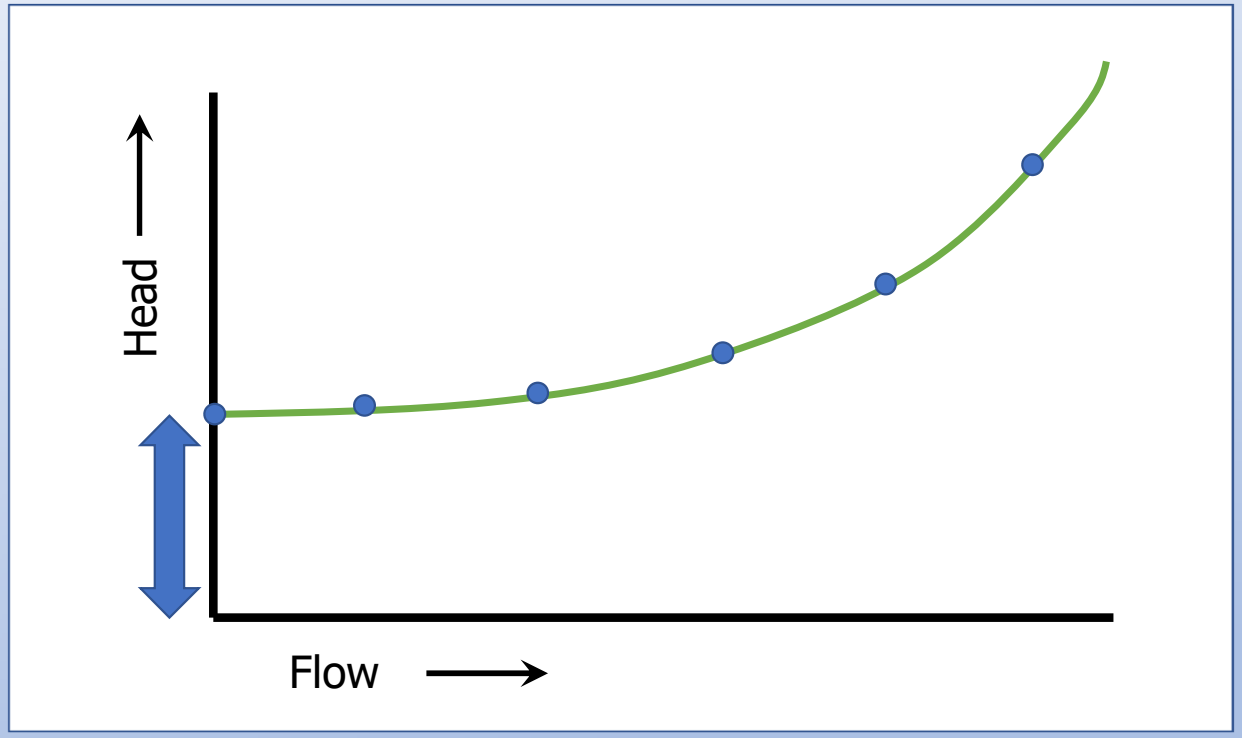
Pumps and System Curves

Module 2

Review

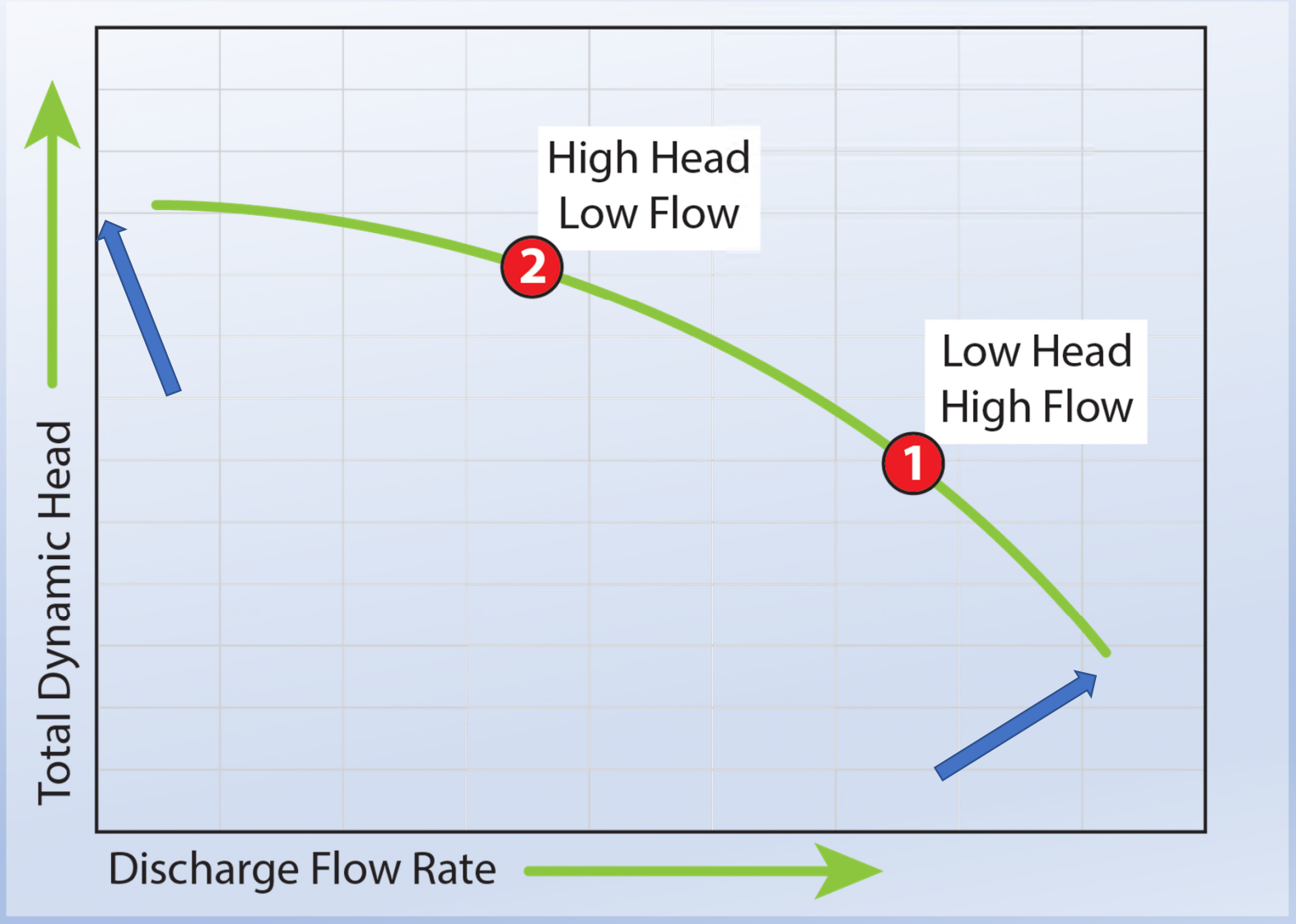
Review

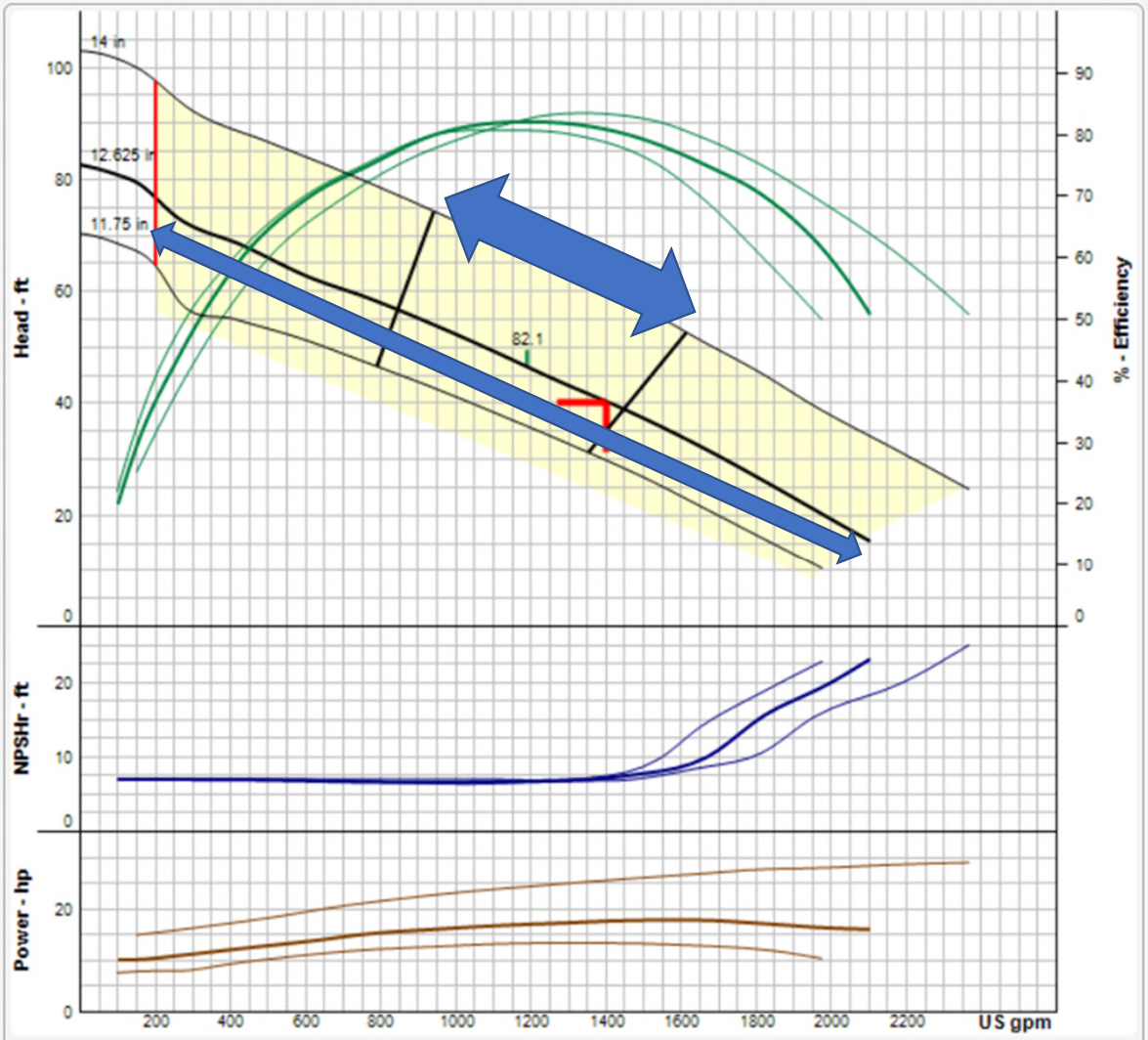
What?



Review

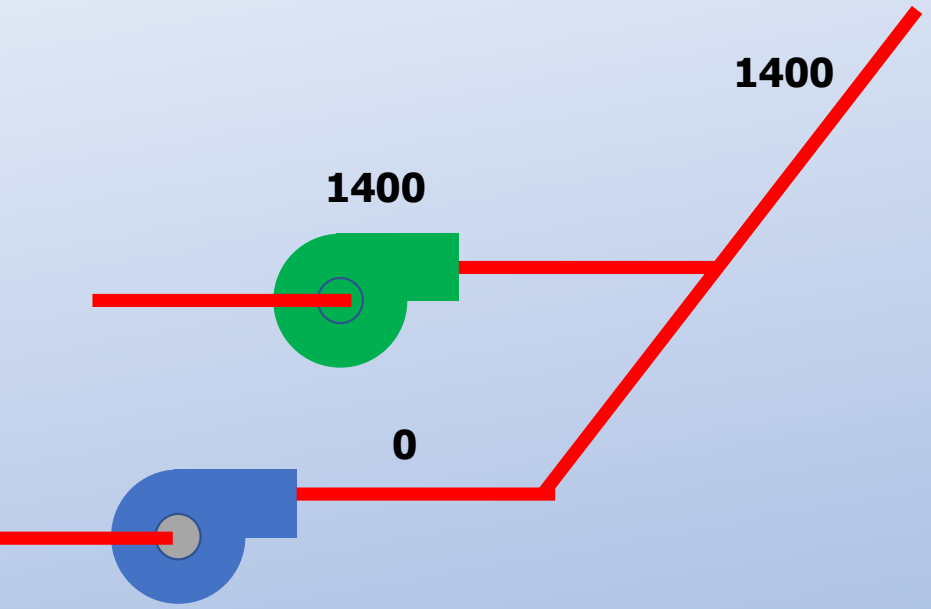
How?

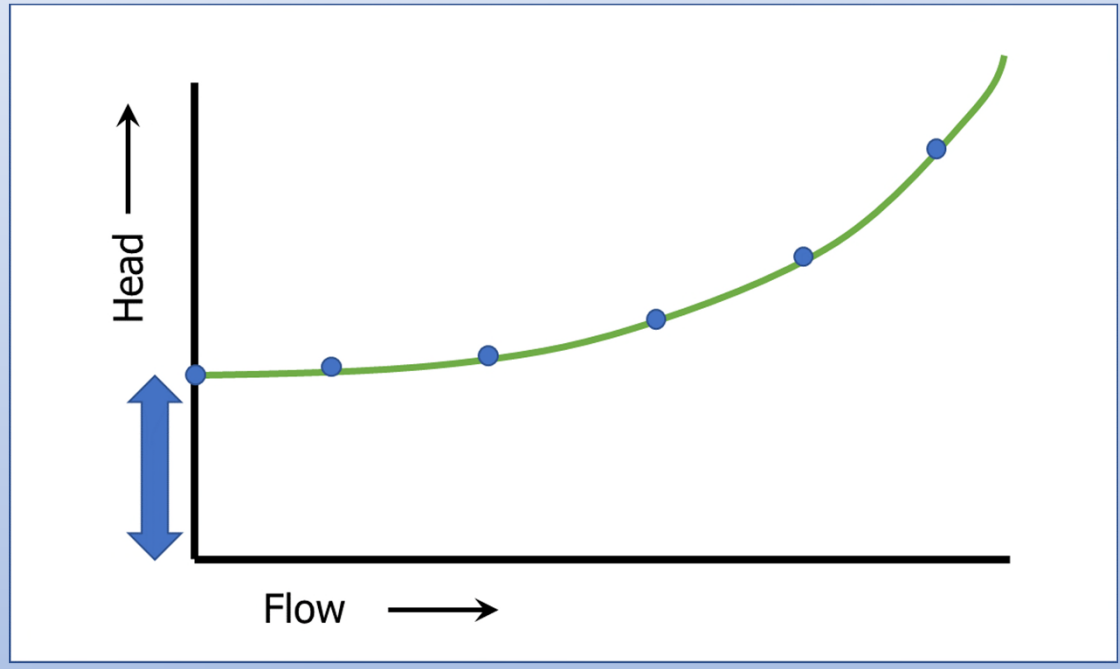

High Head
Low Flow
2
Low Head
High Flow
1
Total Dynamic Head
Discharge Flow Rate



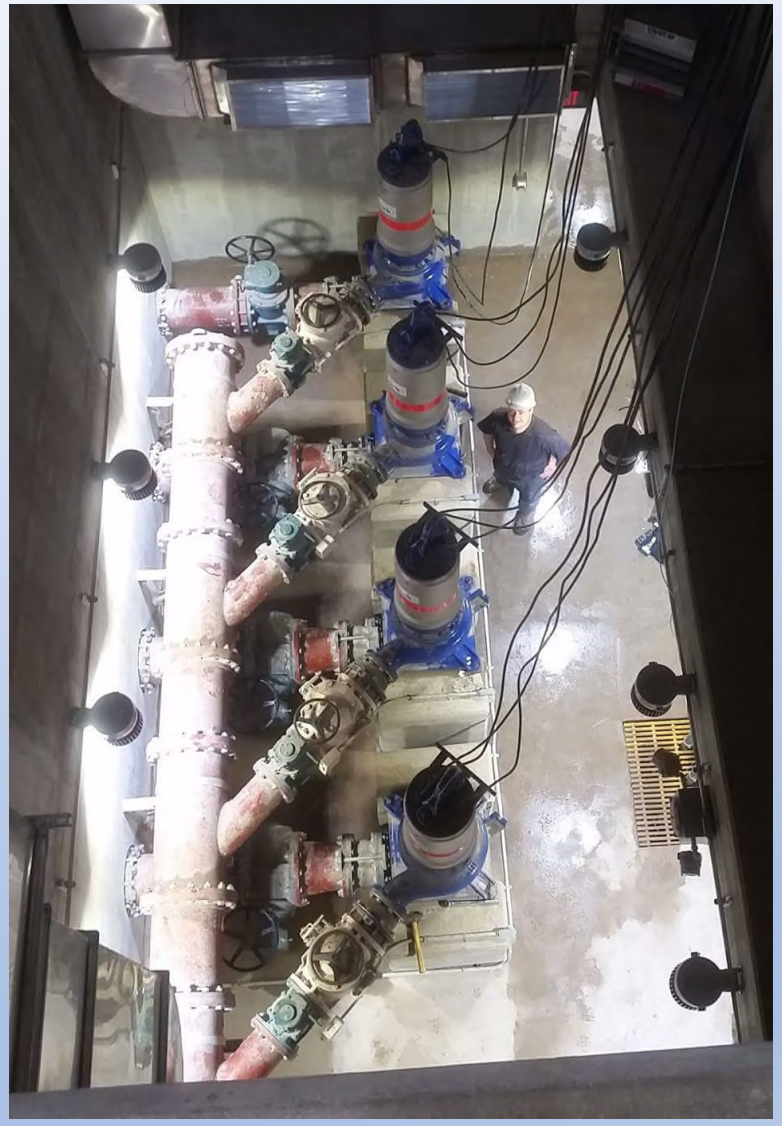
Min flow line represents the absolute lowest flow pump can operate. Consult with factory if operating below 50% of BEP flow

Pumps in Parallel





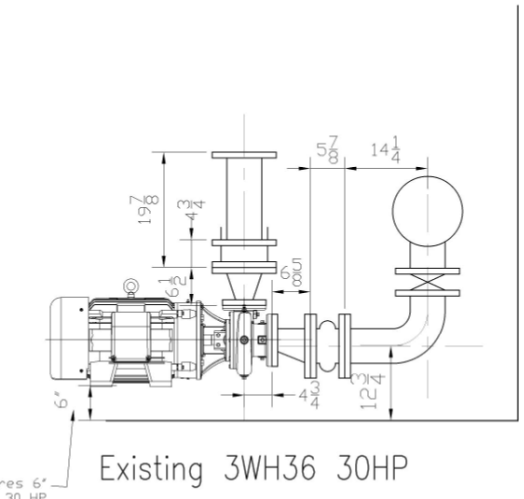
Pumps in Parallel



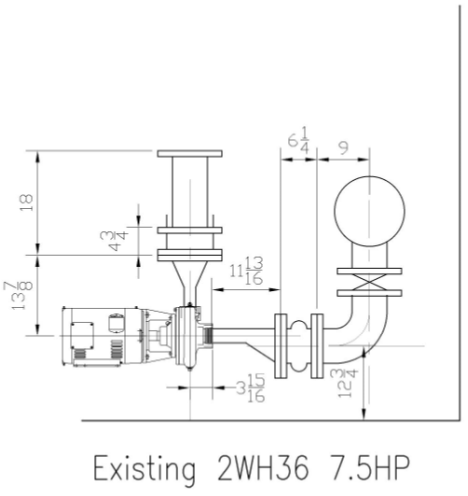
Pumps in Parallel

Pumps in Parallel

FIELD MEASUREMENTS OF EXISTING PIPING AND PUMPS



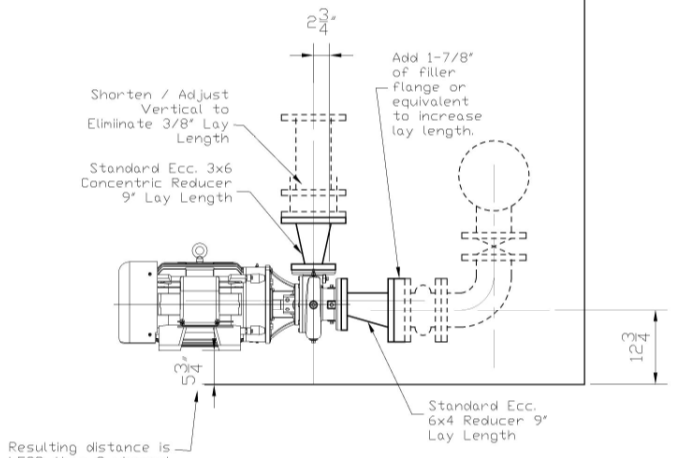
Existing 3WH36 30HP



Existing 2WH36 7.5HP

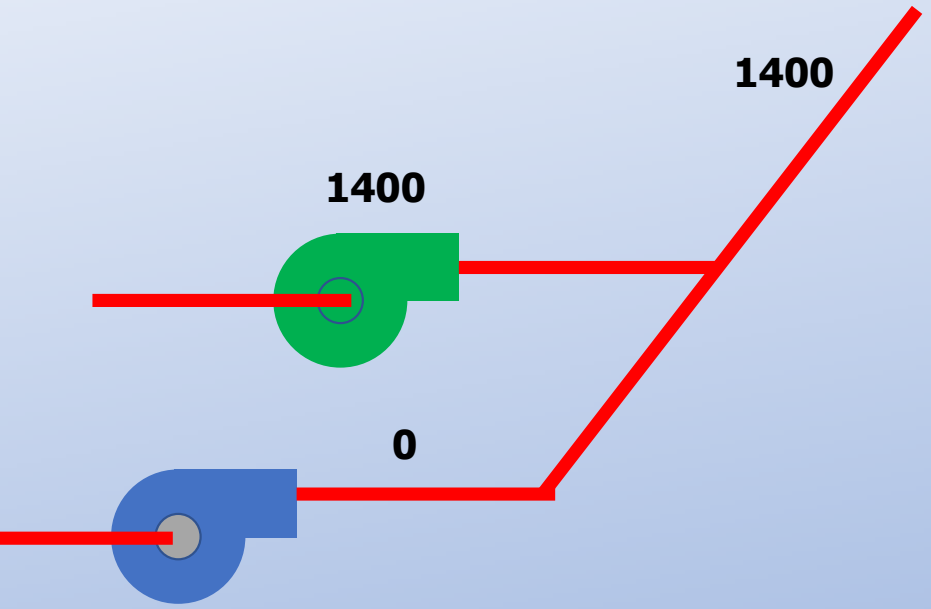
THIS IS THE RECOMMENDED CONFIGURATION -- SHOWN IN MODIFIED PIPING

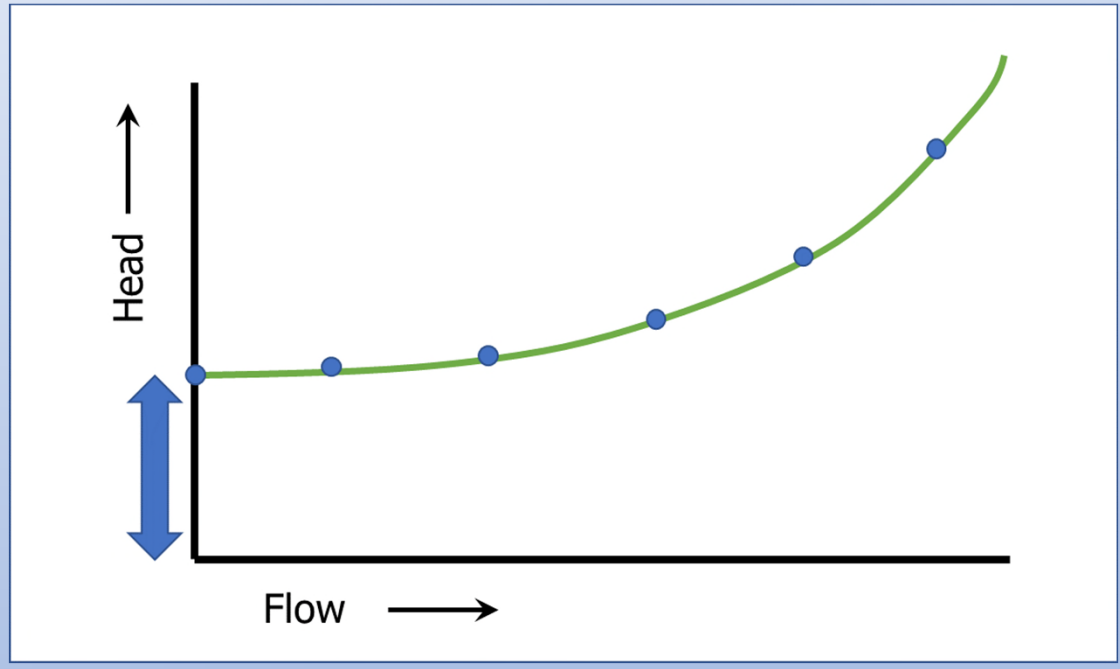
ONLY NEW FITTINGS/PIPE:
2 REDUCERS + FILLER FLANGES.
ONE PIPE MODIFIED.



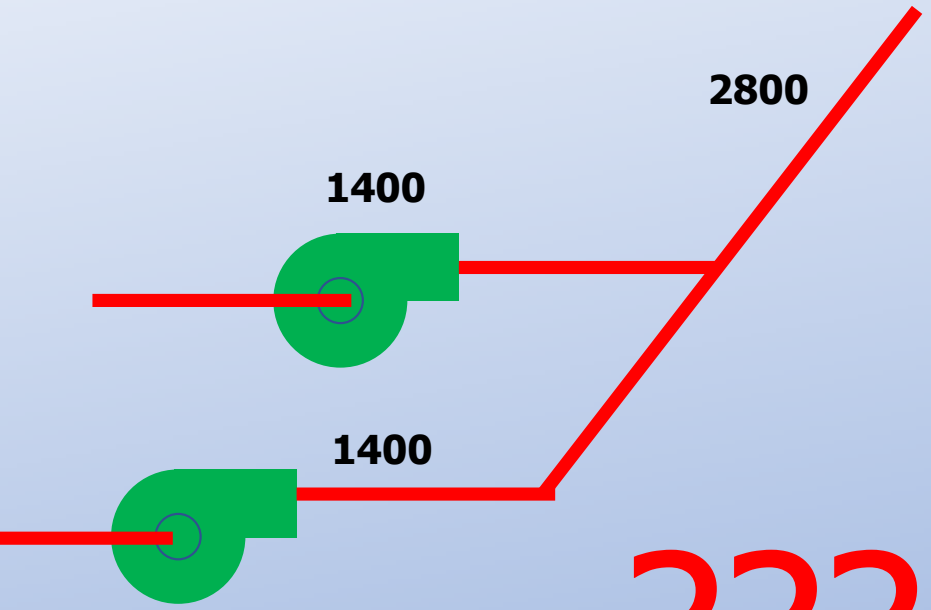
NEW 30HP WHA in Spot of Existing 2WH36 7.5HP CORRECTED PIPING

Pumps in Parallel

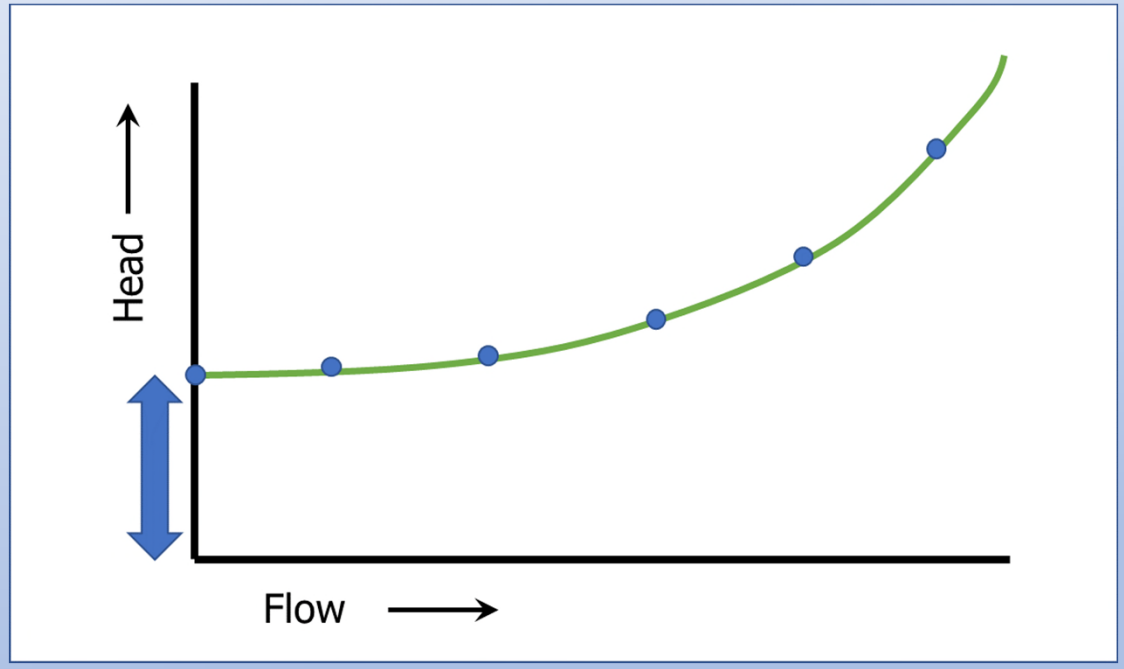




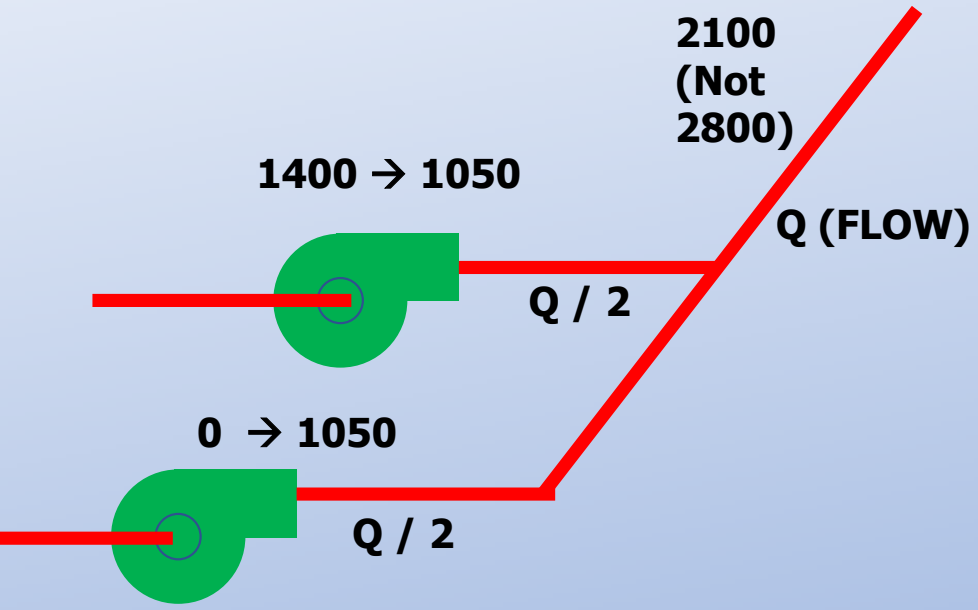
Pumps in Parallel

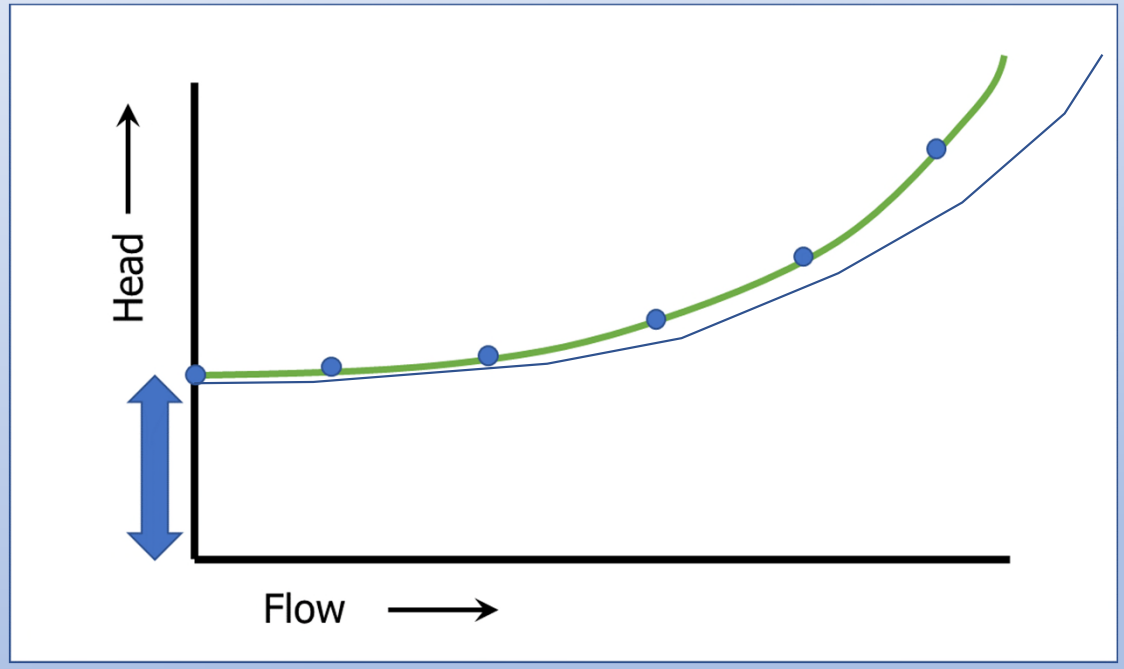


???



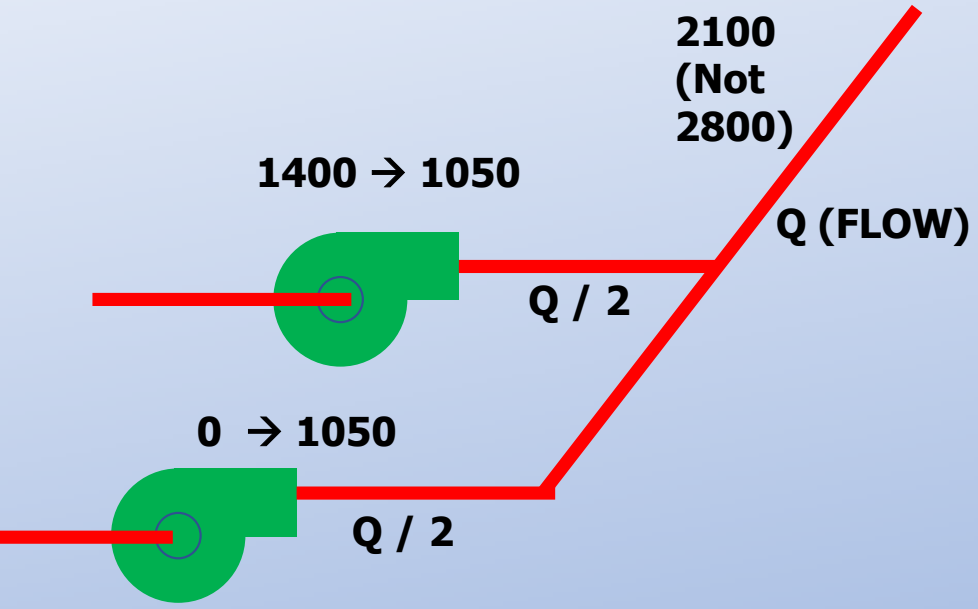
Pumps in Parallel



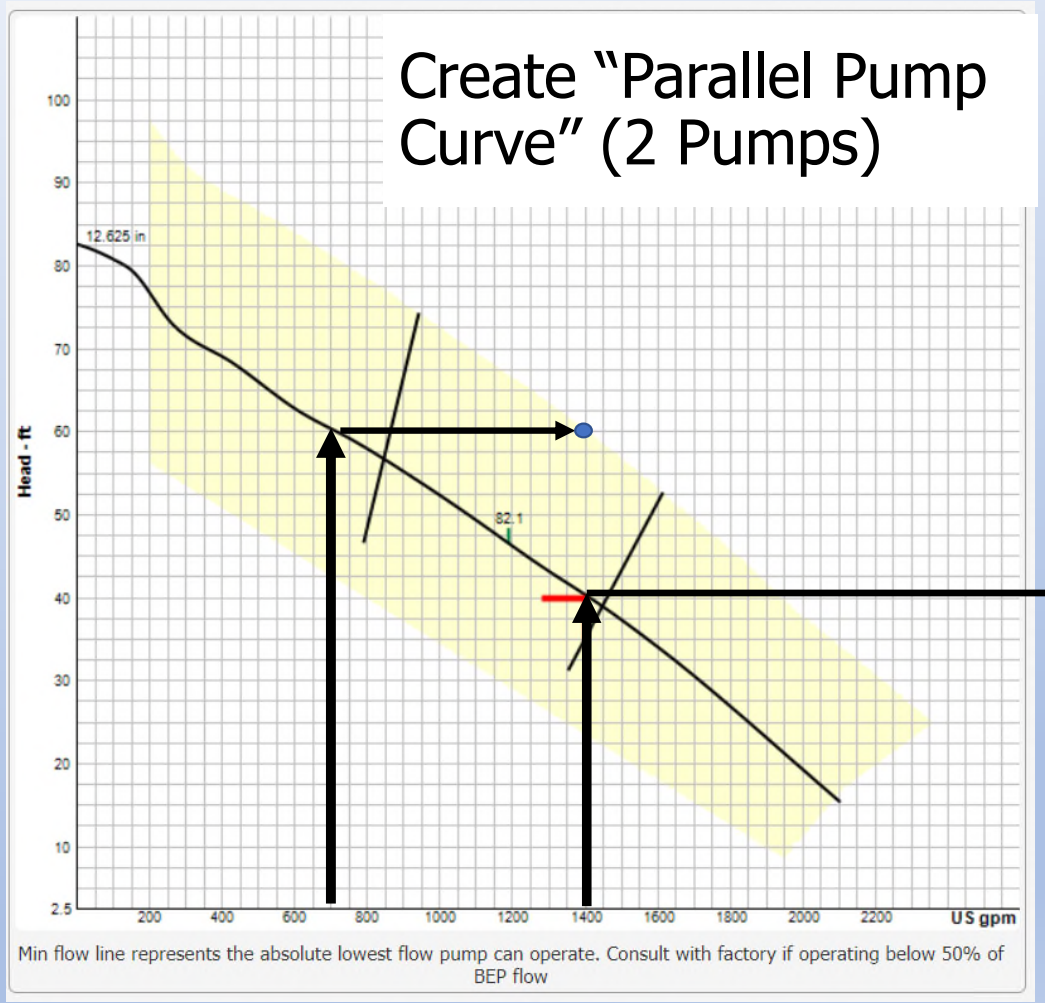


Assume for the moment System Curve doesn't change…

Pumps in Parallel

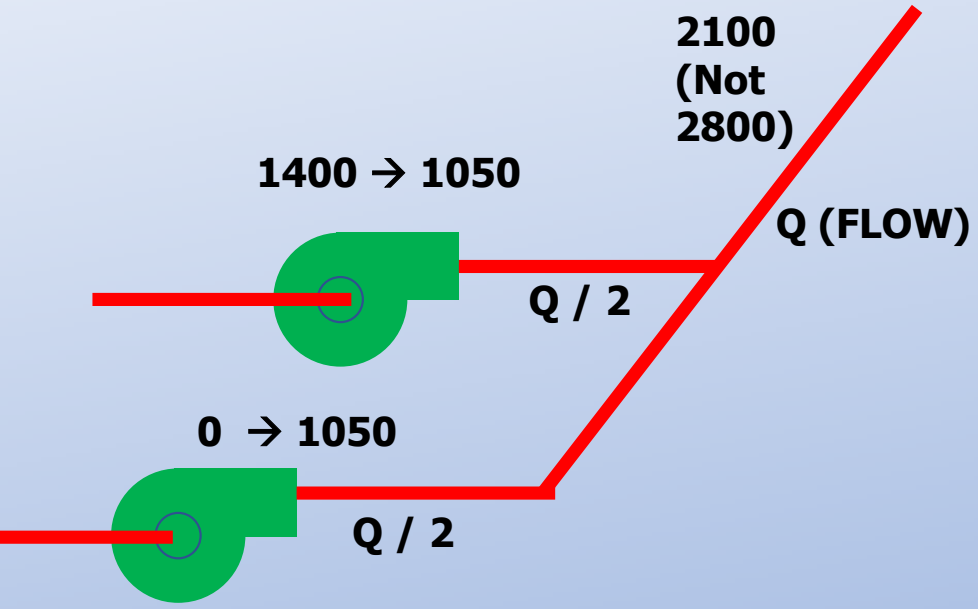


Create "Parallel Pump Curve" (2 Pumps)

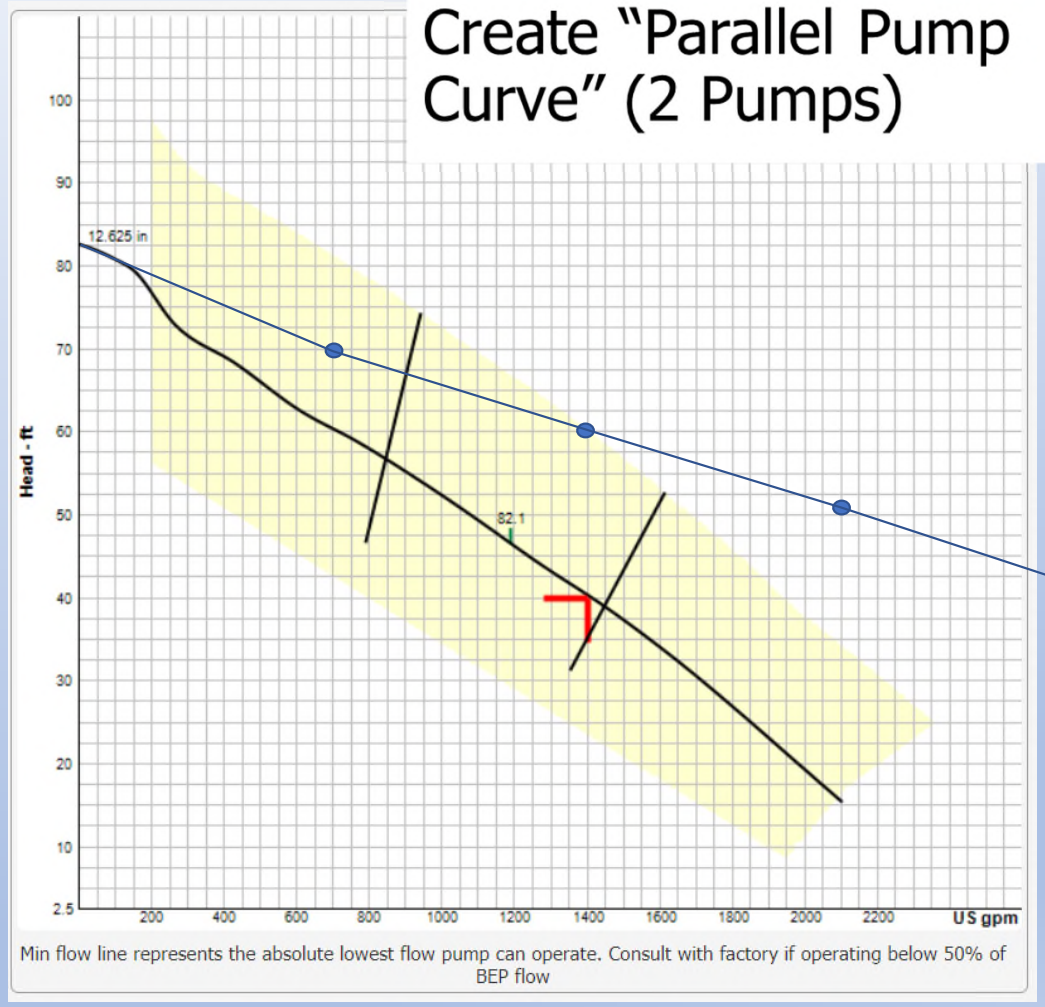


Q (FLOW)

Pumps in Parallel

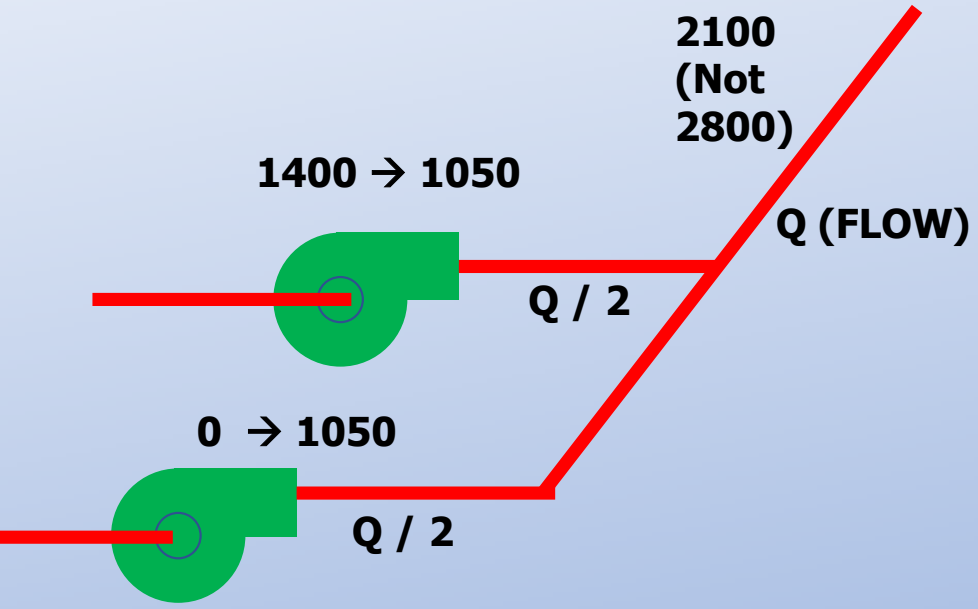


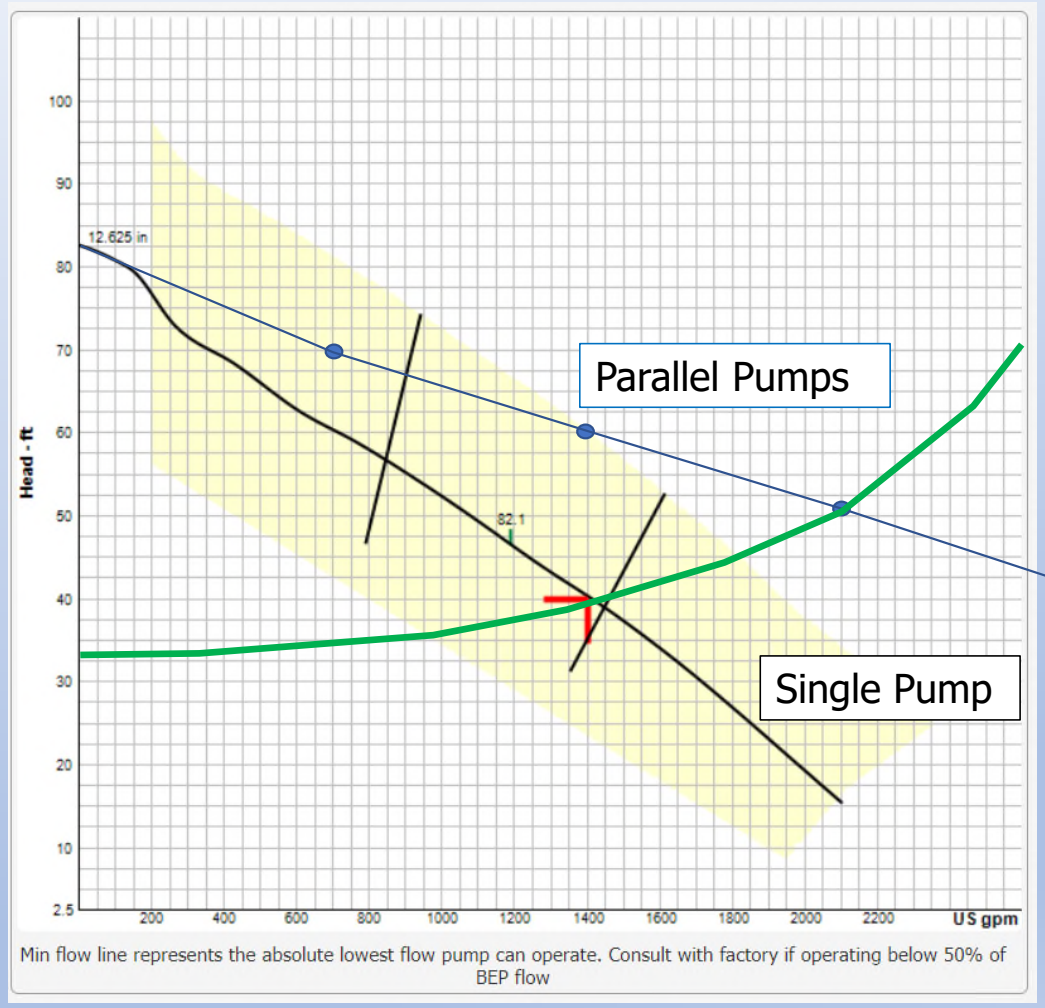
Create "Parallel Pump Curve" (2 Pumps)



Q (FLOW)

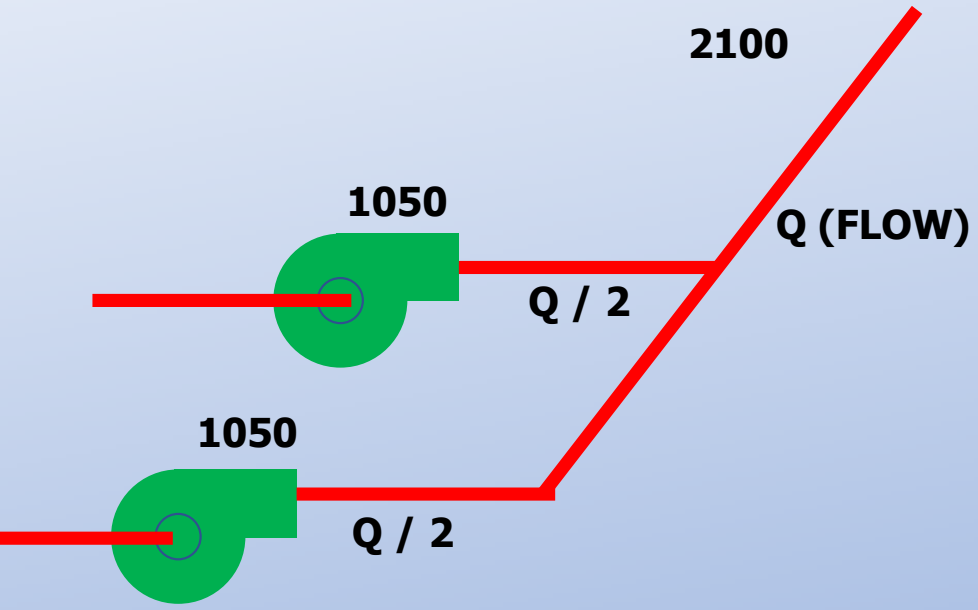
Pumps in Parallel

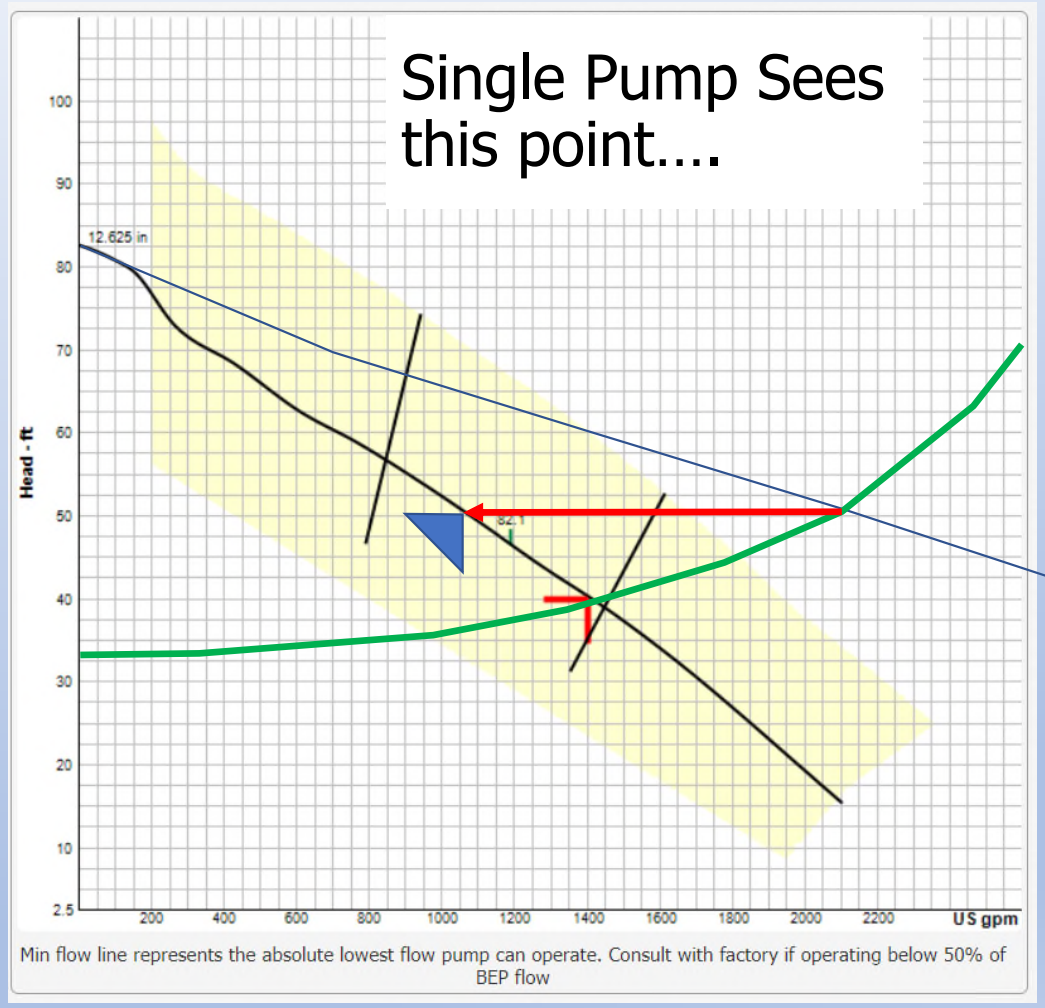




Q (FLOW)

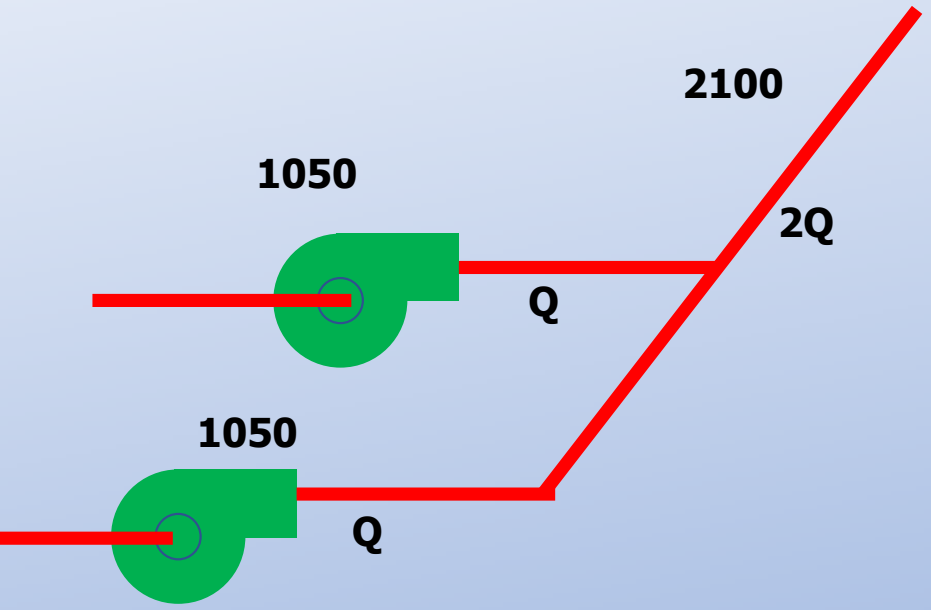
Pumps in Parallel



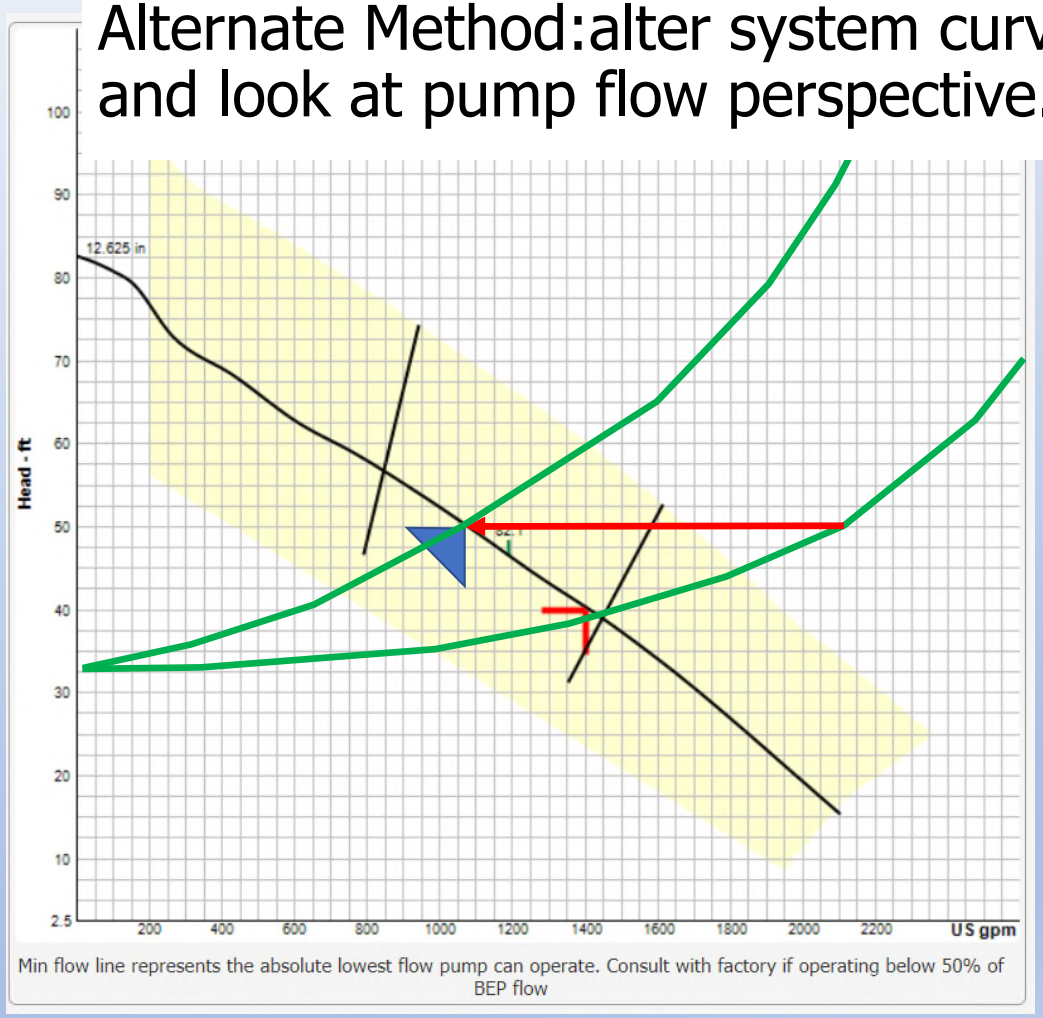


Q (FLOW)
(FROM ALL PUMPS)

Pumps in Parallel

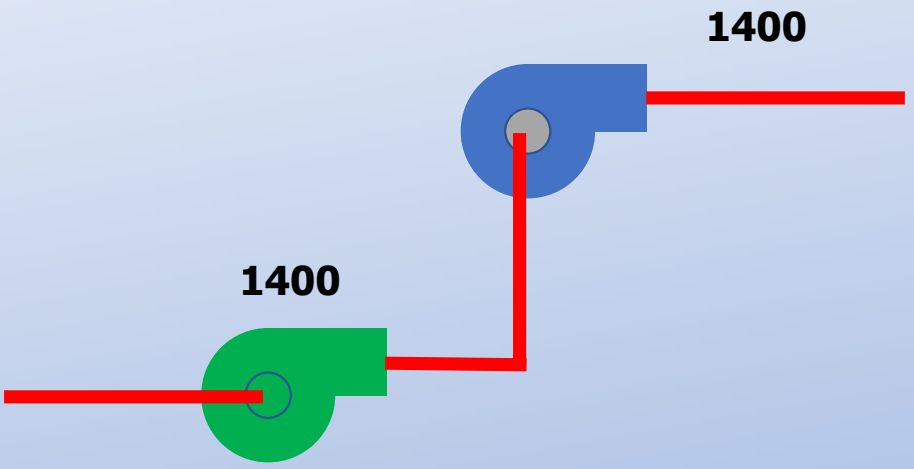


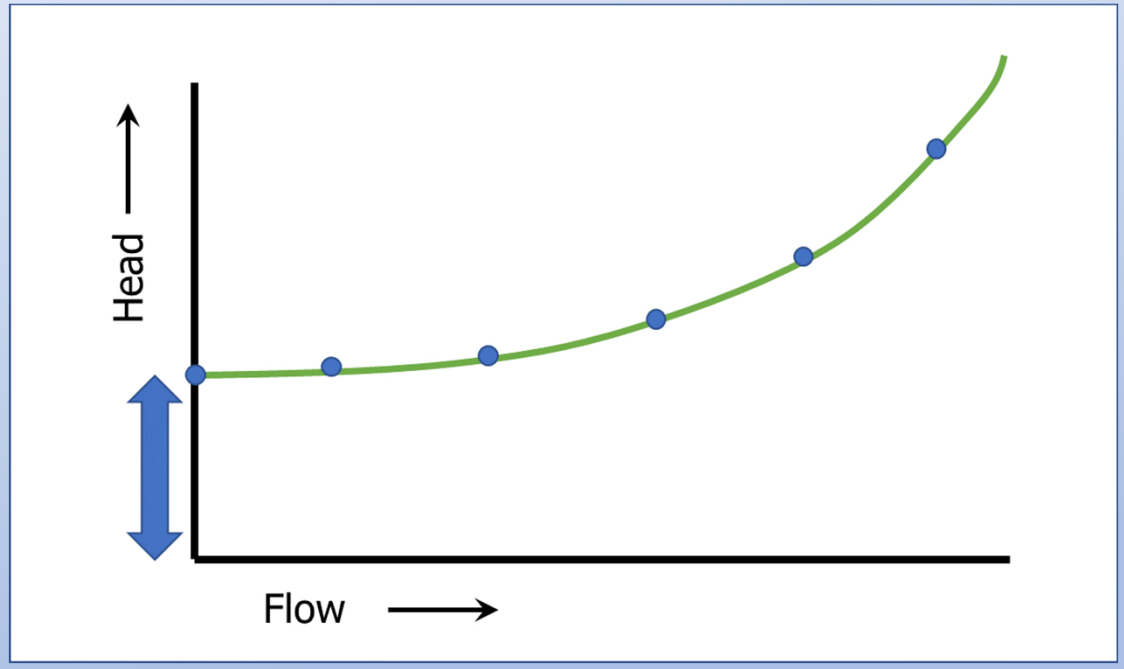
Alternate Method:alter system curve and look at pump flow perspective.



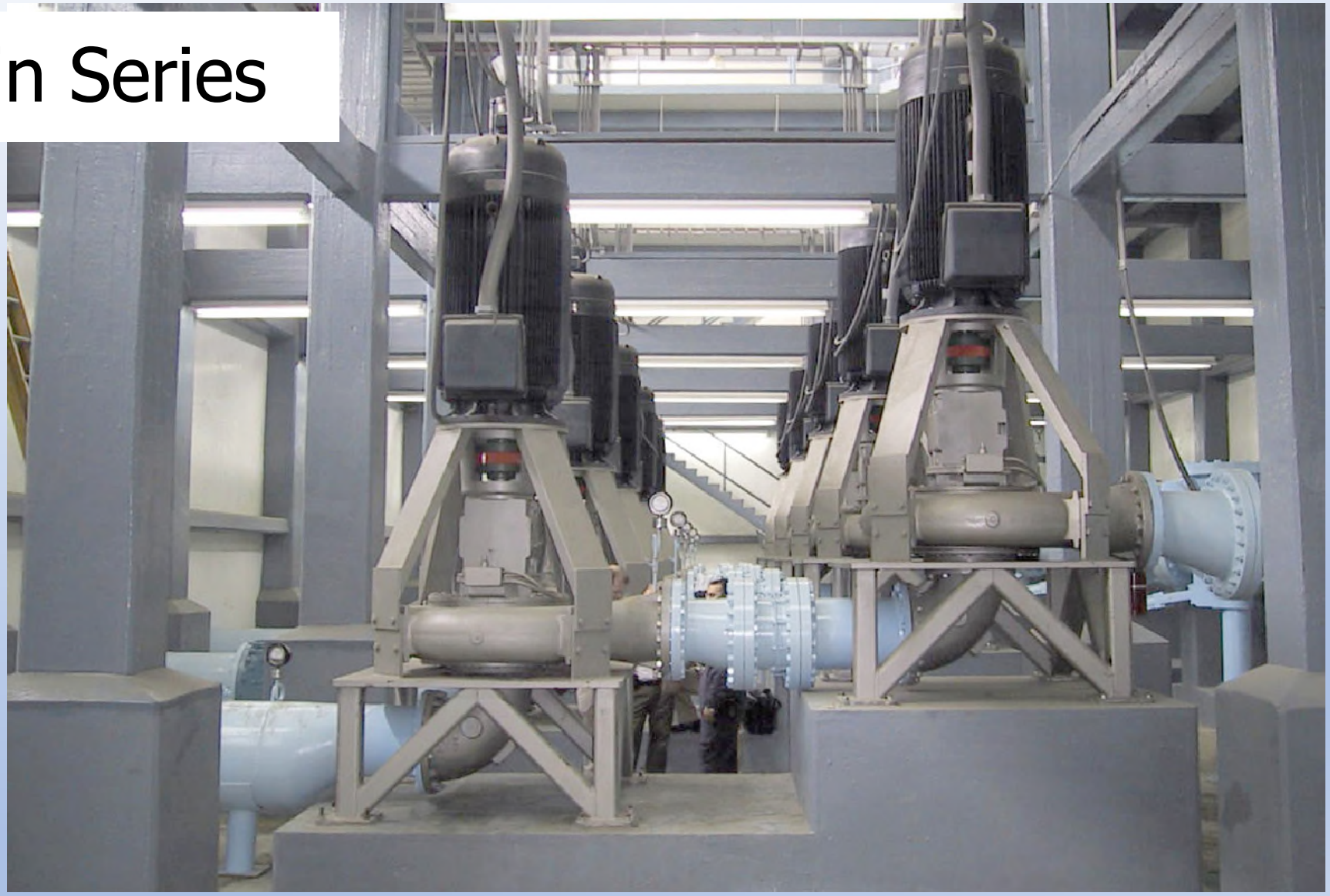
Q (FLOW_
(THRU ONE PUMP)

Pumps in Series

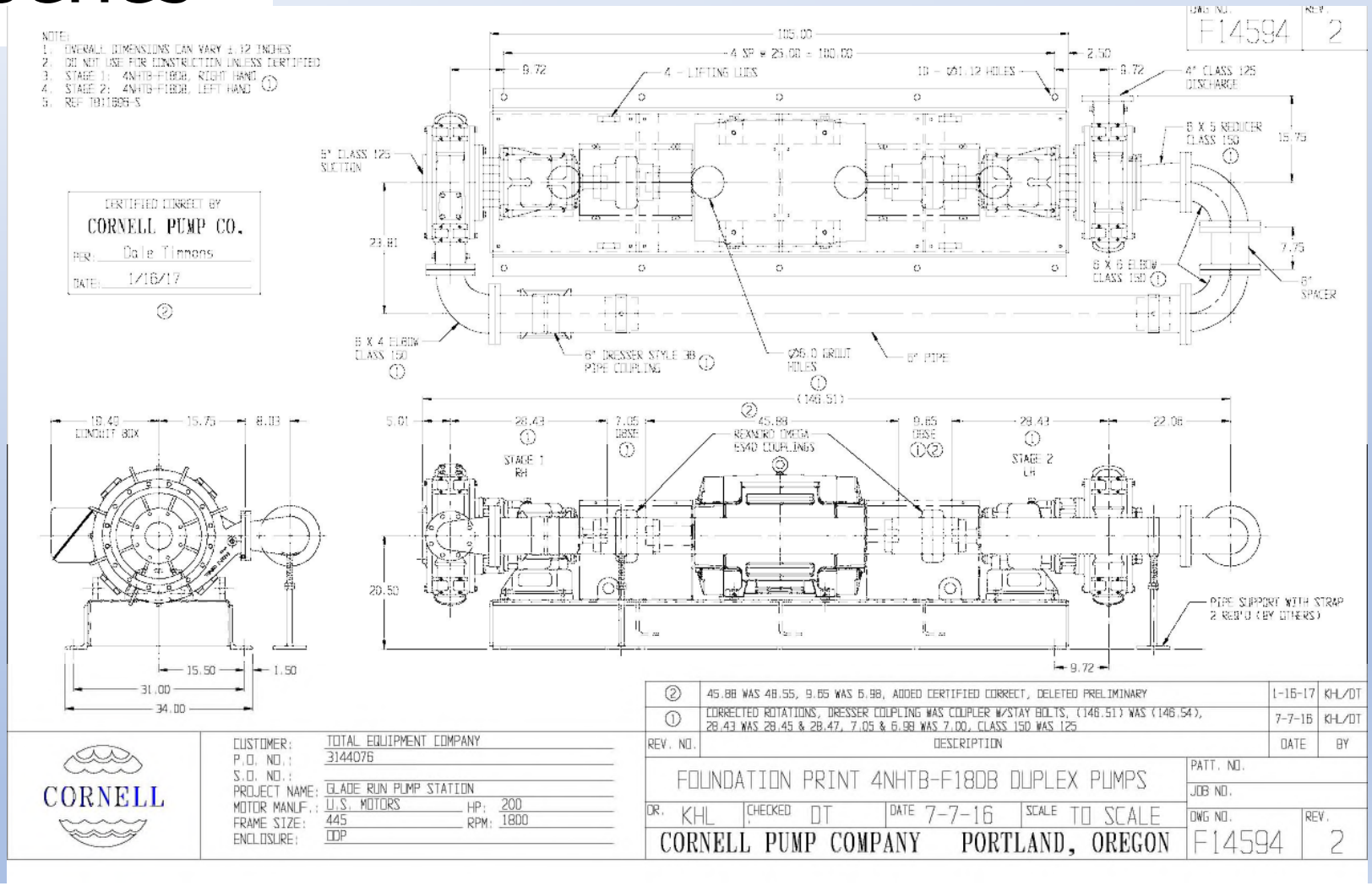




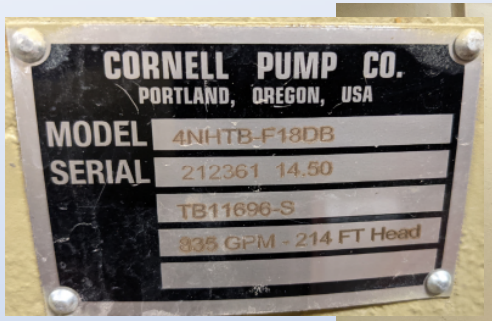
Pumps in Series

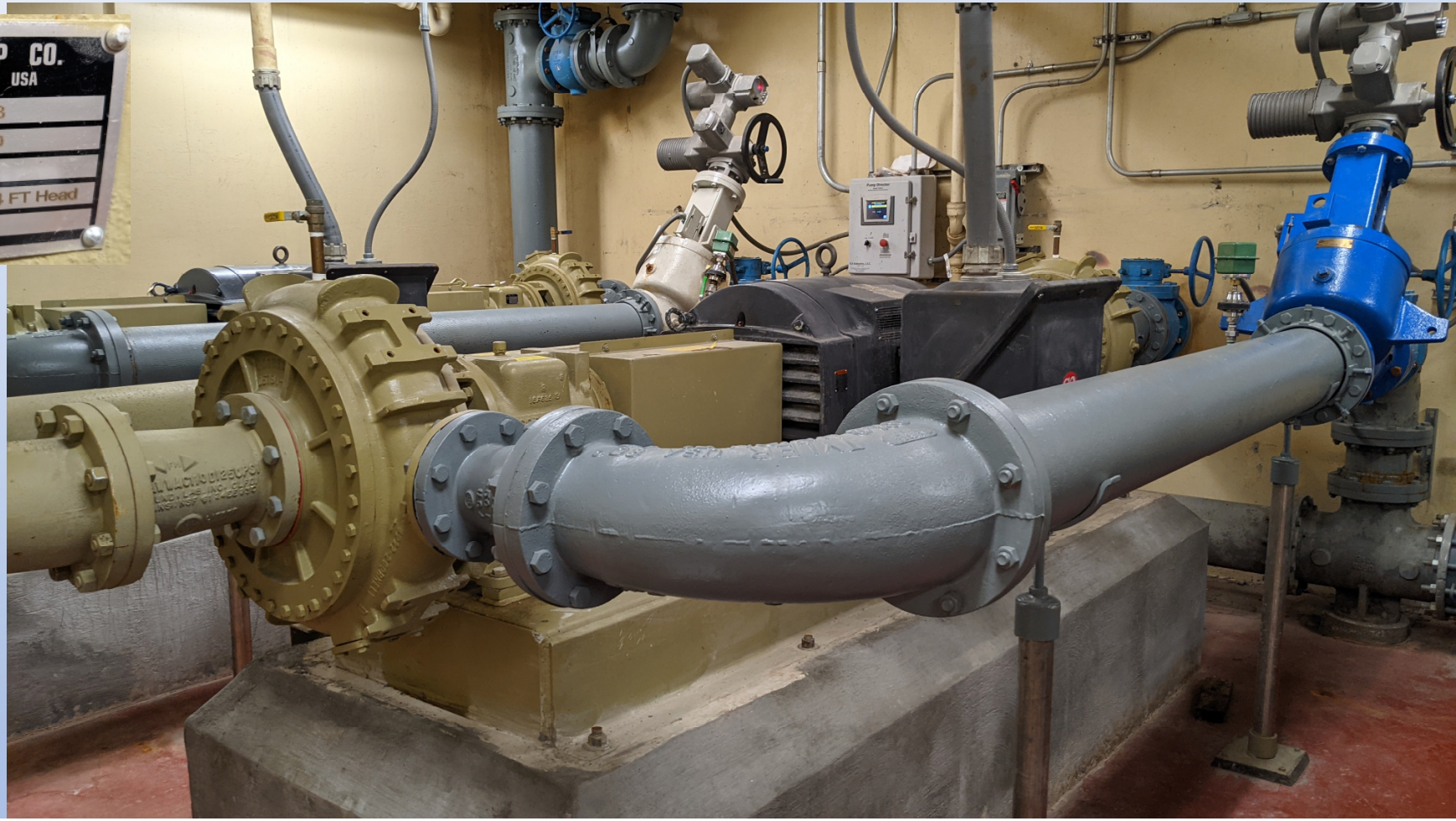


Pumps in Series

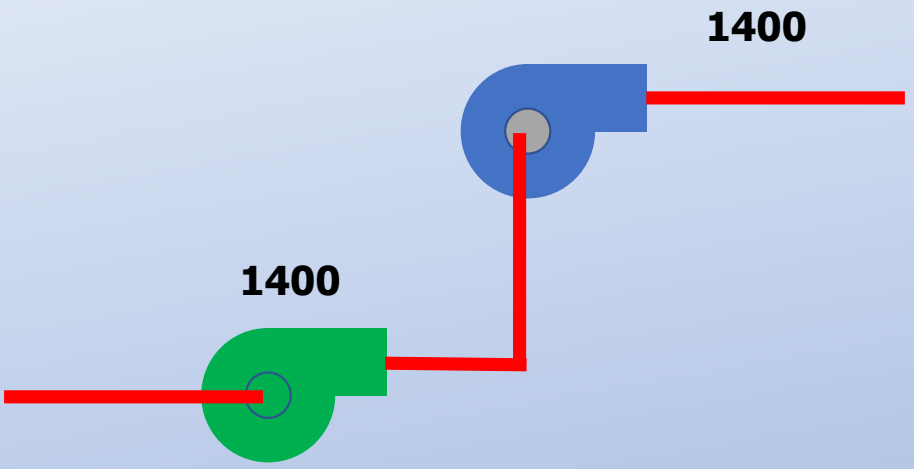


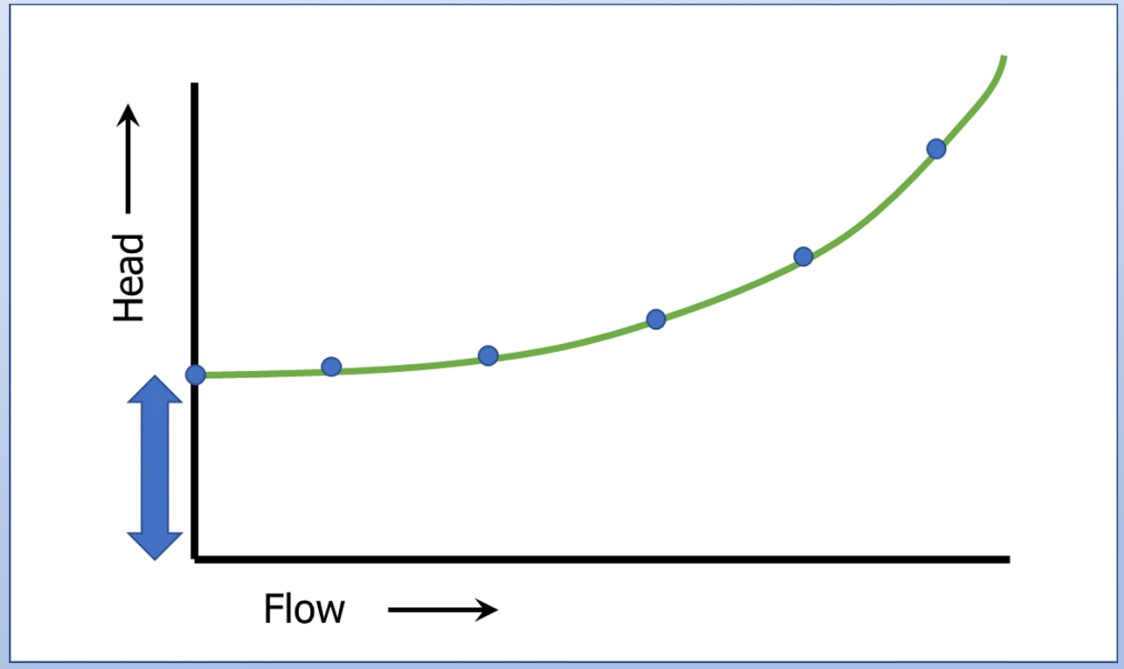
Pumps in Series



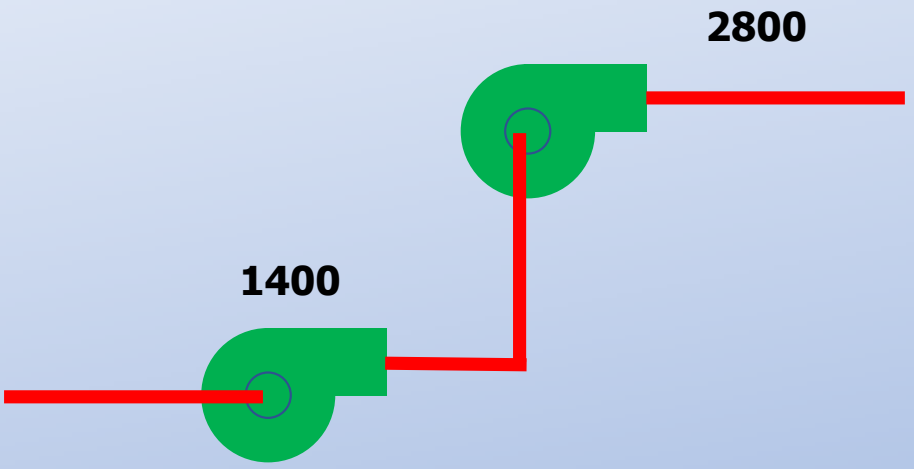


Pumps in Series





Pumps in Series



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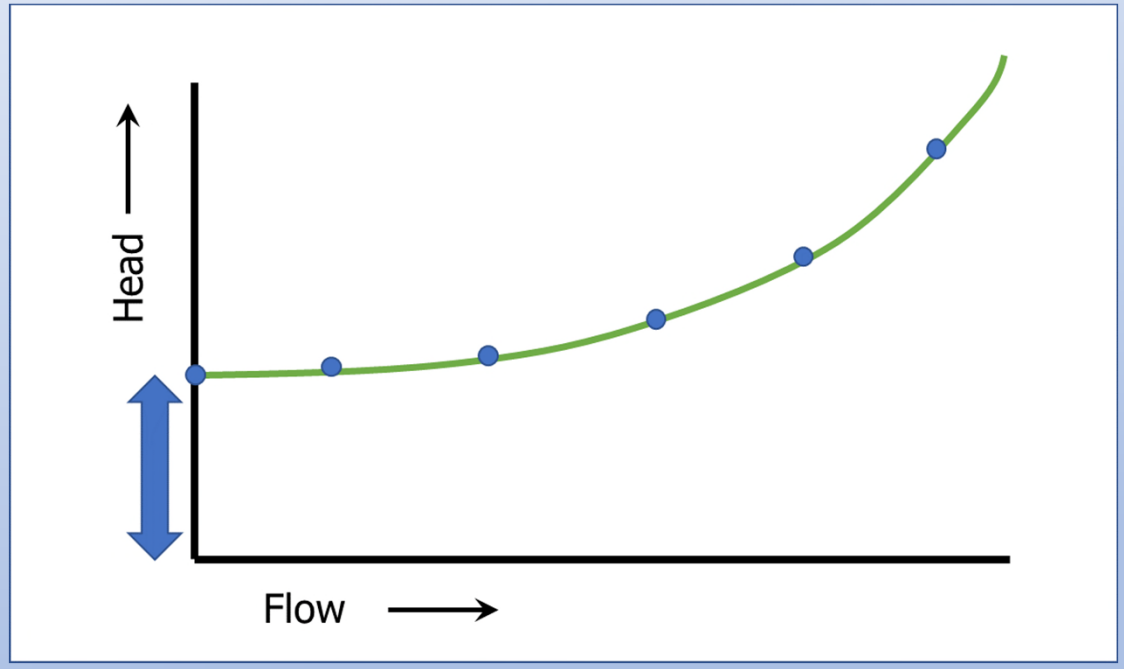
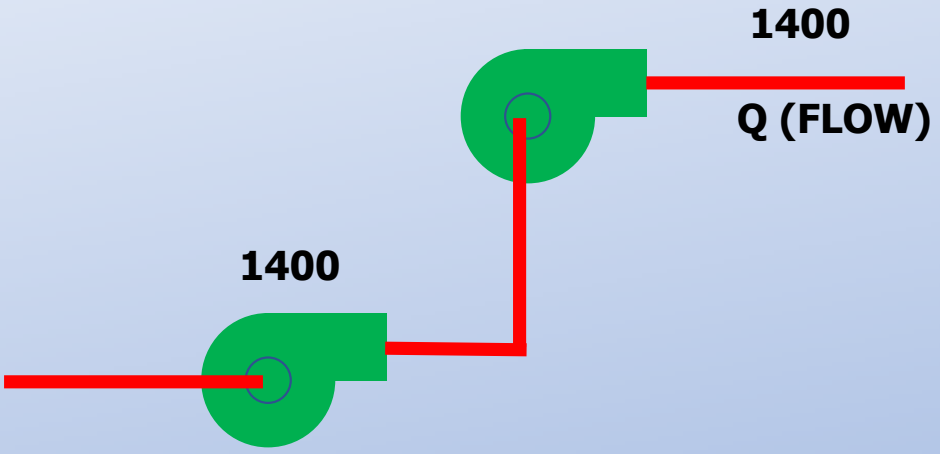
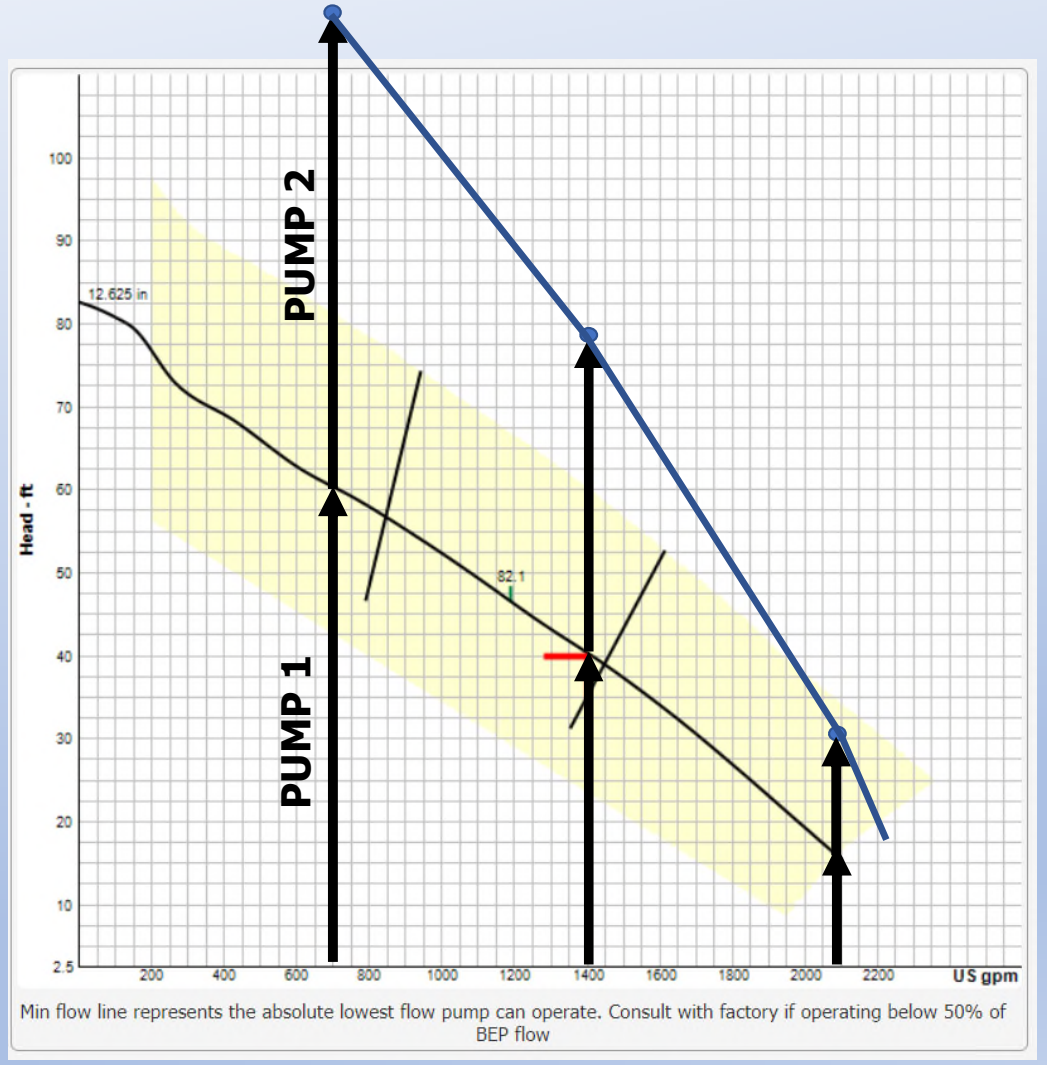


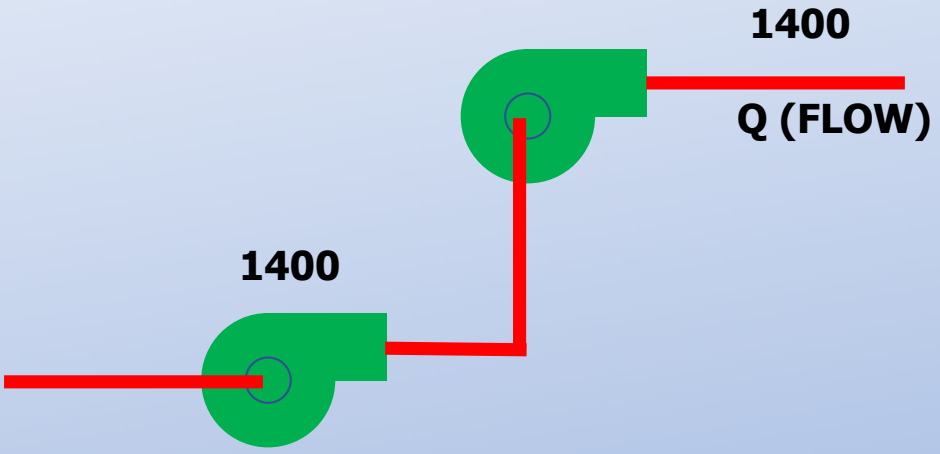
Pumps in Parallel



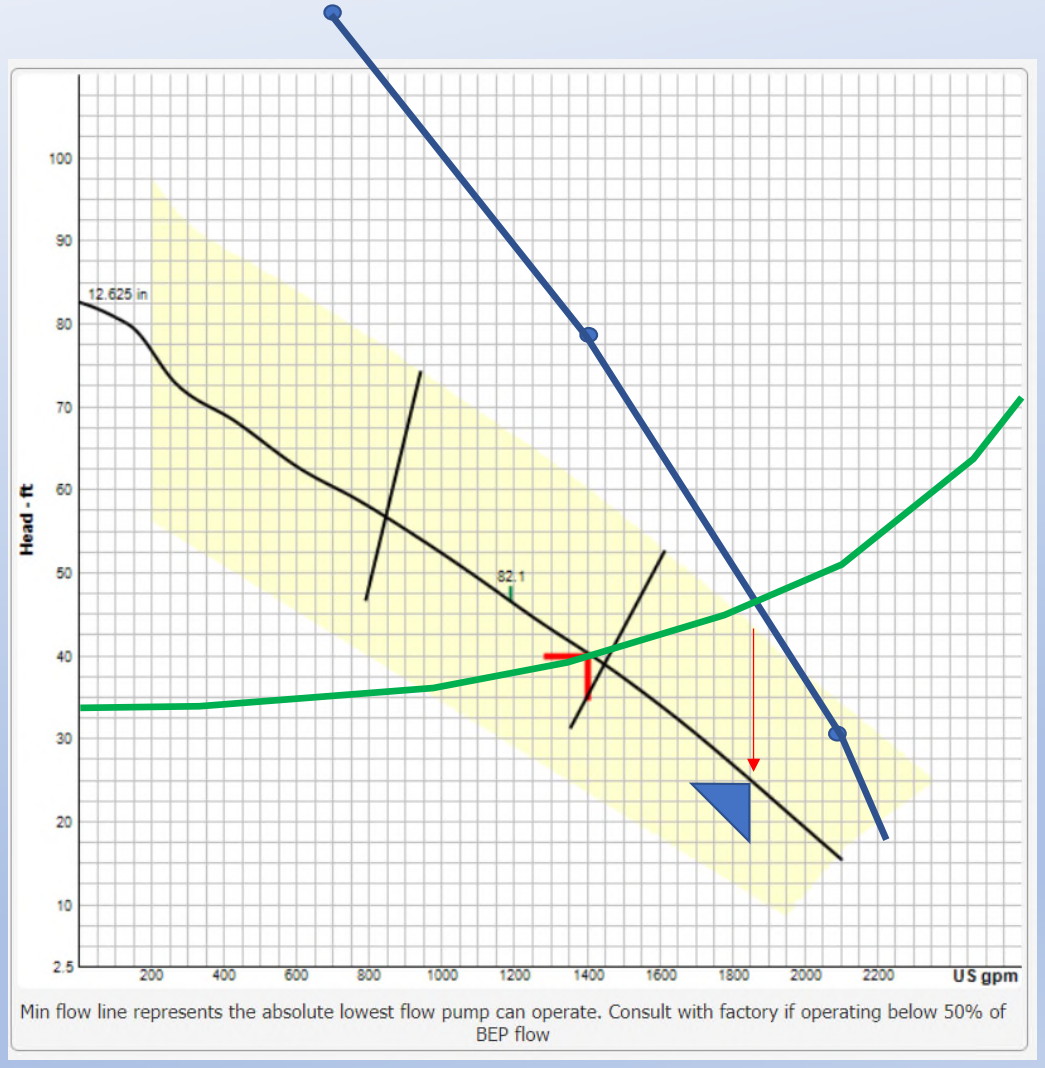
Create "Series Pump Curve" (2 Pumps)



Pumps in Series

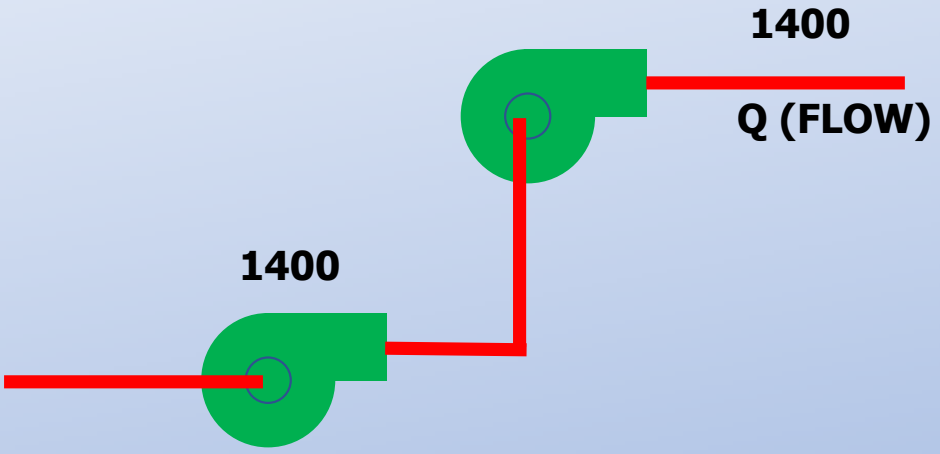


Not much reason with this system curve….

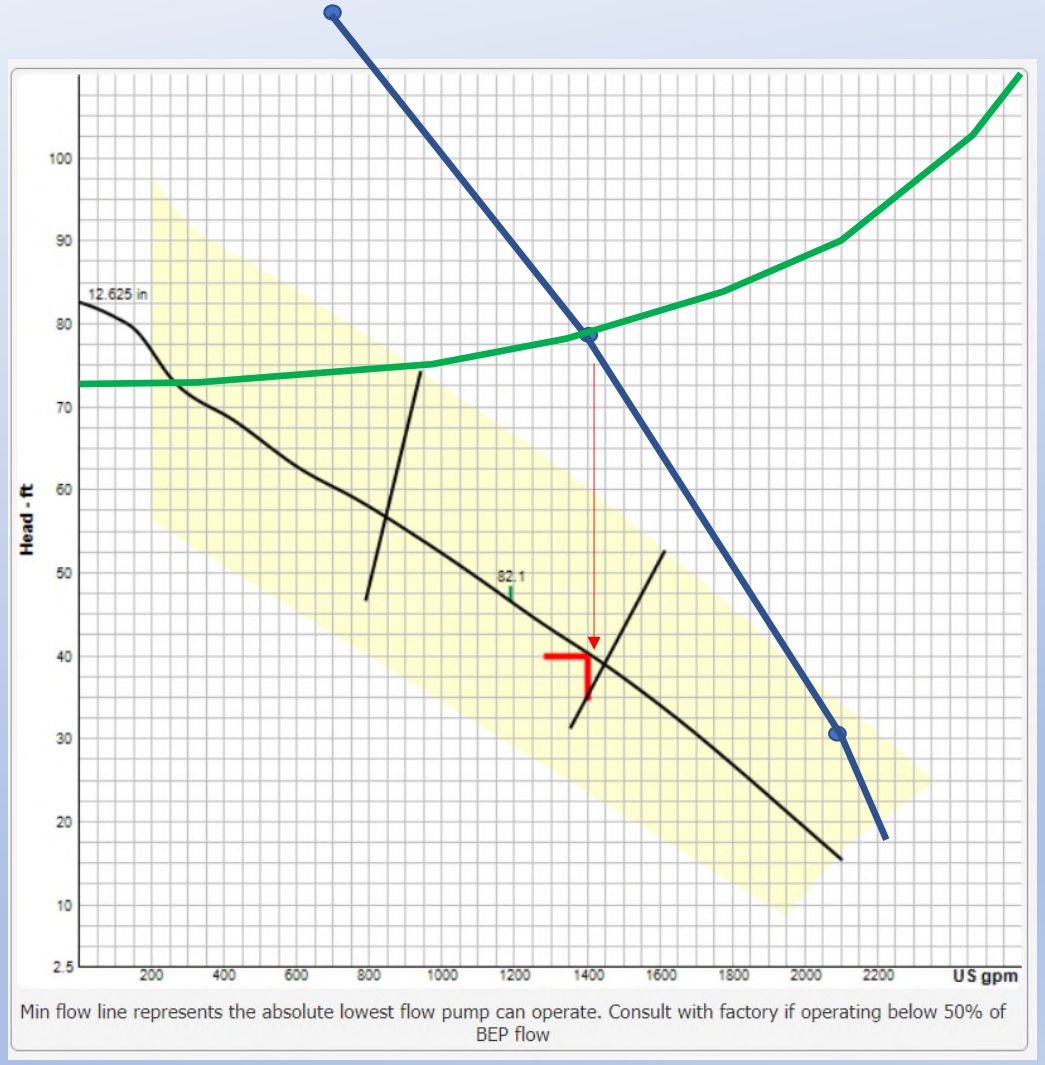


Q (FLOW)

Pumps in Series

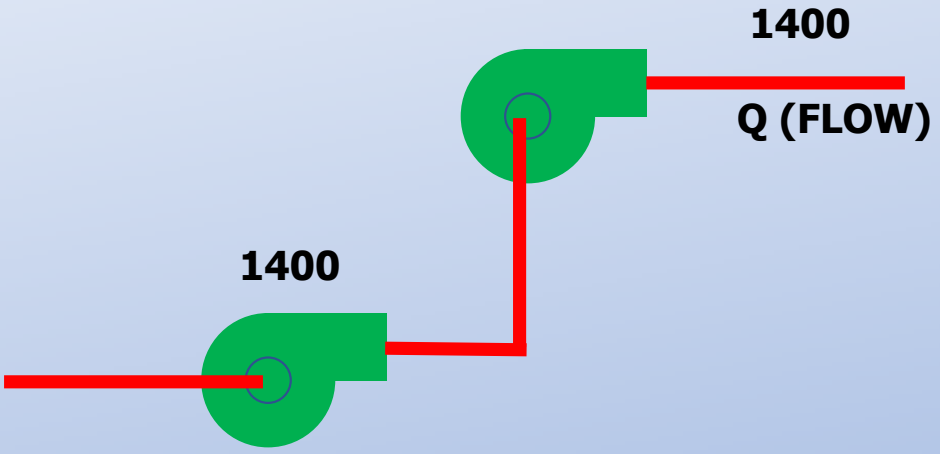


If I have to get over a hill….
(yeh, what's a hill????)

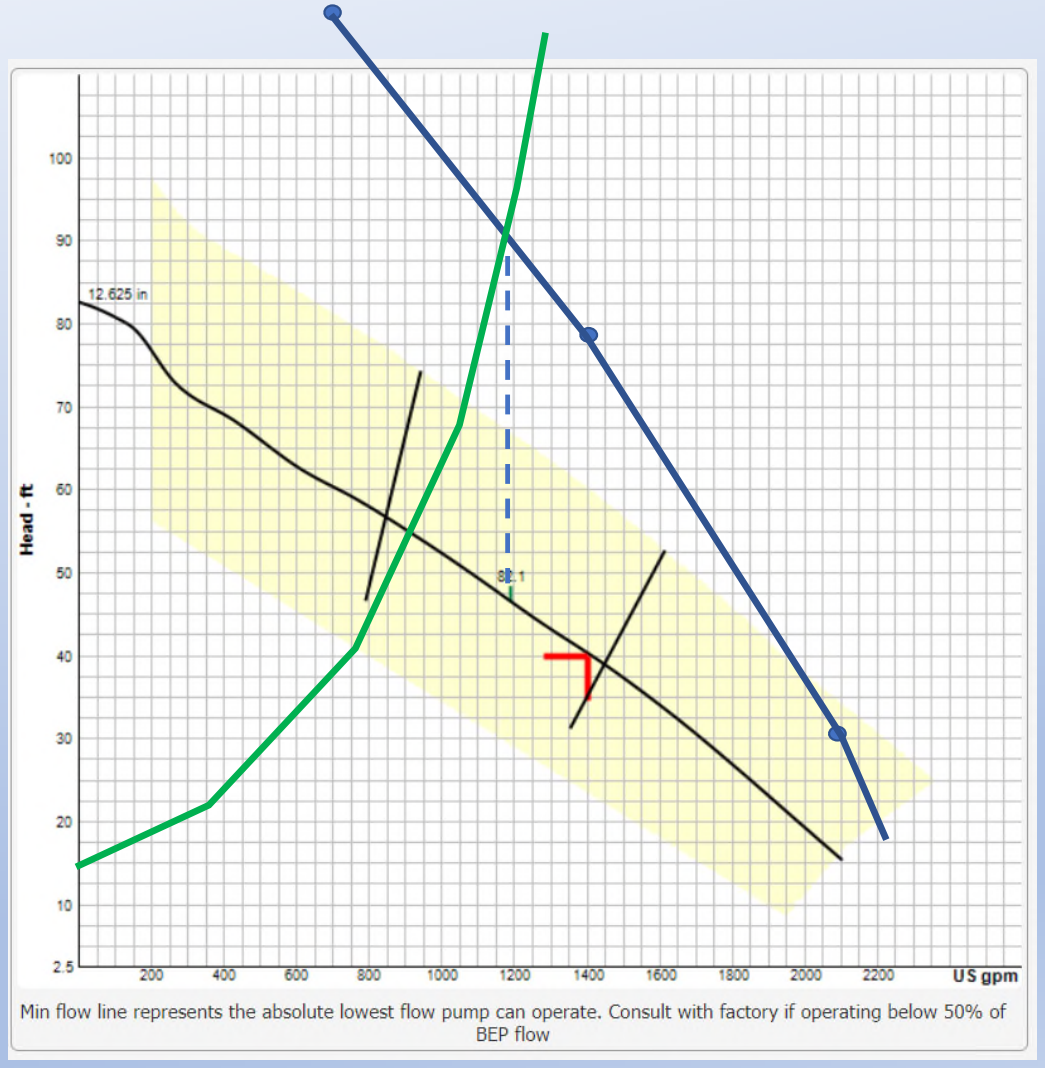


Q (FLOW)

Pumps in Series

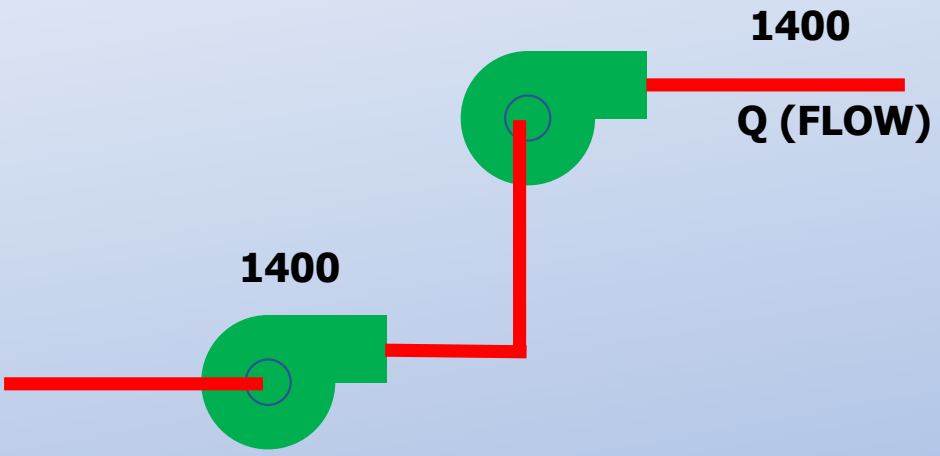


Or if I have high friction loss…

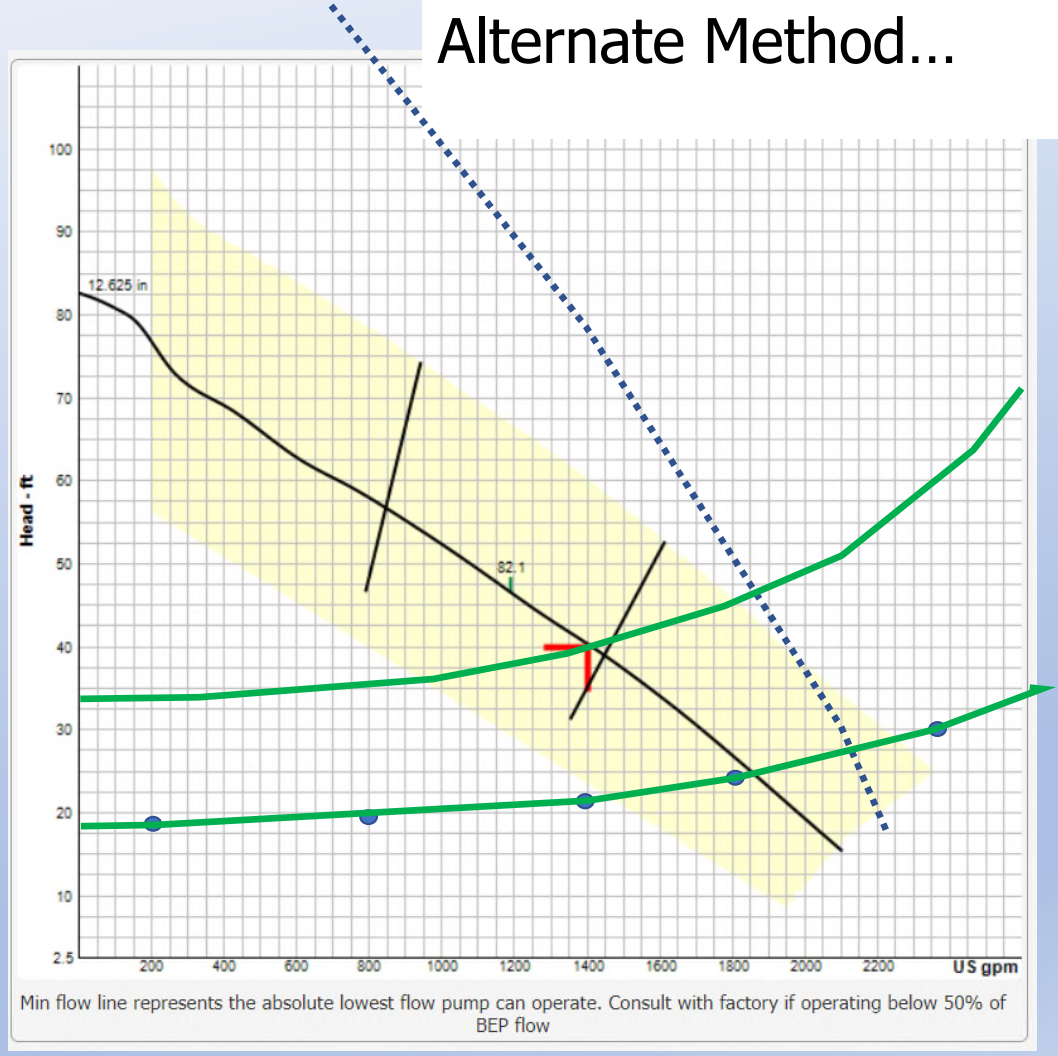


Q (FLOW)

Pumps in Series

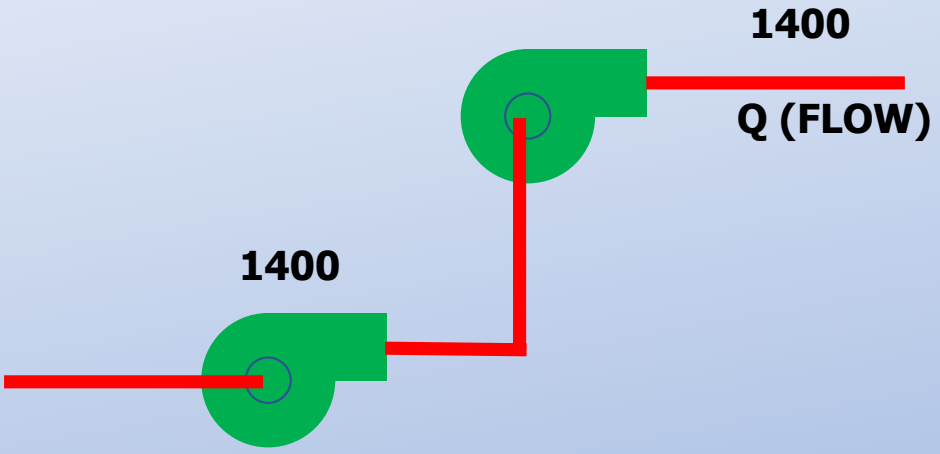


Alternate Method…

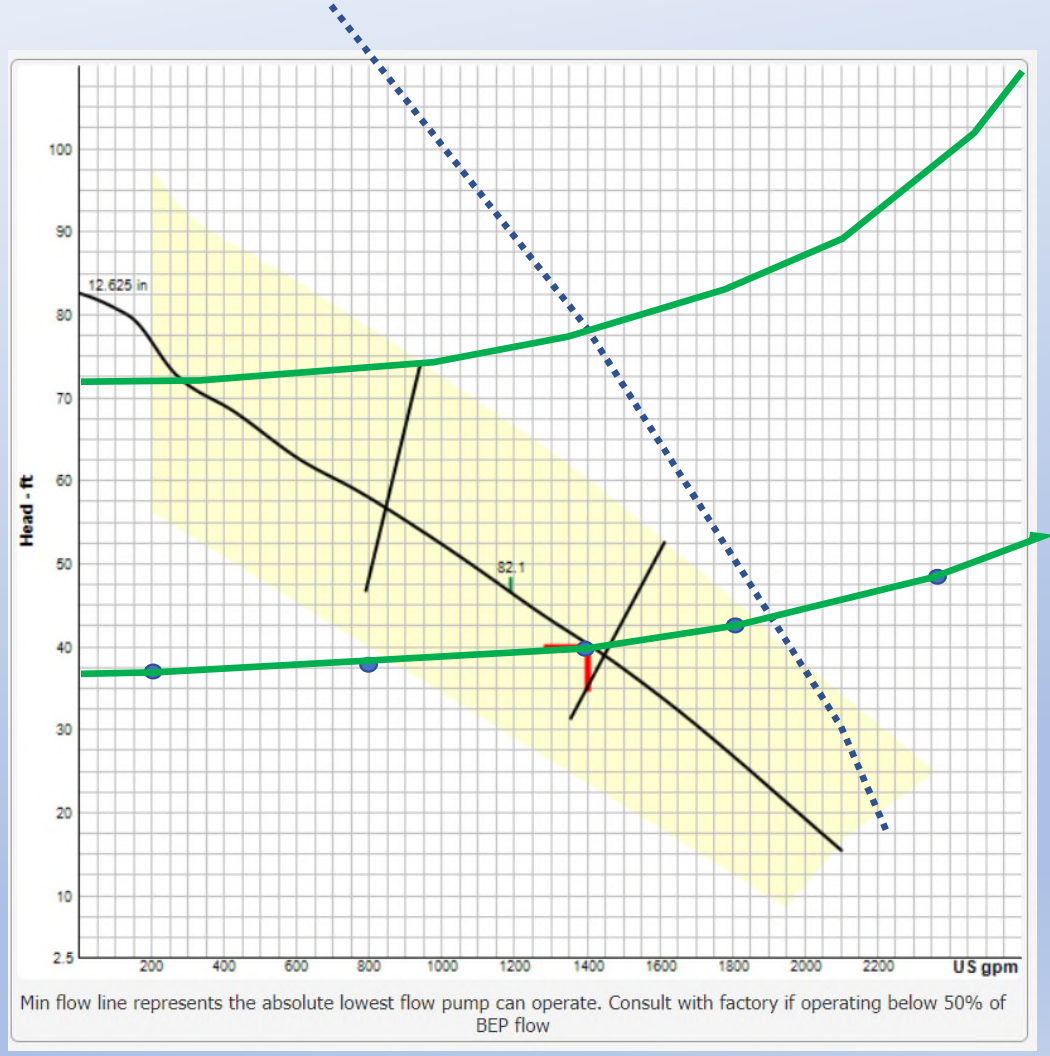


Q (FLOW)

Pumps in Series

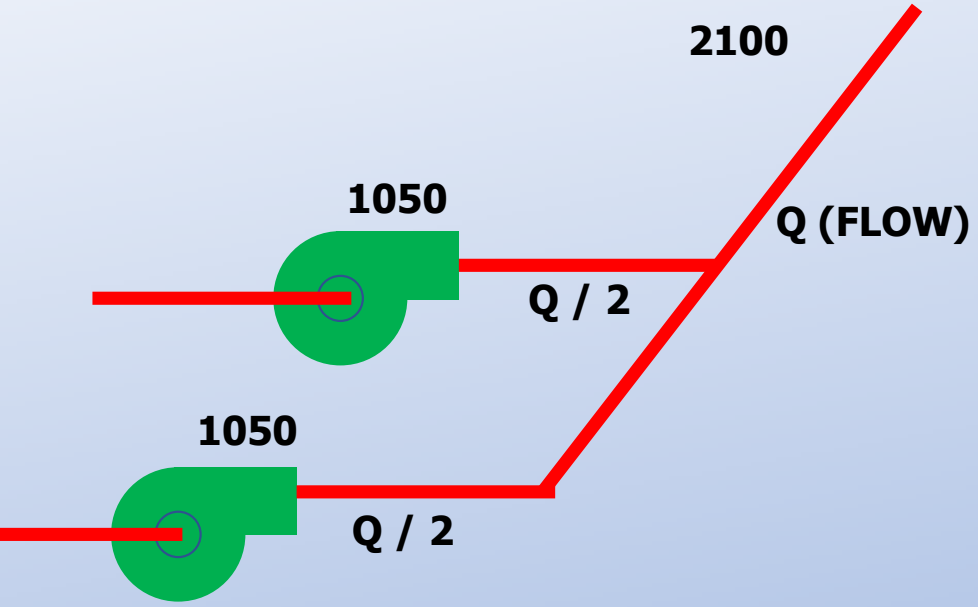


Alternate Method…
Hill example



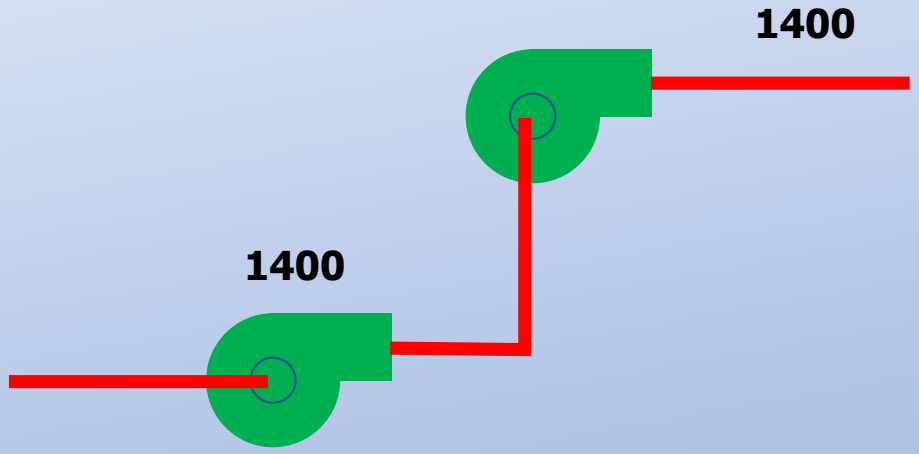
Q (FLOW)

Pumps in Parallel



Pump sees HALF the flow at same head.

Pumps in Series



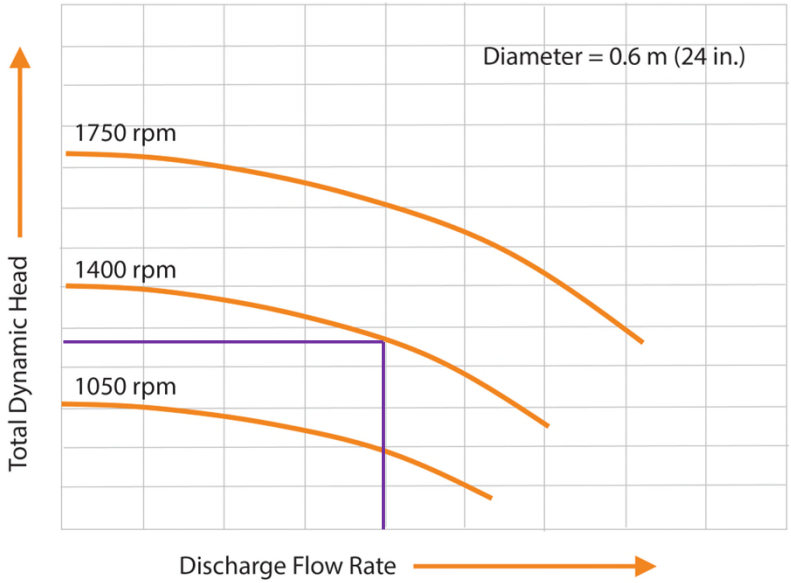
Pump sees HALF the head at same flow.

Stretch Break…

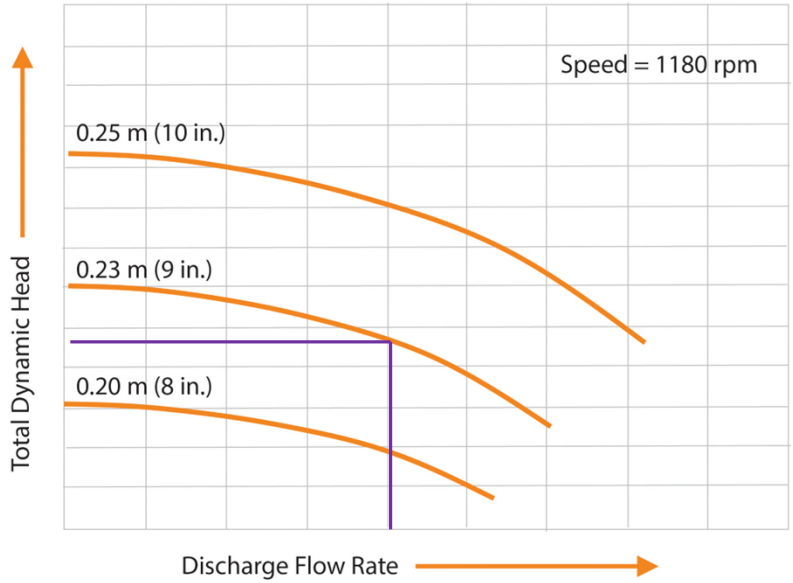
Real Quick (<2 min)

Variable Speed Operation

Variable Speed

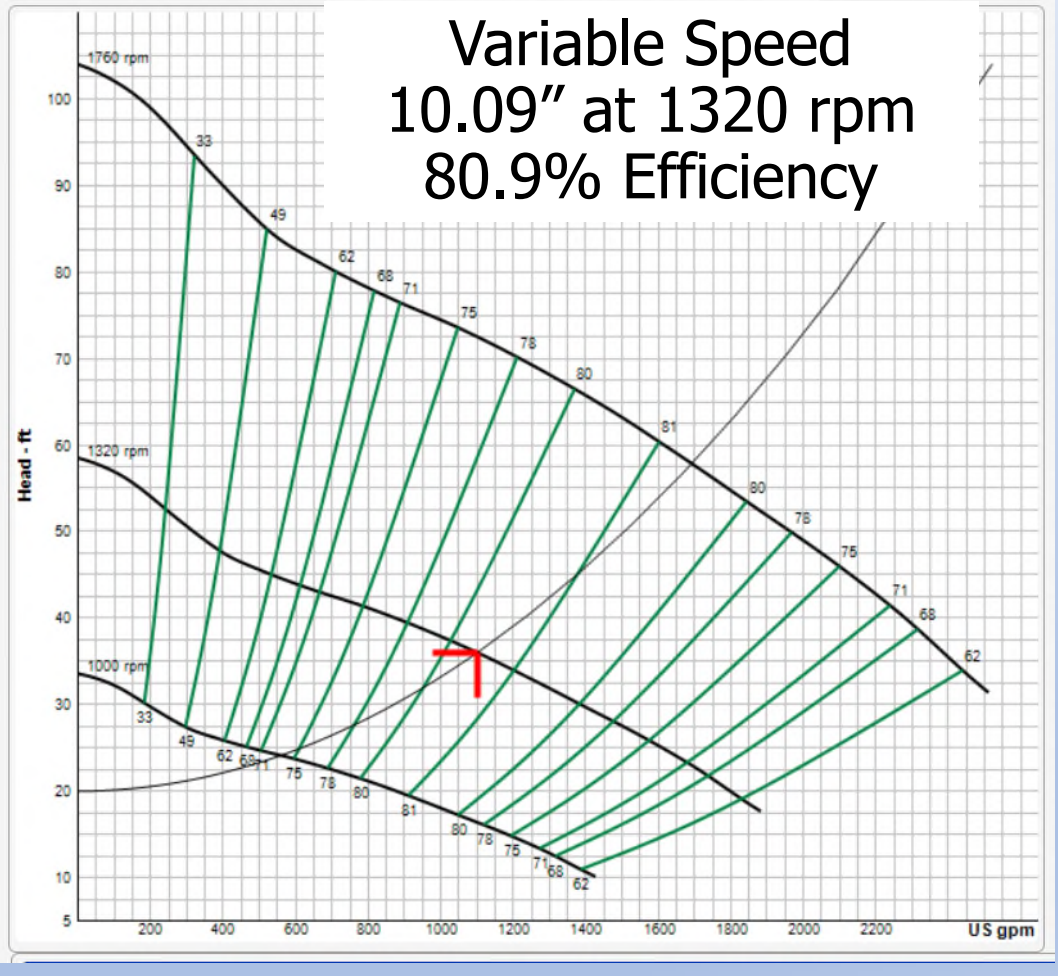


Trimmed Impeller

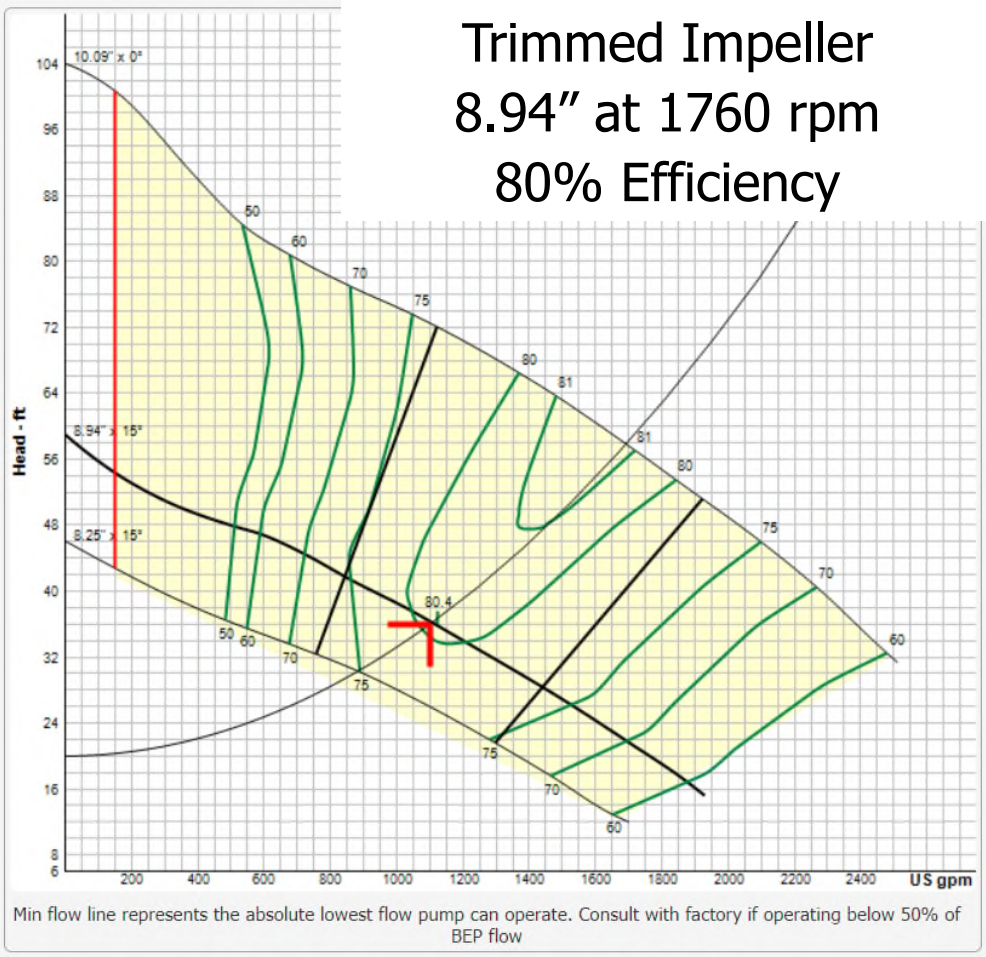


Variable Speed Operation

Variable Speed
10.09” at 1320 rpm
80.9% Efficiency

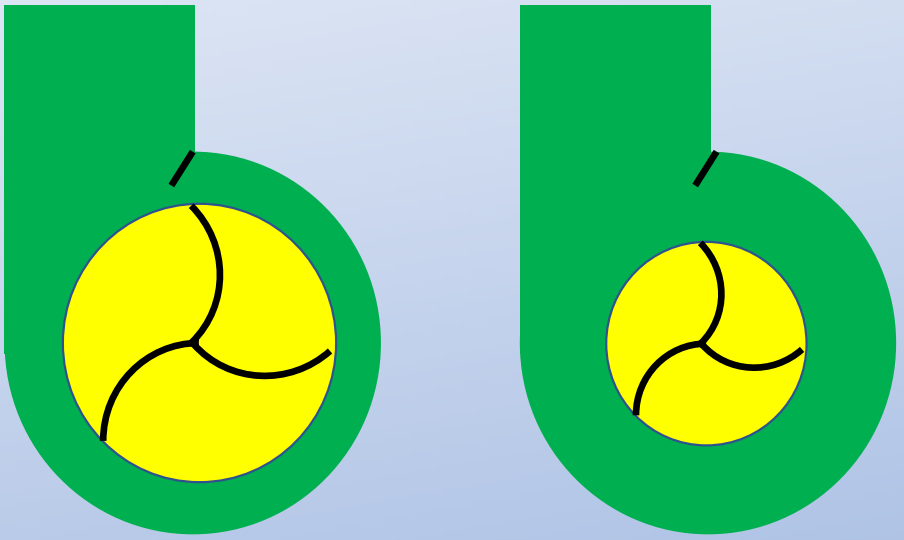


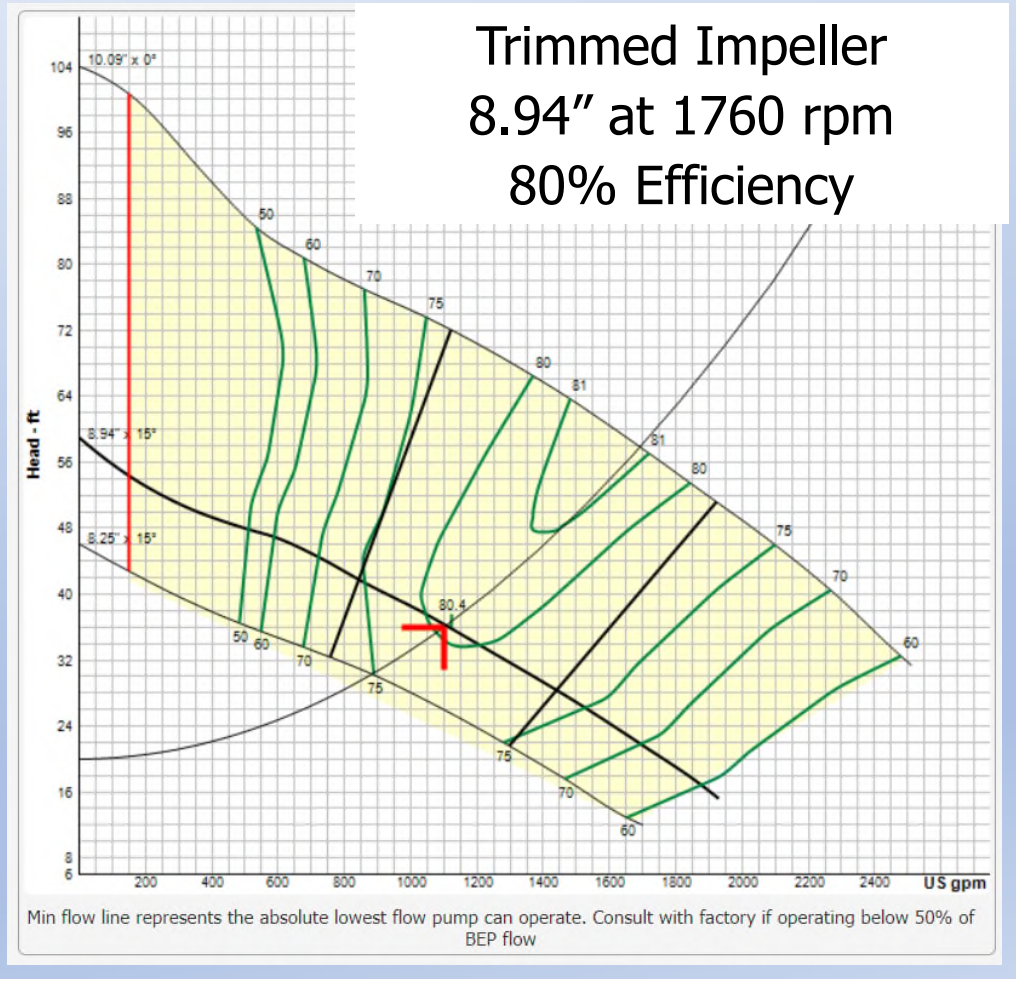
Trimmed Impeller
8.94” at 1760 rpm
80% Efficiency



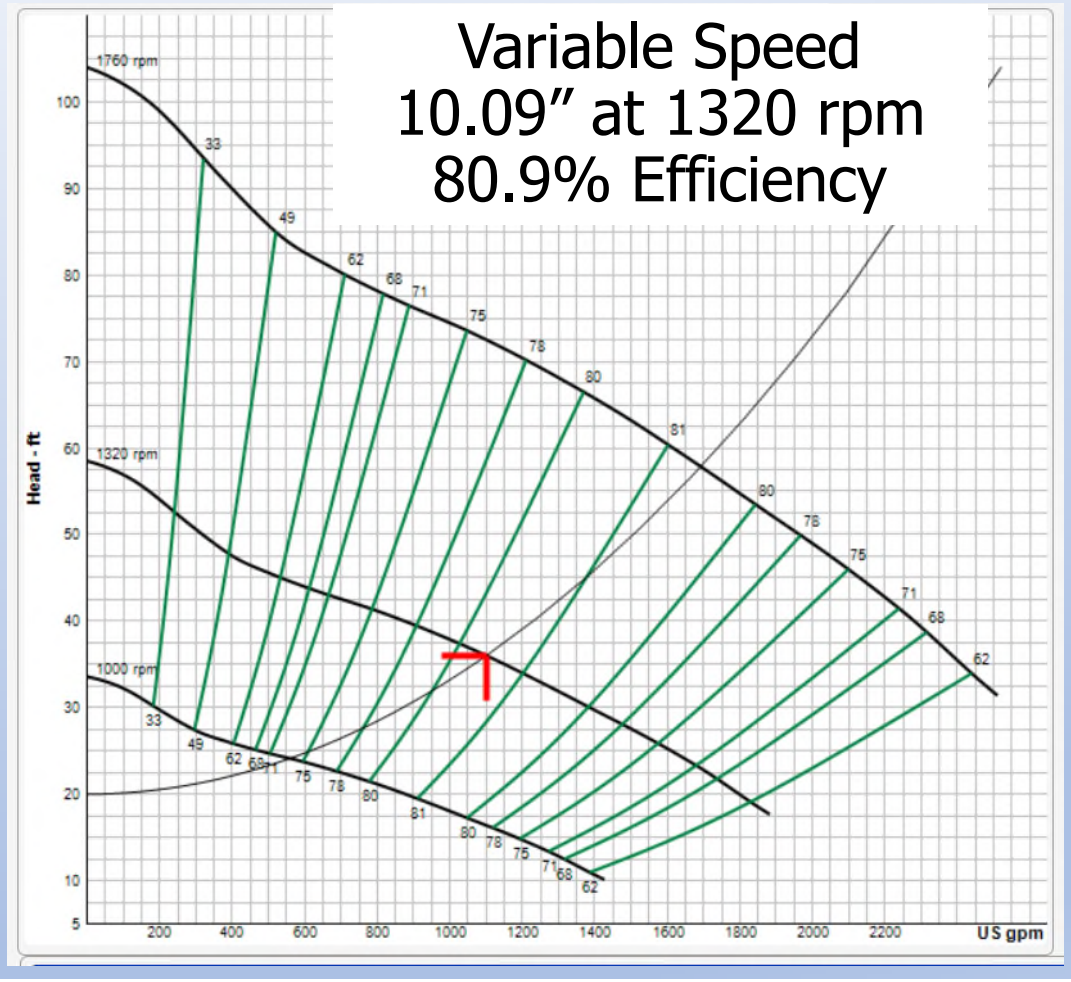
Min flow line represents the absolute lowest flow pump can operate. Consult with factory if operating below 50% of BEP flow

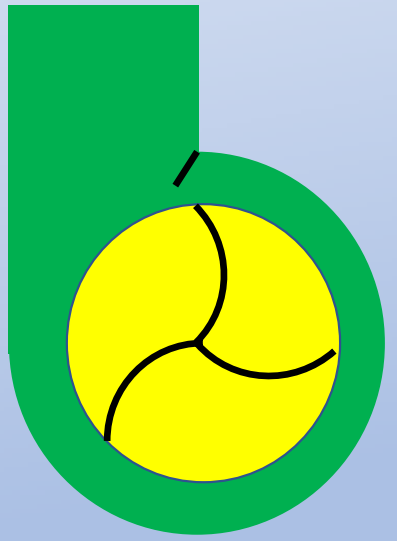
Efficiency Decreases with Trimmed Impeller





Efficiency Holds with Speed Reduction





BUT, Max power on curve dictates motor size…

Variable Speed Operation

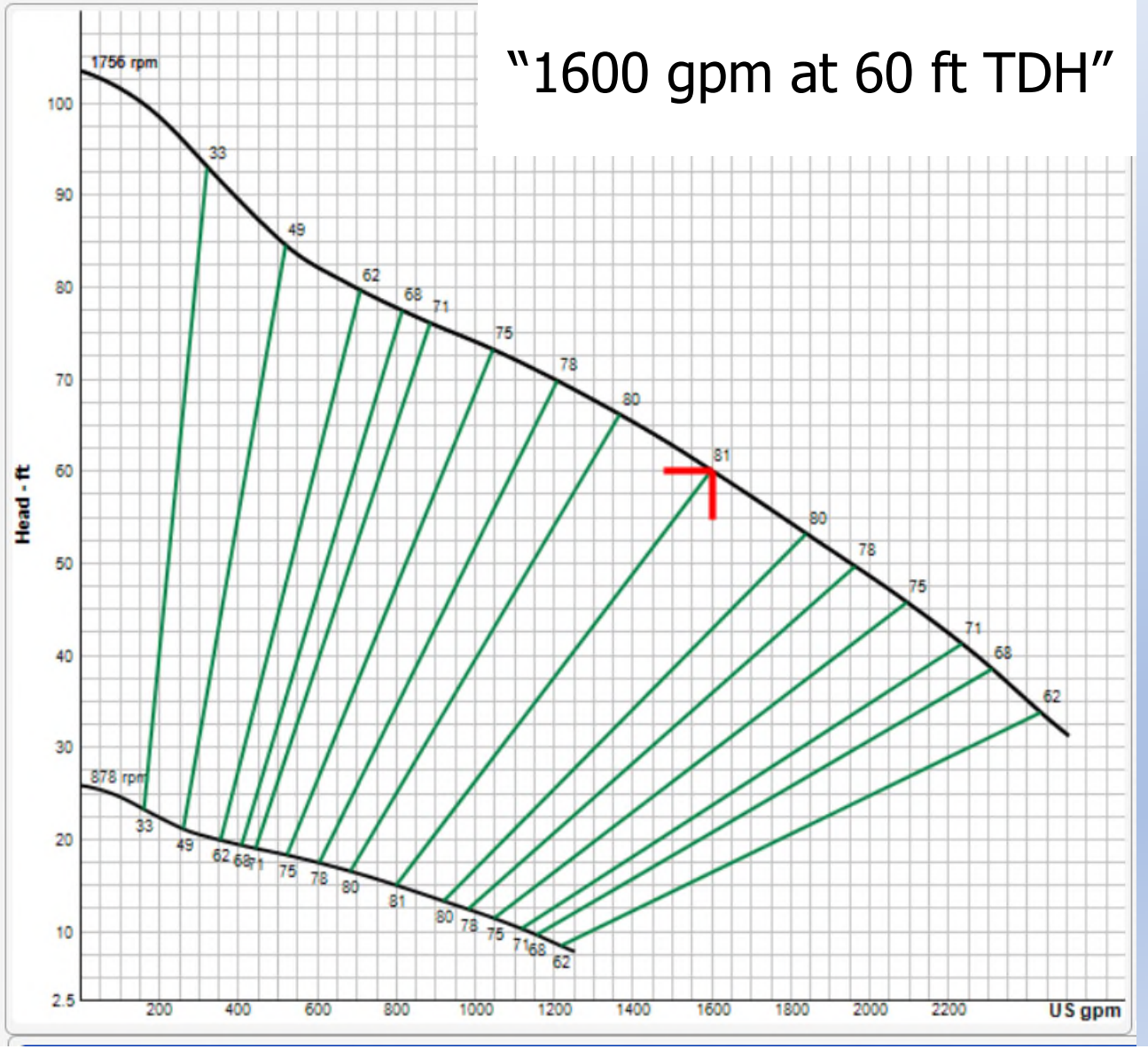
What's the limit?

Consider "1600 gpm at 60 ft TDH"

Full Speed (60 Hz) = 1765 rpm

Red. Speed (30 Hz) = 878 rpm

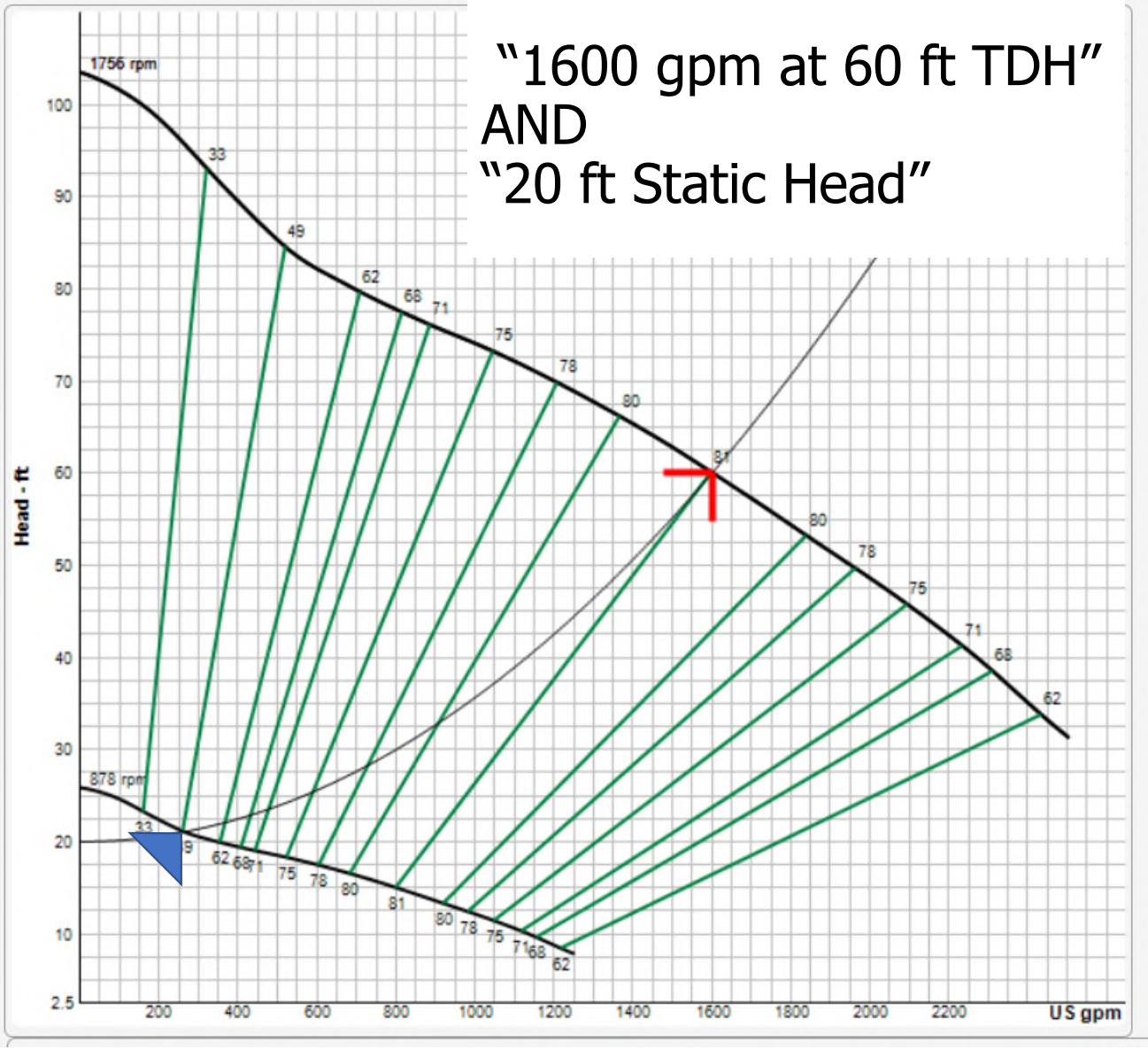
Acceptable to Operate at 30 Hz?????



Full Speed (60 Hz) = 1765 rpm

Red. Speed (30 Hz) = 878 rpm

Acceptable to Operate at 30 Hz?????

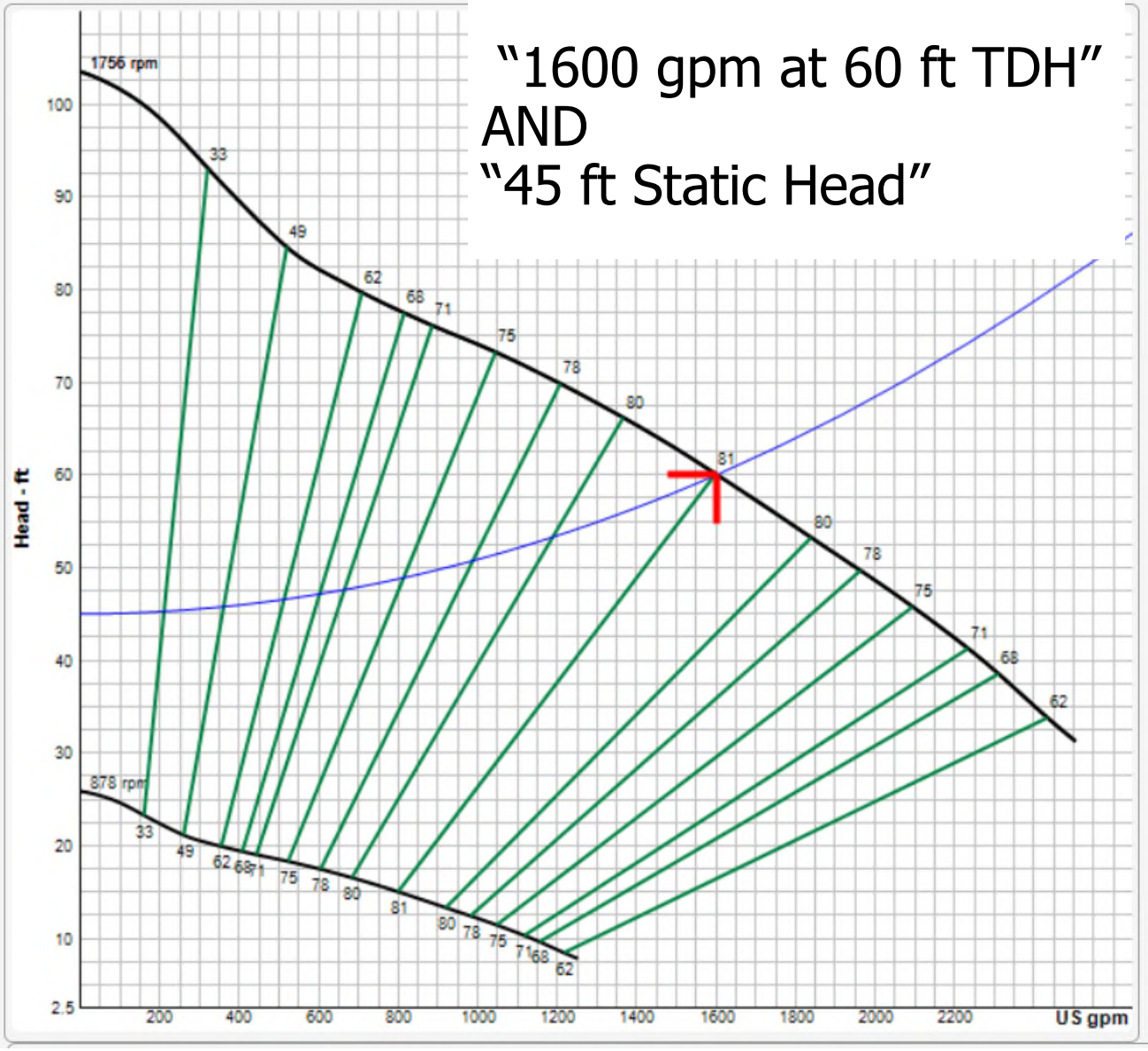


"1600 gpm at 60 ft TDH"
AND
"20 ft Static Head"

Full Speed (60 Hz) = 1765 rpm

Red. Speed (30 Hz) = 878 rpm

Acceptable to Operate at 30 Hz?????

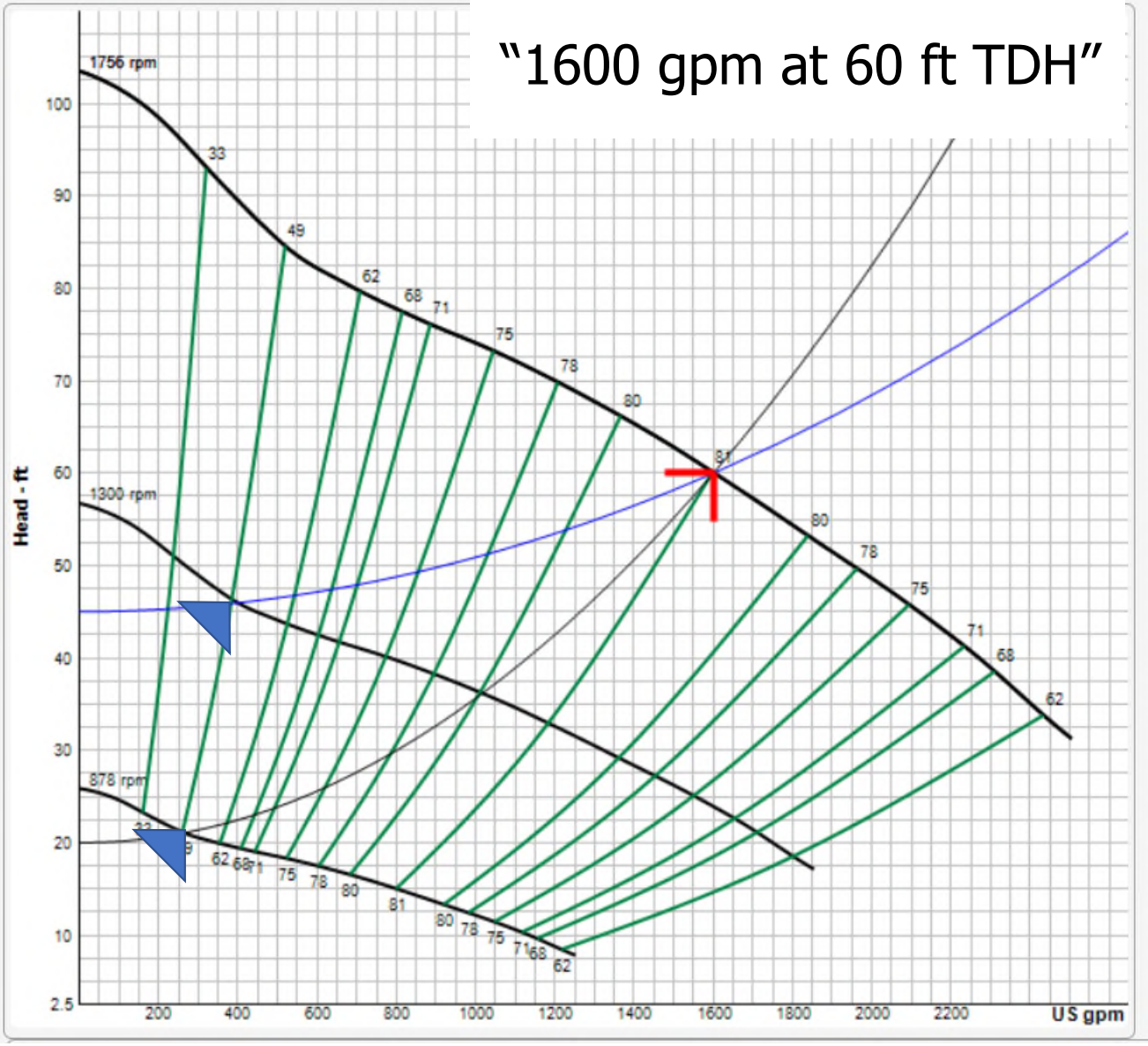


Full Speed (60 Hz) = 1765 rpm

Red. Speed (44 Hz) = 1300 rpm

Red. Speed (30 Hz) = 878 rpm

Acceptable to Operate at 30 Hz…. DEPENDS!!!!

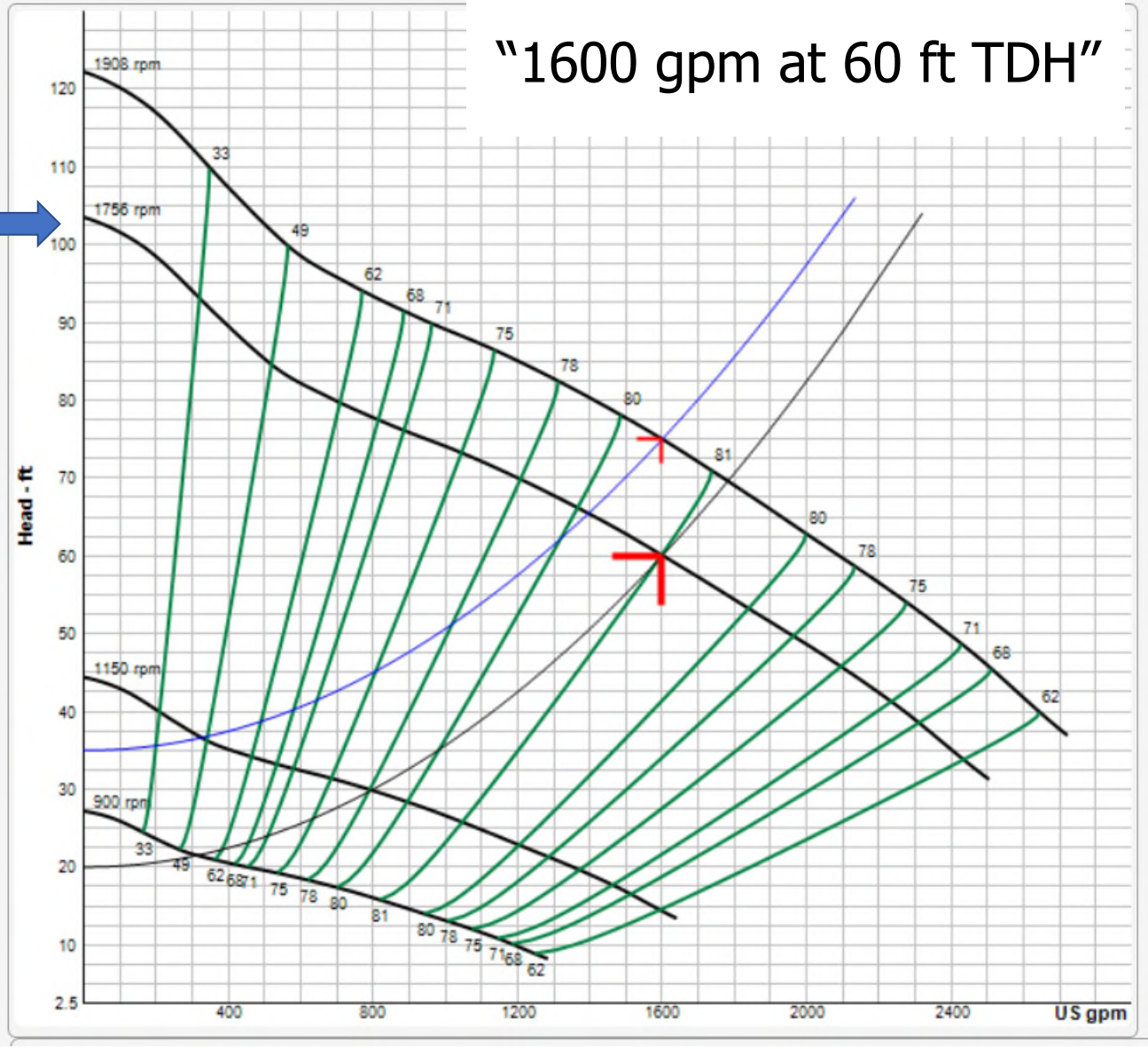


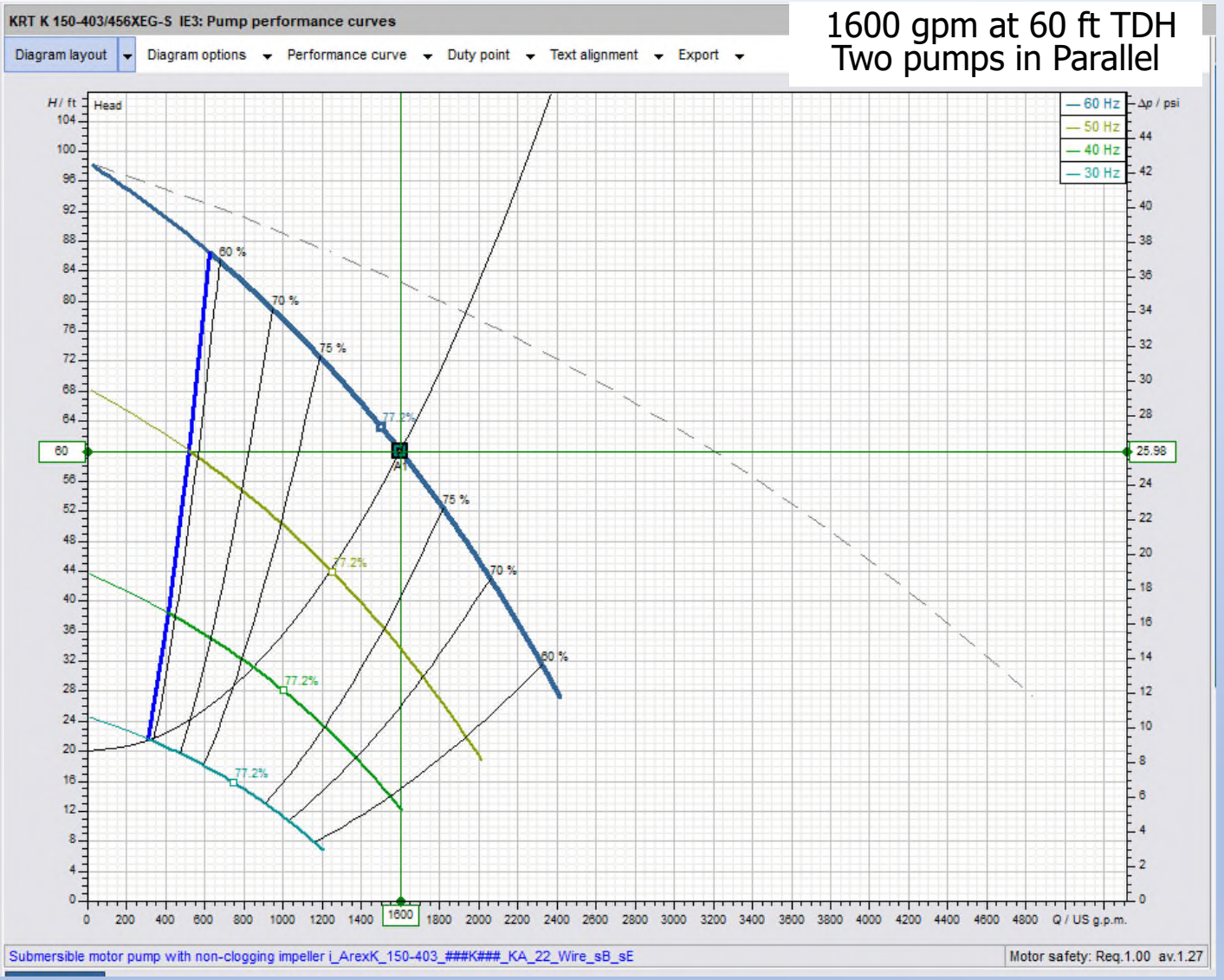
Full Speed (60 Hz) = 1765 rpm

If VFD set for 380 gpm at 900 rpm, but then wet well pumps down…

1150 rpm

900 rpm

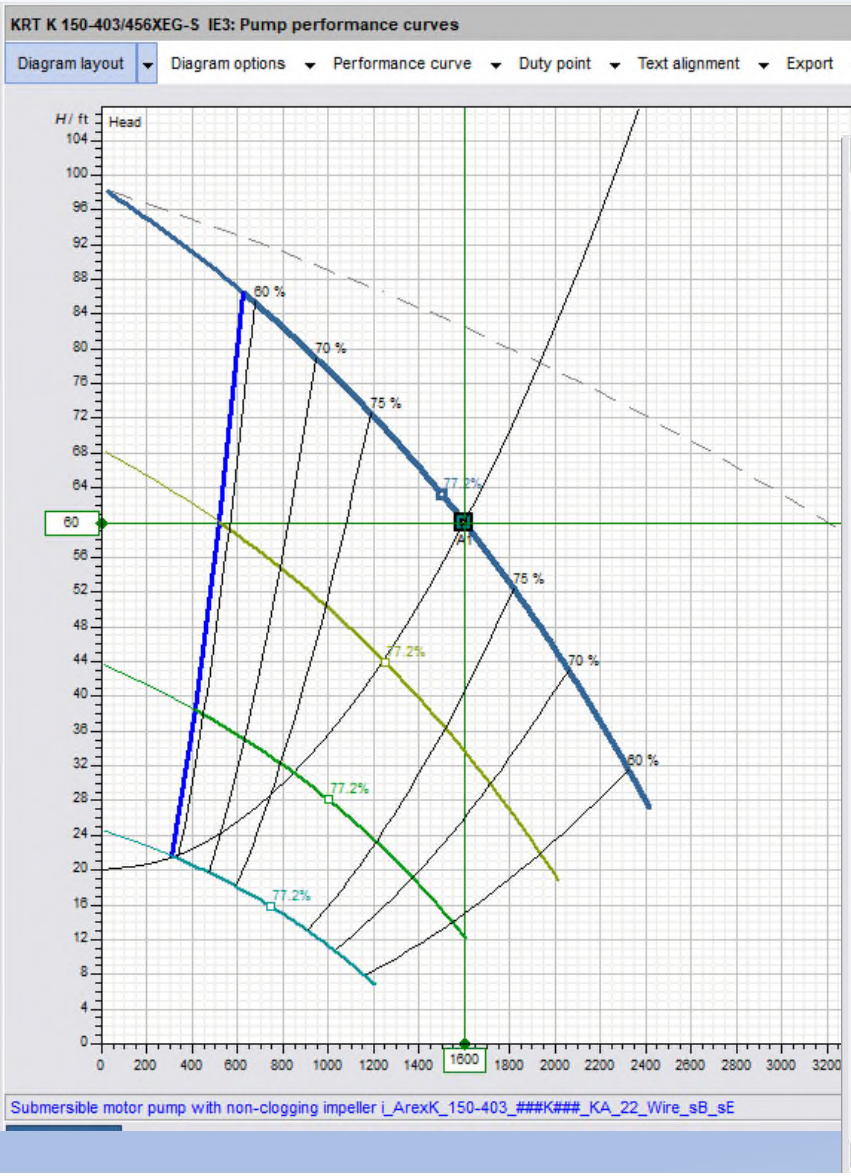


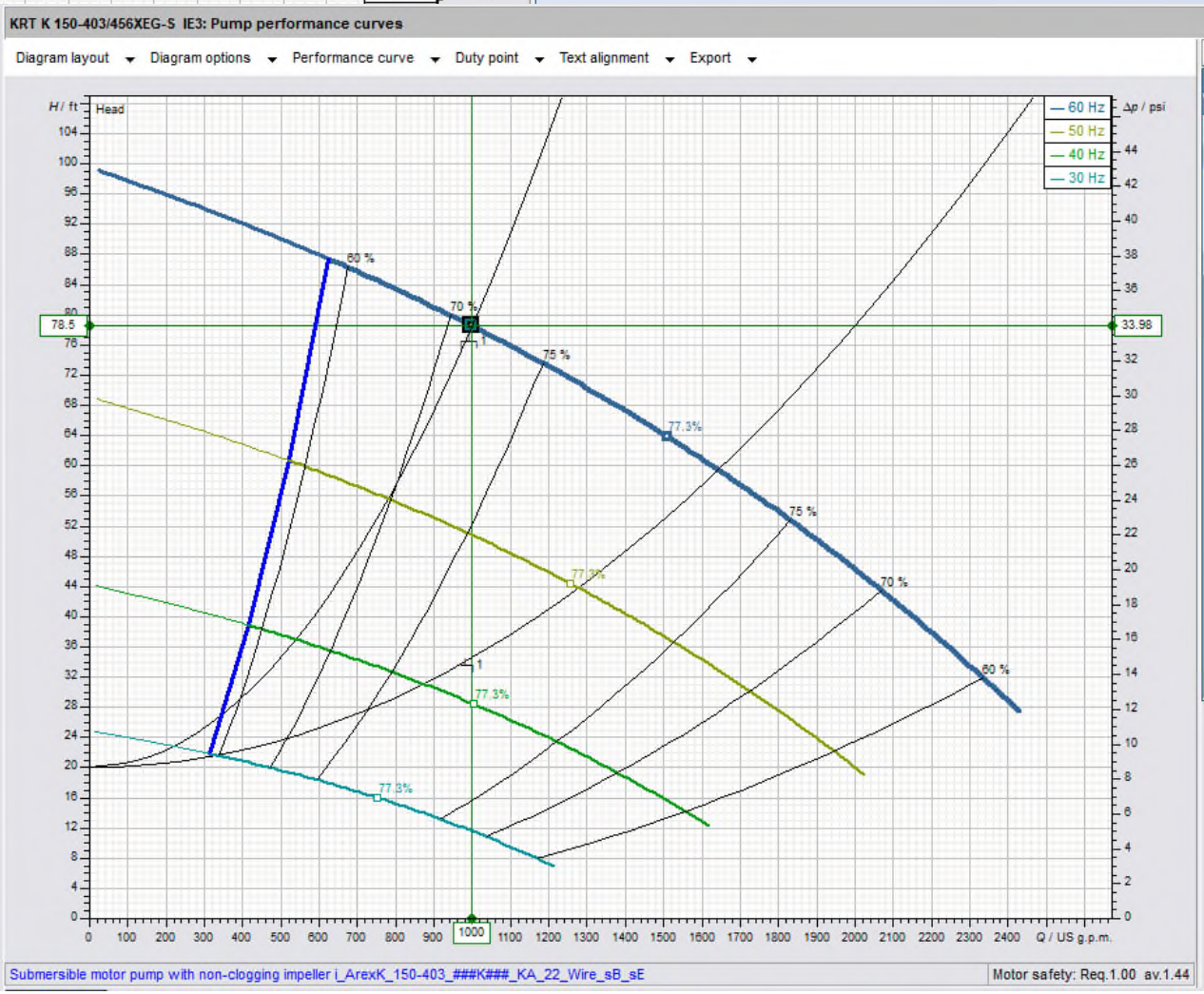


Variable Speed Operation

Pumps in Parallel

1600 gpm at 60 ft TDH
Two pumps in Parallel





Variable Speed Operation

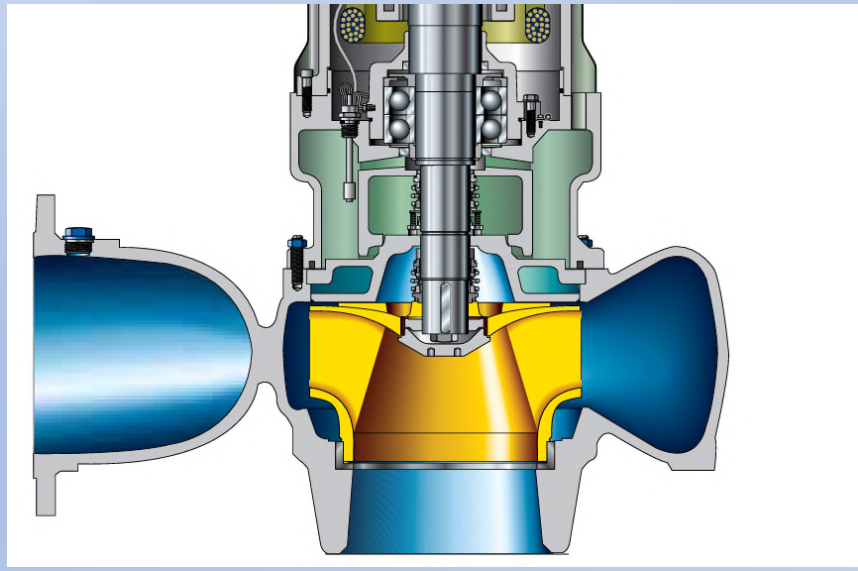
What else should I consider?

- Solids handling
- Startup Torque/Amps
- Variable System Curves
- Control System Settings/Programming

Variable Speed Operation

What else should I consider?

- Solids handling



Variable Speed Operation

What else should I consider?

- Startup Torque/Amps
  - Across the Line
  - Constant power (Variable Torque)
  - Constant torque

Variable Speed Operation

What else should I consider?

- Variable System Curves

Variable Speed Operation

What else should I consider?

- Control System Settings/Programming
  - PLC/HMI Settings, VFD Settings (range, %, Hz, low, high)
  - Doublechecking
  - Operator knowing what is where

Variable Speed Operation

Lessons learned the hard way…

- RAS Pumps – Bearing Fail

Variable Speed Operation

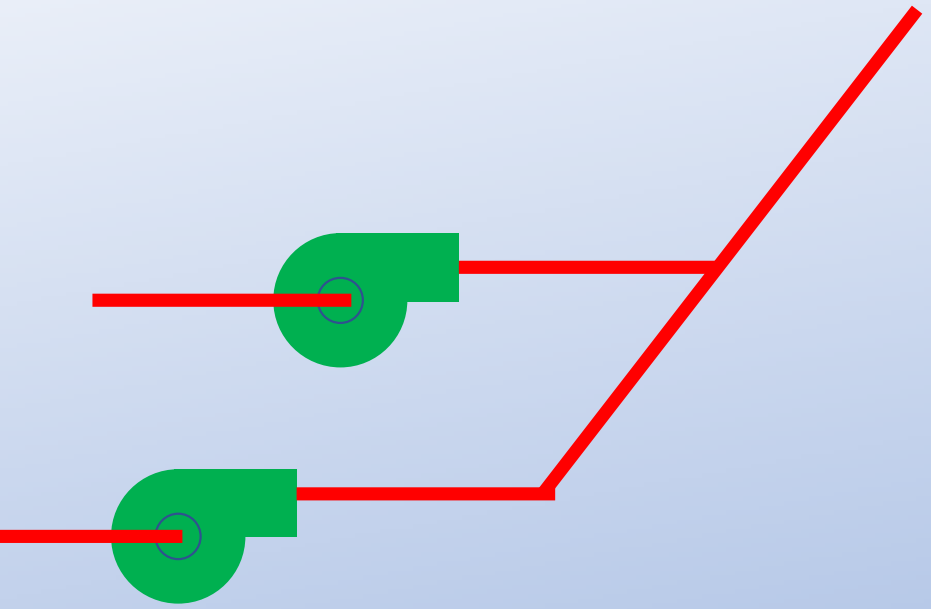
Lessons learned the hard way…

- Pump Cost vs. Control Cost

(vs. Plant Complexity)

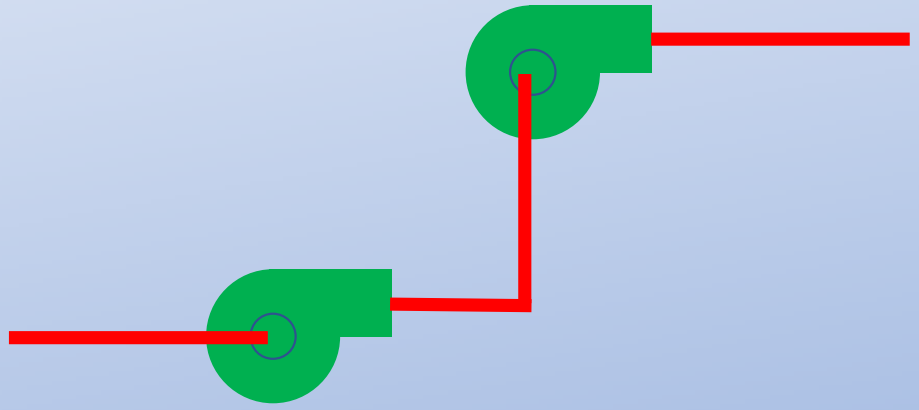
Review/Quiz

Pumps in Parallel



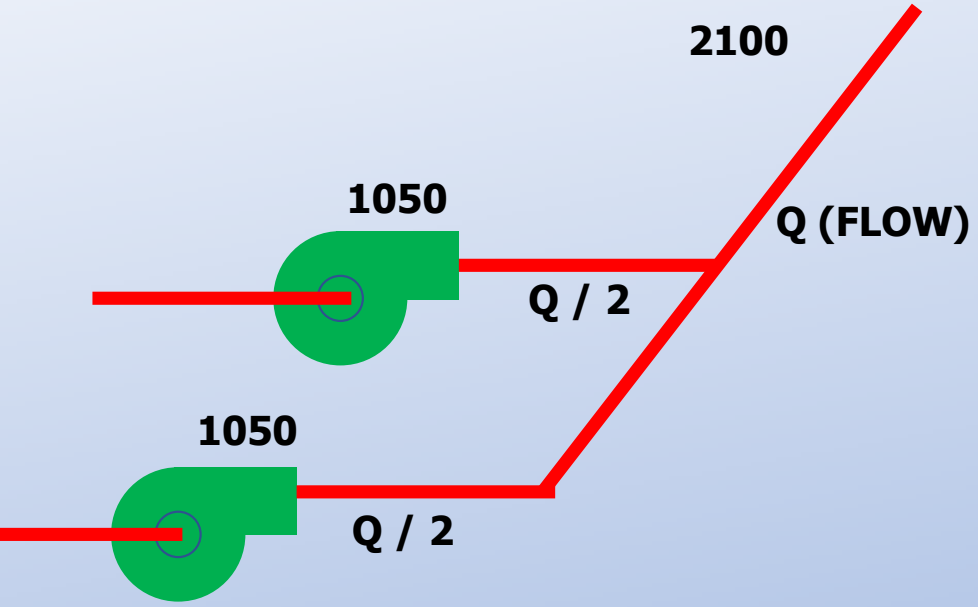
Pump sees HALF the _____ at same ____.

Pumps in Series



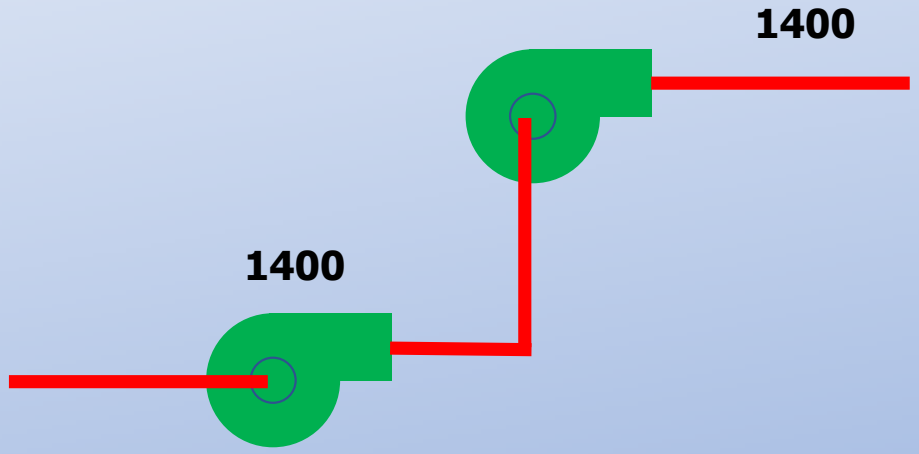
Pump sees HALF the ____ at same ____.

Pumps in Parallel



Pump sees HALF the flow at same head.

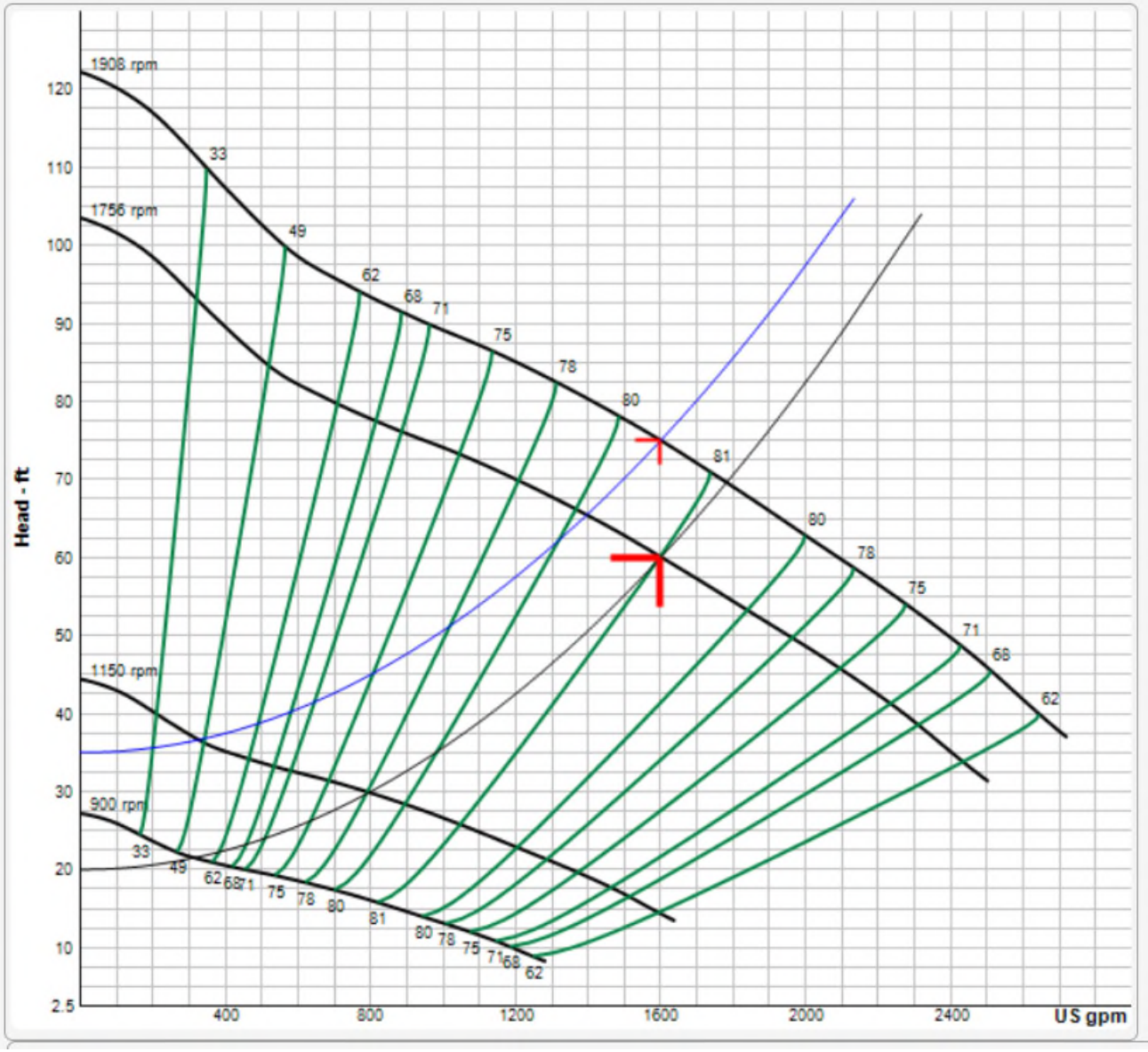
Pumps in Series



Pump sees HALF the head at same flow.

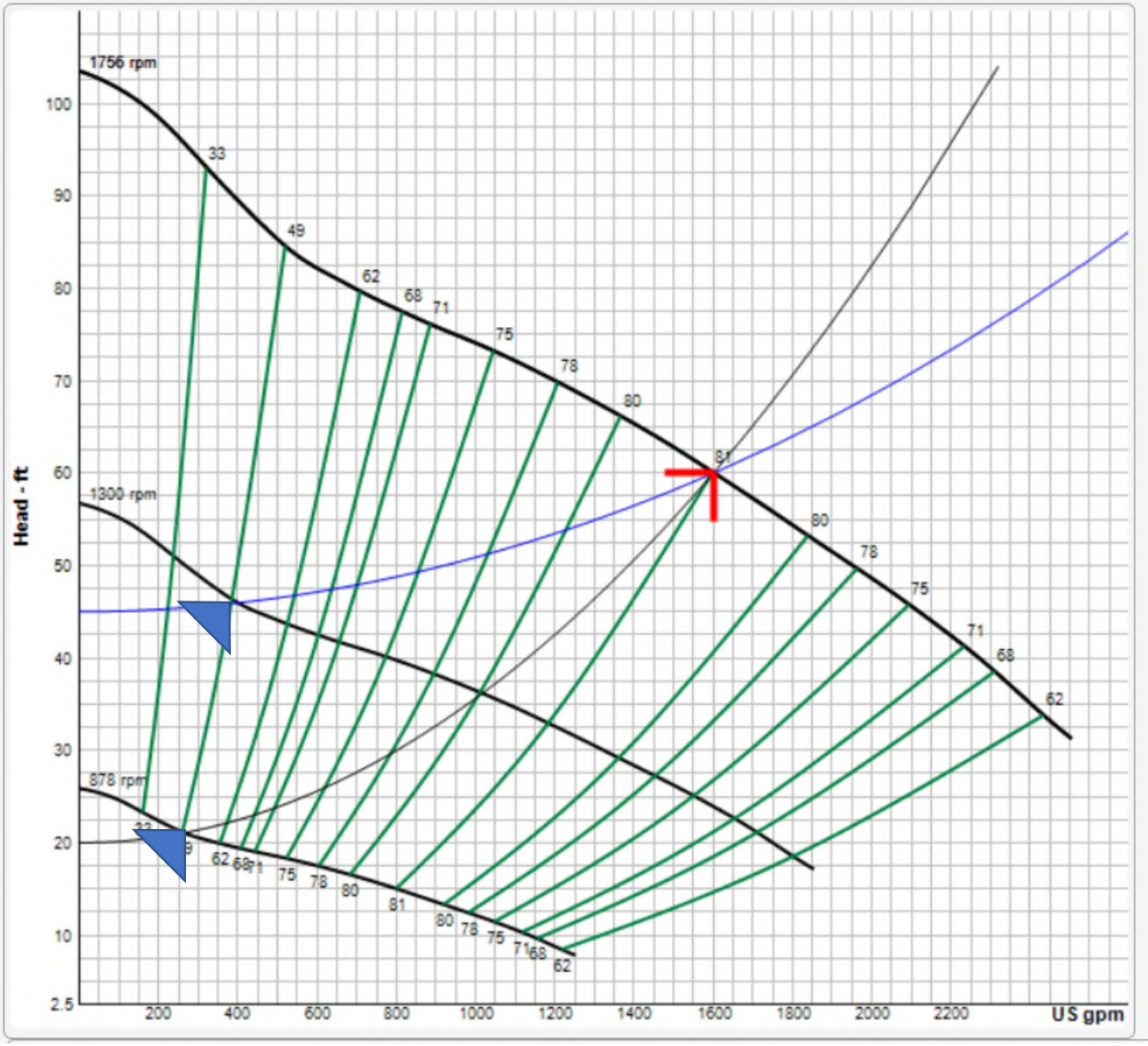
When setting up a VFD, the settings must take in the changes in the wet well because as the wet well level decreases the system curve moves

a. Upwards
b. Downwards
c. Sideways



In this graph, there are two system curves. The design point is the same, but the _____ _____ is different.

(Engineers often forget to specify / consider this in pump selection and system control.)



You made it!!!!

Thanks for stretching
your mind a little
with me….