YOKOGAWA

A Yokogawa Company

PXiSE Energy Solutions

Case Study

Electrifying Transit in Martha's Vineyard

Leveraging a microgrid controller to optimize sustainability and resiliency needs

Overview

Martha’s Vineyard Transit Authority (VTA) links all six of the island’s towns through a fleet of 32 buses that cover the island’s 96 square miles with 14 routes. The buses offer transportation for the island’s 20,000 year-round residents as well as for tourists who bring the population to around 100,000 in summer.

The VTA sees electrification as the future of the island’s public transportation system and has replaced half of its buses with electric models. The desire to eliminate operating emissions and power buses from locally generated solar are driving electrification efforts, as is the need to appeal to rider perceptions of a quieter, more comfortable, and eco-friendly transit system.

The authority has installed a 466kW solar PV array and 16 bus charging stations at its operations center, where buses charge overnight to ensure they’re ready for their routes the next morning. The system relies on Martha’s Vineyard’s electrical grid, which is nearly at its 62.5 megawatt capacity in the peak summer months. VTA plans to install 20 additional charging stations in the future.

The Challenge

In electrifying their fleet, the VTA is facing several key challenges.

Managing multiple distributed energy resources (DERs)
Coordinating a battery energy storage system (BESS), solar PV panels, a backup diesel generator and the large power load from the bus chargers is critical, as is avoiding overloading a system with limited power (1 MW) to share.

Managing renewable intermittency
The VTA needs to manage the effects on solar PV generation of summer storms and decreases in winter generation capacity while maintaining relatively the same fleet charging requirements.

Operating with minimal human resources
The agency operates with a small staff and does not have the resources for manual microgrid optimization and management.

Optimizing demand response and avoiding peak power rates
Finding an automated means to leverage battery storage to avoid purchasing power at peak times and maximizing the benefits of participating in a demand response program is key.

Resiliency
The VTA must ensure a minimum level of transit operations continue to function even when Martha's Vineyard's power grid fails.

Solution

Currently, one microgrid is active at Martha's Vineyard and its primary role is to support electric bus charging equipment. PXiSE installed its Microgrid Controller to unify the control and optimization of all the on-site DERs and ensure the microgrid's primary function is being fulfilled.

Using advanced feedback control and decoupled real and reactive power technology, the PXiSE Microgrid Controller constantly fine-tunes the output of the solar PV and battery energy storage unit, self-adjusting in real-time, to maintain power quality and mitigate intermittency.

GPS data, digital processing, and patented control techniques unify DER control, enabling the assets to operate as a single integrated system.

To configure the system, PXiSE analyzed historical load and weather data, prior electric bills, as well as the seasonal bus schedule to assess charging demand. These inputs combine with current weather forecasts, solar PV production data, as well as the current tariff structure to enable the PXiSE Microgrid Controller to plan 24 hours ahead.

The controller uses that forecast and then adjusts based on real-time data to automatically optimize the system for the following criteria:

- Prioritizes charging to ensure fully charged buses are ready to roll.
- Optimizes import/export of power at the point of interconnection to reduce electricity bills in concert with the demand response program and by avoiding peak demand charges.
- Reduces solar PV curtailment to maximize power generated by renewable assets.
- Optimizes BESS operation to leverage all the benefits battery storage can provide while reducing overall costs.

As additional microgrids are added, each will operate independently, primarily in grid-connected mode, while also providing islanding capabilities. If an unexpected disturbance occurs, synchrophasors alert the system, which switches to island mode within 2 cycles (~38ms). Extended outages automatically trigger start-up of the backup generator, which recharges the system when solar PV and battery power can't meet power demands.

“The PXiSE team was invaluable in suggesting additional ways to get more out of our assets.”

- Angie Gompert, Administrator,
  Martha’s Vineyard Transit Authority

Results

PXiSE’s Microgrid Controller provides constant management of microgrid automatic controls, helping optimize the benefits of renewable energy generation and stored energy. It successfully manages 19 DERs (one BESS, a solar PV array, backup generator and 16 electric bus chargers) and prevents system overload, even when several buses are plugged in at once.

In addition to fulfilling the VTA’s operational and resiliency requirements, the Controller offers critical cost savings to VTA by:

- Maximizing the VTA’s investment in its electric fleet by increasing uptimes.
- Allowing market participation by connecting the battery to the wider power market.
- Optimizing energy management to shift power demand times and reduce peak demand charges in an area where electricity charges are among the nation’s highest.
- Safely managing power quality, potentially reducing or eliminating the need for a costly var compensator or other voltage management system.

The addition of PXiSE’s Microgrid Controller to the VTA’s microgrid project revealed previously unknown operational and economic opportunities and benefits, which are now being incorporated in the planning and implementation of future microgrids on Martha’s Vineyard.

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