Final report related to the delivery of

BPL Global's
Connected Energy (CNRG)
Demand Management Solution

for

Southern California Edison's
Irrigation Load Control Pilot Program

February 18, 2016

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I. Executive Summary

Southern California Edison (SCE) engaged BPL Global (BPLG) to provide SCE with an advanced Demand Management solution that would be used to provide operational control, monitoring and management of irrigation loads. SCE desired to demonstrate a solution that was able to operate through BPLG's Connected Energy (CNRG) Demand Management solution interface as well as respond directly to OpenADR commands. The longer term goal of the pilot is to create a solution that is able to provide both capacity and ancillary services to CAISO through the control of irrigation pumps and wells.

BPLG installed direct load control devices that communicated using On-Ramp Wireless infrastructure. The BPLG load control devices were installed on two different pumps at SCE's Tulare Energy Education Center. BPLG scheduled test events with on-site SCE personnel to verify operation of the controlled devices.

BPLG and SCE then conducted a product demonstration session where BPLG ran the system through a series of agreed upon scenarios that demonstrated the ability to fully control the pumps through both BPLG's CNRG software as well as through an OpenADR open source generated command.

In addition, an advanced Farmer Portal was demonstrated to show the advantages generated to the farmer or grower who participates in a load control program with SCE. These benefits include, remote on/off capability, current and historic operating status of controlled devices, and a weather map overlay feature that shows the farmer or grower the current weather conditions at the site location.

The system performed as expected in providing detailed operating information for system, including on/off operating state of each pump, electrical load of each pump while operating, and the aggregate load of all devices being controlled by the system.

II. Project Overview

SCE contracted BPLG to install BPLG's CNRG Demand Management solution for the control of irrigation load control pumps within SCE's service territory.

The pilot was to consist of up to three field installed BPLG load control devices as well as one lab installed BPLG load control device. The devices were monitored and controlled using BPLG's CNRG Demand Management software hosted within BPLG's solution. Communications to the devices was through an On-Ramp Wireless access point installed within communication's range of the installed devices. The irrigation load control pilot was to be hosted for up to one year after the date of system installation.

As part of the pilot requirements and consistent with BPLG's product roadmap, BPLG demonstrated compatibility with OpenADR 2.0. This was accomplished by allowing the installed devices to receive OpenADR signals from an open source Virtual Top Node (VTN) through BPLG's CNRG Demand Management solution which served as a Virtual End Node (VEN).

III. Solution Description

BPLG's CNRG Demand Management solution consists of the hardware, software, communications and services that are needed to deliver an end to end irrigation load control pilot project for SCE.

BPLG's CNRG Demand Management solution utilizes full two-way communications to enable near real-time monitoring, measurement and verification of individual and aggregated loads. In addition, the solution provides visualization of the field devices in two different ways for two different user purposes.

For utility operators, the CNRG Demand Management Utility Portal provides all of the following:

- Ability to visualize amount of controlled load at any point on the grid
- Operating state of all installed devices
- Current and historic device metrics
- Details related to historic, current and pending events
- Control options to set date/time, duration, control strategy and affected area for events

For the end user (irrigation well/pump owner or operator), the CNRG Farmer Portal provides the following:

- Ability to monitor current state of all devices specific to that end user
- Ability to control (on/off) any or all of the individual devices
- Notification (email/SMS) of any utility scheduled events affecting end user devices

Controls within the system can be enacted to control all devices, specified groups of devices or individual devices in different combinations and at a granular level provides the needed flexibility to manage complex demand management configurations.

Figure 1 below provides a diagram of the Demand Management solution showing the integration of all system components from the project partners, including load control devices from Corporate Systems Engineering (CSE) and communications components from On-Ramp Wireless to achieve the requirements of this project.

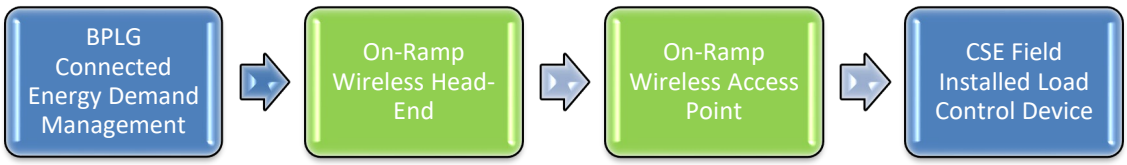


FIGURE 1 – DEMAND MANAGEMENT SOLUTION DIAGRAM

IV. Project Goals and Objectives

To evaluate the success of the pilot project, SCE and BPLG have created the following list of goals and objectives to be attained through the deployment and operation of the pilot project:

1. Utilize BPLG's CNRG Demand Management solution to meet SCE's current pilot phase requirement for irrigation load control
2. Curtail individual agricultural pumps for a scheduled duration of time
    a. Cancel events in progress (Restore load)
3. Curtail all agricultural pumps simultaneously for a scheduled duration of time
4. Demonstrate the control of agricultural pump demand response through the On-Ramp Wireless communication system
5. Demonstrate OpenADR 2.0 functionality

V. Device Deployment and Installation

SCE and BPLG spent considerable time attempting to locate suitable sites for installation of load control devices for the pilot program. Constraints that needed to be managed in identifying suitable locations included:

- Proximity of location to existing or proposed On-Ramp Wireless access points
- Suitable radio coverage of proposed location
- Appropriate load and associated controls at proposed location
- Cooperation from owner/operator of proposed site to secure contract agreement

Due to project delays, we did not start to identify potential customer locations until the summer of 2015. As a result of the delay and due to the project end date of December 31, 2015, we were unable to identify suitable locations and get customer agreements in place to install load control devices at customer sites.

In order to complete the pilot project by December 31, 2015, it was agreed by SCE and BPLG that it would be necessary to find alternative locations to install the load control devices. Subsequent discussions led to the option of potential installs at SCE's Tulare Energy Education Center. BPLG conducted a site visit to validate the equipment available would be suitable for the device installation. As a result of the site visit and following a site safety visit, two different pumps were identified as candidates and load control devices were ultimately installed at both locations.

The Tulare Energy Education Center was a good candidate due to the fact that there was an On-Ramp Wireless access point installed in close proximity to the candidate sites that offered reliable communications services as well as having local SCE personnel available to monitor and validate system operation.

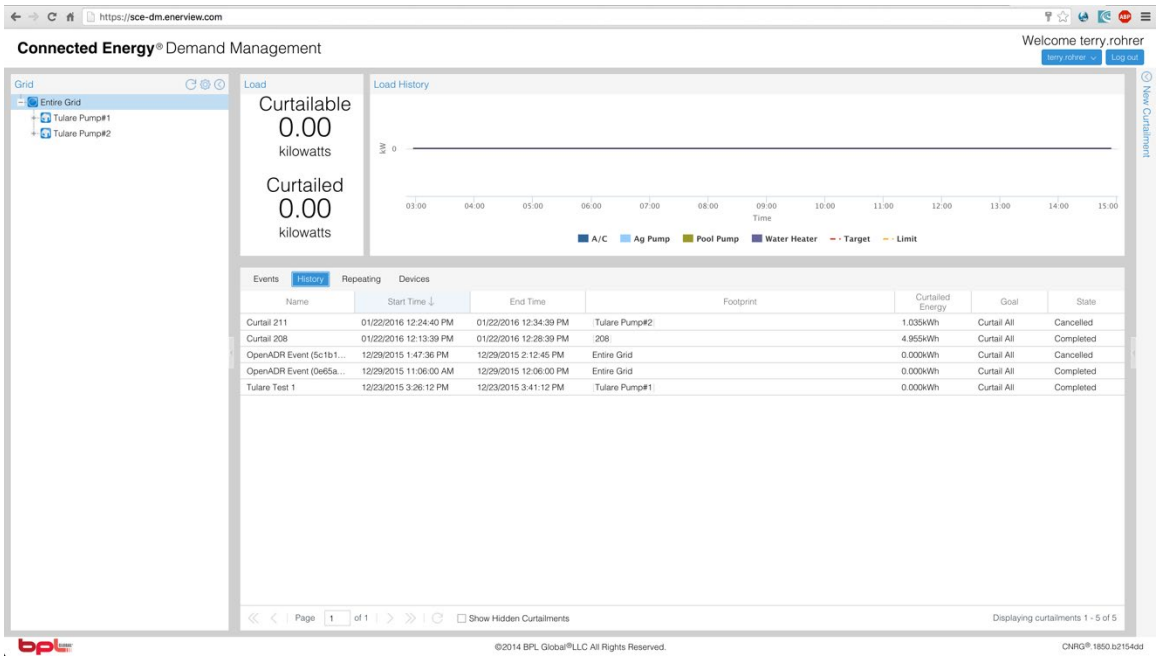
VI. Pilot System Testing and Performance

After installation of the load control devices at the Tulare Energy Education Center was completed, SCE and BPLG coordinated multiple system test events on December 29, 2015 and January 22, 2016 to demonstrate and validate the following system functionality:

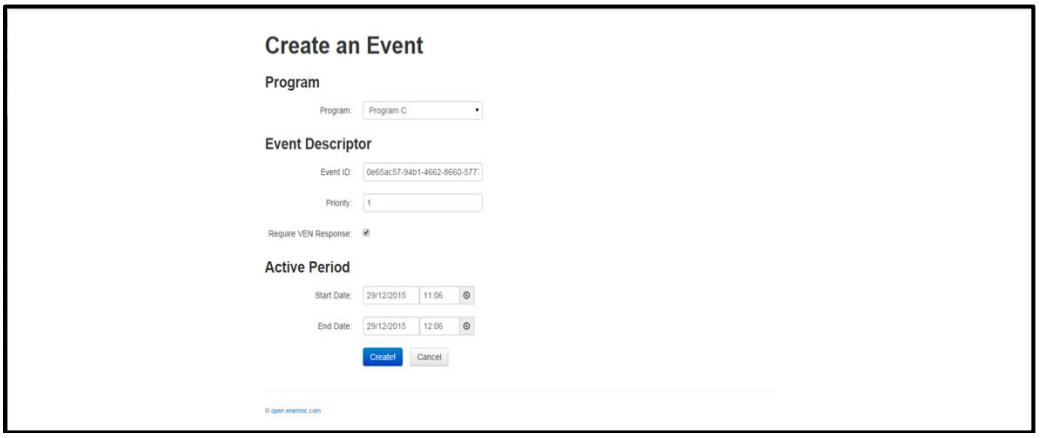
- Use of On-Ramp Wireless communications protocol to demonstrate a simultaneous curtailment event on both pumps
    - Curtail load for specific period of time with normal restore at end of event
- Use of On-Ramp Wireless to demo curtailment event on each, individual pump
    - Dispatch for specific period of time with normal restore
    - Dispatch for specific period of time with unplanned cancellation with restore
- Perform curtailment event defined by kW reduction amount
- Initiate curtailment event using an open source Virtual Top Node (VTN) OpenADR call

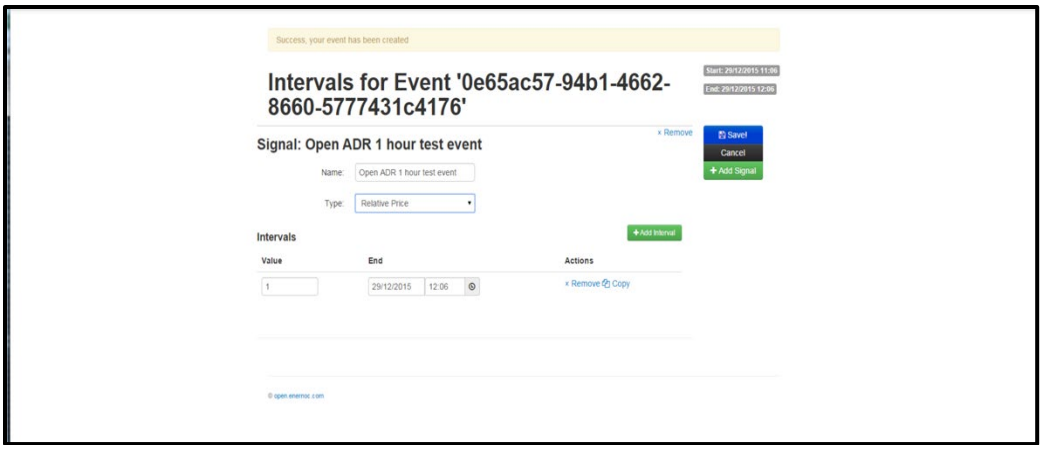
BPLG successfully completed the above tests to demonstrate the required system functionality as outlined in the SOW, which therefore met the pilot program goals and objectives.

The screenshot below documents the dates and times of the above listed tests that were conducted directly from BPLG's CNRG Demand Management Utility Portal:

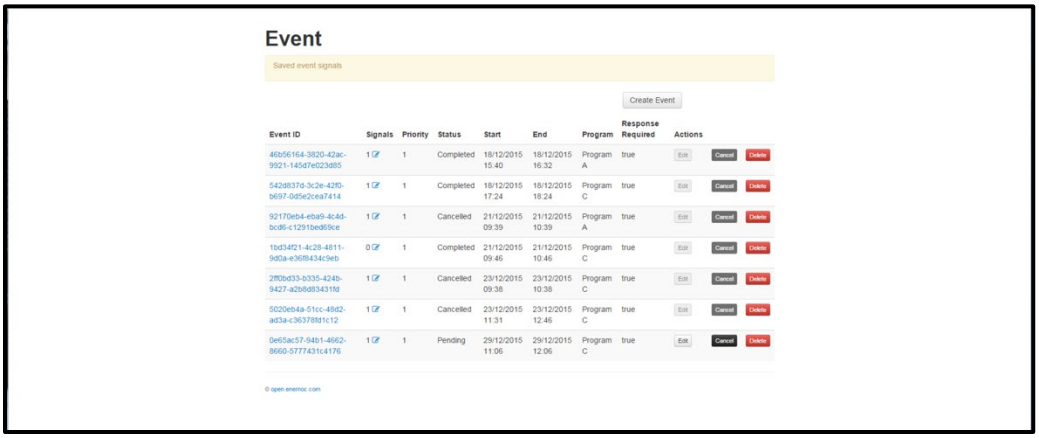


The following 2 screenshots show the use of an open source OpenADR Virtual Top Node (VTN) to schedule a curtailment event directly into BPLG's CNRG Demand Management Utility Portal.



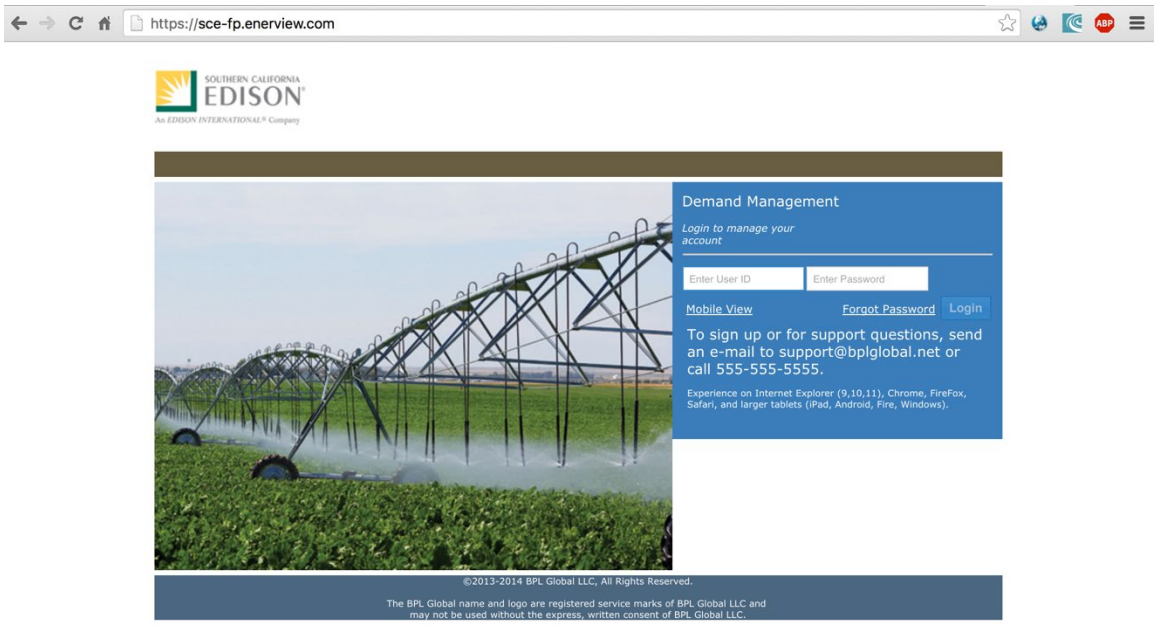


The following screen shot shows that the scheduled event then shows up in the OpenADR tool as shown below:



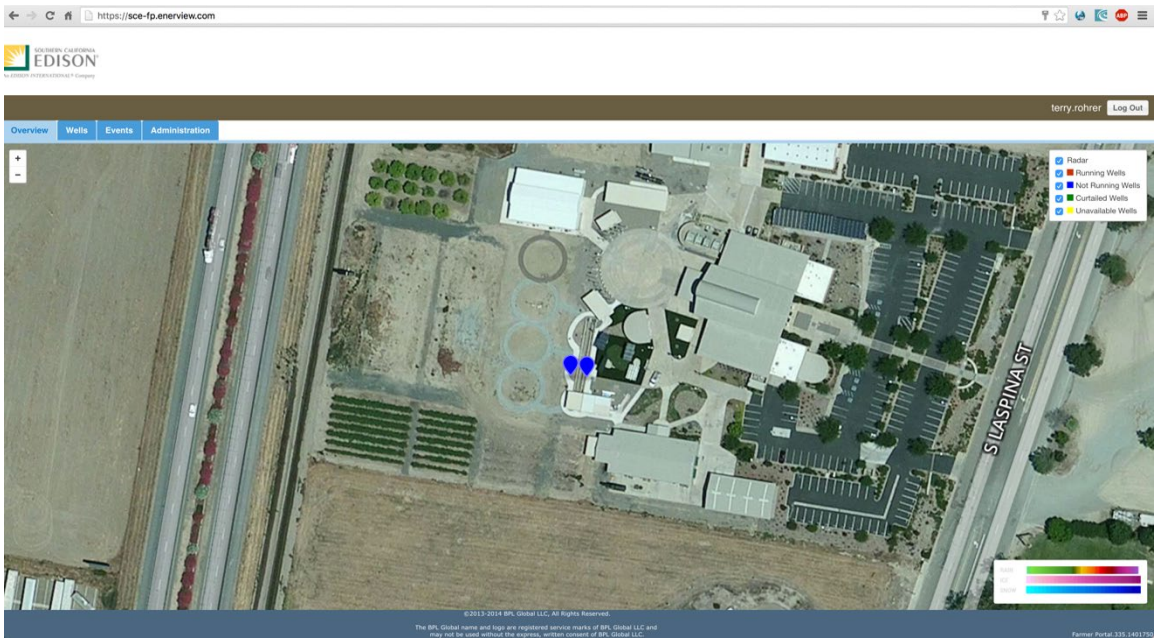
In addition to the original scope of the project and to demonstrate added functionality that would be beneficial to farmers/growers, BPL Global demonstrated a customer facing Farmer Portal that allows farmers/growers to view the operating status of their pumps and control them by turning them on and off remotely using either a smart phone, tablet or computer. This functionality was also tested and demonstrated on the two devices installed at the Tulare Energy Education Center.

The follow screenshot shows the login screen for the SCE branded Farmer Portal that was used and demonstrated as a part of the project:

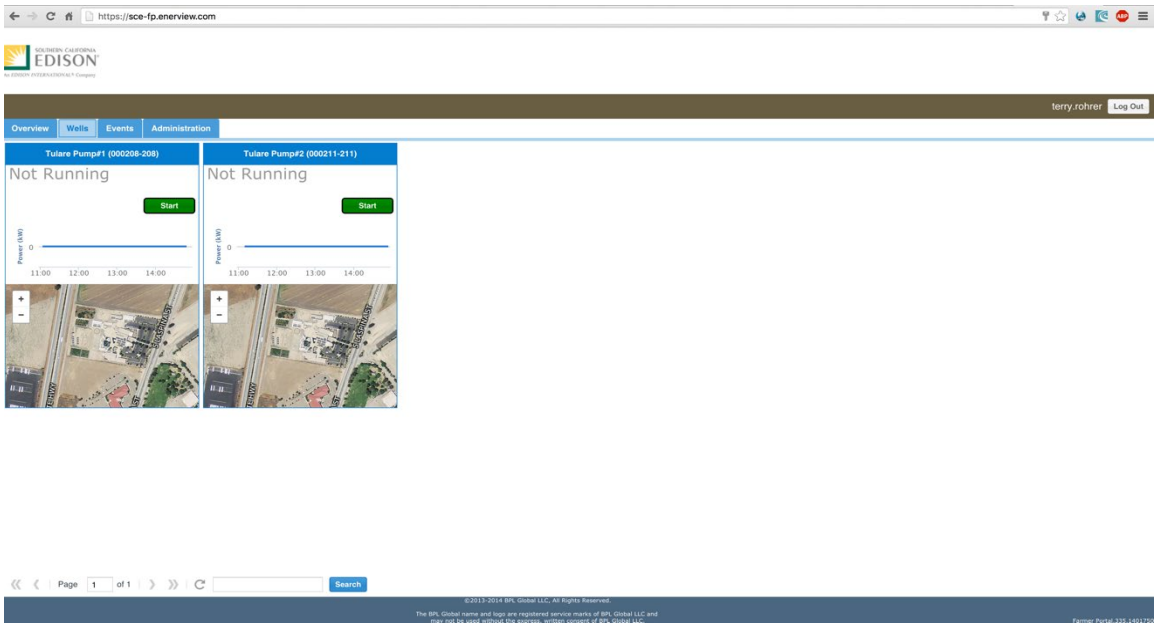


Additional information provided by the Farmer Portal for use of farmers is shown on the following screenshot and includes:

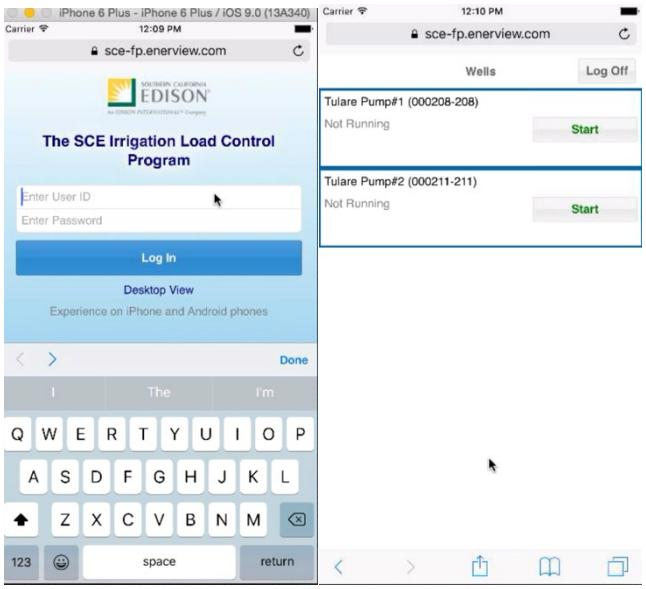
1. Overview map of the wells at the Tulare Energy Education Center. This map includes the current running state of the wells and shows radar to display current precipitation in the area.



2. The Wells tab within the Farmer Portal allows growers to compare operation of wells and see recent history of on/off status and curtailments.



3. The Farmer Portal Mobile access allows growers to view and control their wells from an iPhone, Android or Windows phone. Also, the Farmer Portal can be viewed from iPads, Android tablets, Amazon Fire tablets and Windows tablets. Below is an example of screens on an iPhone.



VII. Project Results Summary and Next Steps

The overall objective of the project was to demonstrate the capability of BPLG's advanced load control technology in anticipation of leveraging the technology as part of a broader program. The BPLG Demand Management solution utilizes a variety of communications backhaul methods (On-Ramp Wireless in this case), responds to OpenADR requests, provides metered metrics at the device level and delivers benefit and value to participating farmers.

The project successfully achieved this objective. In addition, the delivered solution demonstrated added value to farmers and growers through the Farmer Portal. This portal enables the ability for remote on/off control, view of operating state of all participating loads, and geographical overview of devices, including a weather map overlay to provide farmers and growers with current weather at site locations.

The Tulare Energy Education Center is a local resource provide by SCE to aid customers in the educational benefits related to the use of energy. SCE and BPLG have initiated a discussion that would expand the learnings of this pilot project to benefit farmers through this educational resource. BPLG would present the CNRG Demand Management Farmer Portal benefits to farmers at the Tulare Energy Education Center as part of an existing SCE energy education initiative. Next steps are as follows:

- Create and schedule a class/workshop at the Tulare Energy Education Center that conveys program benefits to potential customers
- Broaden the target audience to others within SCE including stakeholders with OpenADR program interests
- Investigate location for installation of a cellular communications load control device to compare latency with On-Ramp Wireless
- Refine the concept of an operating model that allows for the adjusting of controlled load in response to non-spinning ancillary service needs