4. Example 1 - Vessel Elevation and Pump NPSH (continue)

- Vapor pressure credit, $P_{vessel} - P_{sat} = 0$ psi (as blanketed light hydrocarbon)
- Margin = 2 ft or 10%, assume 2 ft for first iteration
- Vessel Elevation (from grade to bottom tangent)

$$\begin{aligned}
\text{NPSHA} &\geq \text{NPSHR} + \text{Margin} \\
H_{vessel} &\geq \text{NPSHR} + \text{Margin} - H_{min\,level} + H_{pump\,elev} + \frac{2.31\Delta P_{pipe}}{SG_{flowing}} - \frac{2.31(P_{vessel} - P_{sat})}{SG_{flowing}} \\
&= 15.7 + 2 - 0 + 2.5 + \frac{2.31 \times 0.51}{0.7074} - 0 \\
&= 21.9 \text{ ft (6.68 m)} \\
&= 22.5 \text{ ft rounded up}
\end{aligned}$$

4. Example 2 - Feed Pump Motor

- Determine feed pump motor size and full load current.
- Pump efficiency

$$\begin{aligned}
\text{Pump efficiency} &= \text{From vendor pump curves, or estimate as shown below} \\
N_S &= \frac{N.Q^{1/2}}{(H)^{3/4}} \\
&= \frac{3550 \times 492.6^{1/2}}{639.4^{3/4}} \\
&= 620 \\
\text{Pump efficiency } \eta_{pump} &\simeq 0.64 \text{ from graph}
\end{aligned}$$

- Pump motor size

$$\begin{aligned}
\text{Brake Power (HP)} &= (1 + \text{Loss}_{gear}) \times \frac{\text{Flow (USgpm)} \times \Delta\text{P (psi)}}{1714 \times \eta_{pump}} \\
&= (1 + 0) \times \frac{492.6 \times 195.8}{1714 \times 0.64} \\
&= 88 \text{ Hp} \\
\text{Motor size} &= 1.1 \times 88 \\
&= 97 \text{ Hp} \\
&= 100 \text{ Hp (75 kW) next std motor}
\end{aligned}$$

- Full load current (assuming 460 Volt, 3 phase)

$$\begin{aligned}
I &= \frac{1000 \times \text{Brake Power (kW)}}{\sqrt{3}.V.\eta_{motor}.PF} \\
&= \frac{1000 \times 75}{\sqrt{3} \times 460 \times 0.944 \times 0.86} \\
&= 116 \text{ Amps}
\end{aligned}$$