**Assessment Recommendation**

**Install Variable Frequency Drive on Pumps**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Assessment Recommendation Summary | | | | | |
| ARC# | Annual Resource Savings | Total Annual  Savings | Capital Cost | Other Cost | Simple Payback |
| 2.4146 | |  |  | | --- | --- | | Electricity: | 15,411 kWh | | Demand: | 29.64 kW | | $701.80 | $1,453.98 | $300 | 2.50 years |

**Current Practice**

The facility uses two variable torque motors for pumping water that run at full speed during the entirety of their operating hours.

|  |  |  |  |
| --- | --- | --- | --- |
| # of Motors | Operating Hours | Motor HP | Motor RPM |
| 2 | 6,240 | 7.5 | 1,800 |

The current energy demand ( of the motors can be calculated by converting the rated horsepower directly into kW.

Where,

*CED* = Current Energy Demand *kW*

= Motor horsepower 7.5 

*N* = Number of Motors 2 *motors*

*C* = Conversion Constant *0.746*

*n* = Motor Efficiency[[1]](#footnote-1) 0*.80*

Substituting,

The current annual energy usage of the motors () can be calculated using the following equation.

Where,

*CAEU* = Current Annual Energy Usage *kWh*

*CED* = Current Energy Demand 13.99 *kW*

*HRS* = Annual hours of operation[[2]](#footnote-2) 6,240 *hrs*

Substituting,

**Recommended Action**

The facility should implement Variable Frequency Drives (VFDs). These will allow the motors to run the necessary power output by manipulating shaft speed.

The shaft load on the motor is determined by the product of shaft speed and torque. With a fixed speed, motor power is determined by the torque of the load. With a change in speed, motor load will not only benefit from the speed reduction, but also any reduction in torque with speed. Positive displacement compressors, fans and motors are constant torque devices. That is, the twisting force required to turn the shaft is constant, regardless of speed. Therefore, the shaft power is determined by operating conditions (pressures) and method of capacity control, which both effect torque. In general, a reduction in speed would provide a proportional reduction in shaft power.

The resulting energy savings from a VFD installation depends on the difference between the current shaft load and the necessary shaft load. This recommendation will estimate that the installation of a VFD results in an average of a 30% reduction in shaft speed over the course of the operational hours for each motor. Since the speed of the motor is reduced, there will be a reduction in peak demand. The proposed energy demand () can be calculated using the relations shown below:

Where,

*PED* = Proposed Energy Demand *kW*

= Proposed Motor horsepower 

*N* = Number of Motors 2 *motors*

*C* = Conversion Constant *0.746*

*n* = Motor Efficiency *80%*

Where,

= Proposed horsepower  *hp*

= Initial horsepower 7.5

= Current RPM 1,800 *rpm*

= Proposed RPM[[3]](#footnote-3) 1,260 *rpm*

Substituting to find ,

*hp*

Substituting to find ,

*PED =* 4.80 *kW*

The proposed annual energy usage of the motors () can be calculated using the following equation.

Where,

*PAEU* = Proposed Annual Energy Usage *kWh*

*PED* = Proposed Energy Demand 7.16 *kW*

*HRS* = Annual hours of operation 6,240 *hrs*

Substituting,

There will be a cost associated with using VFDs; they use significant energy, which will delay the payback period. The energy demand cost of the VFDs (EDCV) and the energy usage cost of the VFDs (EUCV) are calculated below.

Where,

*EMDS* = Estimated Monthly Demand Savings

*N* = Number of VFDs 2 *VFDs*

*V* = VFD Voltage[[4]](#footnote-4) 240 *volts*

*A* = VFD Current Required4 14 *amps*

Therefore,

Substituting,

The estimated total energy demand savings (TEDS) and total annual energy usage savings (TEUS) can be determined as follows.

Substituting,

Given an average demand cost of 12.239 $/kW, and an average electricity cost of 0.022 $/kWh, the estimated total annual savings (*TAS*) associated with this recommendation is determined as follows.

Note that 29.64 kW represents the annual demand resource savings.

**Implementation Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Unit | Cost | Quantity | Total Cost |
| *ATO 7.5HP VFD* | *$726.99* | | *2* | *$1,453.98* |
|  |  |  |  |  |
| *Installation* | *50* | *$/hr* | *6[[5]](#footnote-5) hrs* | *$300* |
|  |  |  | Total | $1,753.98 |

The simple payback period is determined as follows.

1. Estimated by IAC [↑](#footnote-ref-1)
2. 24 hours a day, 5 days a week and 52 weeks a year [↑](#footnote-ref-2)
3. Based on a 30% reduction in RPM. [↑](#footnote-ref-3)
4. Based on ATO 7.5HP VFD [↑](#footnote-ref-4)
5. Estimating 3 hours per installation. [↑](#footnote-ref-5)