AVEVA™ Process Simulation

Built from the ground up, delivering the process digital twin,
to the next generation of engineers.

For Europe Advisory Group Meeting
Cal Depew, AVEVA Simulation Product Director

22 July 2020

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01 **Vision of AVEVA Process Simulation**

02 New Features

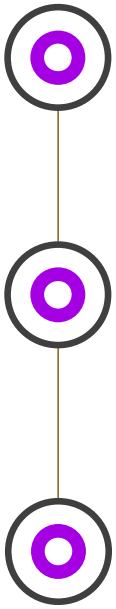
03 Roadmap

04 Feedback and Comments

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The Process Side of Digital Transformation

Designed from the ground up, delivering the process digital twin, to the next generation of engineers



Designed from the Ground Up

- Multi-core
- Multi-user, Continuously Saved
- Role based user interface
- Open model writing

50% reduction in simulation effort across the lifecycle

Delivering the Process Digital Twin

- Design, Rating and Dynamic Mode
- Standard Libraries for different Assets
- One single model for the entire asset lifecycle

Collaboration internally and externally

Improved engineering workflow

To the Next Generation of Process Engineers

- Groundbreaking Ease of Use
- Instantaneous results
- Intuitive User Interface

Enables True Digital Transformation

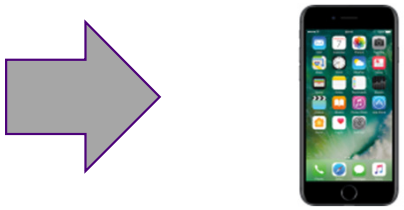
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AVEVA

Reduce Total Ownership Cost and Process Engineering Hours

A unified environment improves personnel utilization, IT accessibility, cross tool integration, and reduce s software training





Steady State	Process Utilities	Hydraulics	Spread-sheets
Dynamic Sim	Flares	Water Hammer	Home Grown



Like a smart phone,

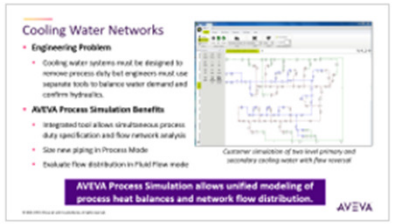
the total value is much higher than the sum of the pieces.

A Typical EPC Process Engineering Department has over 50 applications that they use on a regular basis.

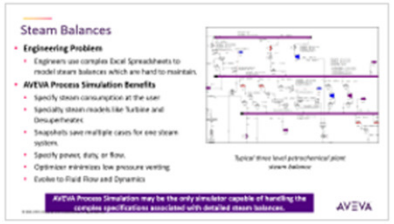
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AVEVA Process Simulation Capabilities Slide 1 of 2

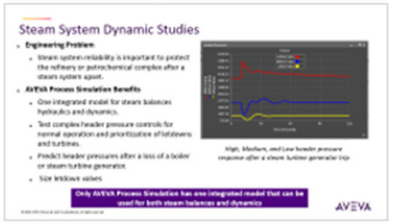
Cooling water networks



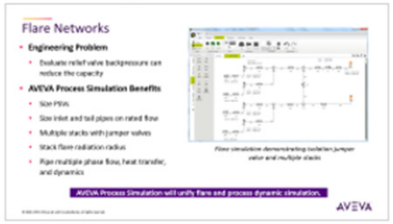
Steam balances



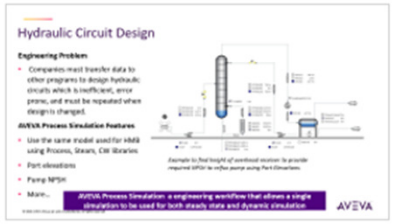
Steam dynamic studies



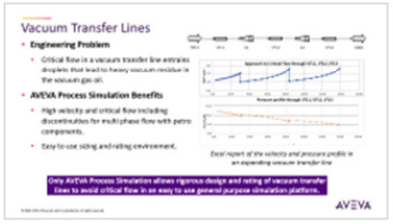
Flare systems



Hydraulic Circuit Design



Vacuum transfer lines



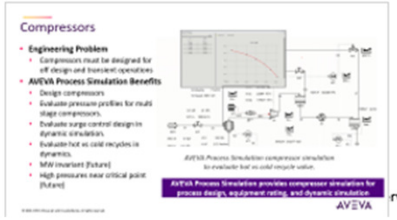
Hot oil networks



Fuel gas balances

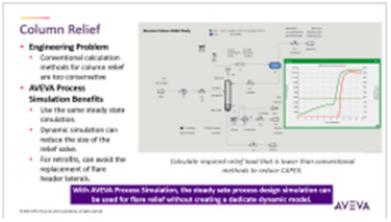


Compressor Dynamics



rved.

Column Relief



Chemical processes



Petrochemical processes

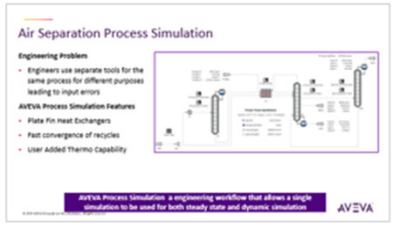


AVEVA™

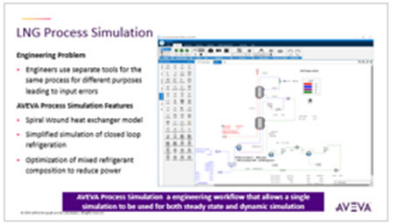
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AVEVA Process Simulation Capabilities Slide 2 of 2

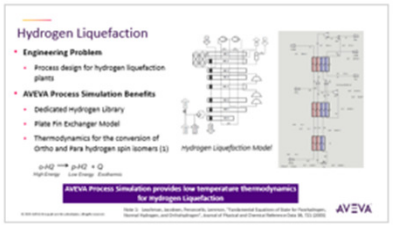
Air separation



LNG processes



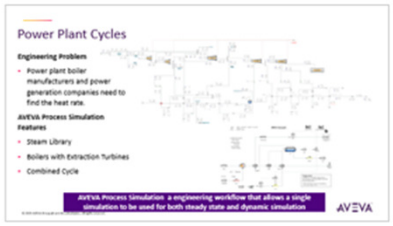
Hydrogen liquefaction



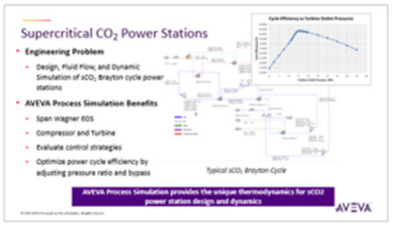
Pressure swing adsorption



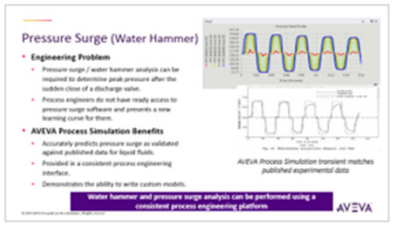
Power plant cycles



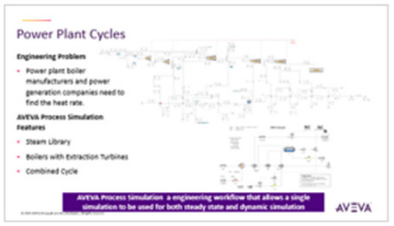
Supercritical CO_2 power



Pressure surge



HX tube rupture



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AVEVA Process Simulation Roadmap

2019	2020	Future
2019 Strategy	**2020 Strategy**	**2021+ Strategy**
• Cooling Water and Steam Utilities • Relief and Flare Systems • Chemical Process Simulation	• Process Utilities Improvements • Relief and Flare Improvements • Chemical Process Simulation Improvements	• Chemical Process Simulation Improvements • Downstream Process Simulation • Upstream Process Simulation
2019 Delivered (4.1)	**2020 in development (4.2 – 5.0)**	**Long range plans (5.1+)**

• Platform
  • Design Optimization
  • Global Variables and Parameters
  • Message Monitor
  • Trapezoidal Integrator
• Process
  • Reactive Distillation
  • Plate Fin and Spiral Would Heat Exchanger
  • Rigorous Pipe Dynamics
  • Mode Change Guidance
  • Pressure Swing Adsorption
  • Heat and Material Balance Excel Report
• Process Utilities and Hydraulics
  • Rigorous Segmented Two Phase Pipe
  • Water Hammer
  • Heat Exchanger Tube Rupture
• Flare
  • Miller Pressure Drops
  • Backpressure, rho-v2, Mach, and Sound Power Level
• Integration/Interface
  • OSI PI External Data
  • External Equation Interface
	• Platform
	  • Model Writing Improvements
	  • Graphical Sub flowsheets and Model References
	  • Scenario Conditional Runs for Batch Simulation
	  • Solver Reports
	  • Incremental Solving
	• Process
	  • More Stream Properties
	  • Rate Based Distillation
	  • Gibbs Reactor
	  • Multiple Compressor Curves
	  • Column Murphree Efficiency
	  • Operational Costs
	  • Rigorous Heat Exchanger
	• Flare
	  • Alternate Pipe Tables (done)
	  • Flare Excel Report
	• Integration/Interface
	  • Export to HTRI Exchanger Suite
	  • User Added Thermo Interface (done)
	  • Thermo Data Access Interface (done)
	  • Scripting Interface
		• Platform
		  • Model Writing Improvements
		  • Snapshot Comparison Tool
		• Process
		  • Batch Distillation
		  • Polymer Reactor Model
		  • Crude Assays and Characterization
		  • Fired Heater Model
		  • Refinery Analyzers
		  • Refinery Reactor Library
		• Utility
		  • Steam Balance Report
		• Flare
		  • PSPPM Interface
		  • DIERS validation
		  • Relief Cases
		• Integration/Interface
		  • Integrated HTRI Exchanger Model
		  • AVEVA Dynamic Simulation (Dynsim) Engine Link
		  • Black Box Interface

• Token Licenses • AVEVA CALM Licensing • Unified Engineering	• PRO/II Stream Migration • AVEVA Connect (Cloud) • Unified Engineering	• Third Party Migration • Unified Engineering

01 Vision of AVEVA Process Simulation

02 New Features

03 Roadmap

04 Feedback and Comments

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AVEVA™ Process Simulation Proposed Release Plan

July Release of 4.3 brings the 4.2 Beta to all users plus more

SimCentral 4.1 December 2019 Released (Dec 2019)

- Flare Library Updates
- DIPPR Lite Component Data
- Invariant Parameters for Unified Engineering
- Process Library Updates
- Performance Improvements
- FLEXlm 11.16.2
- LaaS (with retrofit kit)

AVEVA™ Process Simulation 4.2 Beta Released (April 2020)

- SRK Huron-Vidal (SRKH) Thermo Method
- Ideal thermo Method
- NRTL Binary Data Override
- User Added Thermo Interface
- Predefined Fluid for Heat Medium
- Model References (for Subflowsheets)
- Scenario RUN UNTIL (for Batch)
- Pressure Swing Adsorption Library
- Flare Alternative Pipe Tables
- Process Library Updates
- More Process Stream Properties
- LaaS Licensing
- Air Separation Plant Example
- Performance Improvements

AVEVA™ Process Simulation 4.3 Released (July 2020)

- Electrolyte NRTL Method (eNRTL)
- Lee Kesler Enthalpies
- Process Stream Properties
- Pure Component Data Override
- Henry Component Data Override
- Binary Phase Diagrams include VLLE
- Ternary Phase Diagrams
- Full Manual Solve for large models
- Graphical Subflowsheets
- Gibbs Minimization Reactor
- Rate-based Distillation
- Process Library Updates
- Reference Streams
- Absolute Equipment Elevations
- Stream Flow Resistance

AVEVA™ Process Simulation 5.0 Active (Oct 2020)

Later slides

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Features

Version 4.3 Jul 2020

User Interface

- Modern ribbon design
- Undo / redo changes
- Open multiple simulations
- Changes continuously saved
- Error and warning badges
- Subflowsheets
- Units of Measure
- User Roles

Simulation Modes

- Three simulation modes
- (1) Process simulation mode
- (2) Fluid flow / rating mode
- (3) Dynamics mode
- Return to any mode
- Design Optimization

Solver Management

- Continuously solved
- Free variable specification
- Specification analyzer feedback
- Fast equation-oriented solution
- Robust block decomposition
- Implicit Euler dynamic integrator
- Implicit Trapezoidal Integrator
- Return to any saved snapshot

Thermodynamic Methods

- Ideal
- Industrial Steam Tables IF97
- Soave Redlich Kwong (SRK)
- Peng Robinson (PR)
- SRKH (Huron-Vidal)
- SRKM / PRM
- Wilson
- NRTL
- UNIFAC (Dortmund)
- UNIQUAC
- LACT with EOS for vapor
- Hayden O'Connell for fugacity
- Lee Kesler Enthalpies
- Grayson Streed/Improved GS
- Isomeric Hydrogen
- Span Wagner supercritical CO2
- Bosen and Engels Electrolytes
- Electrolyte NRTL (eNRTL)

Phase Equilibrium

- VLE
- VLWE (beta)
- VLLE

Thermo Data

- Petro components
- SimSci Databanks
- DIPPR Public Data
- DECHEMA Data Import
- Thermodynamics Data Manager (TDM)
- NRTL Binary Override
- Henry Data Override
- Pure Component Override

Model Libraries

- Process
- Cooling Water
- Steam
- Flare
- Transient Flow
- Adsorption
- Rate Based Column
- Pressure Swing Adsorption

Controls Library

- Transmitter
- PID Control
- On/Off Control
- Select
- Switch
- Anti-Surge
- Alarm (preview)
- Wave (preview)

Model Writing

- Parameters
- Variables
- Conditions
- Equations
- Ports
- Submodels
- Connections
- Icons
- Type change propagation

Process Library

- Source / Sink
- Mix / Split / Header
- Drum (2 phase)
- Separator (3 phase)
- Column / Hydraulics
- Valve
- Relief Valve
- Pipe
- PipeRig (two phase)
- Pump
- Compressor
- Reciprocating Compressor
- Expander
- Motor
- Extractor
- Heat Exchanger
- Air Cooler
- Water/Utility Cooler
- Thermosyphon Reboiler
- Spiral Wound HX
- Plate Fin HX
- Recycle
- Fluid Change
- Burner
- Equilibrium Reactor
- Conversion Reactor
- Stirred Tank Reactor
- Plug Flow Reactor
- Gibbs Minimization Reactor

Tools and Utilities

- Snapshots
- Trends
- Profile Plots
- Heat Curve
- Binary Phase Diagrams
- Ternary Phase Diagrams
- Scenario
- Curve (with Image Import)
- Stream / Equipment Tables
- OSI PI External Data
- Global Variables

Excel Reports Add-in

- Excel Ribbon Control
- Compare Snapshots
- Compare Simulations
- Get Value Function
- Set Value Function
- Get Dynamics Value Function
- Get Model List Function
- More Functions

Programming Interfaces

- External Equation Interface
- User Added Thermo Interface

Deployment

- 64 Bit Computation
- Single user Desktop installer
- Token, ALS, CALM, LaaS Licensing

Unified Engineering

- To AVEVA™ Engineering
- From AVEVA™ Engineering

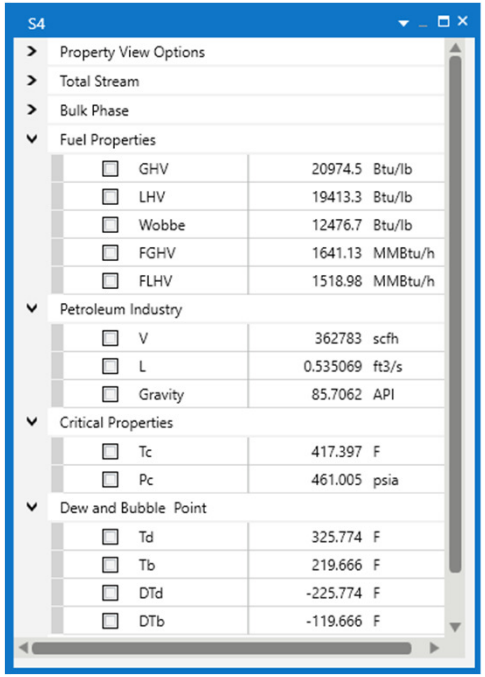
New in 4.3

Notes: (beta/preview) – Feature for feedback. (wip) – Work in progress for future release

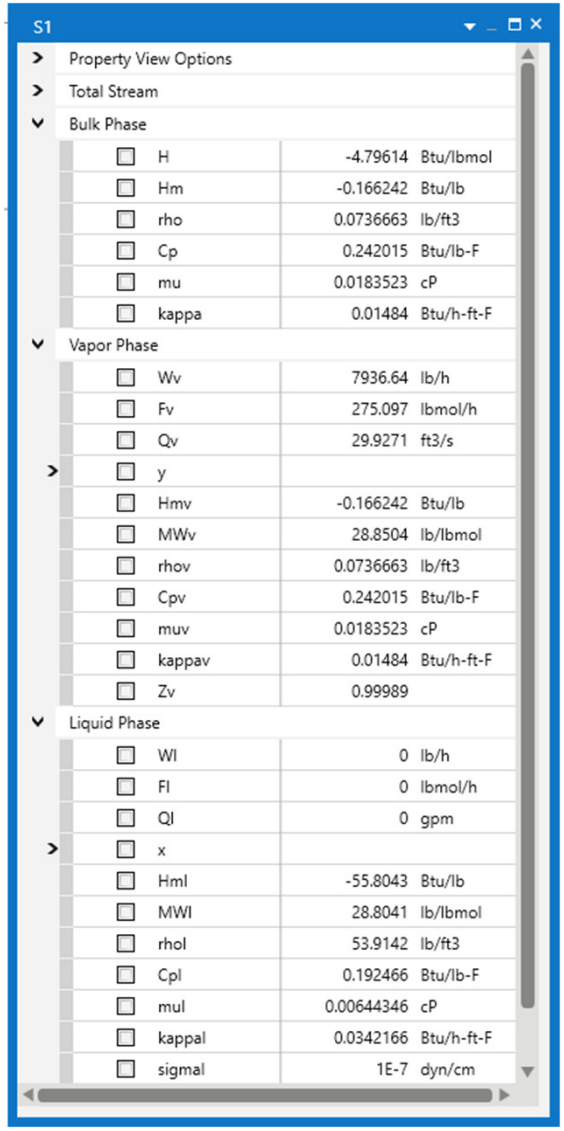
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AVEVA™ Process Simulation 4.3 New Features

More Process Stream Data



- **Fuel Heating values**
  - GHV, LHV, and Wobbe Index
  - Combustion heat flow for fuel balances FGHV and FLHV (4.3)
- **Petroleum**
  - Standard liquid API Gravity Standard Liquid flow L
- **Critical Properties**
  - Traditional Kay's Rule Tc and Pc
- **Bubble and Dew Points**
  - Tb and Td
  - Degrees of superheated and subcooling DTb and DTd



- **Phase thermophysical data**
  - Molecular weight MW_v, MW_l, MW_{l1}, MW_{l2}
  - Specific heat Cp_v, Cp_l, Cp_{l1}, and Cp_{l2}
  - Viscosity mu_v, mu_l, mu_{l1}, mu_{l2}
  - Thermal conductivity $kappa_v$, $kappa_l$, $kappa_{l1}$, $kappa_{l2}$
  - Vapor phase Ideal gas compressibility factor Zv
- **Specific heat ratios for relief valves sizing**
  - Ideal specific heat ratio CpCv (4.3)
  - Isentropic expansion coefficient k (4.3)

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AVEVA™ Process Simulation 4.2 Beta New Features

NRTL Binary Thermo Data Override

Objectives/Background

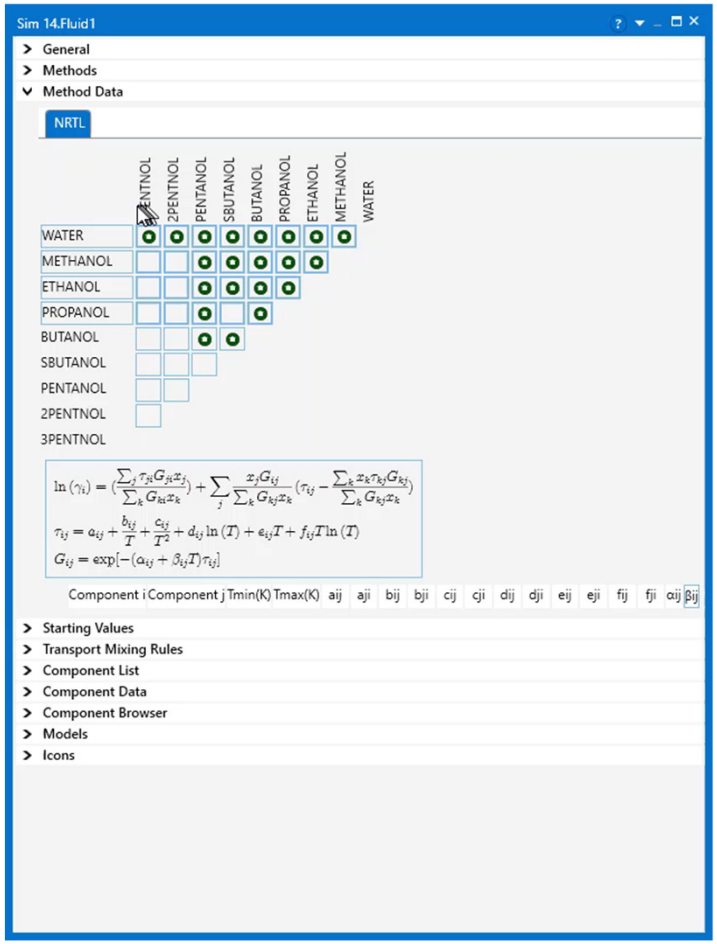
- Quickly see effect of Henry Component Data thermo parameter changes on the simulation.
- Changing data in TDM is not simulation specific.

Solutions

- Fluid Editor contains thermo data to override TDM Library
- Updating lb1 and lb2 files no longer required.
- Thermodynamics specialists may share Fluid with other users in their company.

Delivery Plan

- NRTL binary data override: Version 4.2 Beta (April 2020)
- Pure and Henry's parameters: Version 4.3 (Jul 2020)
- Transport properties: Version 5.0 (Oct 2020)
- More methods after Version 5.0



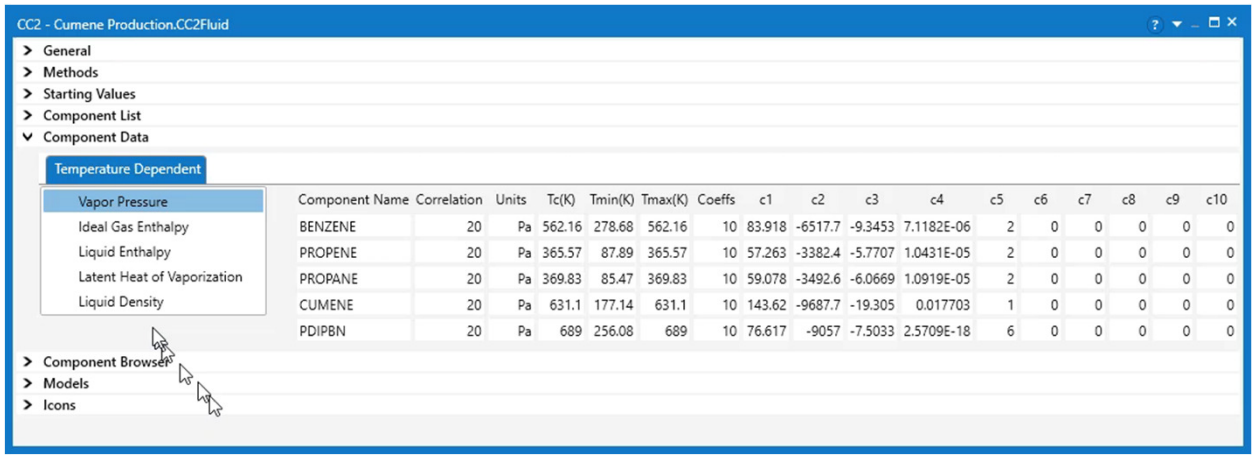
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AVEVA™ Process Simulation 4.3 New Features

Pure Component Temperature-Dependent Thermo Data Override

Objectives/Background

- Quickly see effect of Pure Component Data on the simulation.
- Changing data in TDM is not simulation-specific.



Component Name	Correlation	Units	Tc(K)	Tmin(K)	Tmax(K)	Coeffs	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10
BENZENE	20	Pa	562.16	278.68	562.16	10	83.918	-6517.7	-9.3453	7.1182E-06	2	0	0	0	0	0
PROPENE	20	Pa	365.57	87.89	365.57	10	57.263	-3382.4	-5.7707	1.0431E-05	2	0	0	0	0	0
PROPANE	20	Pa	369.83	85.47	369.83	10	59.078	-3492.6	-6.0669	1.0919E-05	2	0	0	0	0	0
CUMENE	20	Pa	631.1	177.14	631.1	10	143.62	-9687.7	-19.305	0.017703	1	0	0	0	0	0
PDIPBN	20	Pa	689	256.08	689	10	76.617	-9057	-7.5033	2.5709E-18	6	0	0	0	0	0

Solutions

- Fluid Editor contains thermo data to override TDM Library.
- Updating lb1 and lb2 files no longer required.
- Central Thermodynamicist may share Fluid with other users within the company.

Delivery Plan

- NRTL binary data override: Version 4.2 Beta (April 2020)
- Pure properties and Henry's parameters: Version 4.3 (Jul 2020)
- Transport properties: Version 5.0 (Oct 2020)
- More methods after Version 5.0

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AVEVA™ Process Simulation 4.3 New Features

Henry Component Thermo Data Override

Objectives/Background

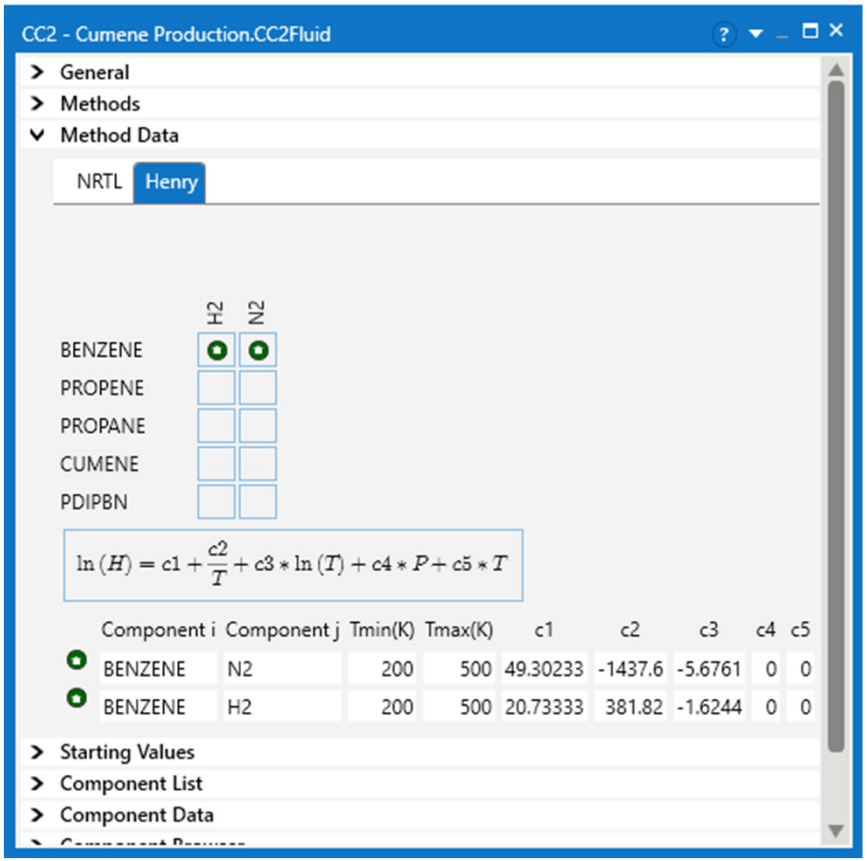
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AVEVA™ Process Simulation 4.3 New Features

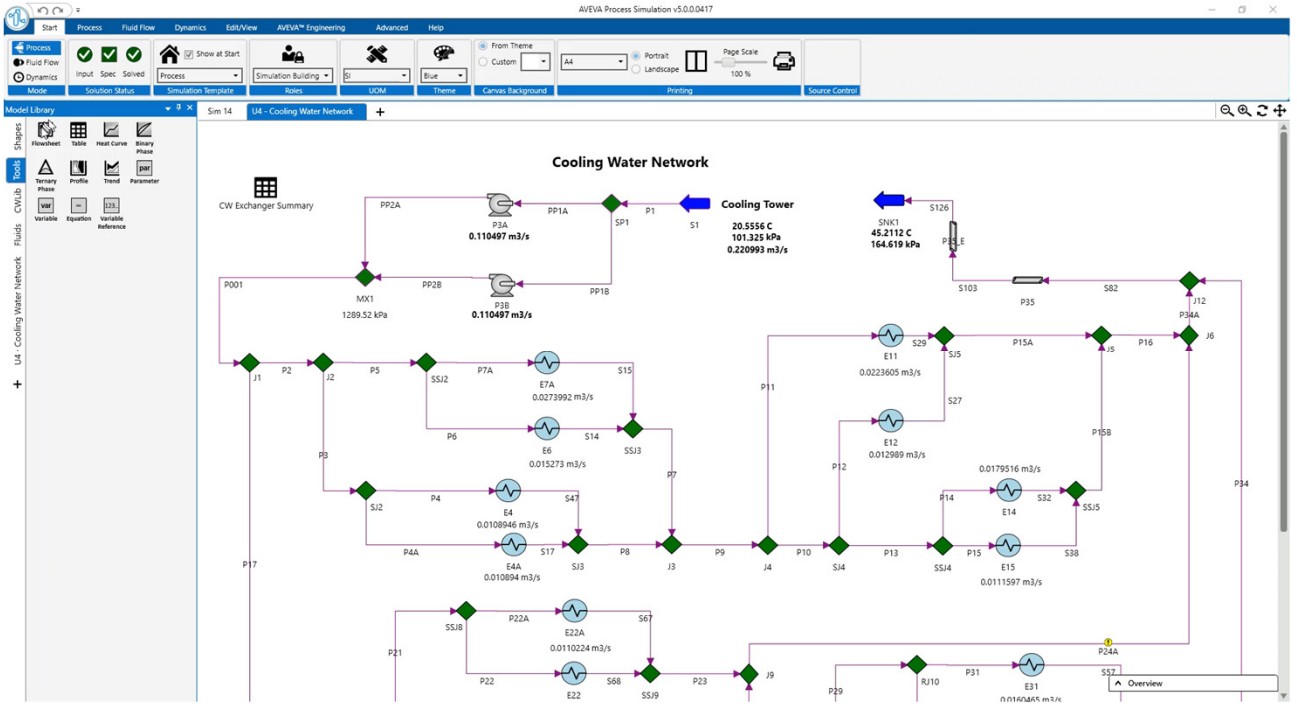
Graphical Subflowsheets and Model References

Problem

- Large simulations on a single flowsheet are hard to navigate and locate objects

Solution

- Drag a subflowsheet from Tools onto the Main flowsheet
- Select subflowsheet using vertical tabs
- Use Model References so that the same model appears in both flowsheets.
- Navigate from Model Reference to another flowsheet by right clicking on Navigate
- Streams, Pipes, Recycles are good choices for reference models.
- Recycle models can allow independent solution by setting them to “Source” mode.
- Move models from one flowsheet to another



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AVEVA™ Process Simulation 4.3 New Features

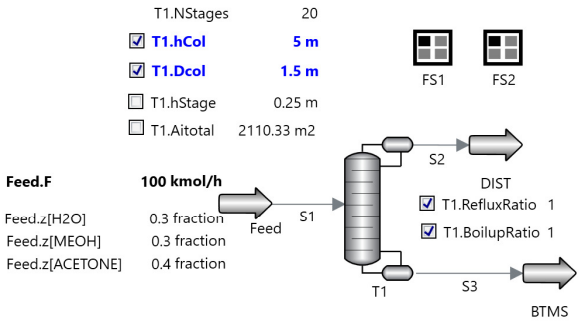
Rate Limited Distillation Column

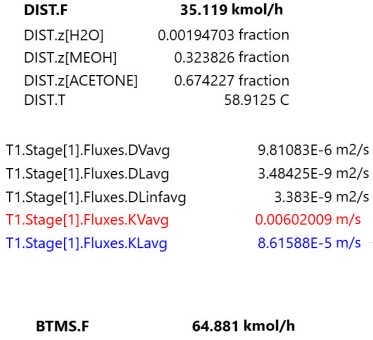
Solution

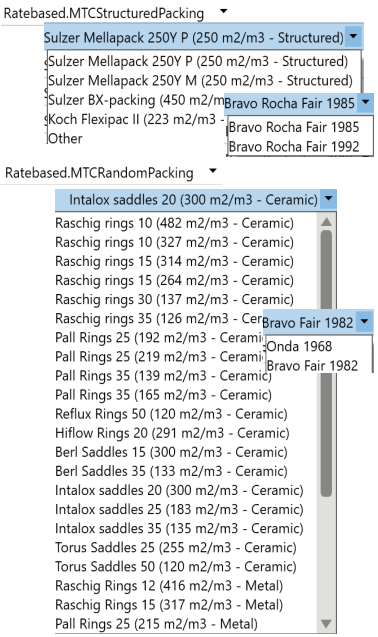
- Binary diffusion methods
  - Gas: Wilke-Lee or Fuller
  - Liquid: Wilke-Chang
- Mass transfer coefficient methods
  - Structured: Bravo-Rocha-Fair (1985 or 1992)
  - Random: Onda (1968) or Bravo-Fair (1982)
  - Sieve trays: Chan-Fair (1984)
  - Bubble caps: Grester (1958)
  - Valve: Scheffe-Weiland (1987)

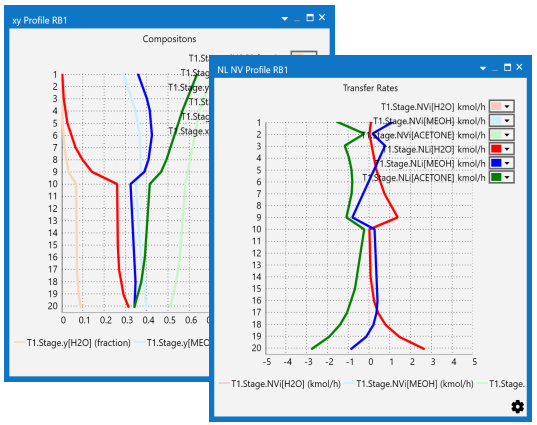
Status/Delivery Plan

- Released in a separate library in 4.3
- Reactions in a future version
- Dynamics in a future version









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AVEVA™ Process Simulation 4.3 New Features

Gibbs Minimization Reactor

Problem

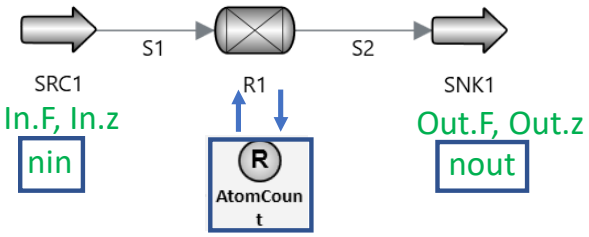
- Sometimes we need an equilibrium reactor, but we do not have the reactions or have time to develop them.

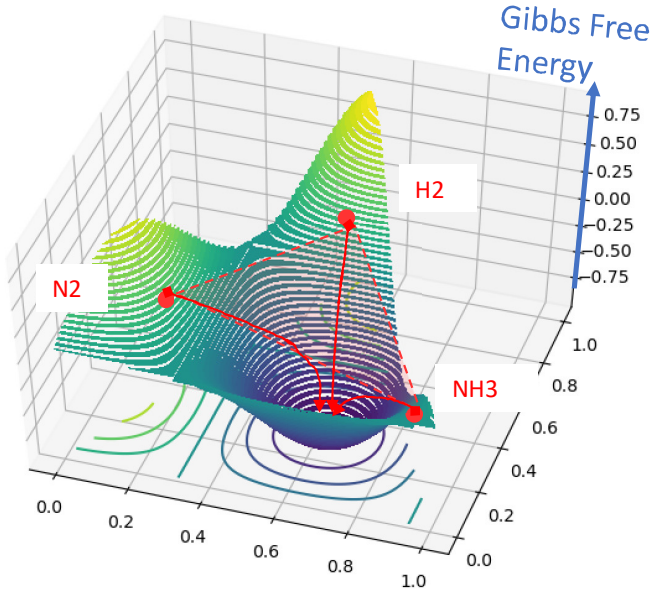
Solution

- Provide a Gibbs Energy Minimization Reactor (GMR) in Process Library.
- Lagrange Multiplier approach eliminates need to use minimization solver.
- Use the replacemable model when needed to calcuate atom count.

Status/Delivery Plan

- GMR model 4.3





$$\text{P}: \min \frac{G(n_i, T, P)}{RT} = \sum_{i=1}^{NOC} n_i \left(\frac{G_i^0}{RT} + ln \frac{n_i}{\sum n_i} + ln \left(\frac{P\Phi_i}{P_0} \right) \right)$$

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AVEVA™ Process Simulation 4.3 New Features

Binary Phase Diagrams for Liquid-Liquid Systems

Objectives/Background

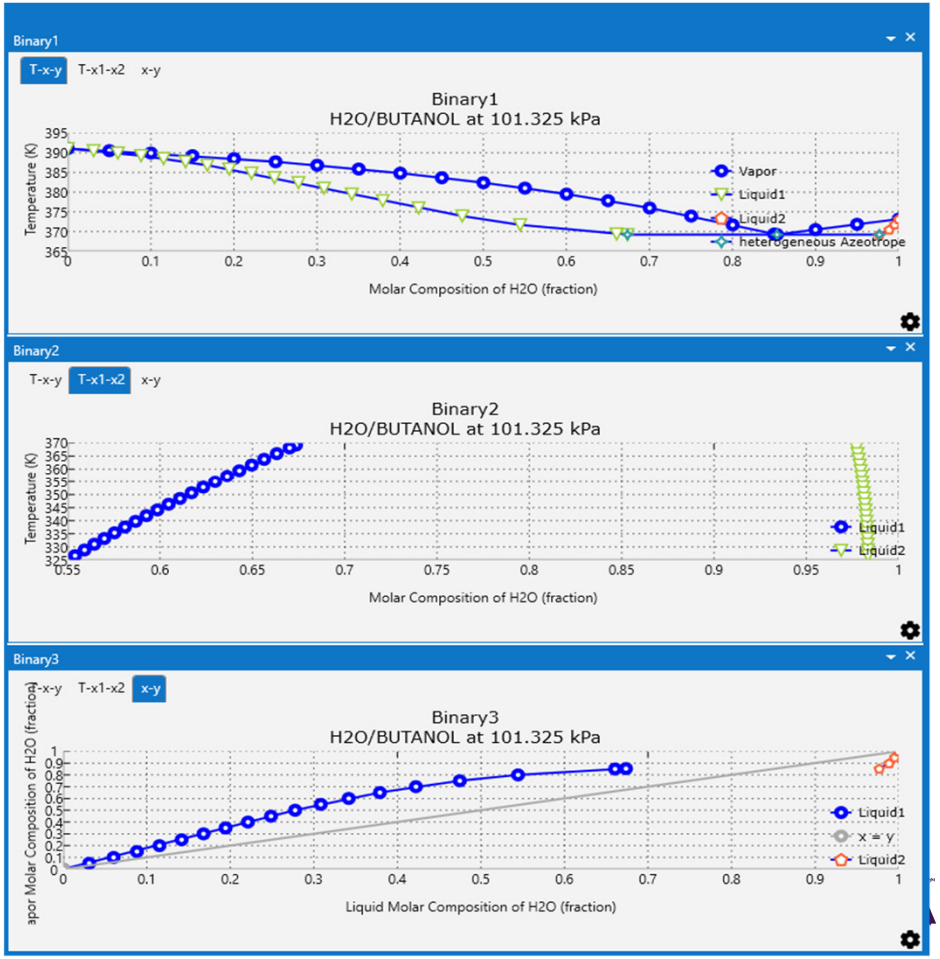
- Judge weather two liquid phases can appear at operating condition of interest

Solutions

- Provide three figure types
  - T-x-y
  - T-x1-x2
  - x-y

Status/Delivery Plan

- AVEVA™ Process Simulation 4.3 (July 2020)



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AVEVA™ Process Simulation 4.3 New Features

Ternary Phase Diagrams

Objectives/Background

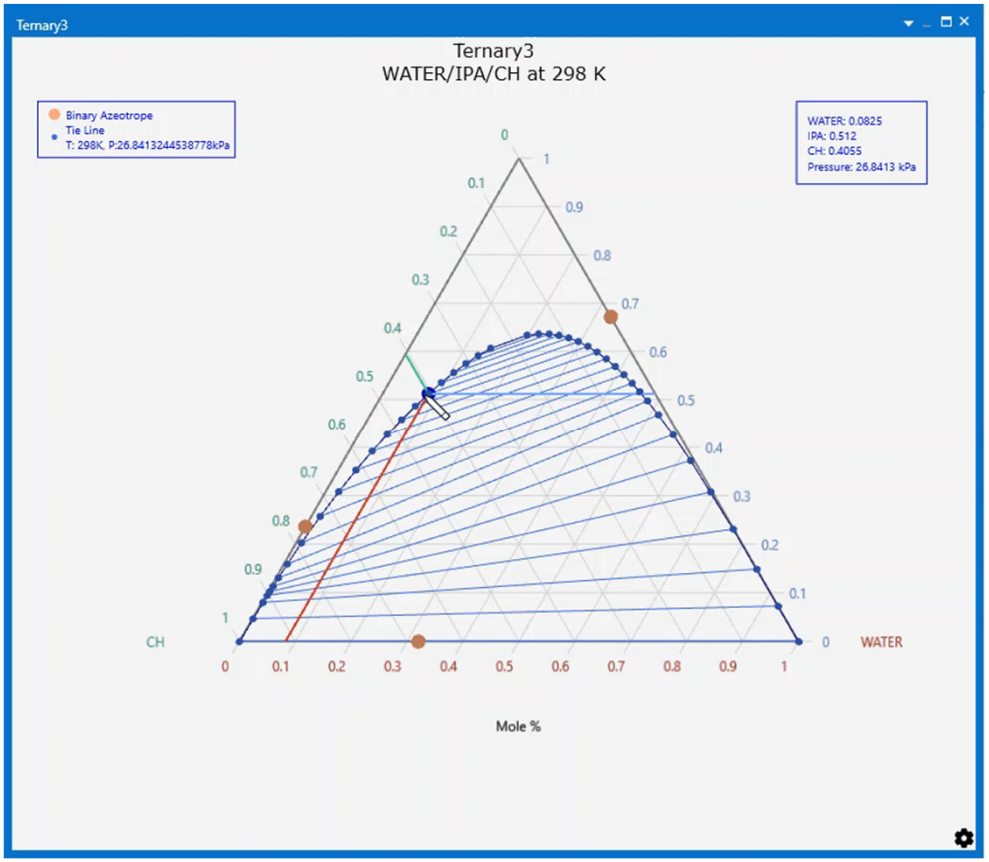
- Provide the classic three component phase diagrams in equilateral triangle form

Solutions

- Use scroll wheel to zoom in and pan left and right so that you can see more detail

Delivery Plan

- Azeotropes (version 4.3)
- Liquid-Liquid Tie-Lines (version 4.3)
- Residue Curves (future version)



Version 4.3 Ternary Phase Diagram Video

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AVEVA™ Process Simulation 4.3 New Features

Manual Solve without Specification Analysis

Objectives/Background

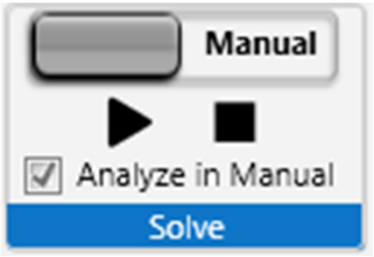
- Specification analysis would occur even in manual so that you know the degrees of freedom. But for extremely large models, this can be slow.

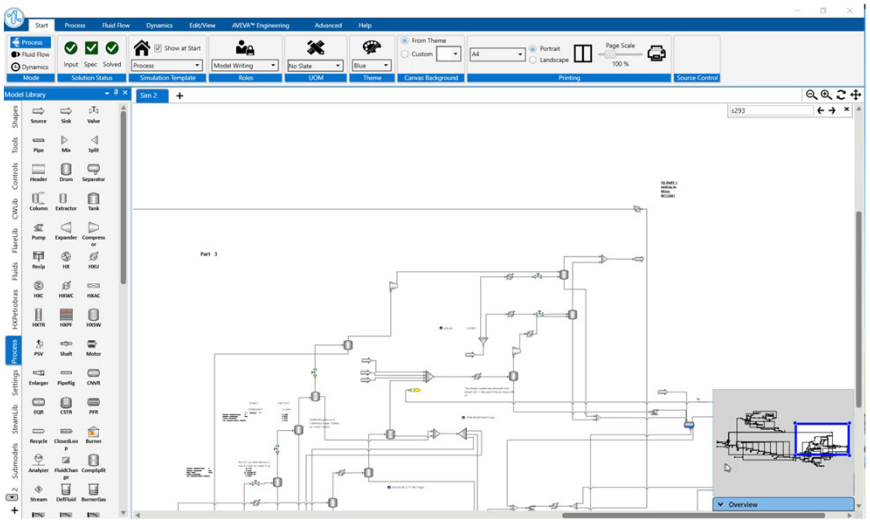
Solutions

- Provide a way to suppress specification analysis.

Warning

- You should solve often to be sure that the simulation is square and solvable.





VIDEO: Large Simulation to modify with in manual mode with Analyze turned off

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AVEVA™ Process Simulation 4.2 Beta New Features

Adsorption Library

Problem

- Adsorption is a cyclic process and require Dynamic Simulation to model

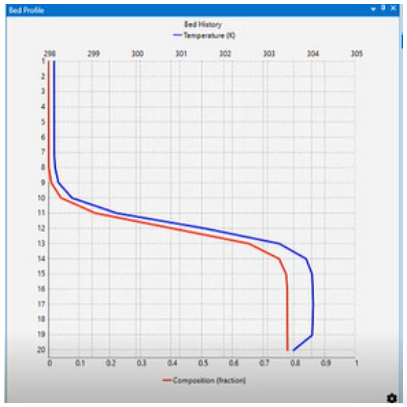
Solution

- Adsorption Library in SimCentral
- Any Isotherm and kinetic relationships can be customized in a submodel for any system just like reactors
- Developed in conjunction with industry expert Dr. Alberto LaCava.
- Validated against experimental data (Farooq et al, 1989)

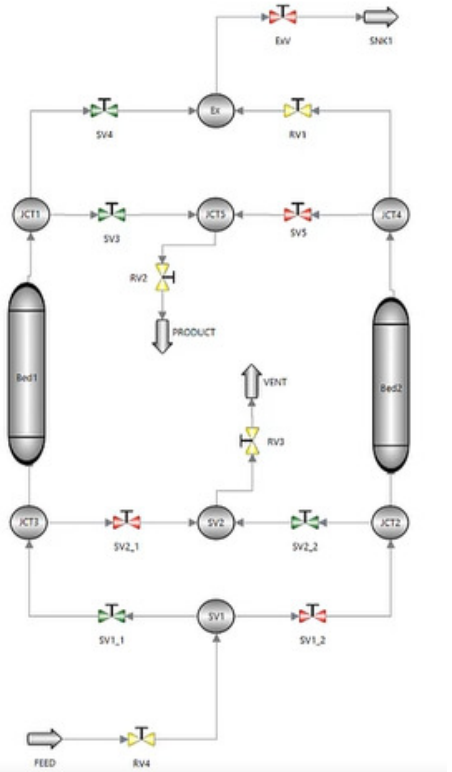
Delivery Plan

- Shipped with in the Example Library Folder





Dynamic simulation of moving front.



Two bed PSA model for oxygen separation.

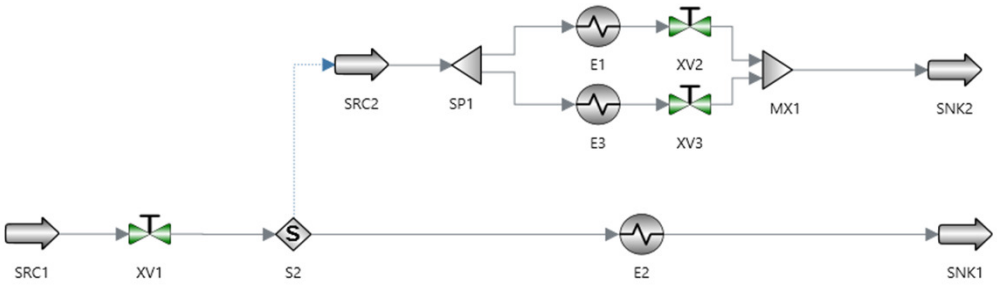
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AVEVA™ Process Simulation 4.3 New Features

Reference Streams Set Source Properties

Problem Statement

- Sometimes you want to perform a side calculations with a duplicated stream composition. But you want the stream to follow a reference stream so that you do not have to enter it again.



SRC2 is the same properties as stream S2 and will update when S2 updates

Solution

- Add a reference stream to the stream model that you can connect to a source.
- Show the stream connection model before you can connect to it.
- Make it a reference model if you want to locate it far away from the original model so that you do not have a dashed line on the canvas.

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AVEVA™ Process Simulation 4.3 New Features

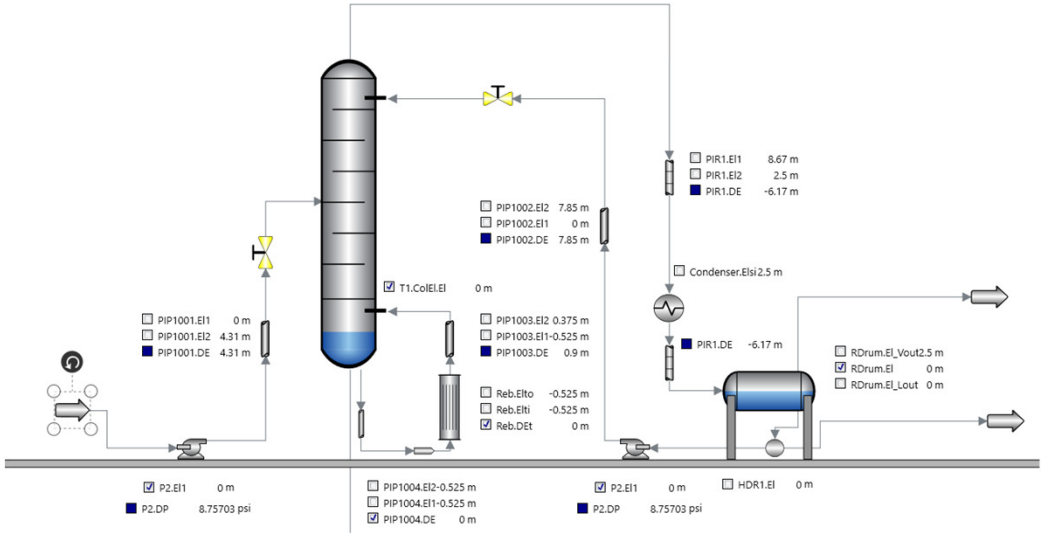
Absolute Equipment Port Elevations for Hydraulic Calculations

Problem Statement

- Specifying elevations in pipes is error prone and requires offline hand calculations

Solution

- Have option for equipment port elevations from tangent line to grade
- Auto calculate column port elevations (from HoldupFactor)
- Provided in Process, SteamLib, and CW libraries



Example to find hieight of overhead receiver to provide required NPSH to relfux pump using Port Elevations

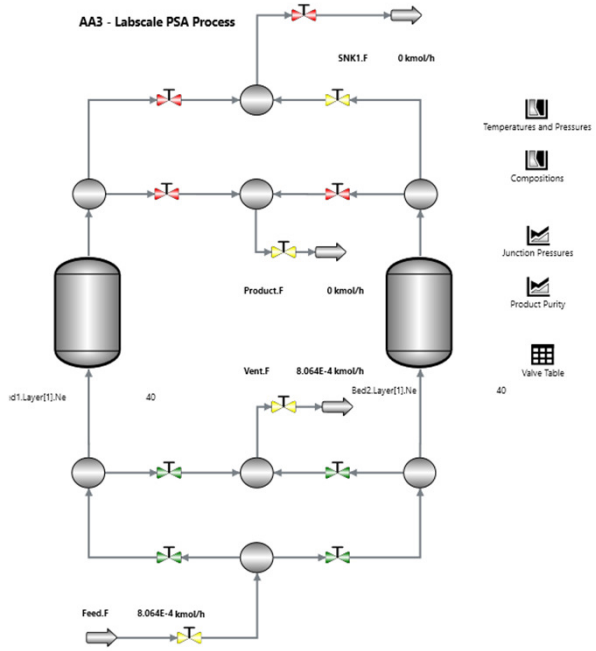
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Hydraulics Video using Equipment and Port Elevations

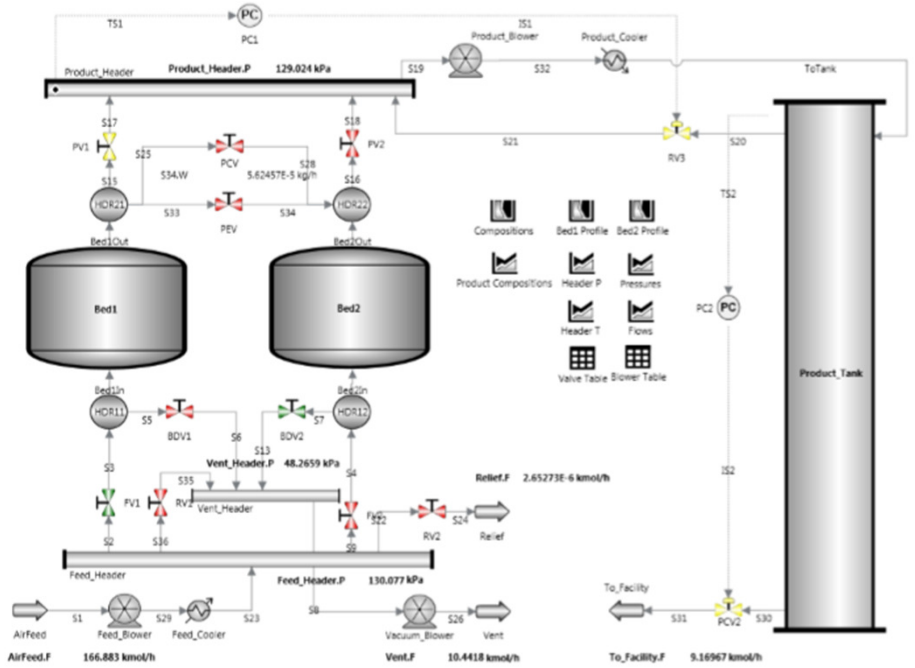


AVEVA™ Process Simulation 4.3 New Features

AA3 and AA4 Adsorption Examples



AA3 – Lab-scale Oxygen PSA process simulation example



AA4 – Full-scale Oxygen PSA process simulation example

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AVEVA™ Process Simulation 4.2 Beta New Features

User Added Thermo Interface

Objectives/Background

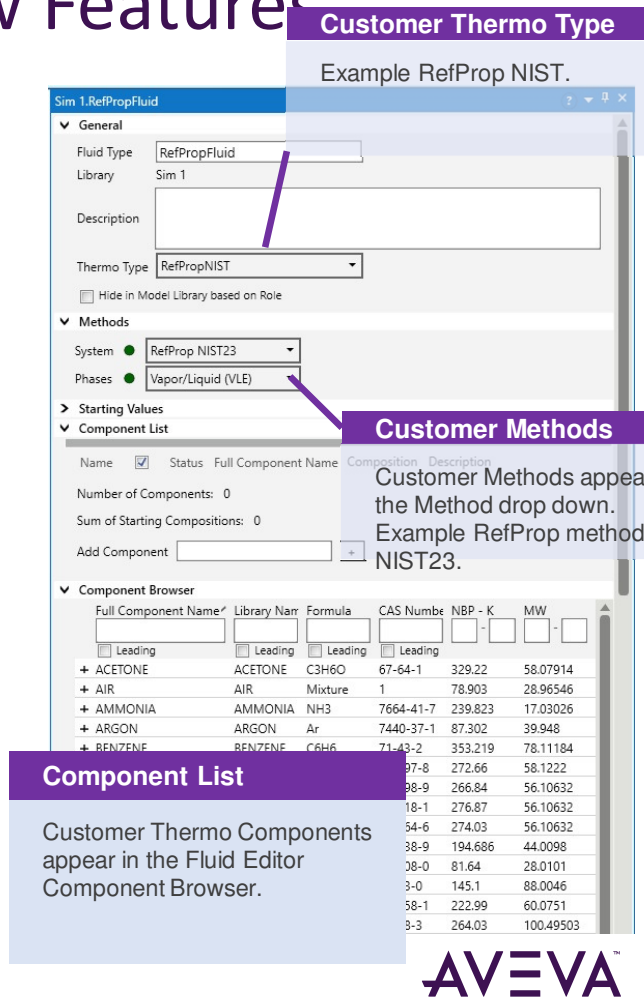
- Some companies have their own thermodynamic methods and data with decades of investment which they know and trust.
- Enable users to apply their thermo on AVEVA™ Process Simulation

Solution

- We provide a user Added Thermo Interface (API) with a development toolkit so that customers can integrate their own thermo.
- Tested with NIST REFPROP (to be delivered later)

Delivery Plan

- Interface API: Version 4.2 Beta (Apr 2020)
- SDK available on request: v4.3 (July 2020)
- Remaining work: Deliver REFPROP from NIST
- Remaining work: Flash improvements to overcome possible convergence issues for missing phases (pseudo roots)



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AVEVA™ Process Simulation 4.3 New Features

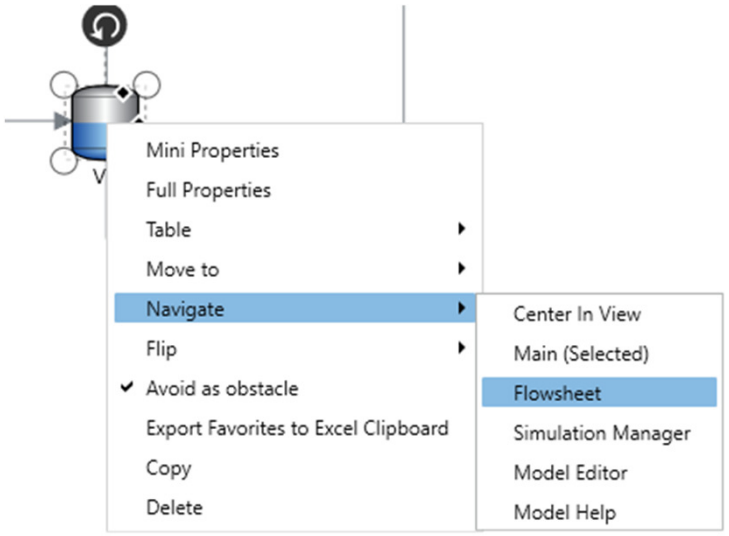
Navigate from the Canvas to Other Places

Problem Statement

- Moving around can take a lot of mouse clicks and many users do not discover model help.

Solution

- Now we give easy navigation commands from the Navigate menu.
  - Simulation Manager
  - References on other flowsheets
  - Model Editor
  - Model Help



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AVEVA™ Process Simulation Proposed Release Plan

July Release of 4.3 brings the 4.2 Beta to all users plus more

SimCentral 4.1 December 2019 Released (Dec 2019)

- Flare Library Updates
- DIPPR Lite Component Data
- Invariant Parameters for Unified Engineering
- Process Library Updates
- Performance Improvements
- FLEXlm 11.16.2
- LaaS (with retrofit kit)

AVEVA™ Process Simulation 4.2 Beta Released (April 2020)

- SRK Huron-Vidal (SRKH) Thermo Method
- Ideal thermo Method
- NRTL Binary Data Override
- User Added Thermo Interface
- Predefined Fluid for Heat Medium
- Model References (for Subflowsheets)
- Scenario RUN UNTIL (for Batch)
- Pressure Swing Adsorption Library
- Flare Alternative Pipe Tables
- Process Library Updates
- More Process Stream Properties
- LaaS Licensing
- Air Separation Plant Example
- Performance Improvements

AVEVA™ Process Simulation 4.3 Active (July 2020)

- Electrolyte NRTL Method (eNRTL)
- Lee Kesler Enthalpies
- Process Stream Properties
- Pure Component Data Override
- Henry Component Data Override
- Binary Phase Diagrams include VLLE
- Ternary Phase Diagrams
- Full Manual Solve for large models
- Graphical Subflowsheets
- Gibbs Minimization Reactor
- Rate-based Distillation
- Process Library Updates
- Reference Streams
- Absolute Equipment Elevations
- Stream Flow Resistance

AVEVA™ Process Simulation 5.0 Planned (Oct 2020)

- Electrolyte Precipitates (eNRTL)
- Non-Equilibrium Solids
- Transport Property Mixing Rules
- Transport Property Data Override
- Heat Curves for HTRI Exchanger Suite
- Compressor Multiple Speed Curves
- Column Murphree Efficiency
- Operational Costs
- Process Library Updates
- Performance Improvements

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01 Vision of AVEVA Process Simulation

02 New Features

03 **Roadmap**

04 Feedback and Comments

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- Graphical Subflowsheets Part 1
- Model References (for Subflowsheets)
- Scenario RUN UNTIL (for Batch)
- Pressure Swing Adsorption Library
- Flare Alternative Pipe Tables
- Process Library Updates
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- Henry Component Data Override
- Binary Phase Diagrams include VLLE
- Ternary Phase Diagrams
- Full Manual Solve for large models
- Graphical Subflowsheets Part 2(move)
- Gibbs Minimization Reactor
- More Process Stream Properties
- Process Library Updates
- Reference Streams
- Absolute Equipment Elevations
- Stream Flow Resistance
- Performance Improvements

AVEVA™ Process Simulation 5.0 Planned (Oct 2020)

Electrolyte Precipitates (eNRTL)
Non-Equilibrium Solids
Transport Property Mixing Rules
Transport Property Data Override
Heat Curves for HTRI Exchanger Suite
Compressor Multiple Speed Curves
Column Murphree Efficiency
Thermo Access Interface for regression
Operational Costs
Process Library Updates
PRO/II Fluid Migration
Performance Improvements

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AVEVA Process Simulation Roadmap

2019	2020	Future
2019 Strategy	**2020 Strategy**	**2021+ Strategy**
• Cooling Water and Steam Utilities • Relief and Flare Systems • Chemical Process Simulation	• Process Utilities Improvements • Relief and Flare Improvements • Chemical Process Simulation Improvements	• Chemical Process Simulation Improvements • Downstream Process Simulation • Upstream Process Simulation
2019 Delivered (4.1)	**2020 in development (4.2 – 5.0)**	**Long range plans (5.1+)**

• Platform
  • Design Optimization
  • Global Variables and Parameters
  • Message Monitor
  • Trapezoidal Integrator
• Process
  • Reactive Distillation
  • Plate Fin and Spiral Would Heat Exchanger
  • Rigorous Pipe Dynamics
  • Mode Change Guidance
  • Pressure Swing Adsorption
  • Heat and Material Balance Excel Report
• Process Utilities and Hydraulics
  • Rigorous Segmented Two Phase Pipe
  • Water Hammer
  • Heat Exchanger Tube Rupture
• Flare
  • Miller Pressure Drops
  • Backpressure, rho-v2, Mach, and Sound Power Level
• Integration/Interface
  • OSI PI External Data
  • External Equation Interface
	• Platform
	  • Model Writing Improvements
	  • Graphical Sub flowsheets and Model References
	  • Scenario Conditional Runs for Batch Simulation
	  • Solver Reports
	  • Incremental Solving
	• Process
	  • More Stream Properties
	  • Rate Based Distillation
	  • Gibbs Reactor
	  • Multiple Compressor Curves
	  • Column Murphree Efficiency
	  • Operational Costs
	  • Rigorous Heat Exchanger
	• Flare
	  • Alternate Pipe Tables (done)
	  • Flare Excel Report
	• Integration/Interface
	  • Export to HTRI Exchanger Suite
	  • User Added Thermo Interface (done)
	  • Thermo Data Access Interface (done)
	  • Scripting Interface
		• Platform
		  • Model Writing Improvements
		  • Snapshot Comparison Tool
		• Process
		  • Batch Distillation
		  • Polymer Reactor Model
		  • Crude Assays and Characterization
		  • Fired Heater Model
		  • Refinery Analyzers
		  • Refinery Reactor Library
		• Utility
		  • Steam Balance Report
		• Flare
		  • PSPPM Interface
		  • DIERS validation
		  • Relief Cases
		• Integration/Interface
		  • Integrated HTRI Exchanger Model
		  • AVEVA Dynamic Simulation (Dynsim) Engine Link
		  • Black Box Interface

• Token Licenses • AVEVA CALM Licensing • Unified Engineering	• PRO/II Stream Migration • AVEVA Connect (Cloud) • Unified Engineering	• Third Party Migration • Unified Engineering

AVEVA Thermodynamics Roadmap for AVEVA Process Simulation

2019	2020	Future
2019 Strategy	**2020 Strategy**	**2021+ Strategy**
• Cooling Water and Steam Utilities • Relief and Flare Systems • Chemical Process Simulation	• Process Utilities Improvements • Relief and Flare Improvements • Chemical Process Simulation Improvements	• Chemical Process Simulation Improvements • Downstream Process Simulation • Upstream Process Simulation
2019 Delivered	2020 in development	Long range plans

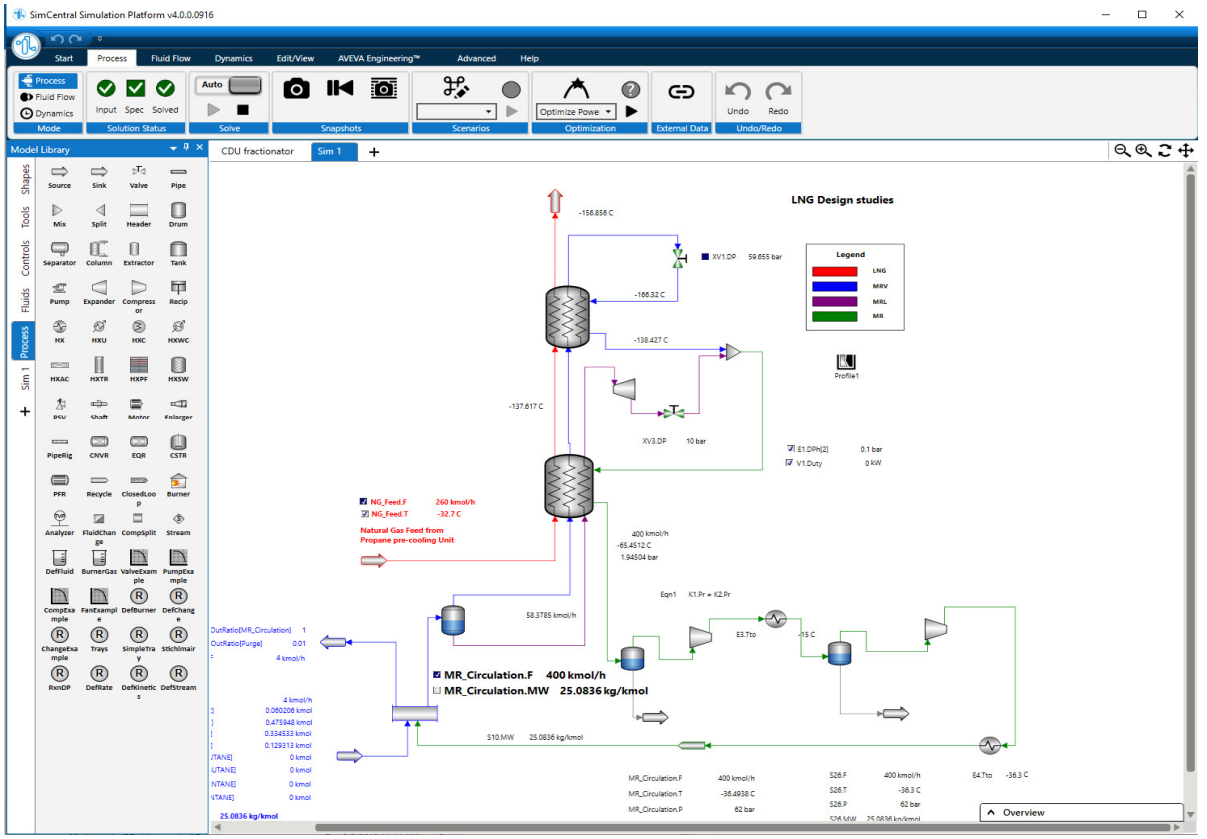
• Thermo Methods
  • Wilson, UNIQUAC, UNIFAC, and NRTL
  • SRK and PR
  • SRKM with the latest alpha and Glycol BIPs
  • Hayden O'Connell
• Thermo Diagrams
  • Heat Curve Diagrams
  • Binary Phase Diagrams (VLE)
• Thermo Data
  • Integration with TDM
  • DIPPR Public Database
  • UNIFAC Data Manage on TDM
  • Extended temperature dependency equations
• Thermo Architecture and Flash
  • Fluid Reaction Models
  • Fluid Concept combines Method, Data, Chemistry
  • LACT with EOS Fugacity (Gamma Phi)
  • Thread Safety for multi core solution
  • VLE
  • VLLE
  • VLWE (beta)
	• Thermo Methods
	  • SRK Huron-Vidal (SRKH)
	  • Lee Kesler Enthalpies (LK)
	  • Electrolyte NRTL Methods (eNRTL)
	  • Ideal Method for Gas and Liquid (Raoult)
	  • HF Thermo
	  • Updated transport property mixing rules
	• Thermo Diagrams
	  • Binary Phase Diagrams (VLLE)
	  • Ternary Phase Diagrams
	  • Thermo Data Override (NRTL, Pure Components and Henry)
	• Thermo Data
	  • Heat Transfer Fluid Data
	  • FILL options
	• Thermo Architecture and Flash
	  • VLE at high pressures above Critical Temperature
	  • Non-Equilibrium Solids
	  • Electrolyte Precipitates
	• Integration/Interface
	  • User Added Thermo Interface
	  • Thermo Access Interface for DPP of and DDBSP of DDBST
		• Thermo Methods
		  • Predictive SRK (PSRK)
		  • Benedict Webb Rubin Starling (BWRS)
		  • Cubic Plus Association (CPA)
		  • Perturbed Chain Statistical Association Fluid Theory (PC-SAFT)
		  • Wax and Asphaltene model
		  • Amine Methods
		  • Refinery Inspection Properties
		• Thermo Diagrams
		  • Unified Fluid Editor with Thermo Data Override for More Methods and REGRESS
		  • Phase Envelope Diagram
		• Thermo Data
		  • Electrolyte Component (Species) and Reaction Data
		  • More FILL options
		  • Heavy Oil Data
		  • Water and Gas Solubility in Oil
		  • New Standard/Data of American Petroleum Inst.
		• Thermo Architecture and Flash
		  • Distillation Curves (TBP, D86, D1160)
		  • Crude Assay Characterization
		  • Updated Hydrate Module
		• Integration/Interface
		  • Interface with Spiral Crude database
		  • Data import from PVT-SIM of CALSEP

• Collaboration with TU Dortmund on e-PC-SAFT has started	• Yearly updates to DIPPR	• Yearly updates to DIPPR

What AVEVA Process Simulation do now for Gas Processing?

LNG Refrigeration Example

- Included Features
  - Heat and Mass Balances
  - Plate Fin Exchanger
  - Spiral Wound Exchanger
  - SS and Dynamics
- Coming Features
  - CPA Thermo
  - Phase Envelope Diagrams
  - Amines
  - JIP VLSE for LNG



LNG Refrigeration Simulation

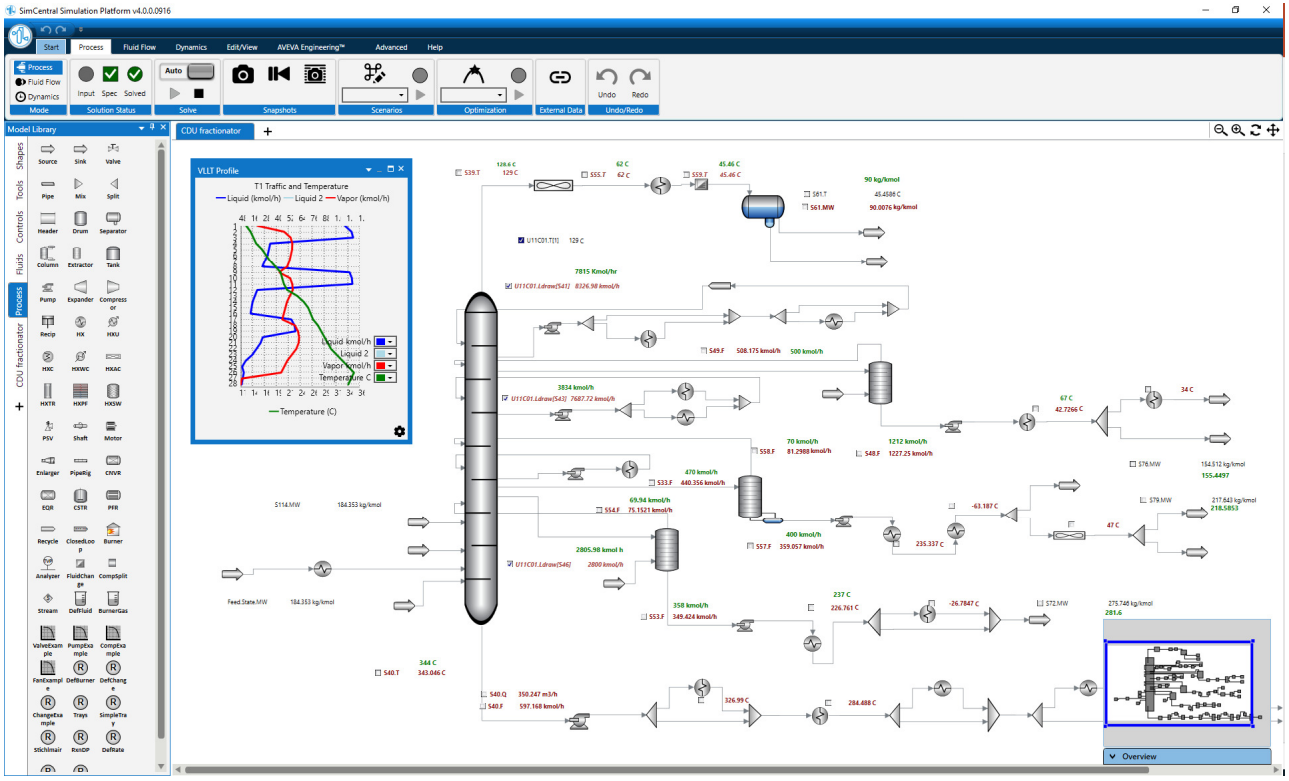
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Internal Use Only

What can AVEVA Process Simulation do now for Refining?

Crude Unit Prototype

- Current Features
  - Heat and Mass Balance
  - Petro components (manually entered)
  - SS and Dynamics
  - Standard Volume Basis Flow
  - Kerosene VLWE Water Solubility
- Coming Features
  - Crude Assay / Characterization
  - More VLWE Water Solubility
  - D86 / TBP Curves
  - Sulfur Tracking and other RIPs
  - PRO/II Migration
  - Refinery Reactors



Prototype Crude Unit Simulation

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01 Vision of AVEVA Process Simulation

02 New Features

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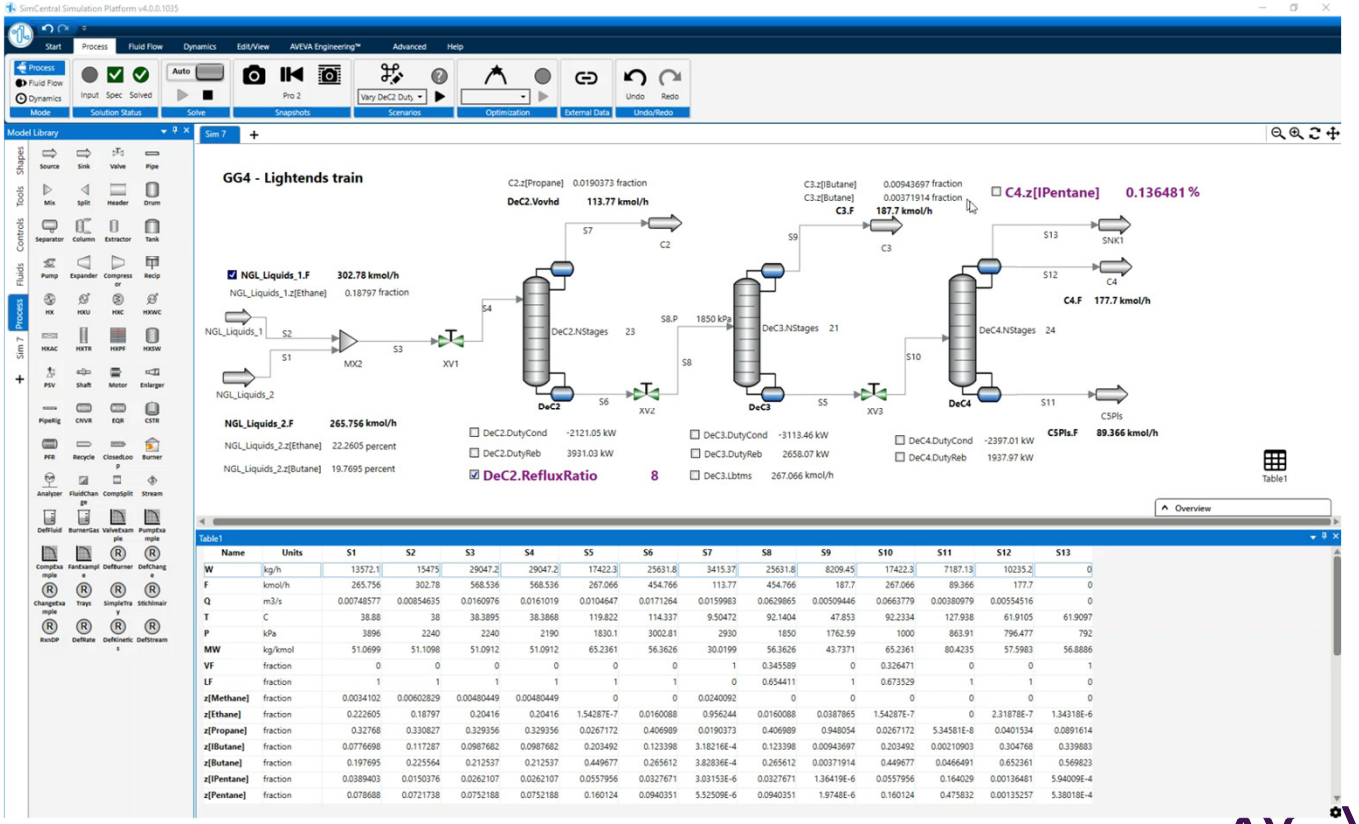
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Video: Equation Oriented Specification Swapping

Calculate the reflux ratio needed in column 1 to set the quality in column 3 (30 seconds)

AVEVA Process Simulation allows you to specify any variable without having to add a controller.

Here we swap specifications to find the required reflux in column 1 for to get a product quality in column 3.



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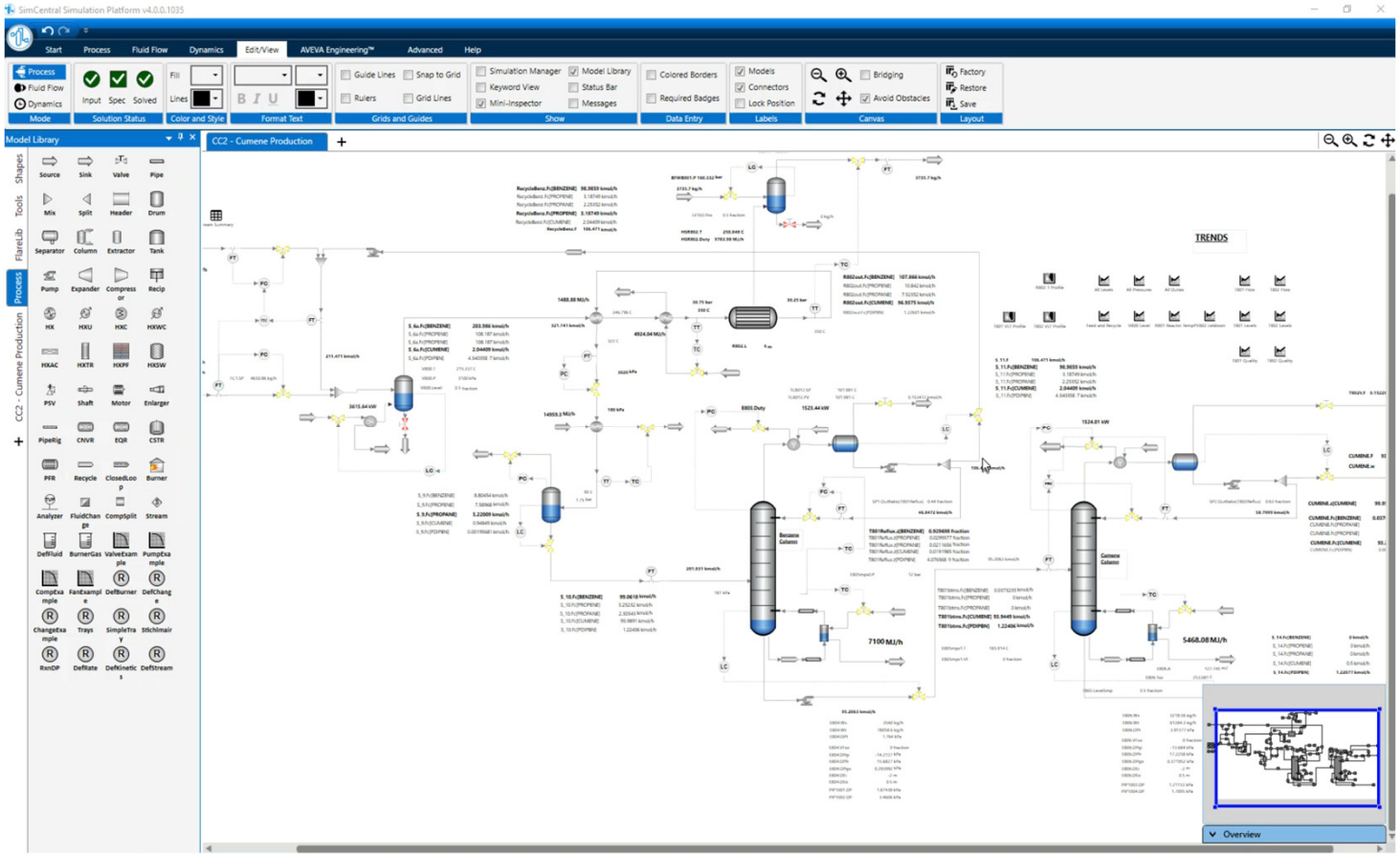
Video: Fast Convergence of Recycles

Set optional recycle model to a source and back to normal and watch it solve (50 seconds)

Recycles can take a long time to solve in traditional sequential modular simulators.

AVEVA Process Simulation can solve a recycle instantly. Watch when we turn the recycle off, set the recycle stream to all benzene, and then let it solve again.

AVEVA Process Simulation's equation oriented design solves it instantly.



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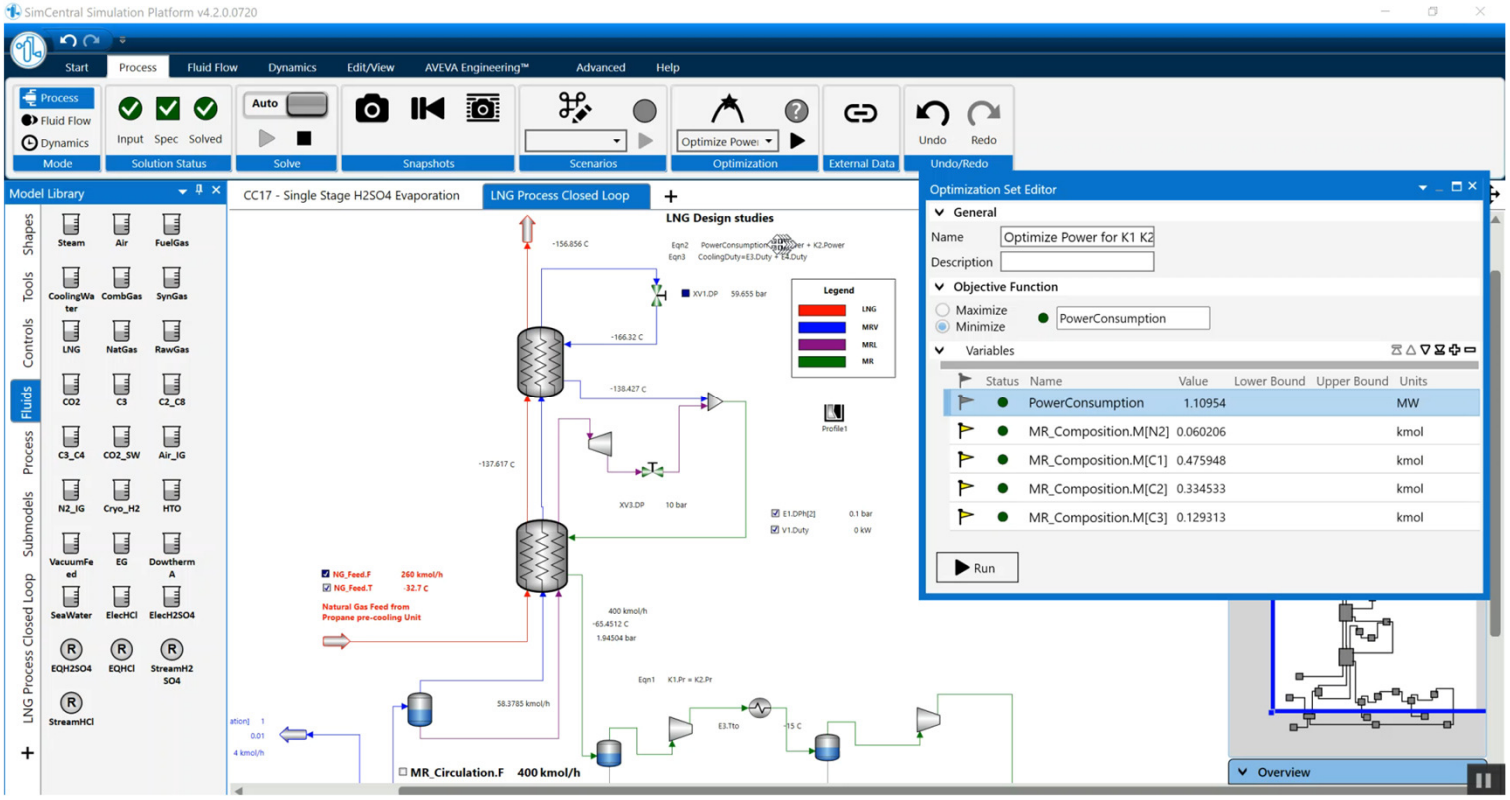
Video: Optimization of LNG Process

What is the optimum mixed refrigeration composition to minimize compressor power (56 seconds)

Mixed refrigerant compressors take a great amount of horse power to liquify LNG.

Find the optimum mixed refrigeration composition to minimize the compressor horsepower.

Design optimization based on ROMeo optimizes multi variable problems quickly and efficiently.



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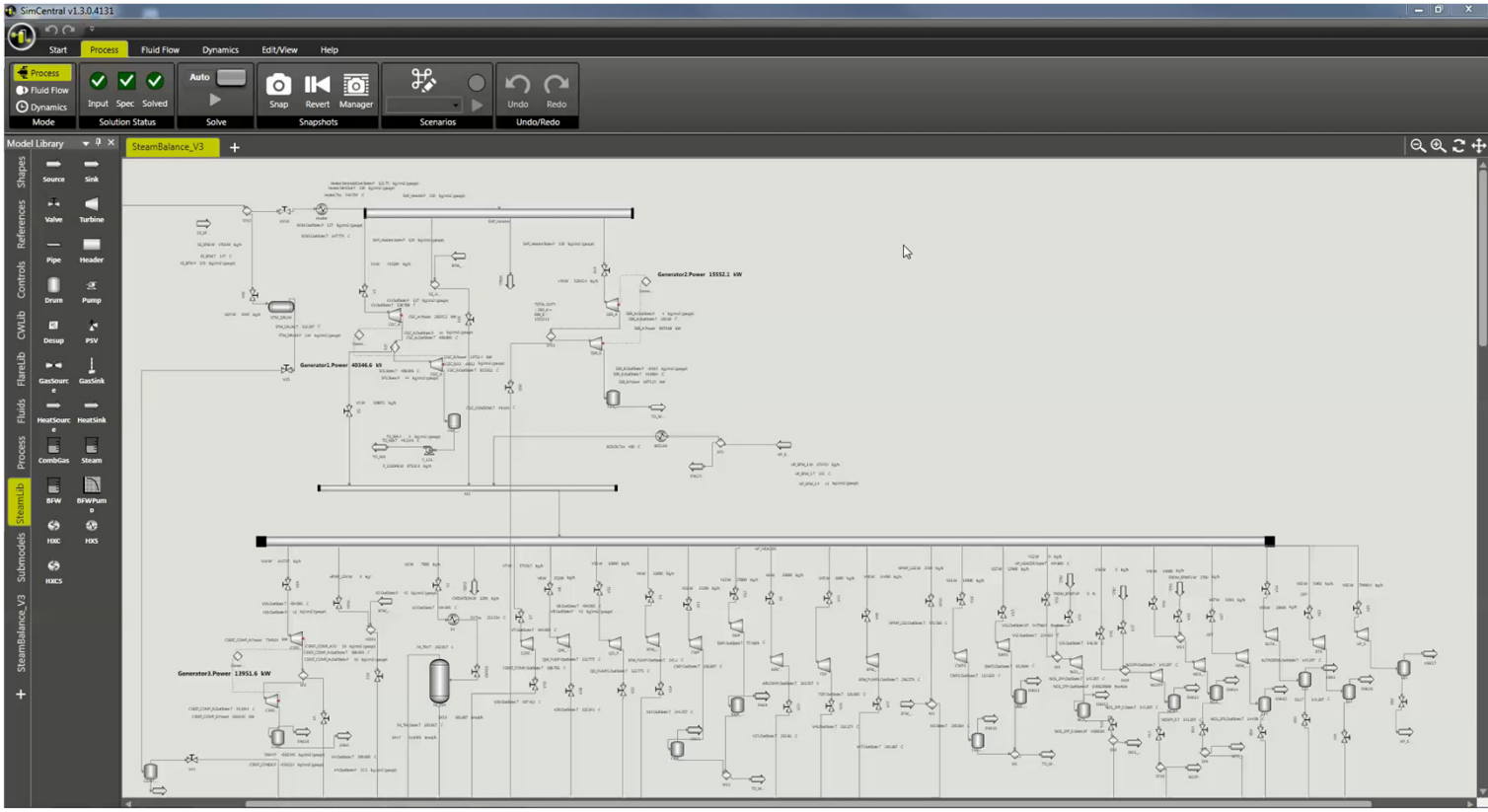
Video: Process Utility Steam Balances

video to show the size of a typical system (24 seconds)

Most companies use Excel for steam balances because process simulators cannot cope with hundreds of product flow specifications.

AVEVA Process Simulation makes this easy and can even optimize letdown flows to minimize venting.

Can also do dynamic simulation of steam distribution systems.



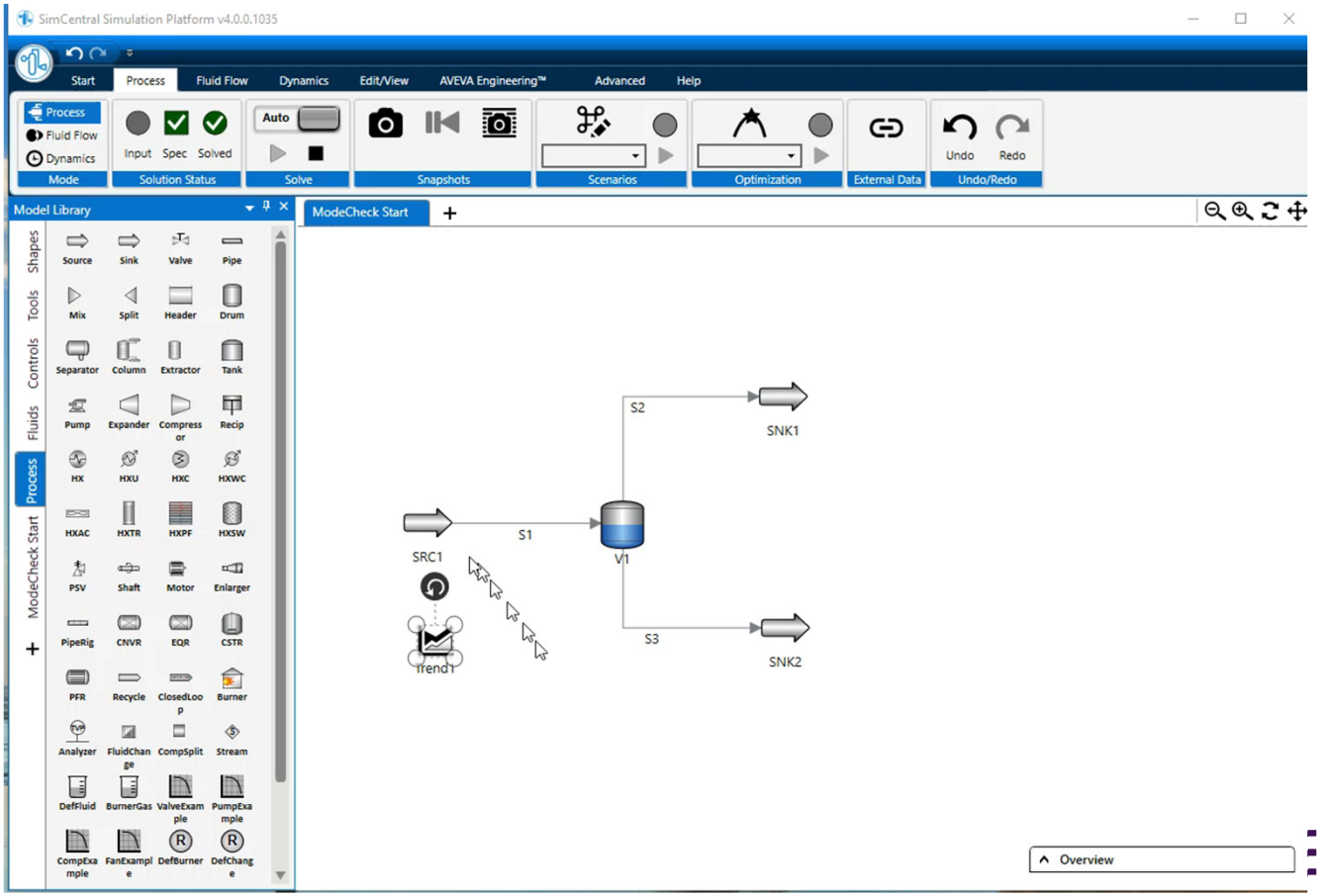
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Video: Change Mode to Dynamics and Back to Process

Follow directions from mode check to make a simulation capable of ALL MODES (90 seconds)

Any simulation can run in all modes: Process, Fluid Flow, and Dynamics.

Mode Check advices you what to do to convert a process simulation to a simulation that can run in any mode so that you just have one simulation for steady state and dynamic simulation.



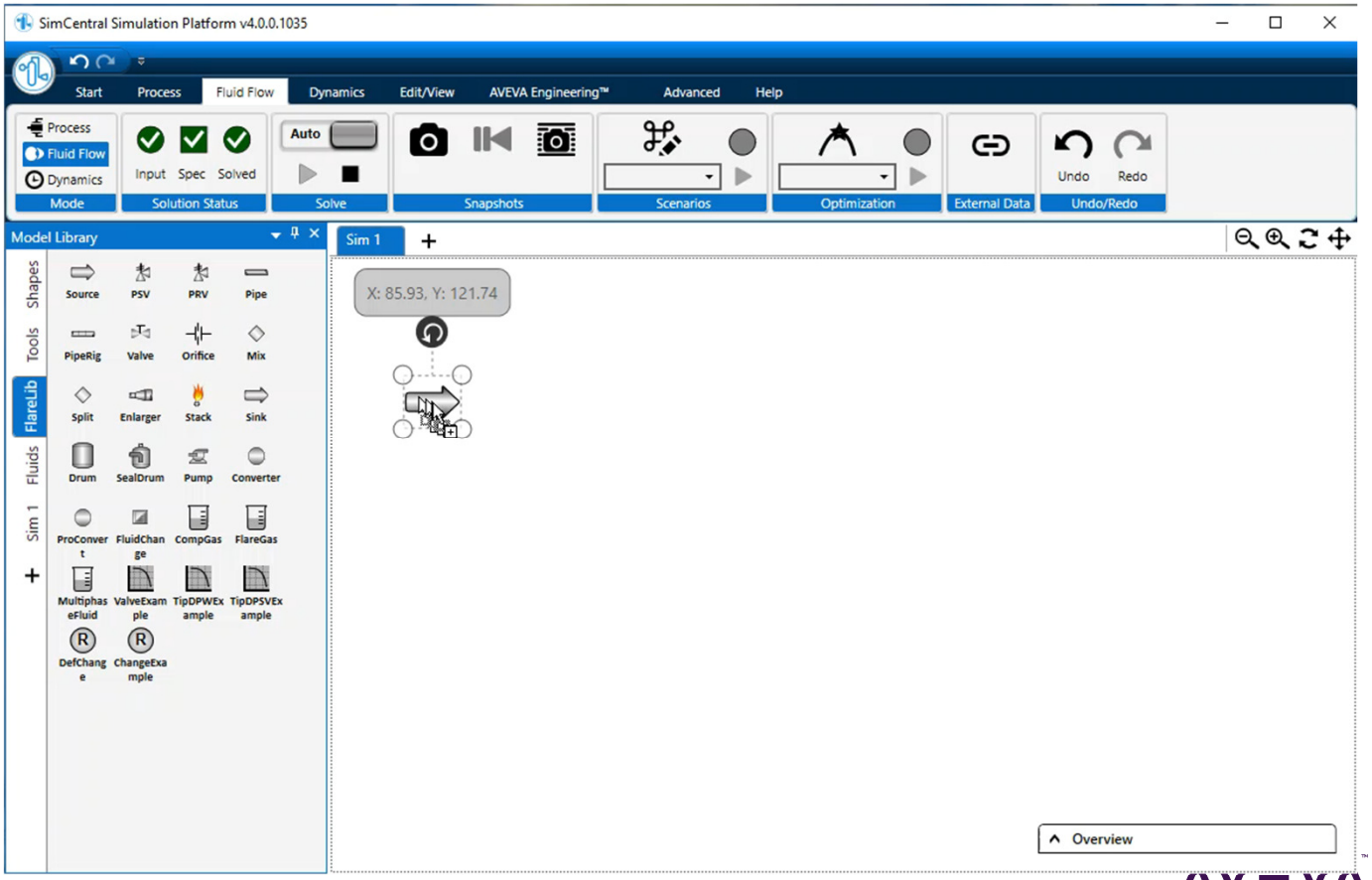
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Video: Flare Systems

Quickly snap together flare models using advanced flowsheet building tools (42 seconds)

Quickly put together flare system models to calculate

- Relief valve backpressure
- Pipe velocity
- Pipe kinetic energy (rho-v2)
- Sound Power Level



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Video: Benzene Column Relief Dynamics

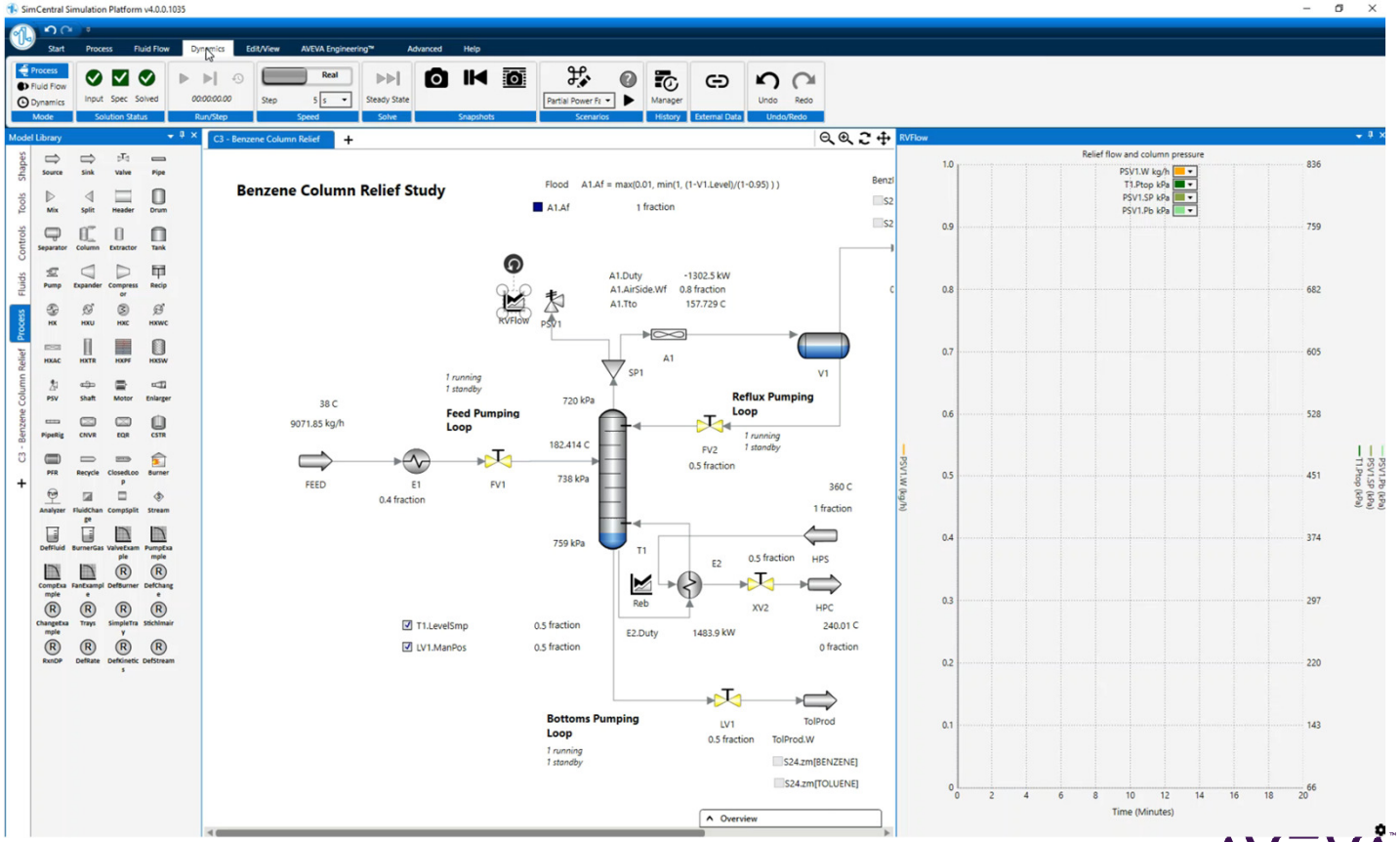
Calculate Lower Relief Loads to the Flare using Dynamic Simulation (18 seconds)

Revamp projects can lead to flare system expansions.

AVEVA Process Simulation allows you to use the same simulation you use for process simulation for dynamic simulation to calculate lower relief loads per API 521.

Watch the overhead receiver flood.

You do not have to create a separate simulation model.



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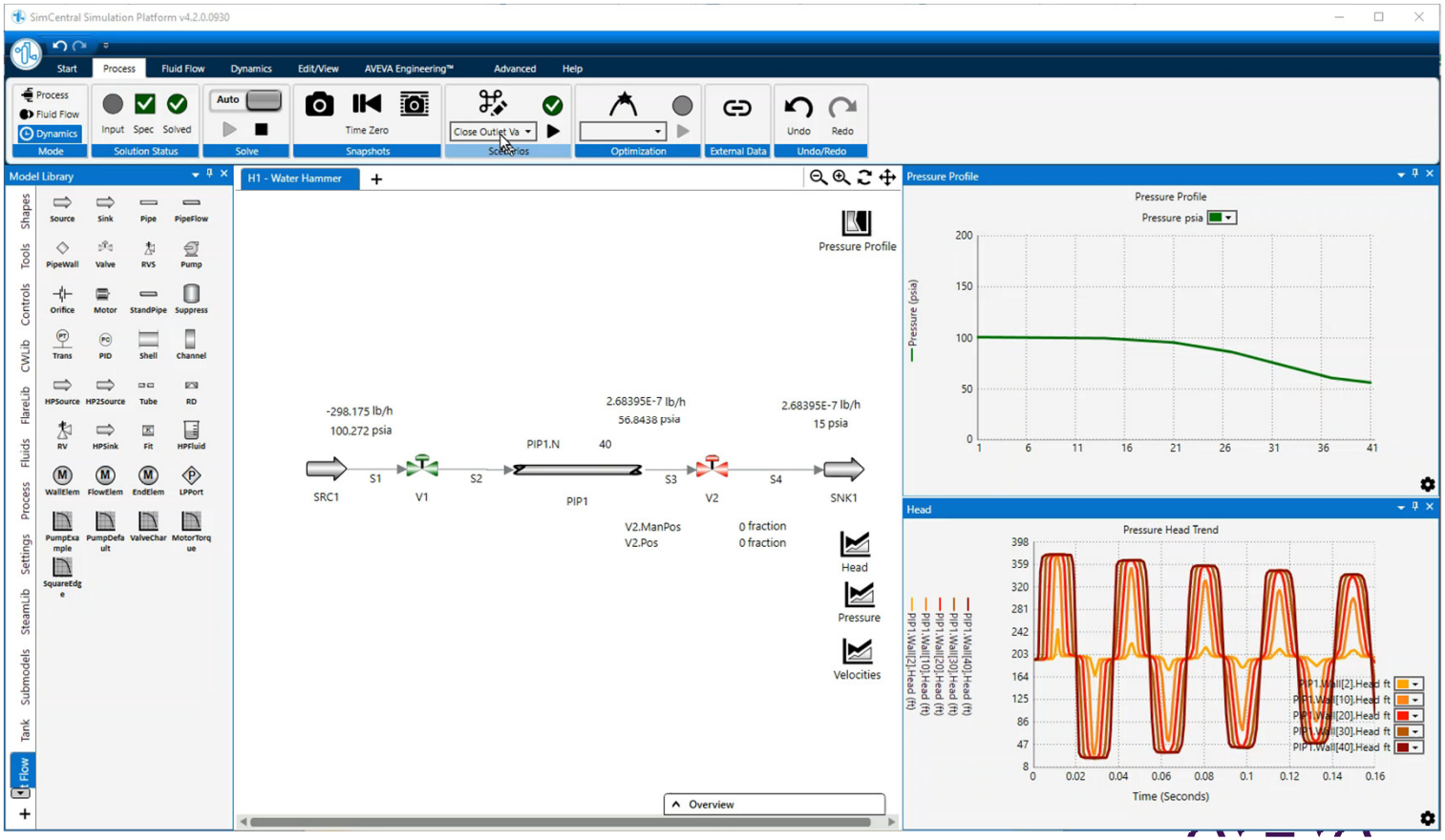
Video: Water Hammer

Calculate Pressure Waves from the fast closing of a valve at the end of a long pipe

AVEVA Process Simulation allows users to create their own libraries. The Transient flow library models water hammer and heat exchanger tube rupture.

See the pressure wave travel due to equations to model the inertial Darcy equation and pipe wall elasticity.

Validated against paper by Contractor, “The Reflection of Water hammer Pressure Wave from Minor Losses”



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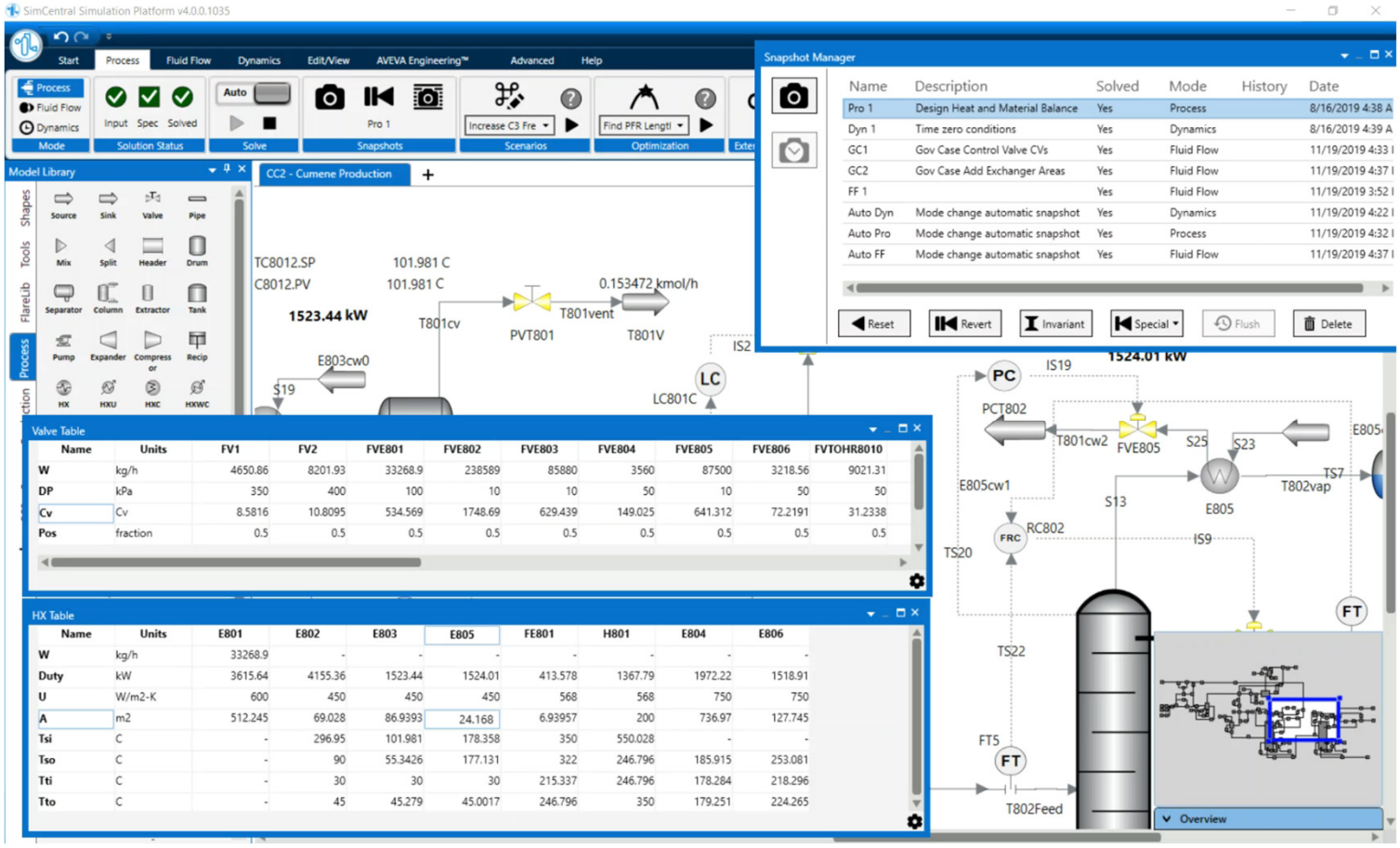
Video: Unified Engineering Round Trip

AVEVA Process Simulation Integration into Unified Engineering (4 minutes)

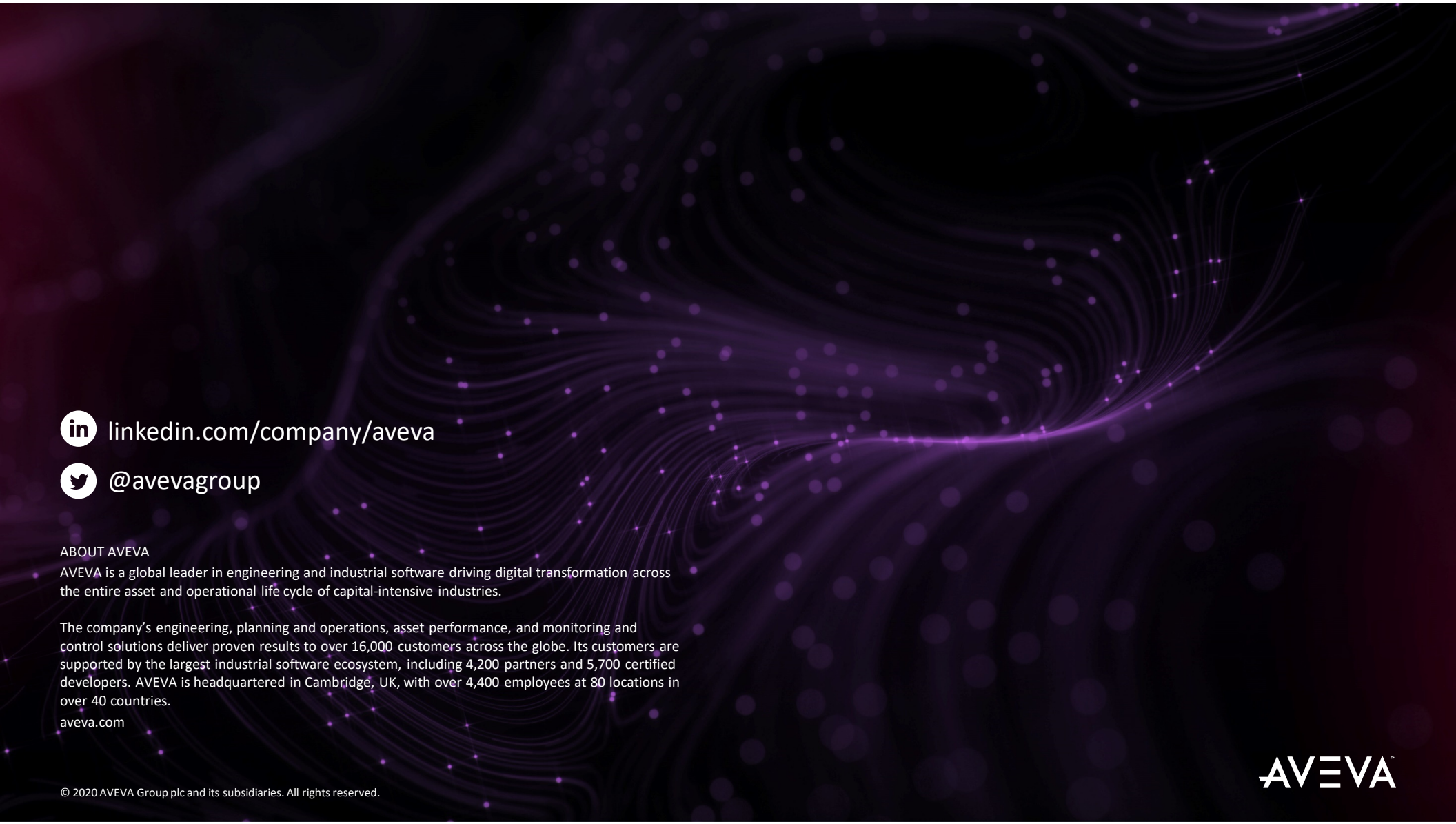
Step 1: Import heat and material balance into AVEVA Engineering.

Step 2: Export control valve Cv and heat exchanger areas back to AVEVA Process Simulation.

Step 3: Observe plant performance with without having to wait for startup or even build a dedicated simulation.



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ABOUT AVEVA

AVEVA is a global leader in engineering and industrial software driving digital transformation across the entire asset and operational life cycle of capital-intensive industries.

The company's engineering, planning and operations, asset performance, and monitoring and control solutions deliver proven results to over 16,000 customers across the globe. Its customers are supported by the largest industrial software ecosystem, including 4,200 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 4,400 employees at 80 locations in over 40 countries.

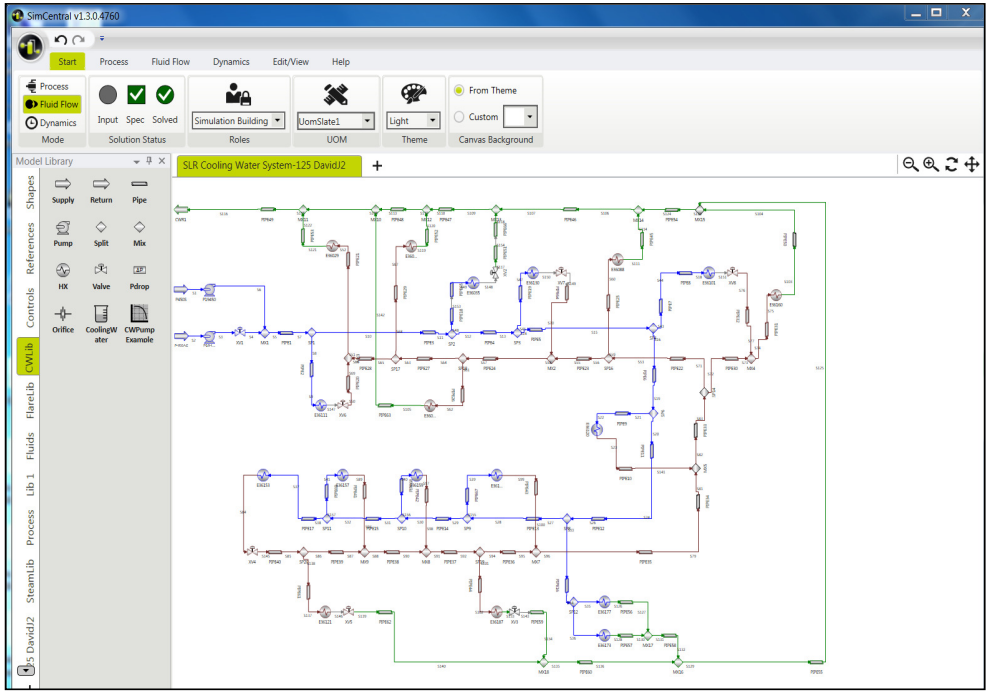
aveva.com

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Optional Slides

Cooling Water Networks

- **Engineering Problem**
  - Cooling water systems must be designed to remove process duty but engineers must use separate tools to balance water demand and confirm hydraulics.
- **AVEVA Process Simulation Benefits**
  - Integrated tool allows simultaneous process duty specification and flow network analysis
  - No need for water balance spread sheet.
  - Size new piping in Process Mode
  - Evaluate flow distribution in Fluid Flow mode



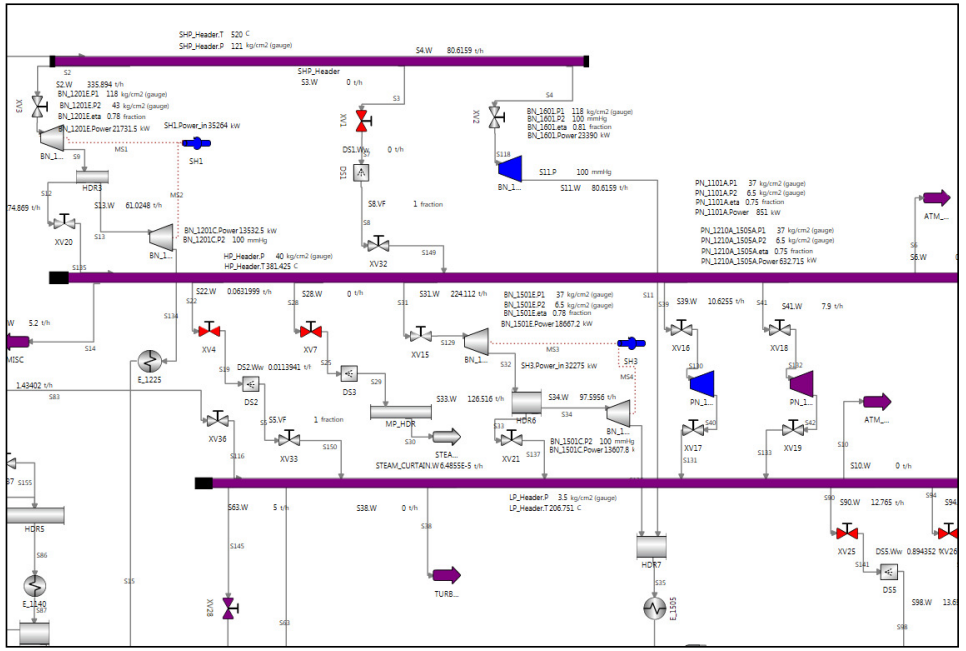
Customer simulation of two level primary and secondary cooling water with flow reversal

AVEVA Process Simulation allows unified modeling of process heat balances and network flow distribution to reduce engineering hours

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Steam Balances

- **Engineering Problem**
  - Engineers use complex Excel Spreadsheets to model steam balances which are hard to maintain.
- **AVEVA Process Simulation Benefits**
  - Specify steam consumption at the user
  - Specialty steam models like Turbine and Desuperheater.
  - Snapshots save multiple cases for one steam system.
  - Specify power, duty, or flow.
  - Optimizer minimizes low pressure venting
  - Evolve to Fluid Flow and Dynamics



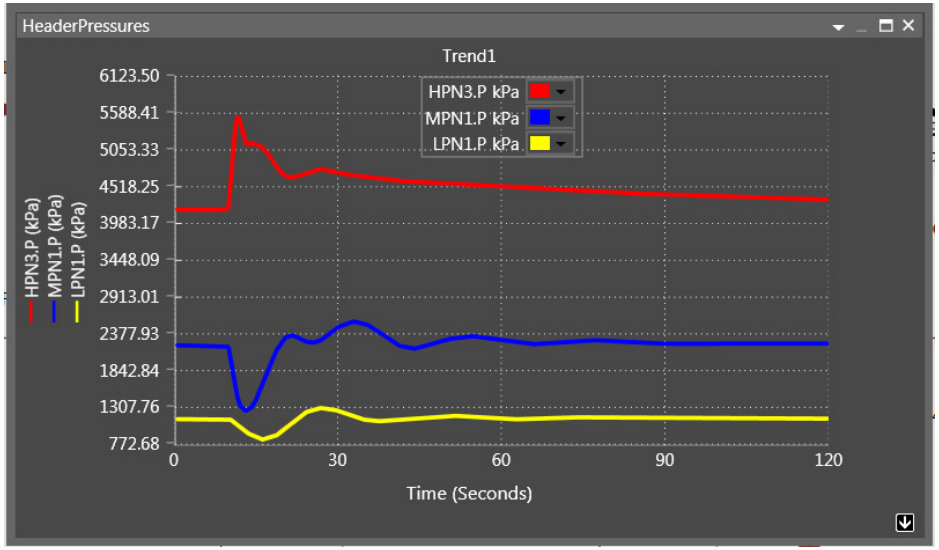
Typical three level petrochemical plant steam balance

AVEVA Process Simulation may be the only simulator capable of handling the complex specifications associated with detailed steam balances.

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Steam System Dynamic Studies

- **Engineering Problem**
  - Steam system reliability is important to protect the refinery or petrochemical complex after a steam system upset.
- **AVEVA Process Simulation Benefits**
  - One integrated model for steam balances hydraulics and dynamics.
  - Test complex header pressure controls for normal operation and prioritization of letdowns and turbines.
  - Predict header pressures after a loss of a boiler or steam turbine generator.
  - Size letdown valves



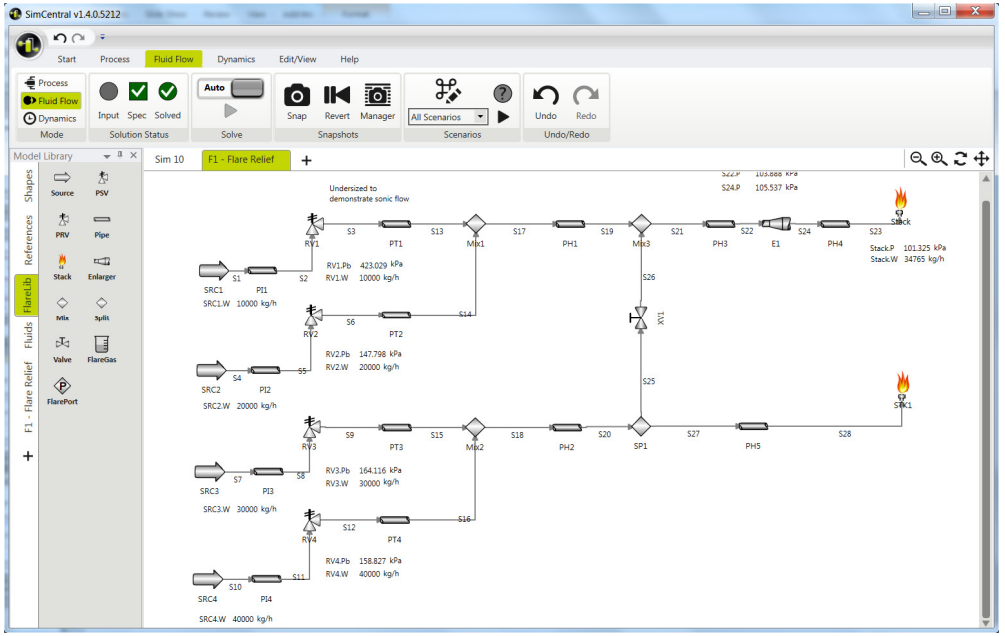
High, Medium, and Low header pressure response after a steam turbine generator trip

Only AVEVA Process Simulation has one integrated model that can be used for both steam balances and dynamic to increase steam availability

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Flare Networks

- **Engineering Problem**
  - Evaluate relief valve backpressure can reduce the capacity
- **AVEVA Process Simulation Benefits**
  - Size PSVs
  - Size inlet and tail pipes on rated flow
  - Multiple stacks with jumper valves
  - Stack flare radiation radius
  - Pipe multiple phase flow, heat transfer, and dynamics



Flare simulation demonstrating isolation jumper valve and multiple stacks

AVEVA Process Simulation will unify flare and process dynamic simulation to reduce flare expansion CapEx cost

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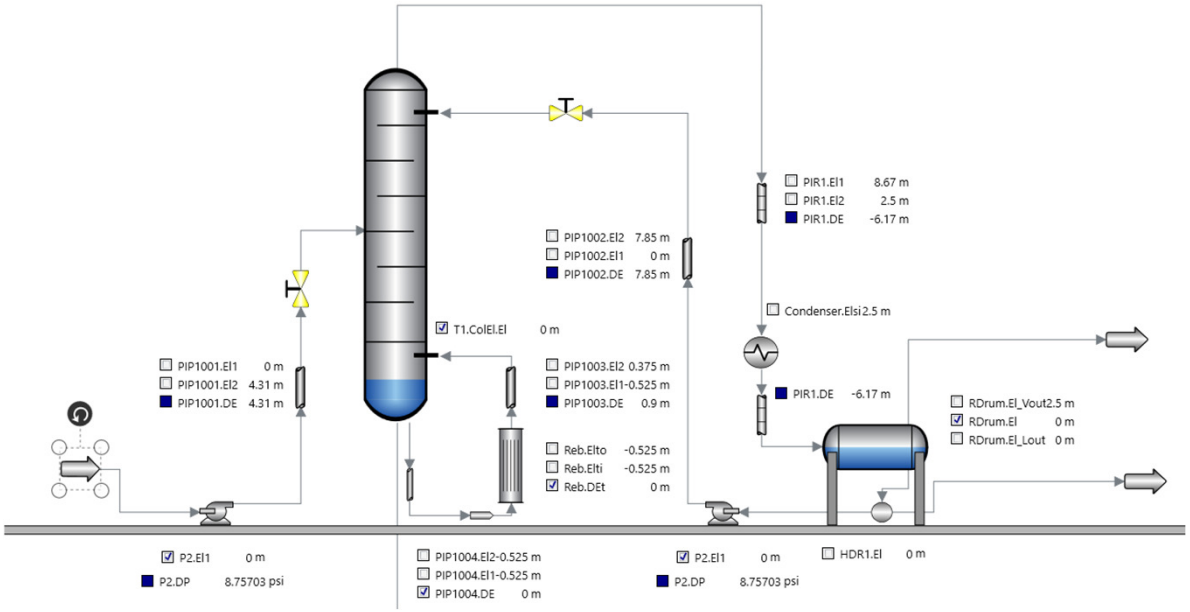
Hydraulic Circuit Design

Engineering Problem

- Companies must transfer data to other programs to design hydraulic circuits which is inefficient, error prone, and must be repeated when design is changed.

AVEVA Process Simulation Features

- Use the same model used for HMB using Process, Steam, CW libraries
- Port elevations
- Pump NPSH
- More…



Example to find height of overhead receiver to provide required NPSH to relfux pump using Port Elevations

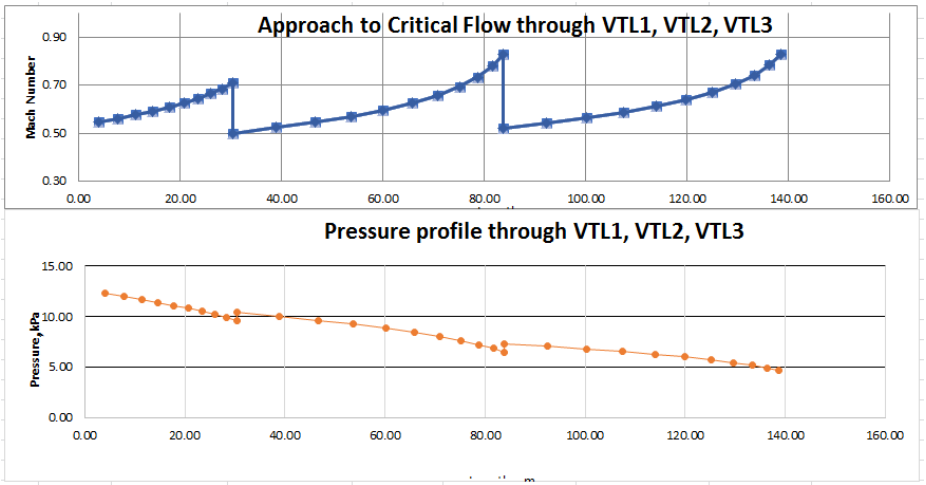
AVEVA Process Simulation process simulation eliminates the need for separate hydraulics to reduce engineering hours and eliminate data errors

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Vacuum Transfer Lines

- **Engineering Problem**
  - Critical flow in a vacuum transfer line entrains droplets that lead to heavy vacuum residue in the vacuum gas oil.
- **AVEVA Process Simulation Benefits**
  - High velocity and critical flow including discontinuities for multi phase flow with petro components.
  - Easy to use sizing and rating environment.





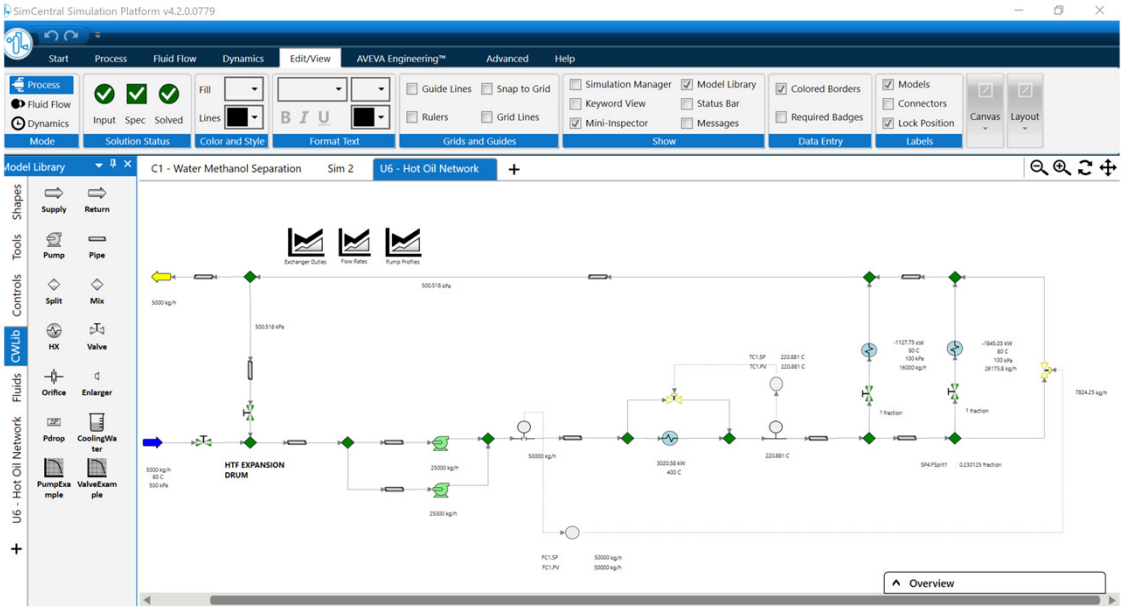
Excel report of the velocity and pressure profile in an expanding vacuum transfer line

Only AVEVA Process Simulation allows rigorous design and rating of vacuum transfer lines to avoid critical flow in an easy to use general purpose simulation platform.

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Hot Oil Networks

- Engineering Problem
  - Pressure surge / water hammer analysis can be required to determine peak pressure after the sudden close of a discharge valve.
  - Process engineers do not have ready access to pressure surge software and presents a new learning curve for them.
- SimCentral Benefits
  - Accurately predicts pressure surge as validated against published data for liquid fluids.
  - Provided in a consistent process engineering interface.
  - Demonstrates the ability to write custom models.



Example U6: Heat Transfer using Hot Oil

Heat transfer fluids such as DowTherm can be used with the Cooling Water library

AVEVA

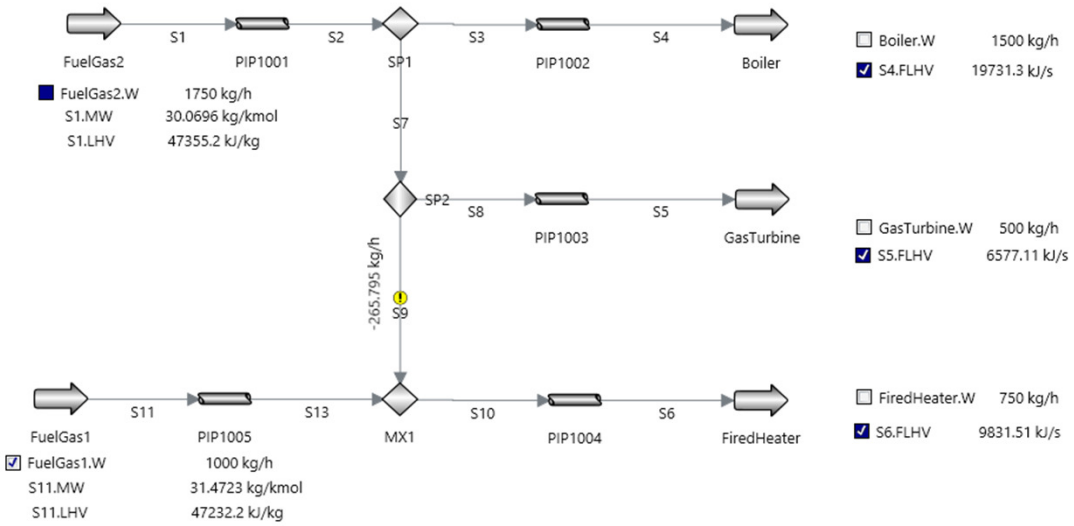
Fuel Gas Balances

Engineering Problem

- Refineries and petrochemical plants have complex fuel balances where they must deliver a fuel value to many consumers based on the composition of the fuel gas.

AVEVA Process Simulation Features

- Integrated mass balance delivering a specified Flow*LHV to each consumer (FLHV)
- Mix different fuel gas compositions (even if some flows reverse) to deliver the same combustion energy
- Integrate with steam balance and process simulation.



Example to calculate additional fuel gas supply needed in FuelGas2 given defined combustion energy flow to boiler, gas turbine, and fired heater.

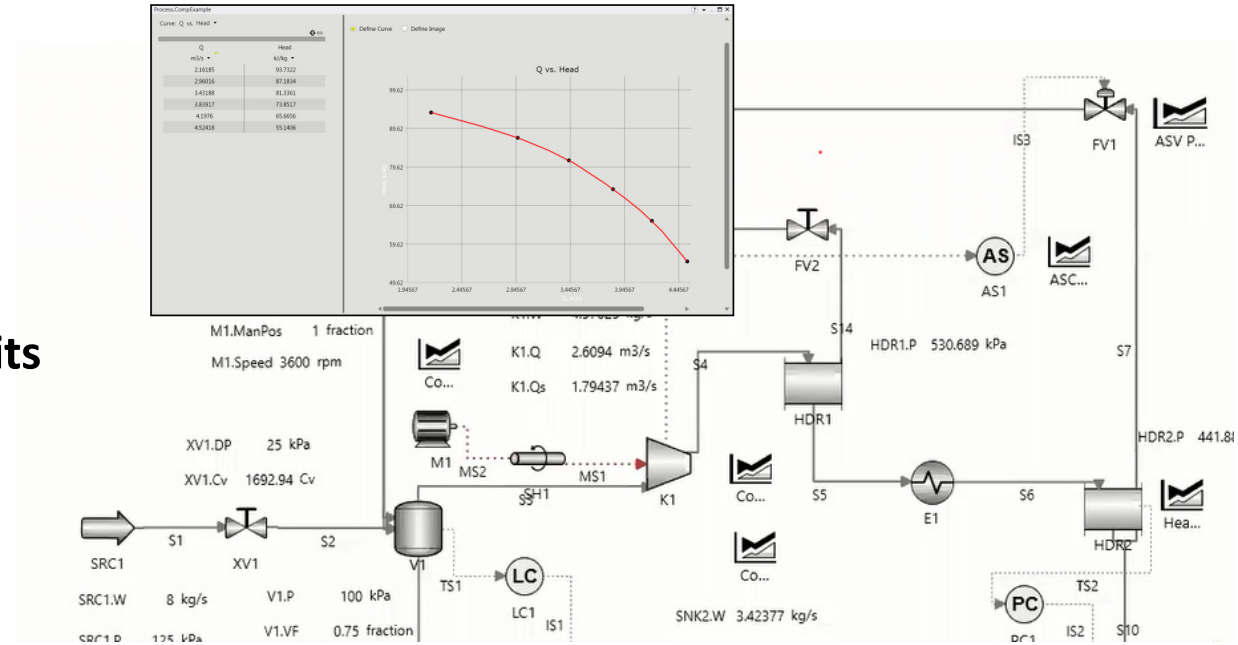
AVEVA Process Simulation provides an integrated tools for fast update of lots of cases to reduce engineering hours

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Compressor Dynamics

- **Engineering Problem**
  - Compressors must be designed for off design and transient operations
- **AVEVA Process Simulation Benefits**
  - Design compressors
  - Evaluate pressure profiles for multi stage compressors.
  - Evaluate surge control design in dynamics.
  - Evaluate hot vs cold recycles in dynamics.



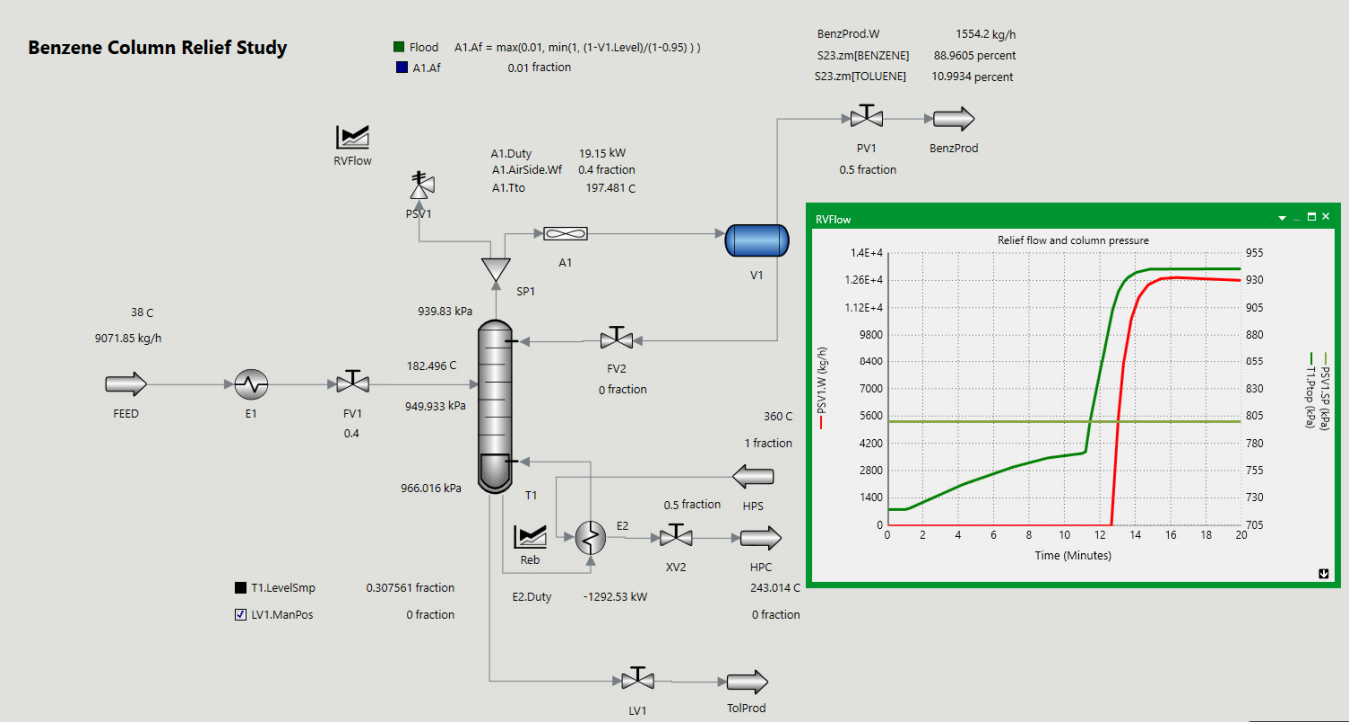
AVEVA Process Simulation compressor simulation to evaluate hot vs cold recycle valve.

AVEVA Process Simulation provides compressor simulation for process design, equipment rating, and dynamic simulation

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Column Relief

- **Engineering Problem**
  - Conventional calculation methods for column relief are too conservative
- **AVEVA Process Simulation Benefits**
  - Use the same steady state simulation.
  - Dynamic simulation can reduce the size of the relief valve.
  - For retrofits, can avoid the replacement of flare header laterals.



Calculate required relief load that is lower than conventional methods to reduce CAPEX.

With AVEVA Process Simulation, the steady sate process design simulation can be used for flare relief without creating a dedicate dynamic model.

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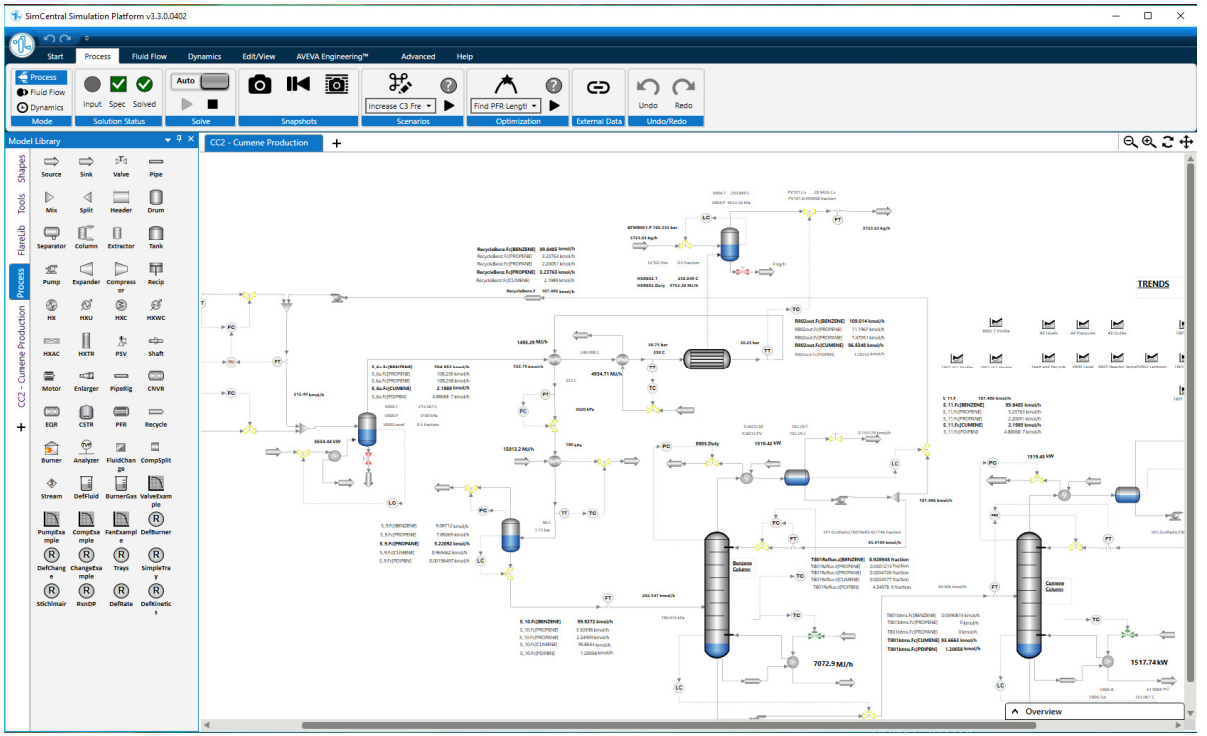
Chemical Process Simulation

Engineering Problem

- Engineers use separate tools for the same process for different purposes leading to input errors

AVEVA Process Simulation Features

- Full EO even for VLLE
- Full set of reactor models
- Binary and Ternary Phase Diagrams Diagrams
- Steady State, Hydraulics, and Dynamics all in one



AVEVA Process Simulation a engineering workflow that allows a single simulation to be used for both steady state and dynamic simulation

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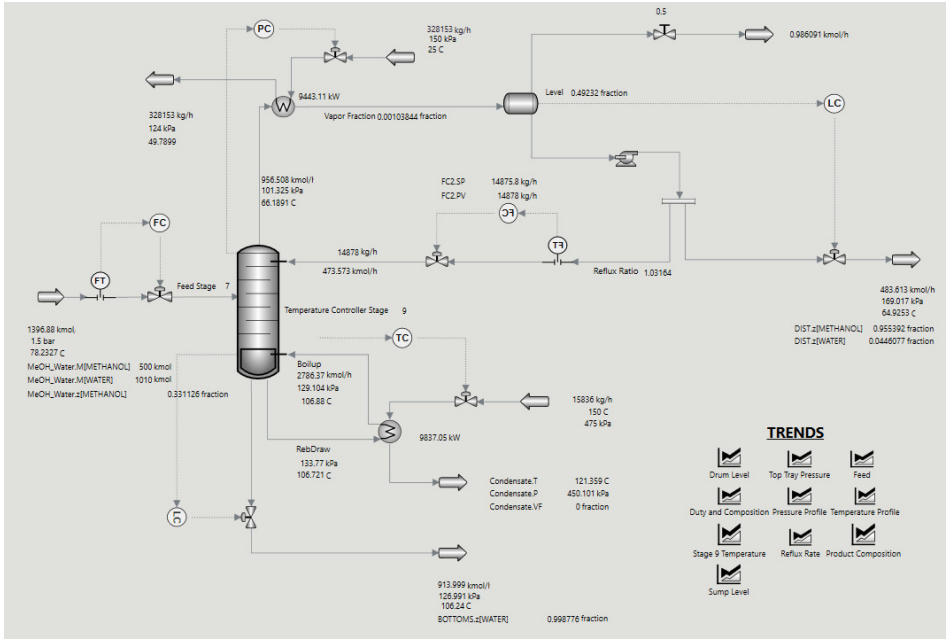
Petrochemical Process Simulation

Engineering Problem

- Engineers use separate tools for the same process for different purposes leading to input errors

AVEVA Process Simulation Features

- Full EO even for VLLE
- Full set of reactor models
- Binary and Ternary Phase Diagrams Diagrams
- Steady State, Hydraulics, and Dynamics all in one



AVEVA Process Simulation a engineering workflow that allows a single simulation to be used for both steady state and dynamic simulation

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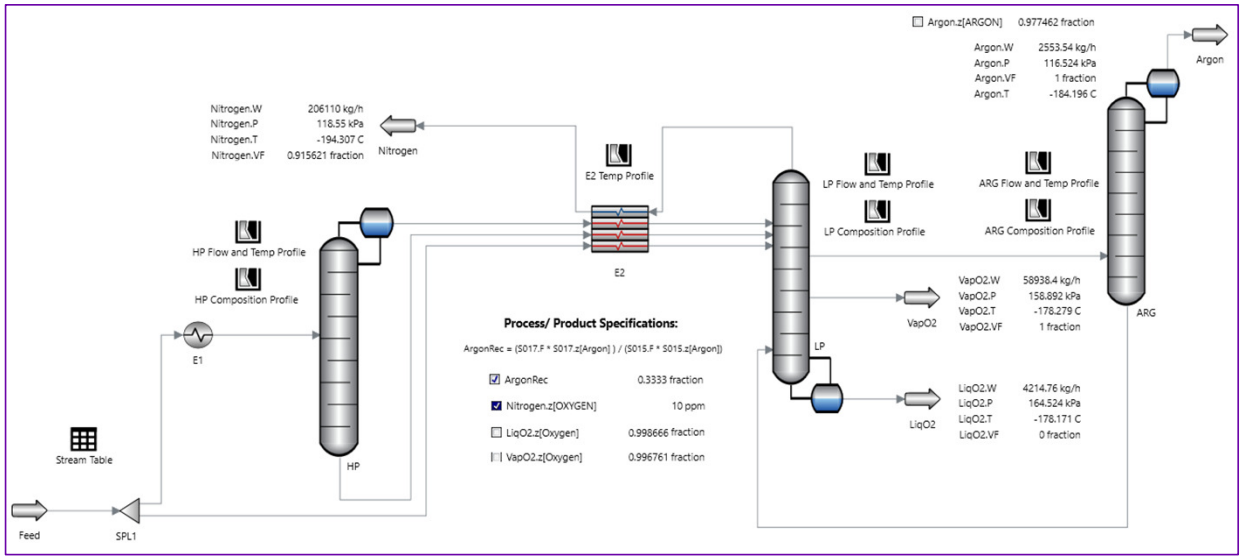
Air Separation Process Simulation

Engineering Problem

- Engineers use separate tools for the same process for different purposes leading to input errors

AVEVA Process Simulation Features

- Plate Fin Heat Exchangers
- Fast convergence of recycles
- User Added Thermo Capability



AVEVA Process Simulation a engineering workflow that allows a single simulation to be used for both steady state and dynamic simulation

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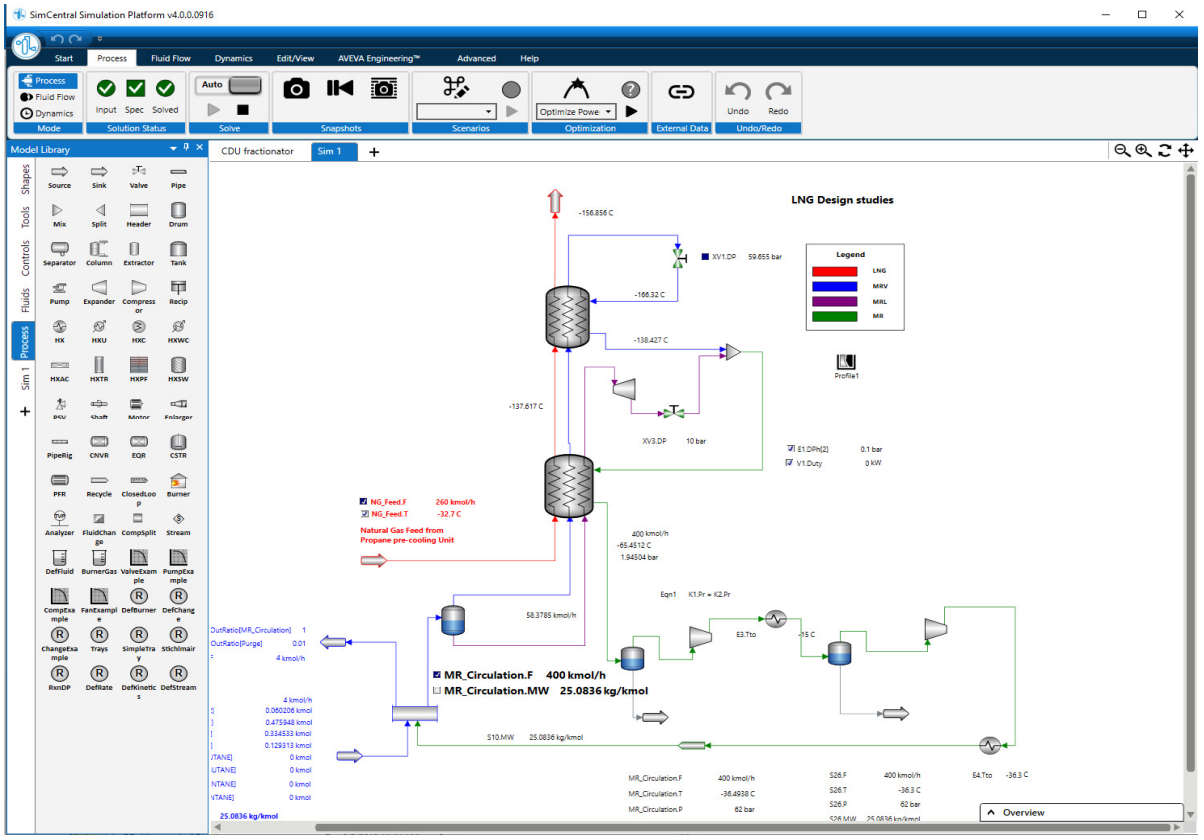
LNG Process Simulation

Engineering Problem

- Engineers use separate tools for the same process for different purposes leading to input errors

AVEVA Process Simulation Features

- Spiral Wound heat exchanger model
- Simplified simulation of closed loop refrigeration
- Optimization of mixed refrigerant composition to reduce power



AVEVA Process Simulation a engineering workflow that allows a single simulation to be used for both steady state and dynamic simulation

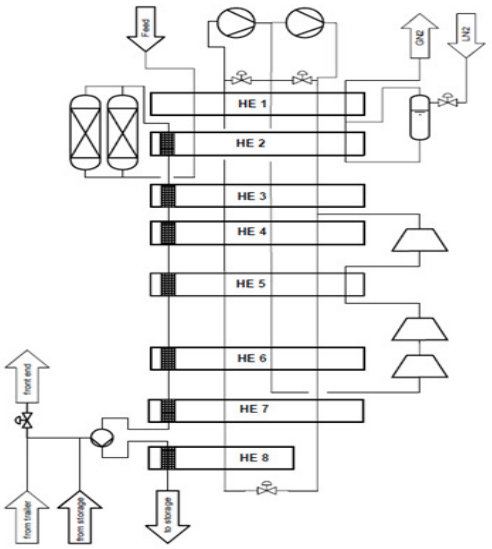
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Hydrogen Liquefaction

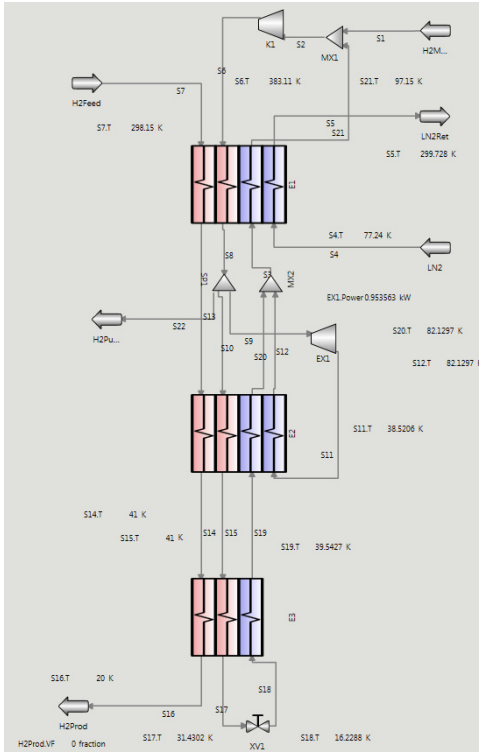
- **Engineering Problem**
  - Process design for hydrogen liquefaction plants
- **AVEVA Process Simulation Benefits**
  - Dedicated Hydrogen Library
  - Plate Fin Exchanger Model
  - Thermodynamics for the conversion of Ortho and Para hydrogen spin isomers (1)

$$o\text{-}H2 \longrightarrow p\text{-}H2 + Q$$

High Energy *Low Energy* *Exothermic*



Hydrogen Liquefaction Model



AVEVA Process Simulation provides low temperature thermodynamics for Hydrogen Liquefaction

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Note 1: Leachman, Jacobsen, Penoncello, Lemmon, "Fundamental Equations of State for Parahydrogen, Normal Hydrogen, and Orthohydrogen", Journal of Physical and Chemical Reference Data 38, 721 (2009)

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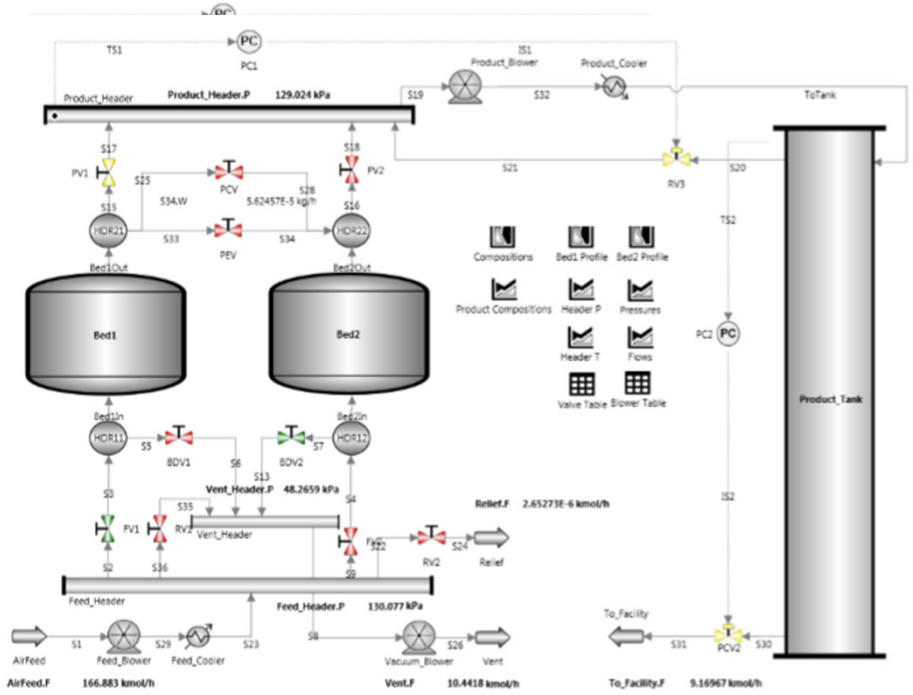
Pressure Swing Adsorption

Engineering Problem

•

AVEVA Process Simulation Features

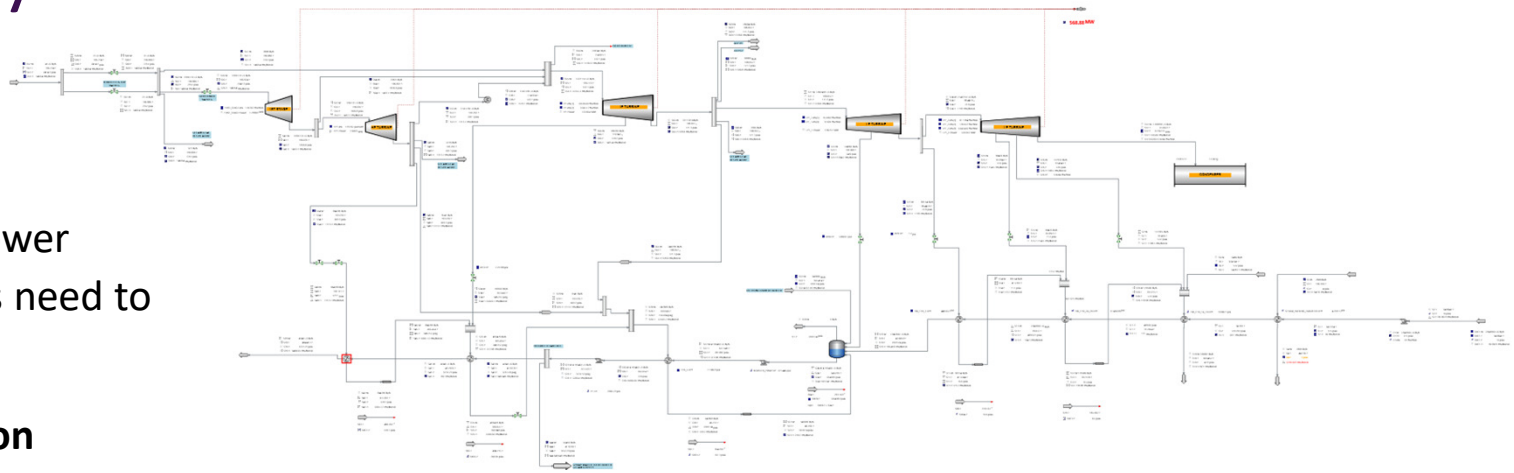
- Separate Adsorption Library
- Uses Dynamics Simulation
- Any Isotherm and kinetic relationships can be customized in a submodel for any system just like reactors
- Developed in conjunction with industry expert
  Dr. Alberto LaCava.



AVEVA Process Simulation a engineering workflow that allows a single simulation to be used for both steady state and dynamic simulation

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Power Plant Cycles

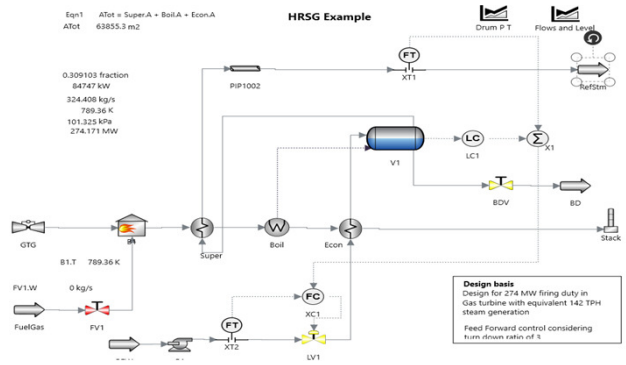


Engineering Problem

- Power plant boiler manufacturers and power generation companies need to find the heat rate.

AVEVA Process Simulation Features

- Steam Library
- Boilers with Extraction Turbines
- Combined Cycle

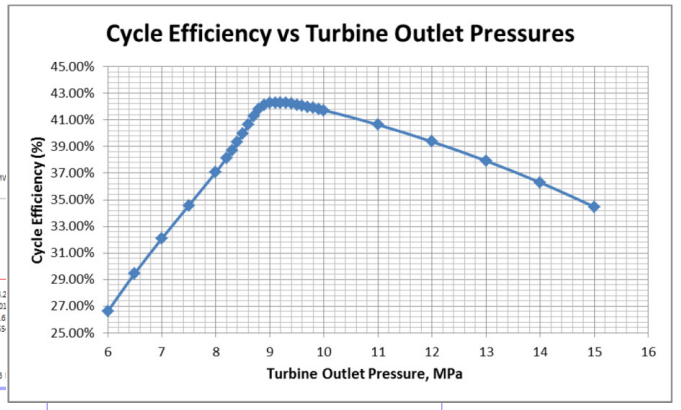


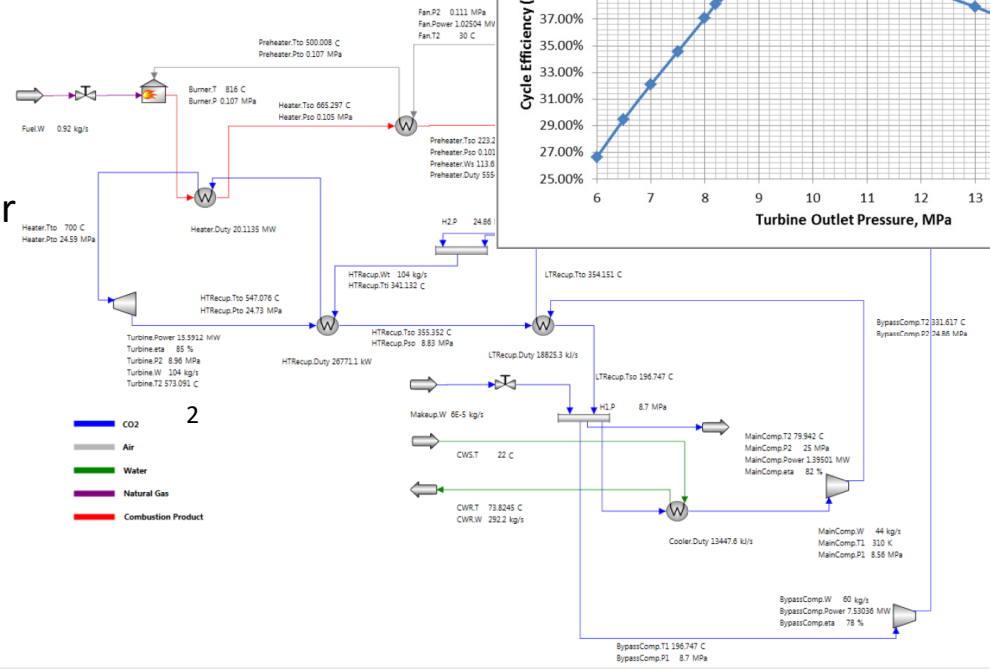
AVEVA Process Simulation a engineering workflow that allows a single simulation to be used for both steady state and dynamic simulation

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Supercritical CO_2 Power Stations

- **Engineering Problem**
  - Design, Fluid Flow, and Dynamic Simulation of sCO_2 Brayton cycle power stations
- **AVEVA Process Simulation Benefits**
  - Span Wagner EOS
  - Compressor and Turbine
  - Evaluate control strategies
  - Optimize power cycle efficiency by adjusting pressure ratio and bypass





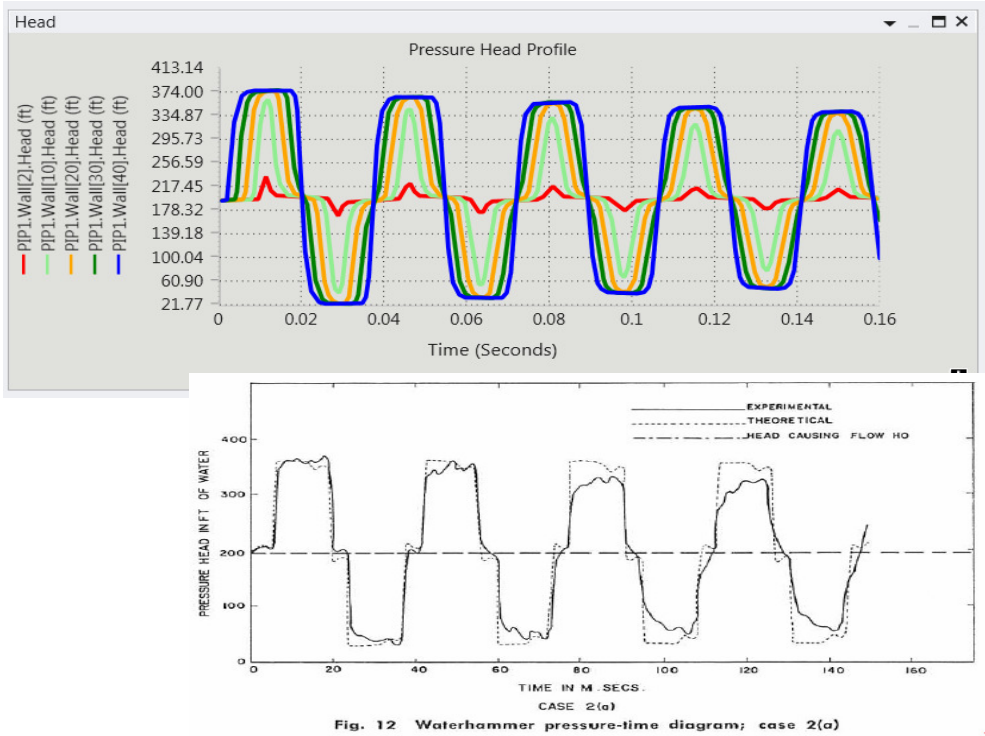
Typical sCO_2 Brayton Cycle

AVEVA Process Simulation provides the unique thermodynamics for sCO2 power station design and dynamics

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Pressure Surge (Water Hammer)

- **Engineering Problem**
  - Pressure surge / water hammer analysis can be required to determine peak pressure after the sudden close of a discharge valve.
  - Process engineers do not have ready access to pressure surge software and presents a new learning curve for them.
- **AVEVA Process Simulation Benefits**
  - Accurately predicts pressure surge as validated against published data for liquid fluids.
  - Provided in a consistent process engineering interface.
  - Demonstrates the ability to write custom models.



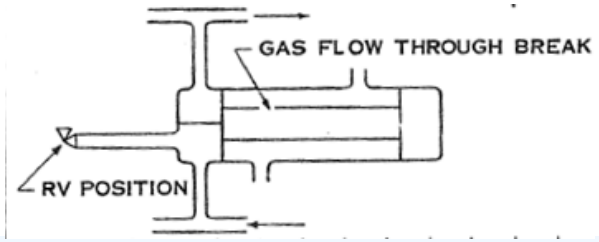
AVEVA Process Simulation transient matches published experimental data

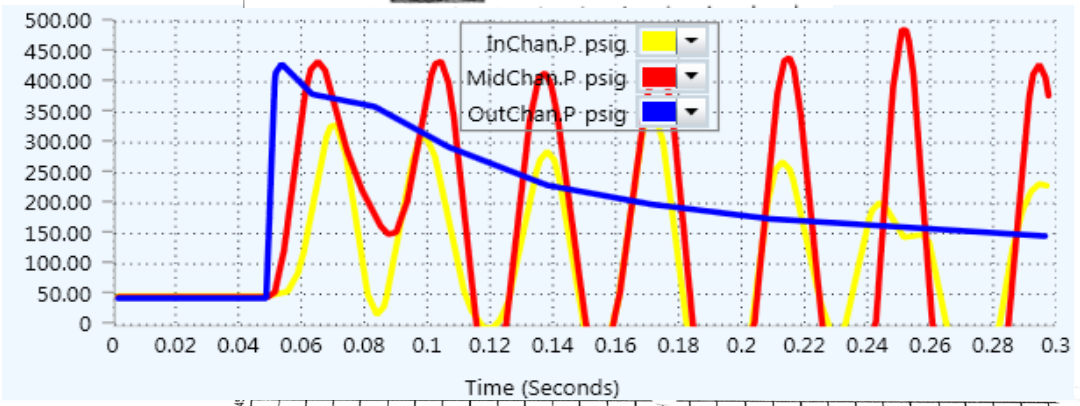
Water hammer and pressure surge analysis can be performed using a consistent process engineering platform

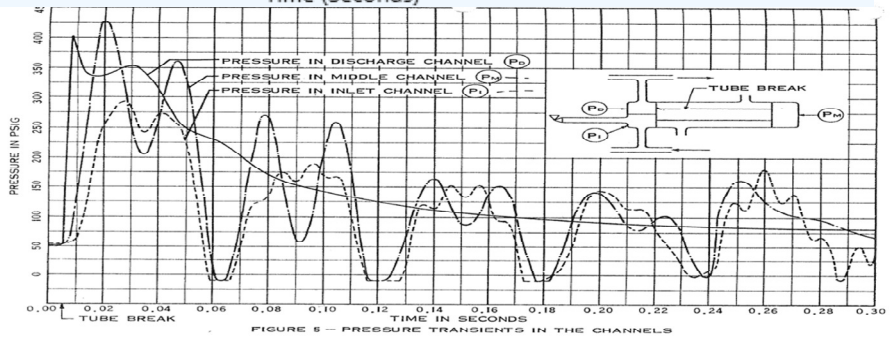
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Heat Exchanger Tube Rupture

- **Engineering Problem**
  - Exchangers that do not meet the 10/13ths rule should rerated, replaced, or evaluated by transient analysis.
- **AVEVA Process Simulation Benefits**
  - Exchanger includes high pressure side gas expanding inside low pressure equipment.
  - Pipe considers inertia of low pressure fluid
  - Relief valve considers inertia of moving disk







AVEVA Process Simulation can predict the pressure surge in low pressure equipment and piping per (API 521 4.4.12.2)

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Features

Version 4.3 Jul 2020

User Interface

- Modern ribbon design
- Undo / redo changes
- Open multiple simulations
- Changes continuously saved
- Error and warning badges
- Subflowsheets
- Units of Measure
- User Roles

Simulation Modes

- Three simulation modes
- (1) Process simulation mode
- (2) Fluid flow / rating mode
- (3) Dynamics mode
- Return to any mode
- Design Optimization

Solver Management

- Continuously solved
- Free variable specification
- Specification analyzer feedback
- Fast equation-oriented solution
- Robust block decomposition
- Implicit Euler dynamic integrator
- Implicit Trapezoidal Integrator
- Return to any saved snapshot

Thermodynamic Methods

- Ideal
- Industrial Steam Tables IF97
- Soave Redlich Kwong (SRK)
- Peng Robinson (PR)
- SRKH (Huron-Vidal)
- SRKM / PRM
- Wilson
- NRTL
- UNIFAC (Dortmund)
- UNIQUAC
- LACT with EOS for vapor
- Hayden O'Connell for fugacity
- Lee Kesler Enthalpies
- Grayson Streed/Improved GS
- Isomeric Hydrogen
- Span Wagner supercritical CO2
- Bosen and Engels Electrolytes
- Electrolyte NRTL (eNRTL)

Phase Equilibrium

- VLE
- VLWE (beta)
- VLLE

Thermo Data

- Petro components
- SimSci Databanks
- DIPPR Public Data
- DECHEMA Data Import
- Thermodynamics Data Manager (TDM)
- NRTL Binary Override
- Henry Data Override
- Pure Component Override

Model Libraries

- Process
- Cooling Water
- Steam
- Flare
- Transient Flow
- Adsorption
- Rate Based Column
- Pressure Swing Adsorption

Controls Library

- Transmitter
- PID Control
- On/Off Control
- Select
- Switch
- Anti-Surge
- Alarm (preview)
- Wave (preview)

Model Writing

- Parameters
- Variables
- Conditions
- Equations
- Ports
- Submodels
- Connections
- Icons
- Type change propagation

Process Library

- Source / Sink
- Mix / Split / Header
- Drum (2 phase)
- Separator (3 phase)
- Column / Hydraulics
- Valve
- Relief Valve
- Pipe
- PipeRig (two phase)
- Pump
- Compressor
- Reciprocating Compressor
- Expander
- Motor
- Extractor
- Heat Exchanger
- Air Cooler
- Water/Utility Cooler
- Thermosyphon Reboiler
- Spiral Wound HX
- Plate Fin HX
- Recycle
- Fluid Change
- Burner
- Equilibrium Reactor
- Conversion Reactor
- Stirred Tank Reactor
- Plug Flow Reactor
- Gibbs Minimization Reactor

Tools and Utilities

- Snapshots
- Trends
- Profile Plots
- Heat Curve
- Binary Phase Diagrams
- Ternary Phase Diagrams
- Scenario
- Curve (with Image Import)
- Stream / Equipment Tables
- OSI PI External Data
- Global Variables

Excel Reports Add-in

- Excel Ribbon Control
- Compare Snapshots
- Compare Simulations
- Get Value Function
- Set Value Function
- Get Dynamics Value Function
- Get Model List Function
- More Functions

Programming Interfaces

- External Equation Interface
- User Added Thermo Interface

Deployment

- 64 Bit Computation
- Single user Desktop installer
- Token, ALS, CALM, LaaS Licensing

Unified Engineering

- To AVEVA™ Engineering
- From AVEVA™ Engineering

New in 4.3

Notes: (beta/preview) – Feature for feedback. (wip) – Work in progress for future release

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AVEVA™ Process Simulation 4.2 Beta New Features

High Level Summary Slide 1 of 2

- **NRTL Data Override.** Change NRTL binary interaction data in the Fluid Editor for a specific simulation or a library to share with other users without having to update the data through the Thermo Data Manager (TDM). See immediate impact on open simulations.
- **SRK Huron-Vidal (SRKH).** Use the Suave Redlich Kwong (SRK) equation of state extended with the Huron-Vidal mixing rule commonly used in other process simulators.
- **Ideal Thermo.** Use a simple thermo method with ideal gas for the vapor and Raoult's law for the liquid.
- **Heat Transfer Fluids.** Select from multiple heat medium components such as DOWTHERM™ or Eastman Therminol® to perform heat balances and hydraulic calculations of hot oil systems
- **User Added Thermo Interface.** Allow external programmers to link integrate proprietary thermo property calculation methods through a documented software programming interface.

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AVEVA™ Process Simulation 4.2 Beta New Features

High Level Summary Slide 2 of 2

- **Event based Scenarios.** Use a RUN UNTIL command to run until a specific process condition is met before performing another the next step or stopping. Very useful for Batch processes.
- **Adsorption Library.** Import the Adsorption library for pressure swing adsorption from the Examples folder and explore example simulations for a lab-scale unit and a commercial full-scale oxygen purification.
- **Flare Alterative Pipe Sizes.** Create your own pipe size table for regions of the world that do not use *"Nominal Pipe Size"* or "*Diametre Nominal"*
- **Air Separation Plant Example.** View an example simulation of an air separation plant based on a AVEVA™ PRO/II™ Simulation.
- **LaaS licensing.** Obtain a license through the cloud

AVEVA™ Process Simulation 4.3 New Features

High Level Summary Slide 1 of 4

- **Electrolyte NRTL Thermo Method.** Model electrolytic systems with the widely used electrolyte Non-Random Two-Liquid (eNRTL) method by supplying a reaction chemistry submodule.
- **Pure Component Data Override.** Change temperature-dependent properties for pure component data in the Fluid Editor for a specific simulation or a library to share with other users without having to update the data through the Thermo Data Manager (TDM).
- **Henry Component Override.** Change Henry component interaction data in the Fluid Editor for a specific simulation or a library to share with other users without having to update the data through the Thermo Data Manager (TDM).
- **Lee-Kesler (LK) Enthalpies.** Override any equation of state method vapor or liquid enthalpy calculations with the Lee-Kesler method.
- **Binary Phase Diagrams.** Now create two-component VLLE equilibrium curves.
- **Ternary Phase Diagrams.** Create triangular three-component equilibrium curves from any VLE or VLLE fluid.

AVEVA™ Process Simulation 4.3 New Features

High Level Summary Slide 2 of 4

- **Rate-Based Distillation Library.** Install this included library to include mass transfer limitations in a distillation column.
- **Gibbs Minimization Reactor.** Model equilibrium reactions without having to specify reactions or equilibrium constants by minimizing the Gibbs free energy.
- **Pressure Swing Adsorption Example.** View example simulations and documentation of a lab-scale pressure swing adsorption (PSA) and a full-scale PSA example to separate oxygen from air.
- **Stream Properties**. Now find specific heat for heat exchanger design, real and ideal specific heat ratio for relief valve sizing, and combustion heating values and flow rates for fuel gas balances.
- **Stream Flow Resistance.** Add a flow resistance in any stream for rapid steady-state to dynamic simulation conversion without having to add a pipe or valve.
- **Equipment Port Elevations.** Specify absolute equipment port elevations with respect to grade for easier hydraulic analysis in the Process, Steam, and Cooling Water libraries.

AVEVA™ Process Simulation 4.3 New Features

High Level Summary Slide 3 of 4

- **Reference Streams.** Designate a Source model to take its properties from any stream (like PRO/II) in the Process and Steam libraries.
- **Graphical Subflowsheets.** Move models from one flowsheet to another with an easy move command.
- **Model References.** Provide links between graphical subflowsheets by placing references to the same model in multiple locations.
- **Incremental Solve.** Add new models to the flowsheet more quickly by not solving the entire simulation.
- **Manual without Specification Analysis.** Manipulate huge simulations more quickly by turning off specification analysis while making changes.
- **Easy Model Navigation.** Quickly navigate from any model on the flowsheet canvas to its model reference on graphical subflowsheet, to the model in the simulation manager, to open the model type in the model editor, or to read the model's help.

AVEVA™ Process Simulation 4.3 New Features

High Level Summary Slide 4 of 4

- **Fixed Component Properties.** Write your own models that access fixed component properties such as molecular weight, normal boiling point, specific gravity, lower heating value, and more.
- **Parent Variable and Parameter Connections.** Write your own replaceable submodels that access top-level variables and parameters without having to change the top-level model.
- **Variable Mapping to AVEVA™ Engineering.** Transfer more process simulation variables values from AVEVA™ Process Simulation to AVEVA™ Engineering for process design. Transfer more invariant variables back from AVEVA™ Engineering to AVEVA™ Process Simulation.

AVEVA Process Simulation Improves Process Design

More effective and efficient design, analysis, and compliance

Reduce Engineering Hours	Reduce Project Risk	Reduce CapEx and OpEx
• Use one simulation over the project lifecycle to reduce effort up to 66%. • Reduce time to build simulations through a modern user experience. • Reduce the time to train engineers using a common platform approach • Improve personnel effectiveness by exchanging engineers more freely. • Add Unified Engineering for greater savings.	• Reduce data entry errors by using one unified model • Eliminate incompatible design through multi discipline collaboration such as controls and automation • Unified Engineering catches engineering mistakes during design (through continuous rating and dynamic simulation). Discovery at startup will cost millions per day of startup delay.	• Reduce OpEx costs by optimized designs that reduce process utility costs. • Reduce CapEx costs by optimizing equipment size. • Reduce Capex through reduced equipment design margins and lower relief system costs through dynamic simulation.