Emerging Markets & Technology Demand Response (DR) Projects

Annual Report: 2011

Table of Contents

Emerging Markets & Technology 1
Demand Response (DR) Projects 1
Annual Report: 2011 1
Table of Contents 1
I. Summary 4
II. Projects Completed in 2011 6
A. DR09.09 Office of the Future (OTF) – Federal Building (Posted on ETCC as DR09SCE1.09) 6
1. Overview 6
2. Collaboration 6
3. Results 6
4. Next Steps 7
B. DR10.02 Office of the Future – GO4 (Posted on ETCC as DR10SCE1.02) 7
1. Overview 7
2. Collaboration 7
3. Results 7
4. Next Steps 8
C. DR10.03 OpenADR Standards Development 8
1. Overview 8
2. Collaboration 9
3. Status 9
4. Next Steps 9
D. DR10.06 PCT Language in Codes and Standards (CASE study and 45-day language available on CEC website) 9
1. Overview 9
2. Collaboration 10
3. Status 10
4. Next Steps 10
E. DR10.07 One-Cycle Control M&V 10
1. Overview 10
2. Collaboration 11
3. Status 11
4. Next Steps 11
F. DR10.09 Demand Response Research Center (DRRC) – DR Tools (Task 2) (Posted on ETCC as DR10SCE1.09.03) 11
1. Overview 11
2. Collaboration 12
3. Results 12
4. Next Steps 12
G. DR10.11 DRRC - Mainstreaming Auto-DR (Tasks 1 & 2) (Posted on ETCC as DR10SCE1.11.03) 12
1. Overview 12
2. Collaboration 13

3. Results 13
4. Next Steps 13
H. DR10.12 DRRC – DR Codes and Standards (Posted on ETCC as DR10SCE1.12) 13
1. Overview 13
2. Collaboration 14
3. Results 14
4. Next Steps 14
I. DR10.13 DRRC - Industrial DR (Posted on ETCC as DR10SCE1.13) 14
1. Overview 14
2. Collaboration 15
3. Results 15
4. Next Steps 16
J. DR11.04 DR Opportunities in Residential Lighting (Posted on ETCC as DR11SCE1.04.01) 16
1. Overview 16
2. Results 16
3. Next Steps 16
K. DR11.05 DR Opportunities in Corridor Lighting (Posted on ETCC as DR11SCE1.05.01 and DR11SCE1.05.02) 17
1. Overview 17
2. Collaboration 17
3. Results 17
4. Next Steps 18
L. DR11.11 Future Outlook for Residential Energy Management (Posted on ETCC as ET10SCE4.07.0) 18
1. Overview 18
2. Collaboration 19
3. Results 19
4. Next Steps 19
III. Projects initiated in 2011 20
IV. Projects continued in 2011 21
A. DR09.02 Home Battery Pilot (HBP) 21
1. Overview 21
2. Collaboration 21
3. Status 21
4. Next Steps 21
B. DR09.08 Expanding Residential DR in the Irvine Smart Grid Demonstration (ISGD) project 22
1. Overview 22
2. Collaboration 22
3. Status 22
4. Next Steps 22
C. DR10.05 Auto-DR PCT 23
1. Overview 23
2. Status 23
3. Next Steps 23

D. DR10.08 DR Pool Pumps 23
1. Overview 23
2. Status 24
3. Next Steps 24
E. DR10.09 DRRC – DR Tools (Task 1) 24
1. Overview 24
2. Collaboration 24
3. Status 24
4. Next Steps 25
F. DR10.11 DRRC – Mainstreaming Auto-DR (Task 3) 25
1. Overview 25
2. Collaboration 25
3. Status 25
4. Next Steps 25
G. DR10.16 Smart Appliances 25
1. Overview 25
2. Collaboration 26
3. Status 26
4. Next Steps 26
H. DR11.01 Ancillary Services Pumping Equipment 26
1. Overview 26
2. Status 26
3. Next Steps 26
V. Budget 27

I. Summary

As described in Section VIII of the Amended Testimony in Support of Southern California Edison's (SCE) Amended Application for Approval of Demand Response (DR) Programs, Goals, and Budgets for 2009-2011 (A.08-06-001[1]) and authorized in California Public Utilities Commission (CPUC) D. 09-08-027[2] Adopting DR Activities and Budgets for 2009 through 2011, SCE Emerging Markets & Technology (EM&T) program executes projects to explore innovative and cost effective DR technologies, understand customer preferences and market potential and provide input on DR codes and standards to enable customer participation in SCE's DR programs. This report is being submitted as directed in Ordering Paragraph 14 of D. 09-08-027 to provide an annual report on the projects undertaken through the EM&T program.

SCE is working 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. The California Investor Owned Utilities (IOUs) meet every month to coordinate, collaborate and share results from each IOUs portfolio of EM&T projects. In the ongoing research efforts to institutionalize and expand DR in California, SCE intends to continue collaborations with other statewide agencies and other parties interested in DR, such as:

- California Energy Commission (CEC) Public Interest Energy Research (PIER) program
- Demand Response Research Center (DRRC) at Lawrence Berkeley National Laboratory
- University of California Berkeley's DR Enabling Technology Development Project for which SCE is on the Technical Advisory Council
- Emerging Technologies Coordinating Council (ETCC)
- California Lighting Technology Center (CLTC)
- Organization for the Advancement of Structured Information Standards (OASIS)
- Open Smart Grid (OpenSG) at UCA International Users Group (UCAIUG)
- Office of the Future (OTF) Consortium including New Buildings Institute (NBI), Department of Energy (DOE), Sacramento Municipal Utility District (SMUD), Pacific Gas and Electric Company (PG&E), Sempra Utilities, National Grid, BC Hydro, NSTAR, Consolidated Edison, and Seattle City Light
- Electric Power Research Institute (EPRI)
- Open Automated Demand Response (OpenADR) Alliance
- Consumer Electronics Association
- U.S. Green Building Council (USGBC)
- North American Energy Standards Board (NAESB)

[1] Amended Testimony in Support of Southern California Edison Company's Amended Application for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011: http://www3.sce.com/sscc/law/dis/dbattach1e.nsf/0/F89EF6F12FE7C562882574C90070BEA6/$FILE/A.08-06-001+2009-11+DR+Amended+App_SCE-01+Amended+Testimony+Vol.+I.pdf [as of March 29, 2012].

[2] Decision Adopting Demand Response Activities and Budgets for 2009 through 2011: http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/106008.pdf [as of March 29, 2012].

The positive results from EM&T advance DR only if those results are communicated to our customers and other stakeholders. As detailed in following bullets, SCE has implemented several approaches for communicating DR advances across SCE to internal stakeholders like the Business Customer Division's (BCD) Account Managers who can then educate and influence customers to enroll in DR programs and adopt DR technologies and strategies. Specific approaches for disseminating information include:

- Customer Information Sheets to aid Account Managers in communicating the opportunities associated with DR technologies and strategies developed by EM&T
- Integrated Demand Side Management (IDSM) exploration through coordination and collaboration between EM&T and the Customer Energy Efficiency & Solar (CEES) organization, as well as partnering with BCD's Design & Engineering Services (D&ES) to execute EM&T projects utilizing the engineering staff within D&ES.
- Quarterly Technology Briefings for BCD representatives by D&ES to communicate the results of EM&T DR and D&ES Emerging Technologies, HVAC Technology and System Diagnostics Advocacy, and Codes and Standards program projects at the Energy Education Center (EEC) in Irwindale, CA.
- DR Forum to help communicate and coordinate DR information across SCE by hosting a distinguished group of industry speakers who have offered varied perspectives on DR-related topics to stakeholders from across the company.
- In addition to the EM&T annual reports provided to the CPUC, full reports on the completed EM&T projects are also available to the public through the ETCC web site (http://www.etcc-ca.com). ETCC coordinates among its members including California's IOUs, the SMUD, the CEC, and the CPUC to facilitate the assessment of promising Energy Efficiency (EE) and DR emerging technologies that will benefit California customers and respond to the initiatives outlined in the California Long Term Energy Efficiency Strategic Plan (LTEESP).

In 2011, SCE chartered EM&T projects in the following areas:

- Establishing DR capabilities in standard commercial product offerings
- Development of DR standards for buildings, appliances and messaging protocols
- Research into the DR potential of consumer appliances and new construction building codes
- Continuation of the Home Battery Pilot (HBP) project
- Enabling future IDSM policy objectives through
  - OTF project collaboration with CEES
  - Exploring Home Area Network (HAN) capabilities for DR by participating in the Irvine Smart Grid Demonstration (ISGD) project

This report summarizes the results and status for individual projects. The DR project numbers assigned to each project are listed and these can be used to locate specific project documentation on the ETCC web site.

II. Projects Completed in 2011

A. DR09.09 Office of the Future (OTF) – Federal Building (Posted on ETCC as DR09SCE1.09)

1. Overview

The purpose of this project was to evaluate an in situ demonstration of the OTF 25% solution (25% better than 2008 Title 24) for typical large office spaces. This project evaluated the DR capabilities of an Advanced Lighting Control System (ALCS) developed by Encellium Systems. The system was installed on half of the 12th floor of the Los Angeles Federal Building. The primary goals of this project included:

- Determine whether the ALCS allows for reliable control of facility lighting loads from SCE, or business management as part of a DR Program,
- Quantify demand reductions that are achievable with a well-designed lighting system, and
- Provide measured and technical data in support of the OTF initiative.

2. Collaboration

This project collaborated with other members of the OTF consortium identified earlier; specifically PG&E and San Diego Gas & Electric Company (SDG&E). Results of these projects have been shared during scheduled monthly conference calls.

3. Results

The new lighting system included LEDs for task lighting and downlights with fluorescent dimming ballasts that were commissioned at a setting of 80% of the lighting's rated electrical input for general lighting. This new commissioning level was designated as the baseline for DR testing. DR testing was successfully conducted on the same business hours over three separate days. To increase data accuracy, recording granularity was set to a 1-minute interval during the test periods. The testing procedure included changing the lighting level to five different settings: 10%, 15%, 20%, 25%, and 30% below the commissioned level. Each setting lasted for one hour, after which it returned to the baseline DR level. A non-test day was also recorded by the data loggers as a comparison to demand during the three test days. The project achieved the stated objectives with the following findings:

- DR testing for the ALCS confirmed that lighting loads may be reliably managed by business management participating in a DR Program. With this technology, the demand reduction was not proportionate to the reduction in all setting levels. If a desired reduction is needed, the controls should be tested and calibrated to determine actual DR reduction rather than relying on the system setting.
- There was a reduction in overhead lighting load demand after the installation of the ALCS and the new lighting fixtures. The DR reduction for lighting was 0.58 kW, or

0.073 Watts per square foot (W/sf) at the 30% DR level. The percentage reduction is approximately 17% assuming a baseline of 3.4 kW. This is in addition to the savings achieved from tuning the system to 80% of full capacity.

4. Next Steps

Although this project has been completed, SCE will continue to monitor OTF efforts and pursue other advanced lighting and controls projects that may influence future DR program offerings.

B. DR10.02 Office of the Future – GO4 (Posted on ETCC as DR10SCE1.02)

1. Overview

The purpose of this project was to evaluate an in situ demonstration of the OTF 25% solution (25% better than 2008 Title 24) for typical large office spaces. This project consisted of the Executive Suites on the fourth floor of the General Office 4 (GO4) building occupied by SCE. As part of this study the DR capabilities of the Convia-enabled Wiremold ALCS were evaluated. This ALCS was installed in the offices on the fourth floor of the GO4 Building. The primary goals of this project included:

- Determine whether the ALCS allows for reliable control of facility lighting as part of a DR Program,
- Examine demand reductions that can be achieved with a well-designed lighting system, and
- Provide measured and technical data in support of the OTF initiative.

2. Collaboration

This project collaborated with other members of the OTF consortium identified earlier; specifically PG&E and SDG&E. Results of these projects have been shared during scheduled monthly conference calls.

3. Results

The new lighting system consisted of LEDs for task lighting and downlights with fluorescent lights for general lighting. The new lighting system was universally tuned down by 20% of its total electrical input. All open office workstations were tuned to meet the preferences and needs of the occupant. Each workstation was equipped with an occupancy sensor that brings lights to the occupant's preferred light level when someone arrives at the desk and reduces lighting levels to 15% power when the space is unoccupied. DR testing was successfully conducted on the same business hours over three separate days. During the test periods recording intervals were reduced to 1-minute intervals. The testing procedure included changing the lighting level to five different settings: 10%, 15%, 20%, 25%, and 30% below the commissioned level. Each setting lasted for one hour, after which it returned to the baseline DR level of 0%. A non-test day

was also recorded by the data loggers as a comparison to demand during the three test days. The following objectives were achieved as a result of this project:

- DR testing for the ALCS confirmed that lighting loads may be reliably managed as part of a DR Program. However, due to issues in isolating lighting loads and variations brought upon by occupancy schedules, the percent power reductions sought, or even the pattern, were not realized.
- There was a reduction in overhead lighting load demand after the installation of ALCS and new lighting fixtures. The DR reduction for lighting was 0.85 kW, or 0.072 W/sf at the 30% DR level.
- This project provides valuable data, and lessons learned which can support the OTF initiative.

4. Next Steps

Although this project has been completed, SCE will continue to monitor OTF efforts and pursue other advanced lighting and controls projects that may influence future DR program offerings. The lessons learned can be applied to any OTF effort or lighting project in general moving forward.

C. DR10.03 OpenADR Standards Development

1. Overview

The Energy Independence and Security Act (EISA) of 2007, appointed the National Institute of Standards and Technology (NIST) with the "primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems…" which resulted in the Smart Grid Interoperability Standards Project. NIST established Priority Action Plans (PAPs) to focus on a variety of the components to achieve Smart Grid Interoperability, including “Standard Demand Response Signals” through PAP 09. One of the two NIST recognized standards for inclusion in the Smart Grid Interoperability Standards Framework that are directly applicable for DR is OpenADR, which defines messages exchanged between utilities and commercial/industrial customers for price-responsive and direct load control over the Internet. Adopting an open standards approach for Smart Grid, advanced meter infrastructure (AMI), and DR has resulted in some delays in deployment due to the slow process of developing, finalizing and adopting standards. However, the end result should expand the marketplace to include the domestic US market and will offer a robust set of products for customers enabled by a variety of interoperable commercial devices rather than proprietary or “California-only” solutions for DR. There are many commercial products being developed by consumer electronics manufacturers whose business models are based on developing products to engage customers with meaningful information and intuitive user interfaces. These products will be capable of providing customers with information about their energy usage, helping customers respond to price or DR event signals, and will also empower the marketplace to innovate and differentiate product

offerings while targeting a variety of customer price points. The primary objective of this project was to drive an expedited development of the OpenADR standard for ratification by OASIS and incorporation as a released Smart Grid interoperability standard by NIST.

2. Collaboration

In this project, SCE collaborated with UCAIUG's OpenSG OpenADR task force, OASIS, NAESB, Smart Grid Interoperability Panel (SGIP), consultants from Xtensible Solutions, and the OpenADR Alliance.

3. Status

Phase one of this project was completed in 2010 with the creation of the system requirements specifications and service definitions. These documents were then incorporated into the work completed by OASIS and released for public comment in November 2010. Phase two of this project further enhanced the capabilities of OpenADR by reviewing security and adding specifications for quick response interactions or "fast" DR. In addition to enhanced capabilities, Phase 2 monitored and encouraged the efforts of OASIS to get three specifications: 1) Energy Market Information Exchange (eMIX), 2) Web Services Calendar (WS-Calendar), and 3) Energy Interoperability (EI) finalized, reviewed by the SGIP, and added to the SmartGrid Catalog of Standards (CoS). This work was completed with eMIX and WS-Calendar added to the CoS in 2011 and EI scheduled to complete this process in the first quarter of 2012. The OpenADR 2.0 profile will be based on elements of these three OASIS standards.

4. Next Steps

Although the OpenADR standards development work has been completed, SCE will continue to participate in the OpenADR Alliance to develop and enhance a testing and certification process for products utilizing the OpenADR standard.

D. DR10.06 PCT Language in Codes and Standards (CASE study and 45-day language available on CEC website)

1. Overview

The purpose of this project was to evaluate feasibility of, and if applicable, develop potential code language for California Title 24 which would mandate Programmable Communicating Thermostats (PCTs), referred to as Upgradeable Setback Thermostats (USTs) in the study, to be installed in all new construction and HVAC retrofit projects that require a building permit. The PCTs would be able to receive price and DR event signals and adjust thermostat temperature set points based upon default factory settings or custom settings programmed by the customer.

2. Collaboration

In collaboration with the statewide IOU Codes and Standards team code language was proposed that would align with national Smart Grid standards currently being developed. Several phone calls and meetings were also with the CEC in an effort to come to an agreement on the language regarding PCTs that should be included in the 2013 Title 24. SCE also hosted a meeting to engage suppliers and industry professionals and to discuss possible provisions for PCTs within Title 24 which further informed the IOUs recommendations to CEC.

3. Status

Meetings with CEC staff and commissioners continued during 2011 and eventually the IOU's and CEC agreed on the language to be proposed. The 45-day language was released on February 24, 2012, with 15-day language and adoption expected to occur in Q2 of 2012.

4. Next Steps

The CEC has released the 45-day language and is awaiting any comments on the proposed language. Depending on the nature and volume of comments, SCE will work with stakeholders to resolve outstanding issues, and develop revised requirements for the 15-day language and adopted code.

E. DR10.07 One-Cycle Control M&V

1. Overview

The purpose of this project was to provide Measurement and Verification (M&V) for a peak load reduction project utilizing battery storage technology from One-Cycle Control (OCC). OCC was awarded a PIER Emerging Technology Demonstration Grant (ETDG) for this project and contacted SCE for assistance because the proposed pilot sites are in SCE service territory. This project included collaboration with SCE's Program Evaluation and Energy Conversions & Storage groups. The scope of work for this project included:

- Ensure compliance with SCE Rules & Tariffs
- Inform vendor and customers of potential safety issues or code violations
- Provide OCC with the forms necessary to request interval meter data for the pilot sites
- Assist in developing the measures to track during the pilots
- Utilize the Energy Conversions & Storage group as technology experts for battery storage
- Validate the results of the pilot sites

2. Collaboration

This was a collaboration project with OCC in support of the PIER ETDG program. SCE played strictly an advisory role, providing measurement and validation for a prototype product.

3. Status

Several meetings and demonstrations were held with OCC to gain a better understanding of their Peak Load Reduction (PLR) battery storage device and its capabilities. OCC's offices were the pilot site for initial testing. SCE reviewed the results from the tests completed and provided a letter of support for the M&V processes utilized.

4. Next Steps

Although the M&V portion of the project is complete, SCE plans to continue working with OCC to perform additional lab testing and a field test at another facility.

F. DR10.09 Demand Response Research Center (DRRC) – DR Tools (Task 2) (Posted on ETCC as DR10SCE1.09.03)

1. Overview

The purpose of this project was to improve the software tools available for estimating DR potential in commercial buildings by evaluating existing tools in a scoping study and developing a statewide DR database. The projects two major tasks had separate deliverables. Task 2 was completed and is included in this section of the report while Task 1 is ongoing and is included in Section IV (Projects continued in 2011) of the report:

a) Task 2 - Statewide DR Database

A web-based database will be set up to collect and store information on facilities and their response to OpenADR signals. The database will include fields for collecting the building size and systems information, DR control strategies, measured demand savings from Auto-DR events. The information collected will be as follows:

- Building Information: address, type, building envelope, building layout, thermal mass, building size, etc.
- Internal Information: number of occupancy, lighting power, plug and misc power, schedules of these internal loads, vertical transportation (elevator), etc.
- HVAC System: system type, operating schedules, zone temperature set points during the cooling and heating seasons, capacity of plant, etc.
- Auto-DR Field Test Information: Field tested control strategies, identify any problem during the test or DR period.

2. Collaboration

This project was completed in collaboration with the DRRC and other California IOU's to enhance the tools available for understanding and furthering the adoption of Auto-DR at commercial sites.

3. Results

The DRRC collaborated with the three IOUs to collect information on existing customers and will coordinate the data collection of new customers. Initial data will be acquired from sites that have worked with the DRRC in the past. For any new site that would like to be a part of this database, a central web-based survey will be developed to collect this information from the building facility managers as their buildings sign up on Auto-DR programs.

4. Next Steps

Begin utilizing the statewide DR database with new potential Auto-DR customers to more accurately determine DR potential based on building types, business segments, and other information.

G. DR10.11 DRRC - Mainstreaming Auto-DR (Tasks 1 & 2) (Posted on ETCC as DR10SCE1.11.03)

1. Overview

The purpose of this project was to facilitate and accelerate the adoption of Auto-DR both in new construction and in existing buildings by developing education and training materials, assessing system capabilities of controls, and evaluating load shape changes and shed attenuation. The projects three major tasks had separate deliverables. Tasks 1 and 2 were completed and are included in this section of the report, while Task 3 is ongoing and is included in Section IV (Projects continued in 2011) of the report:

a) Task 1 - Develop education and training materials

Develop segment specific education and training materials for controls vendors, auditors, retro-commissioning agents, account executives, etc. for commercial and industrial customers. This task also included the development of case studies that will outline DR strategies and value streams from DR.

b) Task 2 - Assessment of controls system capabilities

Assemble a DR guideline that outlines minimum energy management and control system features and functionality for Auto-DR and create an online database of companies with products that support Auto-DR and comply with OpenADR specifications. The DRRC will also survey major controls companies to collect information on legacy systems that can support Auto-DR strategies and comply with OpenADR specifications as well as

legacy systems that are not upgradable to support Auto-DR strategies. The survey will include questions to understand the maintenance contracts between the customers and vendors and develop methods for long-term maintenance of Auto-DR strategies.

2. Collaboration

This project was completed in collaboration with the DRRC and other California IOU's to improve the understanding and adoption of Auto-DR in the market.

3. Results

Customer adoption of concepts and technologies is the key to the success of the Smart Grid in the U.S. One of the key demand-side management activities that link Smart Grid concepts and technologies with the customers is DR. Recent work has shown that simply installing the equipment and letting it respond to DR events is not sufficient. Engaging customers to respond to price or reliability variations of the electricity grid requires a well-defined, streamlined process. This process will require training, education, and decision support tools that are targeted towards key players, to make DR participation possible and more common. A result of this project was the development of a step-by-step DR enablement process, decision support concepts, and tools developed over years of DR field tests and interaction with customers while deploying automated DR technologies. Although this project concentrated on DR process and tools, it does not explore how these tools can be used for integrating operational EE and DR. As a next step, the enablement process should be followed up by an evaluation process which is integrated with operational EE processes.

4. Next Steps

Determine the best strategy to utilize training materials and the assessment of control systems.

H. DR10.12 DRRC – DR Codes and Standards (Posted on ETCC as DR10SCE1.12)

1. Overview

The original scope of this project evolved from an effort to influence California codes and standards to a focus on USGBC's Leadership in Energy and Environmental Design (LEED) certification. The DRRC developed a strategy guide to be used in maximizing the LEED credits a building can receive with a focus on the new credit available for implementing DR. The DRRC also performed a small scale market study of the LEED DR credit, in order to gain a better understanding of the viability of the DR credit. The market study was conducted through interviews with building industry stakeholders.

2. Collaboration

This was a collaboration project with the DRRC and other California IOU's. The DRRC worked with USGBC in developing the DR LEED credit criteria.

3. Results

The market study conducted resulted in the following findings and recommendations:

a) Findings:

- LEED points offer additional incentives for adoption of DR
- EE is not considered in load shed requirements
- Load shed thresholds may be too high for small/medium commercial buildings
- LEED points offered are not equitable for cost and effort required
- DR strategy development effort must be started early in the design process
- Retro-active point acquisition is not available

b) Recommendations:

- Provide more resources to learn about DR opportunities in one's area
- Points awarded should be scaled based on energy performance
- Incentivize early design of DR enablement
- Grant points on proportionate scale to load shed
- Provide option for 'retrofit' points
- Make credit available under LEED CI

A guide aimed at providing information and assistance for LEED projects to participate in DR and Auto-DR programs and assist these projects to achieve the LEED DR pilot credit was also developed as a result of this project.

4. Next Steps

In 2012, SCE plans to participate in the Demand Response Partnership Program effort with the USGBC, the DRRC, and Environmental Defense Fund (EDF) to:

- Enhance the LEED DR credit language
- Develop an understanding of economic and environmental benefits of DR
- Track and improve the persistence and repeatability of DR
- Develop peak demand and DR benchmarking

I. DR10.13 DRRC - Industrial DR (Posted on ETCC as DR10SCE1.13)

1. Overview

As part of California's LTEESP, there are several activities either planned or underway to improve the ability of industry to better manage both peak and on-going electrical energy

use. One synergistic activity is the Superior Energy Performance initiative put forward by the DOE and a number of other public and private sector partners to certify industrial facilities for EE.[3] A core element of this initiative is the adoption and use of an energy management standard, initially ANSI MSE 2000:2008, replaced by ISO 50001 in 2011. The purpose of this project was to understand the relationship between DR as a driver for the adoption of sophisticated controls in participating industrial facilities and the capacity of these facilities to implement the energy management standard. This project leveraged sites which had been selected for the California Superior Energy Performance demonstration program to develop this understanding. The scope of work included conducting a study at these sites to examine the relationship between DR (automated and manual), load management, controls capabilities, and the level of success experienced by the industrial site in implementing the energy management standard.

2. Collaboration

This project was completed in partnership with the DRRC. Other California IOUs are funding portions of the project being undertaken in their service territories.

3. Results

Energy management systems were incorporated into the organization, which led to technical and operational changes. These changes, through increased technical capabilities and increased personnel awareness, have resulted in additional capabilities for DR. The technical changes most relevant to DR were the installation or planned installation of variable frequency drives (VFDs) on process equipment, while the most relevant operational changes were those that increased awareness throughout the organization of DR opportunities and procedures. Additionally, there seems to be a link between DR implementation and energy management capabilities, as shown by the sub meters that Bentley Prince Street received as part of their Auto-DR system. Several other changes could be made which would increase the ability of these facilities to participate in DR. An increase in the control capabilities of both facilities would allow more granular control over facility demand, and an expansion in the portfolio of DR programs offered by utilities would more closely match utility needs with facility resources. An increase in material storage within the process will enhance the flexibility of energy usage. These changes, as well as the ones which were already implemented, are likely to apply to many other industrial facilities. The nexus of energy management and DR could be encouraged in several ways. More comprehensive studies could be undertaken to validate that the findings from this study truly apply to other industrial facilities, as industrial processes and equipment are extremely varied. Utility and market programs offering incentives for either energy management or DR can offer combined programs or keep programs separate but promote both through coordinated marketing. Governmental agencies could mandate that the organizations that they contract with must incorporate energy management systems into their operations wherever applicable. Further experience with

[3] http://www.superiorenergyperformance.net [as of March 29, 2012].

standards-based energy management systems will yield additional insight into their ancillary benefits.

4. Next Steps

Although this project has been completed, SCE will continue efforts to improve load management, control capabilities, and overall energy management at industrial facilities.

J. DR11.04 DR Opportunities in Residential Lighting (Posted on ETCC as DR11SCE1.04.01)

1. Overview

This study evaluated available literature to determine if residential lighting and plug loads coincide with projected peak demand, and to determine the potential for customer acceptance of load reduction during peak demand. Extensive research was conducted through the review of news publications, research documents, surveys, and DR case studies currently available. This research helped to understand and evaluate current information on residential DR for lighting and plug load applications.

2. Results

How consumers use energy in their homes has changed substantially over the past three decades. Over this period, U.S. homes on average have become larger, and most contain more energy-consuming devices such as home electronics. Per capita, and specifically in the residential sector, energy consumption has steadily increased nationally. Within the SCE residential territory today, a typical household attributes 27% of its energy use to lighting, and another 52% to plug loads, or miscellaneous loads. Based on data from 1999, peak lighting load occurs at 8 PM, with a secondary peak at 7 AM. Based on data from 2006, peak plug load occurs at 8 PM.

The projected potential demand savings from EE in the residential sector, 481 MW under current incentives for lighting and 447 MW for miscellaneous from 2004 to 2016, highlight the tremendous potential for savings. The projected increase in customer DR program participation found through the literature review underscores the opportunity for residential DR programs. The literature review also indicates the need to further engage residential customers to introduce them to smart grid technologies and DR programs.

3. Next Steps

Based on the literature review conducted in this study, a second phase of the project could be initiated, pending the analysis of a forthcoming CPUC report on residential lighting (Upstream Lighting Program Evaluation report). The CPUC report will provide time of use data on residential lighting, which can help determine if and when the lighting load growth will lead to peak demand coinciding or exceeding SCE generation. If the result of the analysis of this forthcoming CPUC data shows a peak demand impact, then

Phase 2 of the project consisting of the analysis of the existing infrastructure and a residential customer survey could be pursued.

K. DR11.05 DR Opportunities in Corridor Lighting (Posted on ETCC as DR11SCE1.05.01 and DR11SCE1.05.02)

1. Overview

a) Landmark Square

This project evaluated the DR capabilities of an ALCS developed by Lutron Electronics. This ALCS was installed on the 10th floor of the Landmark Square building in Long Beach, California.

b) University of California, Irvine (UCI)

The purpose of this project was to evaluate the DR capabilities of an ALCS developed by Redwood Systems. Installation of this ALCS occurred on the ground floor of the Natural Sciences 1 building at the UCI.

The objectives of this project at both locations were:

- Examine the ALCS features that allowed for reliable control of corridor lighting loads from business management as part of a DR Program
- Examine demand reductions that can be achieved with a well-designed, smart lighting control system

2. Collaboration

This project was completed in collaboration with SCE's D&ES group, Landmark Square, UCI, and the CLTC.

3. Results

a) Landmark Square

Installation of the lighting system and control hardware was completed in September 2011. The new lighting system consisted of fluorescent lamps and the Lutron ALCS. Commissioning reduced the ballast dimming settings to 65% of the lighting's rated electrical input. This new commissioned level is also designated as the baseline for the DR testing performed at the Landmark Square building. Testing was successfully conducted during the same business hours over three separate days. Part of the testing involved changing the DR level to five different settings: 10%, 15%, 20%, 25%, and 30% reductions with respect to the commissioned level. Each setting lasted for one hour after which it returned to the baseline DR level. A non-test day was also recorded by the data loggers as a comparison to demand during the three test days. The following objectives were achieved as a result of this project:

- DR testing for the ALCS confirmed that business management as part of a DR Program could reliably manage lighting loads.
- There was a reduction in overhead corridor lighting load demand after the installation of the ALCS and the new lighting fixtures. The DR reduction for lighting averaged 7.4 W/fixture, or 0.092 W/sf at the 30% DR level. The percentage reduction was approximately 17%. This is in addition to the lighting savings associated with tuning down the lamps.

b) UCI

Installation of the lighting system and control hardware was completed in October 2011. The new lighting system consisted of LED lamps and Redwood Systems ALCS. Commissioning reduced the light output settings to 85% of the lighting's rated output. This new commissioned level is also designated as the baseline for the DR testing. DR testing was conducted for the same business hours over three separate days. During the test periods recording granularity was set at 1-minute. The testing procedure included changing the lighting level to five different settings: 10%, 15%, 20%, 25%, and 30% below the commissioned level. Each setting lasted for one hour, after which it returned to the baseline DR level. A non-test day was also recorded by the data loggers as a comparison to demand during the three test days. The following objectives were achieved as a result of this project:

- DR testing for the ALCS confirmed that lighting loads can be reliably managed by business management as part of a DR Program, but requires local connection to the controller.
- There was a reduction in overhead lighting load demand after the installation of the ALCS and the new lighting fixtures. The DR reduction for lighting averaged 62W, or 0.031 W/sf at the 30% DR level. The percentage reduction was approximately 43%. This is in addition to the lighting savings associated with tuning down the lamps.

4. Next Steps

Although this project has been completed, SCE will continue to pursue other advanced lighting and controls projects that may influence future DR program offerings.

L. DR11.11 Future Outlook for Residential Energy Management (Posted on ETCC as ET10SCE4.07.0)

1. Overview

To better understand residential customer interest in a number of smart grid-related products and services and to understand the opportunities/barriers for smart grid products and services from the perspectives of manufacturers and members of the supply chain, SCE conducted a two-pronged research study including; a web survey among SCE residential customers and, twelve in-depth telephone interviews among industry decision makers and thought-leaders.

2. Collaboration

This project was completed in collaboration with SCE's D&ES group with input from SCE residential customers and industry leaders. It was also co-funded with the Emerging Technologies and HVAC Technology and System Diagnostic Advocacy programs. Additionally, this project piggy backed off the efforts of the Continental Automated Building Association's national study of the same name.

3. Results

A web survey of 606 residential customers was conducted in SCE service territory and 12 in-depth interviews were conducted with industry leaders who represent manufacturers, vendors, and supply chain distributors for smart grid products and services. The following key findings resulted from these surveys and interviews:

a) Residential Surveys

- The main motivation for saving energy is to lower electricity bills
- Awareness of energy related products, services, and utility programs varies widely and education on specific concepts such as DR is needed
- Many customers have already taken easy and less expensive steps to conserve
- Use of effective, but high cost energy saving solutions has low penetration

b) Industry Leader Interviews

- Two primary barriers to adoption of smart grid products and services:
  - Lack of open and uniform standards and protocols
  - Consumer lack of understanding regarding energy
- Additional innovation is needed to solve energy related problems
- Solutions that require little effort by consumers or bundle energy solutions with other services are needed

4. Next Steps

Results of this study will be used to determine where to focus resources on future residential projects that evaluate emerging markets and technologies.

III.Projects initiated in 2011

All new projects initiated in 2011 were completed by year end. The only projects continuing into 2012 were started earlier in the 2009-2011 funding cycle.

IV. Projects continued in 2011

A. DR09.02 Home Battery Pilot (HBP)

1. Overview

The primary objective of this project, which began in 2009, is to evaluate and test 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 impact, while still alleviating demand on the power grid. A more detailed explanation of this project can be found in Appendix K[4] of SCE's amended testimony DR application (A.08-06-001).

2. Collaboration

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

3. Status

LG Chem. was selected as the vendor to provide the RESU. A prototype device was received in December of 2010 and extensive lab testing has been performed. During 2011, two pre-production units and fourteen additional units were received with increased functionality and several other improvements, including web control. These production units went through the complete series of RESU tests and SCE's energy storage specialists have worked with LG engineers to resolve issues discovered during testing. Unfortunately, UL certification has been delayed leading to a delay in field testing and the need to continue funding this project into the next funding cycle. Advice letter 2685-E was approved, allowing the continuation of this project into the new funding cycle.

4. Next Steps

Necessary design changes have been made and UL certification is anticipated by late-2012. Once the RESU's have UL certification, the field testing phase of the project will proceed. At the conclusion of field testing, a final report will be written to provide information regarding the feasibility of using these types of batteries as a DR resource and any additional learning gained as a result of this project. Additional RESU's will also be included as part of the ISGD project and will receive additional testing in several homes in the ZNE and RESU blocks.

[4] DR application (A.08-06-001) Appendices A through M: 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 [as of March 29, 2012].

B. DR09.08 Expanding Residential DR in the Irvine Smart Grid Demonstration (ISGD) project

1. Overview

SCE has been exploring how to capitalize on the Edison SmartConnect™ metering and HAN deployment to further enable residential DR in coordination with EE and distributed energy resources. To further this goal, EM&T provided some of the "matching funds" allowing SCE to leverage funding from the American Recovery & Reinvestment Act (ARRA) in SCE's proposal for the ISGD project awarded by the DOE[5]. The ISGD project will demonstrate potential EE and DR approaches to enable Zero Net Energy (ZNE) homes in step with California's LTEESP. Several groups of homes will receive different treatments including a ZNE group, a group utilizing Community Energy Storage, and a group utilizing individual RESU. The two major areas of this project are the DR potential of residential HAN devices and the HBP.

2. Collaboration

This project is a collaborative effort with SCE's Transmission and Distribution Unit (TDBU) Advanced Technology Organization and BCD D&ES. This project also collaborates with the DOE in support of their larger, Smart Grid demonstration efforts.

3. Status

The contract with DOE was signed in December of 2010. As detailed plans were developed, several changes in selected vendors were made and customer agreements had to be signed with home owners participating in the project leading to delays in getting products procured and installed in the participating homes. However, during 2011 an early field test was conducted which involved the installation of project SmartConnect™ meters, in-home displays (IHDs), and PCTs in some of the homes. Initial communication tests sending simulated DR events to these devices were successful. Additional tests will continue into the next funding cycle. Due to delays associated with this project, a request to continue activities and funding was granted in the approval of Advice letter 2685-E.

4. Next Steps

Additional testing will be completed during the summer of 2012 to observe actual load drop during several DR events directed at the installed PCTs. Additional HAN devices including an EMS, smart appliances, plug load monitors, and RESUs will be procured, tested, and installed in anticipation of the primary testing phase of the project in 2013.

[5] Department of Energy Recovery Act State Memos: http://www.energy.gov/recovery/documents/Recovery_Act_Memo_California.pdf [as of March 29, 2012].

C. DR10.05 Auto-DR PCT

1. Overview

The purpose of this project is to demonstrate the capability of a PCT using Auto-DR through the OpenADR specification. This solution is intended for commercial customers without a building or energy management system (BMS/EMS). The project goal is to offer a solution that provides some automated air-conditioning load reduction for commercial and industrial customers during Critical Peak Pricing (CPP), or other DR, events by enabling temperature setbacks, without the expense of a full BMS/EMS.

2. Status

An OpenADR compatible PCT was identified during 2010 and procurement of the device was completed in early 2011. These devices were tested in a lab setting during several actual DR events throughout the summer of 2011. The PCTs worked as anticipated, but a need to improve the provisioning of the PCT allowing it to be uniquely tied to a specific customer was identified that required an update to the equipment and the associated software. During 2011 an additional vendor contacted SCE with a similar solution and it was decided to move forward with a field test of both solutions. The procurement and contracting process was completed for both solutions during 2011 and the field testing phase is scheduled for the summer of 2012. Due to the addition of a second vendor and updates needed to the original vendor's equipment, a request to continue activities and funding for this project was granted in the approval of Advice letter 2685-E.

3. Next Steps

Finalize selection of customer sites to participate in the field trial. Install PCT's at selected sites. Monitor PCT functionality during summer DR events. Prepare a final report on the results of the field trial.

D. DR10.08 DR Pool Pumps

1. Overview

The purpose of this project is to perform laboratory and field tests of commercially available pool pumps and pool pump controllers that are designed to enable curtailment of pool pump loads in response to DR event signals or pricing signals. This 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[6]
- Integration of DR into Title 20 for Residential Pool Pumps[7]

[6] Pool Pump Demand Response Potential: http://www.etcc-ca.com/component/content/article/29/2420-pool-pump-demand-response-potential [as of March 29, 2012].

This project will include field trials of a pool pump with integrated DR capabilities, as well as retrofit solutions that would add DR capabilities to existing pool pumps.

2. Status

After initial implementation plans were created, the selected vendor designing the pool pump with integrated communication experienced some delays. The obstacles encountered have been overcome and plans are moving forward to complete the project in 2012. A request to continue activities and funding for this project was granted in the approval of Advice letter 2685-E.

3. Next Steps

Complete field trial of integrated solution according to plans; select and test retrofit solutions during 2012.

E. DR10.09 DRRC – DR Tools (Task 1)

1. Overview

The purpose of this project is to improve the software tools available for estimating DR potential in commercial buildings. The project includes two major tasks with separate deliverables. Task 1 is included in this section of the report, Task 2 was reported on earlier, as it has been completed:

a) Task 1 - Scoping Study

This project includes a review of the literature on existing DR tools being used or under development and the creation of a framework to evaluate tools and categorize them for a variety of users. This will include a summary of metrics and building characterization parameters that allow facility managers to better understand their building's energy consumption.

2. Collaboration

This project is a collaborative effort with the DRRC and other California IOUs to enhance the tools available for understanding and furthering the adoption of Auto-DR at commercial sites.

3. Status

This project will be completed by mid-2012. A request to continue activities and funding for this project was granted in the approval of Advice letter 2685-E.

---

[7] Integration of DR into Title 20 for Residential Pool Pumps - Phase 1: http://www.etcc-ca.com/component/content/article/29/2938-integration-of-dr-into-title-20-for-residential-pool-pumps-phase-1 [as of March 29, 2012].

4. Next Steps

Continue monitoring Task 1 to ensure completion on schedule.

F. DR10.11 DRRC – Mainstreaming Auto-DR (Task 3)

1. Overview

The purpose of this project is to facilitate and accelerate the adoption of Auto-DR both in new construction and in existing buildings. The project included three major tasks with separate deliverables. Task 3 is included in this section of the report since Tasks 1 and 2 have been completed, and are included in the earlier sections:

a) Task 3 - Evaluation of load shape changes/shed attenuation

Demand reductions vary with each event and sometimes demand reductions decrease over time. The DRRC will go through a selected number of audits and estimations done by various engineering firms and compare performance of the buildings over time with the initial estimation in order to evaluate how demand reduction performance changes over time.

2. Collaboration

This project is a collaborative effort with the DRRC and other California IOUs to improve the understanding and adoption of Auto-DR in the market.

3. Status

Delays in securing the data needed by the DRRC to complete this project prevented it from being finalized in 2011.This project will be completed by mid-2012. A request to continue activities and funding for this project was granted in the approval of Advice letter 2685-E.

4. Next Steps

Continue monitoring Task 1 to ensure completion on schedule.

G. DR10.16 Smart Appliances

1. Overview

This project will perform laboratory testing of “smart appliances” from several manufacturers to quantify the DR potential for curtailing load during DR events or upon receipt of a pricing signal. These tests will be done in a controlled lab environment and will provide an opportunity to see first hand how “smart appliances” react to price and DR event signals. Additionally, the results of this study can be used to inform various DR capable appliance efforts underway (e.g. Energy Star connected appliance effort).

2. Collaboration

This project is a collaborative effort with several major appliance manufacturers to test DR potential of smart appliances utilizing SCE's D&ES lab facilities and staff.

3. Status

Initial testing of a "smart" clothes washer was performed during 2011. Testing of additional appliances including clothes washers, refrigerators, and dishwashers from at least three different manufacturers are scheduled for 2012. In an effort to determine trends, a final report will be created at the conclusion of testing which utilizes data collected from all the tests.

4. Next Steps

Delays with getting contracts and Non-Disclosure Agreements (NDAs) in place with manufacturers, acquiring equipment for testing and working with specific manufacturers to create appropriate test cases resulted in the need to continue this project during 2012. Testing of appliances by several manufacturers is scheduled and efforts are being made to procure smart appliances from additional vendors for inclusion in this project.

H. DR11.01 Ancillary Services Pumping Equipment

1. Overview

The purpose of this project is to evaluate the potential of customers with pumping equipment to participate in an Ancillary Services DR program. The planning for this project began in 2010 and included market research to determine customer willingness to participate in a program with short notification and short durations. Market research completed by Global Energy Partners recommended that SCE pursue an Ancillary Services DR program for pumping customers as a potential replacement or complementary program to the existing AP-I DR program that now has a MW cap as a result of transitioning AP-I to a CAISO Reliability Demand Response Program (RDRP) resource. Initial projections are that by 2014 approximately 6% of Agricultural and Pumping customers could be participating in an Ancillary Services program.

2. Status

The planning for this project began in 2010 and included market research to determine customer willingness to participate in a DR program with short notification and short durations. During 2011 several potential technology vendors were identified and the capabilities of each potential solution were evaluated. Once a technology partner is selected, plans will be made for field trials during the summer of 2012.

3. Next Steps

Select the equipment to be used and the customer sites for the Ancillary Services field trials to be completed during the summer of 2012.

V. Budget

Emerging Markets and Technology Recorded Expense – 2009-2011 ($)						
Line. No.	Expense Type	2009	2010	2011	2009-2011 Totals	2009-2011 Authorized Funding
1	Labor	$396,449	$516,734	$981,835	$1,895,018	
2	Non-Labor	$404,515	$896,214	$1,862,709	$3,163,438	
3	Total	$800,964	$1,412,948	$2,844,544	$5,058,456	$9,244,405

The 2009-2011 EM&T Recorded Expenses do not include contractually committed and budgeted funds for the following projects:

- DR09.02 HBP
- DR09.08 Expanding Residential DR in ISGD
- DR10.05 Auto-DR PCT
- DR10.08 DR Pool Pumps
- DR10.09 DRRC – DR Tools (Scoping Study)
- DR10.11 DRRC – Mainstreaming Auto-DR (Load Shape/Shed Attenuation)
- EPRI Technology Testing Collaboration

Under Ordering Paragraph 16 of D.09-08-027,[8] SCE filed an advice letter in 2011 requesting authorization to carry over the unspent committed portion of the EM&T authorized funding from the 2009-2011 funding cycle into the 2012-2014 funding cycle. On March 15, 2012, Advice Letter 2685-E was approved effective January 1, 2012, allowing the remaining $4.2 million committed to the projects listed above to be spent in the new funding cycle.

[8] D.09-08-027, Ordering Paragraph 16. "To continue beyond December 31, 2011, an Emerging Markets and Technology Project funded through the 2009-2011 budgets adopted in this decision, Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company shall each request permission either through a Tier 2 advice letter describing specific projects and the reason for the project to continue beyond the end of the funding period, or by including a request to continue these projects in their next demand response funding application."