FEMA Project Scope of Work

Project Name:

Test and Technology Laboratory

Revision: 0

Date: April 1, 2022

APPROVALS

The signatures below formally approve the FEMA Project Scope of Work Template.

Grant Manager's Name	Signature	Date
[redacted]	[redacted] 2022.04.08 14:19:10 -04'00'	
Department VP's Name	**Signature**	**Date**
[redacted]	[redacted] Date: 2022.04.28 15:45:13 -04'00'	

Document Change Control

This table contains a history of the revisions made to this document

Rev.	Date of Issue	Brief Description of Change
0	01APR2022	Issued for use

Contents

Overview

Project Name:	Test and Technology Laboratory
Project Type:	Restoration to Codes/Standards
Region:	San Juan
Damage Number:	223318
Damaged Inventory/Asset Category:	Other
FEMA Project Number: *(formerly Project Worksheet)*	<Provided by FEMA>

Introduction

The purpose of this document is to present and update a Project Scope of Work (SOW) with Cost Estimates to be submitted to COR3 and FEMA for projects under DR-4339-PR Public Assistance. The completed document will be reviewed by COR3 and FEMA to create and version a specific project worksheet and post fixed-cost estimates to repair, restore, or replace eligible facilities including Section 406 hazard mitigation for a specific project.

LUMA Energy provides the Operations and Maintenance of the electric service to the entire island of Puerto Rico. Puerto Rico Electric Power Authority (PREPA) is the agency that owns the facilities, sites, and systems identified in this Scope of Work that are eligible as critical services facilities as defined in the PAAP (Section 428) and BBA 2018 guidance documents.

This document will be updated with information developed during the initial design and engineering phase through the construction phase.

Facilities

Facilities List

Name	Number	GPS Coordinates	Voltage (kV)
Santurce - [redacted] Building - Basement Area	N/A	[redacted]	NA

The basement of [redacted] Building - in the Santurce administration complex has been preliminarily assigned for the laboratory facility. The assigned spaces are depicted below with a total area of approximately 14,000 sq ft of interior space (Figure 1). Site improvements in surrounding outdoor area are also planned to enable deployment and interconnection of power equipment under test. Additional area of around 4,500 sq ft will be needed at separate facility for distribution apparatus pre-commissioning HV related testing. The selection of that facility is in process.

During detailed engineering locations may change to fit project needs.

[redacted]

Figure 1 - [redacted] Areas Assigned to Test Lab

Facilities Description

Test and Technology Laboratory

The main Test and Technology Laboratory will be housed within an existing PREPA owned facility ([redacted] building is identified as preliminary location). The assigned existing space (~14,000 sq ft) will be reconfigured for proper operation of the test laboratory. The lab facilities will include:

- Adequate space with electrical, mechanical, plumbing and telecommunications facilities to enable operation of advanced electronic test instruments.
- Access to equipment delivery area with pathways and ramps required to accommodate equipment.
- Local Area Network (LAN) infrastructure with proper security features.
- Connectivity to the various communications networks used throughout LUMA with adequate cybersecurity provisions.
- Physical security systems.
- Fire protection systems.
- Storage spaces including space to house an emergency cache of critical and tested components to be deployed in the event of a major service disruption.
- Meeting and training facilities

Distribution Apparatus High Voltage (HV) testing laboratory

A separate test facility will be required for performing pre-commissioning high voltage (HV) related testing of distribution apparatus (Reclosers, Voltage Regulators, Switchgear, etc.). That adjunct test facility needs around 4,500 sq ft. and will Include:

- Adequate space with electrical, mechanical, plumbing and telecommunications facilities to enable operation of high voltage and related test equipment.
- Local Area Network (LAN) infrastructure with proper security features.
- Connectivity to the various communications networks used throughout LUMA with adequate cybersecurity provisions.
- High Voltage Test Cage (Figure 3 shows an example)
    - De-Energization interlock on cage entry door(s)
- Jib Crane
- Indoor Location
    - Flat concrete floor – no cracks. No slope. Non-slip coating throughout (Epoxy or similar Oil/Slip Resistant)
    - Two overhead doors (drive through building)
    - Running water/sewer/restroom(s)
    - Climate controlled
    - Large concrete aprons outside overhead doors (smooth for forklifts when slinging Regulators/Reclosers on/off trailers)
- High voltage & high current access for test purposes – including all distribution voltages present in Puerto Rico
- Forklift for moving electrical Apparatus (Voltage Regulators, Reclosers, Fuse cabinets, etc.)
- Indoor & Outdoor (Galvanized) Racking for storing electrical Apparatus (Voltage Regulators, Reclosers, Fuse cabinets etc.)
- Physical security systems.
- Fire protection systems.
- Storage spaces

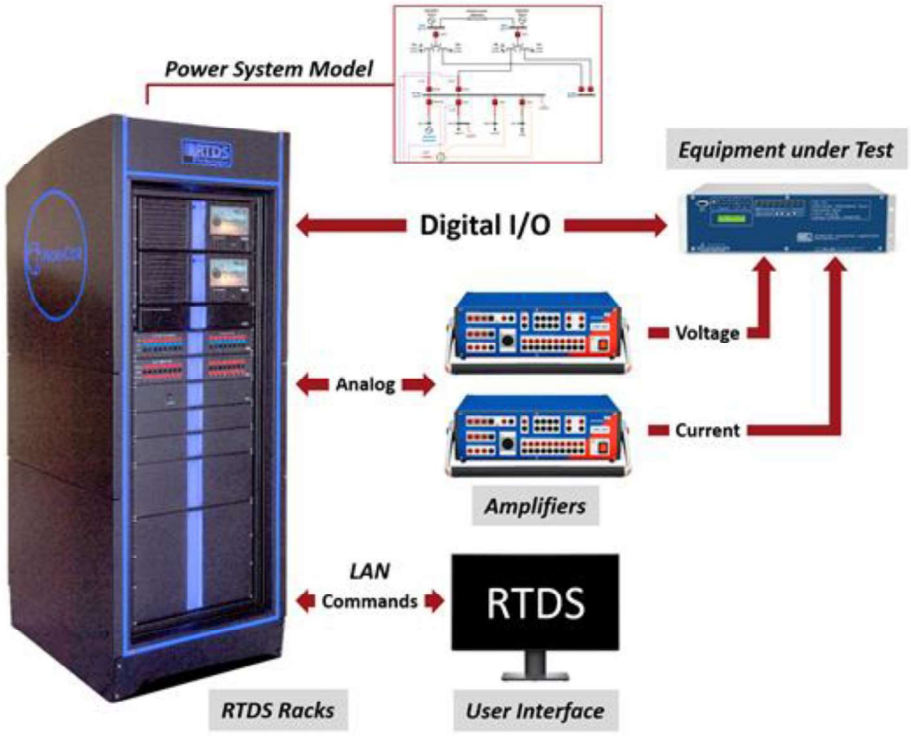

Figure 2 - Test Bed with Real Time Simulation

Length: 28 ft., Width: 16 ft., Height: 10 ft.

Figure 3- Faraday Cage for High-Voltage test Area

Project Scope

Rebuilding a hardened and resilient Puerto Rico's power system includes the deployment of modern technology solutions (hardware / software) and complex processor-based systems that require proper testing and validation before putting in service. A state-of-the-art testing laboratory will enable the proper implementation of new protection, control, and automation (PAC) schemes by testing performance, system integration and impact on the grid.

The reconstruction efforts on the island also need to align with requirements of local laws and regulations that mandate aggressive renewable integration targets as well as Transmission and Distribution Infrastructure hardening for reliability and resilience improvements. Designs need to support adequate integration of renewable energy (RE) and distributed energy resources (DERs) including energy storage systems (ESS) and microgrids at transmission and distribution levels, while maintaining system integrity and stability. This is only possible with the use of upgraded relay protection and control systems, and a wide range of smart grid technologies including smart sensors, controls, and communications, that require adequate testing for system design optimization and performance validation.

A critical component of the system recovery is the extensive deployment of new power apparatus in the distribution system including reclosers, voltage regulators, switchgear, fuses, tripsavers, and other elements that require high voltage and related testing prior to field installation. This type of testing routines is regular utility practice and focused on improvement of reliability by detection of hidden failures before putting in service. As part of the reconstruction effort LUMA is planning to deploy an average of 500 reclosers and 750 tripsavers per year. The project scope includes the deployment of an adjunct Distribution Apparatus High Voltage (HV) testing laboratory identified as a critical need to enable best practices in the distribution system reconstruction efforts.

Laboratory Deployment Process

The laboratory test system deployment requires a sequential process that includes:

- Definition of test use cases
- Test bed design, specification, and selection of test equipment
- Lab set up and configuration design
- Equipment and associated services procurement
- System deployment and Integration
- Commissioning
- Training and Initial test project support

The Test and Technology Lab will also support training of utility personnel on smart grid technologies used for Substation Automation, Distribution Automation, Advanced Metering, and Renewable Integration.

The Distribution Apparatus High Voltage (HV) testing laboratory will be used for related training of field personnel.

Test Equipment

A preliminary list of equipment needed in the Test and Technology Lab facility is presented below.

1. Equipment, instruments, benches, and accessories for testing intelligent electronic devices (IED) including smart sensors, relays, telecommunications equipment, controls, remote terminal units (RTU) and meters, to validate performance, accuracy, compliance, functionality, and proper programming of protection, automation, and control standard schemes.
    - Protection and control test sets (to include IEC 61850 testing functionality).
    - Test Instruments and tools needed for developing and testing of new PAC standard schemes.

- IED racks and other standard substation IED panels with typical in-service PAC configurations, and communications equipment.
- Power supplies, amplifiers, test sets accessories.
- Tools for recalibration of measurement instruments
- Typical power devices for protection and control integration testing (smart inverters, batteries).
- Test and simulation software and supporting hardware.

2. Telecommunications test beds with IT/comms equipment (routers, switches, multiplexers, etc.) and time synchronization devices (GPS) to enable testing of IED communications interfaces and end-to-end performance testing over fiber and radio links.
3. Real-Time Digital Simulation (RTDS) Equipment for hardware-in-the-loop (HIL) testing of protective relays, digital controllers and process control devices for system level testing, performance evaluation and pre-commissioning testing under close to real world conditions. RTDS testing is able to interact with the system under test in real time and thereby find weaknesses and problems as they would appear in the applications, allowing them to be resolved before they cause any mis-operation in the power system. This will support design optimization for Transmission and Distribution infrastructure reliability and resilience. Typical RTDS test applications are:
    - End-to-end protection, automation, and control scheme testing
    - Interoperability and conformance testing
    - Real-time testing of Remedial Action Schemes (RAS)/Special Protection Systems (SPS)
    - Testing of Phasor Measurement Units (PMUs)/PDCs systems
    - Testing of IEC 61850 substation automation systems
    - Testing of Communication Equipment/Systems Performance and Compliance
    - Testing of smart grid technologies with new sensor management and sensor enabled monitoring and control systems
    - Testing of renewable energy controls
    - Testing impact of Renewable Energy Generation on Protection Performance
    - Testing of Microgrid Protection and Control applications including associated communications and smart sensors technology
    - Test operations with smart inverters and other customer equipment.
    - Simulation and testing to optimize proof of concept
    - Test concepts related to various smart grid technologies
    - Post-mortem fault analysis and fault simulation.

The facility for the Distribution Apparatus High Voltage (HV) testing laboratory will as a minimum include the following test equipment:

- Single phase/three phase transformer turns ratio (TTR) test sets
- Partial discharge testing equipment
- AC Hi-pot testing equipment
- Vacuum Interrupter test set
- High Voltage Test Cage
- Electrical test instruments and tools

Space Adequation

This project Includes the adequation of approximately 18,500 square feet of laboratory space, for the installation of racks, fixtures, and all necessary test equipment.

The necessary space adequation of around 14,000 sq ft for the main Test and Technology Lab scope includes:

1. Development of functional and system requirements, list of equipment to be housed, estimate of power and cooling requirements, confirmation space Identified will support the functional requirements and supporting documentation of the equipment to be housed.
2. Development of Request for Quotations for Design Architectural / Engineering team to develop the design / renovation of the space, prepare the construction documents, obtain the construction permits and perform construction administrations services for the project.
3. Follow the RFQ process Including Issuance, response, evaluation, selection and contracting.
4. Complete the design phases of the renovation project including the Schematic Design, Design Development, and Construction Document phases.
5. Development of Request for Proposal for the Construction Team to perform the renovation work in the space to prepare the lab for occupancy.
6. Follow the RFP process including issuance, response, evaluation, selection and contracting.
7. Complete the renovation work of approximately 7,000 square feet to prepare the space to be occupied.
8. Follow the LUMA Procurement manual to procure equipment to support the mission.
9. Installation of required testing computers and simulators, racks, fixtures, and equipment based on all the current standards designs
10. Installing LAN/WAN and all needed telecommunications equipment network connections to the various data and communication networks in compliance with LUMA Cybersecurity framework.
11. Installing proper safety equipment and warning placards.
12. Installing a physical security and monitoring system.

The adequation of the adjunct distribution apparatus HV testing facility with around 4,500 sq ft of space will include a separate effort for design and construction to accommodate safe operation of HV testing hardware.

Initial deployment efforts are already under way and there is urgency in initiating testing before the lab facilities are ready for use. LUMA is seeking expedite procurement of urgently needed test equipment and will start testing on temporary facilities while the test lab areas are finalized.

The final SOW (plans and specifications) and detailed cost estimate is expected to be completed by Q4 2022 and construction is estimated to be completed by Q3 2024.

Type of Project

Indicate whether the intended plan is a(n):

1. **Restoration to Codes/Standards**: Restores the facility(s) to pre-disaster function and to approved codes/standards
2. **Improved Project**: Restores the pre-disaster function of the facility(s) and incorporates improvements including any:
    a. Other improvements, not required by codes and standards
    b. Changes in facility size, capacity, dimension, or footprint
3. **Alternate Project:** Does not restore the pre-disaster function of the damaged facility(s)

Choose One (Restoration, Improved or Alternate) If improved, provide the changes in facility size, capacity, dimension, or footprint. If alternate, provide rationale for recommendation.
Restoration to Codes/Standards
Rebuilding Puerto Rico's power system includes the deployment of technology solutions (hardware/software) that require proper testing and validation before putting in service in compliance with approved codes and standards. A modern testing laboratory will enable the timely, cost effective and proper implementation of new protection, control and automation solutions by testing performance, system integration and impact on the grid. Real-time simulation and testing of integrated systems will support right sizing of the capital investment needed for the grid modernization, and the implementation of other energy efficiency programs. Adequate HV pre-commissioning testing of distribution apparatus will secure adequate performance before energizing with positive impact in reliability, efficiencies, and improved safety. Adequate test facilities are best practice in the utility industry, an essential part of any electrical power grid, and ensure the proper testing/simulation/proof of concept that is required for safety, quality assurance, cost effectiveness and mitigation of future hazards/problems to the grid.
This work will be in compliance with FEMA (Public Assistance Alternative Procedures (Section 428) Guide for Permanent Work FEMA-4339-DR-PR February 2020)

Note: If preliminary A&E work has not been completed, the type of work designation is considered initial and is based on currently available information. The type of work designation may be revised based on the results of the completed preliminary A&E work.

Preliminary Engineering

Is architectural and engineering funding required to help define the intended scope of work?

Yes

Codes and Standards

Which of the following types of codes, specifications, and standards apply to the restoration, replacement, relocation, or alternate scope of work?

The following will be referenced when applying specific codes, specifications, and standards to the project design:

1. Consensus-based codes, per FEMA (Public Assistance Alternative Procedures (Section 428) Guide for Permanent Work FEMA-4339-DR-PR February 2020).
2. Industry standards per FEMA Recovery Policy FP-104-009-5, Version 2, Implementing Section 20601 of the 2018 Bipartisan Budget Act through the Public Assistance Program.
3. FEMA Recovery Interim Policy FP-104-009-11 Version 2.1, Consensus-Based Codes, Specifications, and Standards for Public Assistance.
4. LUMA's latest Design Criteria Document (DCD) which aggregates the design considerations of the vast majority of the consensus-based codes, specifications, and standards listed in FEMA Recovery Interim Policy 104-009-11 Version 2.1 (December 20, 2019).

Codes, Specifications, and Standards

Yes
Applicable building codes and reference standards will be identified and incorporated into the project requirements.

Industry Standards

Yes
The current industry standards utilized by many mainland utilities will be leveraged for this project. These include provisions for physical security, internal security of the laboratory spaces, cybersecurity, and applicable critical infrastructure (CIPs) requirements.

Estimate

Cost estimates to complete the work have been generated at a class 5 level, which is between -50% and +100% of the final project cost. The estimate includes materials, construction labor and equipment, engineering, management, and contingencies.

Estimated Budget for Architectural & Engineering Design:	**$0.93M**
Estimated Budget for Construction:	**$4.61M**
Estimated Budget for Procurement:	**$6.34M**
Estimated Overall Budget for the Project:	**$11.88M**

406 Hazard Mitigation Proposal

406 Mitigation Opportunity Scope of Work

During the preliminary design phase, LUMA will develop and propose 406 Hazard Mitigation proposals consistent with the damages. These proposals will be documented with BCAs.

406 Mitigation Opportunity Cost Estimate

Estimated Budget for Architectural & Engineering to Design:	**Unknown at this time**
Estimated Budget for Procurement:	**Unknown at this time**
Estimated Budget for Construction:	**Unknown at this time**
Estimated Overall Budget for the Project:	**Unknown at this time**

Note: If available, detailed engineering cost estimates will be included as an attachment.

Environmental & Historic Preservation Requirements

EHP considerations will be identified and evaluated during the preliminary design phase and submitted to FEMA for review. Requirements will be incorporated into the final design and construction documents to be approved by FEMA prior to construction activities. The space planned for the primary test facility is inside existing PREPA facilities in the [redacted] building in Santurce (San Juan). The space for the distribution apparatus HV testing has not been identified yet and will be in one of the warehouses used by the distribution team field operations.

Attachments

Document Name	Description
N/A	N/A