AircoSaver Energy Savings for Wireless Telecom Company

Provided by SDG&E and ENERGE Corporation

Project Overview

Cell sites in San Diego contain electronic equipment cooled with oversized package air conditioning systems. The oversized cooling systems are 100% redundant. A typical cell site will have two 5 ton wall-mount or split system package air-conditioning units. Generally, the cooling units provide cooling for the internal heat loads only without outside makeup air to cool. The amount of electronic equipment in each cell site can vary widely, and the typical 5 ton cooling units provided are generally over sized for potential addition of electronic equipment. Typical thermostat control for the air-conditioners will initiate air conditioner start and stop to satisfy room temperature set-points. Since many of the air-conditioning units are oversized, this typical control system leaves a lot of stored energy in the oversize air-conditioner evaporator. This report examines the air conditioner energy consumption resulting from a control device (AircoSaver), added to the thermostat control circuit, that controls the operation of the air conditioner to minimize stored energy in the evaporator and reduce the average air-conditioned energy consumption. Nine cell sites in the San Diego area were selected to quantify air conditioner energy savings resulting from the installation of the AircoSaver.

Technology Overview

Air conditioning systems are usually sized to cope with the extreme cooling demands of the few hottest days of the year. For the cell site environment, air conditions are also oversized to cool potential additional electronic equipment. In most operational conditions, however, this maximum air conditioner output is not required and the system is oversized. Running the air conditioner continuously until the room thermostat switches it off means that the system operates with excess capacity most of the time.

The air conditioner control device being evaluated is the AircoSaver.

“The AircoSaver sensor-driven software algorithms are designed to detect thermodynamic saturation (overcooling of the evaporator) and to optimize the compressor run time accordingly. When overcapacity is detected, the AircoSaver switches the compressor off and avoids inefficient overcooling” (AircoSaver sales literature)

The AircoSaver thermostat control device is wired in series with the room thermostat to control the air conditioner. Following shutdown of the compressor, the evaporator fan is left in service to remove stored energy from the evaporator.

Project Objective

The objective of this investigation is to quantify annual savings for cell sites cooled by package or split system air conditioners with the AircoSaver product installed. The results from this evaluation will be used to quantify savings for additional similar retrofit projects at other San Diego cell sites.

Methodology

The technology was investigated at nine cell sites throughout San Diego County. Weather represented by the selected sites includes coastal and inland areas. Cell sites included metal buildings, concrete block buildings, and internal rooms in existing buildings. The tests were performed in the summer when external temperatures were elevated.

Monitoring Plan

Monitoring equipment was deployed during the summer. Each site was monitored for 1- 2 weeks without the AircoSaver and then for 1- 2 weeks with AircoSaver. Air conditioner amps were recorded, as a proxy for power. Internal temperatures were monitored to confirm desired space temperatures were maintained and ambient temperature was recorded to examine any weather relate effects on the system.

Instrumentation

Monitoring instrumentation was installed by Adam Fitzpatrick, ENERGE Corporation, with inspection of installed equipment by SDG&E Engineer.
For monitoring of the HVAC systems HOBO loggers were used to collect air conditioner amps, room temperature, and external temperature. At some sites not enough data logger recording channels were available so external ambient temperature was eliminated from the monitoring and local weather station data was substituted. A complete list of Cell sites examined and monitoring equipment installed follows:

Site: #1

AC Units: Sum (Marvair Compac II) (one unit operating)
Short term monitoring points

- 4 channel Hobo logger set 8/9
- No Outdoor air temp sensor installed – will have to use air temp from nearby site
- CT on condenser fan and compressor 208V single phase
- Indoor air temp sensor installed next to T stat

T stat – Analog set for 72 F with temperature differential set for 74 – 80 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #2

AC Units: Split System- Outdoor unit (on roof) Rheem RALB-060JAZ, Indoor Unit Carrier
Short term monitoring points

- Hobo logger
- No Outdoor air temp sensor installed
- CT on compressor and condenser fan 208V single phase

T stat – Marvair analog for temperature set point 72 F + 6F dead band. Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #3

AC Units: Split system
York outdoor unit H1RD060S25B
Model H1RD060S25B

Short term monitoring points

- 4 channel Hobo logger set to start this A.M.
- Outdoor air temp sensor installed under outdoor cable tray
- CT on compressor and fan 208V three phase
- Indoor air temp sensor installed next to T stat
- Logger started 8/9

T stat – Honeywell digital set for 76 F with temperature differential set for 74 – 80 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #4

AC Units: Marvair Compac II (one unit operating)
Model AYP60-ACA – 10C0 M94B1

Short term monitoring points

- 4 channel Hobo logger set to start this A.M.
- Outdoor air temp sensor installed under outdoor AC units
- CT on compressor 208V single phase
- Indoor air temp sensor installed next to T stat

T stat – Honeywell digital set for 78 F with temperature differential set for 74 – 80 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #5

AC Units: Marvair Compac II (one unit operating)
Model AYP60-ACA – 10C0 M94B1

Short term monitoring points

- 4 channel Hobo logger set to start this A.M.
- Outdoor air temp sensor installed under outdoor AC units
- CT on compressor 208V single phase
- Indoor air temp sensor installed next to T stat

T stat – Honeywell digital set for 78 F with temperature differential set for 74 – 80 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #6

AC Units: Split System
Outdoor unit (on roof) Marvair 24ABR360A330
Indoor Unit Carrier EC4PNF060

Short term monitoring points

- Hobo logger
- No Outdoor air temp sensor installed
- CT on compressor and condenser fan 208V single phase

T stat – Marvair analog for temperature set point 72 F + 6F dead band. Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #7

AC Units: Sun (Marvair Compac II)
Model AV 60H-1-00N

Short term monitoring points

- Hobo logger set
- Outdoor air temp sensor installed beneath HVAC unit avoiding direct sunlight.
- CT on compressor 208V single phase

Indoor air temp sensor installed next to T stat
T stat – Analog set for 70 F with temperature differential set for 74 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #8

AC Units: Sun (Marvair Compac II) (one unit operating)
Model AV60H-1-00CF

Short term monitoring points

- Hobo logger set
- Outdoor air temp sensor on North side of Sun Units
- CT on compressor 208V single phase

Indoor air temp sensor installed next to T stat
T stat – Analog set for 70 F with temperature differential set for 70-78 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Site: #9

AC Units: Split System
Outdoor unit (on roof)
Rheem Model RALB-060JAZ S
Indoor Unit
Rheem Model RBHA – 24J00NHBG

Short term monitoring points

- Hobo logger -Outdoor air temp sensor installed – between condensing units on roof, CT on compressor 208V single phase
- PowerSight logger- Indoor air temp sensor installed next to T stat

T stat – Honeywell digital set for temperature differential range 74 – 80 F
Two AircoSaver units installed, but connected with bypass in T stat loop

Sampling Period and Interval

For the HVAC study baseline sampling began August 9-10 and was completed on August 24. Sampling with the AircoSaver in control began August 24 and ended September 7. At one location, #2 baseline monitoring was from August 10 –17 with AircoSaver in control monitoring from August 24 - 31. Hobo logger sampling frequency was 3 minutes

Calculation Methods

At each site, air conditioner supply voltage was recorded. Air conditioner power was derived from the formula- (measured volts x measured amps x assumed power factor of .85) = power. Only one site, #3 was supplied with three phase power for air conditioners. The three phase power conversion factor of 1.732 was used to calculate power consumption at that site.

Pre period average hourly power consumption was compared to post period average hourly power consumption and the result was annualized to determine annual energy savings.
No air conditioner performance corrections were made for increased ambient (external) temperature. At eight of the nine sites average temperature during the post period was higher than during the baseline test period. An examination of compressor kW VS ambient temperature showed little difference.

Project Results and Discussion

Average hourly power savings was calculated for each site and extrapolated to annual energy savings. Overall air conditioning savings was 20% of baseline air conditioner energy consumption, and averaged 7071 kWh for the nine sites. Energy savings averaged 6.8% of site total energy consumption.
The AircoSaver control system may be incentivized through the Standard Performance Contract Program at nine cents per annual kWh saved. The incentive is limited to ½ the installed cost, or the calculated incentive, whichever is less.
At an average site electric cost of 14.4 cents/kWh Annual energy Savings for installing the AircoSaver at each site is around $1,000 per year

AircoSaver Summary Data from Each Test Site

Cell Site	#1	#2	#3	#4	#5	#6	#7	#8	#9	average
Total Before Airco Amp hrs	8229	3165	3904	9745	8579	4543	6827	8194	7155	6705
Total After Airco Amp hrs	6705	2557	3116	7564	7061	3737	4940	6399	5669	5305
Avg Before Inside Temp	71.9	75.5	78.5	74.07	74.2	77.3	7502	75	78.2	901
Avg After Inside Temp	72.7	75.4	79	73.73	75	76.5	75.4	75	78.8	76
Avg Before Outside Temp	73	70	73	74.36	71	70	70	73.7	70	72
Avg After Outside Temp	80.5	73	84	73.78	80	72	75	76.9	79	77
Avg Before kW	4.92	3.29	3.49	5.83	4.38	2.63	3.33	4.32	3.9	4.01
Avg After kW	4.01	2.66	2.78	4.52	3.61	2.16	2.62	3.37	3.09	3.20
% HVAC energy savings	18%	19%	20%	22%	18%	18%	21%	22%	21%	20%
Total kWh saved per year	7972	5519	6220	11427	6745	4117	6220	8322	7096	7071

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By SDG&E Engineer and Adam Fitzpatrick, ENERGE Corporation