Texas Commission on Environmental Quality
New Technology Implementation Grant (NTIG) Program

Pedernales Energy Storage Automation & Management with Solar (PESAMS)

Final Report

for:

New Technology Implementation Grant (NTIG) Program

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Task Deliverable/Final Status Report Overview

This final report signifies that Pedernales Electric Cooperative, Inc. ("PEC") has completed the engineering, procurement, and construction (EPC) of the Pedernales Energy Storage Automation & Management with Solar (PESAMS) project. The PSEAMS is a distribution-connected 2.25 MW / 4.5 MWh lithium-ion battery energy storage system (BESS), AC-coupled with a 999 kW_{ac} solar photovoltaic (PV) facility (the Solar PV) (collectively, the BESS and the Solar PV being referred to as the "Project" or "PV+S"), located in Blanco County, Texas within the Electric Reliability Council of Texas (ERCOT) grid.[1]

Introduction/Background

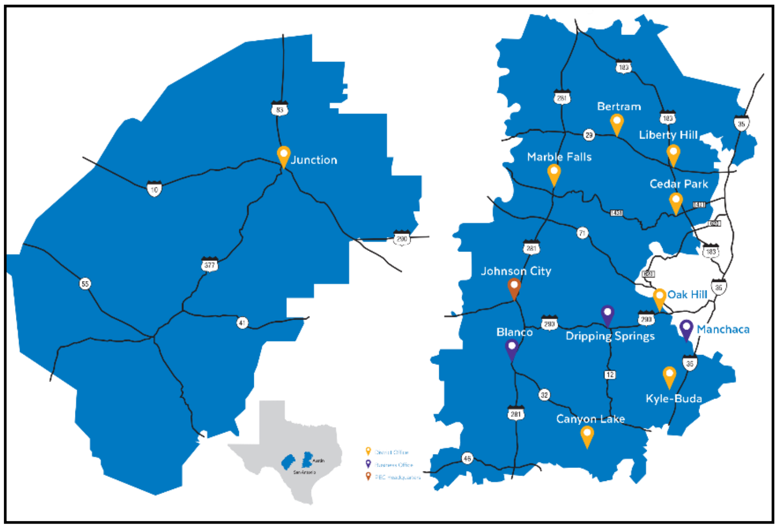

Figure 1 - Map of PEC Territory

Located in Central Texas, PEC is the largest electric distribution cooperative in the United States. Currently, the Co-op serves over 345,152 active accounts covering an area roughly 8,100 square miles with 23,157 miles of line, all encompassed by 24 counties and 44 franchise cities.[2] The Co-op has experienced tremendous growth, serving some of the fastest regions in the U.S. In 2015, the Co-op distributed nearly 5.5 billion kilowatt-hours (kWh) and saw a growth of almost 10,000 meters. Safety and reliability are a high priority for the Co-op, with a 2014 System Average Interruption Duration Index (SAIDI) of 63 minutes, placing the Co-op among the leading utilities in reliability.[3]

In 2017, the Texas Commission on Environmental Quality (TCEQ) and Texas Emissions Reduction Plan (TERP) selected PEC as winner of the 2017 New Technology Implementation Grant (NTIG) Program.[4] PEC was successfully awarded $1.5 million in grant money to help fund the PESAMS Project to help the cooperative achieve a cleaner energy portfolio by implementing technology to reduce the emission of pollutants, consistent with the objectives of the NTIG program, while reducing energy and transmission costs.

The PESAMS was constructed on PEC owned land in Johnson City, Texas and integrates the most economically and technically viable blend of energy storage using a 2.25 MW / 4.5 MWh lithium-ion BESS in conjunction with a newly constructed distribution-tied solar

[1] http://www.ercot.com/
[2] https://www.pec.coop/about-us/service-area/
[3] U.S. Energy Information Administration, Annual Electric Power Industry Report (EIA-861 data file)
[4] https://www.tceq.texas.gov/airquality/terp/ntig.html

array. The Solar PV was constructed by RES Americas Inc. as the Contractor using First Solar PV modules and a Power Electronics inverter. The BESS was constructed by Aggreko, LLC as the Contractor using Samsung batteries, in-house inverters and Energy Management System (EMS) and Sabre enclosures.

The innovative business model utilized by the PESAMS incorporates multiple storage services for integrating renewable resources to achieve maximum emission reduction, while providing the greatest economic and operational benefits to PEC, its members, and the ERCOT grid. PEC regards the PESAMS project as critically important to PEC's ability to rapidly transition to a more efficient and environmentally conscious utility that delivers reliable, safe, clean, and cost-effective energy. The knowledge produced by the PESAMS project will be used to shape PEC's long-term planning process.

Project Objectives/Technical Approach

The objective of the PESAMS project is to demonstrate a cost-effective, duplicable and scalable system design that will immediately achieve reduced emissions, reduced costs and increased operational efficiency. Specific technical objectives include:

- Study the synergies and potential of Solar PV and energy storage to reduce greenhouse gas (GHG) emissions.
- Develop internal capabilities to design, optimize, and analyze an energy storage project to maximize the value for members, PEC, and the grid.
- Field, measure and quantify individual energy storage applications (peak shaving, energy arbitrage and ancillary services) and the compatibility of stacking multiple benefits.
- Develop best practices related to contract terms and conditions to support future BESS procurement or off-take.
- Develop internal process for qualification, testing and scheduling of a distribution-connected Resource into the ERCOT Ancillary Services market.[5]
- Develop internal competencies for dispatching collocated resources.
- Study locational benefits to address distribution system planning needs.
- Develop best practices for interconnection of Distributed Energy Resources (DER) on the distribution system.[6]
- Investigate how storage can enhance system reliability as the penetration of intermittent generation increases across the service territory.
- Develop project life cycle and safety best practices to educate other cooperatives.

Tasks

The NTIG Grant Scope of Work included the following Tasks:

[5] Ancillary services refer to functions that help grid operators maintain a reliable electricity system. Ancillary services maintain the proper flow and direction of electricity, address imbalances between supply and demand, and help the system recover after a power system event.

[6] DERs are physical and virtual assets that are deployed across the distribution grid, typically close to load, which can be used individually or in aggregate to provide value to the grid, individual customers, or both.

- Task 1: Secure Rights to Location
- Task 2: Install and Energize Solar Array
- Task 3: Conduct Request for Proposals (RFP) Process for BESS
- Task 4: Select BESS Integrator Awardee and Review Contracts for Acceptance
- Task 5: Secure Necessary Permits to Install and Operate Project
- Task 6: Execute Contracts and Order Required Equipment
- Task 7: ERCOT Generation Interconnection
- Task 8: Prepare Site for Construction and BESS Installation
- Task 9: Installation: Construct and Interconnect the BESS
- Task 10: Testing of Final Design
- Task 11: Implementation Reporting
- Task 12: Operating Reporting Period

Task 1: Secure Rights to Location

PEC evaluated multiple locations and selected a Project site that would maximize benefits to members and the Texas grid. The project was installed at the Johnson City Substation at 201 Los Encinos Drive, Johnson City, TX 78636 and interconnected at 12.5 kV.

The location was selected for the following reasons:

- Emission Reduction: The site is in an affected area per TCEQ definitions and is near the Solar PV site. The location will satisfy NTIG requirements by shifting solar to peak times and displacing traditional fossil fuel generation and associated emissions.
- Accessibility: The site is owned by PEC and easily accessed by Encino Drive. This provides ease of implementation for construction, installation, and service of the BESS. PEC anticipates the project will enable education and training opportunities for other cooperatives and neighboring utilities. The site is well drained and not within any potential flood zones.
- High Visibility: The site is highly visible and short driving distance from PEC corporate headquarters in Johnson City providing convenient visitation opportunities. The project will additionally provide PEC the ability to showcase their commitment to clean, renewable energy and peak load reduction efforts.
- Reduced Interconnection Costs: The BESS is next to a substation and will utilize an existing medium voltage transformer with spare capacity. The existing infrastructure and reduced line distance reduced interconnection-related expenses for the project.
- Improved System Efficiency: Siting the BESS next to the substation eliminates unnecessary line losses and improved overall system round-trip efficiency that:
    - Increases system performance, emission reduction potential, and cost-effectiveness
    - Decreases charging-related costs and cost per lifetime energy

Figure 2 - Project Location

A letter acknowledging the Project site selection and deed of ownership were submitted to finalize this Task of the Grant Scope of Work.

Task 2: Install and Energize Solar Array

Site Preparation

Construction of the Solar PV involved clearing and grubbing of the existing vegetation; grading necessary for the construction of access and service roads, and the installation of solar arrays; trenching for the electrical DC and AC collection system, including the telecommunication lines; installation of the inverter stations; construction of underground 12.5 kV collection systems leading to the Project substation; and construction of the LV/MV substation, energy storage facility, and the aboveground gen-tie line from the Project substation to the adjacent PEC Substation.

A staging area was utilized to include temporary construction trailers for the management of construction, a parking area, and site security facilities. This area also accommodated the delivery of materials, vehicles, etc. Material delivery for the solar field was ongoing, panels and framing structures were delivered throughout the solar field adjacent to the subunit locations. Temporary staging areas for material laydown including boxes of solar panels, steel, aluminum framing, conduit for underground electrical, transformers, and other project materials were located throughout the Project area. The laydown areas were subsumed by the build-out of the panel array with some exceptions. Materials e.g., boxes of panels, steel and aluminum framing, were laid out between rows of panels and along the access roads.

Solar PV Installation

The Contractor performed the following mechanical activities:

- Installing support foundation (pouring concrete pads or driving piles)
- Installing racking structures
- Installing conduits for wiring from combiner boxes to inverter DC switchgear
- Preparing inverter pad

- Installing grounding system for metal structures and inverter pad
- Installing modules on racking
- Installing combiner boxes on racking structures
- Installing weather/monitoring station to verify proper operation of system
- Installing inverter(s), lightning protection/surge arrestors, and associated DC and AC switchgear

The Contractor performed the following electrical activities:

- Wiring modules into series strings and connecting to combiner boxes
- Running DC wires from combiner boxes to inverter DC switchgear
- Running DC wires from DC switchgear to inverter
- Connecting inverter(s) to interconnection transformer and associated switchgear
- Connecting structure and combiner boxes to grounding system
- Connecting inverter and associated equipment to grounding system and protection equipment
- Installing metering cabinet and associated telecommunications
- Connecting monitoring system to co-op's SCADA system
- Connecting system to electric grid

The following commissioning activities were completed:

- Completing final installation details
- Completing visual inspections
- Verifying compliance with National Electric Code (NEC) requirements
- Conducting electrical verification tests
- Verifying system functionality, including start-up, operations, shutdown, and emergency procedures
- Verifying that system power output and energy production meet performance expectations
- Completing system documentation, including changes for as-built drawings
- Conducting user orientation and training on system operation and safety
- Conducting hazard assessment and safety training

The Solar PV system was commissioning on January 25, 2018. A copy of the Solar PV Commissioning Certificate was submitted to finalize this Task of the Grant Scope of Work.

Figure 3 - Completed Solar PV

Task 3: Conduct RFP Process for BESS

On August 28, 2017, PEC issued RFP #2017-033 from experienced, responsible companies to engineer, design, procure, install, test, and commission a 2.25 MW / 4.5 MWh BESS.

Table 1 summarizes the chronology of procurement-related events.

Table 1 - RFP Timeline

Task	Status
RFP Release	Completed August 28, 2017
Web Conference	Completed September 6, 2017
Pre-Proposal Meeting and Site Visit	Completed September 20, 2017
Q&A	Completed September 27, 2017
Deadline for emailed clarification questions	Completed September 27, 2017
Proposal Due Date	Completed October 4, 2017

A copy of the RFP solicitation package was submitted to finalize this Task of the Grant Scope of Work.

Task 4: Select BESS Integrator Awardee and Review Contracts for Acceptance

On November 29, 2018, PEC received approval from the Board of Directors to enter contract negotiations with Aggreko, LLC.

Task 5: Secure Necessary Permits to Install and Operate Project

PEC and the selected Contractor were required to comply with all environmental and regulatory requirements associated with the construction of the Project. The following environmental survey and permitting project site tasks completed for the Solar PV:

- Geotechnical Investigation
- Section 106 State Historical Preservation Review
- Boundary Survey
- Interconnection Agreement with RES Americas Inc.
- Phase 1 Environmental Site Assessment

There were no permitting requirements for the BESS based on the Project location and Authorities Having Jurisdiction (AHJ).

The following deliverables were submitted to finalize this Task of the Grant Scope of Work:

- Copies of Solar PV permits, studies, and surveys
- Letter acknowledging no permits was required for the BESS

Task 6: Execute Contracts and Order Required Equipment

On May 7, 2019, the contract with Aggreko, LLC was executed.

Long-lead equipment items were procured by the Contractor and delivered to the Project site to include batteries, inverters, transformers, panelboard and switchboard, and Data Acquisition System (DAS).

A copy of the executed contract with the Contractor was submitted to finalize this Task of the Grant Scope of Work.

Task 7: ERCOT Generation Interconnection

Distributed Generation (DG) that intends to participate in Security Constrained Economic Dispatch (SCED)[7] or provide Ancillary Services to the ERCOT system must register as a Distribution Generation Resource (DGR) and undergo qualification testing (see Task 10 Commissioning process).[8]

To register the BESS, PEC completed the following ERCOT tasks:

- Generation Interconnection or Change Request (GINR) using the ERCOT RIOO-IS
- Security Screening Study (SSS)
- Full Interconnection Studies (FIS)
- Standard Generation Interconnection Agreement (SGIA) with the TSP

Once the previous documentation was submitted and approved, the Resource Asset and Registration Form (RARF) was submitted to ERCOT.

The Lower Colorado River Authority (LCRA) was selected as the Qualified Scheduling Entity (QSE) and required to submit offers to sell and/or bids to buy energy in the Day-

[7] During real-time, ERCOT dispatches resources based on economics and reliability to meet the system demand while observing resource and transmission constraints. Security Constrained Economic Dispatch (SCED) is the real-time market evaluation of offers to produce a least-cost dispatch of online resources.
[8] http://www.ercot.com/services/rq/re/dgresource

Ahead Market and the Read-Time Market in ERCOT. PEC provided the following inputs to the QSE:

- ERCOT RARF
- Transformer Specifications
- One-Line Diagram
- CT/PT Specifications
- Fiber to BESS
- SCADA Specifications

Proof that the ERCOT GINR and RARF were submitted was submitted to the TCEQ to finalize this Task of the Grant Scope of Work.

Task 8: Prepare Site for Construction and BESS Installation

Site Mobilization

Civil, Structural and Electrical drawing sets were released, reviewed, and approved throughout the design phase. At this point, all details had been included in the drawing sets, as well as all inaccuracies and omissions had been corrected from previous drawing releases. This led to an Issue for Construction (IFC) drawing set sufficient to start mobilization and site preparation.

Health, Safety and Environmental (HSE) plans to support the project were developed, submitted, and approved by all parties to protect personnel, environment, and equipment. Documentation included, but was not limited to:

- Employee rights and responsibilities
- Location of approved Project Health and Safety Plan, available for review by employees
- First aid and medical facilities
- Emergency response procedures
- Specific Occupational Safety and Health programs or procedures applicable to the construction activities
- General project hazards and the applicable policies and procedures for addressing these hazards
- Construction hazard recognition and the procedures for reporting or correcting unsafe conditions
- Use and maintenance of Personal Protective Equipment (PPE) Procedures for reporting accidents or incidents
- Fire prevention and control
- Alcohol and drug abuse policy
- Disciplinary procedures for safety infractions or violations

All construction permits were submitted and approved to start mobilization.

Site Preparation

The Contractor performed the following site preparation activities prior to BESS installation:

- The Project site was cleared, graded and leveled to allow for the installation of the BESS.

- Storm and water reticulation, culverts and berms were formed, and vegetation was cleared.
- Traffic routes were established, and a security fence was installed.
- Underground conduits and foundations for the BESS and auxiliary equipment were installed.
- Foundations were poured, cured, and checked for leveling and cracks to make sure they were ready for the installation of the BESS equipment.

Factory Acceptance Testing

The Contractor completed Factory Acceptance Testing (FAT) on the system integration to minimize site work and to prove correct operation of the units. FAT included the following system components:

- Battery Block
- Power Conversion System (PCS)
- Control System
- Fire Suppression System
- Thermal Management
- Door Alarms

Figure 4 – BESS Site Preparation Pictures

Photographic evidence of the site preparation was provided to finalize this Task of the Grant Scope of Work.

Task 9: Installation: Construct and Interconnect the BESS

The Contractor managed the installation of all major BESS components. The Project site utilized concrete foundations for each of the BESS with conduit runs between the enclosure and the step-up transformers, which were installed on a concrete pad. Each battery subsystem is comprised of the battery enclosure, bi-directional inverter, medium voltage transformer, and medium voltage switchgear. Medium voltage transformers were installed at the project site to step up the AC voltage from the inverters to the MV level of the substation. A MV switchgear was installed to serve as electrical isolations for each of the battery systems. For auxiliary power, a single auxiliary power transformer was installed near the medium voltage switchgear.

Installation of each battery enclosure included all the necessary cabling, auxiliary equipment, and other required infrastructure to support the operations of the battery. This includes the following:

- DC cabling which connects each Samsung E2 rack to the DC bus installed in each rack. Each DC bus connects to a DC disconnect switch, which serves as an electrical isolation between the battery system and the inverter.
- Programmable Logic Controller (PLC), which aggregates auxiliary equipment operations and sensory data for proper management of heating, ventilation, and air conditioning (HVAC) and fire suppression systems.

For controls, data acquisition, and telemetry, the Contractor installed a server paired with a robust uninterrupted power supply (UPS) to host the EMS. This equipment was installed in the communication cabinet located at the Project site. This communication cabinet also houses the real-time automation controller (RTAC), which serves as the Distributed Network Protocol 3 (DNP3) gateway device for market telemetry between the BESS and the ERCOT to support market operations.

Figure 5 – BESS Site Installation Pictures

Photographic evidence of installation of equipment was provided to finalize this Task of the Grant Scope of Work.

Task 10: Testing of Final Design

The battery system for the Project utilizes Samsung E2 technology and was tested, checked, and commissioned by both the Contractor and original equipment manufacturer (OEM) teams. The battery testing was successfully completed and addressed the following sub tasks/checks:

- Material condition
- Installation verification
- Communication
- Meter and measurement accuracy
- Alarm and protective features

Prior to energization, the Contractor's installation team performed the following activities:

- Pre-installation Inspection: Receipt inspection of equipment was conducted to check for defects or missing parts. This equipment included the Samsung modules, switchgears, and racks.
- Installation Checks: Checks for proper installation and grounding of racks, modules, and switchgears were performed. Other checks completed include auxiliary control power, cable and busbar installation, and system battery management system (BMS).
- Voltage and Communication Checks: Proper rack voltage against calibrated multi-meter and communication devices between battery and customer supervisory control and data acquisition (SCADA) system were verified.

Upon successful completion of these installation and related checks, the battery OEM team performed the following activities:

- Visual Inspection: Inspection of installed system for proper mounting, fastening and torque of racks and modules, and wiring at the module and switchgear level was performed.
- Rack and System BMS Configuration: Addressing and rack assignment for the system BMS and module count and assignment for the rack BMS was checked.
- Battery System Metered Values: Internal meter data was checked, PEC faced numerous questions from the Texas Public Utility Commission (PUC) and had to facilitate lengthy discussion at the state and market levels to address the proper responses for the PUC and measured values were compared against OEM interface for accuracy. These values included rack voltage, current, State of Charge (SOC), cell voltage, and temperature.
- SCADA Verification: Point to point testing and verification of battery system metrics with customer SCADA/EMS was performed.
- Alarm and Trip Checks: Alarm/warning reporting and proper fault handling for abnormal conditions actions were checked.
- Measurement Accuracy: The accuracy between bus voltage at switchgear and software reported voltage was verified.

- Full Battery Diagnostics: A full system test was performed where each critical parameter was changed through the OEM interface to check for proper reporting and fault handling (faults include cell over/under voltage, cell over/under temperature, charge/discharge overcurrent, communication and fan faults).

Enclosure Commissioning and Testing

The battery enclosures for the Project utilizes structures designed and built by Sabre. These concrete buildings are customized battery enclosures, which contain all the necessary thermal management, fire protection/alarm, and sensor equipment necessary for proper and safe BESS operation. The building testing was successfully completed and addressed the following sub tasks/checks:

- Structural
- Fire protection/alarm
- Electrical
- SCADA
- Mechanical

The Contractor installation team in tandem with the OEM engineers completed the following checks of the battery enclosures:

- Structural Inspection and Integrity Checks: Each enclosure was visually inspected for shipping or installation related damages, verification of proper structure anchoring, door operation, and enclosure integrity.
- Fire Alarm and Protection Checks: Proper wiring including functionality verification of installed smoke detectors and fire control panel check were performed.
- Electrical: The enclosure wiring was checked for proper cable management and grounding. All auxiliary AC power cables were verified for proper sizing and terminations. All 24 VDC power supplies, associated cabling, and connections were checked for proper installation. The main DC isolation between the enclosure and the inverter was operated and verified for proper continuity, breaking, and indicating status.
- SCADA: Network connection checks were performed for the enclosure PLC, which aggregates many of the auxiliary systems for the enclosure. This includes fire suppression, thermal management, and door sensing equipment. The Modbus interface for the PLC was configured and verified for each enclosure at the project.
- Mechanical: The bulk of the mechanical checks for the enclosure encompassed the HVAC system for each enclosure. This included confirmation of HVAC sequence of operations, proper HVAC controller function, and accuracy of all ambient humidity and temperature sensors within each building. Feedback and safety integration tests for the fire control panel, DC disconnect status, and door alarm statuses concluded the mechanical tests for the enclosure.

Inverter (Aggreko) Commissioning and Testing

There are 8 inverters installed at the Project. Each inverter, or power conversion system (PCS), is built by Aggreko and is an indoor rated enclosure with a nameplate power rating of 250 kVA. These inverters accept both the main DC cabling from the battery system and AC cabling from the MV transformer. Each inverter underwent inspections and checks in two phases classified as cold and hot commissioning.

The Contractor installation team successfully completed inspection and verification checks for each inverter installed at the Project site. The de-energized checks, classified as cold commissioning, included the following:

- Equipment Inspection: These inspections encompassed multiple checks including material inspection, internal wiring checks, and power module inspection. The purpose for these checks was to ensure the material integrity of the inverter was intact post-delivery.
- Installation Checks: Once installed and electrically connected, the inverter has its external wiring and ground connections verified for proper wiring orientation and labeling. This includes comparing against project electrical IFC drawings, verifying correct color coding, polarity/phase rotation, and torque checks.
- Communications: Prior to energization, control power is applied to the inverter, which allows the checking of communications between the inverter and site SCADA system.

Energized checks or hot commissioning included the following:

- Initial Voltage Checks: These checks ensure that both the DC and AC sources to the inverter are correctly being measured and reported locally to each individual inverter. Each power module within the inverter was checked for proper sensing and calibration of the source voltages.
- Firmware and Settings Verification: The firmware checks verified that each inverter is running on the correct and identical build of software. Each inverter has detailed settings for low voltage ride-through (LVRT), over/under voltage and current tripping, and other protective configurations that were set to the Institute of Electrical and Electronics Engineers (IEEE) 1547 default.
- PCS Alarm and Fault Handling: Each inverter was tested for proper operation during abnormal conditions. This includes removing control power, communications, E-stop initiation, and the simulation of other conditions, which cause the inverter to generate alarms and exhibit proper fault handling.
- Power Verification: Upon completion of all cold and hot commissioning checks, the inverters were individually tested for proper bi-directional functionality at low power output levels. The power was increased at step intervals until full power output was reached. At each power step, the inverter was checked for accuracy and measurements as read both locally at the inverter human machine interface (HMI) and remotely on the site SCADA system.

SCADA/Communications Commissioning and Testing

The SCADA and communications portion of the commissioning tests cover all internal point to point communication, grid measurement, data mapping to external entities, and control system testing. This testing can be considered one of the most important tests for a battery system as it ensures proper telemetry, response, and functionality of all components within the project.

The Contractor installation team completed a comprehensive list of tests associated with the SCADA and communications for the Project to include the following:

- Equipment Setup and Configuration Testing: Verification of installed equipment for proper configuration and wiring with adequate and stable power supply (main and backup sources) was performed.
- Point to Point Data Mapping: Proper telemetry of data between the battery and several entities was verified. These entities included PEC, ERCOT, and field devices.
- EMS Setup and Configuration: Setup of the power quality meter (PQM) was completed. Additionally, numerous tests to verify meter data, accuracy, and records were verified.
- Operational Tests: A variety of Project-specific operation tests were completed to include the pushing and pulling of power at the site level, control mode operability, and transitioning between modes of operation. The system proportional integral derivative (PID) loop was finely tuned to balance speed of response with accuracy of power setpoints during these power excursion tests.
- Functionality and Interlock Testing: Failure mode testing was performed where communication breaks were initiated between several devices to verify proper and safe response of system.
- Response Time Testing: The speed of response for the system during market operations was tested. The system was triggered based on frequency threshold trips and automatic governor control (AGC) driven triggers where the speed of response is accurately timed and must be below the requirement for the ERCOT Fast Responding Regulation Service (FRRS) ancillary service.

The following deliverables were provided to finalize this Task of the Grant Scope of Work:

- The Final Completion Certificate
- A report detailing the testing and commissioning process

Figure 6 - Completed BESS Pictures

Figure 7 - Completed BESS Pictures Continued

Task 11: Implementation Reporting

Quarterly progress reports were submitted in a timely fashion summarizing all aspects of the Project tasks. PEC submitted the following progress reports:

- Q2 / 2017 Progress Report – Submitted July 10, 2017
- Q3 / 2017 Progress Report – Submitted October 2, 2017
- Q4 / 2017 Progress Report – Submitted December 28, 2017
- Q1 / 2018 Progress Report – Submitted April 3, 2018
- Q2 / 2018 Progress Report – Submitted July 4, 2018
- Q3 / 2018 Progress Report – Submitted October 8, 2018
- Q4 / 2018 Progress Report – Submitted December 21, 2019
- Q1 / 2019 Progress Report – Submitted April 1, 2019
- Q2 / 2019 Progress Report – Submitted July 1, 2019
- Q3 / 2019 Progress Report – Submitted October 8, 2019
- Q4 / 2019 Progress Report – Submitted January 8, 2020
- Q1 / 2020 Progress Report – Submitted March 31, 2020
- Q2 / 2020 Progress Report – Submitted July 3, 2020
- Q3 / 2020 Progress Report – Submitted October 2, 2020

A webpage was added to the PEC website to educate visitors about the TCEQ project at https://www.pec.coop/your-service/pec-cares/.

Task 12: Operational Period

PEC will provide annual operation status reports annually for five years and will submit a final operations report at the conclusions of the five-year period.

Discussion/Observations

Objectives and Results

The overall objective of the NTIG Grant Project was to engineer, procure, and construct a 2 MW / 4 MWh lithium-ion BESS to reduce emissions by shifting solar and performing grid services. PEC has successfully met this requirement as well as other technical objectives outlined in this report.

Critical Issues / Technical Goals and Barriers

The PSEAMS Project was a learning process to determine how to best design, procure, and operate a PV+S project to reduce the emission of pollutants from the electric grid. A critical challenge to implementation was the nascent state of policy and market rules related to energy storage in Texas. As expected, several setbacks and scope revisions were encountered, some of which resulted in delays to the project schedule. PEC shared these learning opportunities within the quarterly status reports and coordinated with TCEQ to facilitate amendments to the scope of work and Project schedule as needed.

Lesson #1: The rules regarding energy storage ownership are not always black and white.

The Texas Administrative Code (TAC)[9] is a compilation of state agency rules in Texas. The Public Utility Commission (PUC) rules are under Texas Administrative Code, Title 16, Part II. Substantive Rules Chapter 25 sets rules applicable to electric service providers. Section 25.109 outlines certification, licensing, and registration requirements for Power Generation Companies (PGC). This specific rule states that any Person who owns electric energy storage equipment and generates electricity intended to be sold at wholesale must register as a PGC with the state, *except* for electric cooperatives. Despite compliance with these rules, PEC faced numerous questions from the Texas PUC and had to facilitate lengthy discussions at the state and market levels to address the proper responses for the PUC.

Senate Bill (SB) 1012[10] was filed on March 7, 2019, and the ruling went into effect on September 1, 2019. The following language was added to the TAC Sec.35.152:

(d) Subsection (b) does not require a municipally owned utility or an electric cooperative that owns or operates electric energy storage equipment or facilities described by Subsection (a) to register as a power generation company under Section 39.351(a).

Lesson #2: Vendor offerings vary, and some systems may not be compliant with market rules.

[9] Texas Secretary of State. (2018, June 16). Texas Administrative Code, Title 16, Part II. Substantive Rules Chapter 25. http://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=16&pt=2&ch=25

[10] https://capitol.texas.gov/tlodocs/86R/billtext/html/SB01941S.htm

During procurement, PEC was presented with offerings from a variety of energy storage companies. Each company has a unique system design with variations in:

- Modular versus containerized
- Useable power and energy
- Battery cathode chemistry
- EMS capabilities
- Warranty and performance guarantees

During the vendor interviews it became known that one of the vendors could not separately meter the system's station power e.g., lights, onboard computers, and thermal management. This would result in the BESS not qualifying for wholesale storage load (WSL) treatment. Additionally, the response time of systems varied, which can be critical for qualification into specific ancillary services. Understanding market rules and stress testing vendor compliance proved significantly important in vendor selection process.

Lesson #3: Vendor representations can change during contracting process.

PEC discovered significant gaps in performance guarantee and warranty representations during the contract negotiations process. A third-party consulting firm and attorney were utilized to cure gaps in the contracting language to ensure safeguards for liability, performance, and warranty. Including the purchase agreement with well-defined terms and conditions is a necessary first step in the procurement process. However, additional support from outside experts may be required.

Lesson #4: The testing and qualification procedures for distribution-connected batteries is an evolving process.

Historically, most generation resources in the ERCOT region were large transmission-connected units with established rules and procedures for interconnection, qualification, and testing. Today, the grid is encountering a growing penetration of DERs that pose reliability challenges. ERCOT has been actively working with Transmission and Distribution Service Providers (TDSPs) to develop processes for distribution-connected storage. As a result, the testing (type, number, and nature) and qualification process for battery storage is continuously evolving. This can translate into potential delays in the project schedule and commissioning timeline. Vendor experience with commissioning and operating a BESS within the ERCOT jurisdiction should be thoroughly vetted during the procurement process.

Lesson #4: COVID-19 resulted in construction and commissioning delays.

The Project experienced construction and commissioning delays due to government mandated shutdowns. This presented a new risk that must be evaluated in future projects. Unfortunately, COVID-19 has and continues to disrupt supply and distribution chains, prevent trades and materialmen from working, complicate inspections, and make credit less available to fund construction projects. These issues may disrupt and delay projects in the short and medium term and may affect projects for months and years to come.

Scope for Future Work

The 60-month PESAMS project will demonstrate a holistic integrated energy storage solution that integrates with existing solar PV to meet the needs of PEC members while showing a clear pathway to future deployments. Additionally, the turn-key system design will also enable a high potential for penetration of PV generated electricity within ERCOT and subsequent displacement of fossil fuels by enhancing the performance and value of both new and existing PV systems.

Summary/Conclusions

The engineering, procurement, and construction of the NTIG project has been completed. PEC plans to submit annual operation status reports for the five subsequent years, followed by a final operation report the end of 2025.

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