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Emerging Markets & Technology Demand Response Projects Semi-Annual Report: Q3–Q4 2014

Submitted in Compliance with D.12-04-045
Decision Adopting Demand Response
Activities and Budgets for 2012 through 2014

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Acronyms

AC	air conditioning
ACEEE	American Council for an Energy-Efficient Economy
ADR	automated demand response (also seen as Auto-DR)
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AMI	advanced metering infrastructure
ARRA	American Recovery & Reinvestment Act
ASHRAE	American Society of Heating and Air-Conditioning Engineers
AT	Advanced Technology
BAN	building area network
BCD	Business Customer Division
BESS	battery energy storage system
BEMS	building energy management system
CALTCP	California Lighting Contractors Training Program
CAISO	California Independent System Operator
CASE	Codes and Standards Enhancement
CEC	California Energy Commission
CEE	Consortium for Energy Efficiency
CES	community energy storage
C&S	Codes and Standards
CS	Customer Service
CPUC	California Public Utilities Commission
D	Decision
DOE	Department of Energy
DR	demand response
DRAS	demand response automated server
DRMEC	Demand Response Measurement and Evaluation Committee
DRMS	demand response management system
DRPP	Demand Response Partnership Program
DRRC	Demand Response Research Center
DSM	Demand-Side Management
EDF	Environmental Defense Fund
EE	energy efficiency
EEC	Energy Education Center
EM&T	Emerging Markets & Technology
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ETCC	Emerging Technologies Coordinating Council
EVTC	Electric Vehicle Test Center
FDD	fault detection and diagnostics
HAN	home area network
HVAC	heating, ventilation, and air conditioning
IALD	International Association of Lighting Designers

IDSM	Integrated Demand-Side Management
IESNA	Illuminating Engineering Society of North America
IOU	investor-owned utility
ISDG	Irvine Smart Grid Demonstration
kW	kilowatt
kWh	kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
LEED	Leadership in Energy and Environmental Design
MSO	Meter Services Organization
MW	megawatt
NEEA	Northwest Energy Efficiency Alliance
NPDL	New Products Development & Launch
NYSERDA	New York State Energy Research and Development Authority
OCST	occupant controlled smart thermostat
OP	Ordering Paragraph
OpenADR	Open Automated Demand Response
PCT	programmable communicating thermostat
PLMA	Peak Load Management Alliance
PLS	Permanent load shift
PTR	Peak Time Rebate
QI/QM	Quality Installation/Quality Maintenance
RESU	residential energy storage unit
RFI	Request for Information
SCE	Southern California Edison Company
SONGS	San Onofre Nuclear Generating Station
TES	thermal energy system
TOU	Time of Use
TTC	Technology Test Centers
USGBC	U.S. Green Building Council
VCHP	variable capacity system heat pump
UL	Underwriters Laboratories
VRF	variable refrigerant flow
ZNE	zero net energy

1. Background

The *Emerging Markets & Technology Demand Response (DR) Projects Semi-Annual Report: Q3–Q4 2014* 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 Decision directed Southern California Edison Company (SCE) to submit a semi-annual report regarding its DR Emerging Technology projects by March 31 and September 30 of each year.

Prior to D.12-04-045, the *Emerging Markets and Technology Report* was submitted annually consistent with OP 14 of CPUC D.09-08-027. In that decision, SCE was ordered to provide reports on the previous year's Emerging Markets and Technology (EM&T) activities to the director of the Commission's Energy Division, and provide copies to the most recent service list in this proceeding.

2. Summary

To help realize the benefits of DR—greater grid security, modernization of the grid, and improved use of generating resources, including distributed resources—the EM&T program at SCE develops and delivers emerging, technology-driven DR initiatives, projects, and studies that facilitate customer acceptance of cost-effective DR and promote behavioral change. The EM&T program also works to enable customer participation in SCE's DR programs by providing input to the Codes and Standards (C&S) program, which draws on research into customer preferences and the market potential for DR.

This report on SCE's EM&T Program activities over the second half of 2014 is submitted as directed in D.12-04-045, cited above.

SCE works closely with industry groups, academic institutions, and other utilities to develop a vision for DR, identify technologies that can be leveraged for DR, and establish standards for interoperability of DR technologies. EM&T employees from each of the California investor-owned utilities (IOUs) meet periodically to coordinate, collaborate, and share results from each IOU's portfolio of EM&T projects. In addition, to further institutionalize and expand DR in California, SCE is involved in ongoing collaborations and research with other statewide agencies and third-party stakeholders interested in DR, such as those found in the list at the end of this report.

Further, to advance acceptance and use of DR in the market, SCE communicates positive results from the EM&T program to our customers, external stakeholders, and internal stakeholders, such

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

as account managers within the Business Customer Division (BCD), who educate and influence un-enrolled customers to enroll in DR programs and adopt DR technologies and strategies.

Following is a sampling of some of the EM&T partnership and communications approaches implemented by SCE:

- Development of customer information sheets to aid account managers in communicating the opportunities associated with DR technologies and strategies developed by the EM&T program.
- Exploration of Integrated Demand-Side Management (IDSM) opportunities through coordination and collaboration among EM&T, engineering, and other staff throughout the Customer Service New Products Development & Launch (NPDL) group and the rest of Customer Service (CS) organization.
- Partnerships with BCD's Technology Test Centers (TTC) and the Advanced Technology (AT) organization in Transmission & Distribution to test EM&T products and execute projects.
- Partnership with the Electric Power Research Institute (EPRI) to test and execute DR projects. Besides providing a platform for information exchange among national utilities engaged in cutting-edge DR efforts, EPRI plays a valuable role in developing communication and protocol standards to help manufacturers ensure seamless integration of end-use devices into utility DR programs.
- Maintenance of an internal SCE EM&T Wiki with information on industry trade events attended and current projects to keep interested SCE stakeholders current.
- Periodic DR Forums & Training at SCE to communicate and coordinate DR information across the company.
- Publication of full reports on EM&T projects on the Emerging Technologies Coordinating Council (ETCC) website,[2] to provide them to the public. The ETCC coordinates among its members, which include the California IOUs, Sacramento Municipal Utility District (SMUD), California Energy Commission (CEC), and the CPUC, to facilitate the assessment of promising energy efficiency (EE) and DR emerging technologies that benefit California customers and respond to the initiatives outlined in the California Long Term Energy Efficiency Strategic Plan.[3]
- Assistance in organizing the ETCC Summit, an event held every two years to promote emerging energy technologies, by planning the DR tracks.
- Assistance in organizing the Peak Load Management Alliance (PLMA) spring and fall conferences, events intended to promote and support DR technologies, markets, and programs and services.

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[2] Emerging Technologies Coordination Council (ETCC) website [*available at*: www.etcc-ca.com].

[3] California Long Term Energy Efficiency Strategic Plan [*available at*: http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf].

In the second half of 2014, SCE completed, continued, and started the EM&T projects in the table below.

Category	Project
Codes & Standards	• Development of Compliance Manual for programmable communicating thermostats that are incorporated as new construction building codes by the CEC • Development and implementation of DR standards, such as Open Automated Demand Response 2.0 (OpenADR 2.0) for buildings, appliances, and messaging protocols • Specification development for DR-capable appliances for use by the U.S. Environmental Protection Agency (EPA) to label ENERGY STAR products • DR credit for LEED-certified buildings • Scoping study of standards and activities that affect California's DR and permanent load shift (PLS) efforts • Supporting SMUD in its Codes & Standards Enhancement (CASE) study for residential T-24 for programmable communicating thermostats
Testing, Demonstrating & Simulation	• Field testing of variable capacity heat pumps and climate appropriate AC systems to understand their DR capabilities • Field and laboratory testing of pool pumps as a viable DR-capable end-use technology • PLS opportunities using batteries • Pilot project to test and evaluate small batteries as residential energy storage units • Establishment of DR capabilities in smart appliances • Laboratory and field testing to understand the DR potential of home building energy management systems • Evaluation of the DR potential of systems using advanced refrigerants • Evaluation of a pre-feasibility simulation tool to analyze PLS technologies • Field testing of hotel guest room controls for DR capability • Demonstrating integration of ZNE communities, including community battery storage • Advanced DR concepts in Data Centers • Retrofits for low-income multi-family housing, modular classrooms, and a commercial training facility • Feasibility study to understand the potential for DR using conditioned crawl space
Ancillary Services	• A pumping project to evaluate its potential for serving the ancillary services market
Education	• Education of selected professionals (lighting experts and pool pump industry) about the benefits of DR-ready products
Special Projects	• Mitigation of impact from permanent shutdown of two units at the San Onofre Nuclear Generating Station (SONGS) through pilots investigating customer-owned third-party thermostats and use of a home area networked system to control pool pumps • Testing residential energy storage units and expanding residential DR in the Irvine Smart Grid Demonstration (ISGD) project

This report summarizes the results and status of all individual DR projects undertaken by SCE. The DR project numbers assigned to each project are listed for internal tracking, and to allow their identification in the ETCC website.

3. Projects Completed Q3–Q4 2014

DR10.16 Smart Appliances

Overview

This project performs laboratory testing of various smart appliances from different manufacturers to quantify the load curtailment potential of these appliances during DR events. Conducted in a controlled environment, these tests provide an opportunity to observe how smart appliances react to price and reliability DR event signals. Further study results can inform various DR-capable appliance efforts underway (such as development of the ENERGY STAR "Connected" appliance specification and DOE's Physical Characterization of Grid-Connected Commercial and Residential Buildings End-Use Equipment and Appliances effort). The table below shows the unique project number associated with a manufacturer and appliance.

Appliance	Manufacturer A	Manufacturer B	Manufacturer C
Testing and Reports Completed			
Refrigerator/Freezer	10.16.RF-A	10.16.RF-B	10.16.RF-CH
Clothes Washer	10.16.CW-A	10.16.CW-B	10.16.CW-C
Dishwasher	10.16.DW-A		

Collaboration

This project is a collaborative effort with several major appliance manufacturers to test the DR potential of smart appliances utilizing SCE's TTC laboratory facilities and staff.

Status

As the table above shows, TTC has completed testing and has prepared technical reports for all of the appliances (three refrigerators (manufacturers A, B & C), three clothes washers (manufacturers A, B & C), and one dishwasher (manufacturer A). Results were shared in several public forums, including the American Council for an Energy-Efficient Economy (ACEEE) Summer Study[4] for the years 2012 and 2014 and the 2013 American Society of Heating and Air-Conditioning Engineers (ASHRAE) Annual Conference.[5]

[4] Energy-Efficiency Economy (ACEEE) Summer Study [*more information available at:* http://aceee.org/conferences/2012/ssb and http://aceee.org/conferences/2014/ssb].

[5] 2013 American Society of Heating and Air-Conditioning Engineers (ASHRAE) Annual Conference [*more information available at:* http://ashraem.confex.com/ashraem/s13/cfp.cgi].

DR12.18 Analysis of Next-Generation Home/Building Energy Management Systems

Overview

This project involved research into the next generation of home and building area network energy management and control systems for residential and small commercial customer applications. The project collected and incorporated research information on existing and documented installations with networked technologies from domestic and international research organizations, utilities, manufacturers, and distributors.

Collaboration

This project was executed in collaboration with EPRI, which conducts research on issues related to the electric power industry.

Status

The research, which evaluated new and upcoming technologies from over 50 technology providers, is complete. The project also identified a home area network/building area network (HAN/BAN) system for a future field evaluation (see DR12.19, Field Testing of Networked Systems for Fault Detection and Diagnostics) by determining utility EE and DR program requirements and assessing the potential for integrating such services as energy management, security, entertainment, and building automation. The team initiated the project in November 2012 and completed the bulk of the work in Q1–Q2 2013. The final project report was completed in Q4 2014.

DR13.12 C&S for Residential DR Thermostats

Overview

This is a Codes & Standards Enhancement (CASE) project being led by Sacramento Municipal Utility District (SMUD). SCE's role is to provide technical support for developing the CASE report that will be submitted to the CEC for a rulemaking in 2015. The proposed Title 24 standard would require thermostats installed in residential buildings to be capable of receiving and responding to demand response signals by specifying logical and physical communication interfaces.

Collaboration

California IOUs, including SCE, and SMUD for the CASE proposal development.

Status

California Statewide Codes and Standards Team with SMUD submitted a CASE report that would specify logical and physical communication interfaces within the OCST:

- The proposed logical communication interfaces: OpenADR 2.0 and/or SEP1.1
- The proposed physical communication interface: Wi-Fi and/or ZigBee

The proposed requirements would enhance various DR programs by having OCSTs in new homes that are DR ready (i.e., need not buy an OCST that can communicate with the local utility)

Next Steps

The CASE report was submitted to the California Energy Commission in 2014 for a rulemaking that is scheduled in 2015, and therefore, this project is complete.

DR14.03 Third-Party Programmable Communicating Thermostat Study

Overview

This field study evaluated the potential of leveraging the existing installed base of internet-based OCSTs (also known as programmable communicating thermostats) from third parties, including thermostat manufacturers and home security companies. Such technologies, which enable communication via the Internet (over broadband) with customers, may increase the ease of OCSTs and lower the cost of rapid load shedding by customers during hot summer periods. This is when the demand for power could exceed supply—days SCE designates as "Save Power Days." As part of this project, SCE's existing demand response automation server (DRAS) initiated the DR event, and used OpenADR to communicate over the Internet with the servers of participating third parties. The third parties then issued a signal to the OCST using their proprietary communication protocol.

SCE targeted third-party vendors whose customers were also SCE customers. These vendors contracted with OCST-owning customers that authorized the vendor to pre-cool the home, and/or remotely adjust the OCST to reduce energy use during peak hours on Save Power Days. The agreements included other important provisions. Vendors had to notify customers they would adjust the OCST by 2:30 pm on the day before the Save Power Day, and customers were provided the ability to manually override the remote adjustment.

Further, through these agreements, customers gave SCE permission to release their personal information for program eligibility purposes including, name and service account number information verification results to the vendor.

The test ran during peak hours on Save Power Days from June 1 through October 1, 2014. Project goals were to double the previous year's enrollments/agreements with 6,000 residential customers to provide the potential to shed up to 7.0 MW of peak energy use. Due to contractual constraints including re-enrollment of all customers and co-marketing restrictions, enrollments for 2014 totaled 3,250, short of the original 6,000 goal.

Collaboration

SCE partnered with several third parties and leveraged their existing customers and installations in the field. The diverse mix of partners ranged from a manufacturer of OCSTs to a cloud service provider targeting OCST installers to software developers using the pilot to gain experience in this sector. Contract development focused on creating a generic/standard contract to allow for scalability to serve the needs of growing markets around this concept, and implementing a standard communication protocol in OpenADR 2.0.

Status

The project was initiated again in Q3–Q4 of 2013. By July 2014, the vendors had collectively signed up just over 2,200 residential customers, reaching about 30% of the project's target. Over the summer of 2014, SCE called eight Save Power Days events using these third-party partners, and each of these events resulted in energy shedding. Successful completion of the testing required the development of processes for initiating DR events, recruiting and ensuring the eligibility of customers to participate, providing incentives in bill credits to customers who reduced load, and the payment of a management fee to participating vendors.

This study is now complete. After reviewing results, SCE is preparing to transition this strategy into a Program in 2015.

DR13.02 Demand Response and Permanent Load Shift: A Scoping Study to Review Standards and Activities that Impact California

Overview

Increasing California DR and PLS capabilities requires an understanding of the international, federal, and state organizations that play roles in defining policies, regulations, and mandates for DR and PLS both inside and outside of California. This scoping study explored the policies, plans, initiatives, programs, and mandates of stakeholder organizations and analyzed their potential impacts on California's DR, EE, and Codes and Standards programs. The conclusions and recommendations being developed by this study provide guidance for SCE to pursue future DR, EE, and Codes and Standards activities.

Collaboration

This project is a collaborative effort with SCE's Codes and Standards group.

Status

The project is now complete. Findings and recommendations from this study are providing valuable input to SCE as it advances a range of energy activities.

DR12.30 Smart Energy Profile Ancillary Services Gateway

Overview

This project aims to demonstrate use of a broadband/ZigBee gateway capable of meeting California Independent System Operator (CAISO) requirements for DR bidding of sub-200-kW commercial and industrial DR loads into ancillary service markets. The project calls for lab testing and demonstration of a new architecture that utilizes a smart meter, a ZigBee-to-OpenADR 2.0b gateway, and a demand response management system (DRMS). The gateway will poll the SmartConnect meter for real-time consumption (in kilowatt-hours [kWh]) information in 15-second intervals and send the information through a broadband router to AutoGrid's DRMS. To confirm accuracy of the data, consumption (kWh) data in the meter will be compared to kWh data sent over the Internet to the DRAS.

Collaboration

This project is being conducted in collaboration with SCE's AT Distribution Automation & Communications and the Meter Services Organization (MSO) groups, leveraging their expertise with SmartConnect meters, distribution communications, and OpenADR 2.0 testing.

Status

SCE's AT group performed lab testing and validated transmission of 15 second energy consumption (Wh) data sent from a variable demand source to a 3-phase meter via a ZigBee gateway, and then to a DRMS over OpenADR 2.0b. A comparison of data showed that the simulated demand was successfully transmitted and stored in the meter, gateway, and DRMS. Test results and implications have been summarized in a final report. The project is now complete.

DR12.03.02 Lighting Professional Certification Training Program

Overview

Lighting designers, engineers, and architects often have difficulty keeping current with the rapid development of DR-capable lighting systems. This project intends to fill this knowledge gap by developing training curriculum and certification testing for lighting professionals on the design and selection of DR-capable lighting systems with advanced controls. The goal is to pave the way for future industry-supported advanced DR lighting design certification programs.

The first phase of this program (DR12.03) evaluated the job types and knowledge needed for an effective training and certification program. Efforts in 2013 phase 1 documents findings to develop and deliver a focused training curriculum, classes, and tests for lighting professionals.

Collaboration

This project leveraged the format and structure of the successful California Lighting Contractors Training Program (CALCTP) and included the financial participation of members of the West Coast Lighting Consortium. The success of CALCTP allowed for continued collaboration with the Illuminating Engineering Society of North America (IESNA) and the International Association of Lighting Designers (IALD). The following organizations participated in this project:

- New York State Energy Research and Development Authority
- Consolidated Edison of New York
- Northwest Energy Efficiency Alliance
- National Grid
- NSTAR
- Sempra Energy
- Pacific Gas and Electric Company
- Southern California Edison Emerging Technologies group
- Southern California Edison Codes and Standards group

Status

The project developed two training curriculum analysis (Job Analysis and Body of Knowledge) to help develop various curriculums that support demand response training. The Jobs Analysis (JA) identifies the candidates and skills they should possess upon completion of a training course to be a successful Lighting Planner. The Body of Knowledge (BOK) analysis identifies a set of concepts, terms, readings, and activities required to apply lighting controls that can integrate DR. The project achieved the development of these training concepts and a curriculum baseline to enhance academia for lighting designers, engineers, and architects so demand response education is up to date on the rapid development of DR-capable lighting systems. These concepts are evident in SCE's recent effort to revamp their demand response course program to be inclusive of revised needs assessments and technology advancements. The California Lighting Technology Center will incorporate 2013 and 2016 Title 24 codes and standards curriculum requirements to align the

Certification Program with existing state certification and acceptance training programs. This project is now complete.

DR12.07 Demand Response Partnership Program

Overview

Because of efforts by the IOUs and Lawrence Berkeley National Laboratory (LBNL), automated demand response (ADR) is being piloted as a point for Leadership in Energy and Environmental Design (LEED) for both new and existing non-residential buildings. This pilot encourages building owners to add DR capabilities to their facilities by offering LEED DR credit if the point is adopted.

It is estimated that 58% of the some 1,400 LEED-certified buildings in SCE's service territory, representing 18 million ft^2, could earn the LEED DR credit immediately. Demand reduction will vary by building size and type. However, the initial requirement of the LEED DR point is to achieve a minimum reduction in peak energy use of 10% or 20 kW, whichever is greater.

The goal of the Demand Response Partnership Program (DRPP) is to show that establishing this LEED DR credit will decrease energy use, help stimulate expanded development of DR technologies, and be seen as a benefit by the building owner.

Collaboration

SCE has collaborated with the U.S. Green Building Council (USGBC), the Environmental Defense Fund (EDF), and the Demand Response Research Center (DRRC) at LBNL to complete the project objective of refining the LEED DR credit. Tasks include contacting LEED-certified building owners through telephone calls, webinars, and USGBC meetings; researching the effects of the credit's availability on market adoption and grid reliability; and researching the environmental impact of the point. In addition, EM&T staff worked with SCE's account managers, New Construction Services, and Regulatory Special Projects to achieve this project's objectives.

Status

The USGBC Demand Response Pilot program has successfully completed resulting in a new LEED v4 credit that drives DR technologies as a strategy in LEED building's commissioning scope of work. Building owners can achieve two LEED Credits when a project installs energy management systems that enable them to enroll in DR programs allowing the local utility to curtail energy usage at a minimum of 10% of their peak demand. The USGBC has extended the LEED Credit to service territories across the U.S. that offer no demand-response program allowing the building owner to still garner one point by installing the DR systems and having the procedures in place to participate if and when it becomes available. This LEED credit promotes DR in their inclusive program available across its membership with one or multiple buildings in various utilities' service territories. USGBC is adding the account base data analytics to the report and has submitted a final report to SCE. This project is now complete.

4. Projects Continued Q3–Q4 2014

DR09.02 Home Battery Pilot at Irvine Smart Grid Demonstration

Overview

This project, which began in 2009, is evaluating and testing small (4-kilowatt [kW]) automotive-grade advanced lithium-ion battery modules for use as a residential energy storage unit (RESU). The goal is to evaluate the potential of using in-home batteries during DR events or localized distribution constraints to decrease customer impacts, while still alleviating demand on the power grid. A more detailed explanation of this project can be found in Appendix K[6] of SCE's amended testimony to support its 2009–2011 DR application (A.08-06-001).

Collaboration

The project is a collaborative effort with SCE's Electric Vehicle Test Center (EVTC) in Pomona, California, and leverages their expertise with lithium-ion batteries.

Status

In December 2010, the project team conducted extensive lab testing of a prototype device received from the vendor. During 2011, the vendor delivered 2 pre-production units and 14 additional units with increased functionality and several other improvements, including web control. These 14 production units went through the complete series of RESU tests, and SCE's energy storage specialists worked with vendor engineers to resolve issues discovered during testing. Due to a delay in Underwriters Laboratories (UL) certification, SCE filed, and received approval for, Advice Letter 2685-E[7] requesting a continuation of the project into the 2012–2014 funding cycle. Following receipt of UL certification early in 2013, the team installed several RESU units as part of the Irvine Smart Grid Demonstration (ISGD) project in June 2013 and conducted several tests to determine the effectiveness of these units over the summer of 2013 using the different modes available in the RESU. Participating customers were placed on a Time of Use (TOU) rate to test additional operating modes during the second half of 2014 and the majority of tests were completed.

Next Steps

Testing at ISGD has been completed, but the RESU's will continue to be used and monitored throughout the duration of the project - scheduled to end in mid-2015. A final report, slated for submission at the conclusion of the project, will provide information on the feasibility of using these types of batteries as a DR resource, and any additional project findings.

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[6] SCE's Amended Testimony in support of its 2009–2011 DR application (A.08-06-001), Appendices A through M [*available at*: http://www3.sce.com/sscc/law/dis/dbattach1e.nsf/0/DBCA190DAE972CEB882574C90070C520/$FILE/A.08-06-001+2009-11+DR+Amended+App_SCE-04++Appendices+A-M.pdf], pp. 449–455].

[7] AL 2685-E [*available at*: https://www.sce.com/NR/sc3/tm2/pdf/2685-E.pdf].

DR09.08 Expanding Residential DR in the Irvine Smart Grid Demonstration

Overview

SCE has been exploring ways to capitalize on the Edison SmartConnect™ metering and HAN deployment to further enable residential DR in coordination with EE and distributed energy resources. To advance this goal, the EM&T program provided some of the matching funds—in SCE's proposal for the ISGD project—that allowed SCE to leverage funding from the American Recovery & Reinvestment Act (ARRA) awarded to SCE by the U.S. Department of Energy (DOE)[8] in 2010. The ISGD project is demonstrating potential EE and DR approaches to designing zero net energy (ZNE) homes, in step with California's Long Term Energy Efficiency Strategic Plan.

Within the ISGD project Project DR09.08 focuses on demonstrating residential DR by examining various treatments to three separate groups of homes: a community energy storage (CES) block, a ZNE block (that also uses energy storage), and a RESU block. All the homes received communicating thermostats, energy information displays, and smart appliances. The project will conduct a variety of DR experiments to evaluate the use of SCE's AMI network and load control systems, and the effectiveness of residential DR utilizing a HAN.

Collaboration

This project is a collaborative effort with SCE's AT organization. It also collaborates with DOE to support their larger Smart Grid demonstration efforts.

Status

Monitoring continues on the HAN devices installed as part of the early field test. An update to the system to enable testing of DR events caused a delay in the DR testing planned for 2012. Due to this and other delays, SCE filed, and received approval for, Advice Letter 2685-E, requesting a continuation of the project into the 2012–2014 funding cycle. The project installed all HAN devices during June of 2013 and successfully completed an initial test. In addition, the team completed several tests during 2013, including a December test to determine any heating loads available during winter months. Testing continued during 2014 with test events in February and June to evaluate additional DR strategies with thermostats and appliances. Additional experiments were conducted during the remainder of 2014.

Next Steps

All planned experiments have been completed and analysis of collected data will be included in the final project reports slated for the second half of 2015.

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[8] U.S. Department of Energy Recovery Act State Memos [*available at*: http://energy.gov/sites/prod/files/edg/recovery/documents/Recovery_Act_Memo_California.pdf].

DR12.01 Demand Response Opportunities with a Permanent Load Shift System

Overview

Electrical energy storage–based devices, such as batteries, are still being explored as emerging technologies for their ability to provide permanent load shift and DR resources, including short-term ancillary services and local voltage regulation support for distributed generation. This project will find a commercial site for field testing an advanced battery-based PLS system that will supply all or part of the site's load and be equipped with advanced controls to allow the implementation and evaluation of various advanced DR scenarios.

Through this work, this project will identify the technical requirements needed to enhance the capabilities of a battery-based PLS to perform DR functionality, and investigate and define telemetry and control requirements. The project will also help identify and develop recommendations for any regulatory enhancements to allow the installation of enhanced DR-compatible PLS at a site. The findings of this work will be shared via a technical report to be completed at the conclusion of the project.

Collaboration

This project is being executed by SCE's DSM Engineering group, with support from the EVTC organization.

Status

SCE completed construction and installation of the BESS at the OC site in Q4 of 2014. SCE conducted site acceptance tests (e.g., BESS charging and discharging rate testing, DR response, communication, etc.), and BESS passed all critical tests. SCE enhanced the BESS design by installing interlock systems that will improve safety. SCE conducted electric rate analysis and proposed various rate options to the customer (e.g., during monthly energy bill).

Next Steps

Once SCE fully executes the interconnection agreements, BESS will be ready for the PLS application. SCE will then collect BESS performance data, perform analysis, and produce a report. The report will be completed in Q3 2015.

DR12.08 DR Pool Pumps

Overview

The purpose of this project[9] is to perform laboratory and field tests of commercially available pool pumps and pool pump controllers designed to enable curtailment of pool pump loads in response to DR event (curtailment) or pricing signals. This work is a follow-up to prior studies that estimated the potential for residential pool pumps to act as a DR resource: Pool Pump Demand Response Potential[10] and Integration of DR into Title 20 for Residential Pool Pumps.[11]

This project will include field trials of a pool pump with integrated DR capabilities to assess functionality (DR12.08.01), and retrofit solutions that would add DR capabilities to existing pool pumps (DR12.08.02).

Collaboration

This project is being conducted in collaboration with SCE's AT organization.

Status

DR12.08.01 ZigBee-Based DR Residential Pool Pumps

After completing laboratory testing of the prototype at SCE's HAN lab, the pool pump controller received ZigBee Smart Energy Certification,[12] and the production-ready device is at the SCE HAN lab for final testing. SCE filed, and received approval for, Advice Letter 2685-E,[13] requesting a continuation of the project into the 2012–2014 funding cycle. Testing in the field was completed during Q1 of 2014. Based on the final report showing inconsistencies with the communications to signal DR events and the fairly low DR potential with variable-speed pool pumps, SCE does not plan to pursue this solution.

DR12.08.02 DR-Ready Pool Pumps for Residential Retrofit

The retrofit solution identified as part of this project has been commissioned and some initial testing has been conducted. Final report for this project is being generated and is expected to be released in Q2 2015.

Next Steps

Complete the final report for DR12.08.02 by Q2 2015.

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[9] Reported as DR10.08 in SCE's Semi-Annual Q3–4 2012 EM&T Report.

[10] Pool Pump Demand Response Potential [*available at:* http://www.etcc-ca.com/reports/pool-pump-demand-response-potential

[11] Integration of DR into Title 20 for Residential Pool Pumps - Phase 1 [*available at:* www.etcc-ca.com/reports/integration-dr-title-20-residential-pool-pumps-phase-1].

[12] http://www.zigbee.org/Products/ByStandard/ZigBeeSmartEnergy.aspx

[13] Request to Continue Activities and Funding for Emerging Markets and Technology Projects [available at: https://www.sce.com/NR/sc3/tm2/pdf/2685-E.pdf].

DR12.16 Field Testing of Commercial Variable Heat Pump Systems

Overview

This field study is evaluating the potential of variable capacity heat pump (VCHP) systems that can use smart integrated controls, variable-speed drives, refrigerant piping, and heat recovery. These capabilities provide products that can be controlled by a smart thermostat and that offer such attributes as high energy efficiency, flexible operation, ease of installation, low noise, zone control, and comfort using all-electric technology.

Several strategies can make variable refrigerant flow (VRF) systems DR-ready. Indoor units in one or more spaces of a building could be turned off, allowing the space temperature and humidity to drift (with some spillover of cool air from adjacent spaces with air conditioning [AC]). In addition, the on-off sequencing between zones could be alternated to minimize temperature changes, which minimizes occupant discomfort. Alternatively, units could be operated at a fraction of normal capacity to maintain minimally effective environmental conditions in the occupied space. It is also possible to start the building's outdoor units sequentially to spread out demand spikes caused by starting-power transients.

This project will assess the ability of a building's installed energy management systems to serve as an available resource for load management. This involves simulating load-shedding events to trigger the VCHP's built-in DR algorithm. The project team will conduct DR tests in field installations and in a controlled laboratory environment on EPRI's four-zone VRF testing stand.

Collaboration

This project is being executed in collaboration with EPRI, which conducts research on issues related to the electric power industry.

Status

The field test is progressing, and the equipment has been installed and commissioned. The project team is coordinating with the manufacturer to implement various hardware and software updates to enable possible DR activities.

Next Steps

Field tests are continuing for the spring & summer months of 2015. SCE will analyze the results and complete a final report in Q3 2015.

DR12.17 Field Testing of Climate-Appropriate Air Conditioning Systems

Overview

This field study is evaluating the current and potential DR capabilities of climate-appropriate AC systems, such as evaporative cooling and VCHP. Targeted DR and EE programs can help reduce high peak demand caused by increased AC use and address uncertainties about generation and consumption caused by extreme weather conditions. This field study will analyze how automated and optimized DR technology, combined with an understanding a building's heating, ventilation, and air conditioning (HVAC) capacity and thermal characteristics, can build and implement accurate relationships between DR lead time, customer incentives, DR duration, external environmental conditions, and building occupancy.

Collaboration

This project is being executed in collaboration with EPRI, which conducts research on issues related to the electric power industry.

Status

The project team planned during Q4 2012, and commenced the study in January 2013. Equipment construction is complete, and EPRI has implemented monitoring equipment in the field. The commissioning phase is in process.

Next Steps

EPRI has installed the equipment and engaged the manufacturer with equipment hardware prior to summer 2014. The manufacturer has committed resources to update the field product. Field tests are planned for the summer months of 2015. SCE will analyze the results and complete a final report in Q3 2015.

DR12.19 Field Testing of Networked Systems for Fault Detection and Diagnostics

Overview

This project will leverage the efforts from DR12.18 (Analysis of Next-Generation Home/Building Energy Management Systems) to conduct laboratory and field evaluations of available HAN/BAN systems. This activity will assess the systems' effectiveness in implementing utility DR programs, and evaluate their ability to collect, display, and communicate system fault detection and diagnostics (FDD) information when linked with residential and light commercial HVAC systems. In addition, the project team will explore network system control and automation functionality to determine the potential for automatic response to FDD signals to optimize HVAC system performance.

Collaboration

This project is being executed in collaboration with EPRI, which conducts research on issues related to the electric power industry.

Status

Through market research, the project team identified two HVAC systems that offer advanced FDD functionality and communications with HAN/BAN systems as candidates for laboratory and field assessment. Both HVAC systems are new to the market, and results from market research and discussions with the FDD system manufacturers suggested that additional technology development would be needed to communicate FDD signals to networked systems and to service providers via cloud-based communication technologies. The team completed a proof-of-concept laboratory test in Q4 2013 to evaluate two advanced FDD systems. The test involved a residential AC system communicating FDD information to local and remote cloud-based communications systems available on smart phone and PC platforms. In addition, field assessment of the performance of the two FDD technologies has been demonstrated at four sites in SCE's service territory.

Next Steps

The project report is expected to be completed by the end of Q1 2015.

DR12.20 Evaluation of Permanent Load Shift Solutions for Integrated Demand-Side Management

Overview

Many energy storage technologies aim to permanently reshape the building load profile—and particularly to achieve PLS, which comprises shifting peak-hour loads to non-peaking hours daily. This project seeks to advance and support participation in the statewide PLS Program by creating, calibrating, and validating a pre-feasibility tool using the latest advanced building energy simulation engine. In this tool, thermal energy storage (TES) models will be defined for chilled water systems, ice tanks, and packaged ice storage. This project will also develop training to support the operation of the pre-feasibility tool, and an energy storage technology report.

Collaboration

This project is being executed in collaboration with SCE's PLS program, Field Engineering, DSM Engineering group, and EPRI, which conducts research on issues related to the electric power industry.

Status

A draft tool has been developed and demonstrated to SCE stakeholders for detailed technical review and feedback. This primary feedback is now being incorporated into the tool for finalization. Product handoff and training on the tool are expected to occur in Q2 of 2015.

Next Steps

Once the trial version is this tool is completed, a technical review team (including implementers of the PLS Program) will test drive the tool and provide direct feedback on their progress to the development team. This multi-year project is scheduled for completion by Q3 of 2015.

DR12.21 Field Testing of DR-Ready End-Use Devices

Overview

Manufacturers are introducing new DR-ready end-use devices, including appliances, into the market. This project, a part of EPRI Subproject G[14], is selecting and testing one of these technologies, both in the lab and in the field, to determine its ability to meet SCE's demand-reduction objectives.

Collaboration

This project is co-funded by SCE's Emerging Technologies Program as part of an EE/DR buildings contract with EPRI. The selection and testing will be done in coordination with:

- EPRI Subproject C on next-generation home and building energy management systems
- EPRI Subproject D on evaluation of networks that can provide HVAC fault detection and diagnostics

Status

Project reporting has begun through development of a draft report. Documentation will include findings from all tasks and field analyses. The report will include the lab trial findings on data reporting accuracy of a Friedrich Window AC (Internal DR module) and ThinkEco Modlet unit tested in EPRI's Knoxville laboratory. The draft report will also include recommendations for product enhancements to better support SCE's peak load reduction objectives for connected devices.

Next Steps

Finalizing the field and lab data collection and analyses for the project report. The final draft report is expected to be submitted to SCE in April 2015 for approval.

[14] SCE signed an agreement called Buildings III Supplemental Project with EPRI in December 2013 to collaborate with EPRI on RD&D activities in improving energy efficiency, environmental stewardship, and demand response in residential and commercial buildings. The Buildings III Supplemental Project has five sub-projects, A through E.

DR12.25 Ancillary Services Pumping Equipment

Overview

This project[15] aims to evaluate the potential for customers with water pumping equipment to participate in an Ancillary Services DR program. The project team planned in 2010 and conducted initial market research to determine customer willingness to participate in a program that has short event notifications and durations (e.g., customers must respond within 10 minutes, and the events last no longer than 30 minutes). Market research completed by BPL Global recommended that SCE pursue an Ancillary Services DR program for pumping customers to potentially replace or complement the existing Agricultural Pumping Interruptible DR program, which is subject to a limit (in megawatts [MW]) on the emergency DR statewide. According to initial projections, by 2014 approximately 6% of Agricultural and Pumping customers could participate in an Ancillary Services program.

Collaboration

This project is being conducted in collaboration with SCE's Energy Education Center (EEC)-Tulare, Field Engineering, and the Meter Services Organization (MSO).

Status

The project team has identified vendors that provide field communication systems and evaluated the capabilities of each potential solution. The team has also selected a vendor for the project, and selected and visited a field test site. In addition, a customer agreement has been reviewed and signed, and the communications antenna and control system has been installed at the EEC in Tulare. The team discovered that the antenna installed at EEC-Tulare is mounted too low to communicate with pumps at the field test site. An antenna repeater site has been identified, and SCE is in negotiations with the owner for permission to install the equipment.

Next Steps

This project will continue to be implemented in phases. Six units have been safety testing at SCE's MSO labs in Westminster. Once this testing is complete, SCE has evaluated different communication methods and increasing levels of integration with its DR open source capabilities and future programs (Ancillary Services). The testing is planned for summer of 2015, with completion scheduled for Q3 2015.

[15] Reported as DR11.01 in SCE's Semi-Annual Q3–4 2012 EM&T Report.

DR12.28 DR Pool Pump Study

Overview

This project will leverage past research projects to expand initial field trials to a larger population and help alleviate grid constraints caused by the shutdown of two units at the San Onofre Nuclear Generating Station. The study will utilize networked pool pump controllers that can initiate DR events using either SCE's Advanced Metering Infrastructure (AMI) network and SmartConnect meters or the customer's Internet connection to curtail or shift electric loads caused by pool pumps. SCE will also test whether pay-for-performance tariffs, such as Peak Time Rebate (PTR) with enabling technology, might serve as an adequate incentive for customers to participate.

Collaboration

This project involves partnering with several third-party vendors to provide the pool pump control equipment and installation.

Status

The planning for this project began during the second half of 2012, and it was included as one of several studies proposed in SCE's Application Proposing Improvements and Augmentations to its Existing Demand Response Program Portfolio for the Summers' of 2013 and 2014.[16] After receiving approval for the study in April 2013,[17] SCE launched the project. System and equipment limitations, including the need to customize equipment, created delays in the development and procurement of equipment and pushed the test phase of this project into Q1 of 2014. Besides the HAN/Internet pool pump control solution, another project was launched using pool pump load control switches that use the same VHF radio communication platform used for SCE's Summer Discount Plan (Air Conditioning Cycling DR Program). This project is reported under project number DR14.05 DR VHF Pool Pump Study. Additional issues with field installations of the HAN/Internet solution further delayed testing, which is now scheduled for Q2 of 2015.

Next Steps

Technical issues discovered during field testing delayed the project. The issues have been resolved, but since the customers enrolled in the project could not participate during the period specified in their customer agreement, they will need to agree to a new participation agreement. Once customers agree to these terms and conditions, SCE can move forward with the project. The remaining steps—installation of control equipment, conducting test events, and analyzing results—will be completed by the middle of 2015. Successful findings from this study may lead to the creation of a DR program for pool pumps.

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[16] CPUC proceeding A.12-12-017.

[17] D.13-04-017. [*available at:* http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M064/K342/64342913.PDF].

DR12.40 Field Testing of Occupancy-Based Guest Room Controls

Overview

An occupancy-based guestroom energy management system senses when a hotel room is occupied and adjusts the energy systems—such as HVAC, lighting, and outlets—accordingly to save energy. The control capabilities of these occupancy-based control products could be used for DR. However, implementing this capability requires additional investment in software and communications, and hotels and motels have been reluctant to implement DR measures in guestrooms due to concerns about inconveniencing guests.

Collaboration

This project is being conducted in collaboration with SCE's AT group to leverage their expertise. It will also involve partnering with several third-party vendors to provide the guest room controls equipment and installation.

Status

Since project start in Q1 2013, the team has identified customer sites, obtained signed agreements from customers, and installed the guest room controls. Further, the setup of vendors in the DR servers is complete. As of this date, one of the two vendors has obtained certification for ADR 2.0a, and the second vendor is in the certification process. Due to the sensitivity of accessing clientele information, additional time has been needed to initiate the process in the hotel establishments, which has delayed the initial timeframe.

Next Steps

SCE plans to install power monitoring equipment and initiate accounts on the SCE ADR 2.0 test server. Project completion is anticipated in Q3 2015.

DR13.01 ENERGY STAR "Connected" Specifications for Residential Products

Overview

This project covers SCE involvement in the EPA's specification development for "Connected" ENERGY STAR products. ENERGY STAR typically recognizes products with top in-class energy performance by allowing display of the ENERGY STAR logo on such products and use of the logo in advertising campaigns. Manufacturers voluntarily participate by investing the resources required to design equipment that is more efficient than that of their competitors. This program is well known in the United States and internationally.

In response to the emerging importance of the Smart Grid and recognizing the need for compatible end-use products, in 2011 the EPA began discussions centered on including "Connected" criteria into existing product specifications. "Connected" criteria, which include such functions as communication between a device and the utility and DR capability, represent a significant deviation from ENERGY STAR's historic energy performance realm.

To develop devices that meet "Connected" criteria, developers must define how the products communicate with a utility communication network, what types of signals will be transmitted, and the required responses to those signals. They must also create a test method to verify that the DR functionality exists. Each of these items has many nuances that can affect how utilities design and deploy programs around these capabilities.

History has shown that ENERGY STAR specifications and test methods[18] often are incorporated in whole or in part into mandatory performance standards adopted by DOE or state agencies, such as CEC. It is important to ensure that technical issues are resolved before the specifications and test methods are put into practice and become the mandatory industry standard.

As a participant in the specification and test method development processes, SCE seeks to achieve several objectives:

- Inform the EPA on the technical abilities of Smart Meters and the implications of using various communication schemes
- Provide insight into how DR event definitions play into SCE's vision of its overall DR strategy
- Share SCE's laboratory and field test data on various DR-capable appliances and products

[18] ENERGY STAR Specifications and Test Methods:
[*specification information available at:* https://www.energystar.gov/products/specs/product-specifications-filtered?field_status_value%5B%5D=Under+Revision&field_effective_start_date_value%5Bvalue%5D%5Bdate%5D=&field_effective_start_date_value2%5Bvalue%5D%5Bdate%5D=&=Apply].

- Comment on the DR verification test methods based on prior lab experience, and alignment with eventual DR program deployments

This project is divided into six sub-projects; each addresses a product, as shown in the table below.

Product	Project #
Refrigerators/Freezers	13.01.01
Clothes Washers	13.01.02
Climate Control	13.01.03
Pool Pumps	13.01.04
Clothes Dryers	13.01.05
Dishwashers	13.01.06

Collaboration

This project is funding SCE's portion of a collaborative specification development process with multiple interested parties, such as manufacturers, efficiency advocates, utilities, and regulatory agencies.

Status

13.01.01 – Refrigerators/Freezers

The final specification and test method for refrigerators/freezers[19] was published in May 2013. SCE provided several sets of written comments both on SCE letterhead (Q1[20] and Q2[21] 2013) and with other utilities via the Consortium for Energy Efficiency (CEE)[22] (Q1 2013). Many recommendations were incorporated, but some recommendations presented opportunities for enhancement in the next revision process.

[19] ENERGY STAR® Program Requirements Product Specification for Residential Refrigerators and Freezers; Eligibility Criteria Version 5.0 [*available at*: https://www.energystar.gov/ia/partners/product_specs/program_reqs/Refrigerators_and_Freezers_Program_Requirements_V5.0.pdf?efdc-035c].

[20] Q1 2013 SCE Comments on refrigerator/freezer specifications [*available at*: http://www.energystar.gov/products/specs/sites/products/files/Southern%20California%20Edison%20Comments.pdf].

[21] Q2 2013 SCE Comments on refrigerator/freezer specifications [*available at: id*].

[22] Q1 2013 CEE Comments on refrigerator/freezer specifications [*available at*: *id*]

13.01.03 – Climate Control

The EPA initiated the communicating climate controls effort in 2010. After a lull in project activity since May 2012, EPA developed a new approach and released a memo[23] at the end of Q2 2014. SCE did not provide comments on this memo but has recently been involved in discussions between the industry groups EPRI and Air-Conditioning, Heating, and Refrigeration Institute (AHRI) to work out some of the technical needs and desires for DR-capable climate control equipment.

13.01.04 – Pool Pumps

The EPA released a draft 1 document for "Connected" pool pump criteria[24] in Q1 2014. SCE worked with several other utilities and key players to provide comments to EPRI and CEE. EPA summarized all stakeholder comments into a single comment and response document.[25] Two SCE field studies under way (DR12.08.01 ZigBee-Based DR Residential Pool Pumps and DR12.08.02: DR-Ready Pool Pumps for Residential Retrofit) are lending significant real-world technical data to these discussions. The EPA is expected to finalize the specification in 2014.

13.01.06 – Dishwashers

EPA released a dishwasher draft 1 version 6.0 product specification[26] in Q1 2014. The new specification addressed two major areas: inclusion of a cleaning performance test to ensure efficiency doesn't affect cleaning ability and inclusion of "Connected" criteria. SCE contributed to a comment letter submitted by CEE.[27]

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[23] Climate Controls Memo [*available at* http://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Climate%20Controls%20Memo.pdf]

[24] Pool Pump Connected Functionality – Draft 1 Criteria [*available at* http://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Pool%20Pump%20Draft%201%20Connected%20Criteria%201-14-2014.pdf]

[25] Draft 1 Comment Summary and EPA Response [*available at* http://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Pool%20Pump%20Draft%201%20Connected%20Criteria%201-14-2014.pdf]

[26] ENERGY STAR® Program Requirements Product Specification for Residential Dishwashers Eligibility Criteria Draft 1 Version 6.0 [*available at* http://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Draft%201%20Version%206%200%20Residential%20Dishwasher%20Specification.pdf]

[27] Q1 2014 CEE Comment Letter [*available at* http://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Residential%20Dishwashers%20Draft%201%20Version%206%20-%20CEE%20Comments.pdf]

In Q2 2014 EPA released a draft 2 version 6.0 a dishwasher product specification.[28] SCE plans to provide comments through a CEE comment letter to be submitted in Q3.

Next Steps

SCE will continue to monitor the progress of these (and potentially additional) ENERGY STAR activities to ensure that product specifications achieve the intended goal of placing energy-efficient products with DR capabilities into the hands of consumers. SCE will provide comments as necessary to craft these specifications around products ready for immediate enrollment and participation in utility DR programs.

[28] ENERGY STAR® Program Requirements Product Specification for Residential Dishwashers Eligibility Criteria Draft 2 Version 6.0 [*available at* http://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Draft%202%20Version%206.0%20Residential%20Dishwasher%20Specification.pdf]

5. Projects Initiated Q3–Q4 2014

DR13.06 EPRI EB III A - Variable Capacity Space Conditioning Systems for Residential

Overview

This project evaluates the DR capability of VCHP systems. The tested products will be traditional "American-style" high static ducted systems. Testing will focus on three products. The project team will leverage lab and field testing to evaluate the response of the VCHP system to demand control signals. An appropriate signaling/controlling method will be selected (such as OpenADR 2.0) to enable DR testing under varying operating conditions.

Project plans call for first conducting a survey of technologies, and then developing and executing lab and field test plans. Steps for the field tests include generating and applying site selection criteria, creating site monitoring plans, and installing, commissioning, and testing the systems. Deliverables from the project will include documentation of the steps, test plans and results, and a final report.

Collaboration

The program manager for the Summer Discount Program will be continually engaged to ensure the results are in line with program needs. Further, the project team will collaborate with the program manager and a certified contractor in the Residential HVAC Quality Installation/Quality Maintenance (QI/QM) Program to ensure HVAC technologies are installed and maintained properly.

Status

EPRI submitted documents for deliverables for Task 1 (Survey Available Technologies) and 2.1 (Select Equipment for Lab Evaluation). The team is identifying a Residential HVAC QI/QM Certified Contractor for field test effort, identifying potential field sites, and installing and maintaining HVAC equipment. SCE EM&T is soliciting feedback from SCE program managers to provide comments on the deliverables to EPRI.

Next Steps

EPRI, the certified HVAC contractor, and SCE will consult on the field testing, which is projected to begin Q2 2015. The project is slated for completion in Q4 2015.

DR13.07 EPRI EB III B – HVAC & Refrigeration Systems Using Advanced Refrigerants

Overview

In response to the continuing phase-out of halogen-based refrigerants, the industry is seriously examining ultimate replacements, focusing on ammonia and hydrocarbon refrigerants. Ammonia is receiving particular attention, thanks to its exceptional thermodynamic characteristics, and ammonia systems are being developed for conventional applications. Such systems may increase efficiency over halogenated refrigerants, and the industry is working to mitigate the disadvantages of ammonia and hydrocarbon refrigerants—namely toxicity and flammability—by developing new configurations using small refrigerant charges in sealed systems and secondary hydronic loops.

Further, advanced product development engineering is creating ever-more flexibility. Ammonia can now be used in smaller refrigeration systems, primarily due to use of capacity variation and integrated controls. This engineering approach may allow these new systems to serve as tools for energy efficiency, DR, intermittent generation integration, and other utility load management strategies.

This project will explore and document advances in product development for advanced refrigerants in applications fueled by natural gas and electricity, with the goal of identifying products for laboratory evaluation and field deployment. Once appropriate systems are selected and laboratory tested, this project intends to field test systems using advanced refrigerants in commercial and small industrial applications at multiple sites in SCE's service area to evaluate their effectiveness for energy efficiency and demand response.

Collaboration

This project was initiated by the Customer Service NPDL group and is being executed by EPRI with project management from SCE's TTC.

Status

The project team has made significant progress on Task 1, the survey of technologies, and has identified several promising technologies for laboratory and field demonstrations.

Next Steps

The project team will continue exploring technologies for laboratory and field demonstrations and zero in on the actual technologies to be tested in both gas and electricity applications. In addition, SCE will start the search for customer sites for field testing. The project is slated for completion in Q4 2015.

DR13.08 EPRI EB III D – Advanced Energy Efficiency and Demand Response Concepts in Data Centers

Overview

The goal of this project is to conduct field test to evaluate three measures that could provide energy efficiency and demand response capabilities in the data center environment:

- A software program that reduces computer power demand in response to an OpenADR signal
- Liquid cooling technology for data center servers
- Replacement of existing computer servers with more efficient equipment

The evaluations will cover the performance, customer acceptance, operational viability, efficiency and demand savings, and cost-effectiveness of the technologies. Steps in the project will involve identifying technologies to be evaluated, developing test plans, locating field sites for testing, conducting tests, and reporting results.

Collaboration

The work will be done in collaboration with EPRI, which conducts research on issues related to the electric power industry.

Status

To date, the project team has identified several technologies for evaluation:

- Sub-Project A – A software program has been installed at a customer data center, and baseline usage information is being collected. A test plan to send a DR signal to the software and monitor system response has been prepared.
- Sub-Project B – A liquid cooling system for rack-mounted computers
- Sub-Project C – Blade servers for micro computers

Next Steps

The project team is now focused on finding field test sites and developing test plans. This project will continue through Q3 2015, with the final report slated for completion in Q4 2015.

DR13.09 EPRI EB III E – DR-Ready Consumer Products

Overview

This project seeks to build understanding of the potential for—and possible barriers to—DR from mass market (residential and small commercial) DR-ready devices. By analyzing test data and conducting lab evaluations of devices not yet tested, the project will determine the mass market end-use devices with highest DR technical potential in SCE's service area. Testing will also demonstrate device response by signal type and method, and determine what verifying data is sent by each device to the utility. In particular, testing will help identify gaps between program requirements and device response (if any). Devices to be tested may include central HVAC, pool and agricultural pumps, window air conditioners, plug load controls, and appliances.

The project will also identify the functional specifications needed to enable the devices to deliver the desired DR. These specifications, which should serve as the basis for standards development, may be aligned with current and future DR needs for SCE, using automated-DR technology (such as OpenADR), and Title 24 and national requirements. Plans call for transferring evaluation results to manufacturers and standards organizations for standards and product development.

Collaboration

This project was initiated by the Customer Service NPDL group and is being executed by EPRI with project management from SCE's TTC.

Status

The project team has made significant progress on Task 1, analyzing the DR potential of mass market devices in SCE's service area. A prototype calculation tool was developed and is being revised to capture necessary information and provide a more useful end product.

Next Steps

The team will finalize the calculation tool and use it to analyze the DR potential of various residential devices, applying the best available residential usage profiles. Once this analysis is complete, the team will develop a laboratory testing plan to address the gaps in existing DR intelligence. The project is slated for completion in Q4 2015.

DR14.01 Deep Retrofits in Low Income Multi-Family Housing

Overview

This ZNE Deep Energy Retrofit sub-project will showcase a range of high-efficiency IDSM technologies within a 30-unit subset of a 100-unit 1970s low-income multi-family (LIMF) development.

Collaboration

EPRI is the project lead, with the CEC, SCE, Southern California Gas Company, BIRAEnergy, and the building complex owner (LINC Housing) acting as project partners.

Status

BIRAEnergy is performing energy modeling, which is nearly complete. This will give SCE an accurate estimate of the DR savings potential of this project.

Next Steps

The project will develop a replicable and scalable financial model for implementing LIMF ZNE retrofits across SCE territory. Testing of 3-5 brand models of Programmable Communicating Thermostats will be deployed for DR testing across 100 MF units. Schedule to complete Q1 2017.

DR14.05 DR VHF Pool Pump Study

Overview

As SCE pursued options for a DR pool pump program and determined that a HAN solution (sending signals via the AMI network through smart meters) was not feasible due to limitations with the control platform, a solution quick to market and scalable needed to be identified. A solution using similar load control switches and the one-way VHF radio network used in SCE's Summer Discount Plan - SDP (Air Conditioning Cycling DR Program) was selected. Customers were recruited via a direct mail and e-mail campaign and the control devices were installed by a selected contractor. The majority of DR test events were called with SDP events with an additional three pool pump only test events called toward the end of the project. Over 115 customers participated in test events and surveys showed high overall customer satisfaction with the project.

Collaboration

This project was undertaken with cooperation from various stakeholders at SCE.

Status

Test events concluded in October of 2014. Results from the test events were mixed. Actual load drop for pool pumps that participated in the DR events was higher than anticipated at 1.5 kW per device. However, the overall average load drop per device was approximately 0.5 kW. This most likely resulted from SDP events being scheduled later in the day than anticipated and participants changing the scheduled runtime of their pool pumps. During the recruitment process, customers with their pool pumps running from 2pm to 6pm were targeted, but many of the SDP events ran later in the day in the 4pm to 8pm timeframe. Initial analysis also seems to show that some participants changed the schedule when their pool pump would run. Additional analysis is planned to determine if a large scale program would be cost effective and provide significant DR savings.

Next Steps

Analysis and next steps will be determined during Q1 2015 following the completion of a lessons learned report.

DR14.07 Conditioned Crawl Space (CCS)

Overview

This DR project is being conducted with the larger CCS project, which is studying if energy efficiency improves when the building envelope is modified by moving the pressure boundary (conditioned space) of the building envelope from the floor to the earth grade underneath the floor.

A second important element is to research the possibility of replicating these efficiency measures in modular housing. This housing sector is a significant segment of the housing/ "re-locatable" school building stock in SCE territory.

Finally the project will help SCE drive new EE technologies by developing cost-effective/ incentive-ready emerging technology measures around the CCS area. This project will break ground on existing and new construction with CCS, using the PCT to signal DR events.

Collaboration

EM&T is collaborating with Codes and Standards to maximize the data derived from this Field Test research for the 2019 Code Cycle.

Status

Test sites have been chosen, Customer Agreements and construction contracts are in process.

Next Steps

Gather all signatures and begin data monitoring equipment installation. Scheduled to complete Q1 2017.

6. Budget

Emerging Markets and Technology Recorded Expenses: 2012–2014 ($)					
Expense Type	2012	2013	2014	2012–2014 Totals	2012–2014 Authorized Funding
Labor	622,051	788,537	867,147	2,277,735	
Non-Labor	675,631	1,493,971	2,849,318	5,018,920	
Total 2012–2014 Funding Cycle	**1,297,682**	**2,282,508**	**3,716,465**	**7,296,655**	**8,278,969**
Labor	361,391	4,552	61,975	427,918	
Non-Labor	768,537	2,014,572	50,616	2,833,725	
Total 2009-11 Carryover[29]	1,129,927	2,019,124	112,592	3,261,644	4,230,000
Grand Total	**2,427,610**	**4,301,632**	**3,829,057**	**10,558,299**	**12,508,969**

[29] Authorized in SCE's Advice 2685-E [available at: https://www.sce.com/NR/sc3/tm2/pdf/2685-E.pdf].

7. SCE's Third-Party Collaborative DR Stakeholders

- American Council for an Energy-Efficient Economy (ACEEE)
- Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
- California Energy Commission (CEC)
- California Lighting Technology Center (CLTC)
- California Public Utilities Commission (CPUC)
- Consolidated Edison of New York
- Consortium for Energy Efficiency (CEE)
- Consumer Electronics Association (CEA)
- Custom Electronic Design & Installation Association (CEDIA)
- Demand Response Research Center (DRRC) at Lawrence Berkeley National Laboratory (LBNL)
- Electric Power Research Institute (EPRI)
- Emerging Technologies Coordinating Council (ETCC)
- Environmental Defense Fund (EDF)
- Illuminating Engineering Society of North America (IESNA)
- International Association of Lighting Designers (IALD)
- National Grid
- New York State Energy Research and Development Authority (NYSERDA)
- Northwest Energy Efficiency Alliance (NEEA)
- NSTAR
- Open Automated Demand Response (OpenADR) Alliance
- Pacific Gas & Electric (PG&E)
- Peak Load Management Alliance (PLMA)
- Sacramento Municipal Utility District (SMUD)
- San Diego Gas & Electric (SDG&E)
- Sempra Energy
- U.S. Green Building Council (USGBC)
- University of California Berkeley's DR Enabling Technology Development Project
- West Coast Lighting Consortium
- West Coast Utility Lighting Team (WCULT)