
2016 IAGT Workshop, Montréal

# Gas Turbine Operations for Natural Gas

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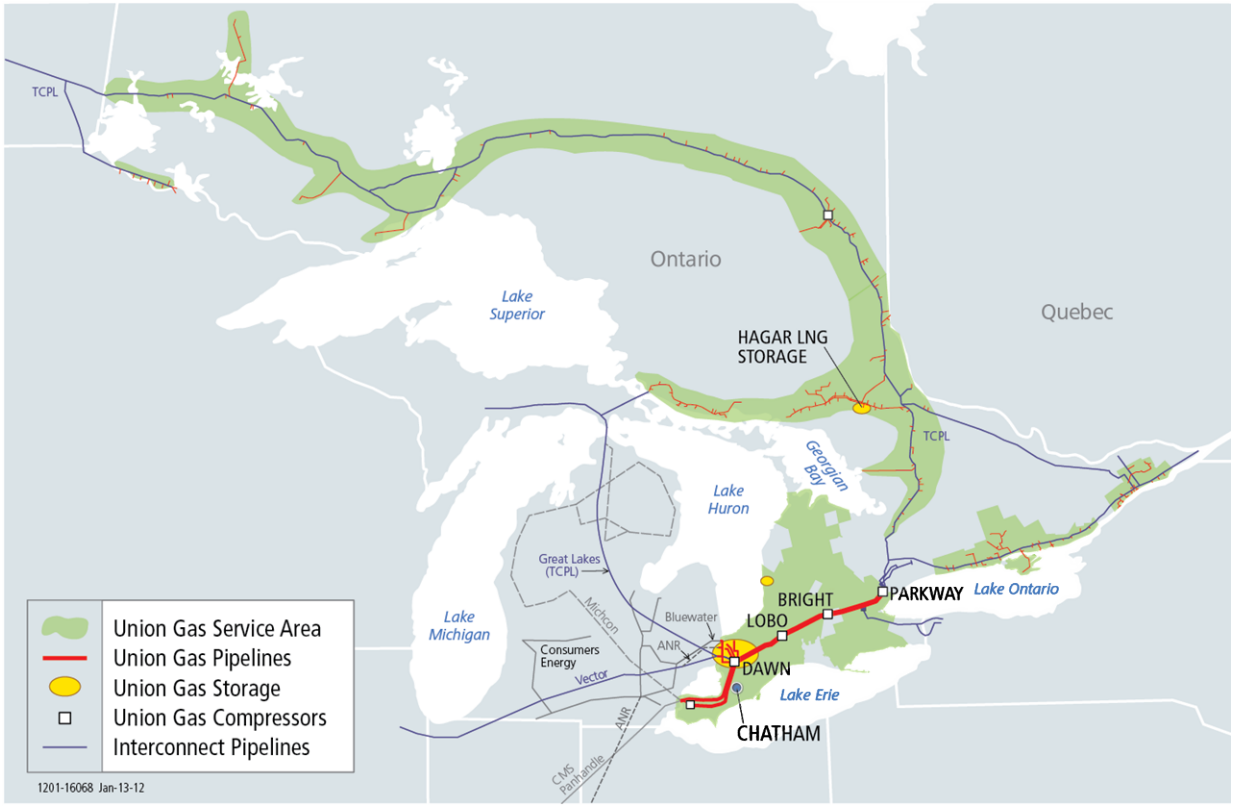
# Agenda

| | |
|---|---|
| **Welcome** | |
| **Union Gas Overview** | |
| **VIGV Technology**<br>• Background<br>• Application<br>• Benefits | **Darryl Arnold** |
| **Compressor Conversion**<br>• Overhung vs. Beam style<br>• Beam style Conversion<br>• Benefits | **Boye Olaoye** |
| **Q&A** | |

# Union Gas Overview



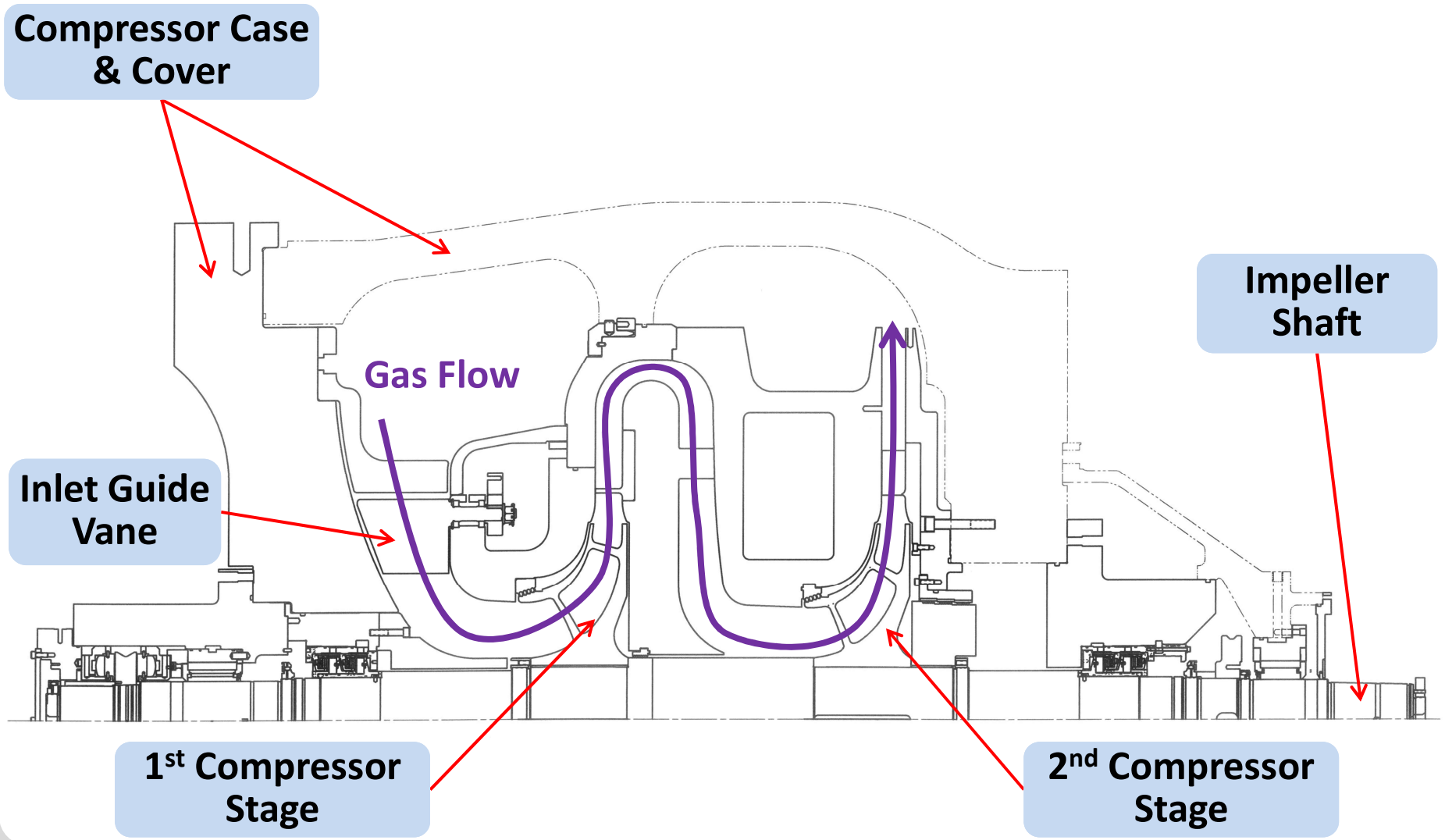

## Current Expansion

| | |
|---|---|
| Parkway | 2 new plants |
| Bright | 1 new plant<br>3 re-aeros |
| Lobo | 2 new plants<br>6 re-aeros |
| Dawn | 1 new plant |

| | |
|---|---|
| Retail Customers | 1.4 million |
| 2015 Pipeline Throughput | 1.2 Tcf |
| Distribution Pipe | 64,800 km |

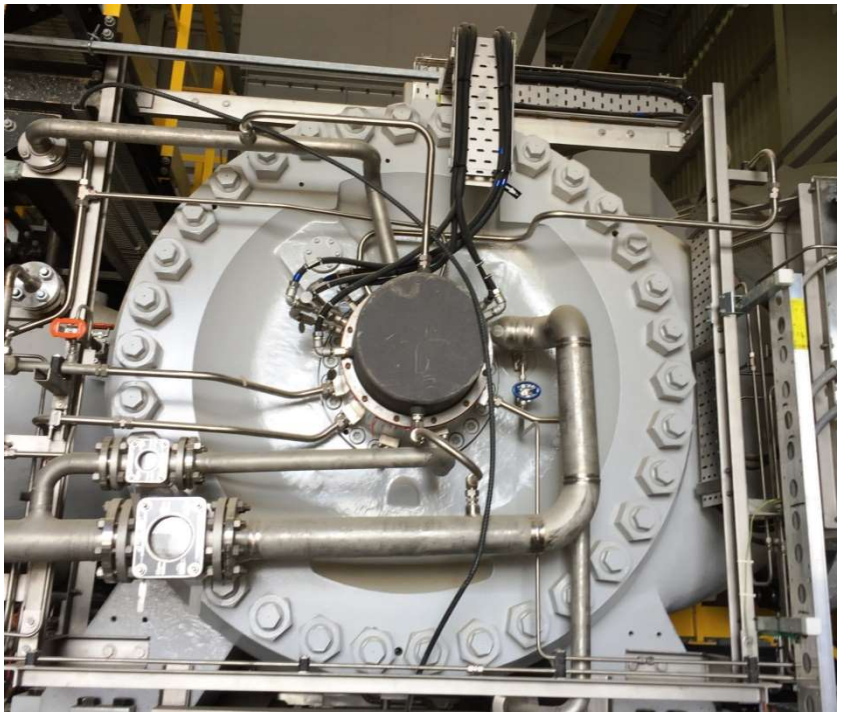
| | |
|---|---|
| Storage Capacity | 160 Bcf |
| Transmission Pipe | 4,811 km |

# Centrifugal Compressor Overview



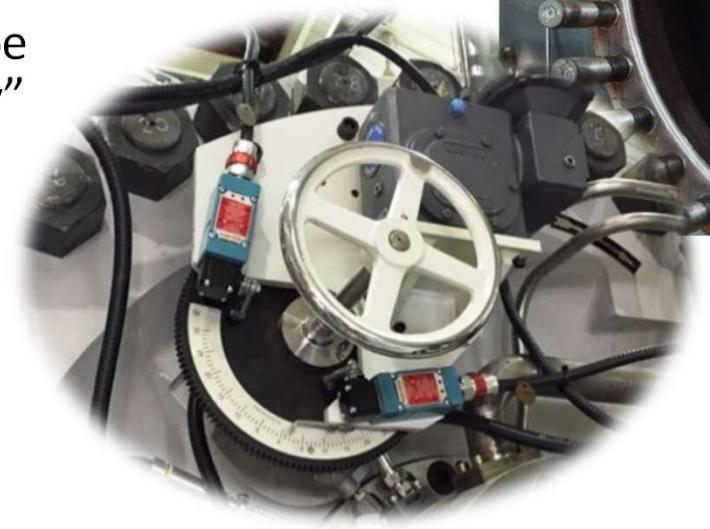
# Inlet Guide Vanes (IGV) – What Are They?

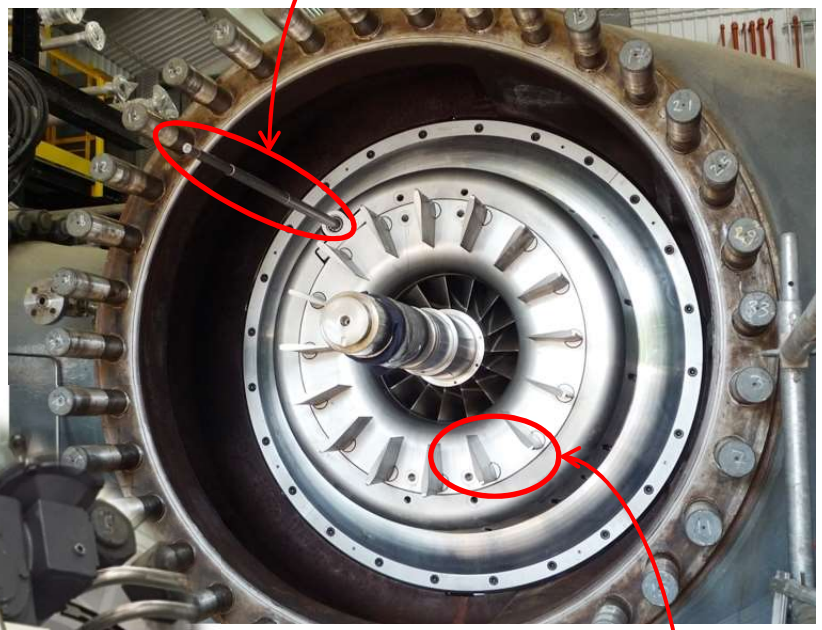
- Control the incident angle of the fluid flow into the impeller
- Provide a defined swirl into the compressor to adjust the aerodynamic performance: Efficiency, Flow, Head
- Static position
  - Older design: cast into the compressor case cover
  - Newer design: bolted onto case cover
- To change position the case cover requires removal; usually only completed during a reaero



# Variable Inlet Guide Vanes (VIGV)

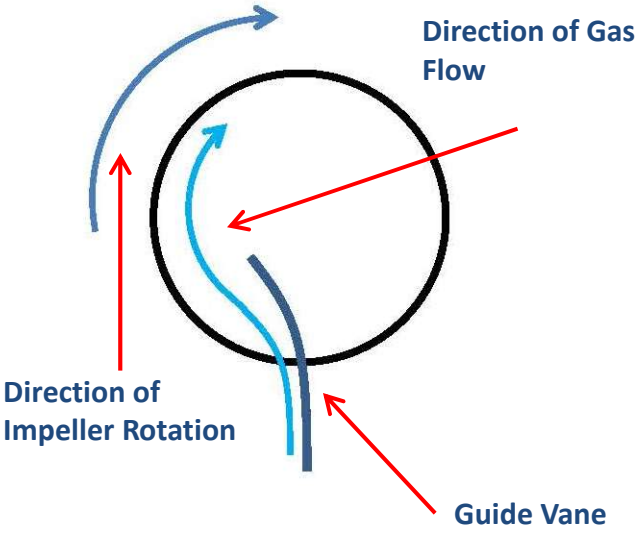
- Variable Inlet Guide Vanes (VIGV)
- Three set positions
  - 30° Pre-swirl
  - Radial (centre position)
  - 20° Counter-swirl
- Position change can be completed “on the fly”
- Surge Control





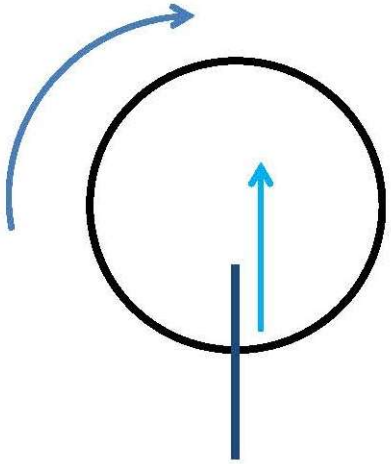
# VIGV – con't

## Pre-swirl Position

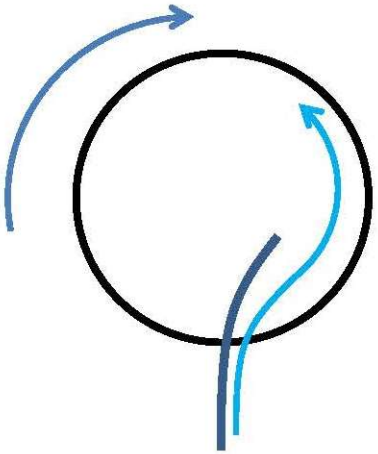



**Condition the gas into the direction of rotation**

## Radial Position

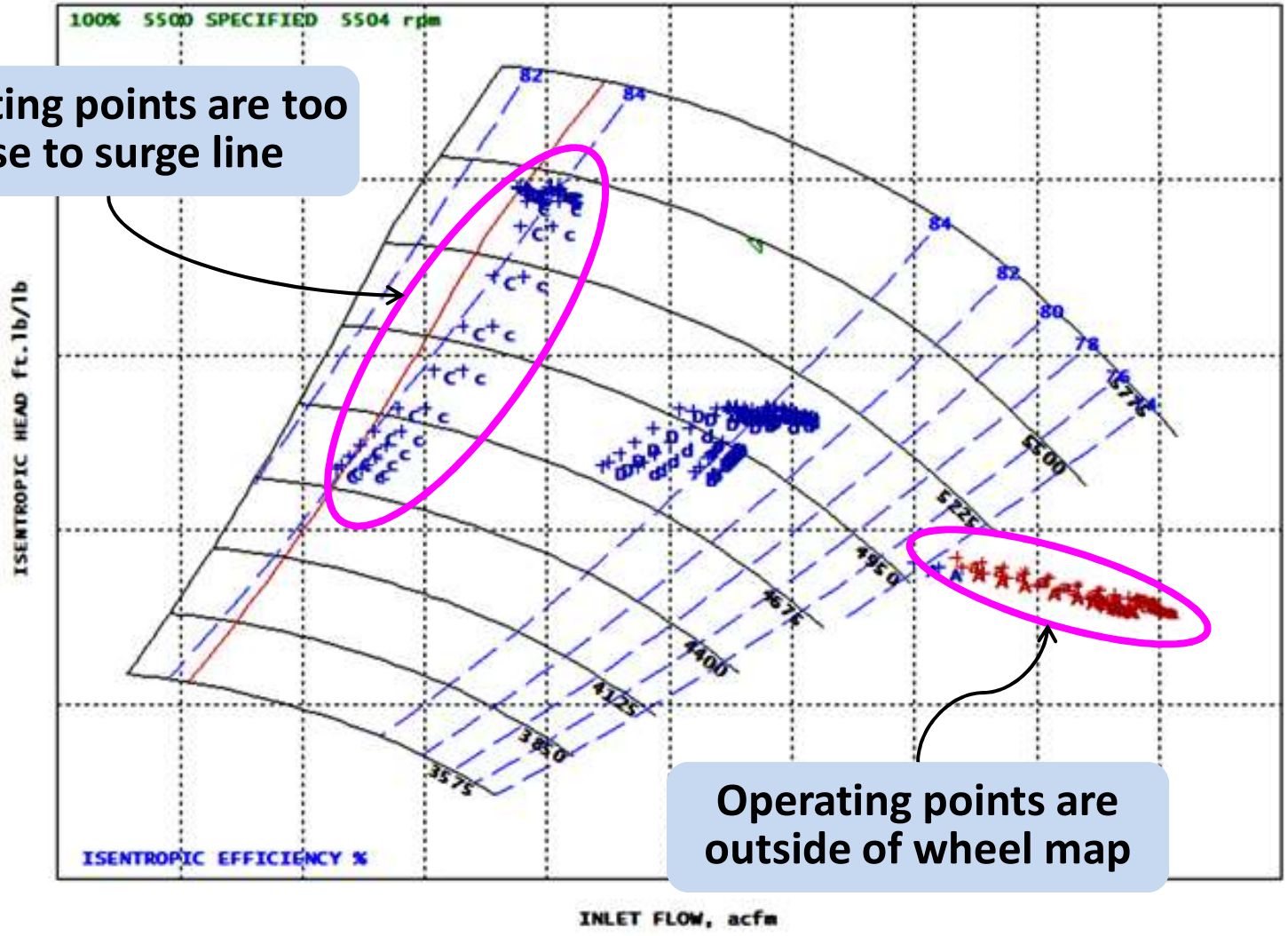


## Ctr-swirl Position



**Condition the gas into the direction opposite of rotation**

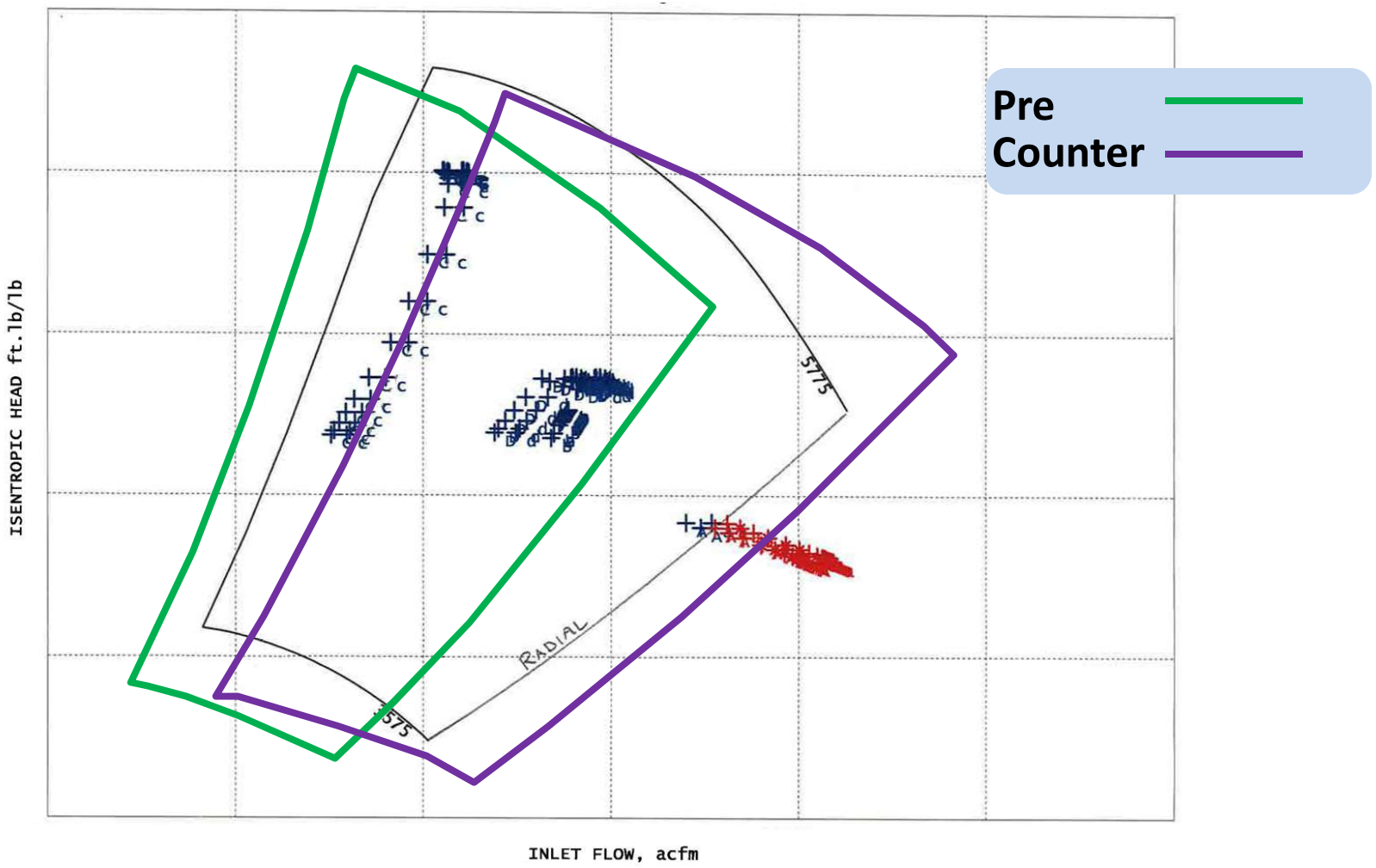
# Standard Wheel Map – Radial IGV Position



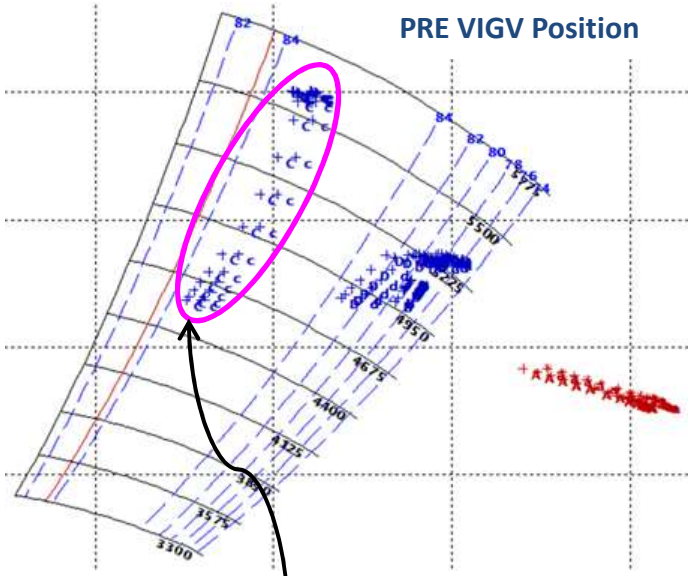

**Operating points are too close to surge line**

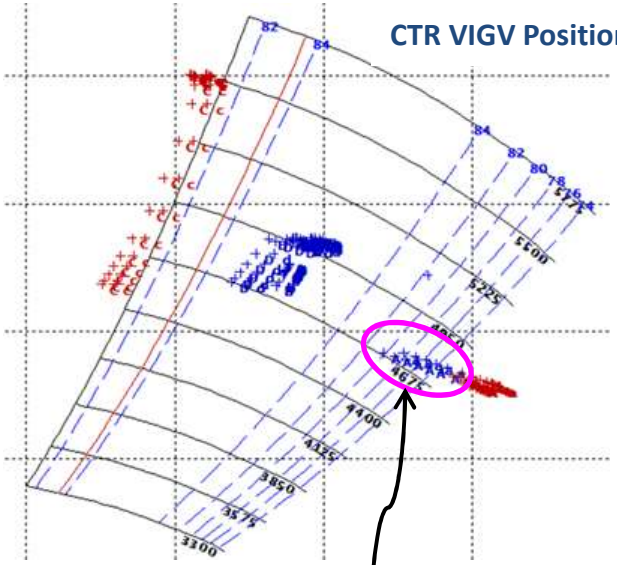
**Operating points are outside of wheel map**

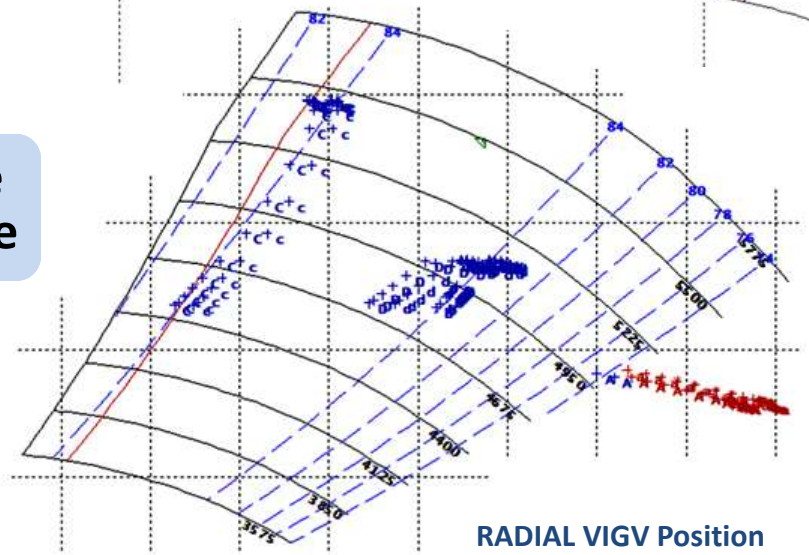
# VIGV Wheel Map



# Wheel Map Comparison



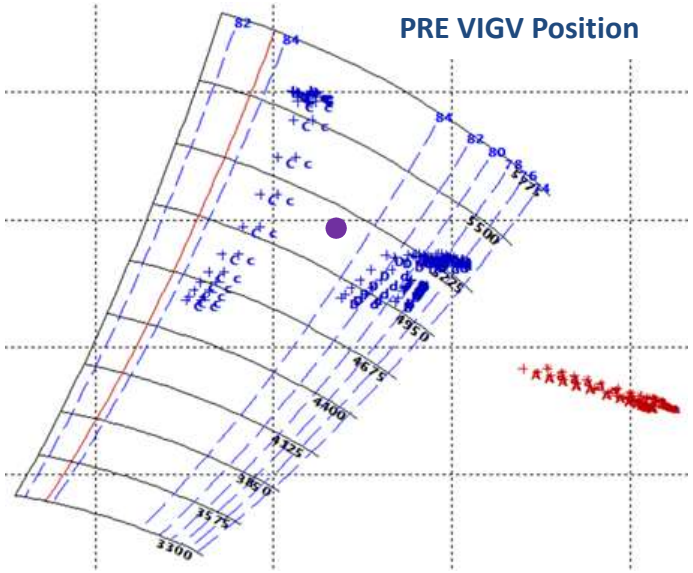

**Operating points are now off the surge line**

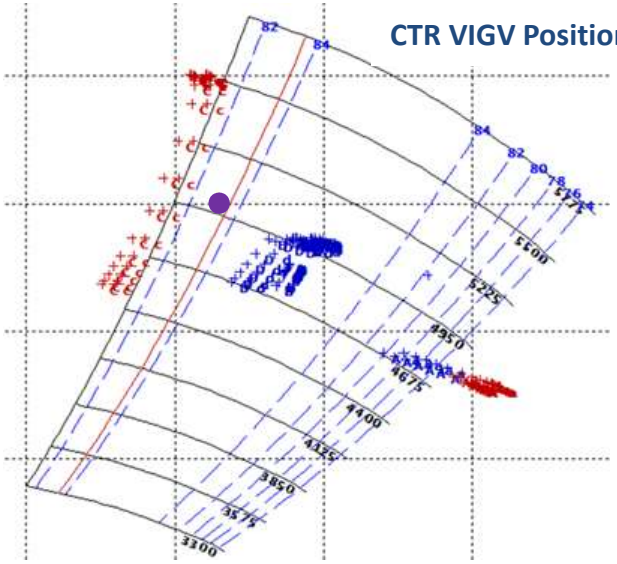
**Point are within wheel map**

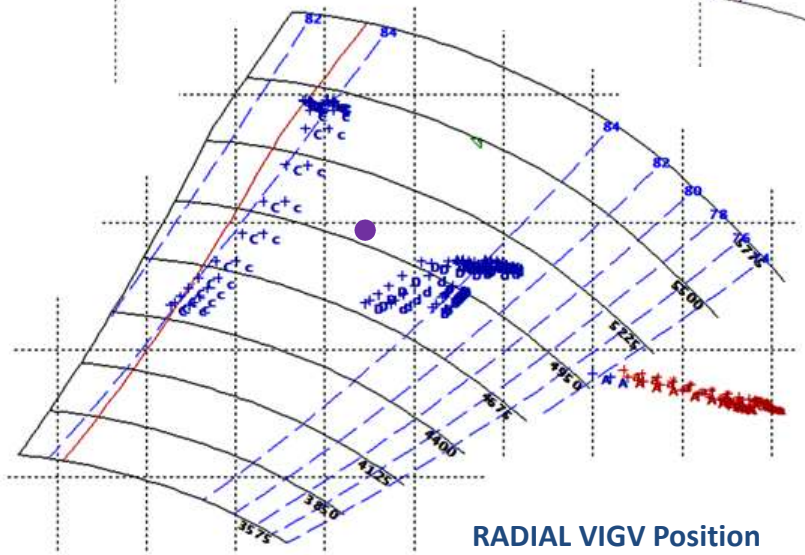
# Benefits

- Reduced recycle of gas
- Reduced short fall on design days
- Reduced short fall on LCU scenarios
- Normal operation, operate in a better part of the map

# Benefits con't

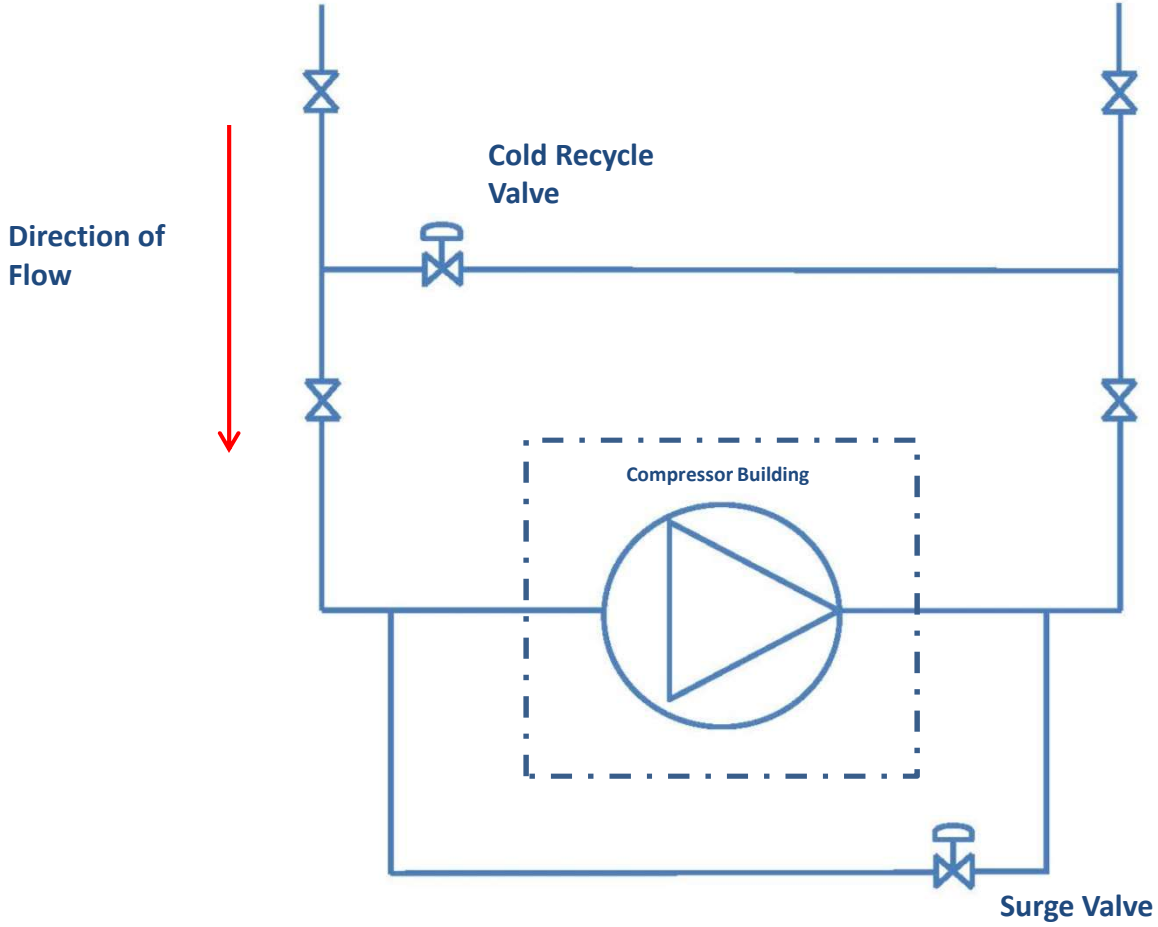


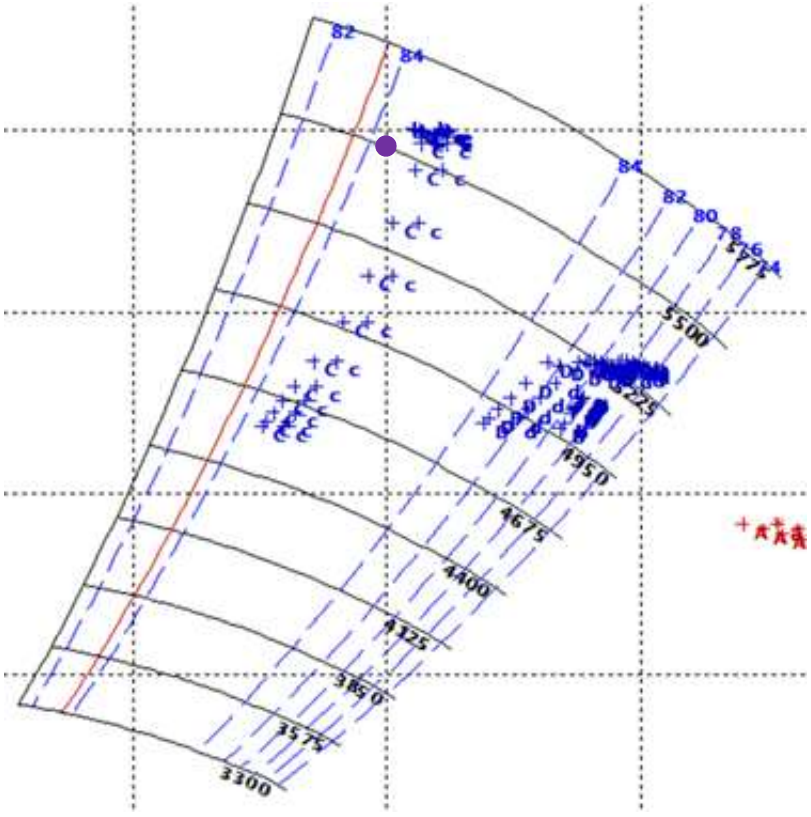




Normal Operating Point

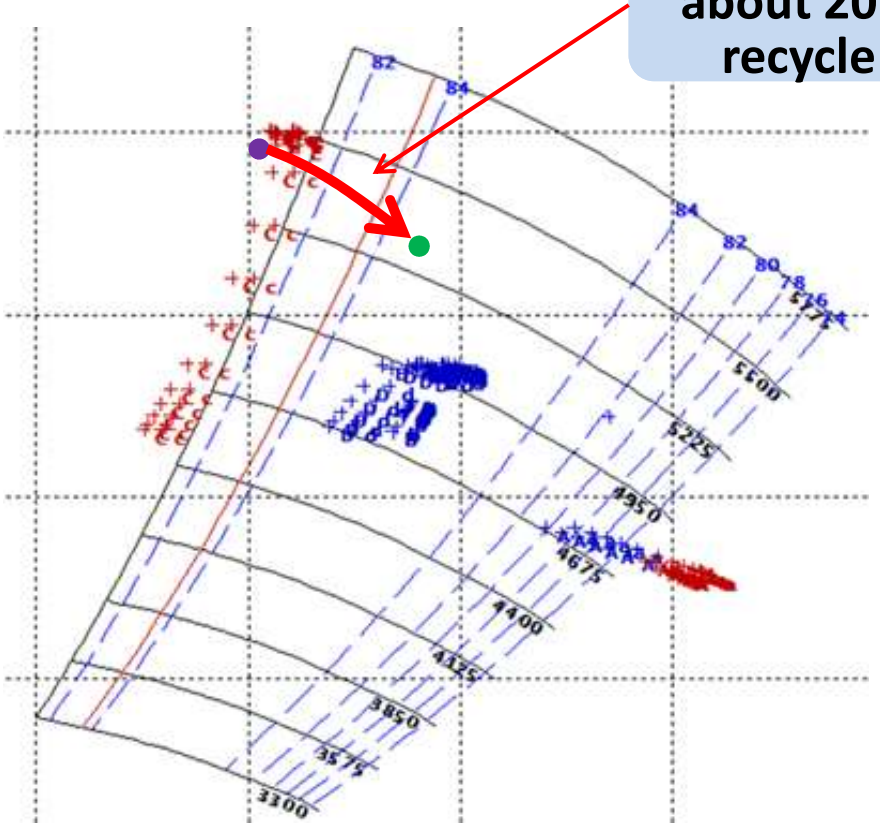
# Benefits – Flow Recycling



# Benefits – Flow Recycling




PRE VIGV Position



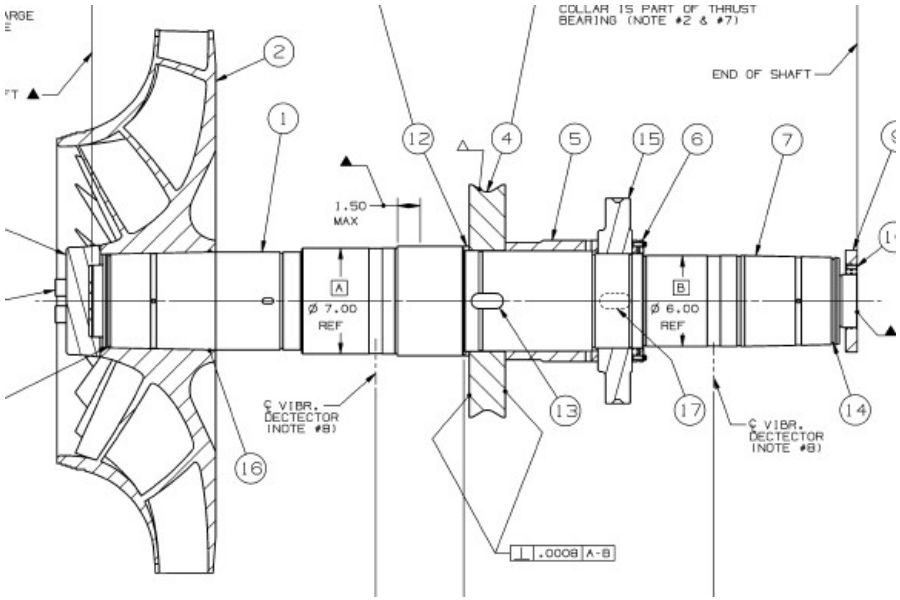

CTR VIGV Position

# Benefits – High Level Cost Analysis

| Condition | High Level Cost |
|---|---|
| Flow Recycling<br>(10 to 20%) | $3,000 - $6,000 / day |
| Efficiency<br>(~ 5%) | $1,800 / day |
| Design Day Gas Shortfall | 2.0 bcfd |

# Overhung vs. Beam Style

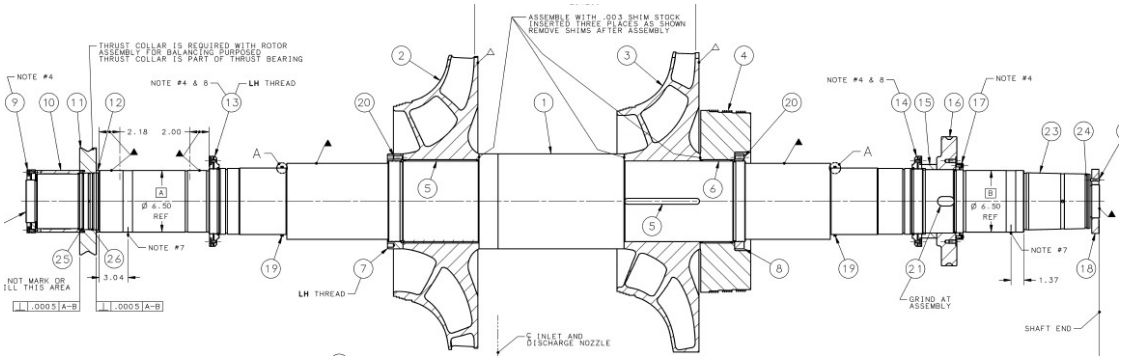
- Overhung style
  - impeller is located at the non-drive end of the shaft; outboard of the non-drive end radial bearing.
  - Limited to single stage.




**Removal of existing overhung style rotor assembly from our A2 plant**

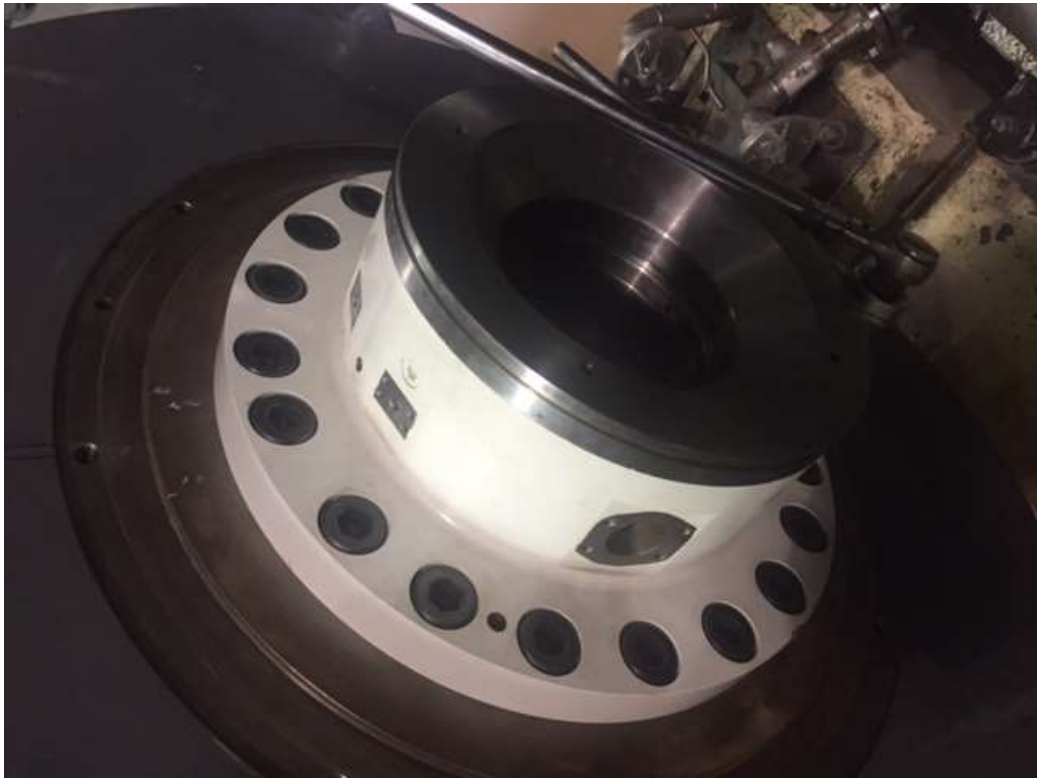
# Overhung vs. Beam Style

- Beam style configuration
  - Impellers are located between the radial bearings
  - Multistage centrifugal compressors



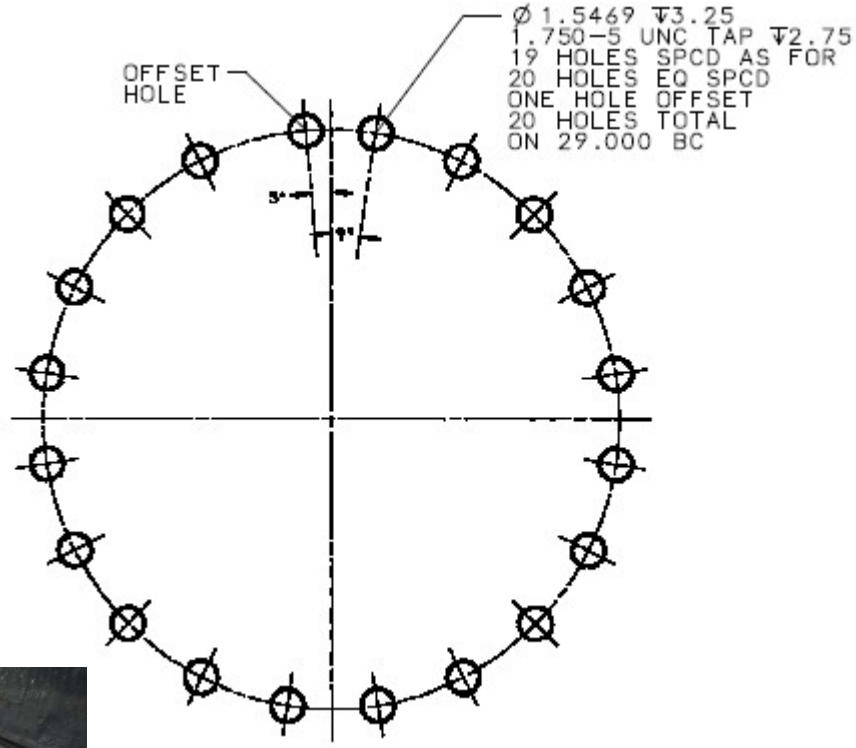

# Beam style Conversion

- Balance piston line
- Seal housing location
- Machine work
  - Housing: aux drive
  - Casing: compressor
  - Adapter: coupling



# Beam style Conversion

- Casing: Compressor
  - Drill bolt pattern for seal housing

# Beam Style Conversion

- Casing: Compressor
  - Compressor drilling fixture
  - Mag-based drill

**Mounting drilling fixture on compressor casing**

# New Casing vs. Retrofit

- Cost benefit
- Shop testing
- Familiarity
- Learning opportunity/Employee development

# uniongas

A Spectra Energy Company

# Q&A

Canada's Top 100 Employers 2016

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