37.66 $20,000gpm$ **of water flows through a turbine in a hydroelectric power application. The inlet pressure is** $50psig$ **and the exit pressure is 1 atmosphere. The turbines have an overall efficiency of 80%. What is the electrical capacity of the hydroelectric plant?**

A. $350KW$

B. $435KW$

C. $470KW$

D. $540KW$

A hydroelectric turbine performs the opposite function of a pump. Pumps consume mechanical *brake* horsepower and produce *hydraulic* horsepower; hydroelectric turbines consume *hydraulic* horsepower and produce *brake* horsepower — the power of a rotating shaft. Therefore, we can start by writing the formula for *whp*, then express the electrical power as a fraction of the *whp*. Any losses are accounted for by the efficiency of the turbine (and since it is an *overall* efficiency can be assumed to include any generators that may be part of the electricity producing system downstream.)

$$whp = \frac{Q_{[gpm]}\Delta P_{[psi]}}{1714}$$

$$P_{elec} = \eta_t \cdot whp$$

Since the inlet pressure was given as $50psig$ and the outlet pressure is atmospheric pressure, $\Delta P = 50psi$. The volume flow rate was given in *gpm*. Combine the two formulas above, substitute, solve, and convert to KW.

$$P_{elec} = \frac{\eta_t Q_{[gpm]}\Delta P_{[psi]}}{1714} = \frac{(0.8)\,(20,000)\,(50)}{1714} = 466.7hp\left(\frac{0.7457KW}{1hp}\right)$$

$$P_{elec} = 348KW$$

Answer A