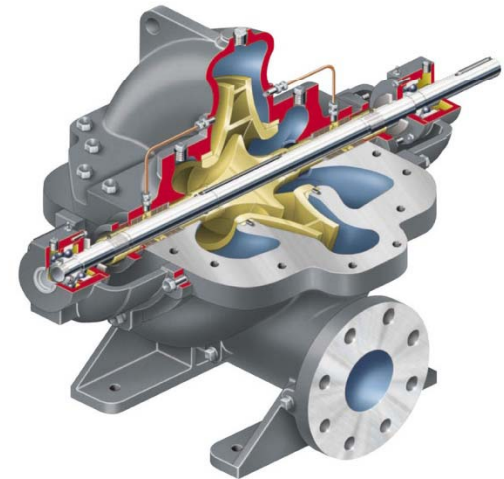
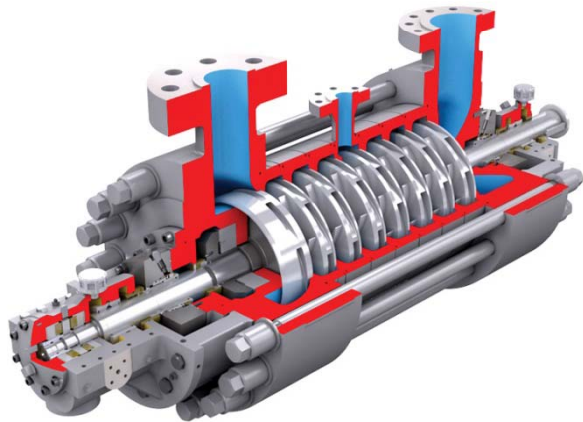


# Pipeline Pumps

**Presenter**

Ralph Dickau Enbridge Pipelines Inc.

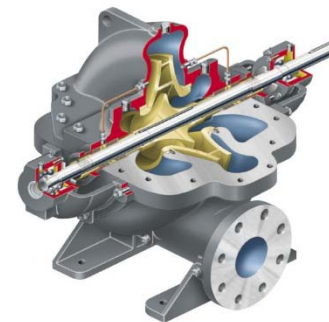
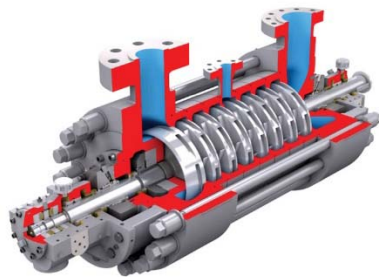


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**Presenter Name**  
**Ralph Dickau**

**Bio**

Ralph Dickau is a Senior Engineering Specialist at Enbridge Pipelines. Ralph has worked for Enbridge for almost 30 years in a variety of roles and has been involved in pump station design, pump selection, installation, writing company specifications and standards for pumps, trouble shooting pump operating problems, and vibration analysis. Ralph has presented courses on pipeline pumps for Enbridge International to companies from many parts of the world. Ralph has presented at the ASME International Pipeline Conference, and Texas A&M International Pump Users Symposium. Ralph currently sits on the PRCI Pump and Compressor Technical Committee and the API 610 12th edition taskforce.



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# Pipeline Pumps

A photograph showing a long, single-file line of large, orange-colored pipeline pumps. The pumps are positioned on a dark asphalt surface, with a bright yellow line painted along the ground next to them. To the left of the pumps is a tall, blue corrugated metal building. A small blue sign with the word "ENBRIDGE" is visible on the building's wall. In the background, a group of about five people are walking away from the camera towards the end of the pump line. The sky is clear and blue.

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# What Makes Pipeline Pumps Unique



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# What Makes Pipeline Pumps Unique



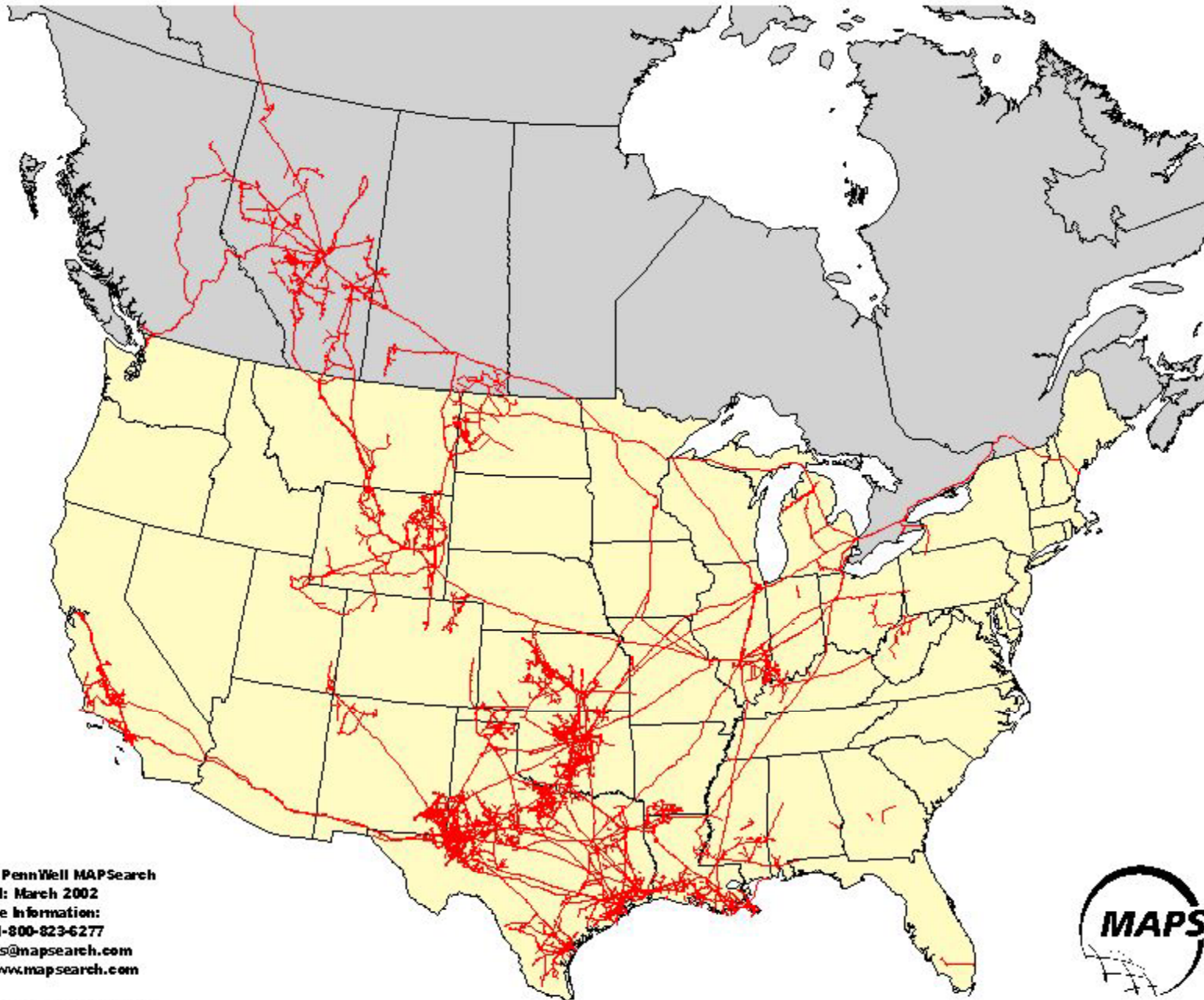
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# PennWell MAPSearch Pipeline Coverage - Crude Oil

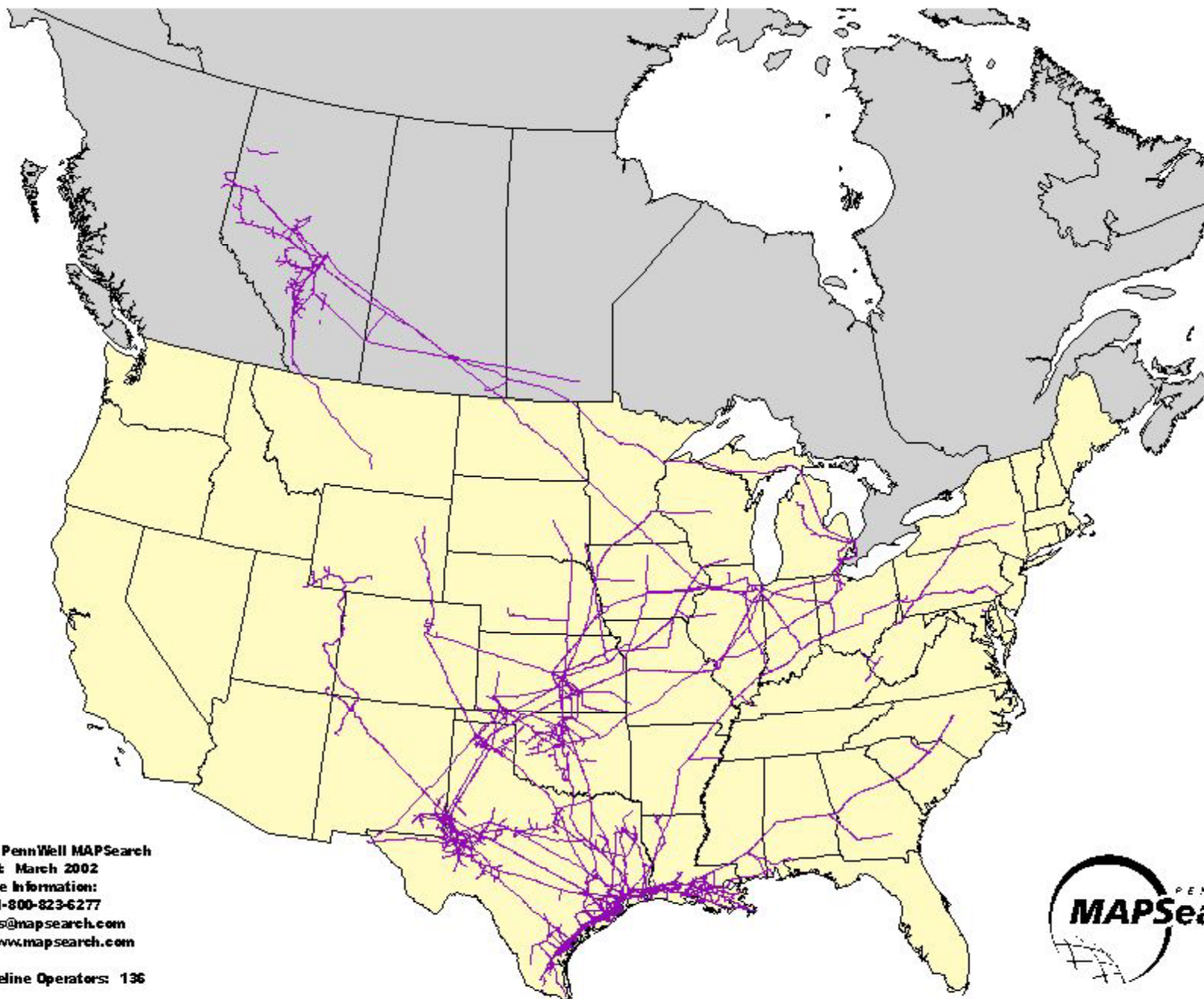


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For More Information:  
Phone: 1-800-823-6277  
E-Mail: [sales@mapsearch.com](mailto:sales@mapsearch.com)  
Web Site: [www.mapsearch.com](http://www.mapsearch.com)

Number of Pipeline Operators: 149



## PennWell MAPSearch Pipeline Coverage - LPG/NGL



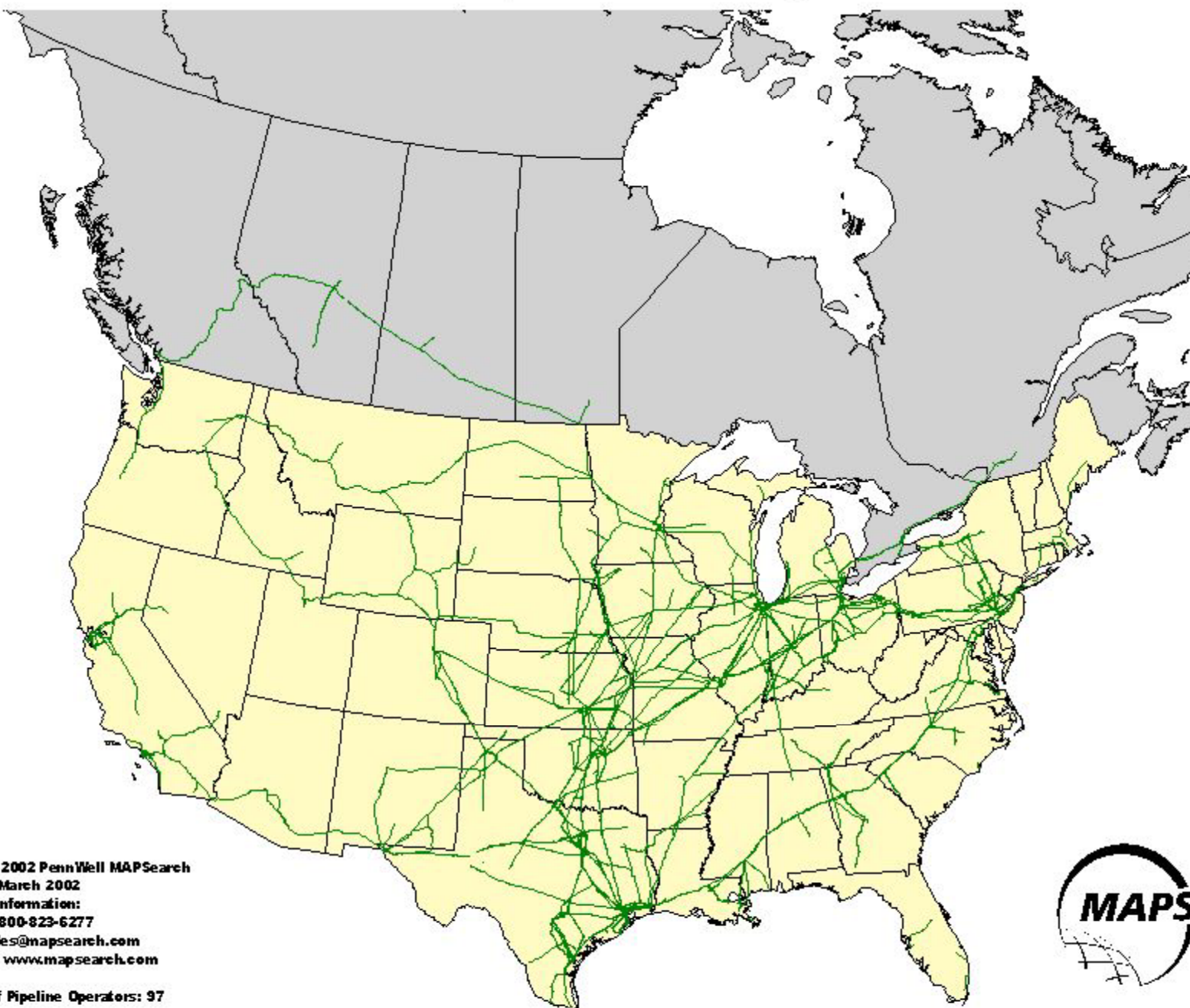
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For More Information:  
Phone: 1-800-823-6277  
E-Mail: [sales@mapsearch.com](mailto:sales@mapsearch.com)  
Web Site: [www.mapsearch.com](http://www.mapsearch.com)

Number of Pipeline Operators: 136





# PennWell MAPSearch Pipeline Coverage - Refined Products



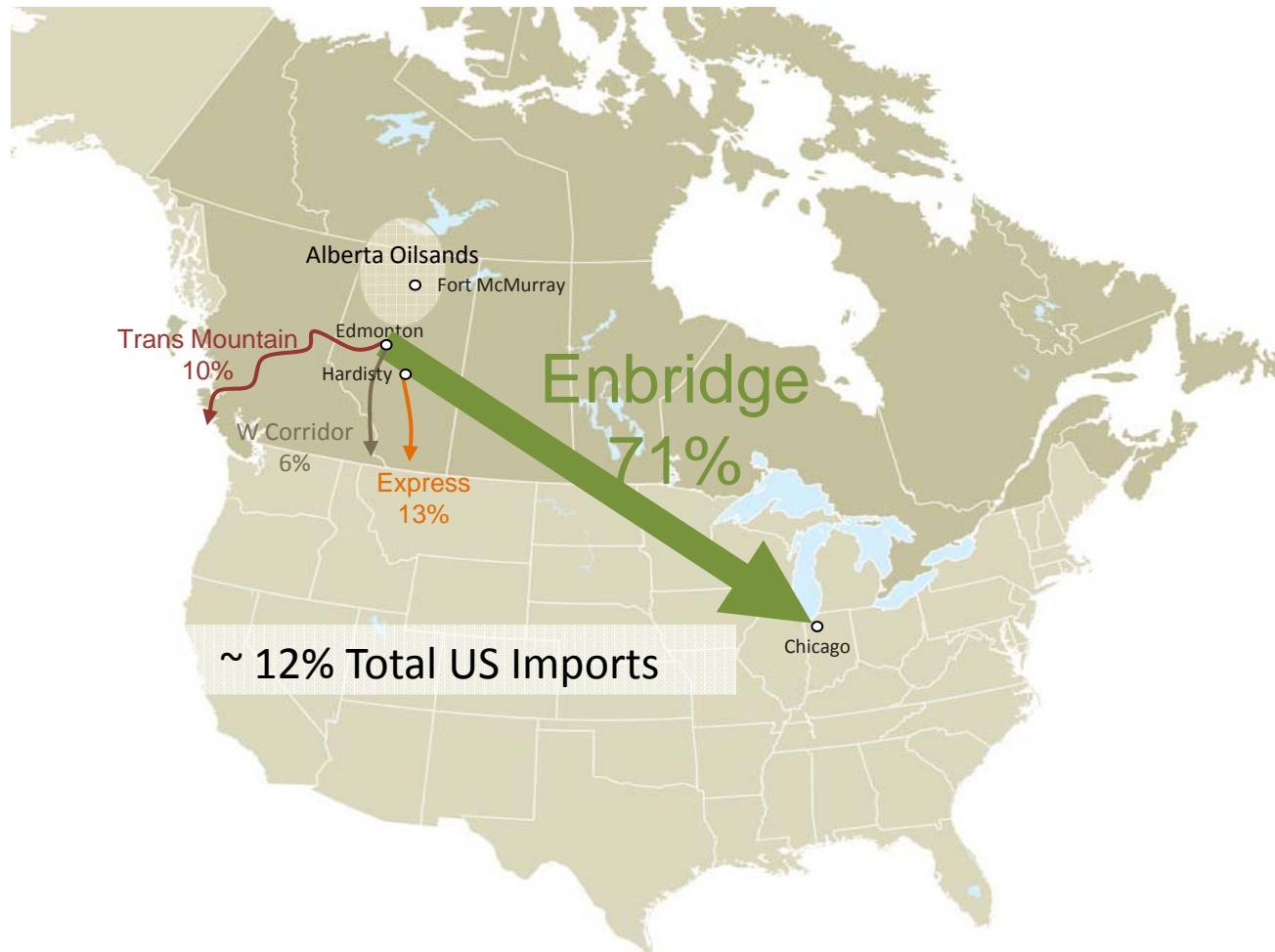
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Phone: 1-800-823-6277  
E-Mail: [sales@mapsearch.com](mailto:sales@mapsearch.com)  
Web Site: [www.mapsearch.com](http://www.mapsearch.com)

Number of Pipeline Operators: 97





# USA Crude Oil Supply



2009

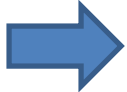
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# What Makes Pipeline Pumps Unique

- Pump stations are unmanned
- Help can be 100s of km away
- Control of the pumps can be 1000s of km away at a control center in another country
- Pumps may be run stop/start
- Large flow variability
- Rely on instrumentation for control and protection



# What Makes Pipeline Pumps Unique

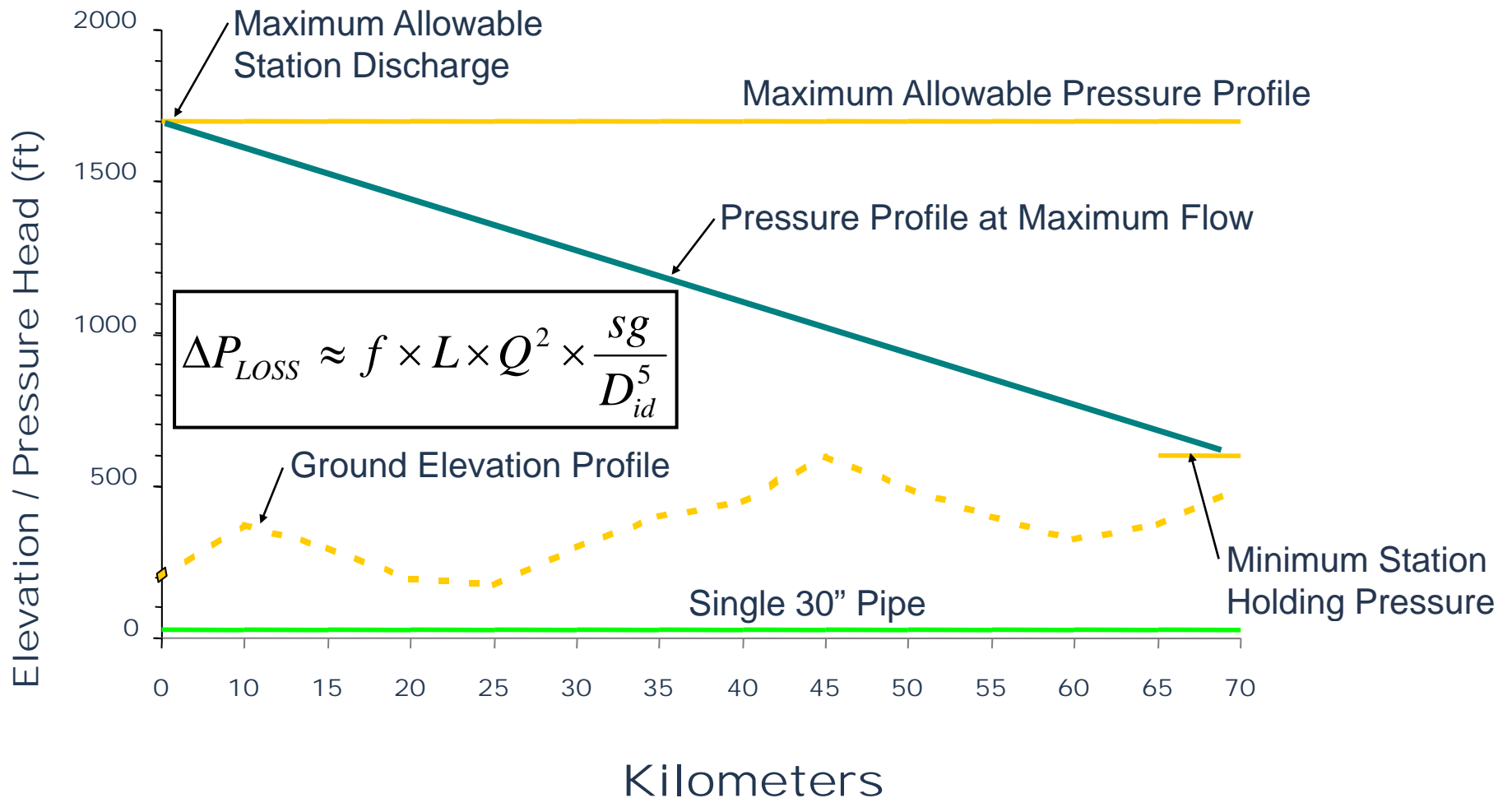
- Frequently multi-products in the pipe
- Pump efficiency is very important
- Electric power costs are high
  - Eg. 24" pipe, 1000 mile long, 300 kbpd heavy crude @ \$0.08 /kwh
  -  \$100,000,000 per year

# What Makes Pipeline Pumps Unique

- Pipelines and Pump Stations are built to:
  - CSA Z662 in Canada (Gas and Liquid)
  - ASME B31.4 in USA
- Regulatory codes by Federal and State or Provincial Governments
  - NEB Act and Regulations in Canada
  - DOT CFR 49 Part 105 in USA
- Current political and environment climate e.g. Keystone and Gateway



# Pipeline Hydraulics



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# Pipeline Hydraulics

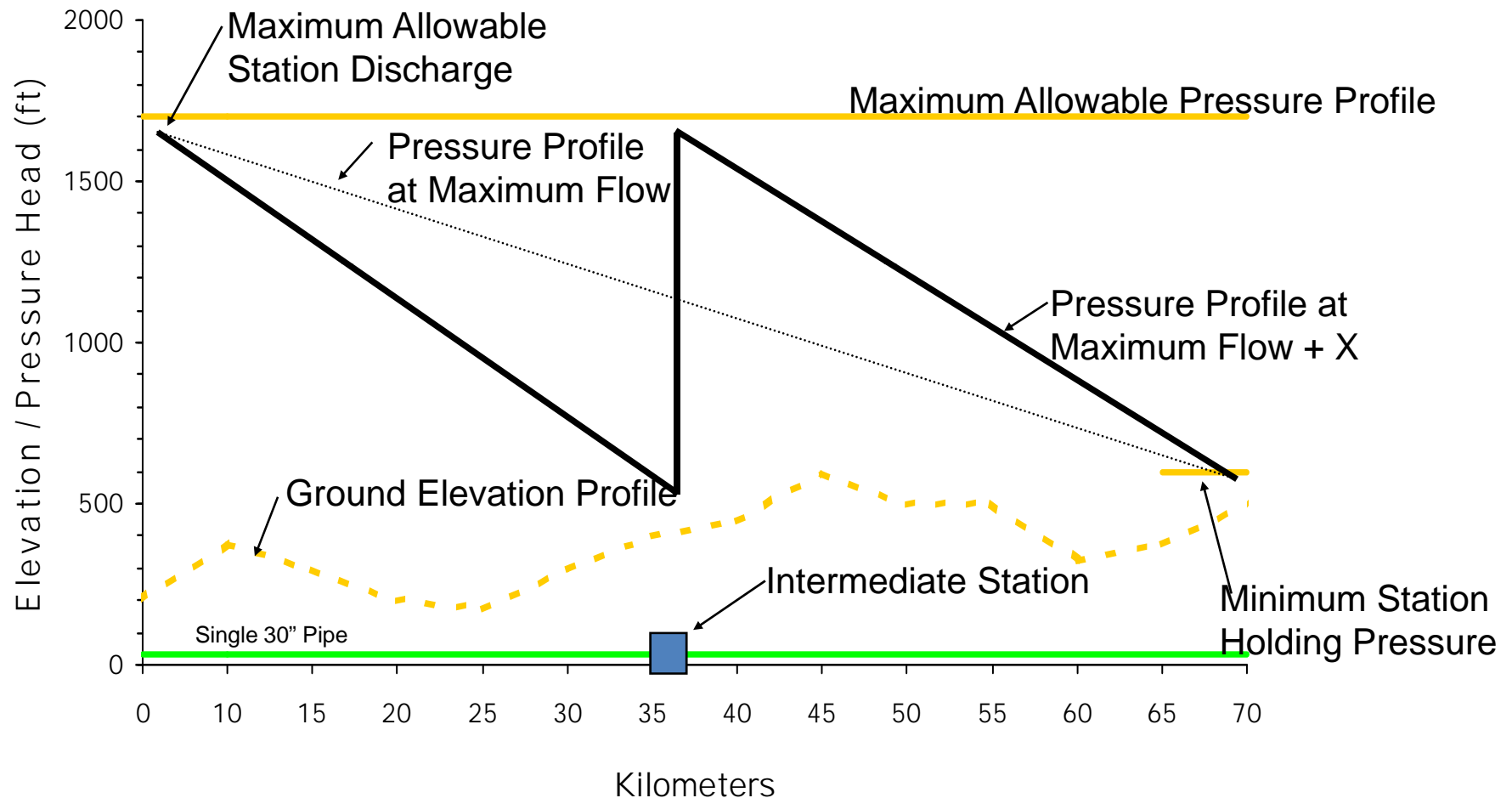
## How to Increase Pipeline Capacity

- Replace pipe with larger pipe or higher strength
- Add a parallel line (looping)
- Re-hydro (pressure) test under-rated pipe
- Add pump stations
- Add or replace pumps
- Use Drag Reducing Agent (DRA)



# Pipeline Hydraulics

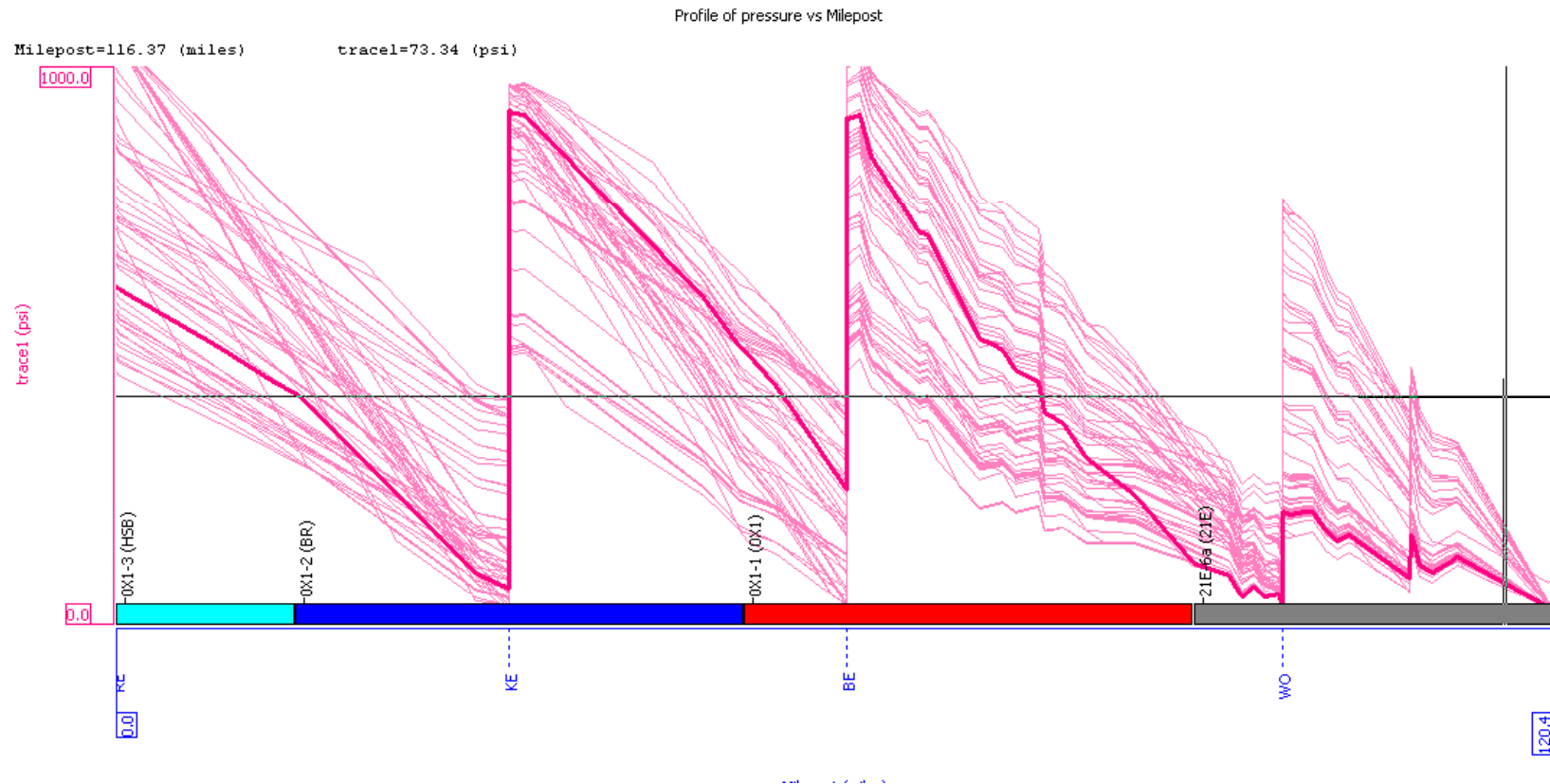
## Add a Station



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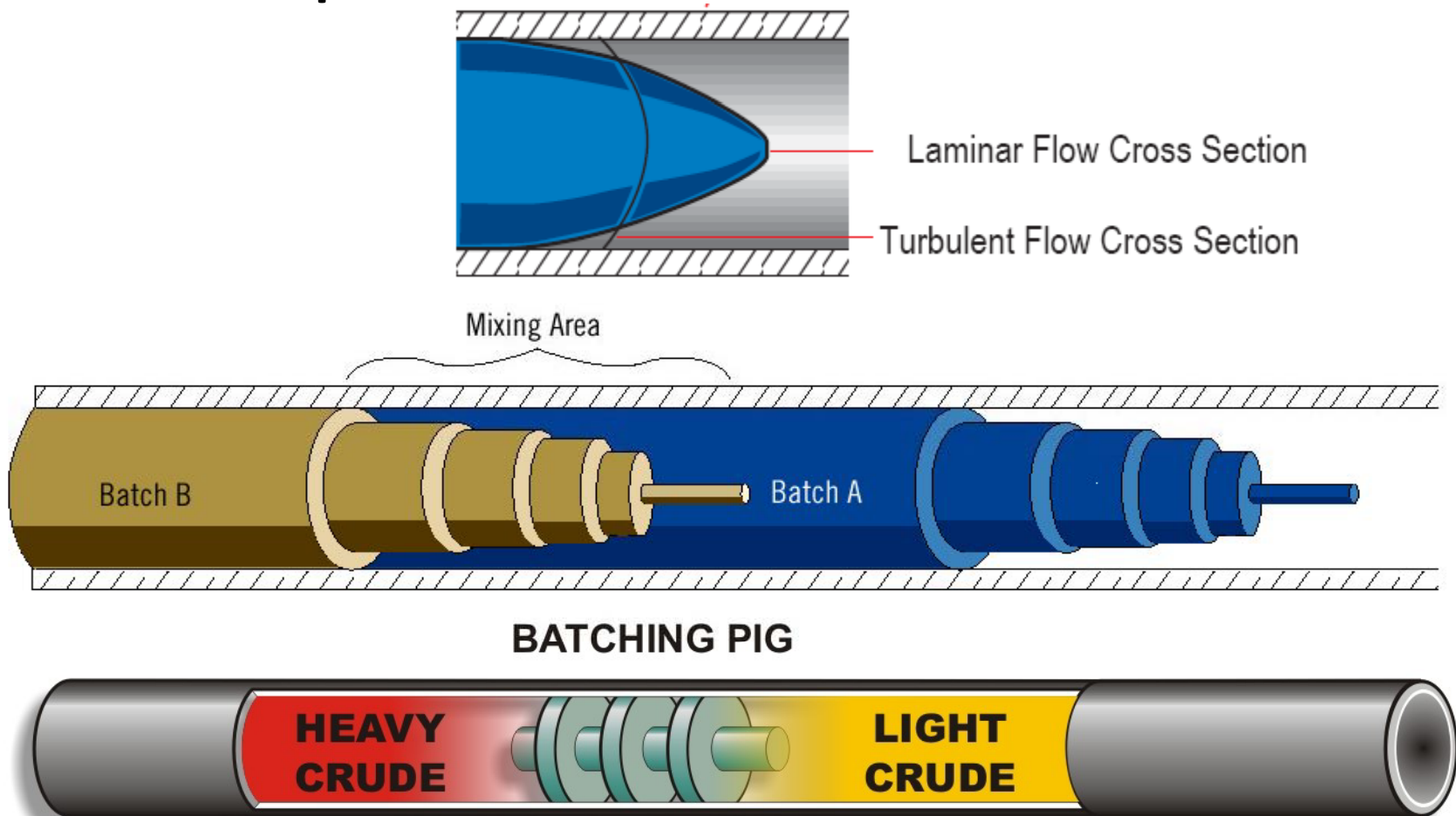
# Pipeline Hydraulics – Batched Operation

Config: EB5530-E07-MA1209-EXP-UNC Case: 3by3\_15kbpd\_90design

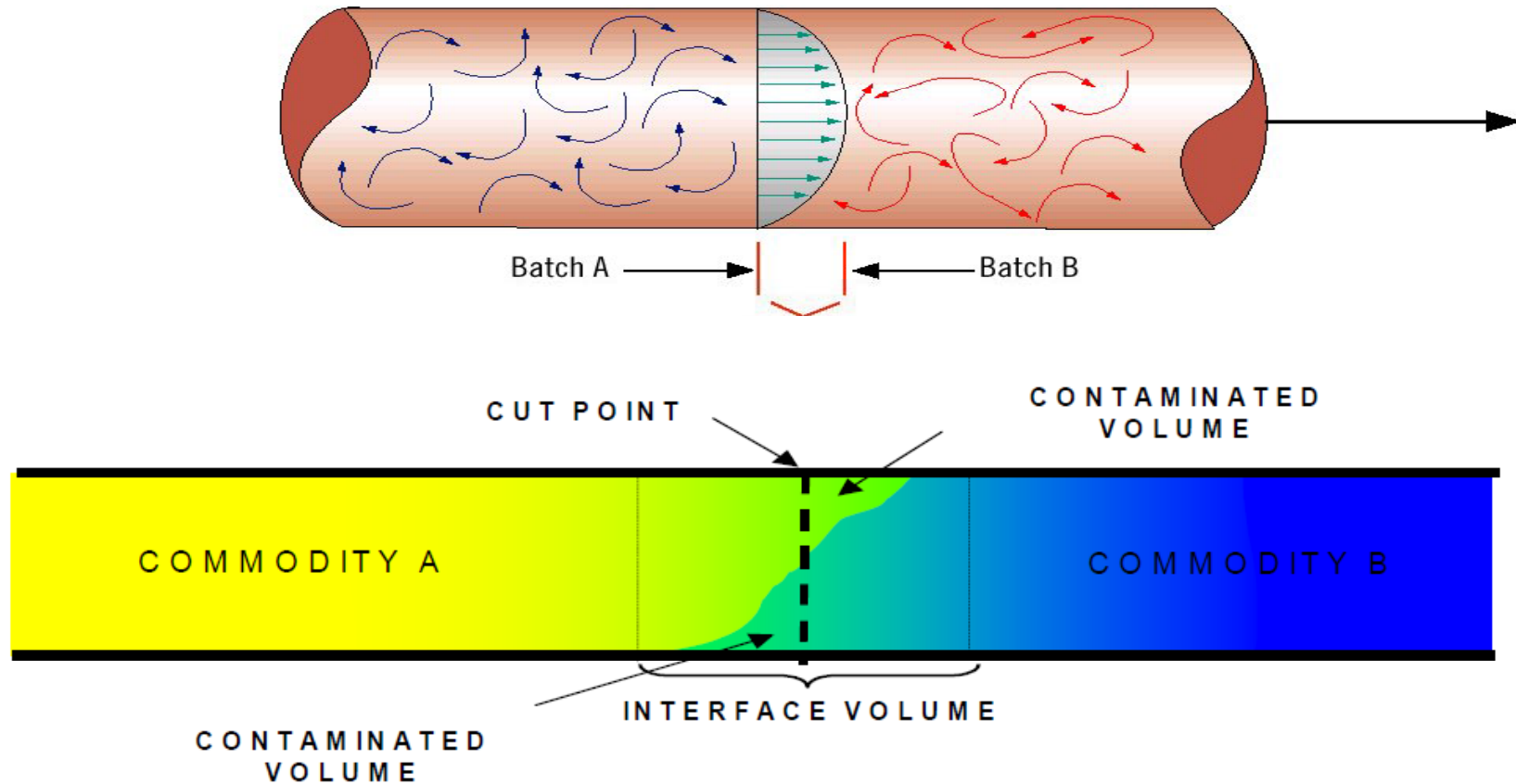


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# Pipeline Hydraulics – Batched Operation – Laminar Flow



# Pipeline Hydraulics – Batched Operation – Turbulent Flow



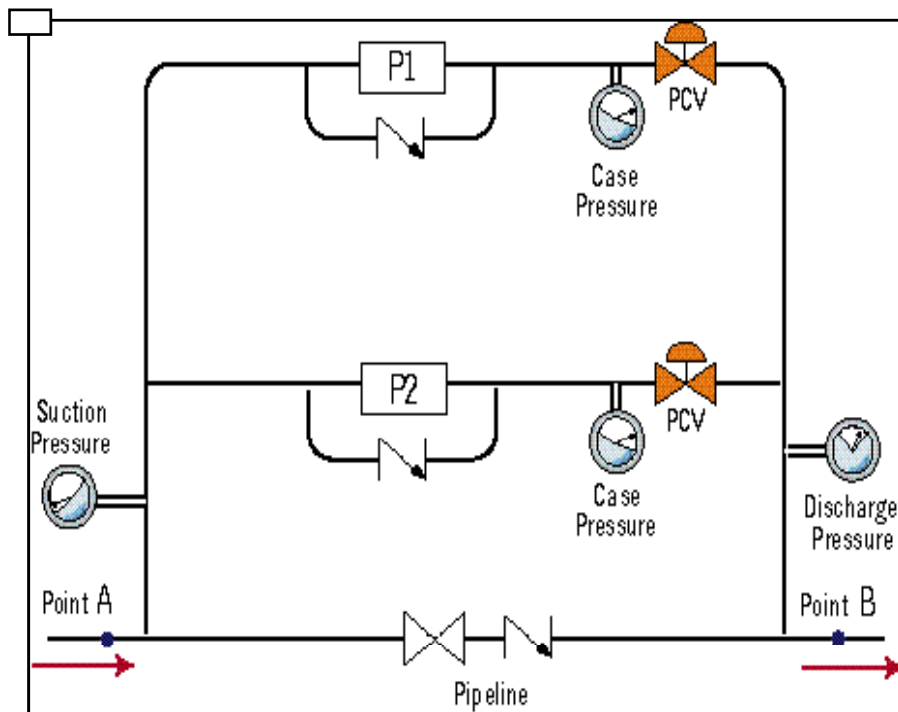


# Pipeline Pump Fluid Properties

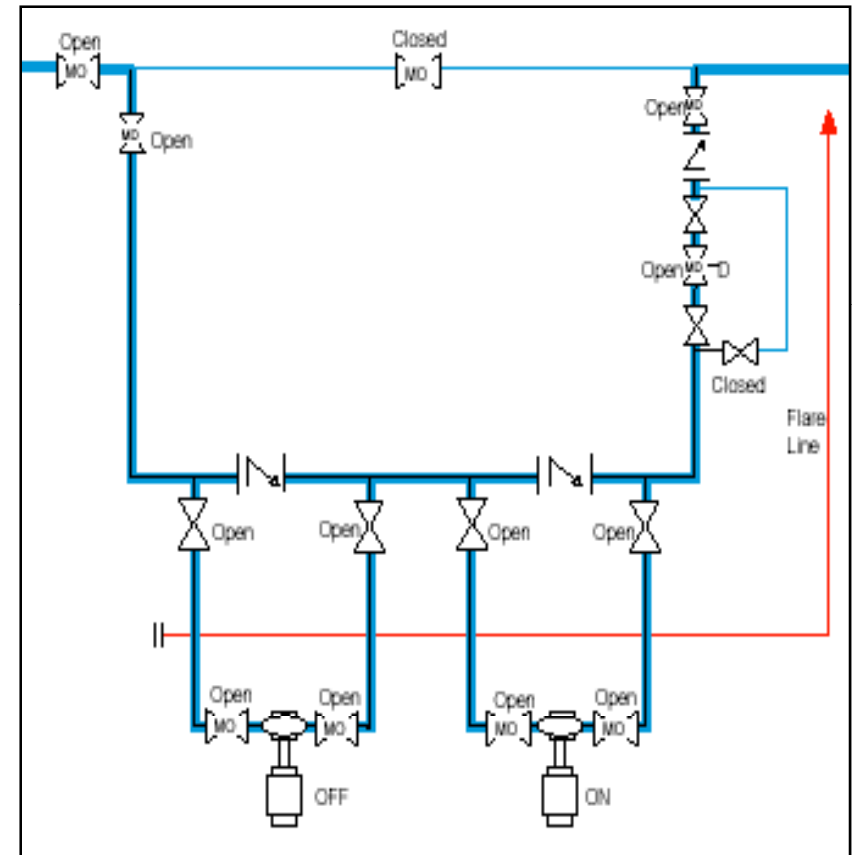
- Ethylene to Bitumen (density)
- Vapor Pressure
- Solids Content

Commodity	Density (SG)	Viscosity (cSt)
Ethylene	0.37	0
NGL	0.5 – 0.6	0 – 0.4
Light Crude	0.8 – 0.87	2 - 20
Heavy Crude	0.9 – 0.94	150 – 350

# Series vs Parallel Pump Station

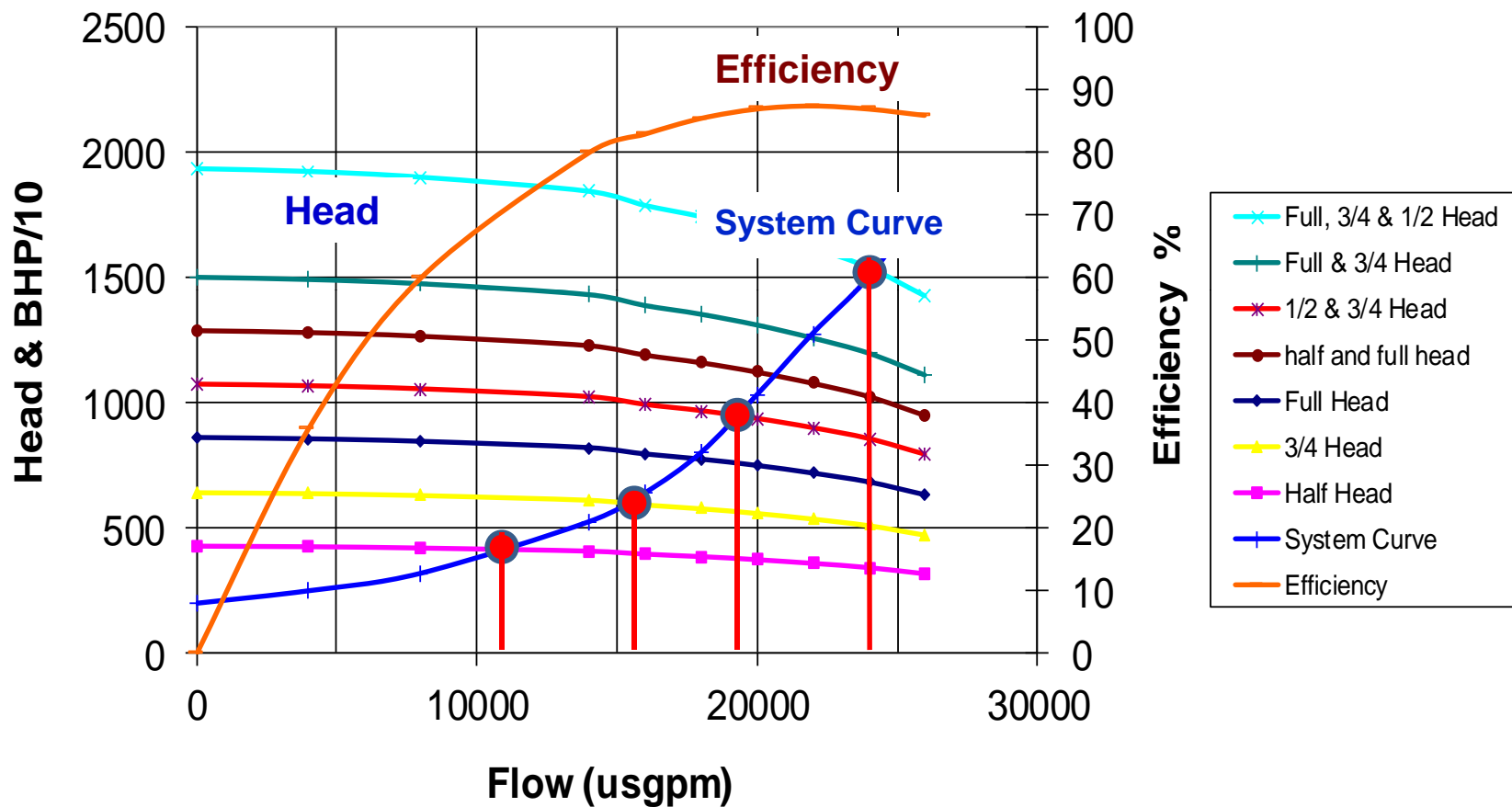


**Parallel Pump Station**



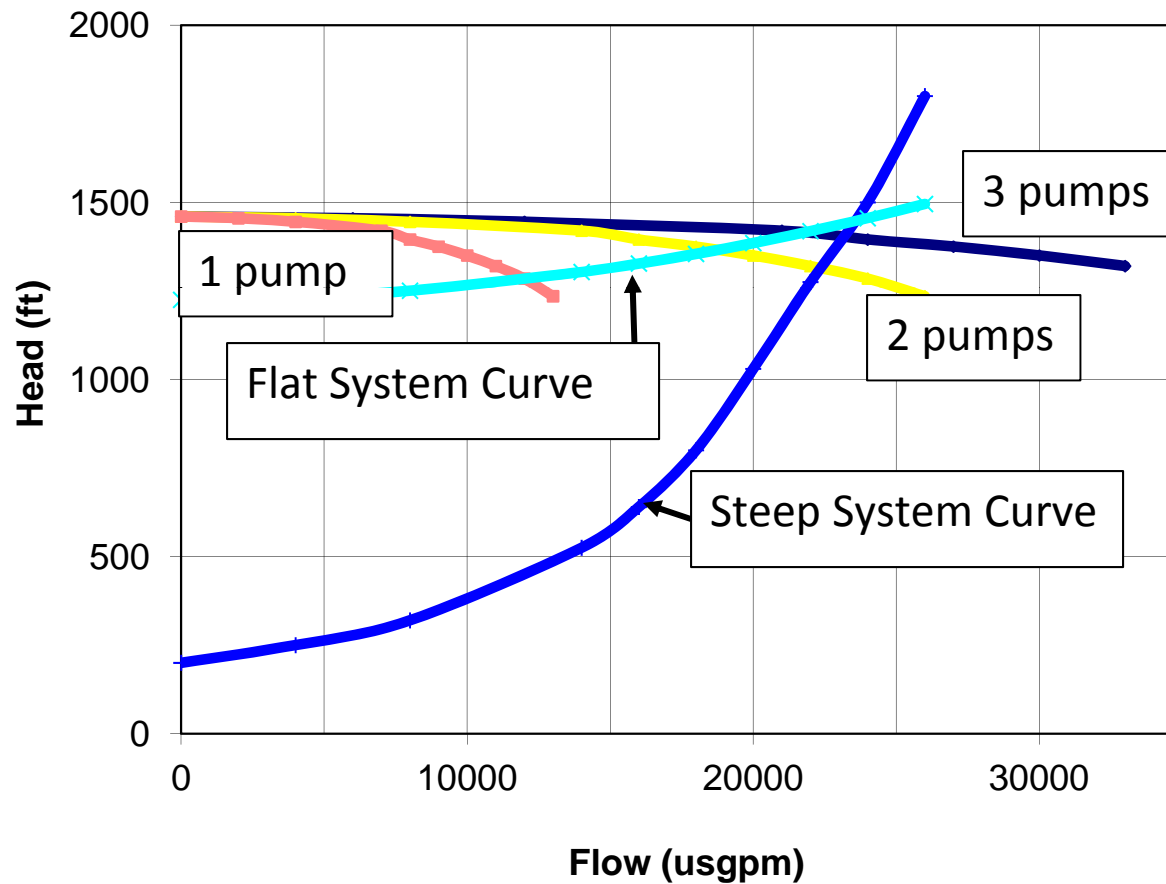
**Series Pump Station**

# Pumps in Series



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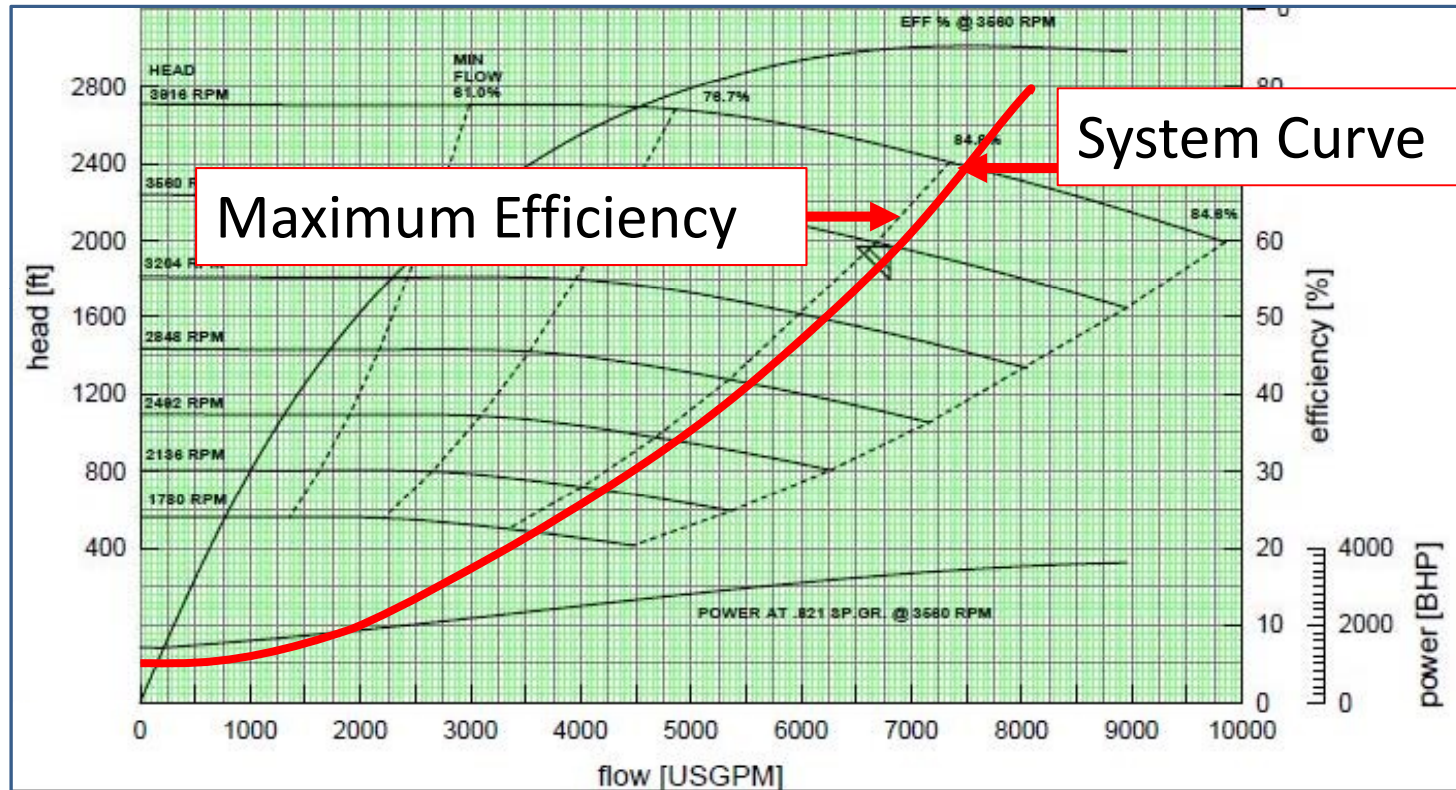
# Pumps in Parallel



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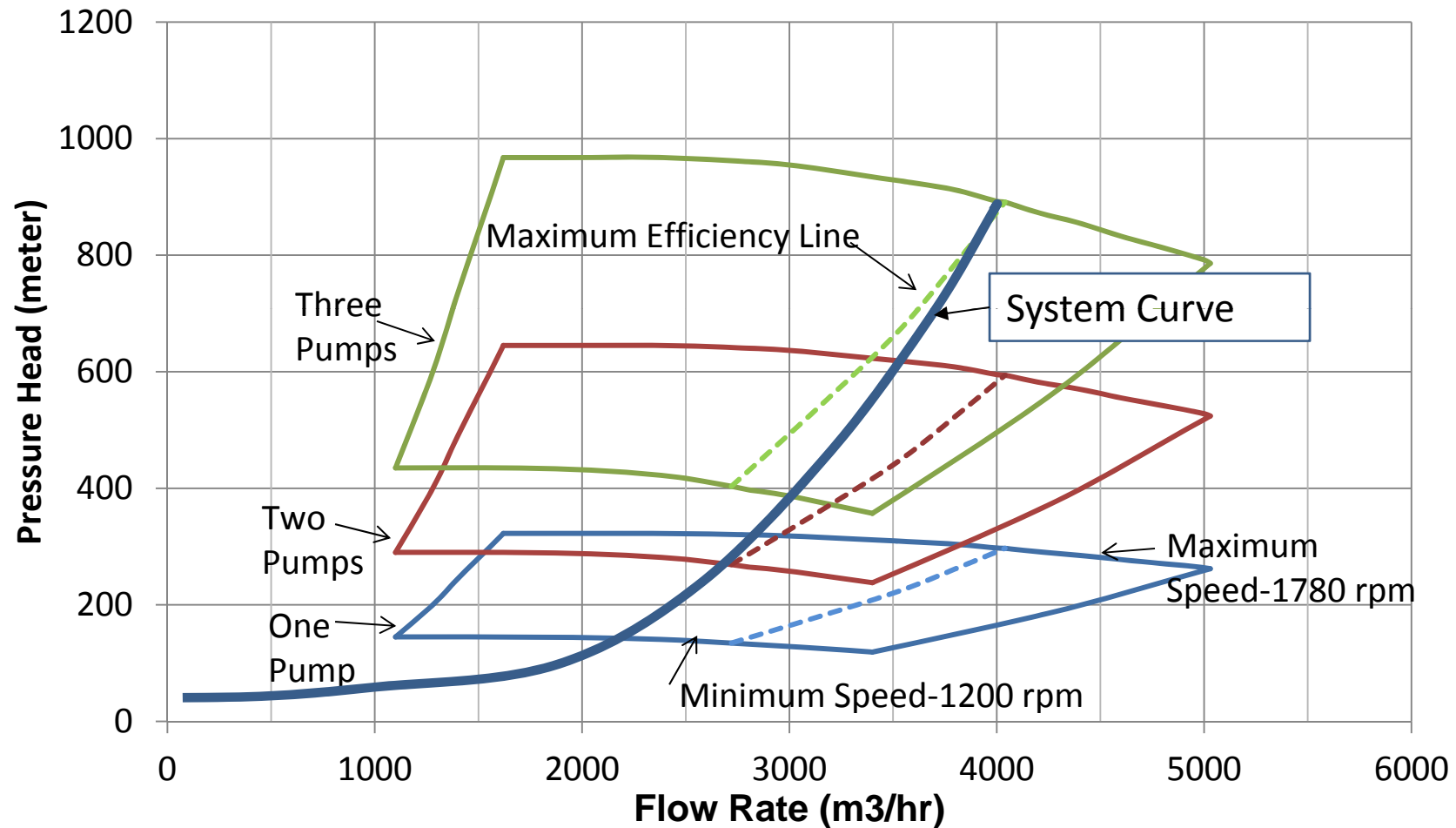
# Head & Efficiency vs Pump RPM



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# Variable Frequency Drive Effects

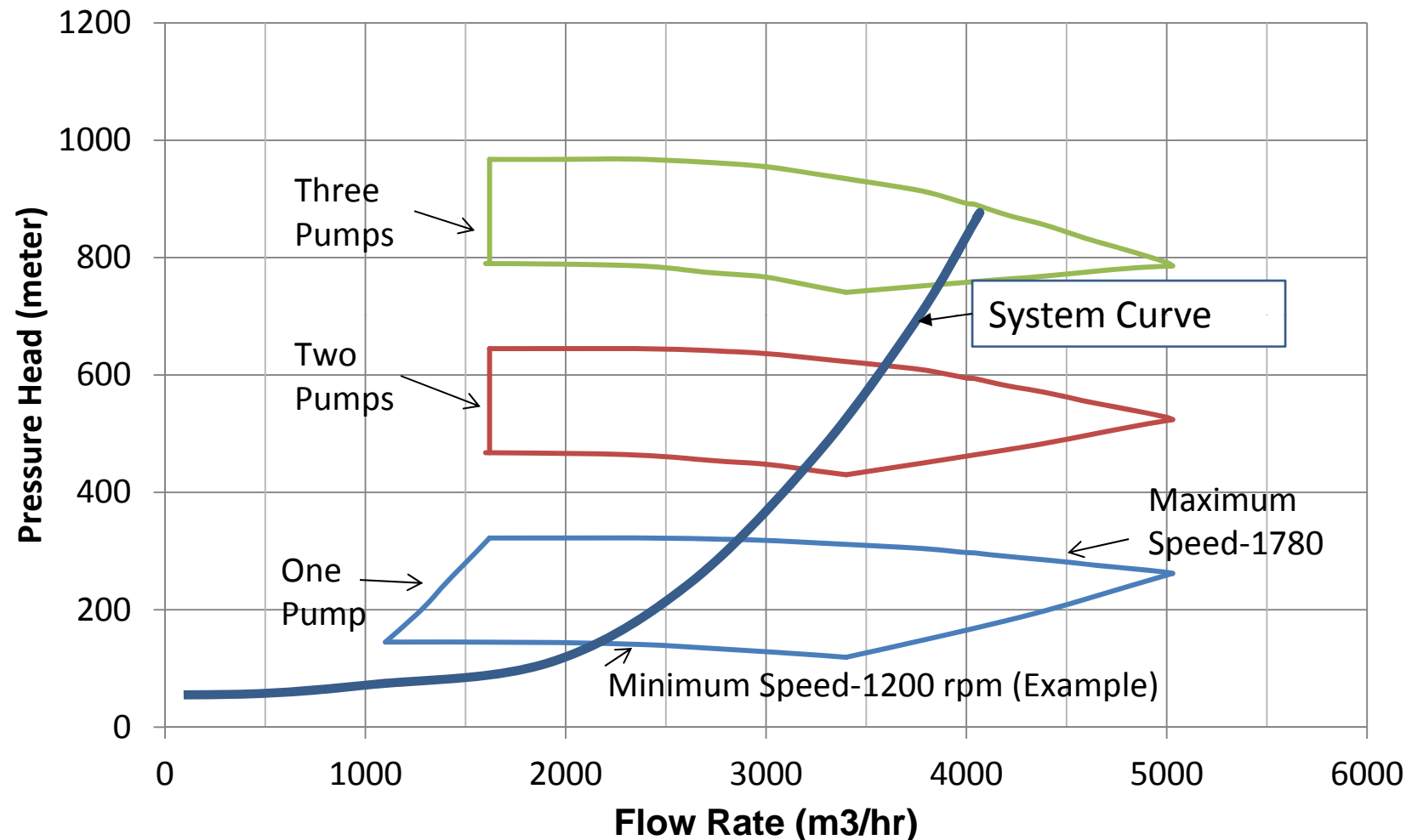
## 1 VFD per Pump



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# Variable Frequency Drive Effects

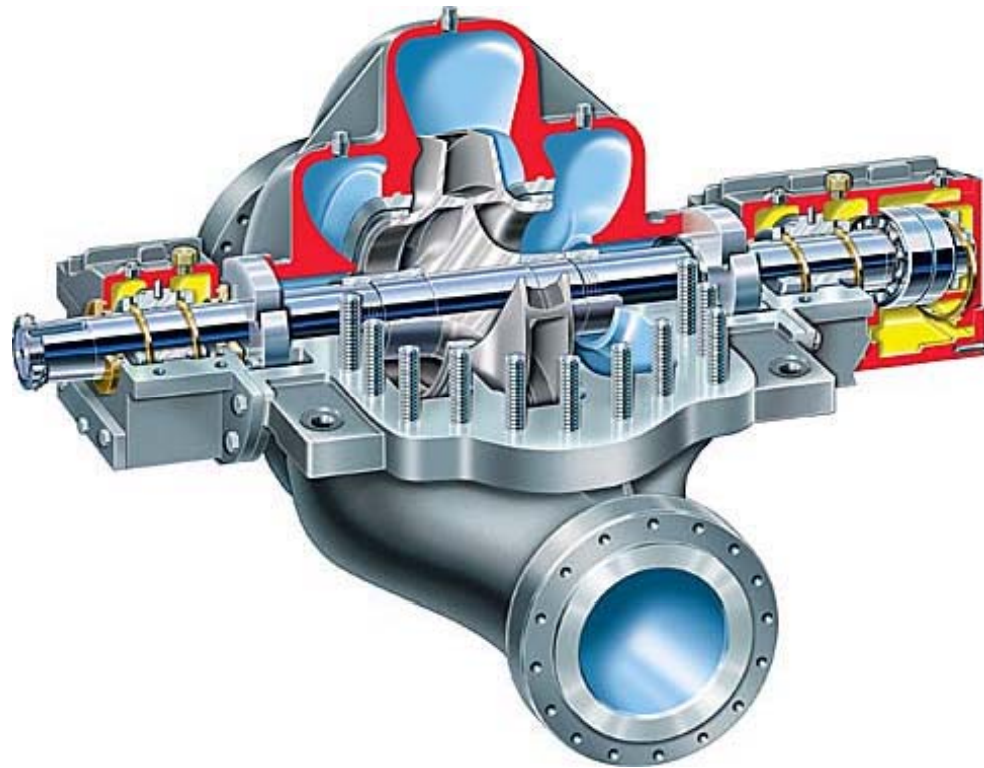
## 1 Shared VFD



# Pipeline Pump Types

## Single Stage API 610 Type BB1

Low Head – High Flow



Courtesy Flowserve

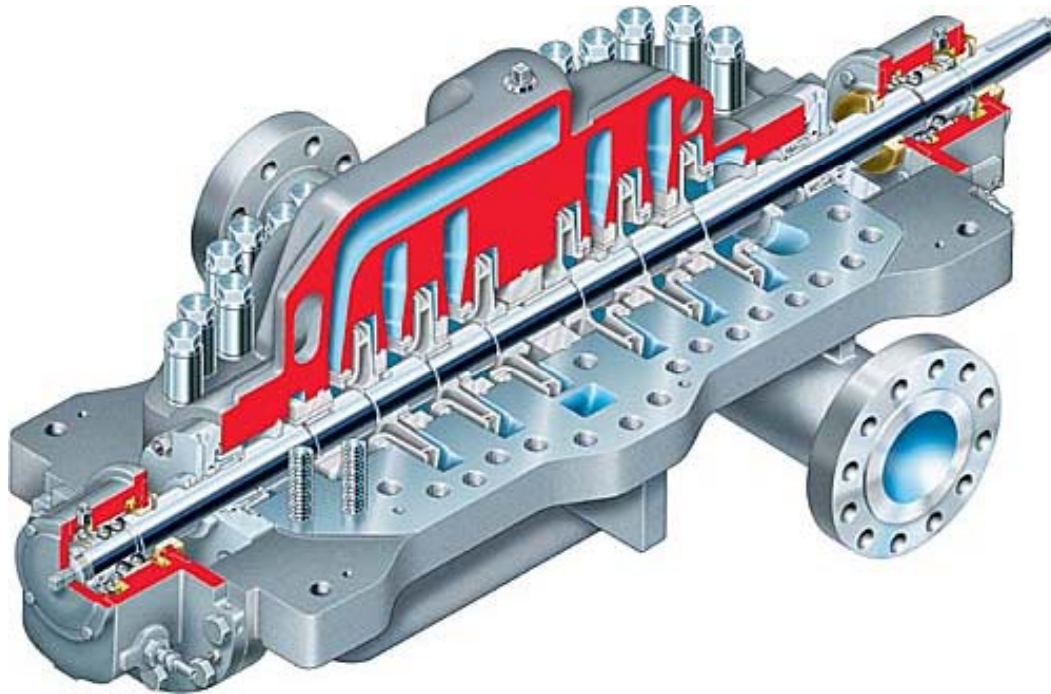
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# Pipeline Pump Types

## Multistage API 610 Type BB3

High Head – Low Flow

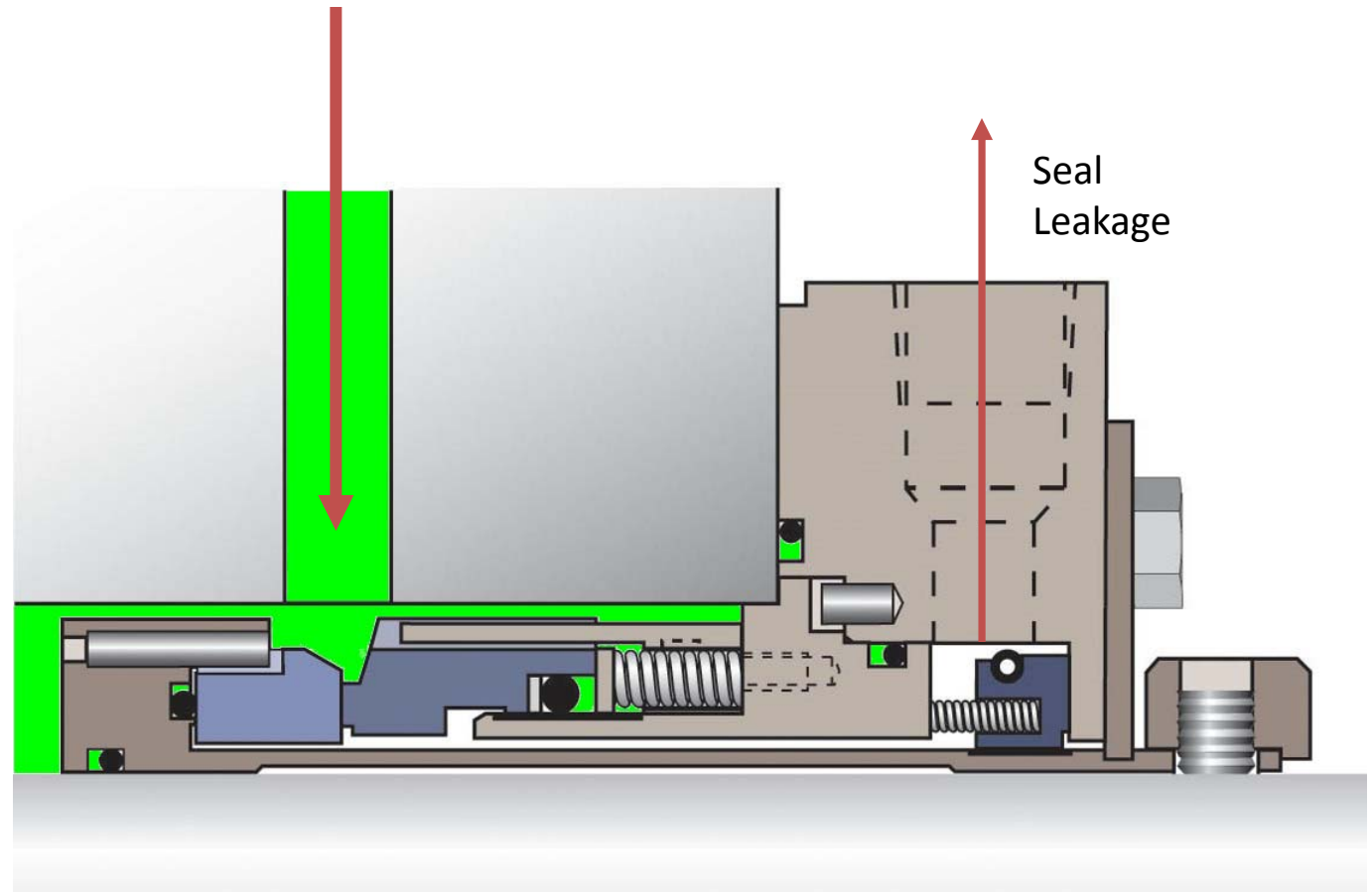


Courtesy Flowserve

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# Mechanical Seal Type

- Hard faces SC on SC or TC – for wear resistance
- Stationary pusher spring design
- Flush through seal chamber
- High suction pressures on 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> pumps
- Segmental carbon bushing
- Set screw collar

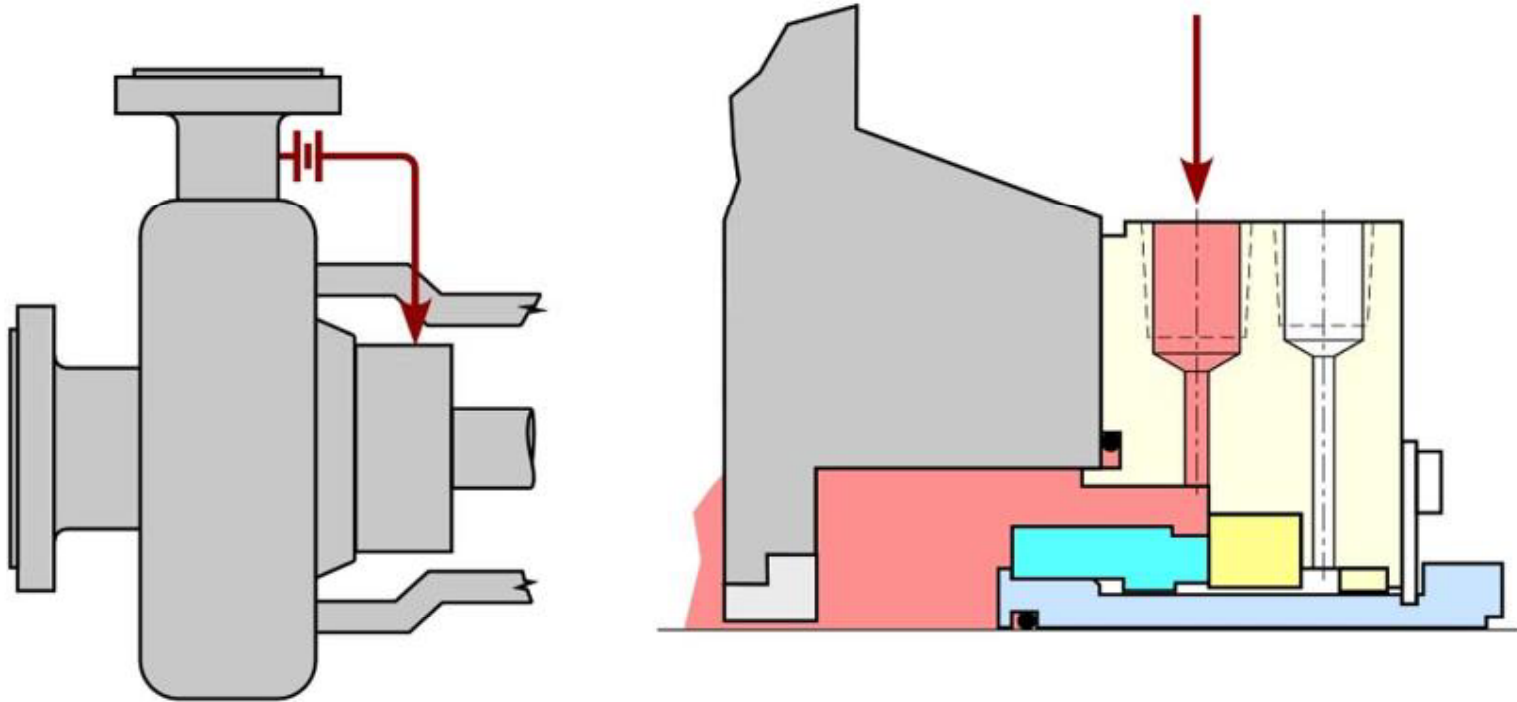


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# Mechanical Seal Flush

## API Plan 11

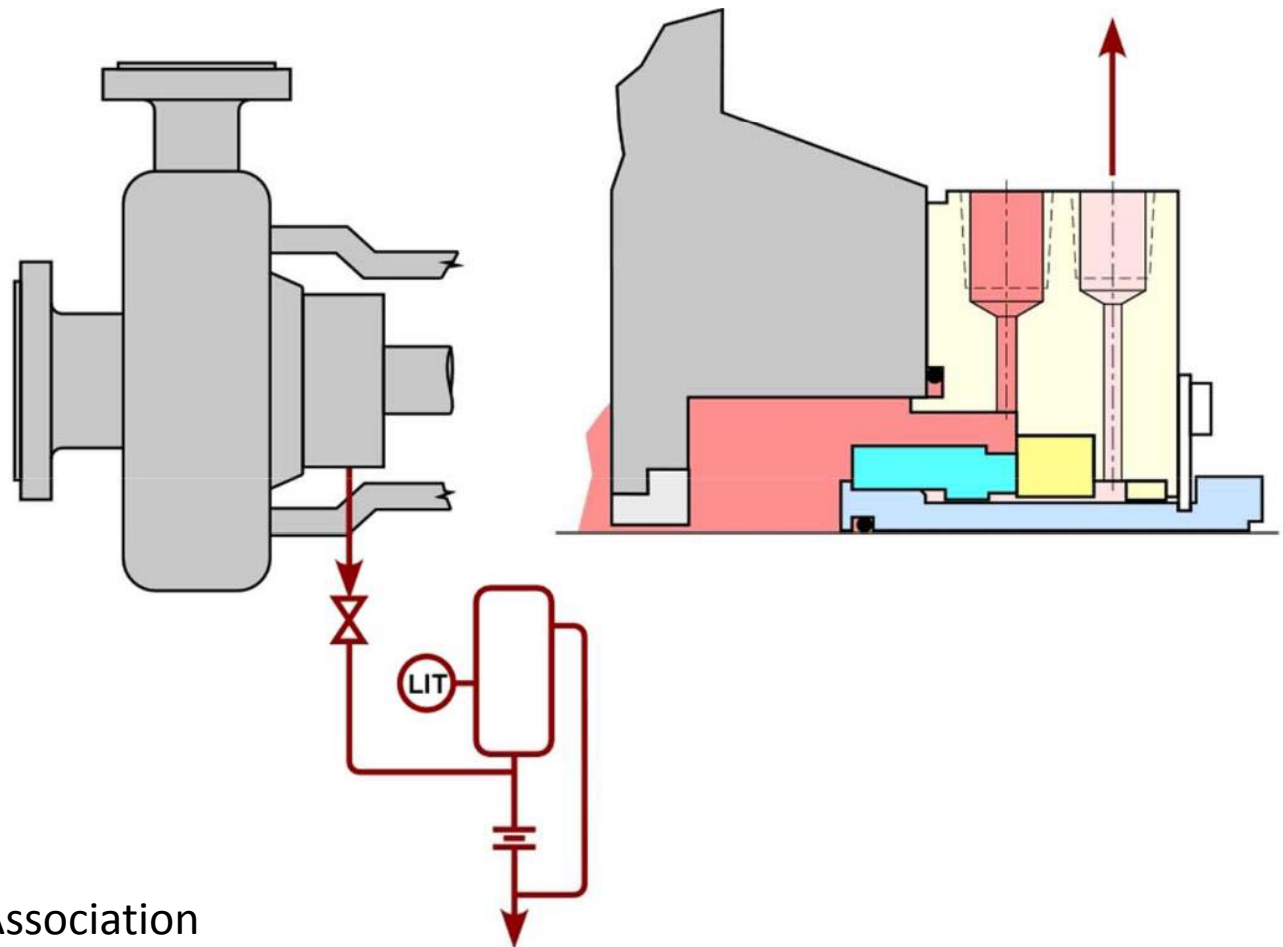


Courtesy Fluid Sealing Association

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# Seal Leakage Detection

- API Plan 65A Typical
- Gravity Drainage to Sump
- Vessel with Level Detector



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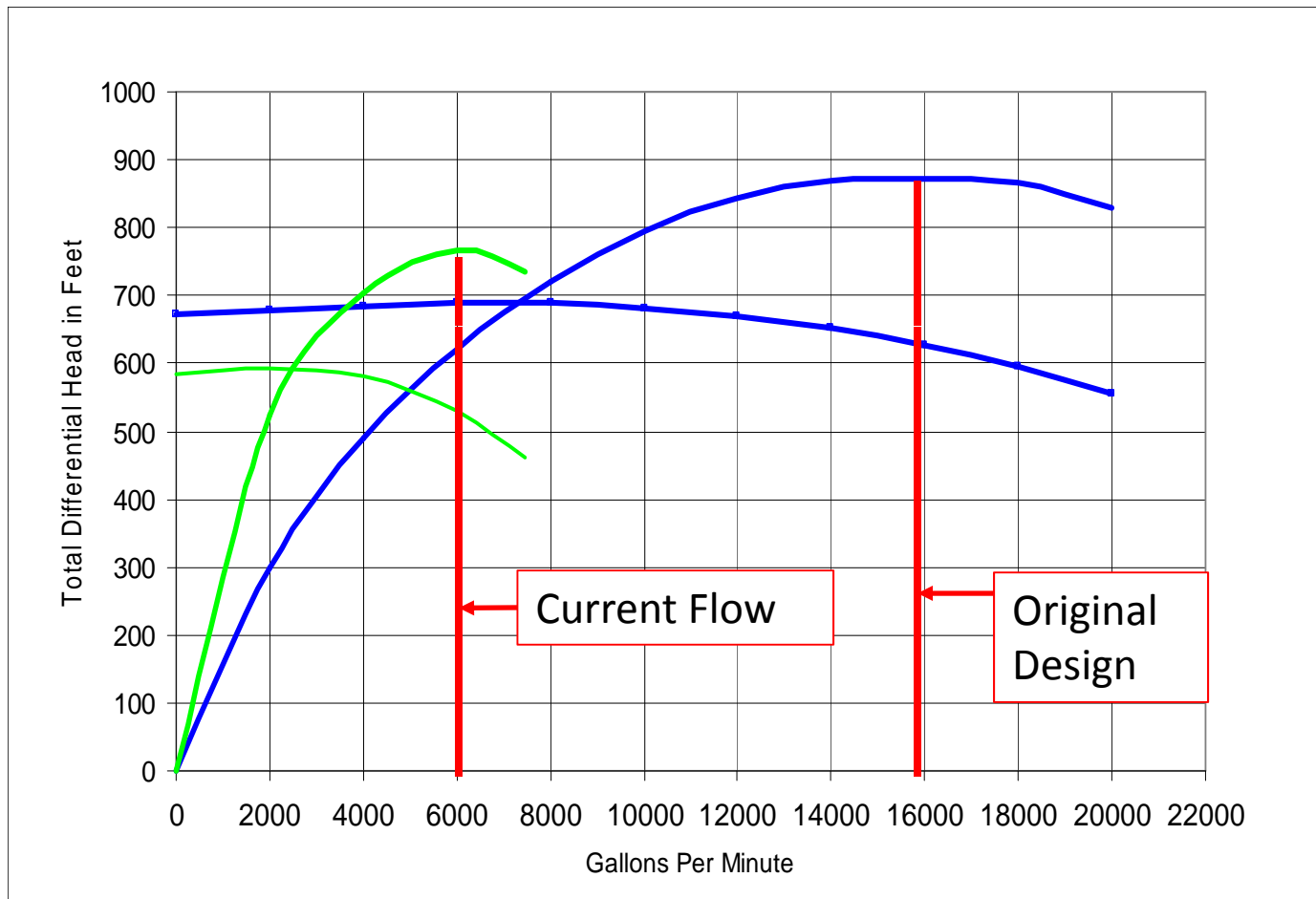
# Pipeline Pump Instrumentation

- Monitor for
  - Bearing Vibration
    - Use Transmitter (Velocity)
  - Bearing Temperature
    - Inboard and Outboard insertion RTD
  - Pump Case Temperature
    - Insertion Thermowell and RTD

# Pump Rerating

- Pump is too large
  - Too much contingency
  - Higher flow rates in the future
  - Flow rates have dropped off
- Pump too small
- Benefits of rerating
  - Higher efficiency
  - Smoother running

# Pump Rerating



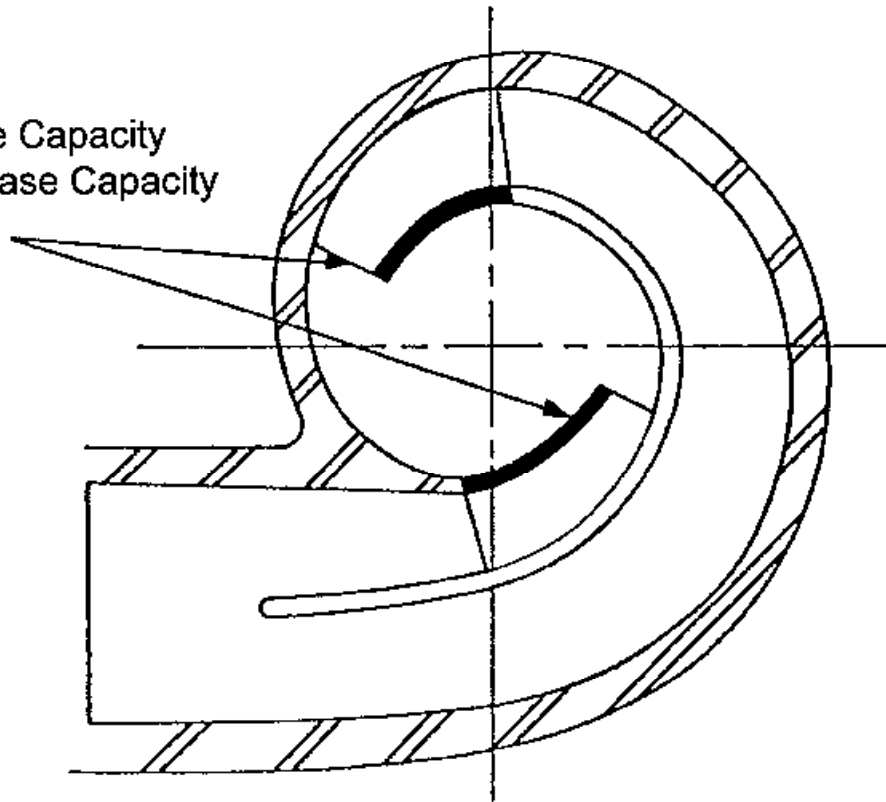
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# Pump Rerating

- Change the speed (VFD)
- Trim the impeller
- Volute modifications
  - Weld in new volute lips
  - Weld in new cone inserts
  - New diffuser ring (diffuser pumps)

# Pump Rerating

Extend Volute Lip to Reduce Capacity  
Cut Back Volute Lip to Increase Capacity





# Replacement Volute Lips



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# Conclusions

- Pipelines are like railroads, pumps like engine
- Pipeline pumps must run reliably (remote)
- Pumps typically operate in series
- VFD adds flexibility
- Typically pusher seal type and Plan 11 / 65 flush/ drain plan
- Pump rerating option for changing pump curve

# Questions?

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