APPLICATION NOTE

CAS DATALOGGERS

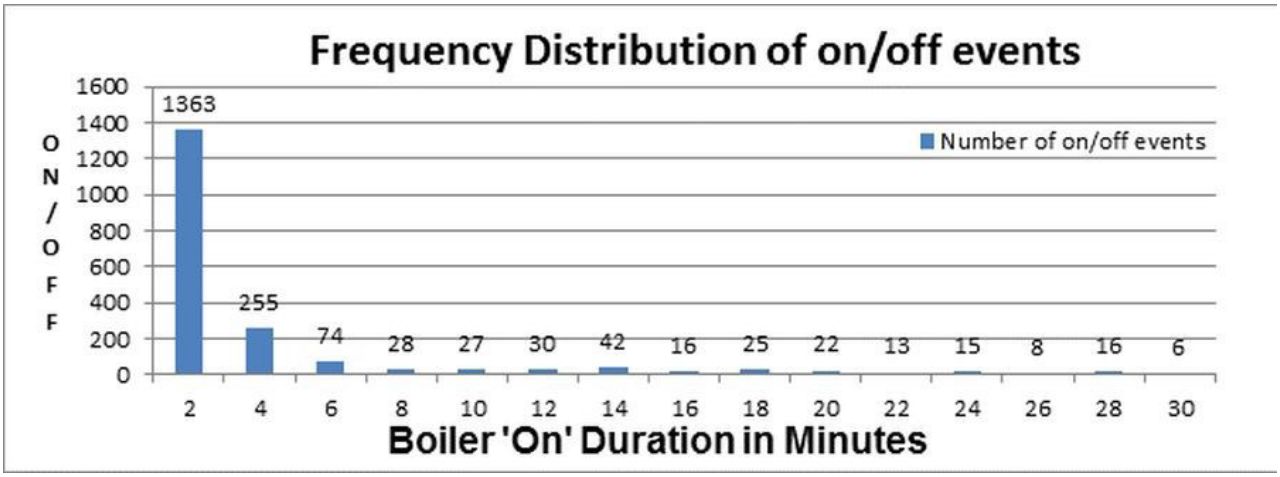
Identify Energy Savings by Monitoring On/Off Switch Control System Cycling

Increasing Energy Efficiency with an Accsense Electrocorder

In equipment that uses simple on/off switches for control, frequent cycling can waste money and reduce life in many systems including:

- Thermostatically-controlled heating systems
- Pressure-controlled pumping systems
- Luminescence or occupancy controlled lighting systems

For example, CAS DataLoggers supplied an Accsense Electrocorder EC-1V data logger to monitor a customer's oil-fired boiler in their office building over a period of 6 months. After collecting the data, users graphed the following astonishing results:



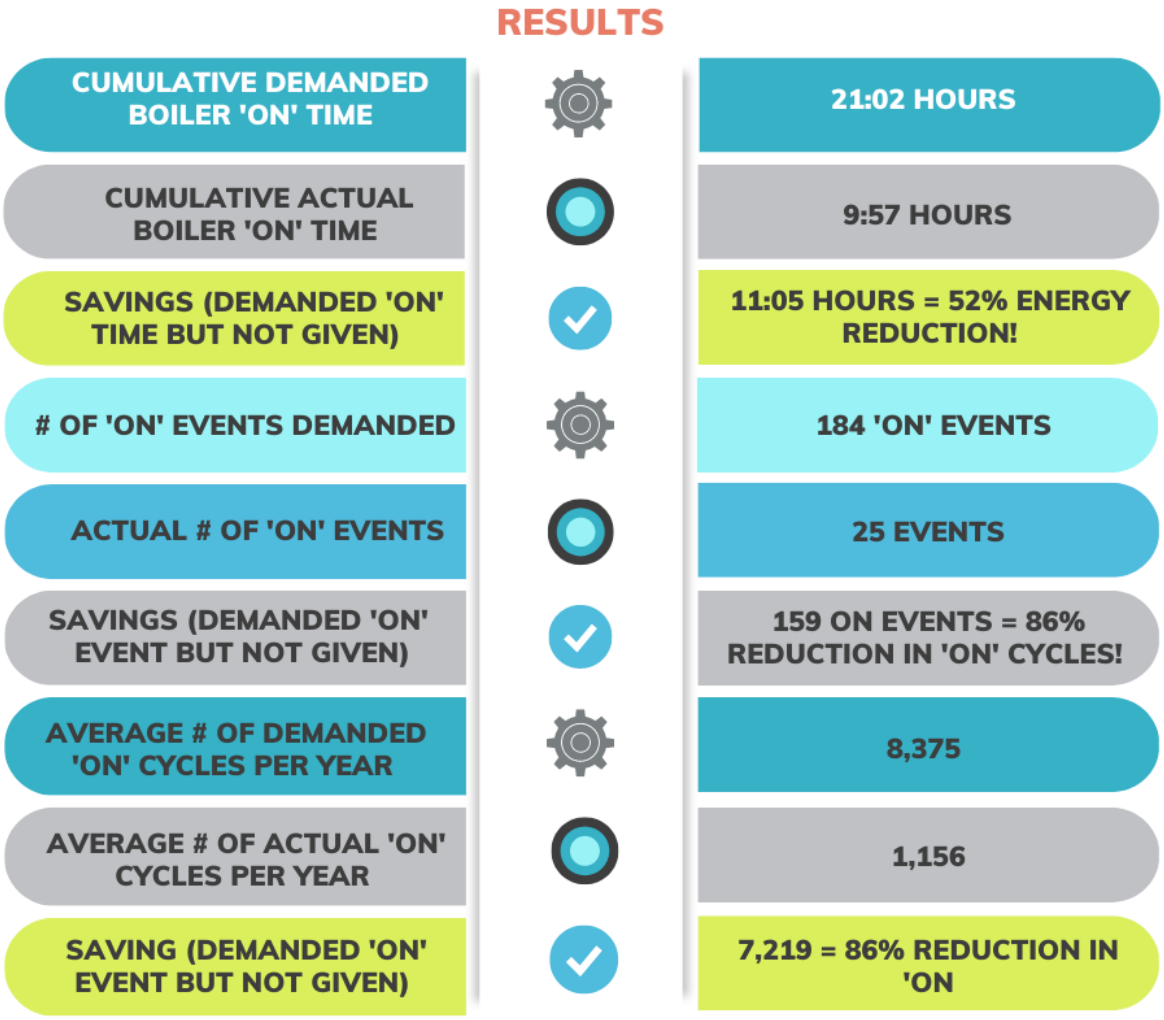
This data shows that over this time the thermostat requested 1363 instances where the boiler came on for 2 minutes or less, and 255 events 2 to 4 minutes in length. Adding up the cumulative time that the boiler ran, our customer found that for 33% of the time, the boiler was only on for a period of 10 minutes or less.

This data is significant because for the short duration ‘on’ cycles the boiler barely gets a chance to come up to temperature and does not add much heat to the building environment. Most of the fuel is used to start the boiler and the energy is wasted warming the boiler before it can be transferred to the environment. Analyzing the data shows that if these short-duration events lasting less than 10 minutes can be eliminated, an estimated minimum savings of 30% should be realized.

Q. How do you solve this problem?
A. Use a delay 'on' timer.

The customer installed a timer that provided a 10-minute delay between the thermostat activation and the boiler trigger event. If the thermostat was deactivated during this window the signal to the boiler was reset. This eliminated cycling when the thermostat activation signal was less than 10 minutes. The assumption was that cycle requests less than 10 minutes duration are false requests for heat caused by air motion within the building.

After installing the delay timers, the customer used two Accsense Electrocorder EC-1V Single Phase Voltage data loggers to monitor their new system over a defined period and found:



Results

Since the boiler on signal is subject to a 10-minute delay, when the demand is due to a real temperature drop, the office temperature continues to fall slightly during the 10-minute delay. That means that when the boiler comes on, it takes slightly longer to bring the office building back up to the set point of 70°F, therefore using more energy. However, even accounting for this, our customer still achieved an energy **savings** of 52%!

The obvious disadvantage of this setup would be a delay between the demand and the supply for heat. However, the data shows that 56% of the demands for energy were not real temperature demands but were just the result of localized temperature disturbances around the thermostat. The customer saw no noticeable effect on internal office temperature during the trial of the timer. As an added benefit, this reduction in run time and in the number of 'on' cycles has increased the effective boiler life.

Monitoring Pump Cycling

The EC-1V can be used for cycle analysis in many other types of applications as well. For example, pump cycling can be an issue in liquid pumping and pneumatic compressor systems, where the set point is a pressure level and the system tries to maintain that set point. Sometimes these systems use hysteresis or a dead band system, where the turn-on and turn-off pressures are managed separately. The minimum pressure (say 10 bar) activates the pump and the maximum pressure (say 15 bar) turns it off.

With pumps and compressors, the reduction of the number of on/off cycles has a major effect on the life of the system. If you have a system with a single defined pressure set-point, then the adjustment of the hysteresis window can help reduce cycling. For pneumatic systems, it is important to look at the minimum working pressures of the items fed from the compressor reservoir and also the maximum air demand before setting adjusting the window. The turn-on pressure should not be low enough to cause the air reservoir to be depleted by air demand before the compressor starts, but the difference between the on and off pressure should be large enough to ensure that the compressor does not short cycle when demand is low.

Monitoring Automated Lighting

Controlled lighting is also prone to cycling. In this application, the light can be controlled by an occupancy sensor or a light sensor that measures the ambient lux level. In the latter, the systems use a dead band where there are separate on and off set points; the lighting is turned on whenever that minimum level is observed and a value greater than the maximum

set point turns the system off again. Ideally, cycling normally only happens at dawn or dusk due to the ambient light level. However, adjustment of the set points to avoid cycling throughout the day can be tricky. The light level measured by the sensor(s) will be dependent not only on normal dawn/dusk variations but on sensor placement and subject to variations caused by weather, clouds, and seasonal changes. The ability of the EC-1V to capture cycling data and correlate it with the day and time can help ensure optimal performance of the system to balance energy use with occupant satisfaction.

In addition to cycle monitoring, the Accsense Electrocorder EC-1V data logger is also widely used to monitor voltage variations on site, allowing voltage problems to be highlighted quickly for further investigation using traditional recorders. When recording, the Electrocorder will store the average voltage over the period chosen (1 sec to 60 min), and also records the highest (max) & lowest (min) cycle values during that period making it useful to identify short-duration events like power sags or surges.

For more information on the Electrocorder Data Loggers, or to find the ideal solution for your application-specific needs, contact a CAS DataLogger Application Specialist at **(800) 956-4437** or www.DataLoggerInc.com.