**OBJECTIVE AND SIGNIFICANCE:** Conservation voltage reduction (CVR) is one of the most cost-effective ways to save energy. The main principle of CVR is that energy and peak demand can be lowered by reducing the voltage level. A reduction in energy consumption in the range of 0.7% to 0.9% is anticipated for every 1% reduction in voltage. This is the primary value proposition of effective CVR implementation – reduced energy use by more effective management of customer service voltage.

**BACKGROUND:** Working in close collaboration with Marine Corps Facilities personnel in Okinawa, seven (7) distribution service transformers on a branch of the 13.8 kV distribution circuit serving the Plaza Housing complex, as shown in Figure 1, was identified for CVR field test and evaluation. The CVR controlled feeder section is isolated with a new voltage regulator (VR) to control the voltage at “downstream” service transformers, essentially behaving like a substation transformer load tap changer (LTC) for the limited section of the feeder under test. The LTC action (emulated by the VR) shifts the voltage profile of the feeder up or down, but it does not have the ability to manage individual low or high voltage points along the feeder path. The lowest the LTC can go is constrained by the minimum voltage point at any point along the feeder. HNEI has patented and field demonstrated a method of localized voltage management with an Advanced CVR device to: (1) smooth the voltage profile; (2) boost the lowest voltage at a distribution service transformer and thereby allow the LTC to further shift down the entire feeder voltage; and (3) provide local CVR benefit for downstream customers.

![Figure 1. CVR Demonstration Single-Line-Line Diagram.](image)

**PROJECT STATUS/RESULTS:** Utilizing HNEI GridSTART’s hardware-in-the-loop (HIL) laboratory platform, test and validation of the HNEI developed CVR control algorithm, including communication between the controller and field meters to be located at service transformers, all to achieve maximum CVR benefits, was completed. Figure 2 depicts the major components of the HIL test set-up.

![Figure 2. CVR Real-time HIL test.](image)

Multiday real-time HIL simulations using field voltage measurements collected from the project site were completed to ensure robust and reliable operations of the algorithm and HNEI-controller under a full range of load conditions. Figure 3 is an example of a 24-hour period with and without the CVR algorithm in operation.

![Figure 3. Voltage Profiles with CVR on and off.](image)

Field design and construction to install all components of the CVR system is underway in Okinawa. Full operation is set for Q1, 2020.

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