33.41 **A pump was originally specified to deliver $300gpm$ of water against $200ft$ of head. To be conservative, the design engineer makes a selection that is 10% oversized by gpm and head. The pump and motor efficiencies are 75% and 95%, respectively. The cost of electricity is $\$0.16$ per KWH. What is the additional annual cost to operate the oversized pump continuously?**

A. \$3300

B. \$4700

C. \$6300

D. \$27,000

Calculate the Water Horsepower for the pump originally specified. Consider the original pump State 1 and the oversized pump State 2.

$$whp_1 = \frac{Qh}{3960}$$

$$whp_1 = \frac{(300)(200)}{3960} = 15.15hp$$

Calculate the Water Horsepower for the oversized pump.

$$whp_2 = \frac{[(300)(1.1)][(200)(1.1)]}{3960} = 18.33hp$$

Determine the difference in whp.

$$\Delta whp = whp_2 - whp_1$$

$$\Delta whp = 18.33hp - 15.15hp = 3.18hp$$

Determine the input power to the pump motor by accounting for both the efficiency of the pump and the motor. Convert from hp the KW.

$$\dot{W} = \frac{whp}{\eta_{pump}\eta_{motor}} = \frac{3.18hp}{(0.75)(0.95)} = 4.47hp\left(0.7457\frac{KW}{hp}\right) = 3.33KW$$

Calculate the additional annual cost based on continuous running 24/7.

$$Cost = (3.33KW)(8760hr)\left(0.16\frac{\$}{KW \cdot hr}\right) = \$4667$$

Answer B