ESTIMATED ENERGY SAVINGS using VFD: 95% [$ 16,574]

Introduction:

Energy consumption calculations for water pressure booster systems are simplified for a constant speed pressure booster system. This system is governed by a pressure switch and an *Automatic Control Valve*. When there is a drop in pressure, the pressure range switch activates a timer which causes the pumps to run. The timer usually keeps the pumps running for 3-5 minutes. However, in most cases a large horsepower pump is used to satisfy a small demand. To avoid over pressurizing the system, the *ACV* is installed on the discharge side of the pumps, which causes the water to circulate within. This may result in issues such as overheating of water and excessive wear and tear of the pump components.

Energy consumption calculations for Variable speed pressure booster systems are complex due to the variation in pump power consumption enabled by the VFD (variable frequency drives). A VFD is a system that controls the rotational speed of an AC motor by controlling the frequency of electrical power supplied to the motor.

Cost of running:

(Total HP) **X** (0.746 [kW/HP]) **X** (Number of Hours of operation per day) **X** (Number of days of operation per year) **X** (Cost of energy per kWHr)

Estimated annual cost of Variable Speed Booster System:

Data for proposed variable speed system:

Number of pumps in system = **3**
Horsepower of each main pump = **2Hp**
Pumps running at same time = **2**

To calculate the cost of operating a variable speed booster system, we use the "*cost of running motor*" formula and calculate the cost for varying load conditions for the entire system.

Cost of operating variable speed booster system at each load condition:

At 10 0 % L o a d:

(4HP) X (0.746) X (2 Hrs) X (365 Days) X (0.125 kWHr) = **$ 217**

At 80 % L o a d:

(3.2HP) X (0.746) X (2 Hrs) X (365 Days) X (0.125 kWHr) = **$ 174**

At 40 % L o a d:

(1.6HP) X (0.746) X (4 Hrs) X (365 Days) X (0.125 kWHr) = **$ 174**

At 20 % L o a d:

(.8HP) X (0.746) X (4 Hrs) X (365 Days) X (0.125 kWHr) = **$ 87**

At 10 % L o a d:

(.4HP) X (0.746) X (6 Hrs) X (365 Days) X (0.125 kWHr) = **$ 130**

Load Condition	Hours of Operation
100%	2
80%	2
40%	4
20%	4
10%	12

Total estimated cost of operating a variable speed system:
= $ 784

To calculate energy savings:

$$\frac{(\$\ 17{,}358) - (\$\ 784)}{(\$\ 17{,}358)} \times 100 = 95\%$$

***Estimated Energy Savings:* 95% [$ 16,573]**

Estimated annual cost of Constant speed booster system:

Data for existing constant speed system:

Number of pumps = 3
Horsepower of each pump = **15Hp**

One 15Hp pump runs 24/7/365:
(1 x 15 HP) **X** (0.746) **X** (24Hrs) **X** (365 Days) **X** (0.1 kWHr) = **$ 12,253**

One 15Hp pump runs 10/7/365:
(1 x 15 HP) **X** (0.746) **X** (10Hrs) **X** (365 Days) **X** (0.1 kWHr) = **$ 5,105**

Total ANNUAL cost of constant speed booster system:
= $ 17,358

References:
American Water Works Association
Electric motors & drives: Fundamentals and applications [3rd edition]

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