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October 1, 2018

Ed Randolph
Director, Energy Division
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

Re: A.11-03-001 et al- Southern California Edison Company's 2018 Semi-Annual Report on Demand Response Emerging Technologies Program

Dear Mr. Randolph:

In accordance with Decision 12-04-045, Ordering Paragraph 59, attached please find Southern California Edison (SCE) Company's semi-annual report. This report is also being served on the most recent service lists in Application 11-03-001 et al. and Rulemaking 13-09-011, and has been made available on SCE's website. The URL for the website is:

Go to www.sce.com;

- Click on the "Regulatory" Information link at the bottom of the page;
- Select "CPUC Open Proceedings";
- Enter "A.11-03-001" in the search box;
- Locate and select the "SCE Emerging Markets & Technology DR Projects 2018 Q1-Q2 Semi-Annual Report" link to access associated document.

If you have any questions, please feel free to contact me.

Sincerely,

/s/ Nathanael Gonzalez

Nathanael Gonzalez

cc: A.11-03-001 et al. Service List
R.13-09-011 Service List

Enclosure

Demand Response Emerging Markets and Technologies Program

Semi-Annual Report: Q1 – Q2 2018

Prepared by:
Southern California Edison (U-338-E)

September 2018

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Contents

1. Summary

The Emerging Markets & Technologies (EM&T) Demand Response (DR) Projects Semi-Annual Report: Q1 – Q2 2018 is provided in compliance with Ordering Paragraph (OP) 59 of the California Public Utilities Commission (CPUC) Demand Response Decision (D.) 12-04-045[1], dated April 30, 2012. The subject Decision directed Southern California Edison (SCE) to submit a semi-annual report regarding its DR EM&T projects by March 31 and September 30 of each year. This report is provided for SCE's EM&T program activities in compliance with D.12-04-045.

As described in SCE's 2018-2022 DR program application (A.17-01-012, et al[2]) and ultimately approved in D.17-12-003, the EM&T program facilitates the deployment of innovative new DR technologies, software, and system applications that may enable cost-effective customer participation and performance in SCE's DR rates, programs, and market resources. SCE has administered this program through several DR program cycles, in coordination and support of the changing role of DR in California. The current DR EM&T program strategy is focused on four key areas:

1. Enhancing the availability of cost-effective DR-enabling, end-use technologies for SCE customers participating in DR programs
2. Supporting and developing DR in the California Energy Commission (CEC) T-24 Codes and Standards (C&S)
3. Encouraging innovative DR emerging technologies, as well as customer acceptance and engagement, through upstream market enablement, and
4. Reducing technology barriers for the integration of SCE's retail DR programs into the wholesale market through Participating Load, Proxy Demand Response (PDR), and other market tariffs.

SCE works collaboratively with other California Investor-Owned Utilities (IOUs) that deploy similar DR programs, as well as with other DR research organizations, national laboratories, and state agencies, to investigate innovative applications and software that could enable increased customer participation in SCE's DR program portfolio through the four strategies of the EM&T program.

In accordance with the CPUC direction for the reporting of the DR EM&T program, SCE has identified completed, continued, and initiated EM&T projects and presented them in this report for the first half (Q1 and Q2) of 2018. This report summarizes each project, estimates the expected term, identifies potential benefits, describes the activities undertaken, and explains the results and status of these EM&T DR projects during the timeframes between January 1, 2018 and June 30, 2018.

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[1] D.12-04-045, Decision Adopting Demand Response Activities and Budgets for 2012 through 2014, Ordering Paragraph 59, *available at*: http://docs.cpuc.ca.gov/PublishedDocs/PUBLISHED/GRAPHICS/165317.PDF].

[2] A.17-01-018, SCE's 2018-2022 Demand Response Application, Testimony Vol. 2, p. 41

2. Projects Completed Q1 – Q2 2018

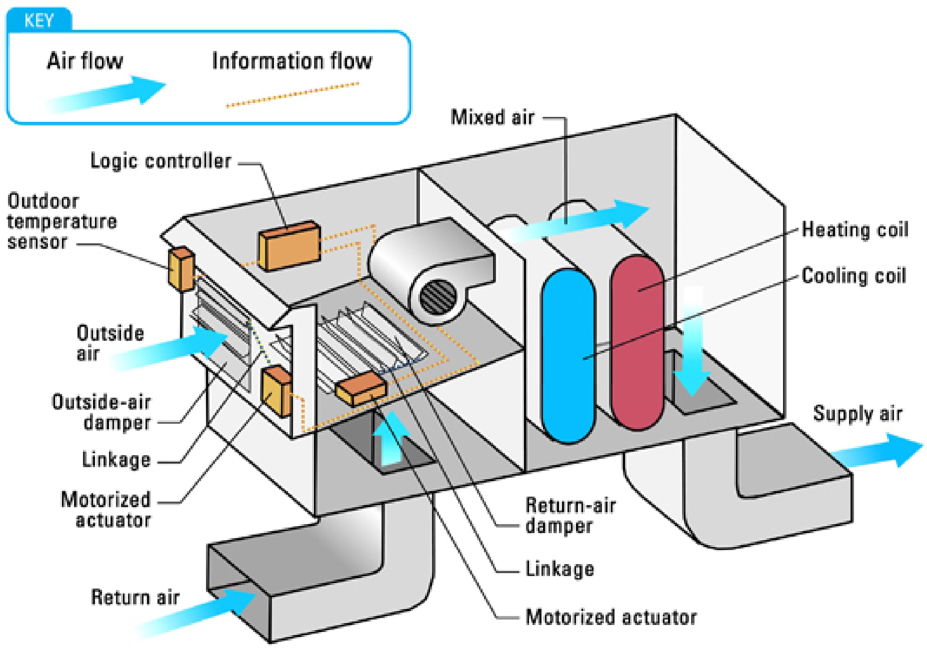
DR16.05 Laboratory Assessment of Demand Response Rooftop Unit Air Conditioner Controller

Overview

This project tests the functionality of the rooftop unit air conditioner (AC) controller. The ability to control air conditioners using automatic signals would benefit responsiveness during demand response events. Between January and June of 2018, lab tests were performed on the controller. Results indicate that the controller can potentially reduce power demand. The majority of Southern California's electrical power demand and energy consumption during the summer months is associated with residential and commercial AC systems. Peaking electrical demand during occasional heat storms in constrained areas can also adversely affect local grid reliability. To manage these issues, utilities have offered DR programs, with economic incentives, to reduce power demand and usage at certain times of the day that coincides with the peak demand. However, to fully take advantage of these programs and maximize the load impacts, the DR programs need automatic signals to effectuate responsiveness, and so customers will (in the future) need access to:

1. Equipment and appliances that enable rate and grid condition communications.
2. Equipment and appliances that offer integrated control capabilities to respond to the information received.

These DR signaling capabilities can be embedded in the devices and achieved at the factory level, or by retrofitting and installing add-on devices to existing equipment. The air conditioning DR signals for rooftop unit (RTU) AC systems are the subject of this project.



Typical RTU AC System

This project was conducted in SCE's Technology Test Center's (TTC) controlled environment test chambers to assess the ability of a typical RTU AC system to communicate via the OpenADR protocol for demand response operations. A controller was preprogrammed with test messaging strategies so that the RTU system would respond (in accordance with the manufacturer's specifications) to two distinct DR events ("high" and "moderate"). For moderate DR events, average total power demand over the test period was reduced by up to 33 percent (see link to final report under Next Steps, below, for details). For high DR events, average total power can potentially be reduced by 60 percent. Eight tests quantified power demand reductions for each strategy under two indoor and outdoor climate conditions. The indoor conditions were Dry-Bulb Temperature (DBT) of 80 degrees Fahrenheit (°F) and Wet-Bulb Temperature (WBT) of 67°F, as well as DBT of 75°F and WBT of 63°F. The outdoor DBTs were 95°F and 105°F.

Collaboration

The manufacturer's certified contractor installed and set up the controller. The OpenADR Alliance was consulted for OpenADR 2.0 protocols. Cooling capacities and performance characteristics were determined in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 210/240. This standard adopts Test Standard 37, developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). TTC staff assisted with the test set-up and execution, as well as with data collection.

Results/Status

Project results indicate the controller responded to both moderate and high DR signals through a central gateway. Tests also confirmed each event's pre-programmed DR controller strategy was executed properly. Results also indicate demand reduction is possible as part of an overall EE/DR strategy.

High DR events resulted in a rise in indoor DBT, as expected. For moderate DR events, the rise in indoor dry bulb temperature (DBT) was 6°F to 9°F. The rise in indoor DBT was more evident for high DR events, with temperatures ranging between 14°F and 17°F.

Next Steps

The final report is posted to the Emerging Technologies Coordinating Council (ETCC) website at:

https://www.etcc-ca.com/reports/laboratory-assessment-demand-response-rooftop-unit-rtu-controller

DR16.06 Market Characterization Study of Automated Demand Response Capabilities of Variable Refrigerant Flow

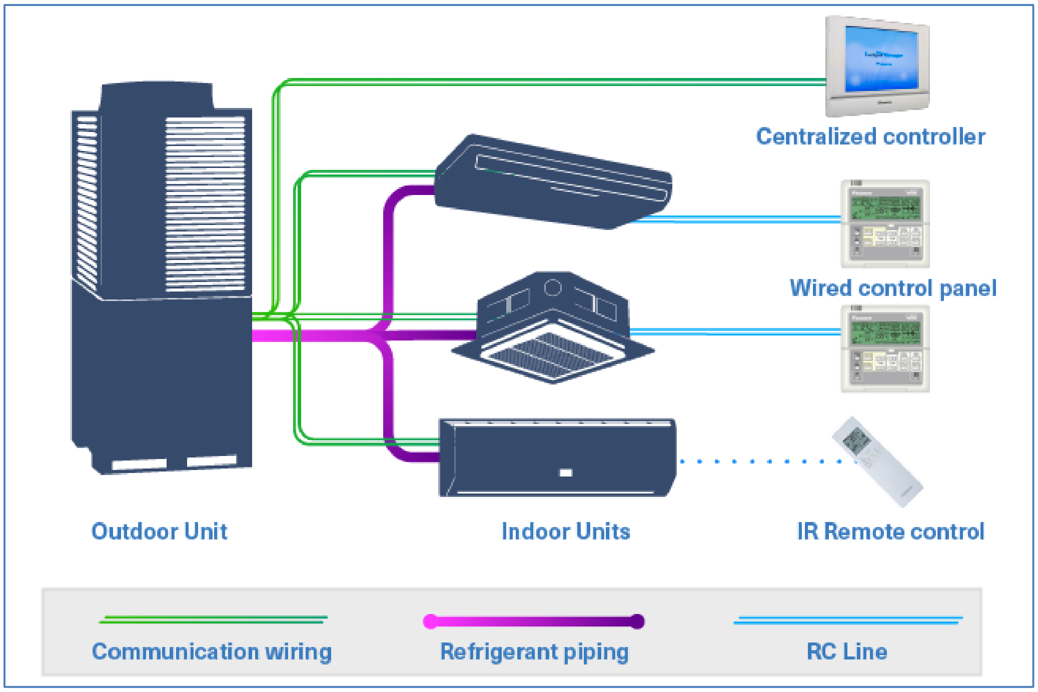
Overview

The first phase of this project studies the capabilities of Variable Refrigerant Flow (VRF) for air conditioning systems by various manufacturers. VRF is beneficial to DR integration as described below. Between January and June of 2018, SCE consulted with VRF manufacturers to understand the capabilities of their products. The study showed that significant development and coordination with manufacturers is needed before VRF systems can be used with California's Demand Response programs. The next phase of this project involves laboratory tests and outreach to manufacturers and other stakeholders.

Variable Refrigerant Flow for AC systems may be well suited to DR integration because of its high energy efficiency (EE) and inherently flexible design. Additionally, sophisticated factory VRF controls are available. Although VRF has been successfully used for EE programs, its applicability to Automated Demand Response (ADR) is still unclear.

The objectives of this study are to understand the status of DR-capable controls across VRF manufacturers, and to report on their compliance with ASHRAE and California building energy code DR requirements.

Project deliverables include a report to be published identifying the status of ADR-capable VRF controls among various VRF manufacturers, determining whether VRF controls meet DR requirements in the California energy code, and reporting on VRF manufacturer plans to offer ADR-capable controls. Recommendations are also provided in the final report.



Typical VRF System Structure

Collaboration

VRF manufacturers were key project stakeholders. SCE's EM&T and Emerging Technologies Program teams, as well as other program groups, have been consulted and engaged to provide feedback. The VRF technical audience will use findings from this project for future technical programs, handbooks, and research projects associated with VRF and DR capabilities. SCE also plans to share this information (in an anonymized fashion) with its stakeholders in the ETCC and other forums. Vendor feedback is considered internal information at this time.

Results/Status

The potential for increasing and enhancing California's DR programs require significant development and coordination with manufacturers to take advantage of the flexibility of commercial VRF systems with advanced controls. This phase of the project demonstrated a need to educate manufacturers on minimum code requirements and additional requirements for voluntary program participation, including OpenADR certification.

Existing software within the VRF system allow existing control capabilities to include adjusting variable-speed compressors for demand limiting, cycling, or rotating indoor units; improved displays; and DR event reporting. Despite having sophisticated controls and a built-in communication network between system components, VRF systems to implement turnkey OpenADR are not yet fully available.

Next Steps

Project information that includes vendor-specific information will be merged into another project phase which includes the following steps:

- Develop a laboratory and field test facility for DR testing.
- Coordinate with SCE's TTC to develop test procedures.
- Work with a consultant to develop a DR outreach workshop for VRF manufacturers and other industry stakeholders.

DR16.08 Demand Response and Demand Flexibility Codes and Standards Enhancement

Overview

This project involves efforts to update the California's Building Energy Efficiency Standards. Updates to the code are potentially beneficial to clarify existing demand response requirements for consistency and ease of understanding. Between January and June of 2018, SCE and other stakeholders evaluated existing standards and submitted a report with recommendations to the CEC. The recommendations submitted are detailed below.

The CEC, a division of the California Natural Resources Agency, is responsible for activities such as forecasting future energy needs, promoting EE through appliance and building standards, and supporting renewable energy technologies. One of its primary responsibilities is to maintain California's energy code.

California's Building Energy Efficiency Standards are updated on a three-year cycle. Their compliance code is Title 24 (Part 6). The 2016 Standards improve upon 2013 Standards for residential and non-residential building new construction, additions, and alterations. The 2019 Standards will go into effect on January 1, 2020.

This project's objective is to better define and clarify existing DR requirements from the Title 24 2016 version, so it will be properly scripted for the 2019 version. All sections of the standards must be upgraded to use consistent terminology and approach. In collaboration with the stakeholders mentioned below, SCE provided code language recommendations to the CEC. The goal is to make the DR requirements easier to comply with and understand, ultimately making it easier for building occupants to receive economic benefits of utility DR programs.

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support the CEC's efforts to update California's Building Energy Efficiency Standards (Title 24, Part 6) to include new requirements (or upgrade existing requirements) for various technologies. This project focuses on the DR and Demand Flexibility Codes and Standards Enhancement Project report, which will be submitted to the CEC for consideration in the 2019 Title 24 rulemaking. The objective of this code change proposal report is to clean up and clarify the existing demand response (DR) requirements so that all sections of the standards use consistent terminology and approach. The goal is to improve comprehension of and compliance with the existing requirements. The CASE report proposal strives to make it easier for occupants of compliant buildings to realize the economic benefits of their buildings' demand responsive controls by enrolling in DR programs.

Building System	When DR Requirement Applies	Required Automatic Response to DR Signal	Technology Required for Compliance	Compliance Verification
Nonresidential Lighting	• Building area ≥10,000 square feet • Habitable spaces where lighting power density >0.5 watts/square foot	Reduce lighting power by ≥ 15%	• Lighting system capable of reducing lighting power (e.g., dimming) • DR lighting control (could be an EMCS)	Acceptance Test
Nonresidential HVAC (with DDC to zone level)	All building types	Adjust temperature setpoints in non-critical zones ≥ 4° F	DR HVAC control (could be an EMCS)	Acceptance Test
Nonresidential HVAC (without DDC to zone level)	All building with single-zone AC or heat pumps*	Adjust temperature setpoints ≥ 4° F	OCST	Certified OCST installed
Sign Lighting	• Electronic Message Centers • Connected load ≥15kW	Reduce lighting power by ≥ 30%	• System capable of reducing lighting power • DR control (could be EMCS)	design review

Title 24, Part 6: Existing DR Requirements for Non-residential Buildings

The report additionally recommends improvements to the language in the Standards, Reference Appendices, Compliance Manuals, and compliance documents to:

1. Improve the clarity of the code language without changing the stringency of the standards
2. Harmonize the demand responsive control requirements to include the application of open or standards-based communications protocols
3. Clarify and improve the compliance and enforcement process, and
4. Establish a foundation within the Title 24, Part 6 Standards, Appendices, and Alternative Calculation.

Method Reference Manuals and Compliance Manuals, upon which additional measures have load reshaping and ancillary service benefits, can be added in future code cycles.

The modifications aim to align the terminology used in Title 24, Part 6 with terminology used by industry, model codes, utility programs, and other regulating bodies such as the Federal Energy Regulatory Commission and the California Independent System Operator (CAISO). Revisions also aim to provide sufficient detail on how to comply with the standards while maintaining the appropriate level of leeway to allow for continued market innovation and transformation.

Collaboration

Various stakeholders worked together on this project, including SCE, the CEC, and the statewide C&S team, which included the California investor-owned utilities and two municipal utilities. California ratepayers, architects, builders, building operators, tenants, demand response providers, and various government entities will all benefit from this project.

Results/Status

The Demand Response and Demand Flexibility Codes and Standards Enhancement Study was submitted to the CEC for review on September 1, 2017. The CEC provided the Review and Comments Stage for the 45-Day Language, which was released in January 2018. Adoption of the 2019 Title 24, Part 6 was on May 9, 2018. The effective date of the 2019 code will be January 1, 2020.

This table lists the CEC's adopted Title 24, 2019 DR modifications:

Section of Existing Standards	Summary of Proposed Revision(s)
10-103(b)2	Adds language to clarify that building owner/occupant should receive information about the buildings' control systems, including the DR control systems.
100.1	Updates and adds definitions.
110.2(c)	Revises wording of requirements for thermostatic controls to improve clarity.
110.10	• Revises wording of solar-ready tradeoffs that allow the use of thermostatic controls that comply with Joint Appendix 5 (JA5) improve clarity. • Replaces the phrase "home automation system," which is not defined, with the defined term "energy management control system," which is defined.
110.X (new section)	• Adds new section that contains all requirements for demand responsive controls. • Content was removed from the following sections and added to this new section: 120.2, 130.1(e), 130.3, 130.5(e). • The original language was reworded to improve clarity. • Clarifies and harmonizes communications protocol requirements for all demand responsive controls other than thermostatic controls that comply with JA5 (revisions to JA5 include modifications to communications protocol requirements that harmonize with the communication protocol requirements for all other demand responsive control systems required by the standards).
110.Y (new section)	• Adds new section that contains all requirements relating to when an Energy Management Control System can be used to comply with building control requirements. • Content was removed from the following sections and added to this new section: 130.0(e), 150.0.
120.2	• Revises section heading name to be consistent with all other sub-sections with in Section 120. • Revises wording of requirements for thermostatic controls to improve clarity. • Moves demand responsive control requirements from this section to section 110.X. This section direct readers to section 110.X
130.0(e)	Moves requirements that indicate when EMCS can be used from this section to section 110.Y. This section keeps a reference to direct readers to section 110.Y
130.1(e)	Moves demand responsive control requirements from this section to section 110.X. This section direct readers to section 110.X.
130.3	• Revises section heading name to be consistent with all other sub-sections with in Section 130. • Moves demand responsive control requirements from this section to section 110.X. This section direct readers to section 110.X.

130.5(e)	• Revises section heading name to be consistent with all other sub-sections with in Section 130. • Moves demand responsive control requirements from this section to section 110.X. This section direct readers to section 110.X.
141.0(b)2E	Revises wording of requirements for thermostatic controls to improve clarity.
150.0(i) and (k)	• Revises wording of requirements for thermostatic controls to improve clarity. • Moves requirements that indicate when EMCS can be used from this section to section 110.Y. This section keeps a reference to direct readers to section 110.Y
150.2(b)1F	Revises wording of requirements for thermostatic controls to improve clarity.

Next Steps

After adoption of the 2019 Title 24, Part 6 code, the CASE report team has been working on updating the Compliance Manuals according to the adopted DR code changes. CEC will be approving the Compliance Manual updates in November 2018.

The IOU Codes and Standards team has drafted a list of potential code update measures for the 2022 code cycle. This list includes several DR-related measures which will be shared with IOU and Industry stakeholders. The CEC also provides feedback on what measures have the greatest potential for adoption. The IOU Codes and Standards team will finalize the list of 2022 measures by February 2019.

The CASE reports are docketed both with the California Energy Commission (https://www.energy.ca.gov/title24/2019standards/) and the Title 24 Stakeholders website (www.title24stakeholders.com).

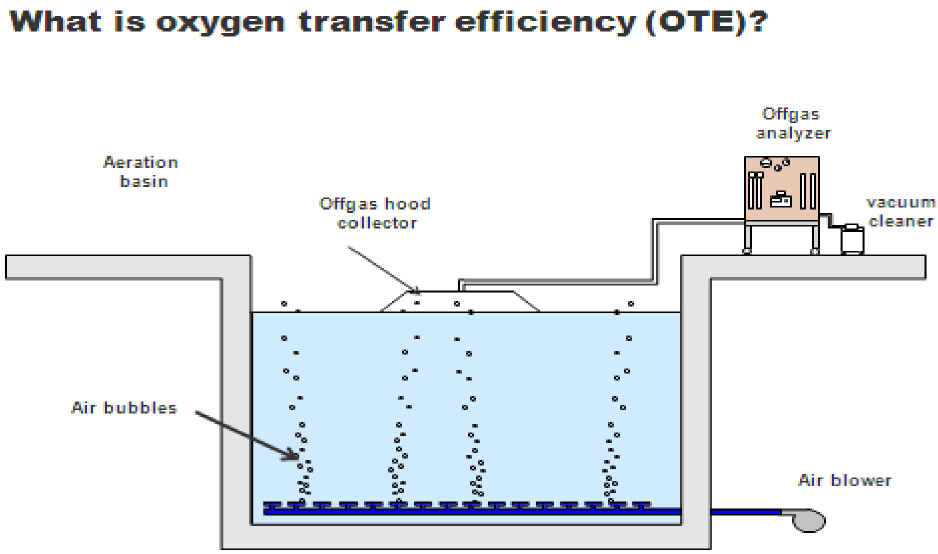
3. Projects Continued Q1 – Q2 2018

DR15.18 Wastewater Treatment Plant Demand Response

Overview

Wastewater (WW) processing is an energy-intensive and continuous industrial process, subject to varying hourly surges and a critical process that cannot be interrupted. Typical WW Treatment Plants (WWTPs) have limited capacity to store incoming WW, thereby prohibiting effective DR strategies. This may require shifts or changes in process operations. WWTPs are also subject to rigorous State and Federal WW discharge permit requirements.

Recent technological developments have shown that a significant reduction in electrical power may be possible for WWTPs. A reduction in power could improve their efficiency and present an opportunity for DR. Aeration blowers, which can effectuate the process of oxygen transfer efficiency (OTE), are used as part of the secondary treatment stage (activated sludge). They may account for 50% of a plant’s energy demand and usage and can be controlled through new technology to significantly reduce power requirements, thereby making effective DR event responses possible.



Wastewater Aeration System

This project tests changes to a WW treatment facility's aeration operation to facilitate DR capabilities and impacts. The goal is to find the optimum configuration that meets the DR objectives without compromising the process operations; in other words, maximizing power reduction with minimal impact to the plant's operation. The technology is designed to improve overall plant efficiency for wastewater aeration. This effort demonstrates the potential for DR event participation. The research supports the EM&T policies for providing greater grid security through energy load reduction on demand, while integrating the increased energy efficiency through precision process control.

Project deliverables include:

- A report including methods, site data logs, results of DR effectiveness, and recommendations for future development and application.
- A permanent advanced OTE analyzer installed at the Chino, California site.

An effective DR response, plus sustained process control, will enable WW treatment facilities throughout Southern California to adopt this technology. The DR results could be of significant value to the plant operators if they participate in DR programs.

Collaboration

As described below, multiple stakeholders have come together to provide support, thus helping to ensure project success through meaningful engagement:

- DrH2O, the prime contractor, which developed the OTE Analyzer was responsible for all field work and technical expertise.
- University of California at Irvine supports this work as a subcontractor to DrH2O.

- SCE's field engineering staff, working with the DrH2O team, supports the field and technical work.
- The Inland Empire Utility Authority (IEUA) WW facility in the city of Chino provided the installation site.

Results/Status

Telemetry development and data collection is ongoing. All stakeholders, including those at the host test site, are satisfied with the progress. Preliminary results support the project goals of examining how this system can contribute to local grid resiliency through DR load impacts, as well as increasing EE through using the OTE analyzer for precision WWTP aeration system process control. Preliminary findings are significant and promising. Completed work to date and planned activities are:

1. The data collection systems are operational, allowing the project team to gather continuous data to assess the long-term functionality of the off-gas analyzer and routinely calibrate it as data is collected.
2. The Dissolved Oxygen (DO) probe calibration is complete and is checked periodically throughout the project testing.
3. The power demand interface is nearing final development, and at its completion, the actual WW plant power demand will be compared to the interface data.
4. The analyzer will continue to be tested, with upgrades and modifications to be added as needed.
5. The data from 2017 and the first half of 2018, along with new data, will continue to be analyzed.

Next Steps

The project continues to measure and evaluate configurations that meet the desired objectives in the overall research plan. The test will also examine additional benefits that include reduced maintenance and energy costs of the aeration systems. The testing is expected to continue through mid-2018, with a goal of publishing results at some time in late 2018.

DR15.20 Dispatchable Condenser Air Pre-Cooler

Overview

As outdoor air temperature increases, AC efficiency quickly reduces, taking more energy to deliver the same amount of space cooling. This is compounded by the fact that during hotter periods, cooling needs increase. SCE seeks viable solutions for increasing EE and implementing DR during high-temperature operating conditions and applying these solutions to the most prevalent type of RTU.

This laboratory and field study were contracted to the University of California at Davis (UC Davis) as part of a three-year effort to determine the energy and demand impacts after an evaporative pre-cooler is turned on to pre-cool condenser air coming into the RTU measured by meter data in kWh. Researchers will study the transient response of cooled inlet condenser air and its impact on improved compression cycle efficiency and demand load profile reduction.

Example of Direct Evaporative Cooling of Condenser

A dispatchable pre-cooler technology will be field tested at a site that has an existing pre-cooler installation. The data will be used to determine the potential of using pre-coolers as dispatchable resources for load modification. This may lead to a solution for a new program design for load shifting that may help enable and expand DR program or TOU rate adoption.

Collaboration

The key entity undertaking this project is UC Davis' Western Cooling Efficiency Center. The Center is located at UC Davis, and SCE is a supporting partner along with many other HVAC industry stakeholders. The Center educates and collaborates with industry stakeholders to stimulate the development of cooling technologies that can reduce building energy demand and water consumption, and this effort will be shared through those partnerships.

Results/Status

The laboratory test has been completed and the results are being compiled in a draft report. The data verifies single-compressor RTU demand reduction after a pre-cooler is activated; however, signal delays were observed during testing, which resulted in slower response for some of the test locations. A review of the manufacturer's RTU literature has been completed, to investigate delays required to turn off compressors in multiple-compressor units. The report will give a more detailed explanation of the impacts of pre-cooling for demand savings associated with this RTU system.

SCE has worked with UC Davis to assess more empirical demand impacts during the first half of 2018. UC Davis selected the site and installed sensors on the equipment to access vital performance indicators. Preliminary results show a power reduction of 20 percent for the RTU, while yielding a coincident 10-percent increase in cooling capacity. Power reduction findings are 75 percent in one minute of DR signal dispatch, and 100 percent power reduction within 13 minutes of DR signal dispatch.

Next Steps

Findings from laboratory testing, manufacturer literature, and the preliminary field testing have resulted in a better understanding of how this system provides DR load impact capabilities. SCE will assess whether to incorporate this strategy as a recommendation for these types of systems (in the context of a final report). UC Davis has gained further understanding of the operation, benefits, and strategies for Air-Handling Unit (AHU) pre-coolers. This understanding could potentially expand DR load shed and shifting capabilities.

DR15.21 Mosaic Gardens Low-Income Multi-Family Housing

Overview

A large percentage of new construction in California is now Multi-Family (MF) residential. Much of this housing stock is targeting a long-overlooked segment — Low Income. As a result, State programs are including incentives to encourage the development of new Low Income Multifamily (LIMF) residential construction projects.

This project provides SCE a real-time "in situ" opportunity to demonstrate Zero Net Energy (ZNE) measures in new LIMF construction. The knowledge gained will assist in understanding implementation barriers that can lead to greater adoption of ZNE in this sector. The goal is to conduct a field test to evaluate the installation and operation of viable measures that could provide EE and DR capabilities in individual residential units and communities.

Mosaic Gardens complex

Located in Pomona, Mosaic Gardens is a new three-story LIMF residential development consisting of forty-six apartment units constructed on an infill lot. The apartment units vary in size from one to three bedrooms. The community serves tenants that are low-income; half the units are designated for displaced residents. Renewable energy generation technologies implemented at this development include a 34 kW rooftop PV array, complemented by a grid-tied storage battery. Both of these serve the common areas. The interaction of these systems is fundamental to attaining ZNE goals.

The project includes the demonstration of key DR features such as: smart communicating thermostats to reduce electricity demand in response to an OpenADR signal; grid-tied battery storage; and advanced building controls using Virtual Net Energy Metering (VNEM) to support grid stabilization.

As part of this unique field assessment, the project evaluation will cover the performance, customer acceptance, operational viability, EE, DR, and cost-effectiveness of the applied technologies. SCE expects to gain a comprehensive understanding of installation costs and barriers to ZNE in new construction.

This project will also explore the benefits of DR controls through wireless communicating thermostats and DER interaction. The technology is expected to provide improvements to LIMF community management and operations, and improved tenant comfort with low energy costs. Additional predictive outcomes from this project are expected to provide insights into how and when energy is used in a LIMF development. The detailed real-world data collected on the interaction of building technologies with residents shall provide insights into the high-performance building industry in planning future LIMF developments.

Collaboration

Many stakeholders are collaborating in this multi-faceted project, contributing to achieving the project goals. The facility owner, LINC Housing, is a key stakeholder, demonstrating support as an early adopter of new technologies for the LIMF segment. The California Energy Commission is another important stakeholder, providing support to collect and analyze energy usage data which demonstrates the building system's performance.

SCE's stakeholders include the Emerging Technologies Program, the Emerging Markets and Technology Group, the Savings by Design Group, and the Codes and Standards Group. Together, these stakeholders provided much support which included: leveraging resources to investigate DR and DER opportunities, providing SMEs, helping the owner identify measures that qualify for incentive payments, and providing SMEs to support the project throughout the design and construction process.

Results/Status

Building construction is complete and occupancy is 100% as of early 2018. All building systems are in operation, including the PV array, except for the battery storage system. Construction best practices and cost data are identified and documented. The Construction data is helping to support the development of a new MF Commercial Building Code.

Measurement and verification (M&V) equipment supporting the end-use data acquisition system (DAS) is operating and has started recording data for a year after occupancy.

Next Steps

Data at the site are being continuously gathered and documented to assess performance of the building to meet the overall intent of the ZNE design. Additional activities include:

- Installing the grid-tied battery by the end of third quarter 2018.
- Fully commissioning an energy information community dashboard, which will display end-use energy data (expected to be completed by the end of 2018).
- Planning a training session for Q4 2018 to educate site personnel on properly operating equipment such as a dashboard, thermostats, and other technologies.

After a year of collecting occupancy performance data, the project is expected to be complete and a final report is expected in mid-2019.

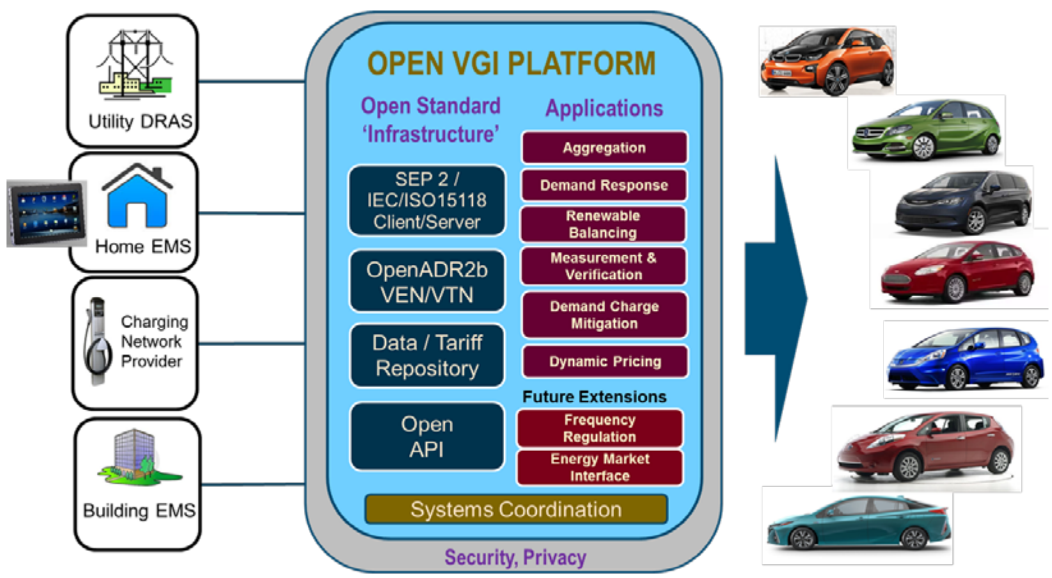
DR16.02 Open Vehicle Grid Integration Platform (OVGIP)

Overview

Plug-in Electric Vehicles (PEVs) represent a rapidly growing class of smart, connected loads with increasing nationwide adoption. Utilities have an opportunity to manage PEV charging in a manner consistent with DR and DSM objectives. However, the PEV infrastructure and load management landscape is currently fragmented, with PEVs and charging network providers positioning themselves as aggregators seeking to leverage their proprietary telematics, charging networks, and interfaces.

To streamline PEV charging, EPRI's Electric Transportation program has engaged with eight leading global PEV manufacturers over the last two years, to develop a proof-of-concept for an Open Vehicle Grid Integration Platform (OVGIP). This platform may enable access to data-on-vehicle energy use, charging profiles, and consumer responses to various signals or inducements to affect charging. With these capabilities, utilities would be able to integrate all PEVs in their service territories into DR and DSM programs.

The project objective is to advance the open platform concept into the product development and testing stage. It will assess the effectiveness of an open standards-based platform to seamlessly integrate PEV charging with grid objectives through DR and DSM mechanisms.



EPRI OVGIP Project Architecture

The project includes the following objectives:

1. Create requirements and use cases for a unified grid services platform that is secure, low-cost, open, and extensible.

2. Develop an architecture and functional representation of a platform that enables PEV integration into DR and DSM use cases.
3. Assess platform performance against industry requirements through field trials at utility host sites.
4. With this platform, enable multiple manufacturers to participate in DR programs regardless of the communication protocol used by these manufacturers to communicate with EVs.
5. With OVGIP, enable the utilities to use one platform to reach out to multiple OEMs and receive an aggregated capacity from these OEMs.

Project deliverables are:

- A report describing the technical requirements, architecture, design, and open-interface specifications.
- Open grid services platform software to integrate and apply to future extensions of other end-use devices and additional grid services.
- An EPRI final report to be posted on the ETCC website.

Collaboration

Original Equipment Manufacturers (OEMs) are enhancing their platforms to enable accurate DR action when dispatch events are received. The project is in collaboration with EPRI, multiple industry vehicle OEMs, and utilities. EPRI is coordinating the participating utilities and will prepare the final report.

Automotive industry participants include BMW, Daimler, Fiat Chrysler, Ford, Honda, Nissan, and Toyota (GM, Tesla, and VW Group: Observers).

These utilities form the development team: PG&E, SDG&E, SMUD, Puget Sound Energy, Hawaiian Electric, New York Power Authority, Southern Company, Duke Energy, American Electric Power, and Con Edison.

Results/Status

- Architecture testing is complete.
- Use cases have been tested on a few beta vehicles enrolled in the project.
- Honda launched a larger “pilot” using the design requirements for this project.
- Project is currently enrolling more customers.
- Design of customer survey is in progress.

One of the OEM's participation seems unlikely due to technical issues on their end. They could not expend appropriate resources for this project in time and are behind on their technical development. The project will move forward with only one OEM at this point. Any changes to this status will be provided in the next update report. Testing is on track to be finished in Q3 2018, and the final EPRI report, including a DR communications assessment, is targeted for completion by the end of 2018.

Next Steps

A customer survey will be sent to participants to receive feedback on their experience during participation and on the enrollment process for this project. After testing is concluded a final report will be published at the end of 2018.

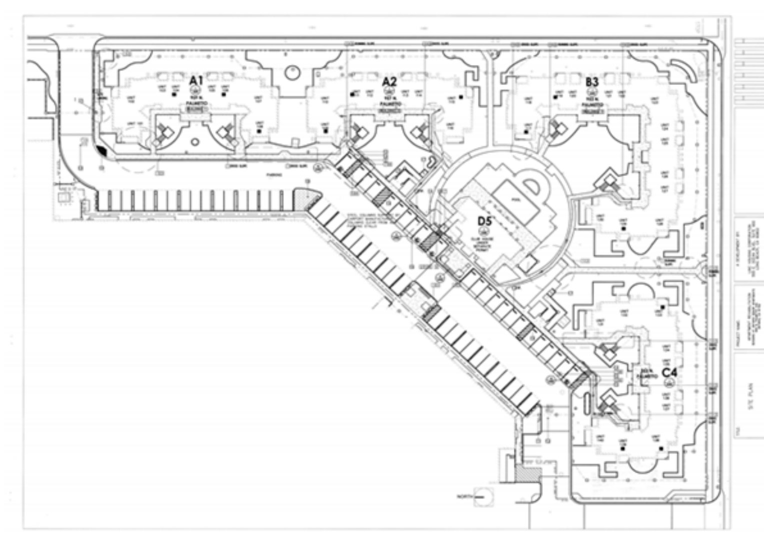
DR17.02 Customer-Centric Approach to Scaling IDSM Retrofits

Overview

California’s Building Energy Efficiency Standards are moving the state closer to achieving its Zero Net Energy (ZNE) goals. All new low-rise residential buildings are to be ZNE by 2020, and all new commercial buildings are to be ZNE by 2030.

Achieving these goals is a major improvement in energy efficiency in the construction industry’s building practices and presents occupants with energy, cost, and Green House Gas (GHG) reduction opportunities. While the state’s ZNE goals are a major step forward, they represent a fraction of the energy, cost, and GHG reductions that buildings can achieve.

This project is a partnership through an Electric Program Investment Charge (EPIC) solicitation, with Electric Power Research Institute (EPRI) as the awardee. The EPIC solicitation is titled, *Scaling Customer-Centric Energy Efficiency Retrofits with Integrated Demand Side Management (IDSM)*. The project's primary goal is to formulate, demonstrate, and evaluate an innovative retrofit methodology combining a traditional technical approach with customer-centric needs. The focus is on designing IDSM/ZNE packages and guidelines for EE retrofits that could enable scaling EE and DR measures in existing low-income communities.



Site Plan of Apartments and Community Center

This project is intended to demonstrate Integrated Demand-Side Management (IDSM) and ZNE solutions in the multi-family (MF) sector category. A LIMF property will be used in the demonstration.

Project objectives are to:

- Formulate IDSM and ZNE solutions for MF residences.
- Create new resources for IDSM retrofit solutions to meet ZNE goals.
- Create IDSM retrofit guidelines for residences in low-income communities.
- Develop a list of technologies that create customer-centric packages for future retrofits.

Collaboration

Many stakeholders are involved, starting with the CEC, which developed the EPIC solicitation. EPRI won the EPIC solicitation and is therefore the overall project lead. Another key stakeholder is LINC Housing, an affordable housing owner and operator. SCE is the host utility, technology lead, grid-side lead, and is providing SME assistance as part of its advisory role for the EPIC project. SCE is also providing additional financial support for EPRI to collect data to support the project outcomes. Sustainable consulting is provided by BIRAenergy.

Results/Status

Construction work is well underway on the implementation of measures, also known as the Energy Efficient Retrofit Packages (EERP). As part of the EERP, the apartment units are undergoing HVAC retrofits at a pace of ten units per week. The data collection devices are installed and commissioned, using circuit-level plug-load data collection devices. Tankless gas water heaters are being installed in lieu of heat pump water heaters (HPWH), as physical room for installation of HPWH was not available.

Next Steps

Construction is expected to be completed by late Q3 or early Q4. The project outcomes are on track to provide information via active feedback to various project and industry stakeholders to demonstrate appropriate ZNE and IDSM technologies. After occupancy, the site will be monitored for a year to quantify ZNE performance of the shell and end uses.

The final report is scheduled for delivery in January 2020. After final approval, the report will be posted on the ETCC website.

DR17.03 Demonstration of Affordable, Comfortable, and Grid-Integrated ZNE Communities

Overview

A large percentage of residential new construction in California is in the multi-family (MF) housing sector. In alignment with California's policy goal of ensuring that all new residential construction is ZNE by 2020, this project gives SCE an opportunity to demonstrate the “building blocks” of how that can be accomplished for ZNE in new MF construction. This project represents a partnership with sector stakeholder Meritage Homes, a large production homebuilder which will design, build, and monitor a new 44-unit ZNE MF residential community in Irvine, CA.

A primary goal of this project is to demonstrate the technical and economic feasibility of the advanced measures for ZNE homes within the MF housing sector, in accordance with the research objectives of the California Energy Commission grant funding opportunity. A secondary goal is to study how the ZNE MF home with solar and storage can possibly develop the appropriate strategies for effective integration to the electric grid. This integration would be accomplished via load management and load modifying end-use operation, using appropriate technologies such as smart air-conditioning controls and other end-use measures.

As with all ZNE construction, there are important demand response elements in the building design and operation that can accommodate the solar and energy storage systems often included as part of the overall integration. By examining how the systems can interact and optimize their operation for meeting the intent of the ZNE design, as well as provide a better understanding of maintaining a minimal impact on the local grid system, the project will provide valuable information for the MF building industry, one of the most robust new construction sectors in California.

Architectural Rendering of ZNE MF housing

Project outcomes are expected to provide input to the development of the California Energy Code, help develop neighborhood planning tools, assist in cost-effective ZNE implementation for developers and builders, and support utility distribution system planning to consider ZNE home electrical load performance.

This project will also provide feedback on the implementation of voice-activated DR control in-home technologies (if applied) and grid-interactive heat pump water heaters.

Collaboration

This project includes collaboration with:

- EPRI, overall project lead.
- Meritage Homes, builder and seller of the MF units.
- SCE, technology lead and grid lead.

Results/Status

SCE provided advisory review of the ZNE designs at value engineering meetings held in the first half of 2018 to develop a design plan to demonstrate cost-effective measure packages to builders. The measure packages that came out of these activities were evaluated using a whole-building approach, and the builder incorporated many energy technologies (ETs) into the design. The project is currently under construction with the first model homes expected to be completed by October 2018.

Meritage will install a measure package consisting of the following ETs:

1. Induction cooktops.
2. OpenADR-connected, API-controllable heat pump water heaters.
3. Heat pump dryers.
4. Electric barbeque grills.
5. High-performance windows.
6. Variable refrigerant flow heat pumps.
7. Network-connected ecobee smart thermostats with DR capabilities.
8. Ducts located in air conditioned attic spaces.
9. Voice assistant-driven smart home energy management systems.
10. Smart intermittent ventilation systems.
11. Integrated smart electric-load panels, with built-in circuit energy monitoring.
12. Integrated grid distribution planning for ZNE.
13. Integrated DR controls to improve electric load shaping.

Next Steps

Project outcomes are on track to provide information to the various stakeholders and will enable future designers and homebuilders of MF ZNE homes to include in their offerings residences with built-in DR features.

Testing and data monitoring of this project still under design will begin when the housing units are built and sold, and will continue until June 30, 2019. The final report is expected by December 31, 2019. After review and approval, the report will be posted to the ETCC website.

DR17.04 Energy Management Circuit Breakers

Overview

Circuit breakers (CB) are standard home and building electricity service components, which automatically protect electrical circuits from damage caused by overcurrent (typically the result from an overload). CBs interrupt current flow after a fault is detected. Most CBs are simple electromechanical safety devices (switches) that remain closed during normal operation.

This project is an EPRI product development collaboration and nationwide field evaluation that will assess a new approach to end-use energy management through a low-cost, simple-to-install Energy Management Circuit Breaker (EMCB). The EMCB is a single-or double-pole, thermal-magnetic circuit breaker, commonly installed in electrical service panelboards. It's designed to protect an electrical circuit from damage caused by overcurrent, overload, or short circuit. The EMCB also has integrated metering, remote control, and the ability to connect to a wireless local area network (WLAN) for communication. Currently, EMCBs have been installed in 500 homes throughout the nation, and SCE will select a few homes to test the system as part of its collaboration with the other utilities.

EMCB Devices

Participating end-use EMCB loads fall into these major categories:

- HVAC
- Water heaters
- Vehicle charging (via standard EMCB or dedicated EV-EMCB)

A major goal is to understand the functionality and potential value propositions for each device circuit currently in service on utility-owned use cases. The EMCB may prove to be a powerful device to control solar power generation, electrical battery storage, and as a monitoring and verification (M&V) device.

Collaboration

SCE is participating in this project with EPRI as the lead project coordinator. There are eleven other participating nationwide utilities, with most support from:

- Duke Energy
- Southern Company
- CenterPoint Energy
- ComEd
- Pepco

EPRI is also testing the capability of accurately collecting and sharing data, receiving and sending controls to other smart equipment (such as thermostats and water heaters), and shifting home on-and-off grid connections during emergencies.

Results/Status

- DR and energy monitoring use cases were tested at two locations within the SCE service territory. Data is still being collected.
- The DR testing concluded in Q2 2018 and the information has been analyzed in the context of other field tests with other EPRI members.
- The energy monitoring use case was concluded in July 2018, and EPRI will develop a list of use cases for this technology.
- Currently, the equipment is being removed from the test sites in other locations and will be reviewed for performance by EPRI.

Next Steps

A final report on platform options in the EMCB design will summarize the results from these use cases and will be authored by EPRI. The report is expected to be published at the end of 2018.

DR17.06 Aquanta Smart Water Heater Controller

Overview

SCE is interested in examining advanced load management and dispatchable demand response opportunities for future GHG-mitigating technologies, such as non-gas water heater systems. In efforts to advance research and learn more about advanced Electric Water Heater (EWH) control systems, SCE has selected Aquanta, a water heater controller, for initial evaluation and assessment. Aquanta is a “smart” controller for storage water heaters.

The efficient electrification of residential end uses is expected as a result of activities promoting achievement of Zero Net Energy (ZNE) buildings. Because of this, there is much interest in the opportunities associated with electric water heaters. Retrofit controls are available for water heaters, to reduce demand/energy consumption. These controls learn and adapt to the unique usage patterns of a water heater: they reduce standing losses, and ensure water heating is only operational when needed, ideally at low electricity cost periods. These controls are applicable to electric and gas tank/storage water. SCE’s TTC investigated the Aquanta controller to confirm that the product is an adoptable retrofit solution.

Smart Water Heater Connections

Collaboration

This project was initiated by the ETCC, with stakeholders from PG&E, SCE, SoCalGas, SDG&E, the CEC, SMUD, and the L.A. DWP. SCE's ET division was selected to investigate OpenADR compliance with Aquanta's cloud-based system. The SCE TTC developed a test bed to evaluate Aquanta's control with other water heaters.

Results/Status

The project is testing the Aquanta system for OpenADR communications and identifying the performance architecture to achieve effective flexible DR performance. This effort includes system installation and commissioning activities which have begun.

The scope of work includes these major milestones:

1. Baseline testing and controller conditioning: Run for two weeks under a normal water draw profile, with no controller operational influence.
2. Load curtailment testing via portal: Run a 24-hour test, and schedule a two-hour load curtailment event at 6:00 p.m.
3. Time-of-Use (TOU) pricing controls: Run two 24-hour tests for the SCE TOU-DA-weekdays and weekends rate design.
4. Grid Interactive Water Heater (GIWH) thermal storage: Run 24-hour tests under a thermal storage profile test for flexible DR opportunities.

Next Steps

SCE has started a process to conduct lab testing in Phase 1 and field testing in a potential Phase 2. Laboratory testing planned through the end of 2018 will help SCE understand the controller's communication technology, how the device may give customers better energy management, and how utilities may use it for strategic flexible DR initiatives with improved GHG mitigation benefits of non-fossil fueled water heating.

DR17.14 Packaged Ultra-Low Charge NH3 Refrigeration Field Monitoring

Overview

According to the International Institute of Ammonia Refrigeration (IIAR), ammonia is 3 to 20 percent more thermodynamically efficient than competitive synthetic refrigerants. This allows ammonia-based refrigeration systems to use less power to maintain a specific refrigeration load. As a result, ammonia refrigeration systems can offer low long-term operation costs. This project will assess a demonstration of replacement hydrofluorocarbon (HFC) refrigerants with zero GWP ammonia and provide EE and flexible DR benefits to California cold storage users in various refrigeration applications.

Findings from a Port of Long Beach study will determine the site equipment control strategies to be demonstrated at two facilities. One is a 240,000 square foot Long Beach plant and the other is a smaller 70,000 square foot facility at a South Gate, CA. The goal is to achieve at least 20% demand reduction by taking advantage of the NXTCOLD equipment manufacturer's design features and inherent (built-in) site storage capabilities.

Refrigeration Facility Field Test Site

This assessment will also demonstrate whether replacing hydrofluorocarbon (HFC) refrigerants with zero GWP ammonia can provide an integrated solution of highly efficient EE savings reductions and flexible DR benefits to California cold storage users in various refrigeration applications. Both integrated demand side management (IDSM) opportunities are being examined in this field demonstration.

The load shifting strategy for DR opportunities to be examined is based on the thermal mass of frozen or refrigerated food, which will allow customers to temporarily shed electrical load and meet permanent peak shift requirements. Ongoing performance monitoring of all energy and demand metrics will enable real-time data acquisition and analytics, metering, and DR controls. These activities will verify usage and flexible DR abilities (to add load, reduce load, and shift load) and will help build a calculation tool to support the technology's market adoption and knowledge transfer. This information will then be extrapolated to other facilities within SCE's service territory and California.

Collaboration

Project stakeholders include NXTCOLD/Hillphoenix, General Cold Storage, Cypress Ltd., and SCE's EM&T and SCE Emerging Products teams.

Stakeholders' levels of engagement are:

- NXTCOLD/Hillphoenix: equipment manufacturer
- General Cold Storage: field test site, customer
- SCE Emerging Products: Project Lead/Designer
- Cypress Ltd.: M&V, Project Consultant

Results/Status

As of the first half of 2018, the project was in the preliminary evaluation stages, and the packaged system optimization design for assessment was being completed. Thus, no data is yet available. Instrumentation for monitoring DR process performance is being installed at the Port of Long Beach site to initiate the data collection. Based on the South Gate new construction site's cold storage and blast freeze operational requirements, this project will define a set of flexible DR control options and strategies, including testing and measuring results.

Next Steps

- The project will be collecting data that will include the results of energy, demand, temperature, and power metering due to DR testing strategies.
- These data results will inform opportunities for the development of cost-effective measures for the AutoDR incentive program, as well as the other opportunities discussed in this report.
- Calculation tool recommendations will be provided in the report, which will be available by first quarter 2019, pending availability of testing strategies and customer schedules.

4. Projects Initiated Q1 – Q2 2018

There were no relevant DR EM&T projects formally initiated in the first half of 2018. Several projects are either in development or have been committed to but are awaiting next steps. Other projects are currently pending scoping and execution or awaiting collaborative funding through other research activities in anticipation of initiation.

5. Budget

The following is a breakdown of the total expenditures for SCE's 2018-2022 EM&T budget. These values are based on the authorized funding and expenditures as reported in SCE's *Monthly Report on Interruptible Load Programs and Demand Response Programs, Table I2, SCE Demand Response Programs and Activities Expenditures and Funding, 2018*.

Values do not reflect commitments for projects, including those described in this report. Those projects have been scoped and contracted, but not yet executed.

Southern California Edison's Emerging Markets and Technology Program (D.17-12-003)	
Approved 2018-2022 Budget	$14,610,000
Budget Spent in 2018[3]	$547,225
2018-2022 Budget Remaining	$14,062,775

[3] As of June 30, 2018