Search Energy Solutions, Inc.

Energy Conservation Analysis

Tests Conducted On
Underlying Technology For

PowerSentri™-CH_2O
PowerSentri™-CST
PowerSentri™-LTH

Date: 02/04/06

CONFIDENTIAL

EXECUTIVE SUMMARY

City of New York
Department of Citywide Administrative Services
Heating System Fuel Reduction Pilot Program

The attached technical report summarizes the Energy Saving Performance of the ***PowerSentri™*** energy saving controls which were installed at the following locations:

- **Bronx Supreme Courthouse - 198 East 161St Street, Bronx NY:**

PowerSentri™-CH2O controls were installed on two (2) 6,280,000 BTU gas fired Cleaver Brooks hot water boilers used for the buildings perimeter heating. The controls were installed on December 15th, 2005 and data was collected until January 7, 2006. It was determined from logged data that Boiler #1 did not run during the pilot period. During the pilot period the ***PowerSentri™*** **controls reduced fuel consumption by 17.85%.** This reduction in burner run time was achieved without significant degradation of the space temperature and no noticeable impact to the building's occupants. Average space temperatures during the pilot period were 71.5° on the days when the ***PowerSentri™*** control was out of the circuit and 71.1° when in the circuit. Also notable is the fact that the ***PowerSentri™*** **control reduced the on/off cycling of the Boiler by 33.1%.**

- **Jamaica Civil Courthouse - 89-17 Sutphin Boulevard, Jamaica NY:**

PowerSentri™-CH2O controls were installed on two (2) 8,368,000 BTU gas or #2 fuel-oil fired Cleaver Brooks hot water boilers used for the building's heating. The controls were installed on December 14th, 2005 and data was collected until January 10, 2006. During the pilot period the ***PowerSentri™*** **controls reduced fuel consumption by 62.06%.** This reduction was achieved with no significant degradation of the space temperature and no noticeable impact to the building's occupants. Average space temperatures during the pilot period were 70.3° on the days when the ***PowerSentri™*** control was out of the circuit and 70.1° when in the circuit. Also notable is the fact that the ***PowerSentri™*** **controls reduced the on/off cycling of the Boilers by 49.0%.**

- **Manhattan Co-OP High School - 321 East 96th Street. New York** NY:

PowerSentri™-CST controls were installed on two (2) 250 HP / 10 PSI gas fired A.L. Eastmond steam boilers used for the building's perimeter heating. One ***PowerSentri™-LTH*** control was installed on one (1) 800,000 BTU gas fired PVI Hot Water Heater used for the buildings domestic hot-water supply. The controls were installed on December 9th, 2005 and data was collected until January 11th, 2006. During the pilot period the ***PowerSentri™*** **controls reduced fuel consumption of the Steam Boilers by 16.51% and the fuel consumption of the Domestic Hot-Water Heater by 31.07%.** This reduction was

achieved with no significant degradation of the space temperature and no noticeable impact to the building's occupants. Average space temperatures during the pilot period were 73.7° on the days when the *PowerSentri™* control was out of the circuit and 73.5° when in the circuit. Also notable is the fact that the *PowerSentri™* **controllers reduced the on/off cycling of the Steam Boilers by 30.1% and the Domestic Hot-Water Heater by 32.3%.**

All of these systems operate on a 24 hours per day, 7 days per week basis. The pilot program data was collected using "alternating day" methodology which is further described later in this report. The Report contains the documentation that supports the summary results and further details the specific length of the pilot program, overall temperature performance during the pilot, and the predictability of the system performance after the *PowerSentri™* effect. This improvement in operational efficiency and reduced energy usage was achieved while providing consistent temperatures. The considerable reduction in on/off cycling can be expected to reduce wear and tear on these systems, maintenance requirements, and pollution.

Special Note:

The Park West High School (ECF) located at 525 West 50th Street, Manhattan NY was selected as a fourth pilot site but not included in this report due to skewed data. Technical personnel were instructed by the facility staff that Boilers #1 and #2 were used for normal operation, that Boiler #3 was used for back-up, and that Boiler #4 was not serviceable. Based on this information it was decided to install the *PowerSentri™* controls and data collection equipment on Boilers #1 and #2. During a required on-site visit to download data, it was discovered that Boiler #3 was being used to heat the building. Due to this occurrence during the pilot period, the data collected from boilers #1 and #2 could not be properly analyzed since it was impossible to determine the influence that Boiler #3 had on the results.

Search Energy Solutions, Inc.

712 US Hwy One
Suite 200
North Palm Beach, FL 33408

Test Report

Report No. 12149-1
Date: 2/4/2006

Customer	Test Site Location
NYCDCAS	Bronx Supreme Court 198 East 161st Street, Bronx, NY Contact: Ted Batista

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER

Product Tested: ☐ HWR ☐ LTH ☐ LTC ☑ CH2O ☐ CST ☐ RA ☐ CA ☐ REF ☐ OTHER

Type of Equipment	Test Dates
Manufacturer: Cleaver Brooks Model: CB 700-150 Capacity/SetPt: 6,280,000 BTU Input / 190 degs F Fuel Type: Natural Gas Application: Perimeter Heating Only Area Served: Misc: 90 Sec. Prepurge, 15 Sec. Postpurge	Start Date: 12/15/2005 End Date: 1/7/2006 ======= No. of Days in Test: 24

BURNER RUN-TIME		BURNER USAGE FACTOR	
PowerSentri™ ON-DAYS:	54:00:45 ☑ in HRS.	PowerSentri™ ON-DAYS:	19%
PowerSentri™ OFF-DAYS:	61:33:51 ☐ in MIN.	PowerSentri™ OFF-DAYS:	21%
RUN-TIME was reduced by:	12.27%		

HEATING DEGREE DAYS (for test period)		USAGE PER DEGREE DAY	
PowerSentri™ ON-DAYS:	320	PowerSentri™ ON-DAYS:	0:10:07
PowerSentri™ OFF-DAYS:	300	PowerSentri™ OFF-DAYS:	0:12:19
TOTAL DEGREE-DAYS:	620		
It was 6.80% Colder on the On-Days			

SOLAR LOAD COMPENSATION		BURNER CYCLING REDUCTION	
PowerSentri™ ON-DAYS:	10,042	PowerSentri™ ON-DAYS:	556
PowerSentri™ OFF-DAYS:	11,280	PowerSentri™ OFF-DAYS:	831
It was 10.98% Sunnier on the OFF-Days		Cycling was reduced by:	33.10%

Adj. Savings = 17.85%

Comments: Boiler #1 did not run for the duration of the test period. Runtimes have been reduced by 105 seconds (prepurge time + postpurge time) times the number of cycles for each case.

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Test Report

Report No. 12149-2
Date: 2/4/2006

Customer	Test Site Location
NYCDCAS	Civil Court 89-17 Sutphin Blvd, Jamaica NY Contact: Tom

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER
Product Tested: ☐ HWR ☐ LTH ☐ LTC ☑ CH2O ☐ CST ☐ RA ☐ CA ☐ REF ☐ OTHER

Type of Equipment

Manufacturer: Cleaver Brooks
Model: CB 200.200
Capacity/SetPt: 8,368,000 BTU Input / 180 degs F
Fuel Type: Natural Gas or #2 Fuel Oil
Application: Heating Only
Area Served:
Misc: 90 Sec. Prepurge, 15 Sec. Postpurge

Test Dates

Start Date:	12/14/2005
End Date:	1/10/2006
	=======
No. of Days in Test:	28

BURNER RUN-TIME

PowerSentri™ ON-DAYS:	103:39:37	☑ in HRS.
PowerSentri™ OFF-DAYS:	267:10:14	☐ in MIN.
RUN-TIME was reduced by:	61.20%	

BURNER USAGE FACTOR

PowerSentri™ ON-DAYS:	31%
PowerSentri™ OFF-DAYS:	80%

HEATING DEGREE DAYS (for test period)

PowerSentri™ ON-DAYS:	339
PowerSentri™ OFF-DAYS:	332
TOTAL DEGREE-DAYS:	671

It was 2.30% Colder on the On-Days

USAGE PER DEGREE DAY

PowerSentri™ ON-DAYS:	0:18:21
PowerSentri™ OFF-DAYS:	0:48:21

SOLAR LOAD COMPENSATION

PowerSentri™ ON-DAYS:	18,710
PowerSentri™ OFF-DAYS:	22,973

It was 18.56% Sunnier on the OFF-Days

BURNER CYCLING REDUCTION

PowerSentri™ ON-DAYS:	357
PowerSentri™ OFF-DAYS:	700
Cycling was reduced by:	49.00%

INDIVIDUAL RUNTIMES

	Boiler 1	Boiler 2		Boiler 1	Boiler 2
ON-Day Runtime	55:51:17	47:48:20	OFF-Day Runtime	150:58:16	116:11:58
ON-Day Cycles	106	251	OFF-Day Cycles	336	364

Adj. Savings = 62.06%

Comments: Boiler #1 did not run for the duration of the test period. Runtimes have been reduced by 105 seconds (prepurge time + postpurge time) times the number of cycles for each case.

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Test Report

Report No. 12149-3
Date: 2/4/2006

Customer	Test Site Location
NYCDCAS	Manhattan Co-op High School 321 East 96th Street, NY, NY Contact: Mike Reilly

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER

Product Tested: ☐ HWR ☐ LTH ☐ LTC ☐ CH2O ☑ CST ☐ RA ☐ CA ☐ REF ☐ OTHER

Type of Equipment	Test Dates	
Manufacturer: A.L. Eastmond (Steam Heat)		
Model: FST 250	Start Date:	12/9/2005
Capacity/SetPt: 250 HP/10 PSI		
Fuel Type: Oil (75 GPH)	End Date:	1/11/2006
Application: Heating		=======
Area Served:	No. of Days in Test:	34
Misc: 150 Sec. Prepurge, 15 Sec. Postpurge		

BURNER RUN-TIME			BURNER USAGE FACTOR	
PowerSentri™ ON-DAYS:	114:38:15	☑ in HRS.	PowerSentri™ ON-DAYS:	28%
PowerSentri™ OFF-DAYS:	127:54:50	☐ in MIN.	PowerSentri™ OFF-DAYS:	31%
RUN-TIME was reduced by:	10.38%			

HEATING DEGREE DAYS (for test period)			USAGE PER DEGREE DAY	
PowerSentri™ ON-DAYS:	450		PowerSentri™ ON-DAYS:	0:15:18
PowerSentri™ OFF-DAYS:	419		PowerSentri™ OFF-DAYS:	0:18:19
TOTAL DEGREE-DAYS:	869			
It was 7.30% Colder on the On-Days				

SOLAR LOAD COMPENSATION			BURNER CYCLING REDUCTION	
PowerSentri™ ON-DAYS:	3,904		PowerSentri™ ON-DAYS:	228
PowerSentri™ OFF-DAYS:	4,025		PowerSentri™ OFF-DAYS:	326
It was 3.01% Sunnier on the OFF-Days			Cycling was reduced by:	30.10%

INDIVIDUAL RUNTIMES

	Boiler 1	Boiler 2		Boiler 1	Boiler 2
ON-Day Runtime	39:55:36	74:42:39	OFF-Day Runtime	47:24:04	80:30:46
ON-Day Cycles	66	124	OFF-Day Cycles	162	202

Adj. Savings = 16.51%

Comments: Boiler runtimes are an aggregate of Boilers #1 and #2. Runtimes have been reduced by 165 seconds (prepurge time + postpurge time) times the number of cycles for each case. Equipment for Boiles #1 and #2 were the same.

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North Palm Beach, FL 33408

Test Report

Report No. 12149-1
Date: 2/4/2006

Customer	Test Site Location
NYCDCAS	**Manhattan Co-op High School** **321 East 96th Street, NY, NY** **Contact: Mike Reilly**

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER

Product Tested: ☐ HWR ☑ LTH ☐ LTC ☐ CH2O ☐ CST ☐ RA ☐ CA ☐ REF ☐ OTHER

Type of Equipment
Manufacturer: PVI Hot Water Heater
Model: 1000N600A
Capacity/SetPt: 800,000 BTU Input
Fuel Type: Natural Gas
Application: Domestic Hot Water
Area Served:
Misc: 60 Sec. Prepurge, 15 Sec. Postpurge

Test Dates	
Start Date:	**12/9/2005**
End Date:	**1/11/2006**
	=======
No. of Days in Test:	**34**

BURNER RUN-TIME			BURNER USAGE FACTOR	
PowerSentri™ ON-DAYS:	**11:08:04**	☑ in HRS.	**PowerSentri™ ON-DAYS:**	**3%**
PowerSentri™ OFF-DAYS:	**16:09:08**	☐ in MIN.	**PowerSentri™ OFF-DAYS:**	**4%**
RUN-TIME was reduced by:	**31.07%**			

BURNER CYCLING REDUCTION	
PowerSentri™ ON-DAYS:	**113**
PowerSentri™ OFF-DAYS:	**167**
Cycling was reduced by:	**32.30%**

Adj. Savings = 31.07%

Comments: Runtimes have been reduced by 75 seconds (prepurge time + postpurge time) times the number of cycles for each case.

Testing Methodology

Search Energy Solutions Inc.

EQUIPMENT USED FOR TESTING PURPOSES

Specific timing and data logging devices are used to gather detailed information about the unit(s) being evaluated. Each device has been carefully selected for its reliability, capability and function. The individual devices used are explained below.

1. TIME CLOCK:

Manufacturer: Tork Model: 8007V-0

Is used to switch the ***PowerSentri™*** product in and out of the circuit. This is done on a 24 hour basis. The result is that the ***PowerSentri™*** product is in control ("in" the circuit) one day and not in control ("out" of circuit) the next day. A 14 day time clock was selected so that a complete alternation of days that ***PowerSentri™*** is in control would result.

2. CURRENT SWITCH:

Manufacturer: Veris Industries Model: Hawkeye 608/908

The current switch is used to monitor when current is being drawn by the cooling/refrigeration compressor or heating burner. When current is sensed it is "On" when no-current is sensed it is off "OFF". The current switch is used in conjunction with the "Change-of-State" data logger.

3. "CHANGE-OF-STATE" DATA LOGGER:

Manufacturer: Onset Computer Corp. Model: H06-001-02

This device monitors and logs the "change-of-states" (the on / off status) of the unit being tested. It is used in conjunction with the CURRENT SWITCH, above, and time and date-stamps (logs) each change of status. By processing the logged data, the durations for each cycle can be determined.

4. "LIGHT INTENSITY" DATA LOGGER

Manufacturer: Onset Computer Corp. Model: HLI

This data logger is used to monitor and log Light Intensity and is used to determine the solar-load influence on the facility.

5. "T/Rh " DATA LOGGER

Manufacturer: Onset Computer Corp. Model: H08-004-02

This data logger is used to monitor and log the temperature and relative humidity in the conditioned space.

6. 'TEMPERATURE" DATA LOGGER

Manufacturer: Onset Computer Corp. Model: H08-001-02

This data logger is used to monitor and log the outdoor air temperature, and is used to determine the degree-day influence on the facility

WHAT DATA IS COLLECTED

Linking all of the above together with the ***PowerSentri™*** product being "in" and "out" of the circuit, on alternating days, yields the following data:

? How many on/off cycles per day (if applicable).
? Total "on time" per cycle, per day.
? Total "off time" per cycle, per day.
? What the solar load of the facility was during the test period (if applicable).
? What the relative humidity in the conditioned space was during the test period (if applicable).
? What the temperature of the conditioned space was during the test period (if applicable).
? What the outdoor air temperature was during the test period (if applicable).

How The Data Is Analyzed

Upon completion of the test, all the data is evaluated to calculate the reduction of consumption (savings).

Short-term testing analysis can only be performed properly by the elimination and reduction of as many variables as possible and through the analysis of the data on a statistical basis. The alternating "in" circuit / "out" of circuit testing has the advantage of minimizing the variations due to time-sensitivity, day-of-week sensitivity, degree-day effects, etc.

In order to properly evaluate the data, the following must be determined:

1. A baseline must be established. Baseline consumption data is the "use" or consumption information that is unaffected by the ***PowerSentri™*** economizer ("out" of circuit). This may be derived during the test (which is what is done here) or from historical records. The advantage of deriving the base-line during the test is that site specific degree-day and solar data may be determined as opposed to weather-service data that may or may not be indicative of the test site.

2. It is necessary to determine what effects or influences are caused by solar- load and degree-day variations. This is done by performing a statistical analysis on the solar and degree-day data collected during the base-line phase.

3. In order to properly compare the two consumption cases (***PowerSentri™***"in" and "out" of circuit), and determine the savings, it is necessary to adjust (or "normalize") the data collected during the "in-circuit" phase. The consumption data collected when the ***PowerSentri™*** economizer was "in-circuit", is "normalized" by compensating for the effects of the solar and degree-day influences that occurred during the same phase of the test. This is accomplished by applying the statistical analysis results of the solar and degree-day influences (collected during the base-line phase) as a means to compensate for the solar and degree-day variations that occurred during the "in" circuit phase of the test.

4. The normalized consumption data acquired during the "in" circuit phase is compared to the base-line data and the savings determined.