020.

JOINT MOTION BY LUMA AND PREPA SUBMITTING CORRECTED WORK PLAN IN COMPLIANCE WITH PREB'S RESOLUTION AND ORDER OF DECEMBER 31, 2020

TO THE PUERTO RICO ENERGY BUREAU:

COME NOW, LUMA ENERGY, LLC as Management Co., per its responsibilities under the Puerto Rico Transmission and Distribution System Operation and Maintenance Agreement (OMA), **LUMA ENERGY SERVCO, LLC** (collectively, LUMA), and the **PUERTO RICO ELECTRIC POWER AUTHORITY** (PREPA) (jointly "LUMA and PREPA"), through their respective undersigned legal counsel and respectfully state and request the following:

1. On January 29, 2021, before noon, and in compliance with the Resolution and Order issued by the Puerto Rico Energy Bureau (Energy Bureau) on December 31, 2020, LUMA and PREPA submitted jointly a *Plan for Distribution System Interconnection Capacity Map and Power System Inventory*. **Exhibit 1** to motion filed at 11:42 am, January 29, 2021.

2. At page five, the plan document that was filed before the Energy Bureau included a typographical error in the form of a code reference: "Error! Reference source not found." We understand that the error code resulted involuntarily when the document was converted to pdf format.

3. LUMA and PREPA hereby submit a revised document, **Exhibit 1** *Plan for Distribution System Interconnection Capacity Map and Power System Inventory*, that corrects the aforementioned typographical error. No other revisions or alternations were made to **Exhibit 1.**

WHEREFORE, LUMA and **PREPA** respectfully request that the Energy Bureau take notice of the aforementioned, accept the revised **Exhibit 1** that is tendered herewith, and deem that they complied with the order issued on December 31, 2020, to file by January 29, 2020, a joint work plan and schedule on the three tasks identified by the Energy Bureau that involve planning of distribution resources.

RESPECTFULLY SUBMITTED.

In San Juan, Puerto Rico, this 1st day of February 2021.

We certify that We filed this motion using the electronic filing system of the Puerto Rico Energy Bureau.

Counsel for LUMA Energy LLC as Management Co. and LUMA Energy ServCo LLC

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Exhibit 1

Corrected Plan for Distribution System Interconnection Capacity Map and Power System Inventory

Plan for Distribution System Interconnection Capacity Map & Power System Inventory

NEPR-MI-2019-0011

January 29, 2021, Version 0.4

Implementation Plan

REPORT CONTRIBUTORS

- Hiram Medero
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- Carl Wilkins
- Hugo Bashualdo
- Gerardo Sanchez
- Chris Loo
- Alex Nassif

Contents

Introduction

This document lays out the joint LUMA - PREPA workplan to create interconnection capacity maps in a progressive approach and update critical distribution feeder data for operating and maintaining the grid. The plan will be undertaken across three orders, set out below, in accordance with the Resolution and Order issued December 2020 in NEPR-MI-2019-0011[1].

The Resolution and Order of NEPR-MI-2019-0011 orders LUMA and PREPA to jointly plan the execution of the following three Orders and states the following due dates:

Order 1. Voltage Level Maps, to be completed by May 31, 2021
The creation of digital maps that show the geographical route of all the primary power distribution feeders across Puerto Rico, including Vieques and Culebra.

Order 2. Preliminary Maps of Interconnection Capacity, to be completed by September 30, 2021
A digital map will be created showing distribution feeders' layout and displaying the feeders' available capacity to host additional distributed generation.

Order 3. Power Grid Inventory, to be completed by December 31, 2021
The collection of different types of data spread across 10 subtasks. Each subtask will proceed using the following framework:

- Determining what data is available
- Determining how to store the data
- Assembling available data
- Developing a plan to find and collect unavailable data

In April 2020, PREPA offered a phased approach to produce and publish hosting capacity data. The phases are defined as levels:

- **Level 1:** Feeders are color-coded based on voltage levels.
- **Level 2:** Feeders are color-coded per voltage class, and existing renewable sources are shown. Those with more than 15% DG capacity integration over feeder peak demand are highlighted.
- **Level 3:** Power flow simulations (i.e., voltage fluctuation, reverse power flow and voltage level) are evaluated of the main truncal line only.
- **Level 4:** A full analysis is proposed, including feeder branches.

As part of NEPR-MI-2019-0011 PREB has provided guidelines for the distribution system planning. Included in the guidelines are:

- **Guiding principle 3: Availability of Information**, aims to create useful information for consumers to facilitate and expedite the interconnection of distributed generation, i.e., voltage and interconnection capacity of feeders.
- **Guiding principle 7: Flexibility**, suggest the use of optimal approach to enhance the implementation of technology and software to improve the operation, maintenance and restoration of the system.

[1]NEPR-MI-2019-0011 Principles Applicable to the Planning of the Distribution System. Resolution and Order

Adequate and updated data, i.e., system topology, equipment and system condition data, are paramount to address this principle.

LUMA and PREPA understand the goal to provide DER developers with progressive system visibility. Integration of renewable resources brings important opportunities and challenges to the utility. Hosting capacity is known as key information to assist developers in targeting areas where DG integration may potentially be cost effective, and utility planners in quickly assessing area planning should levels of DG penetration increase. Hosting capacity is generally defined as the maximum amount of DER capacity that can be interconnected to a distribution feeder or node without creating problems or violations for the system operator, such as (among others) reverse power flow, equipment overload and voltage violations. According to the Electric Power Research Institute (EPRI), hosting capacity is the amount of DER that can be accommodated without (i) adversely affecting power quality or reliability under current configurations and (ii) without requiring infrastructure upgrades.

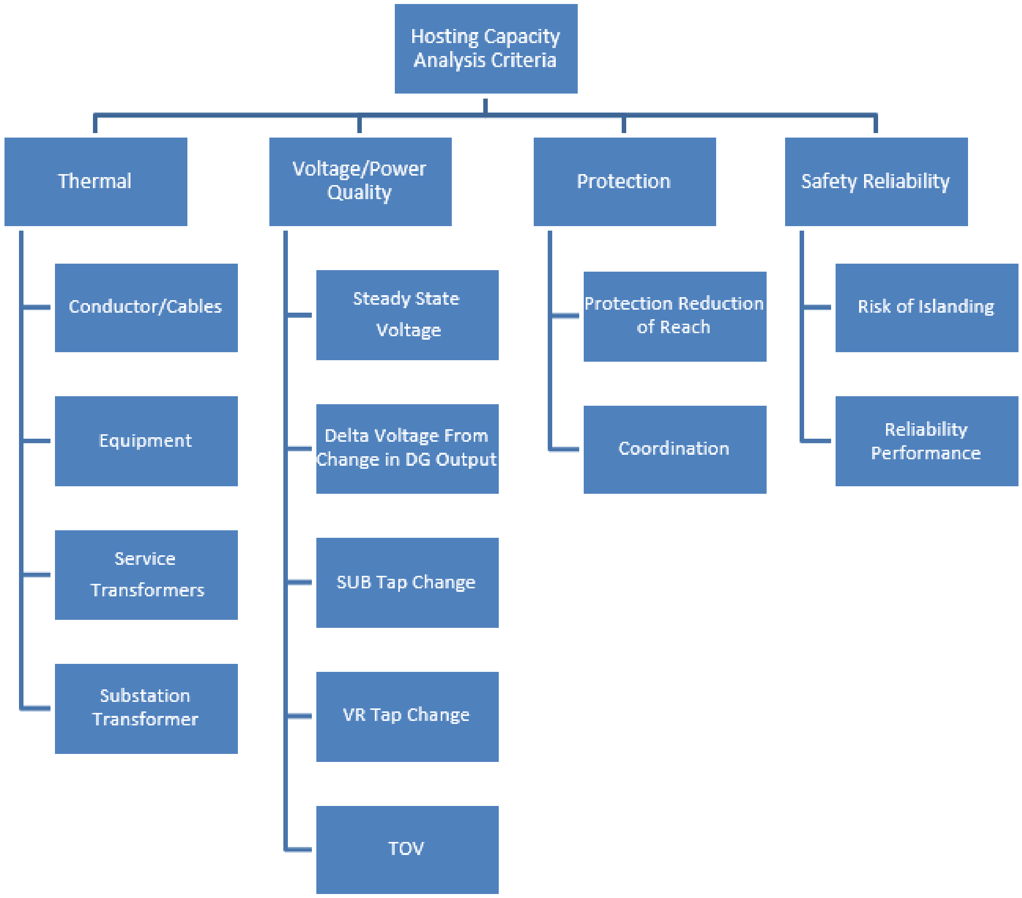
LUMA plans to build the capabilities required to automate and periodically enhance these analyses as more data becomes available and as DG penetration levels increase. Figure 0-1 shows a long-term conceptual framework for DG hosting capacity evaluation. This framework includes potential optional criteria that eventually may become part of standard DG hosting capacity analyses. In the early stages of DG adoption, evaluation of thermal limits and voltage levels are the priority, but as penetration levels grow, other aspects, such as protection systems and interaction with sub-transmission and transmission systems, become increasingly relevant.

The execution responsibilities for the workplan have been defined as following:

Table 0-1. Work Plan Responsibility

Order — Description	Responsible
Voltage Level Map	PREPA
Preliminary Maps of Interconnection Capacity	LUMA
Power Grid Inventory	LUMA

Figure 0-1. Progressive Hosting Capacity Analysis



1.0 Order 1: Voltage Level Map

As stated in Order 1, PREPA must create digital maps that show the geographical route of all the primary power distribution feeders across Puerto Rico, including Vieques and Culebra. The maps will be available on PREPA's website and must be updated at least quarterly. The maps will display and contain at least the following information:

- Feeder number
- The voltage level of each feeder (4.16kV, 4.8kV, 7.2kV, 8.32kV, and 13.2kV)
- Path of each primary feeder based on the most recent geospatial information (GIS) with sufficient resolution to be able to identify its path at street level
- Identify feeders that require supplementary studies using the updated information from the document identified by PREPA on its website as the "List of Feeders that Require Supplementary Studies and Supplemental Areas"

The following steps are necessary to develop web-accessible heatmaps, detailing known voltage classes by area defined by PREPA circuits, and intended as a preliminary application as LUMA develops Order 2.

- **GIS layer of voltage levels by feeder**: PREPA will maintain a layer of the GIS system with each feeder's voltage levels. These levels are 4.16kV, 4.8kV, 7.2kV, 8.32kV and 13.2kV.
- **GIS layer with feeders that require supplementary studies**[2]: Update and publish over the internet a GIS layer with feeders that exceed 15% DER. PREPA will maintain this layer.
- Digital configurations and integrations:
  - Configure relevant PREPA applications, software APIs, and integration tools
  - Import voltage data to GIS application based on as-designs, cross-reference with circuit GIS
  - Develop/configure visualization tool to accept data from GIS and display intended solution
  - Develop GIS visualization layer presentment to PREPA web portal
  - Embed the ArcGIS Online (AGOL) solution within the appropriate PREPA web portal
  - Update AGOL license

[2] Criteria for Supplementary Study, as established in Regulation 8915 "Reglamento para Interconectar Generadores con el Sistema de Distribución Eléctrica de la Autoridad de Energía Eléctrica y Participar en los Programas de Medición neta"

2.0 Order 2: Preliminary Maps of Interconnection Capacity

As requested by PREB, a digital map will be created showing distribution feeders' layout and displaying the feeders' available capacity to host additional DG. At this stage, two interconnection capacity groups will be evaluated and displayed:

1. RUDIMENTARY INTERCONNECTION CAPACITY

For those feeders without updated or validated data (i.e., GIS, equipment, loading, DG). The rudimentary approach will evaluate the aggregate capacity of existing and queued[3] DG compared with the feeder peak demand, as follows:

$$DG\% = \frac{DG_{existing+queued}(MW)}{Feeder\ Peak\ Load(MW)}$$

A 15% threshold[4] will be used to evaluate the feeder capacity to interconnect additional DGs.

2. DISTRIBUTION FEEDER HOSTING CAPACITY:

For those feeders with updated and validated data in GIS and technical systems (i.e., feeder topology, equipment ratings, loading, DG). This approach is based on modeling, simulation, and power flow evaluation. At this stage, and in compliance with the PREB order, the evaluation will consider reverse power flow at the feeder head, thermal constraints, and voltage constraints as primary hosting capacity criteria.

Hosting capacity is an evolving concept directly depending on updated, reliable and accurate GIS and technical data. The increasing complexity and need for additional analysis are a function of the potential impacts of DG interconnection on the system, which are expected to increase as penetration levels grow. In compliance with the Resolution and Order, the criteria to be considered in this plan are within the green dashed area of Figure 2-1.

To evaluate the substation's limitations, a basic approach which compares the substation daytime light demand with the existing and queued DG aggregated by the substation will be implemented. If the aggregated and queued DG capacity is above the daytime light demand, then reverse power flow at the substation level will be considered a limiting factor to allow more DG. Such a circumstance will trigger a supplemental study for the substation and all its distribution feeders.

[3] Queued DG are defined as an approved distributed generation application pending its interconnection and enabling its net metering tariff.

[4] "Criteria for Supplementary Study," as established in Regulation 8915 "Reglamento para Interconectar Generadores con el Sistema de Distribución Eléctrica de la Autoridad de Energía Eléctrica y Participar en los Programas de Medición neta"

Implementation Plan

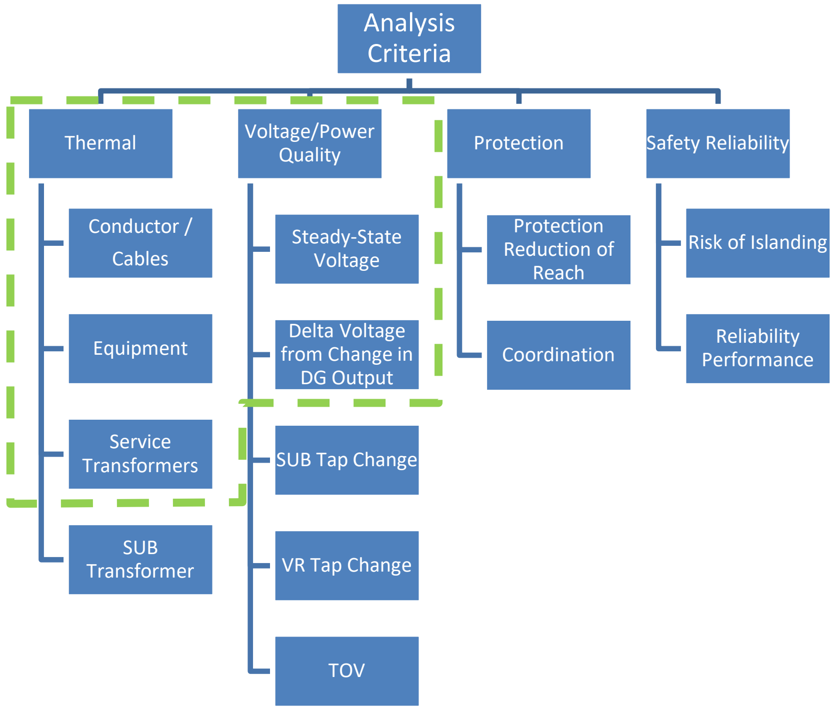


Figure 2-1. Initial Hosting Capacity Analysis Criteria (within green dashed area)

2.1 Scope of Work

The scope of work defined to carry out Order 2 considers the following tasks.

TASK 2.1. INTERCONNECTION CAPACITY CRITERIA DEFINITION

For rudimentary interconnection capacity analysis and display, the existing and queued DG capacity will be evaluated against the feeder peak demand, where 15% DG will be considered the threshold to identify whether a supplementary study is needed. Table 2-1 details the rudimentary interconnection capacity display criteria.

Table 2-1. Rudimentary Interconnection Capacity - Color Code Display

DG % Criteria	Color Code
DG < 10%	TBD
10% ≤ DG < 15%	TBD
15% ≤ DG	TBD

Feeder hosting capacity analysis and display will be evaluated via modeling and power flow simulation. The hosting capacity study will be based on the evaluation criteria identified in Figure 2-1. and defined in Table 2-2.

Table 2-2. Hosting Capacity Analysis Criteria

Detail	Criteria
Reverse power flow (kW) at feeder head	No reverse power flow
Conductor/cable thermal loading	100% cable/conductor normal rating
Equipment thermal loading	Ignore rating of fuses, sectionalizers, and switches
Voltage limitations (ANSI standard). 120 V base	Max = 126 V (1.05 p.u.) Min = 114 V (0.95 p.u.)
Voltage regulator settings	124 V, 2 V bandwidth or as set in the field
Capacitor bank settings	Fixed or as set in the field
Existing DG settings	Power factor = 1
DG capacity drop for delta voltage analysis	From 100% to 5%
Delta voltage limits (IEEE Std. 141, local standard)	3%

The hosting capacity display will be based on available feeder section hosting capacity ranges and color-coded as defined in Table 2-3.

Table 2-3. Hosting Capacity Ranges and Color Code Display

Hosting Capacity	Color Code
DG < 300kW	TBD
300kW ≤ DG < 1,000kW	TBD
1,000kW ≤ DG < 3,000kW	TBD
3,000kW ≤ DG < 5,000kW	TBD
5,000kW ≤ DG	TBD

TASK 2.2. DG DATA AND PROCESS

All available distributed generation information will be collected from several sources, including the PREPA DER Access database for customer service, DER database, DER data from GIS, and PREPAEE data. Existing and queued DG will be consolidated for each distribution feeder.

The available information of existing and queued DG will be classified per distribution circuit. This data will be used to estimate the percentage of existing and queued capacity per feeder.

TASK 2.3. LOADING DATA AND PROCESS

Currently, for 90% of distribution feeders, only single-phase (typically phase A) reading capability is available. Data is collected at 20-second intervals at the feeder head level. Five percent of distribution feeders have three-phase readings collected for DER interconnection technical studies using portable recording devices. These devices are installed at the feeder head for windows of approximately two weeks. Readings consider volts, MW, and MVar, or amps and MVA. The remaining 5% of feeders do not have reading capability

For those feeders with single-phase readings, a rudimentary interconnection capacity analysis will be performed. One-year data will be processed from the collected 20-second interval load profile. The following subtasks will be conducted:

- Converting the data to hourly resolution and assumed to be a three-phase balanced load
- Cleansing the hourly load profile of data outliers (e.g., outage, transients, errors, etc.)
- Identifying feeder peak and light daytime demand
- Evaluating peak demand against existing and queued DG

For those feeders with three-phase readings, the peak and light load identification will begin first with a cleansing process of the load profile, followed by the decoupling of existing DG expected production. The decoupled load will then be allocated in the Synergi modeling process for hosting capacity analysis.

TASK 2.4. MIDTERM PROJECT REVIEW

A midterm workshop will be conducted to ensure the agreed upon criteria and analyses are met throughout the project execution. If needed, criteria, schedule and resources will be revised accordingly.

TASK 2.5. RUDIMENTARY INTERCONNECTION CAPACITY DATA PROCESS

For those feeders without updated or validated data, the existing and queued DG capacity will be aggregated and processed against the feeder peak load. The analysis result will be tabulated to create the interconnection capacity as defined in Table 2-1.

TASK 2.6. COLLECT GIS DATA

Two main objectives are identified in this task:

- Review the GIS data attribute defined in Order 1 (Voltage Level Maps) and add up the interconnection capacity results from the rudimentary interconnection capacity analysis (Task 2.5).
- For those feeders with updated and validated data in GIS and technical systems, collect the updated GIS data to perform the hosting capacity analysis via power modeling, simulation, and analysis. The data will be considered updated when the following minimum characteristics are covered:
  - Clean feeder connectivity
  - No missing conductor/cable cross-sections and length
  - Identified phasing
  - No missing equipment rating and control settings (i.e., voltage regulators and capacitor banks)
  - No missing service transformer nameplate

TASK 2.7. MODELING AND SIMULATION

Modeling and simulation are for feeders with updated data. PREPA has upgraded the GIS to Synergi modeling capability, which will enhance and optimize the modeling process. Model conditioning will be required when basic power flow calculations identify voltage level and/or thermal capacity values far from typical values.

Once the feeders are conditioned, hosting capacity analyses in Synergi will be carried out. The use of Python scripts will be required since this is a highly iterative process. The output from the power flow models often needs post-processing to translate them into a format that GIS map applications can process and display based on the defined criteria included in Table 2-2 and Table 2-3.

The rudimentary approach to evaluate the substation limitation will compare the substation daytime light demand with the aggregated existing and queued DG, as follows:

$$Factor = \frac{DG_{existing+queued}(MW)}{Aggregated\ SUB\ daytime\ minimum\ load(MW)}$$

If the factor is 1 or more, then reverse power flow at the substation level limits the substation capacity to the interconnection of additional DG. A supplemental study request will be triggered.

In addition to the hosting capacity values for display, the following data will be consolidated on a per-feeder basis in a drop-down menu window:

- Substation ID
- Feeder ID
- Feeder peak demand (MW)
- Feeder daytime light demand (MW)
- Aggregated existing DG (MW)
- Aggregated queued DG (MW)
- HC limiting factor (e.g., overvoltage, $\Delta V>3\%$, thermal capacity, reverse power flow)
- Substation - HC limiting factor (i.e., reverse power flow)

TASK 2.8. UPDATE INTERACTIVE MAPS

With all processed data, the existing mapping application (from Order 1) will be updated with the rudimentary interconnection capacity for feeders with outdated data and feeder hosting capacity for feeders with updated and validated data.

TASK 2.9. REPORT PREPARATION

To ensure continuity and consistency on the project execution framework for quarterly updates, the project team will document the process of carrying out the study, comprising criteria definition, assumptions, mechanical calculations, and map display updating.

2.2 Quality Control

LUMA implements quality control (QC) and quality assurance (QA) as an integral part of business processes to ensure the highest quality. QC/QA procedures help ensure all defined and agreed upon criteria are met throughout the analysis and map displaying. Senior LUMA team members will also perform QC/QA to ensure criteria and mitigation practices are followed and implemented consistently.

2.3 Project Resource Roles and Responsibilities

The project will be sponsored by LUMA's Director of Asset Management, Darrell Wilvers, and led by the Specialist Engineer in Distribution Planning, Alex Nassif. Key project stakeholders include the PREPA Manager of Distribution Planning, Tomas Velez, and the Director of IT, Hiram Medero. Team consistency is important across tasks dealing with business aspects. Table 2-4 captures the roles and responsibilities for key personnel specifically working on the Order 2 plan.

Table 2-4. Order 2 RACI

Task		D. Wilvers	A. Nassif	H. Bashualdo	G. Sanchez	T. Velez	H. Medero
2.1	Interconnection capacity criteria	I	R	C	R		
2.2	DG data and process	I	A	C	R	C	
2.3	Loading data and process	I	A	C	R	C	
2.4	Midterm project review	I	R	A	R	R	R
2.5	Rudimentary interconnection capacity	I	A	C	R		
2.6	Collect GIS data	I		C	R		A
2.7	Modeling and simulation	I	A	C	R	C	
2.8	Update interactive maps	I	R	C	R	C	C
2.9	Report preparation	I	R	C	R		
2.10	Final project and report review	I	R	A			

R: Responsible for performing the task or creating the document
A: Accountable for the task or document delivery
C: Provides consulting or expertise to the person responsible for the task or document
I: Informed of task progress or results, usually by the person responsible

3.0 Order 3: Power Grid Inventory

In response to PREB 2019-0011 Order 3, LUMA has investigated the collection of the following data:

- The geographic position of distribution mainline circuits and service transformers
- The availability of SCADA operational information for the distribution system
- The availability or absence of information about customer demand profiles, per feeder
- The identification of DERs existing on the network, categorized by:
  - Type of resource
  - Operational capacity
  - Distribution feeder
- The typical daily profile of the services provided by DERs
- The identification of the state and useful remaining life of service transformers and distribution substations
- The identification of technical and non-technical losses per distribution feeder
- The identification of physical and cyber vulnerabilities of each distribution substation and associated protection yards
- The identification of feeders that:
  - Supply critical loads
  - Supply priority loads
  - Are considered candidates for supplementary interconnection studies
- The location, state, and joint use, as applicable, of each distribution pole

Overall, Order 3 has 10 subtasks, and each one involves the collection of different types of data. Generally, each subtask's work will proceed according to the following framework:

- **What data is available:** Assess the availability of data in PREPA's existing systems.
- **How to store the data (what is the deliverable):** Determine how the data should be stored to accomplish this order (e.g., a GIS field, a database, etc.). Create the necessary templates and frameworks.
- **Assemble available data:** For data available in existing systems, collect and input it into the selected storage method.
- **Collect unavailable data:** For data that is not available, create a plan to collect it. Where there are synergies, align with other existing data collection efforts.

Some data types are relatively easily available, but some will require lengthy data collection and verification efforts across the electric system. For the data types that require lengthy collection efforts, LUMA has multi-year plans, presently pending approval, to collect and verify asset data across the electrical system and enter it into GIS and a computerized maintenance management system (CMMS). It is recommended for cost and labor efficiencies to align all of Order 3's lengthy system-wide data collection efforts with the existing data collection and verification plans. However, these plans are multi-year and will not be complete by 2021. Details are given in each specific item below where there is such a recommendation.

The various types of data and information requested may have different ideal storage solutions, according to industry best practices and available enterprise / operational systems. For example, some may best be stored in GIS, whereas others may be better stored in planning or security documents. In most of the sub-tasks, key stakeholders will meet to determine the best storage solution.

It is assumed that the order is requesting data collection and storage but not data publishing. If is further assumed that PREPA has enough licenses for all systems to be used in the collection and processing of this data, such as GIS, Pi Historian and Synergi.

3.1 Scope of Work

The following tasks will be executed to comply with Order 3.

TASK 3.1. GEOGRAPHIC POSITION OF THE CIRCUITS AND SERVICE TRANSFORMERS THAT MAKE UP THE SYSTEM

Much of this circuit and service transformer location data is presently available in PREPA's GIS. However, approximately 95% of this data requires field verification. The verification of this data is a very time- and labor-intensive task.

LUMA has a multi-year plan, presently pending approval, to collect and verify asset data and enter it into GIS and a CMMS. This plan covers distribution circuit and service transformer positions and is within the Distribution Lines Inspection Program. The proposed strategy involves accomplishing this goal during data collection to take advantage of synergies and reduce the need for costly repeat site visits. As much as possible within the constraints of the Distribution Lines Inspection Program's plans, this data collection will be carried out on a region by region basis. Details will be determined during the execution of this task.

GIS data experts from LUMA and PREPA will jointly cooperate in assessing the availability of data and its quality. If data is available from local or federal agencies, then it will be included in the assessment. This team will identify gaps and incorporate them into the data collection and verification plans LUMA has in place. This task's work plan will be continually adjusted to align with any Distribution Lines Inspection Program changes.

Note that this goal is planned to be accomplished simultaneously with Task 3.6. Identification *of the state and useful remaining life of service transformers and distribution substations*) and Task 3.10. *The location, state, and joint use, as applicable, of each distribution pole)*, as both can leverage the data collection efforts.

TASK 3.2. VISIBILITY LEVEL AND AVAILABILITY OF OPERATIONAL INFORMATION OF THE DISTRIBUTION SYSTEM

The PREPA SCADA database will contain this information. Any existing SCADA engineering documentation, such as point lists, may also contain this information.

The project team (SCADA experts from LUMA and PREPA) will assemble a list of distribution devices and what data is available for each in the SCADA system. If data is available from local or federal agencies, then it will be included in the assessment. This will be done by examining the SCADA database and SCADA engineering documentation, such as point lists. GIS experts within LUMA and PREPA will determine how to represent this information, such as a GIS field or some other method. The project team will implement the GIS team's selected method and enter the data collected.

TASK 3.3. THE AVAILABILITY OR ABSENCE OF INFORMATION ABOUT THE DEMAND PROFILE OF CUSTOMERS

PREPA's Pi Historian has single-phase feeder telemetry data recorded by SCADA. There may be other data sources available to supplement this, such as planning documentation or metering data. Due to the level of SCADA penetration in the distribution system, this data will likely be available only at the level of individual feeders.

This order is assumed to be only requesting that we note the presence or absence of demand profile data. Producing the profiles is assumed to be out of scope.

SCADA, planning, and metering (as applicable) experts from LUMA and PREPA will assess historical demand data availability. If data is available from local or federal agencies, then it will be included in the assessment. This team will determine where there is sufficient data to establish a profile. Also, GIS experts within LUMA and PREPA will determine how to represent this information, such as a GIS field or some other method. The project team will implement the GIS team's selected method and enter the data collected.

TASK 3.4. THE IDENTIFICATION OF DERS EXISTING ON THE NETWORK, CATEGORIZED BY (I) TYPE OF RESOURCE, (II) OPERATIONAL CAPACITY, (III) DISTRIBUTION FEEDER

PREPA has this information available, across multiple sources, including GIS, a planning database, and a customer service database. Some information may be incomplete. For example, a customer service database may not have operational capacity, and some DERs may not be in all databases.

The project team (GIS and planning experts from LUMA and PREPA) will determine the best method to store this data, with the intent of ensuring a single source of truth (e.g., modeled in GIS). They will then collect and consolidate the data from multiple sources and identify gaps requiring field checks or other research. Field checks or other data collection efforts required to collect the missing data will be executed. All of this data will be entered into the selected storage method.

TASK 3.5. THE TYPICAL DAILY PROFILE OF THE SERVICES PROVIDED BY THE DERS

It will be assumed that all PV and wind generators within each region have identical resource profiles. CHP units will be assumed to have constant power output equal to their capacity factor. There will be no validation at this stage. No-load flow modeling will be used; rather, a calculation in Python, Matlab, or similar will be used to create these profiles. The profiles will be provided with hourly resolution.

The project team (SCADA, planning, and metering experts from LUMA and PREPA) will create a DER profile on a per-region basis. If data is available from local or federal agencies, then it will be included in the assessment. This team will create a PV generation profile, on an hourly basis, for each of its regions based on a widely accepted database, such as that provided by NREL/NASA. The same approach will be used for wind resource profiles. Combined heat and power (CHP) will be addressed using a similar approach, but assuming generation is constant and equal to their yearly capacity factor.

GIS and planning experts from LUMA and PREPA will determine whether this information should be stored in GIS or another method and enter the data into the selected method.

TASK 3.6. IDENTIFICATION OF THE STATE AND USEFUL REMAINING LIFE OF SERVICE TRANSFORMERS AND DISTRIBUTION SUBSTATIONS

The transformer life of service depends on several variables, such as ambient temperature, humidity levels, power outages, overvoltages, and serviced load profile. The proposed strategy for determining useful remaining life is to take the manufacturing date to calculate the asset's life. This life will be compared against the asset's life expectancy, using either internal data, if available, or otherwise, industrial typical life expectancy, ranging from 25 to 40 years.

PREPA has some of this manufacturing date information for substations available in the Microsoft Access asset database.

The project team will assess the availability of manufacturing date data in GIS and asset databases. If data is available from local or federal agencies, then it will be included in the assessment. Where manufacturing date data is available, it will be used directly to calculate the asset age. For any gaps, asset age will be determined by field check performed during the data collection and verification plans as described for Task 3.1. If a quick rudimentary estimate is more important than accuracy, then the age can be estimated using an average of nearby assets. From this age information, the useful remaining life will be calculated.

TASK 3.7. THE IDENTIFICATION OF TECHNICAL AND NON-TECHNICAL LOSSES PER DISTRIBUTION FEEDER

At present, the rudimentary report of constant loss factors proportional to peak load will be reported. The continuous improvement of loss evaluation processes is in LUMA's long-term vision. Initially, LUMA will carry out simple estimated technical loss calculations. As the data quality improves and is validated, LUMA will transition to a model-based loss calculation. The identification of non-technical losses will be handled through a separate program.

The project team will assess existing information availability, identify gaps, and perform the required calculations to fill the gaps. GIS experts from LUMA and PREPA will work together to determine whether this information should be stored in GIS or another method (e.g., a planning document) and enter the data into the selected method.

TASK 3.8. IDENTIFICATION OF PHYSICAL AND CYBER VULNERABILITIES OF EACH DISTRIBUTION SUBSTATION AND ASSOCIATED PROTECTION YARDS

Through preliminary visits to a sample of substations, LUMA has assessed vulnerabilities in broad general terms. However, identification of vulnerabilities at specific substations will require detailed assessment work. This assessment work is a very time- and labor-intensive task.

LUMA has a multi-year plan, presently pending approval, to perform detailed substation assessments. This plan is within the Transmission Substation Rebuild Program. The proposed strategy is to accomplish this goal during the substation assessment work to take advantage of synergies and reduce costly repeat site visits. As much as possible within the constraints of the Transmission Substation Rebuild Program's substation assessment plans, this data collection will be carried out on a region by region basis. Details will be determined during the execution of this task.

Security and asset management experts from LUMA and PREPA will identify major industry-standard physical and cybersecurity vulnerability classes and determine a process to assess each distribution substation against these classes. This team will incorporate the security assessments into the overall substation assessment work that LUMA has planned for future years. This task's work plan will be continually adjusted to align with any Transmission Substation Rebuild Program changes. Additionally, if data is available from local or federal agencies, it will be included in the assessment.

Additionally, this team will identify a proper means to store this inventoried data, appropriate to its sensitive and confidential nature.

TASK 3.9. THE IDENTIFICATION OF FEEDERS THAT SUPPLY: (I) CRITICAL LOADS, (II) PRIORITY LOADS, AND (III) FEEDERS CONSIDERED CANDIDATES FOR SUPPLEMENTARY INTERCONNECTION STUDIES

LUMA and PREPA planning team will consolidate available lists of critical and priority loads. Feeders requiring supplementary interconnection studies are those where the distributed generation penetration is 15% or greater, and this should be identified as part work on item 2.C.iv. If data is available from local or federal agencies, then it will be included in the work.

GIS and planning experts from LUMA and PREPA will determine whether this information should be GIS or another method (e.g., a planning document) and enter the data into the selected method.

TASK 3.10. THE LOCATION, STATE, AND JOINT USE, AS APPLICABLE, OF EACH DISTRIBUTION POLE

See Task 3.1. We will follow a similar process, including leveraging the multi-year data collection plan, to accomplish this goal.

3.2 Project Resource Roles and Responsibilities

The project will be sponsored by LUMA's Director of Asset Management, Darrell Wilvers, and led by the Senior Engineer in Asset Management, Chris Loo. Key project stakeholders include PREPA's Manager of Distribution Planning, Tomas Velez, and the Director of IT, Hiram Medero. Table 3-1 captures the roles and responsibilities of key personnel.

Table 3-1. Order 3 RACI

Task		D. Wilvers	A. Nassif	C. Loo	M. Robin	J. Gutierrez	I. Reyes	S. Erb, J. Badenhorst	Field Insp. Crew	GIS Supervisor	T. Velez	N. Simonetti (or	O. Soto
3.1	Geographic position of circuits and service transformers	I	R	A	R				R	R		C	
3.2	Visibility level and availability of operational information of the distribution system	I		A	C	R		C		R			C
3.3	Availability or absence of demand profile information	I	R	A	C	C		C		R	C		C

Implementation Plan

Task		D. Wilvers	A. Nassif	C. Loo	M. Robin	J. Gutierrez	I. Reyes	S. Erb, J. Badenhorst	Field Insp. Crew	GIS Supervisor	T. Velez	N. Simonetti (or	O. Soto
3.4	Identification of DERs, categorized by type of resource, operational capacity, and distribution feeder	I	R	A	R			C		R	C		
3.5	Typical daily profile of DER services	I	R	A	C	C		C		R	C		C
3.6	Identification of state and remaining life of service transformers and distribution substations	I	R	A	R			C	R	R	C	C	
3.7	Technical and non-technical losses	I	R	A	C			C			C		
3.8	Physical and cyber vulnerabilities of distribution substations	I		A	C		R	R	R				
3.9	Critical loads, priority loads, and candidates for supplementary interconnection studies	I	R	A	C					R	C		
3.10	Location, state, and joint use of each distribution pole	I	R	A	R				R	R		C	

R: Responsible for performing the task or creating the document
A: Accountable for the task or document delivery
C: Provides consulting or expertise to the person responsible for the task or document
I: Informed of task progress or results, usually by the person responsible

Some of this work may be outsourced as workload requires.

3.3 Project Schedule

Table 3-2 provides a summary of year-end deliverables. Details are given in the Gantt chart in section 5.

Table 3-2. Summary of Year-End Deliverables

Sub-Project	2021	2022	2023	2024	2025	2026
3.1 Circuit and Transformer Position	◔	◔	◔	◔	◔	●
3.2 Visibility of Operational Information	●					
3.3 Demand Profile Availability	●					
3.4 DER Data	●					
3.5 DER Profiles	●					
3.6 Transformer and Substation Life	◔	◔	◔	◔	◔	●
3.7 Losses	●					
3.8 Vulnerabilities	◔	◔	◔	◔	●	
3.9 Critical Loads and Supplementary Studies	●					
3.10 Distribution Poles	◔	◔	◔	◔	◔	●

Notes:

● Completely delivered

◔ Partially delivered

4.0 Cost

The project cost, estimated to be $1,266K, is planned to cover the project execution from February to December 2021. The required budget from January 2022 onward is not considered in the current cost estimation. It will be coordinated and financed with related projects that LUMA has incorporated into the 10-year operating expenditure plan.

PREPA will be responsible for executing and financing Order 1.

LUMA will be responsible for executing Orders 2 and 3.

- Order 2: Will be delivered by September 30, 2021.
- Order 3: Six of the ten sub-projects will be delivered by December 31, 2021. Four are multi-year efforts, as detailed in the Section 3 project schedule.

Table 5.1 depicts the forecast project cost from February until December 2021. It consists of two stages:

- Stage 1: To be executed during the front-end transition period with an estimated cost of $814K. From the estimated cost, $614K is not included in the current forecasted front-end transition budget.
- Stage 2: To be executed after the commencement date with an estimated cost of $452K, funded with LUMA's annual budget[5].

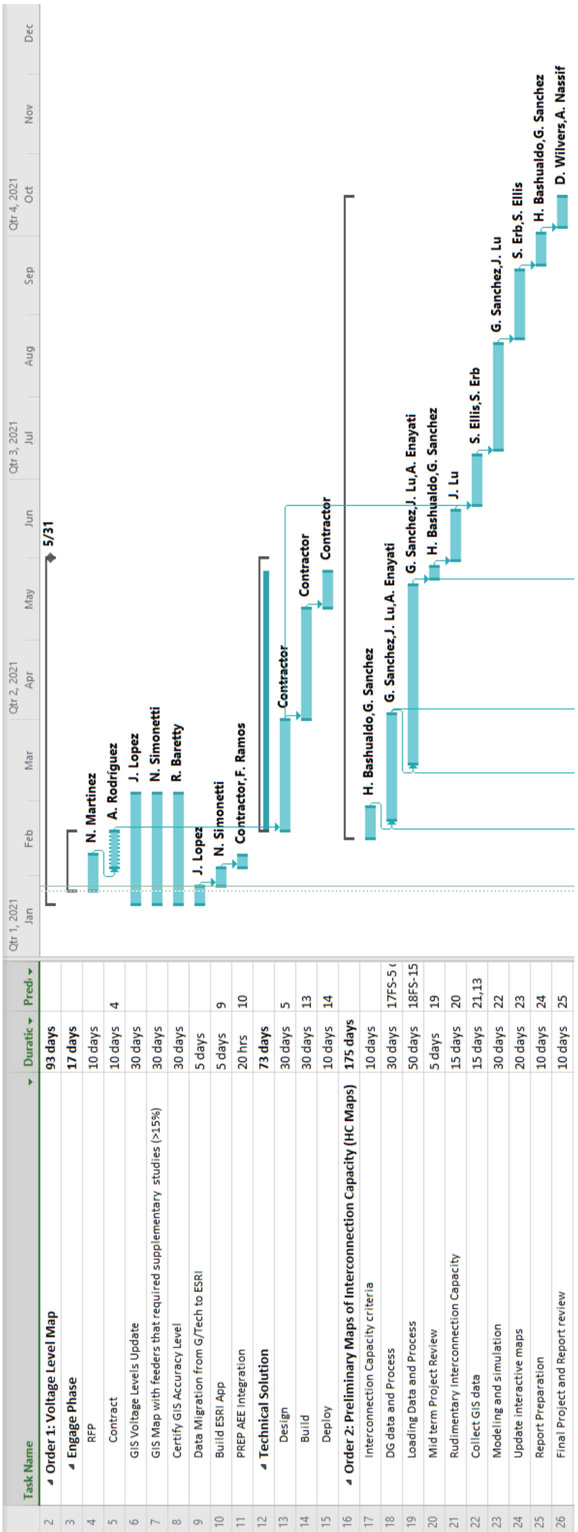
Table 4-1. Project Cost Estimation

Order	Stage 1 Front End Transition Period ($ thousands)	Stage 2 Post Commencement Period until Dec 31, 2021 ($ thousands)	Responsible
Order 1	$200		PREPA
Order 2	$332	$257	LUMA
Order 3	$282	$195	LUMA
Total	$814	$452	

[5] LUMA's Inspection Program Plan

5.0 Schedule

ORDERS 1 AND 2



Implementation Plan

ORDER 3

	Task Name	Duration	Predecessors
27	**Order 3: Power Grid Inventory**	**1544 days**	
28	**3a Geographic position of circuits and service transformers**	**1544 days**	
29	Assess quality of circuit and service transformer position data in GIS; identify gaps.	43 days	
30	Coordinate data collection efforts with GIS data collection and verification plan.	22 days	
31	Collect missing data.	1370 days	
32	Aggregate and enter data into the selected storage medium.	1370 days	
33	**3b Visibility level and availability of operational information of the distribution system**	**174 days**	
34	Assess availability of SCADA visibility information.	43 days	
35	Determine preferred method for storing data (GIS field, other database, etc.).	23 days	
36	Collect visibility data.	22 days	
37	Enter data into the selected storage medium.	66 days	
38	**3c Availability or absence of demand profile information**	**144 days**	
39	Determine preferred method for storing data (GIS field, other database, etc.).	23 days	19SS
40	Collect availability data. (coordinate with 3.5.x)	22 days	19
41	Aggregate and process data into the selected storage mediun	45 days	
42	**3d Identification of DERs, categorized by type of resource, operational capacity, and distribution feeder**	**159 days**	
43	Assess DER information available in GIS and other source - coordinate with order 2	43 days	18SS
44	Collect DER data - coordinate with order 2.	65 days	18
45	Enter missing data into GIS	45 days	
46	**3e Typical daily profile of DER services**	**174 days**	
47	Assess DER profile information.	43 days	
48	Determine preferred method for storing data (GIS field, other database, etc.).	23 days	
49	Collect and calculate DER profile data. (coordinate with 3.3.x)	43 days	
50	Enter profile data into the selected storage medium.	66 days	
51	**3f Identification of state and remainig life of service transformers and distribution substations**	**1544 days?**	
52	Assess available asset data (GIS, MS Access, etc.)	43 days	
53	Determine preferred method for storing data (GIS field, other database, etc.).	23 days	
54	Coordinate data collection efforts with GIS data collection and verification plan.	22 days	
55	Collect missing data.	1370 days	
56	Aggregate and process data into the selected storage mediun	1370 days