SCE DRET Findings
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DR12.40: Field Testing of Occupancy-Based Guest Room Controls

HOTEL PARTICIPATION IN DEMAND RESPONSE EVENTS

Guest comfort is key to a hotel's business strategy. In the past, traditional Demand Response (DR) programs have posed a challenge for hotel participation - how to reduce energy consumption while not reducing comfort or affecting the guest experience?

With recent advances in automated building energy management and control systems (EMCS), DR participation has been proven easier to implement and promises to be more effective at balancing guest comfort with electrical grid reliability. Regardless of occupancy pattern, hotel electric loads, such as lighting and HVAC, tend to run at full capacity throughout the day, providing multiple opportunities to curtail loads. Additionally, because guests are often not in the hotel in the mid-afternoon (a typical time for a DR event), guests may not notice the effects of electrical load reductions. This gives hotels more flexibility when reducing loads through a DR strategy.

The ability to load-shed on demand can have a financial benefit. Large energy consumers like hotels pay for electrical energy consumption as well as peak electrical demand. Shedding load during peak demand periods can have a financial benefit; as an offer to lower energy cost or other form of rebate provided a large power consumer is supporting the curtailment on multiple occasions during the year as requested from the electric utility DR program scheduler. Through an EMCS integrated control strategy, the peak-demand load can be distributed into the building where the and individual guestrooms, and depending on rented and occupancy state load can be reduced by widening the guestroom temperature control bands.

This study used retrofitted thermostat products that include occupancy sensing as well as a magnetic door position sensor that communicates wirelessly with the thermostat. The technology is a part of the hotel's Property Management System (PMS) which is integrated with the EMCS.

INTRODUCTION

What Is This Technology?

OCCUPANCY BASED

The control products tested in this study are retrofit thermostat products that include occupancy sensing using a passive infrared sensor incorporated into the thermostat or mounted on the ceiling. All the systems also use a magnetic door position sensor that communicates wirelessly with the thermostat. When the system identifies that the door is opened, it will search for an occupant. Once the thermostat senses the occupant, it assumes the room remains occupied until door is opened again, at which time another search is conducted. When the system concludes the room is unoccupied it puts the HVAC system in an energy conserving mode. While the room is occupied the guest has control over the thermostat and room temperature. The products are also capable of networking to a front desk system and more complicated whole building control, including demand response, although these features were not tested in this study.

The PMS/EMCS is continuously performing calculations that evaluate how far each guest room's temperature can drift from the guest's preferred temperature setting to maximize energy savings. This type of hotel guest room control system may provide more opportunity for hotels to participate in DR programs since management can have confidence in a quick recovery time.

What We Did

4-TON VARIABLE CAPACITY RTU INSTALLED AND MONITORED

Groups of guestrooms were chosen to, as much as possible, be matching in room orientation and floor number. All guestrooms have a door switch that disables the air conditioning and heating when the door is open to an exterior. The occupancy sensor was disabled in the rooms for the baseline test so that the thermostats functioned like a manually controlled digital thermostat.

The room and supply temperatures were measured and used along with unit power to determine the mode of operation (i.e. fan/cool/heat). The power used during cooling periods for all guestroom HVAC units were plotted against outdoor air temperature to develop a linear fit between cooling power and outdoor air temperature. Cooling energy consumption was calculated using the same fit for all units along with the outdoor air temperature and cooling run time. The total cooling energy use data for each day was then grouped (by temperature bin) by average daily outdoor air temperature and compared between data groups (bins) to determine energy savings.

TEST PROTOCOL (GENERAL PARAMATERS)

Control Status	Room Status	Check-In Status	Test Protocol
Normal	Occupied	Checked-In	- Guest Controlled - No setback - Arrival setting of 72°F (default setpoint)
Normal	Unoccupied	Checked-In	- Maximum setback of 4°F not to exceed 76°F - Guest Opt-In for time based setback of 4°F
Normal	Unoccupied	Checked-Out	- 12:00am to 12:00pm (night) set point up to 82°F - 12:01pm to 11:59pm set point up to 78°F
Demand	Occupied	Checked-In	- Cooling mode temperature 2°F above set point
Demand	Unoccupied	Checked-In	- Cooling mode temperature 2°F to 4°F above set point
Demand	Unoccupied	Checked-Out	- Cooling mode set point of 82°F - Check-In event arrival setting of 74°F

FINDINGS

ABILITY TO SHED LOAD DURING PEAK DEMAND PERIODS Based upon the results of this assessment, it appears that the contribution of the centralized guest room controls integrated with the PMS/EMCS offers energy reduction potential but not as significant as expected unless rooms go unsold longer than seventy-two hours. The real potential of the PMS/EMCS is the ability to shed load during peak demand periods and participate in the utility DR programs.

ADDITOINAL BENEFITS OF PMS/EMCS SYSTEMS In the event that HVAC units are malfunctioning, the PMS/EMCS systems can alert engineering resources to be deployed selectively and proactively while ensuring continuity of comfort. Predictive maintenance takes preventative maintenance one-step further by using sensor data to recognize hazardous trends and alert the appropriate maintenance personnel before the issue escalates. Additionally, the system is able to monitor system performance and provide reports to track unusual occupancy statistics, and identify equipment that has declined in efficiency.

PROPER OUTREACH AND EDUCATION NEEDED To drive a shift to better understanding of the benefits of DR in the hospitality market, outreach and education would be a crucial first step. Combining this technology offering with an educational outreach program may result in proven energy savings benefits and compel the hospitality industry to invest in centralized guestroom controls.

HIGH OCCUPANCY RATE This project demonstrated that for a hotel that has a high occupancy rate, the technology costs are significant and may not warrant investment in centralized guestroom controls. Based upon the results of this assessment, it appears that the contribution of the centralized guest room controls integrated with the PMS/EMCS offers energy efficiency potential but not as significant as expected unless rooms go unsold longer than seventy-two hours. If the hotel management is willing to allow for deeper setbacks when as soon as a room goes unsold, energy efficiency potential may be greater. In this project, hotel management did not allow for setbacks due to the increased recovery time and resulting in limited energy efficiency setbacks.

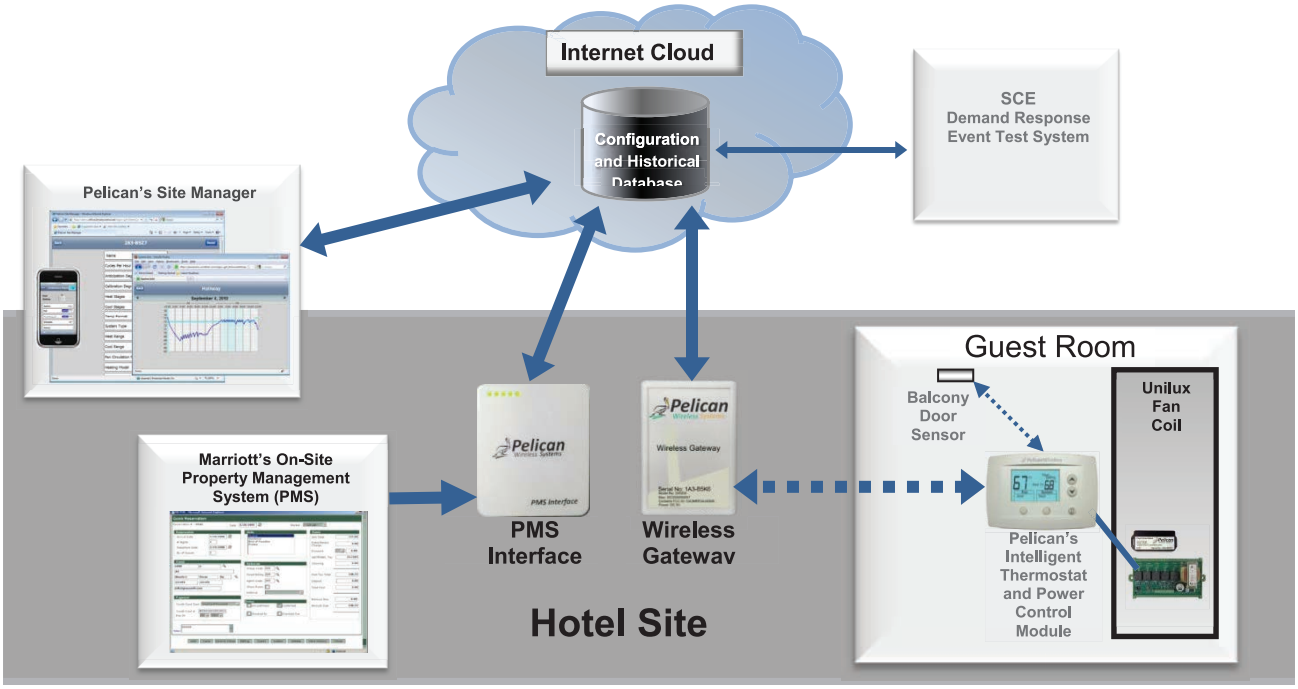

Figure 1: Diagram of a Centralized Guestroom Control System with Demand Response Capability

CONCLUSIONS

What We Concluded

FUTURE STUDIES NEEDED

In areas of the country where tourism is a significant portion of the local economy, hotels, resorts, and casinos often contribute to a large portion of the system load. Their participation in DR programs creates an opportunity for significant benefits in terms of alleviating capacity constraints and helping other facilities maintain operations. In this respect the PMS/ECMS systems offer the potential for substantial DR program and market impacts.

Although there is significant potential, few hotels are willing to implement these load flexing strategies due to concerns for their patrons' comfort if services are reduced. Future studies should attempt to develop strategies to assure hotel participants and operators that comfort is not significantly compromised, and that guests may willingly cooperate under emergency or extenuating circumstances. Future studies could link the PMC/ECMS system to real-time hourly pricing information from the utility to demonstrate opportunities to reduce load and overall energy use.

These Findings are based on the report "Centralized Guest Room Controls," which is available from the ETCC program website, https://www.etcc-ca.com/reports.

Lessons Learned

There are a few gaps for managing demand response at hotels at present that should be addressed before implementing DR software for hotels on a large scale:

LACK OF VENDORS AND SYSTEM DEVELOPERS SUPPORTING OPEN DR PROTOCOLS.

Ideally, the controls architecture or solutions for hotels and motels should be open and standard. One such option for education and outreach is the advocacy that the OpenADR Alliance provides.
The Open ADR alliance was formed to build on the foundation of technical activities to support the development, testing, and deployment of commercial open standards for DR programs. By participating in the OpenADR Alliance it enables all PMS/ECMS developers to participate in automated DR, dynamic pricing, and electricity grid reliability programs offered by utilities.

UTILITY SUPPORT. Utilities should provide a framework of what a reasonable implementation would be so that future studies may be designed to fully investigate this technology. Increased financial benefits are a consideration to encourage both vendors to market their product for DR and for hotel operators to see a benefit from participating.

Technology improvements. Future technology should seek to study methods to improve equipment networking capabilities on network reliability and security to enhance acceptance of hotel owners to employ technology. Additionally, improvements should also be made on the device and website, to make it more user friendly. The thermostat should also be designed to provide feedback to the user about why it was in the DR setting mode.