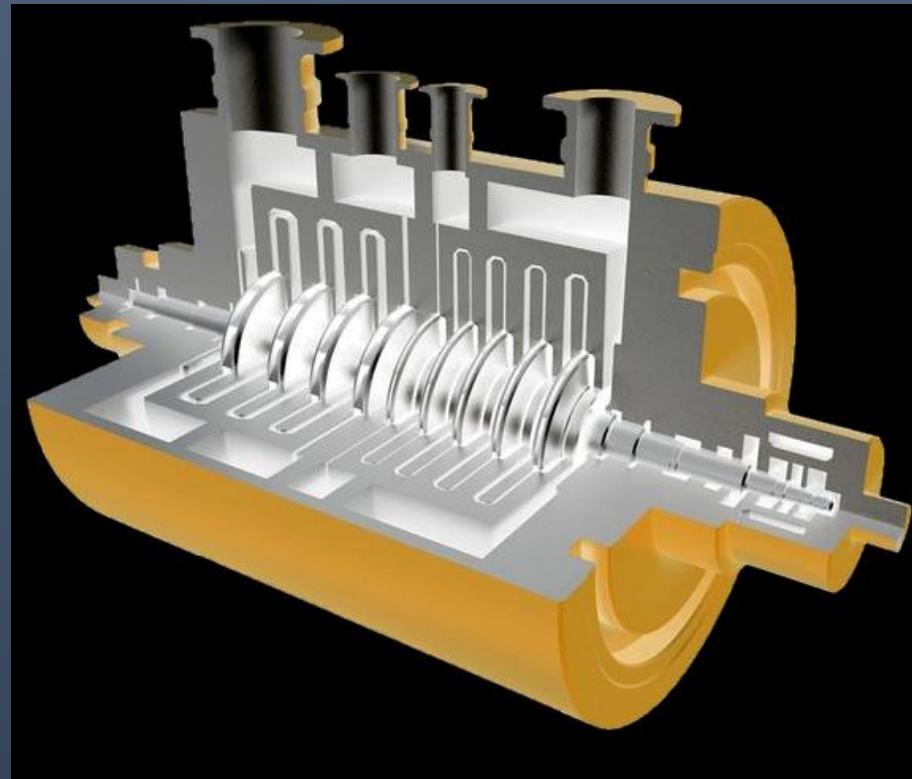


# *CTrend* Performance Simulation Software for API617 Process Centrifugal Compressors



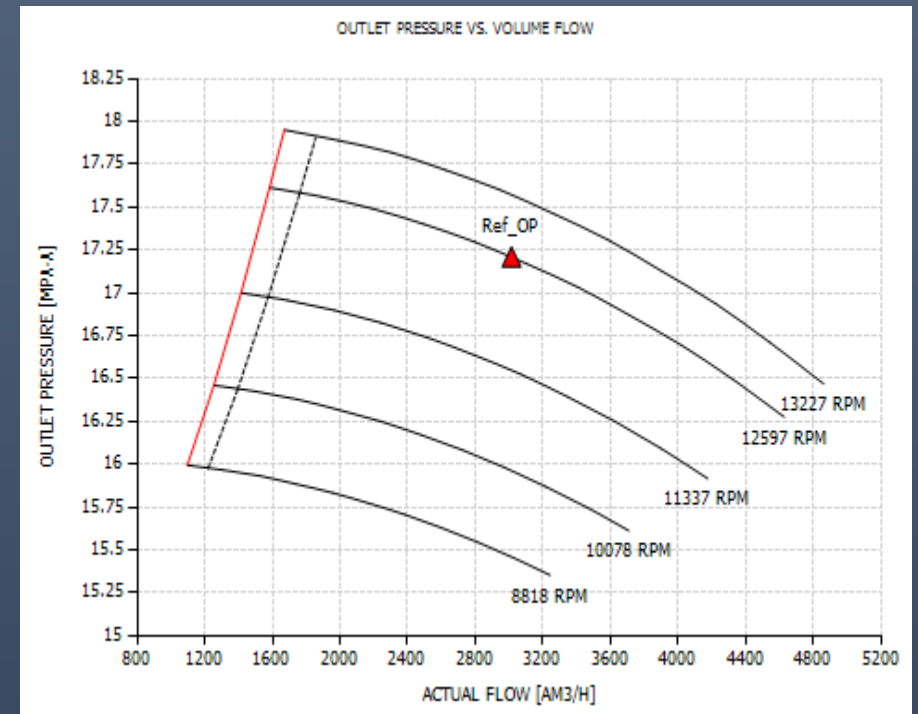
# Summary

- Introduction
- Modeling Process & Software Description
- Benchmarking & Demo (Case Study)

# Introduction



## Reference Compressor Map (provided by Vendor as part of Databook)

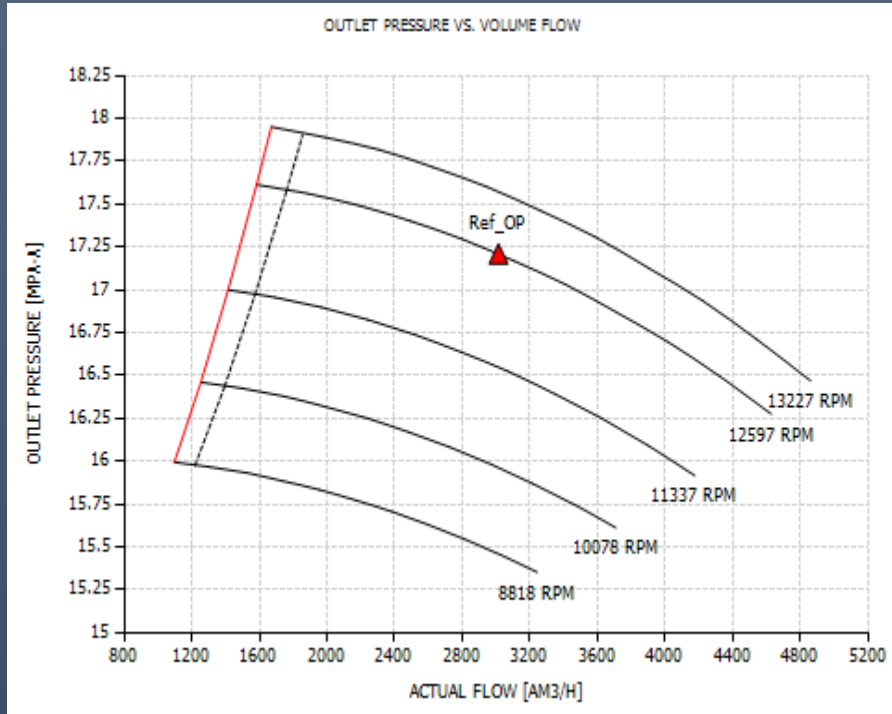


## Illustration of Existing Compressor

Photo: Siemens Energy

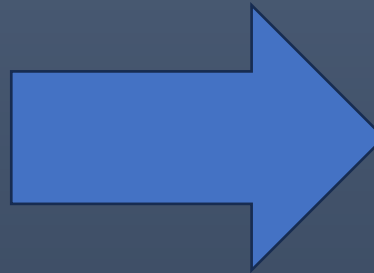
# Introduction

## Centrifugal compressor map is dependent upon inlet conditions



Compressor operating  
@ REFERENCE conditions

Changes in field  
conditions, gas  
composition etc.



Compressor operating  
@ NEW conditions

# Introduction

- Tandem Train / Multi-Casing & Back-to-Back Compressors
- Changed Field Conditions and Gas Composition
- Higher Pressures (Compressibility ↗ ↗)



**Ctrend simulates  
performance output  
@ new conditions  
based on reference  
map information**

# *Modeling Process & Software Description*

## **STEP 1**

Obtain existing  
compressor process data  
and impellers information  
( datasheet)

Obtain existing  
compressor map  
(convert in tabular format)

Define design condition  
and speed

## **STEP 2**

Enter data into CTrend and  
generate automatically a  
so-called thermodynamic  
signature of the existing  
compressor section

## **STEP 3**

Simulate  
off-design and new  
conditions  
performance

# Modeling Process & Software Description

The screenshot displays the CTrend software interface for modeling a compressor section. The interface is divided into several key areas:

- PROCESS SECTION SELECTOR:** Located in the top-left pane, it shows a tree view with 'Process Section' expanded to 'PS1'.
- OPERATING CASES:** Located in the middle-left pane, it shows a tree view with 'Process Case' expanded to 'Ref\_OP'.
- SPEED CURVES:** Located in the bottom-left pane, it shows a tree view with 'Speed Curves [100%=12597 RPM]' expanded to show four curves: 'Curve No.1 (80%)', 'Curve No.2 (90%)', 'Curve No.3 (105%)', and 'Curve No.4 (70%)'.
- COMPRESSOR SECTION INTERNALS:** The central area, titled 'Stage - PS1', contains a 'D2 mm' column with 11 rows of dropdown menus (all set to 355). Below this is a 'Train' section with buttons for 'DRIVER', 'COUPLING', and 'PS1'.
- PROCESS DATA MASK:** The right-hand area, titled 'Alternative Case: Ref\_OP', contains a 'Search Criterion' dropdown (set to 'Speed') and a table of 'Molar Fraction (Mol. %)' for various gases.

Molar Fraction (Mol. %)	
Methane	1.25
Nitrogen	0
Carbon Dioxide	0
Ethane	0.38
Propane	0.61
n-Butane	0.12
Isobutane	0.3
n-Pentane	0.011
Isopentane	0.059
n-Hexane	0.14
n-Heptane	0
n-Octane	0
n-Nonane	0
n-Decane	0
Hydrogen	97.06
Oxygen	0
Carbon Monoxide	0
Water	0.07
Hydrogen Sulfide	0.002
Helium	0
Argon	0
Sum %	--
Normalize	<input type="checkbox"/>

Additional parameters shown in the 'Alternative Case: Ref\_OP' section include:

- Inlet Pressure: 14.53 MPa-a
- Inlet Temperature: 317.15 K
- Massflow: 45556 kg/h
- Outlet Pressure: 17.21 MPa-a
- Shaft Speed: BY PROG. RPM
- Mol. Weight: 2.969 g/mol

Filename: AdvancerHC\_PA.prj

# Modeling Process & Software Description

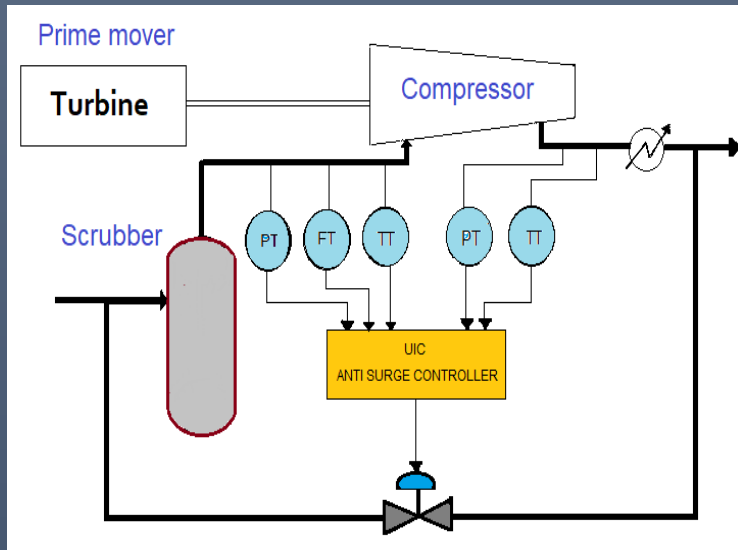
The screenshot displays the CTrend software interface. The main window is titled 'Stage - PS1'. On the left, there is a 'Process Section' tree with 'PS1' selected, and a 'Process Case' tree with 'Design' selected. Below these are 'Speed Curves' and 'Train' buttons labeled 'DRIVER', 'COUPLING', and 'PS1'. The central area is titled 'OEM Tabulated Map' and contains a 'Generate Thermodynamic Signature' button, a 'Variables' dropdown set to '(HPol., Etap) vs. Vol. Flow', and a 'Design Speed (RPM)' input field set to '11222'. Below this is a table with the following data:

RPM	Inlet Flow Am3/h	Polytropic Head kJ/kg	Polytropic Efficiency %	Condition Basis
11222	7128.6	145.348	72.619	Design
11222	7197.24	145.069	72.777	Design
11222	7401.08	144.459	73.279	Design
11222	7600.77	143.857	73.753	Design
11222	7798.38	143.249	74.26	Design
11222	8000.14	142.217	74.553	Design
11222	8199.83	140.939	74.831	Design
11222	8399.51	139.414	75.062	Design
11222	8601.28	137.639	75.215	Design
11222	8803.04	135.587	75.33	Design
11222	8998.57	132.293	74.927	Design
11222	9200.34	127.563	74.153	Design
11222	9402.1	118.652	71.709	Design
11222	9499.86	113.528	70.15	Design
11222.01	5573.85	140	71.951	CASE1
11222.01	5798.12	138.493	72.494	CASE1
11222.01	5999.29	136.991	72.989	CASE1
11222.01	6200.47	134.97	73.1	CASE1
11222.01	6398.35	132.158	73.12	CASE1
11222.01	6596.23	129.55	73.079	CASE1
11222.01	6800.71	126.31	72.982	CASE1
11222.01	6998.59	121.901	72.133	CASE1
11222.01	7196.47	116.714	71.078	CASE1
11222.01	7397.64	109.409	69.061	CASE1
11222.01	7493.29	105.415	67.908	CASE1
11222.3	7511.86	145.765	72.707	CASE2A

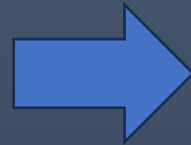
OEM  
REFERENCE  
MAP DATA



# Modeling Process & Software Description



Monitoring  
& Trending



MODBUS  
CONFIGURATION

MODBUS & Sampling Settings

Protocol: TCP/IP  
Format: WORD16+  
Server Unit ID: 1  
First Register: 300001  
Timeout (Second):  
TCP/IP  
Server IP Address: 127.0.0.001  
Server Port: 502  
RTU/ASCII  
Parity: NONE  
Port (COM): 1  
Baud Rate: 9600  
Stop Bits: 1

Scanning Settings  
Screen Buffer Size (No. Sample): 100  
Scan Delay (T1) (>= 1 sec): 5 Second  
Signal Averaging  
No. Sample: 1  
Scan Interval (mSecond): 100

Filter (ModRsim2 Simulator)  
Interval (mSecond): 100  
Constant: 1E-7

Apply Cancel

ModRsim2 Filter  Scan Only  Scan+Predict

Scan Status  
Stopped

Analog Inputs Plot Setup Log Data

Units  
Pressure: MPa-a Temperature: K Flow: kg/h

ID	Tag	Description	Address	Data Low	Data High	EU Low	EU High	PS
1		FLOW	300001	0	65535			1
2		SUCTION PRESSURE	300002	0	65535			1
3		SUCTION TEMPERATURE	300003	0	65535			1
4		DISCHARGE PRESSURE	300004	0	65535			1
5		DISCHARGE TEMPERATURE	300005	0	65535			1
6		SHAFT SPEED	300006	0	65535			1

PS	Mixture	Map Basis	Speed Ratio%	Threshold PR.Ratio%	Threshold Efficiency%	Threshold Power%
1	Design	Design	100	0.5	0.5	0.5

# *Benchmarking & Demo (Case Study)*

## Benchmarking

- NIST Data (US Institute of Standards and Technology)
- GASCALC Software

## CTrend Case Study

Fixed speed machine application

## Utilities Demonstration

- NACE risk analysis tool
- QHmap tool
- GERG head calculation tool