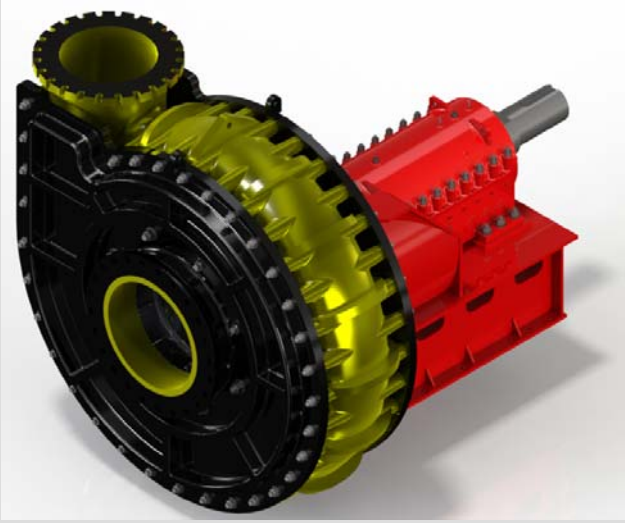
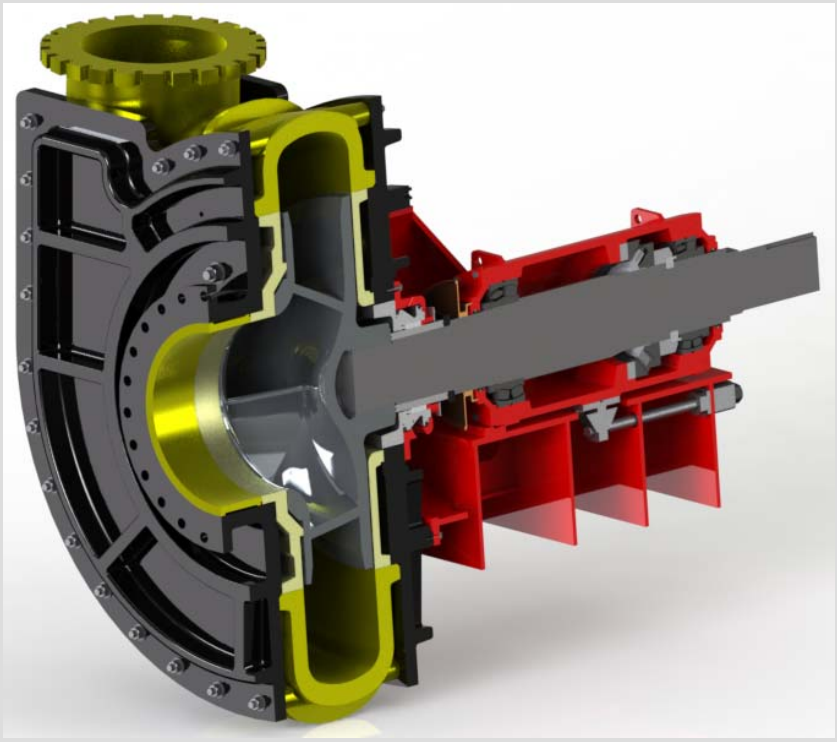
Dredge Pump Design Evolution at SPI Mobile Pulley Works

Philip Nettles, Engineer

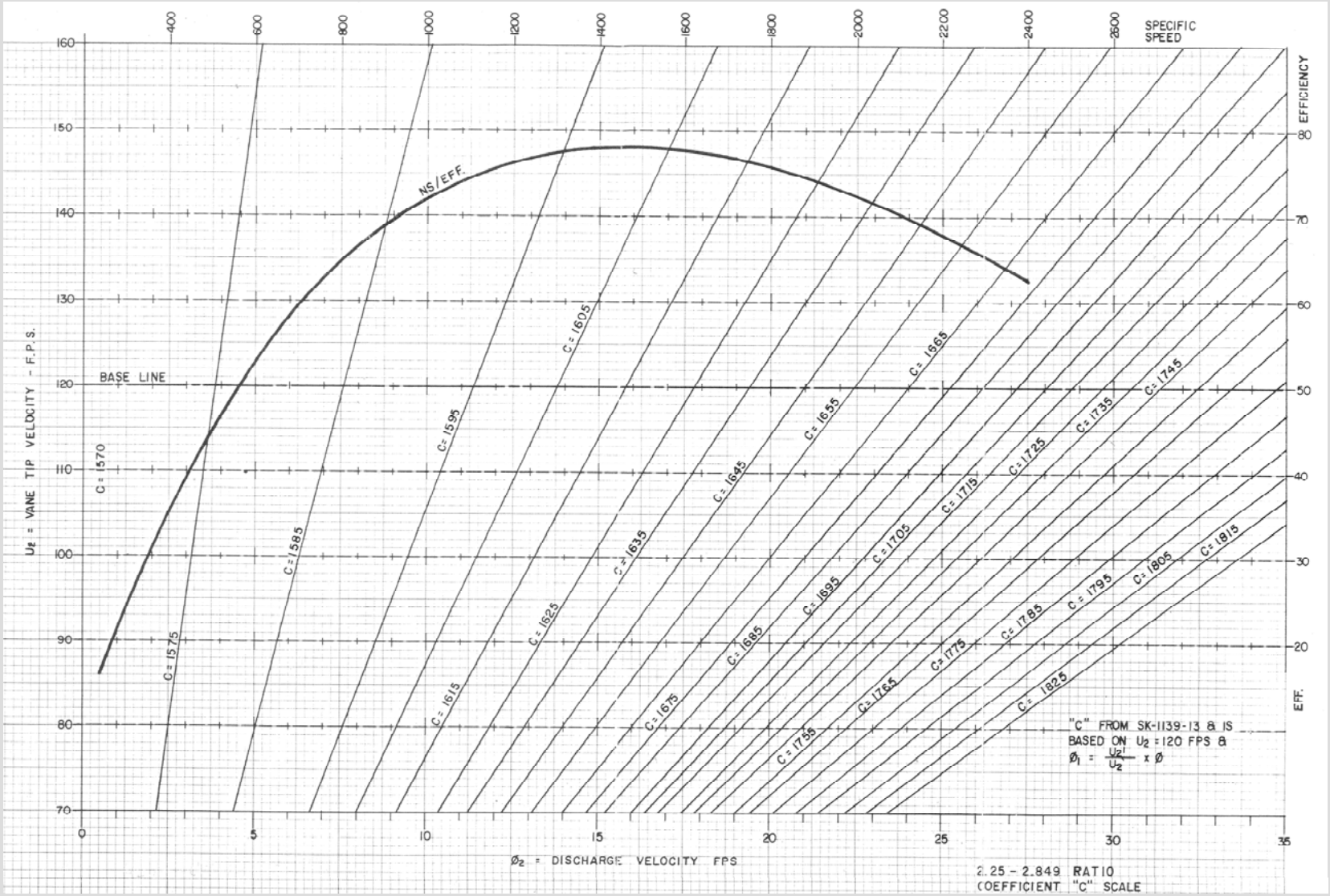


Introduction

- Early 1950's Dredging Industry
  - Pumps
    - Consultants (Frank Paulson / Ole Erickson)
  - Mechanical designs
    - Bearing assemblies
- Hydraulic Pump Test
  - On Dredge
    - Charts & Data



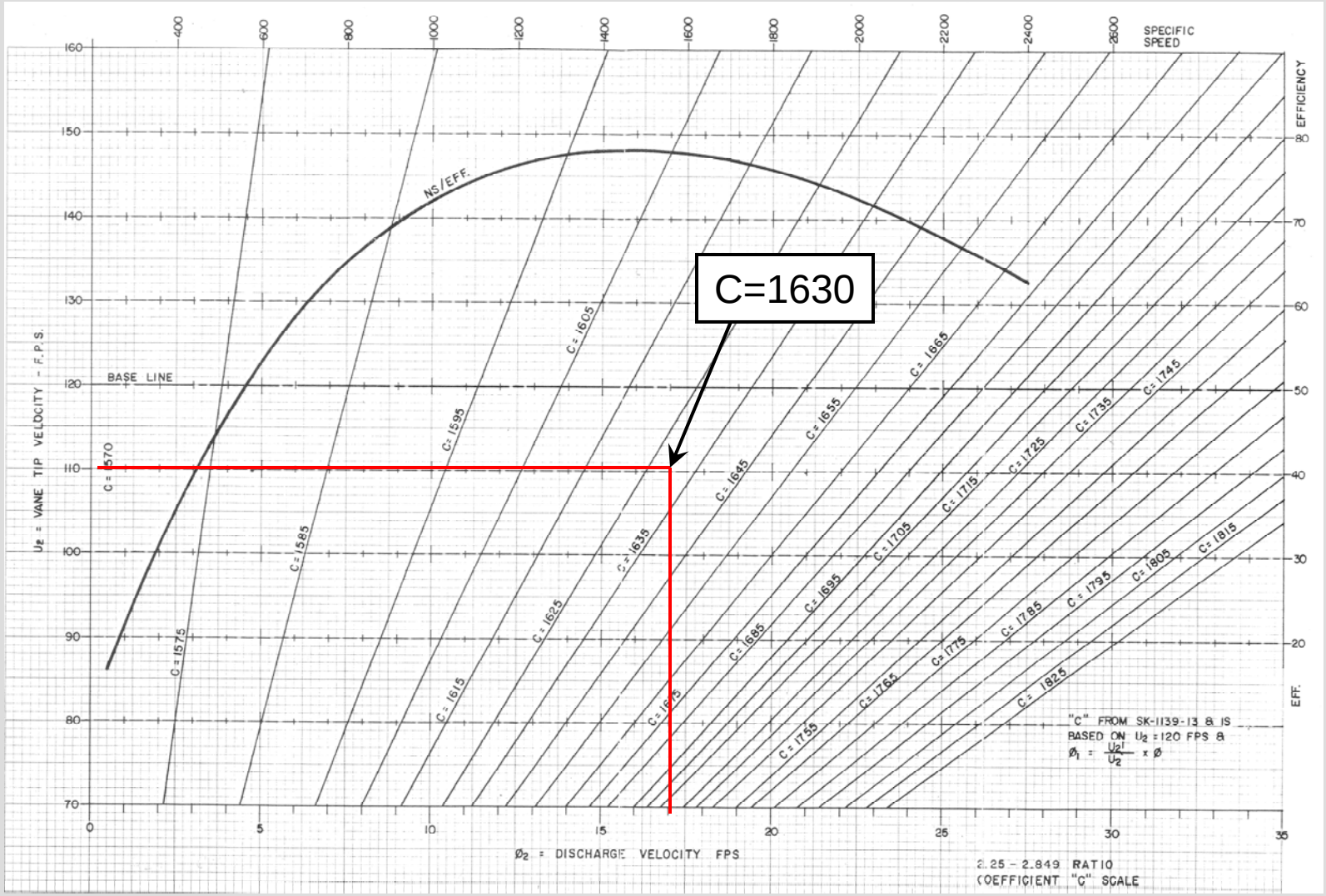
Impeller Coefficient “C” Scale



Using the Chart

- Pump Specs
  - 24” x 27” x 72”
  - 350 RPM
- Determine Ratio & Tip Speed
  - Ratio = OD / SID = 2.67
  - TS = OD x N / 229 = 110 FPS
- Refer to Chart for Impeller Coefficient

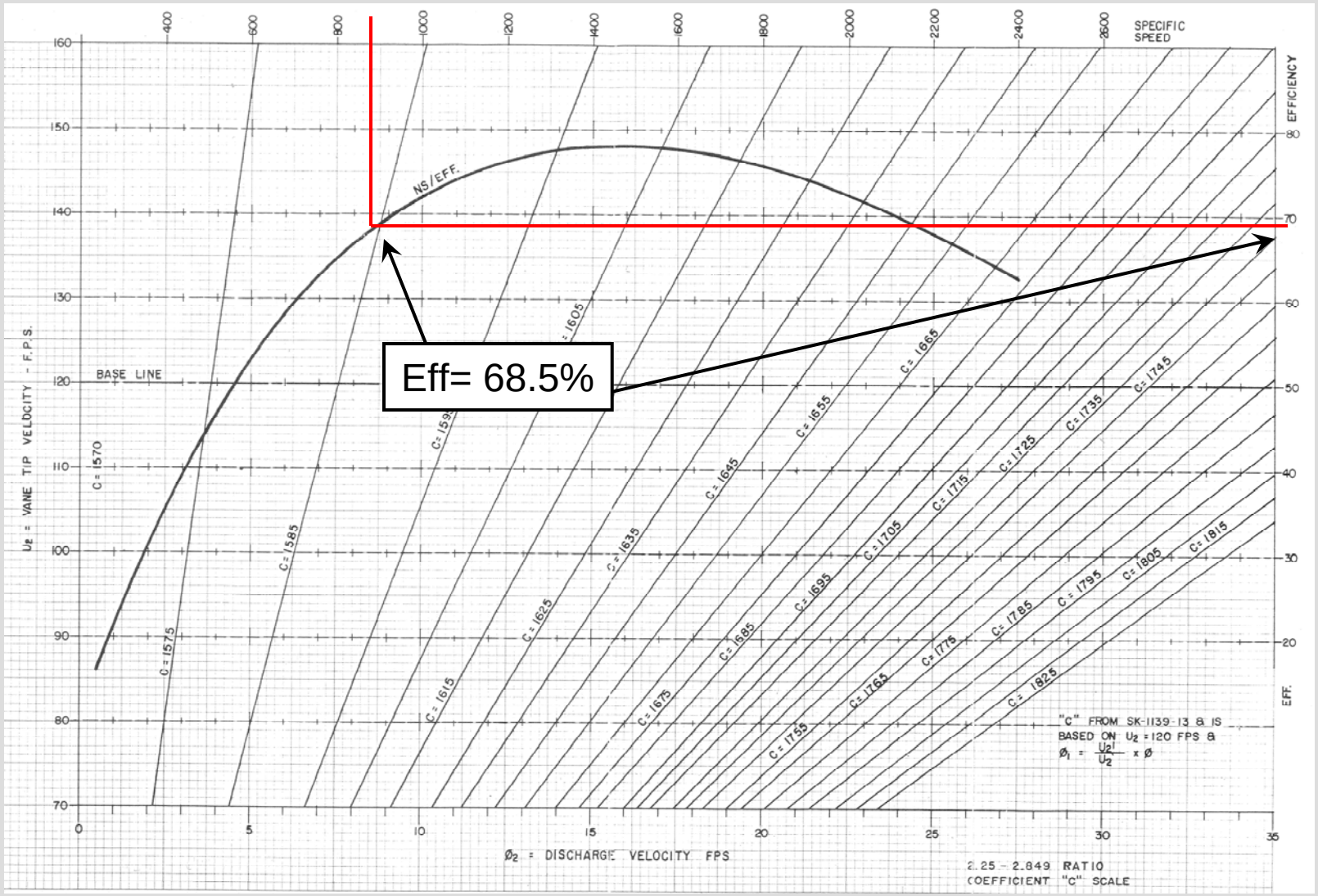
Impeller Coefficient “C” Scale



Using the Chart

- Calculate Head
  - $H = (N \times OD / C)^2 = 239$ feet
- Determine Specific Speed
  - $NS = N \times Q^{1/2} / H^{3/4} = 892$
- Refer to Chart for Efficiency

Impeller Coefficient “C” Scale

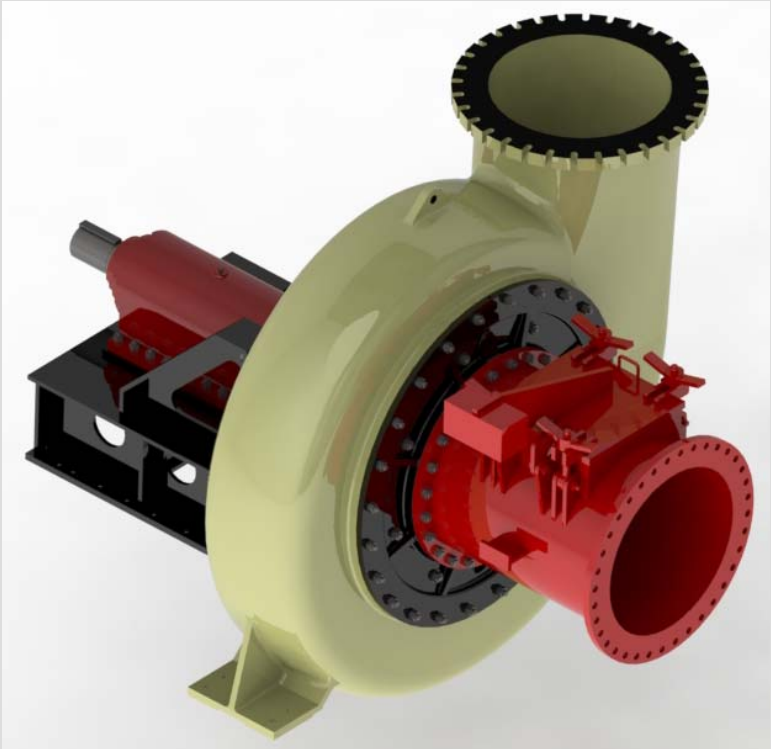


Pump Material

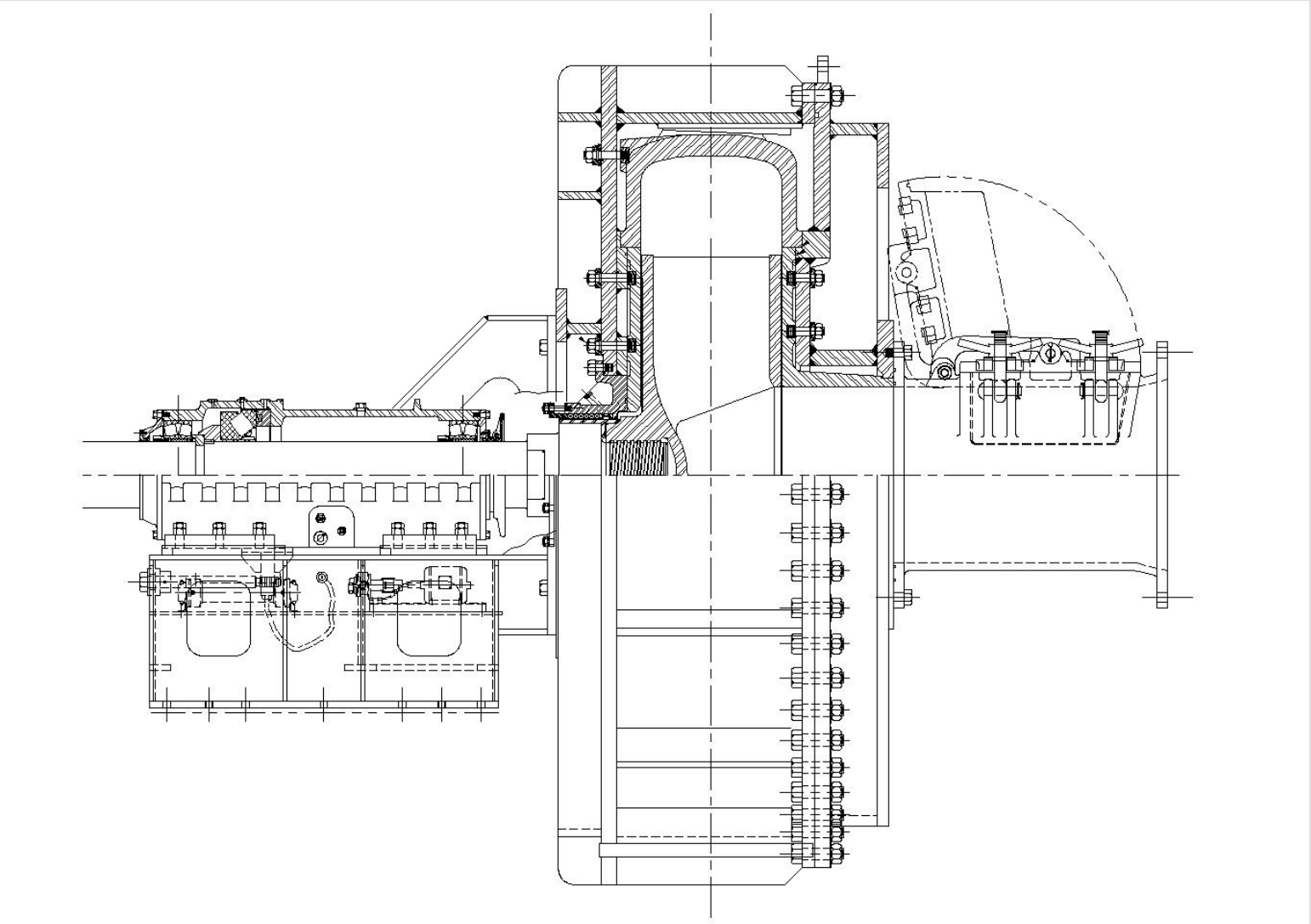
- Moballoy
- Initially Outsourced
  - Long lead times
- Started Casting White Iron
  - Purchased Machining Equipment
  - Shipping Concerns
- Improved tooling
  - Diamond tooling

Pump Development

- Lined Pump
  - Developed in 1965
  - Higher Pressure Brought Safety Concerns
    - Moballoy shell liners
    - Water Hammer and Rocks
- Underwater Pump
  - Design Challenges
    - Small profile
    - Large spherical passages
  - 1970 First Ladder Pump
    - One of the first in the U.S.
    - Underwater Electric Motor

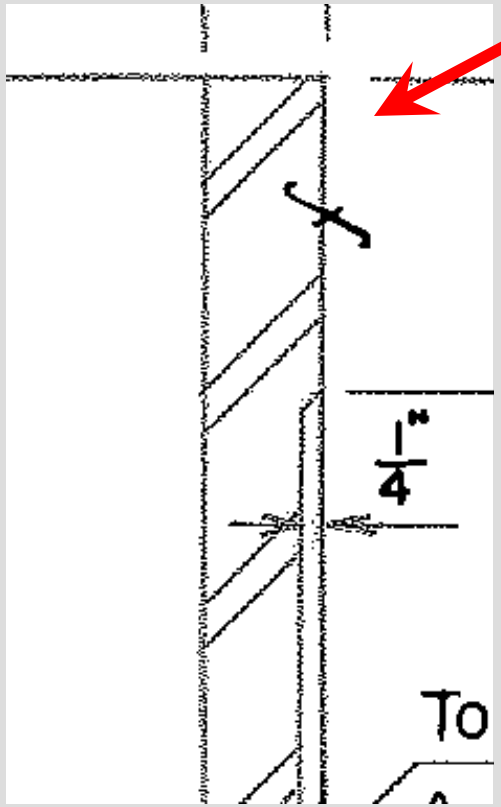


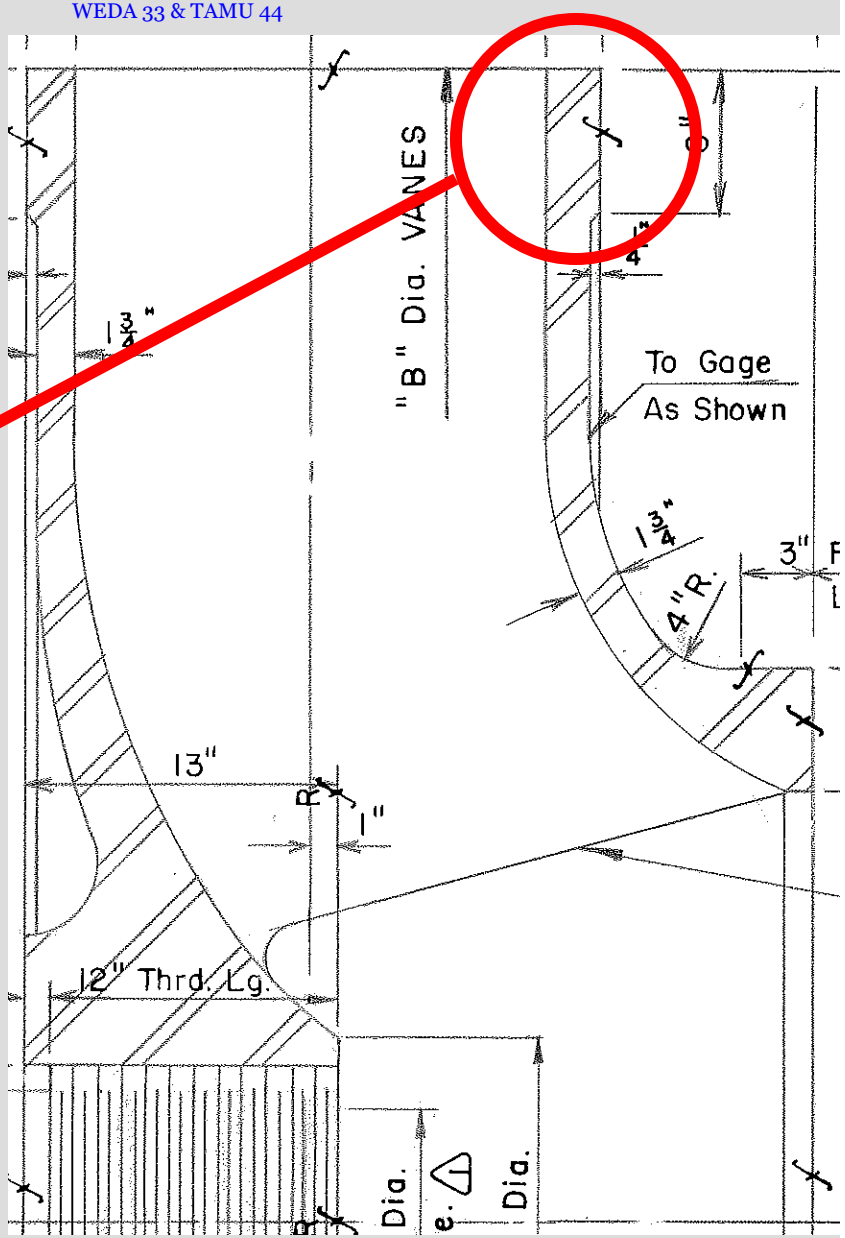
Lined Pump



Pump Improvements

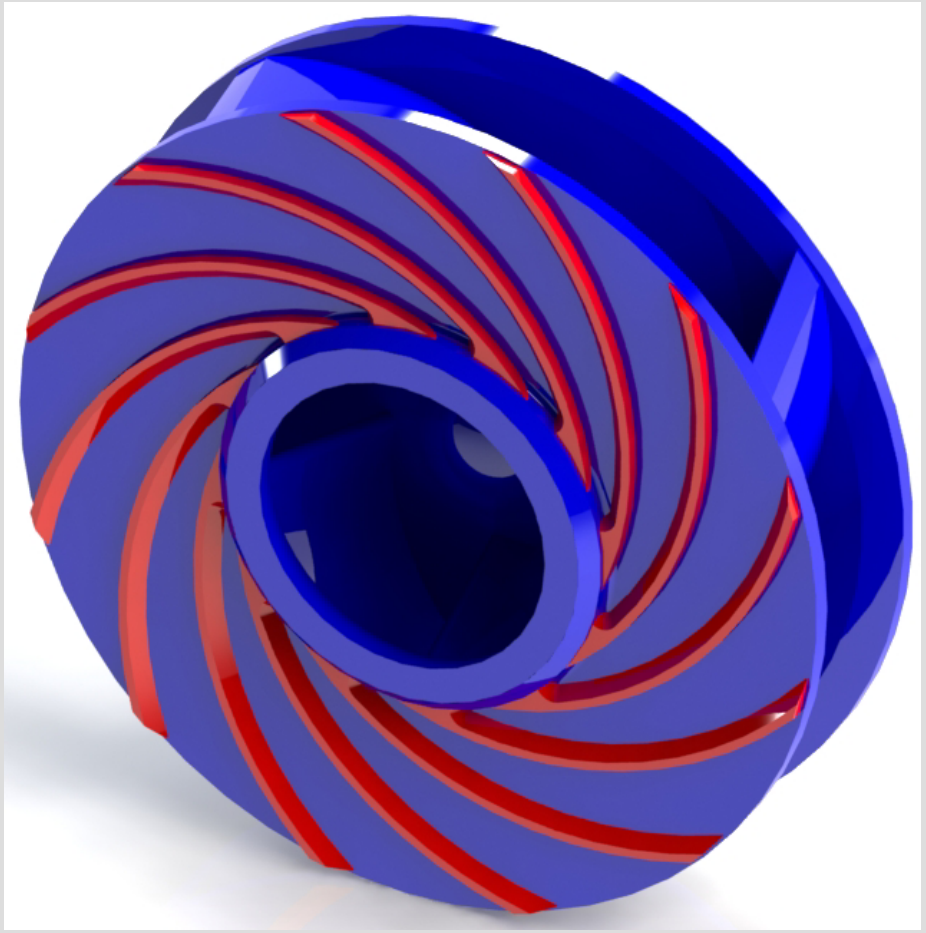
- Suction Side Wear Rates
  - Raised Ring on Impeller
    - Disaster





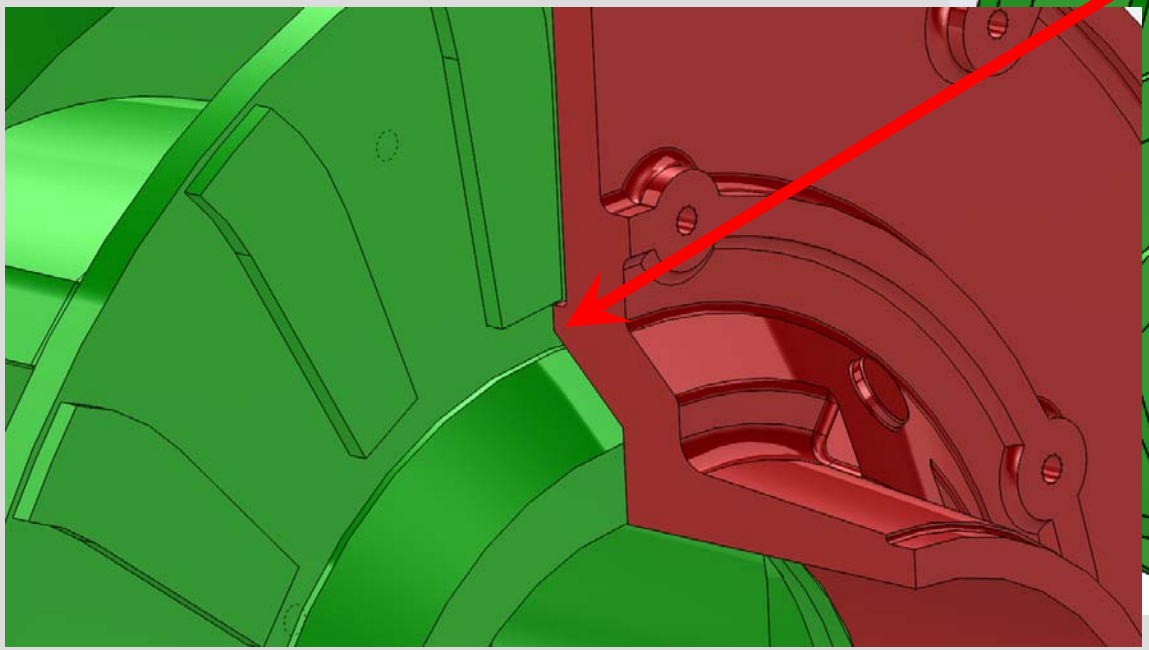
Pump Improvements

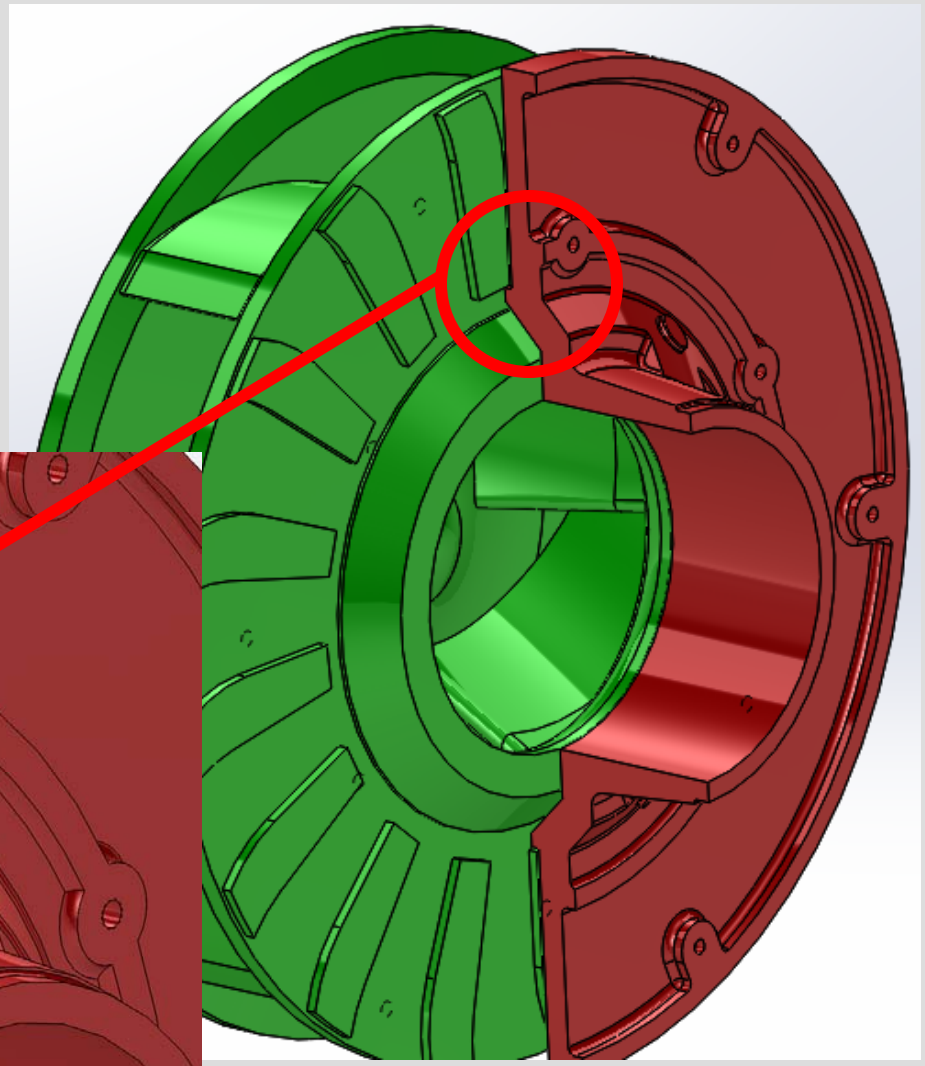
- Suction Side Wear Rates
  - Raised Ring on Impeller
    - Disaster
  - Wiper Vanes



Pump Improvements

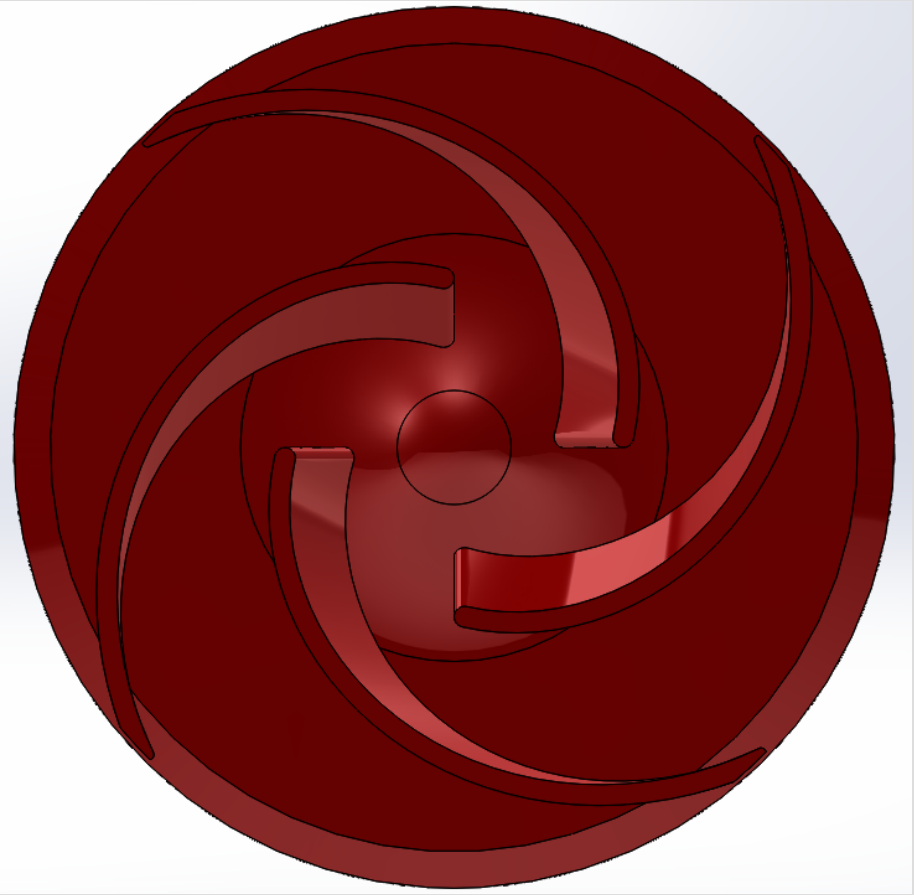
- Suction Side Wear Rates
  - Raised Ring on Impeller
    - Disaster
  - Wiper Vanes
  - Suction Side Excluder





Pump Improvements

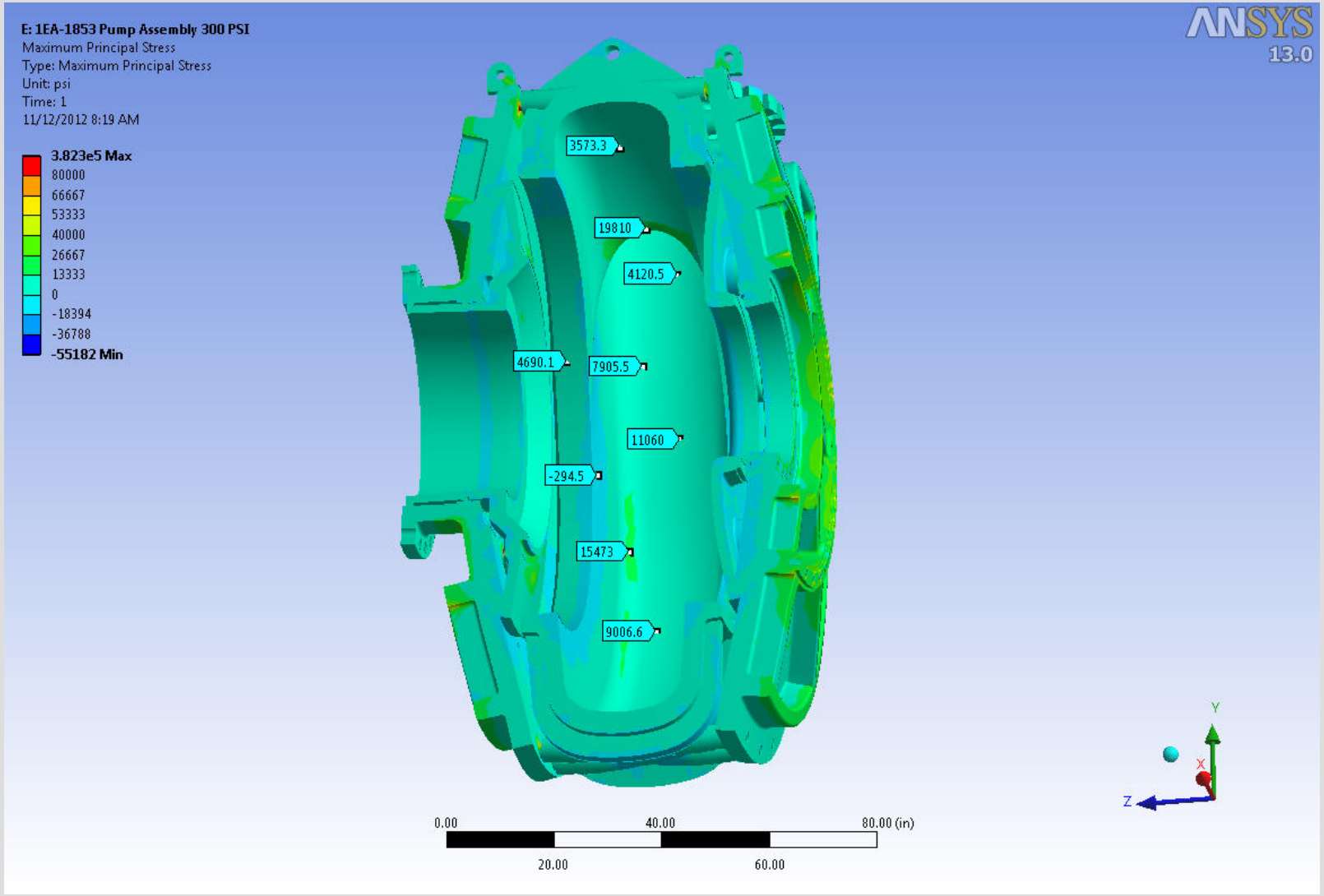
- SuperVane Impeller
  - Twisted Vane
    - Improved Efficiencies
      - Reduced Turbulence
      - Narrower Profile



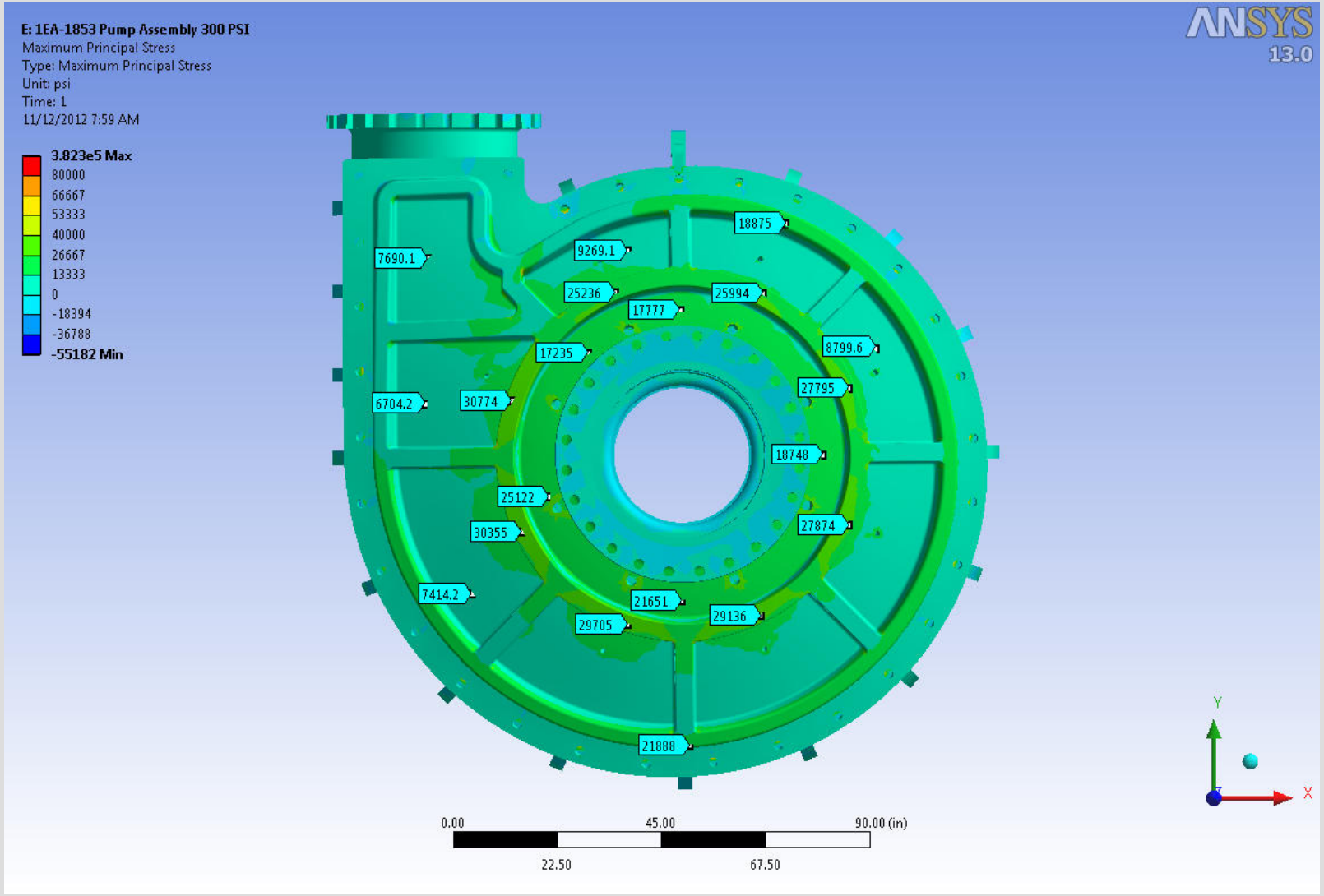
New Computer Tools

- Mid 1980's
  - Finite Element Analysis (FEA)
    - Crude and Time Consuming
- 2000's
  - FEA
    - More useful, less time consuming
    - Reduced Excess Weight Pump
    - Predict Working Pressures
    - Improve Designs

FEA Pump Assembly



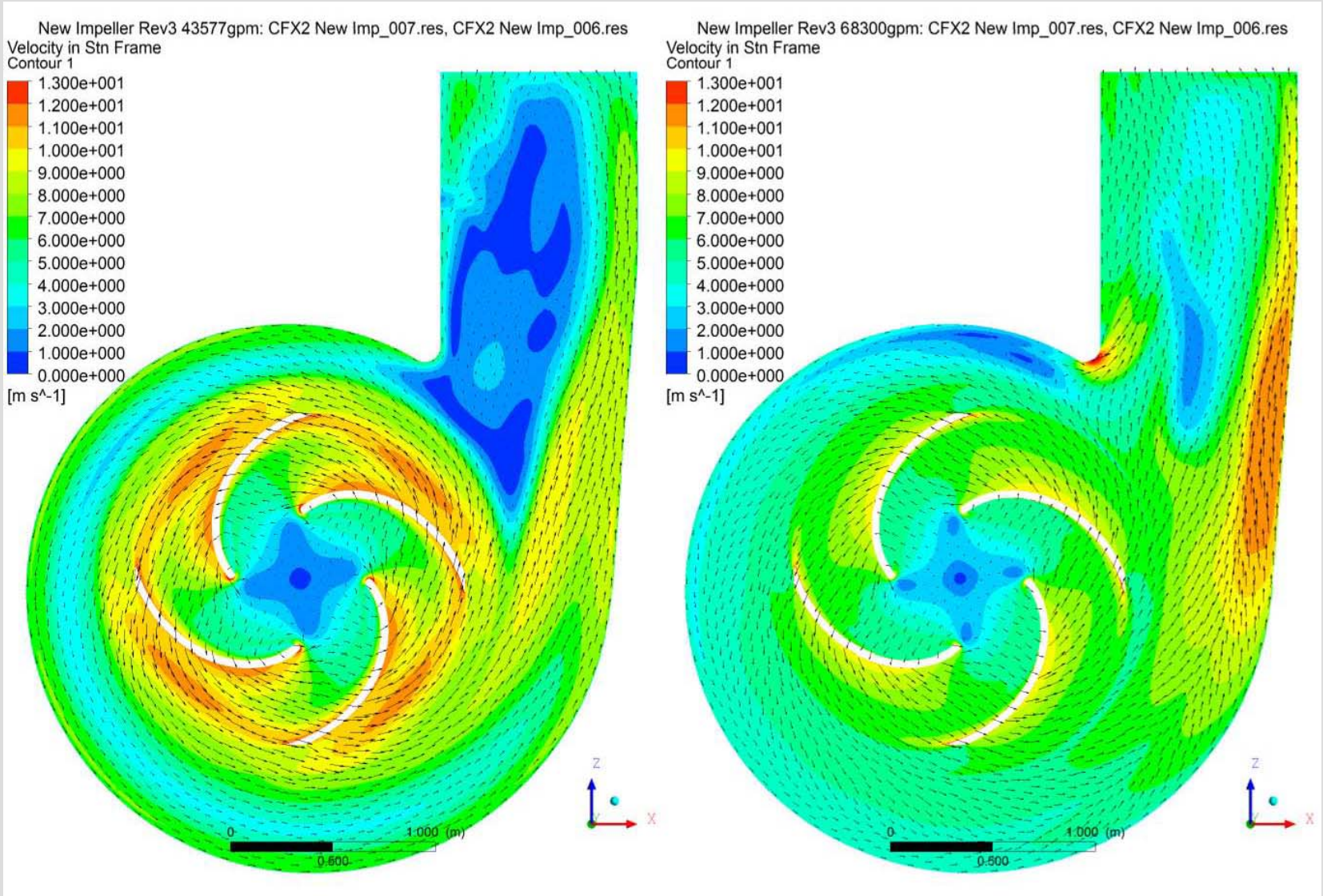
FEA Pump Assembly



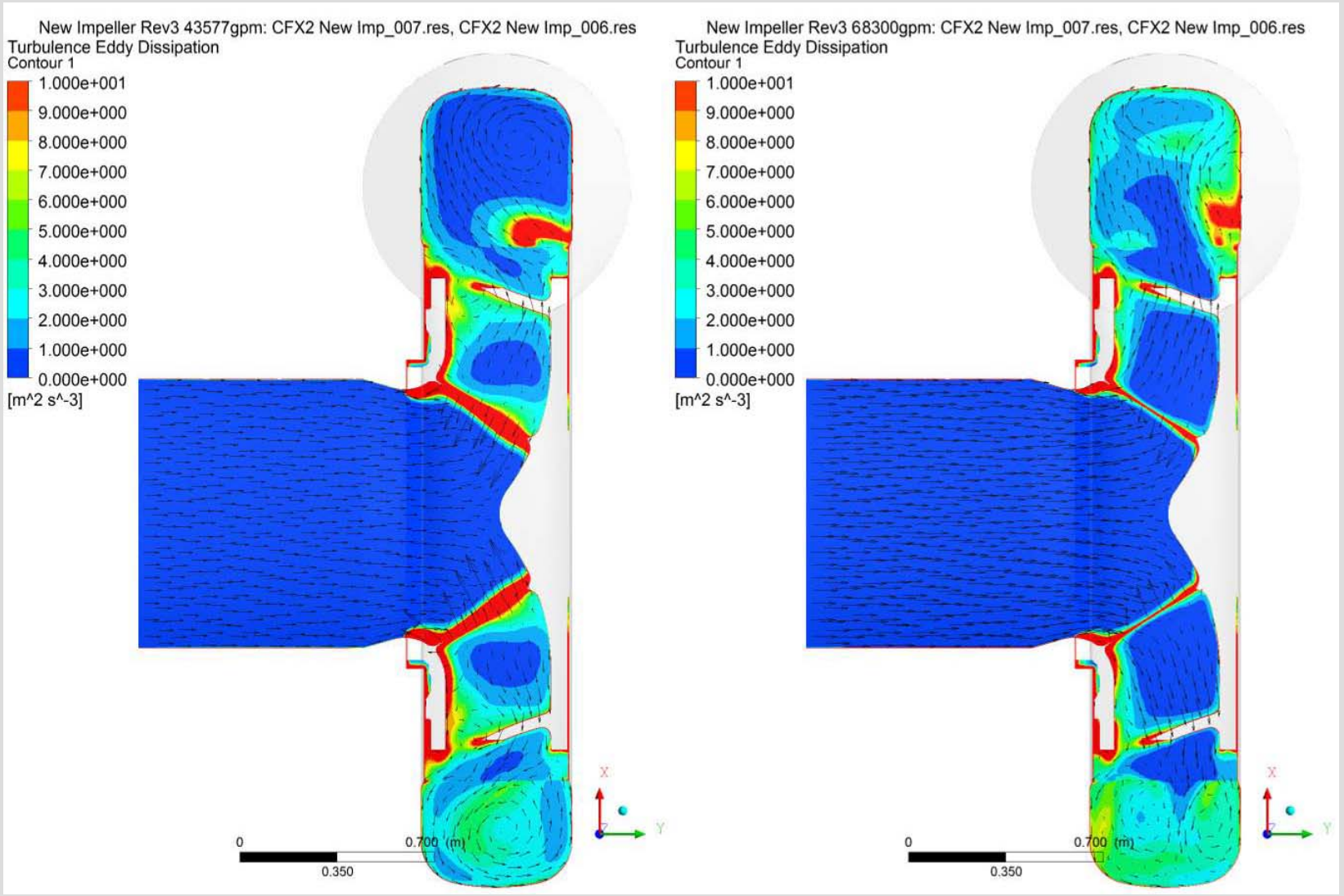
New Computer Tools

- Computational Fluid Dynamics (CFD)
  - Verify Pump Designs
  - Improve Areas
    - Turbulence / Recirculation
    - Velocity or Pressure
  - Best Results Closer to BEP
  - Hopeful Advances
    - Wear Predictability
    - Reliability

CFD Analysis



CFD Analysis

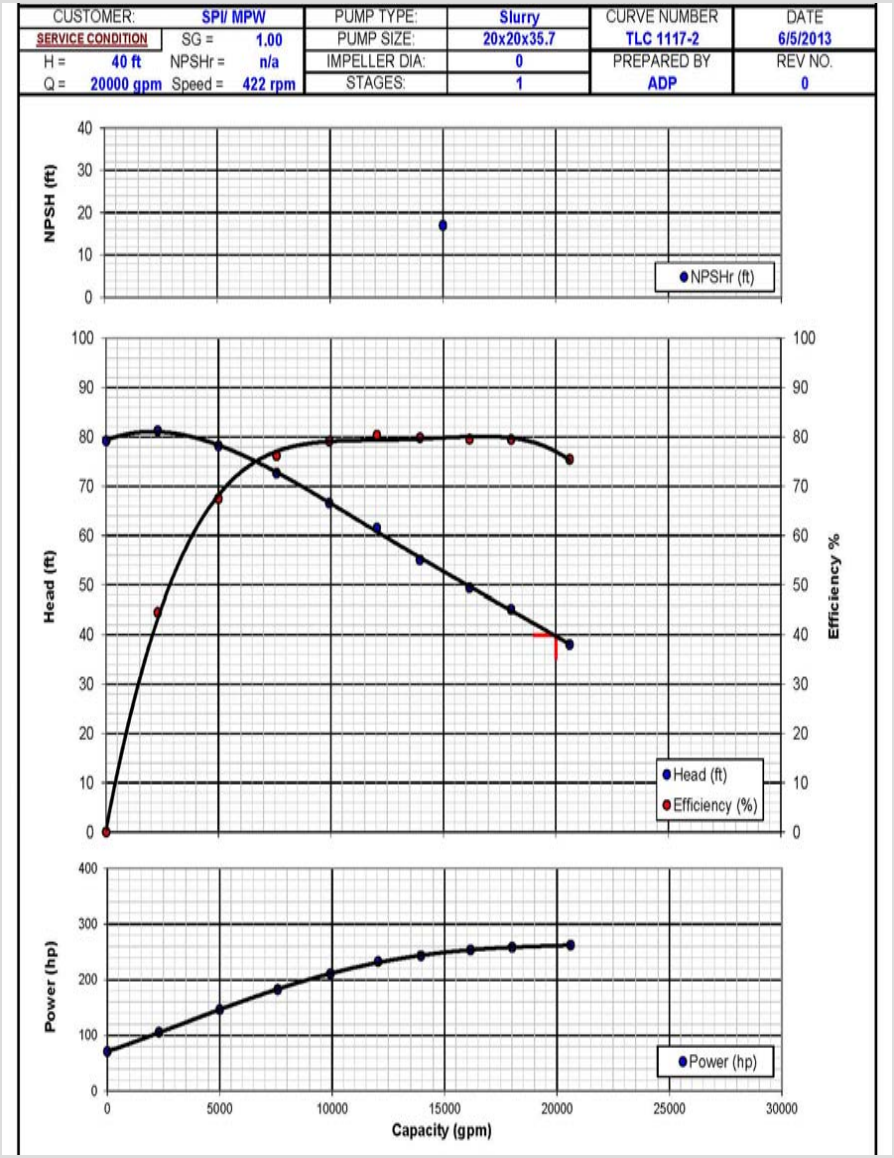


Pump Testing

- Pump Hydraulics
  - Scaled Pump
  - Verify CFD and Design
  - Pump Curve
  - Correctly Instrumented

Pump Curve

CUSTOMER:	SPI/ MPW	PUMP TYPE:	Slurry	CURVE NUMBER	DATE
SERVICE CONDITION	SG = 1.00	PUMP SIZE:	20x20x35.7	TLC 1117-2	6/5/2013
H = 40 ft	NPSHr = n/a	IMPELLER DIA:	0	PREPARED BY	REV NO.
Q = 20000 gpm	Speed = 422 rpm	STAGES:	1	ADP	0



Information is Key

- New Pump Designs / Redesigns
  - Required flow rate, line length
  - Available HP, RPM
  - Higher Fuel Costs
  - Longer Line Lengths

Conclusion

- Higher Efficiency Pumps
- Longer Wear Life
- Use of FEA and CFD Streamline Design
- Demand Changes, Design Changes and Progresses

Questions?