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SAVINGS FROM OPERATIONS & MAINTENANCE

ARTICLE

Of the many operations and maintenance activities (O&M) required to keep a facility operational, some also lower utility bills. The beauty of O&M measures that create operational savings is that they are not capital investments. By taking care of what you already have, you can reap savings equal to the energy you would have otherwise used.

Dividing O&M into two pieces is helpful. O&M activities can come from the same group or person, and both include working smarter, but 'O' and 'M' create savings in different ways.

Maintenance

There is running like new and singing beautifully, and there is just running. Most mechanical equipment is designed to accept a range of conditions, including fouling (fouling is the technical term for 'gunk' that builds up on heat exchanger surfaces and makes it harder for the unit to do its job). Just because it is running does not mean it is running efficiently. It was standard practice to put sand in the fire box of a steam locomotive once it had difficulty making it up the hill – by the time performance is noticeably impacted, significant energy efficiency had been lost and extra fuel spent. For most machines, what happens within the design range of adverse conditions is to simply draw more power or consume more fuel. *Maintenance that is targeting efficiency will act before performance is lost.* Of course, there is a balance and cleaning a heat exchanger every five minutes is not practical. Maintenance for energy savings is a strategy that identifies the range of 'good' condition vs. 'performance loss' condition and intervenes at some mid-range point. A common example is a heat exchanger: when it is 'clean' the heat exchange rate is as good as it gets for that machine, and the performance indicators can be recorded so it is clear what 'clean' looks like. For this example, as the indicators of fouling move away from 'clean', a point is reached where a maintenance event is triggered. **Table 1** lists examples of optimized maintenance events.

Table 1. Optimized Maintenance Events

System	Common	Optimal
Heat exchanger, boiler, chiller, air/water coil	Periodic	Approach temperature (difference between key fluid temperatures in a heat exchange process) compared to 'clean' unit performance.
Filters for air/water	Periodic	Pressure drop compared to 'new filter'.
Compressed air leaks	Periodic or when gross leaks are audible	Compressed air flow meter reading with compressor on and end uses off establishes 'tight' system; Periodic re-check will prompt maintenance when leaks have crept up again.
Steam traps	Periodic or when steam equipment performance is degrading	Leak testing methods show when a steam trap is functioning normal, where normal = letting condensate pass with minimal steam.
Hydronic sealed system hot water or chilled water leaks	None. Automatic fill replenishes	Make up water flow exceeds limit. Meter required.
Air economizer	Only if it generates a complaint	Annual check to run the economizer through its paces.
V-belt adjustment	Belts jumping or belts broken	Temperature rise on the drive and driven pulleys to indicate slippage.
Automatic control start/stop schedule settings, overrides	None	Annual review of schedule settings vs. actual requirements, monthly clearing of overrides or repair what is necessitating overrides, interval data identifies usage in closed periods.

Heat exchangers are an important part of maintenance activities that target efficiency. This is a residential refrigerator coil, badly fouled. Large and small machinery is affected the same way when heat exchangers are fouled. The equipment was maintaining temperature – the only clue was near constant operation. Meanwhile, energy use increased up to 25%.

High flue gas temperature can indicate fouling and prompt maintenance action to control fuel use.

Operations

Operations savings come from how systems are operated. The ideal operational strategy provides enough of the service to satisfy the process or comfort, but no more and no longer than needed. Optimization is usually at odds with simplicity. It takes more effort to achieve savings. It also requires knowledge of the building or systems served and may require additional training such as working with automatic controls.

Reference **Figure 1** as an example of optimized operation. The scenario is an air blower feeding a process that has an array of end points where the air comes out and a variable 'appetite' for the air. Each end use has a valve that controls the amount of air needed for the process, so the amount of air is driven by what the process needs. However, the process does not care about the pressure the air is delivered at, only that it receives the required amount. Knowing that the air delivery machine power requirement is a function of both flow and pressure, the pressure can be optimized.

- Option 1 is the easy way: Provide a constant pressure to the control valves at all times based on the highest flow demand period. In periods of low demand for air flow, the excess pressure is dissipated by the control valves that close down part way.
- Option 2 is the optimized way: See diagram. Automatic control of the main 'air blower' source is extended to the points of use so there is awareness of what the demand for air is at all times. Each point of use is scanned to find the one with the greatest demand for air. The main system pressure is gradually reduced while watching the end use point of greatest demand, until it is 90% open – when this is achieved the process is operating with the least amount of blower input power. Optimized.

The example optimized operational strategy was for a process. However, the same concepts (enough, but just enough) can be applied to other systems including the following. For each item a phrase is implied like ‘only when needed’, ‘just enough’, etc.:

- Starting/stopping of lighting and equipment.
- Staging of equipment for best overall efficiency.
- Maximizing economizer free cooling.
- Preventing simultaneous heating and cooling.
- Resetting temperatures and pressures of air/water circulating systems.

Done properly the optimized and non-optimized service is no different to the end user but optimized operation uses less resources.

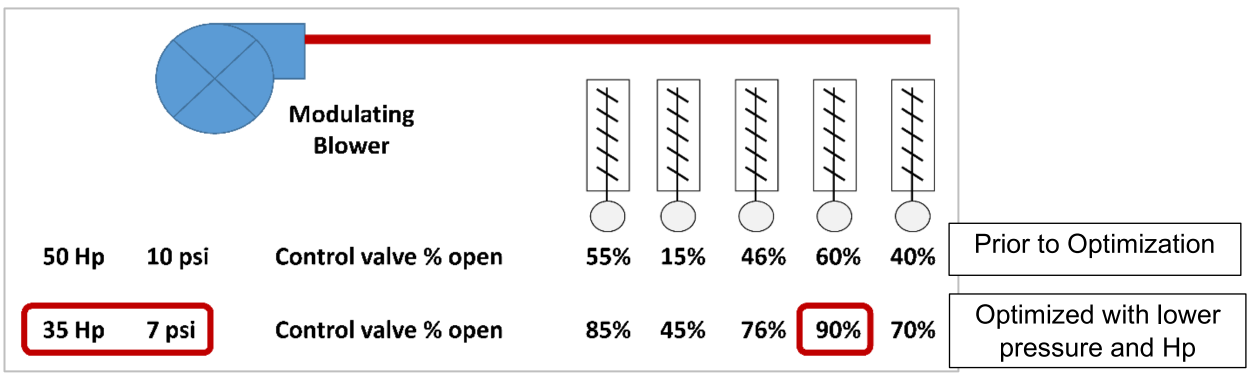

Figure 1. Diagram for Optimized Control Example

Enablers for O&M Savings

- Feedback. Provide expectations, goals, and accountability.
- Training. Where tasks are technical, training is a necessary tool. Training can pay for itself when outsourcing costs are reduced as a result.
- Measure results. Whether measured or calculated, provide a path for assigning numbers to the activities.
- Tools. Besides training, time is a necessary tool for the tasks. For maintenance activities, measurements may be needed to prompt the maintenance activity. This can be based on time (clean heat exchanger annually) or performance (clean heat exchanger when measurements indicate it is becoming fouled)

Defining O&M Savings

This is done by comparing optimized energy use to baseline energy use – savings being the avoided cost. In some cases, it may be possible to actually operate in two modes and measure the differences, but usually the savings are estimated from tables or calculations. Clean vs. dirty heat exchanger;

operating pressure ‘x’ vs. ‘y’. The point is savings are real and have a tangible business case. Like all energy reduction measures, the improvement is greatest when the baseline condition is the worst, like incandescent lights vs. LED. But in all cases, money spent by *not* optimizing is subtracting from business profits and is preventable.

Other O&M benefits besides energy

Equipment that is maintained generally lasts longer, runs better and is more reliable. Attention to O&M promotes a sense of value and pride in the staff who then search for additional ways to save. Consistent comfort and process conditions are enablers for productivity and company image.