Recommendation #: Utilize controls to operate equipment only when needed (ARC 2.6231)

Est. Electric Energy Savings = *12,000 kWh/yr*
Est. Demand Savings = *Not Applicable*
Est. Total Cost Savings = *$800/yr*
Est. Implementation Cost = *$850*
Simple Payback Period = *13 months*

Recommended Action

Cease ventilation to the blasting cabinets while parts are not being sandblasted. Retrofit a pneumatic relay switch to the compressed air (used for sandblasting) and the motor switches of the dust collectors.

Background

Two dust collection systems remove debris from the sand blasting operation. One 20hp motor is used for removing air directly from the sand blasting cabinets, and a smaller 7hp unit removes air from the environment between the cabinets. Currently, both ventilation systems are independently switch controlled, and may be turned on or off by operators and maintenance staff.

For the sake of convenience or negligence, these dust collectors may be left operating though the entirety of a working shift, even though the cabinets are utilized six to eight hours a day.

By tying the motor switches of the ventilation fans to the the pressure in the sandblasting lines, dust collection will only occur while sandblasting is in progress. Because the station operator is already involved in opening and closing the pressure valves for sandblasting, this retrofit eliminates the responsibility of the operator activating or deactivating the ventilation. Furthermore, it reduces the ending shift responsibilities of the maintenance staff to turn off the ventilation equipment.

Anticipated Savings

The estimated energy savings are calculated from the opportunity cost of the electrical motors running the ventilation fans. E_{usage} is the combined energy consumption of the 20hp and 7hp electric motors. The energy consumption of each motor is calculated from the measured amperage and voltage values at the motors power enclosure.

$$E_{usage} = (P) * (I_1 + I_2) * (\sqrt{3}) = 24\text{kW}$$

Where:
P= measured plant average of 482.5volts.
I_1= measured average of 20.0 amps going to the 20hp dust collector.
I_2= measured average of 8.8 amps going to the 7hp dust collector.
$\sqrt{3}$= KVA to KW conversion factor for three-phase power.

The assumption is made that the ventilation systems are left on for an average of two hours(H_{shift}) during a work shift when the sandblaster is not in use. The average of two hours is used to calculate H_{saved} .

The energy savings of consumption ($ES_{consumption}$) are calculated by multiplying the reduced hours of operation (H_{saved}) by the Energy used (E_{usage}) . The hours of operation saved are erratic; it is unlikely that the billed peak demand will be affected. Therefore, the energy savings due to reduced demand are considered negligible.

$$H_{saved} = H_{shift} * 5\frac{days}{week} * 50\frac{weeks}{year} = \mathbf{500}\boldsymbol{hr/yr}$$

$$ES_{consumption} = H_{saved} * E_{usage} = 12{,}000\ kWH/yr$$

$$ES_{demand} = E_{usage} * M = \mathbf{0}\ kW/yr$$

Where:
H_{shift} = average hours of unneeded ventilation per workday = 2.
M = number of months in the year = 12.

The cost savings(CS) are calculated as the energy saved(ES) multiplied by the energy cost(EC).

$$CS_{consumption} = ES_{consumption} * ECc = \mathbf{\$800/yr}$$

$$CS_{demand} = ES_{demand} = \mathbf{\$0/yr}$$

$$CS_{total} = CS_{demand} + CS_{consumption} = \mathbf{\$800/yr}$$

Where:
EC_c = Energy consumption cost = $0.06662/kWh.
EC_d = Energy demand cost = $18.89/kW.

Implementation

The retrofit requires three components to be purchased. A high-pressure air-actuated switch (air-to-electric switch), miscellaneous fittings, and a three-phase high amperage relay switch (motor starter).

High-pressure air-actuated switches commonly work with 10-120psi. They may be found as a momentary switch closing a circuit in the presence of line pressure, and automatically opening when line pressure drops to atmosphere. Furthermore, they commonly work with a 24V DC control circuit.

Miscellaneous fittings will be needed for the high-pressure air-actuated switch. A simple solution will be to add a T-adapter in line with the existing pipe and to attach the air-actuated switch to the T-adapter.

A high amperage relay switch will be needed to run the motors. High-pressure air-actuated switches are not commonly designed to work with high amperage. (Note: 86.5A was the combined amperage of both motors when measured). The existing switches are manual and will

require an automatic switch that activates via the high-pressure air-actuated switch. Furthermore, the control voltage for the motor switch will need to be compatible with the control voltage of the high-pressure air-actuated switch.

The implementation cost, IC, is the summation of the cost of parts and instillation.

$$IC = (C_{pnumatic\ switch}) + (C_{misc}) + (C_{motor\ switch}) + (H_{labor} * HC_{labor}) = \$850.00$$

Where:
$C_{pnumatic\ switch}$ = high-pressure air-actuated switch(air-to-electric switch) = $120.00.
C_{misc} = miscellaneous fittings between pipe and actuated switch = $30.00.
$C_{motor\ switch}$ = Motor-Switch able to handle both motors = $400.00.
H_{labor} = Estimated Hours of labor = 6.0hr.
HC_{labor} = Estimated cost of labor = $50.00/hour.

The simple payback period, SP, associated with the ratio of initial cost(IC) over the total cost savings (TCS).

$$SP = \frac{IC}{TCS}$$

$$SP = (\$850/\$800) = 1.06\ years \approx \textbf{13 months}$$

Additional Commentary

Ceasing ventilation operation with sanding operation may provide inadequate ventilation. Ventilation is needed for clearing the cabinets and work area of remaining air-bound sand after the sanding operation has ceased. An easy solution is to delay the time between the pneumatic switch and the motor switch.

One solution is to install a control relay with a timing function between the pneumatic switch and motor switch. These often offer a control knob for adjusting the delayed time. Such components are easy to find and may be purchased for about $50.

Another solution is to incorporate the switches into a PLC. PLCs already exist in the plant, and both the pneumatic and motor switch mentioned above may be found in PLC compatible variants.