

Kongsberg Oil & Gas Technologies

CAPE-OPEN meeting – September 2014

Roar Nilsen

K-Spice Product Manager



KONGSBERG

200

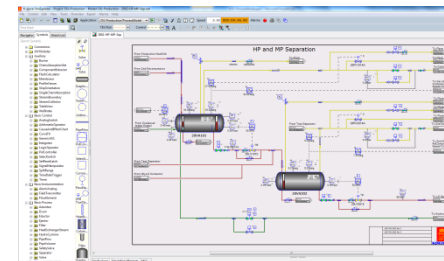
K-Spice®

- CAPE-OPEN compliant for thermodynamics

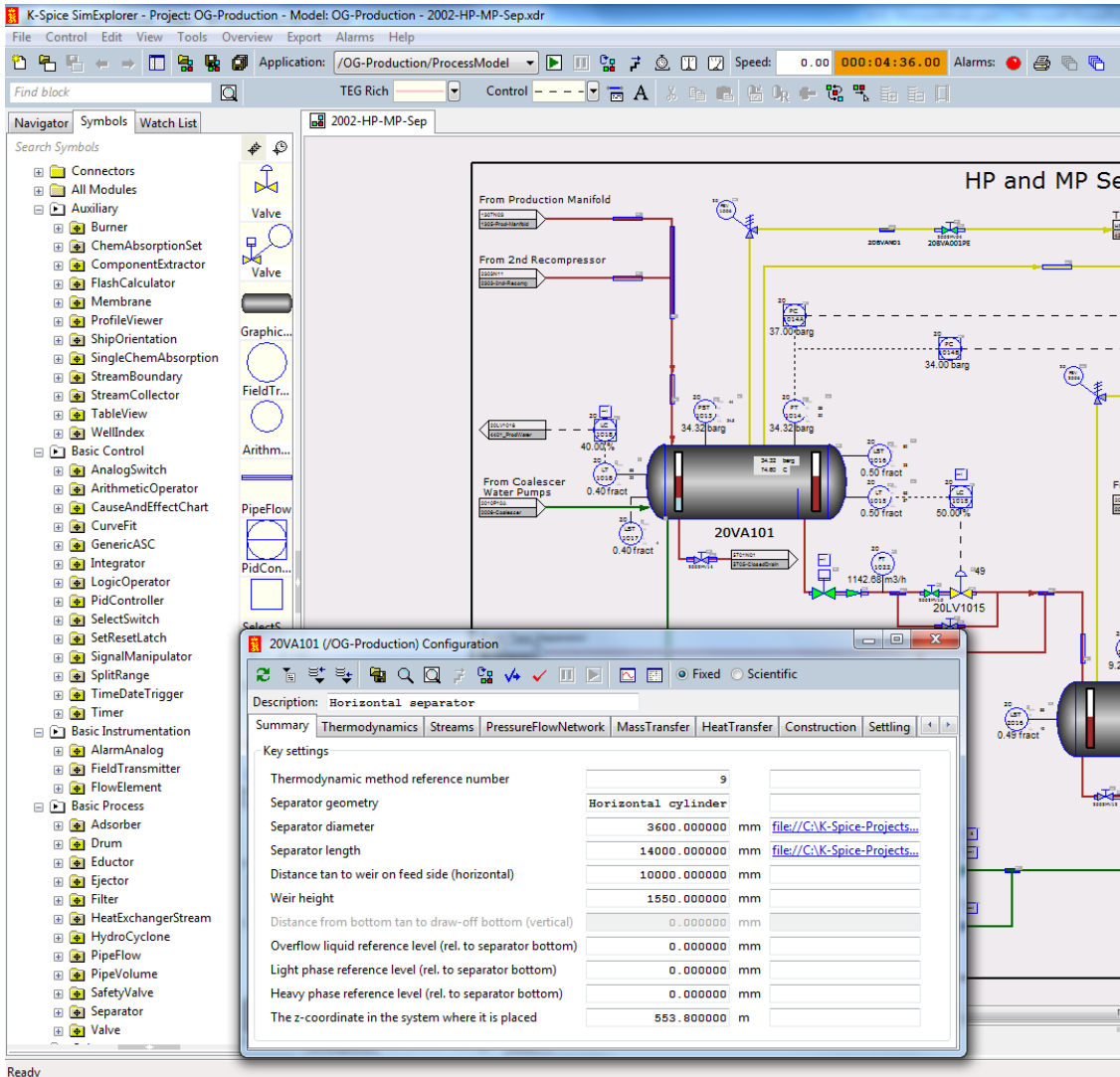
- Background
 - Dynamic Process Simulation
 - Life-Cycle Simulation Concept

- CAPE-OPEN interface for thermodynamics
 - Technical Solution

- Demo



Building a Dynamic Process Model in K-Spice



K-Spice SimExplorer - Project: OG-Production - Model: OG-Production - 2002-HP-MP-Sep.xdr

Application: /OG-Production/ProcessModel | Speed: 0.00 | 000:04:36.00 | Alarms: [Red Light]

Find block: TEG Rich | Control: [Dropdown]

2002-HP-MP-Sep

HP and MP Sep

From Production Manifold

From 2nd Recompressor

From Coalescer Water Pumps

20VA101

20LV1015

20VA101 Configuration

Description: Horizontal separator

Key settings	Value	Unit
Thermodynamic method reference number	9	
Separator geometry	Horizontal cylinder	
Separator diameter	3600.000000	mm
Separator length	14000.000000	mm
Distance tan to weir on feed side (horizontal)	10000.000000	mm
Weir height	1550.000000	mm
Distance from bottom tan to draw-off bottom (vertical)	0.000000	mm
Overflow liquid reference level (rel. to separator bottom)	0.000000	mm
Light phase reference level (rel. to separator bottom)	0.000000	mm
Heavy phase reference level (rel. to separator bottom)	0.000000	mm
The z-coordinate in the system where it is placed	553.800000	m

- High fidelity models
- Produced with a sound basis in first-principles physics, chemistry and engineering
- Usually a one-to-one correspondence between an entry on an equipment data sheet and an item in the model
- Multiphase Flow Models (LedaFlow®)
- Control Modules
- Shutdown Systems (C&E)
- Sequences
- Compressor Control Algorithms

Building a Dynamic Process Model in K-Spice

K-Spice SimExplorer - Project: OG-Production - Model: OG-Production - 2002-HP-MP-Sep.vxd

File Control Edit View Tools Overview Export Alarms Help

Application: /OG-Production/ProcessModel Speed: 0.00 000:04:36.00

Find block TEG Rich Control

Navigator Symbols Watch List

2002-HP-MP-Sep

Search Symbols

- Connectors
- All Modules
- Auxiliary
 - Burner
 - ChemAbsorptionSet
 - ComponentExtractor
 - FlashCalculator
 - Membrane
 - ProfileViewer
 - ShipOrientation
 - SingleChemAbsorption
 - StreamBoundary
 - StreamCollector
 - TableView
 - WellIndex
- Basic Control
 - AnalogSwitch
 - ArithmeticOperator
 - CauseAndEffectChart
 - CurveFit
 - GenericASC
 - Integrator
 - LogicOperator
 - PidController
 - SelectSwitch
 - SetResetLatch
 - SignalManipulator
 - SplitRange
 - TimeDateTrigger
 - Timer
- Basic Instrumentation
 - AlarmAnalog
 - FieldTransmitter
 - FlowElement
 - TrueOp...
- Basic Process
 - Adsorber
 - Drum
 - Eductor
 - Ejector
 - Filter
 - HeatExchangerStream
 - HydroCyclone
 - PipeFlow
 - PipeVolume
 - SafetyValve
 - Separator
 - Valve

Valve

Graphic...

FieldTr...

Arithm...

PipeFlow

PidCon...

SelectS...

Corrosi...

FlowEle...

HeatEx...

Colum...

Filter

Graphic...

From Production Manifold

From 2nd Compressor

From Coalescer Water Pumps

From Test Separator

20VA101

34.32 barg

34.00 barg

37.00 barg

0.40 fract

0.50 fract

0.50 fract

1142.88 m³/h

20LV10

20VA202

9.21 barg

9.21 barg

0.49 fract

0.49 fract

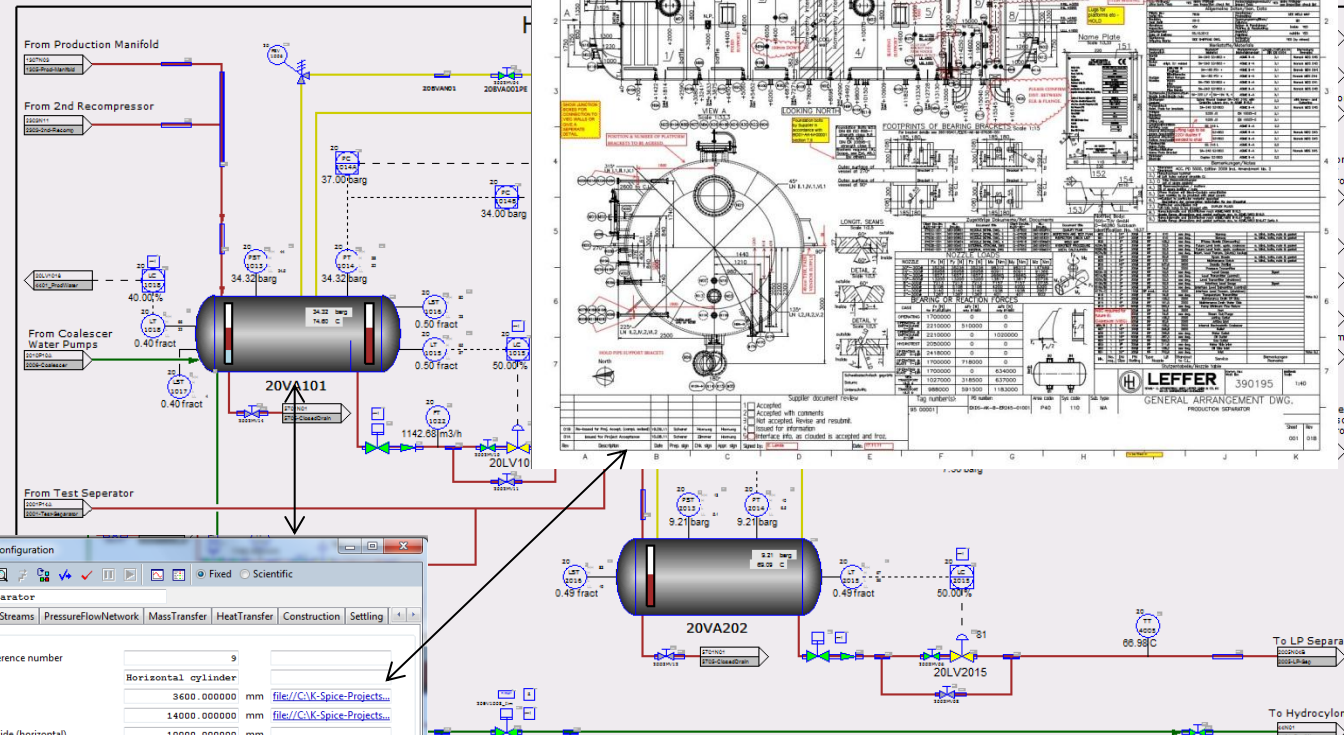
50.00%

20LV2015

66.88 C

To LP Separator

To Hydrocyclone



SEPARATOR "SECRET FOLDER"

1	Accepted
2	Accepted with comments
3	Not accepted. Review and resubmit.
4	Resubmit for information.
5	Interface info. or. clouded in accepted and final.

LEFFER 390195
GENERAL ARRANGEMENT DWG.
PRODUCTION SCHEMATIC

OGP-202-2002 Rev 0
OGP-202-2003 Rev 0

KONGSBERG

20VA101 (/OG-Production) Configuration

Description: Horizontal separator

Summary Thermodynamics Streams PressureFlowNetwork MassTransfer HeatTransfer Construction Setting

Key settings

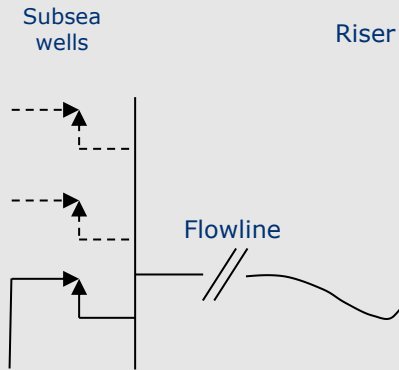
Thermodynamic method reference number	9
Separator geometry	Horizontal cylinder
Separator diameter	3600.000000 mm
Separator length	14000.000000 mm
Distance tan to weir on feed side (horizontal)	10000.000000 mm
Weir height	1850.000000 mm
Distance from bottom tan to draw-off bottom (vertical)	0.000000 mm
Overflow liquid reference level (rel. to separator bottom)	0.000000 mm
Light phase reference level (rel. to separator bottom)	0.000000 mm
Heavy phase reference level (rel. to separator bottom)	0.000000 mm
The z-coordinate in the system where it is placed	553.800000 m

Utilizing the evolution of the model and knowledge throughout the whole Life Cycle

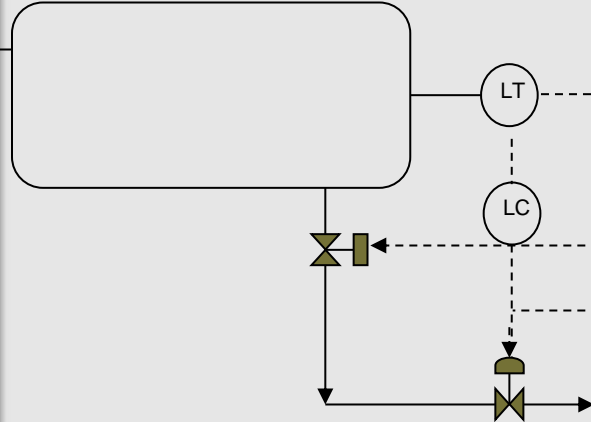


Engineering Simulator

Flow Assurance LedaFlow



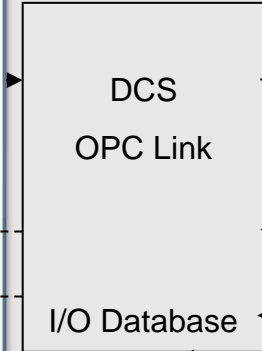
Engineering Studies K-Spice®Design



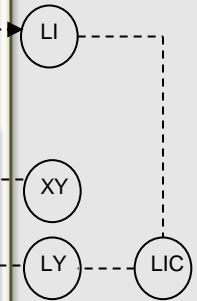
Operator Training Simulator

K-Spice®Train

DCS Check-out K-Spice®Verify



DCS Logic



KsimIoListAbbitsCom : Select Query

KsimTag	KsimVar	ItemName	DataType	StaticValue	Max	Tolerance	Connected
▶ 20I0179	NOUT	Applications.C25_OIL_PROCESS.LT_20_0179_Value	12		100	0.001	<input checked="" type="checkbox"/>
20I0179a	REMSET2	Applications.C25_OIL_PROCESS.LY_20_0179A_Value	12		100	0.005	<input checked="" type="checkbox"/>
20I0179b	REMSET2	Applications.C25_OIL_PROCESS.LY_20_0179B_Value	12		100	0.005	<input checked="" type="checkbox"/>
*							<input type="checkbox"/>

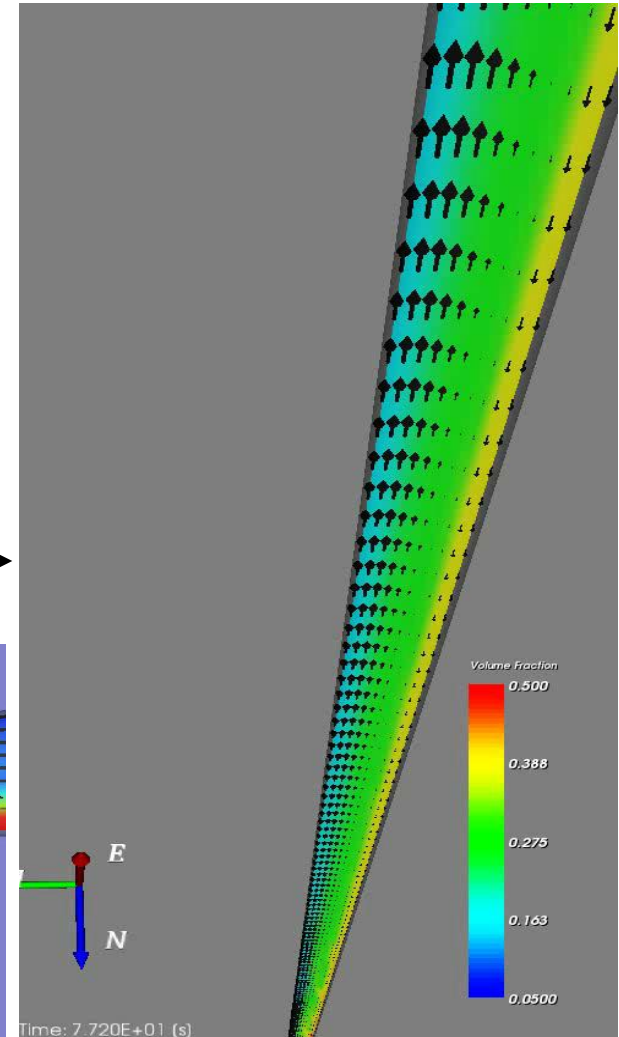
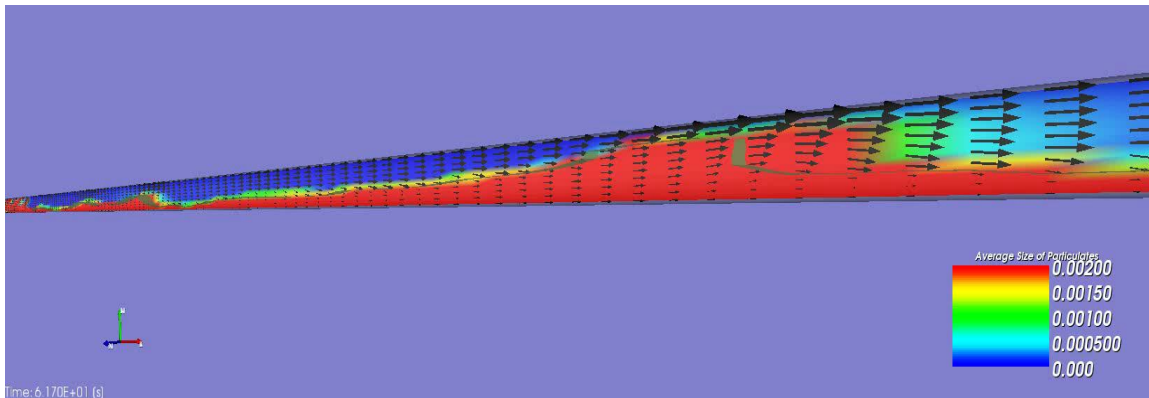
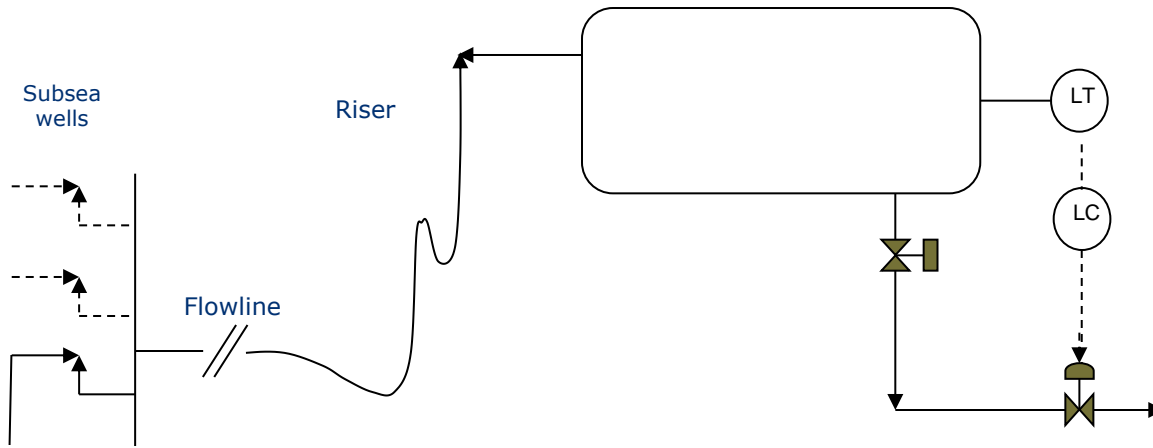
Record: 14 | 1 | of 3 (Filtered)



Example of LedaFlow Multiphase flow in Flowline and Riser

Flow Assurance
LedaFlow

Engineering Studies
K-Spice



Reuse existing model in decision support applications

Engineering Simulator

Operator Training Simulator K-Spice®Train

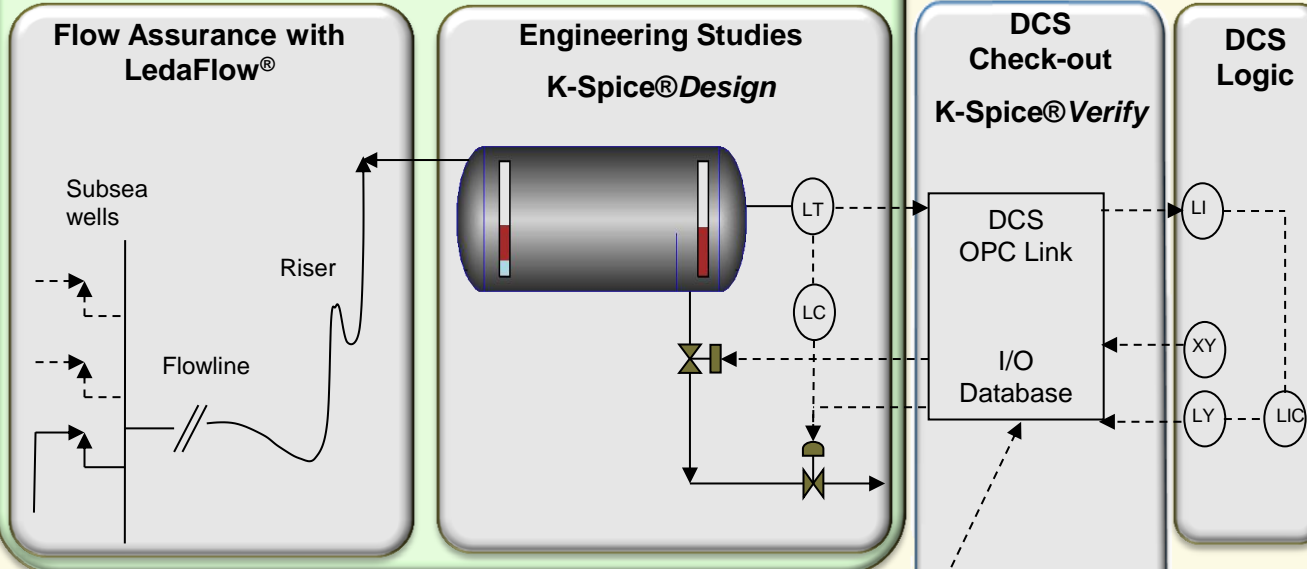
Online Simulator

Production Assurance K-Spice®Assure

Look-ahead predictions
 Slug management
 Scraper management
 Leak detection
 Hydrate prediction
 Inhibitor management
 Measurement
 Reconciliation
 Multi-well virtual metering
 Production allocation
 Sensor validation
 Environmental monitoring
 Condition monitoring

Online OTS K-Spice®Match

Model validation
 Model tuning
 Analysis of process upsets
 Modification studies
 OTS initialization



KsimListAbbitsCom: Select Query

KsimTag	KsimVar	ItemName	DataType	StaticValue	Max	Tolerance	Connected
20M0179	NOUT	Applications.C25_OIL_PROCESS.LT_20_0179_Value	12		100	0.001	<input checked="" type="checkbox"/>
20M0179a	REMSET2	Applications.C25_OIL_PROCESS.LY_20_0179A_Value	12		100	0.005	<input checked="" type="checkbox"/>
20M0179b	REMSET2	Applications.C25_OIL_PROCESS.LY_20_0179B_Value	12		100	0.005	<input checked="" type="checkbox"/>

Record: 1 of 3 (Filtered)

K-Spice®

- CAPE-OPEN compliant for thermodynamics

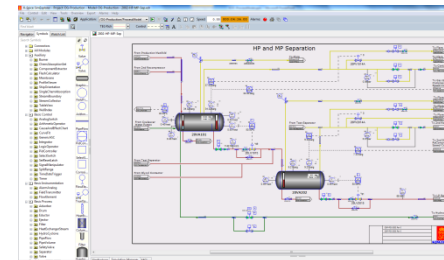
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- Demo



Two thermo types available in K-Spice

ThermoTable (CAPE-OPEN compliant)

Generate thermodynamic look-up tables (offline) to be loaded into memory during initialisation of a K-Spice model

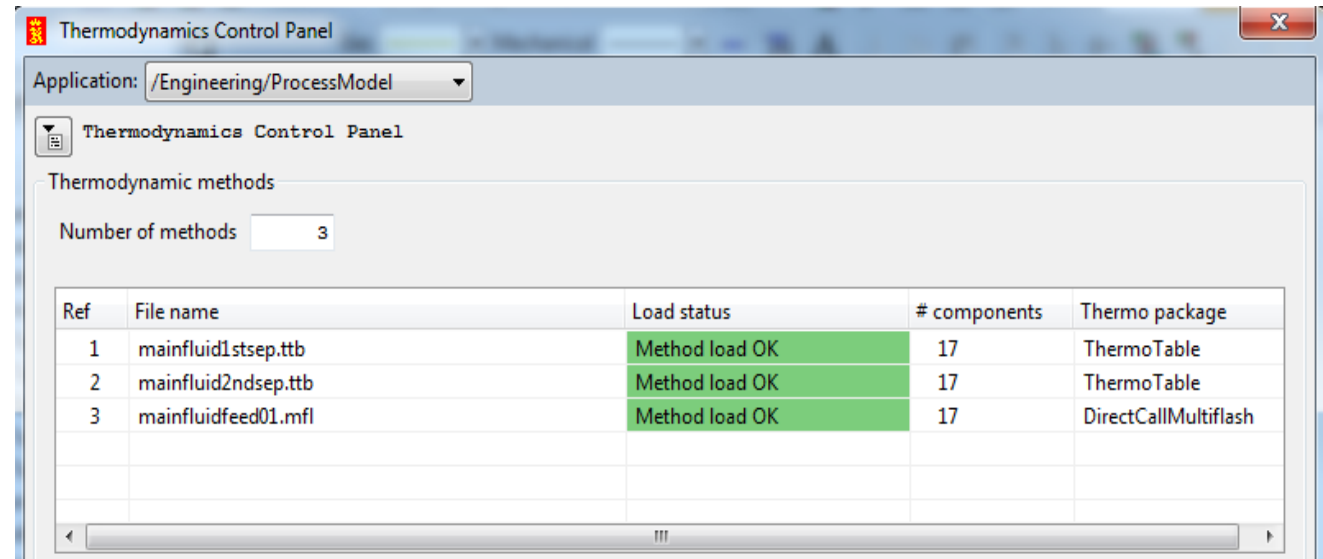
DirectCallMultiflash (Optimized solution for Multiflash)

Using Multiflash in direct calls (Rigorous method), load a *.mfl file during initialisation of a K-Spice model

Example:

2 ThermoTable methods

1 Rigorous method

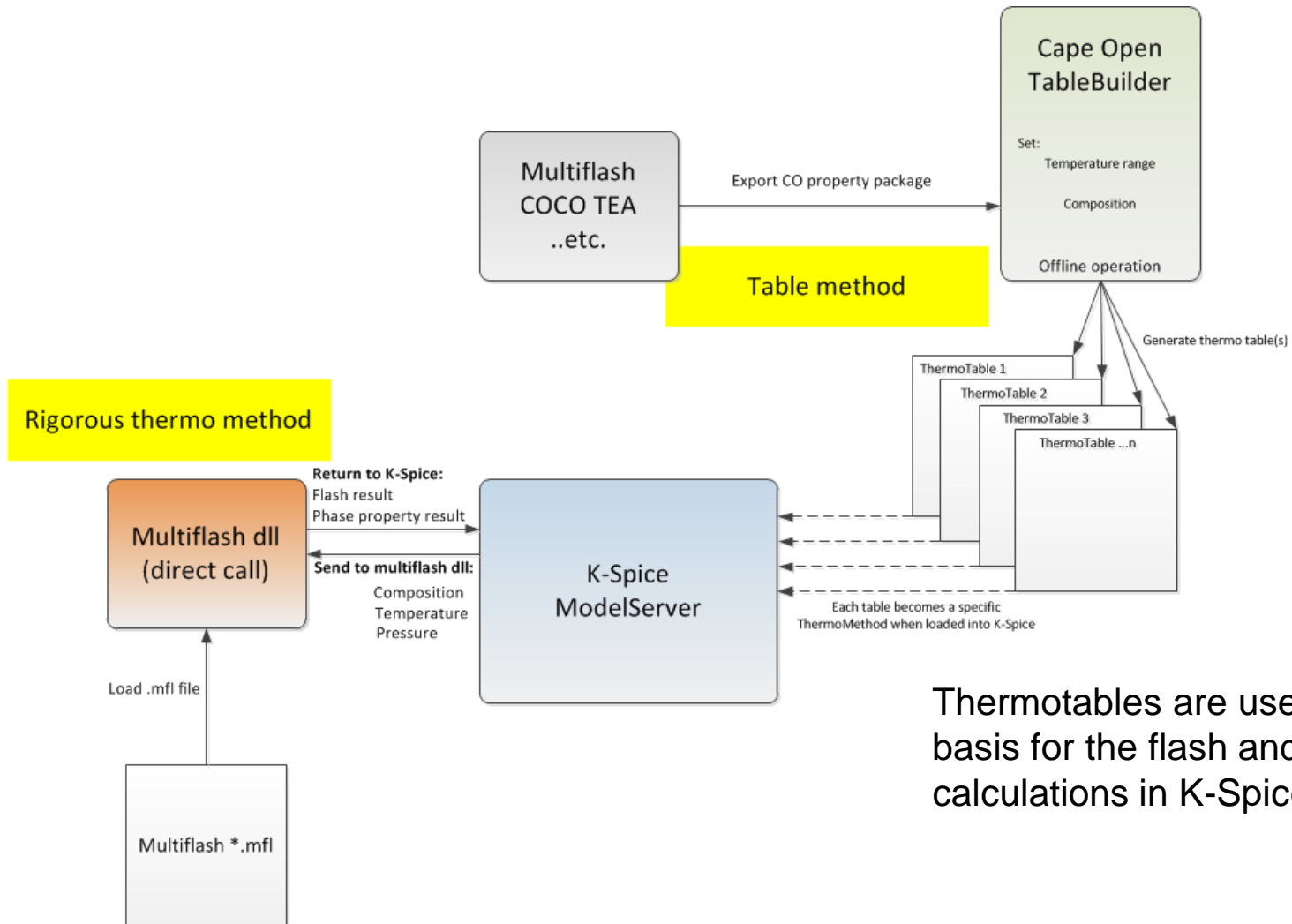


The screenshot shows the 'Thermodynamics Control Panel' window. The 'Application' dropdown is set to '/Engineering/ProcessModel'. Under 'Thermodynamic methods', the 'Number of methods' is set to 3. A table below lists the methods:

Ref	File name	Load status	# components	Thermo package
1	mainfluid1stsep.ttb	Method load OK	17	ThermoTable
2	mainfluid2ndsep.ttb	Method load OK	17	ThermoTable
3	mainfluidfeed01.mfl	Method load OK	17	DirectCallMultiflash

K-Spice thermodynamics

..how it interacts with the K-Spice simulator



Thermotables are used as basis for the flash and property calculations in K-Spice

K-Spice®

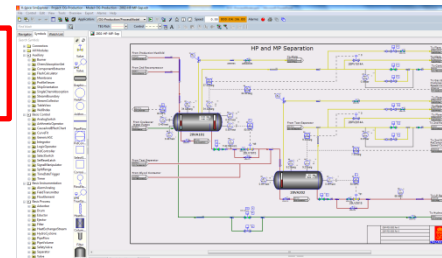
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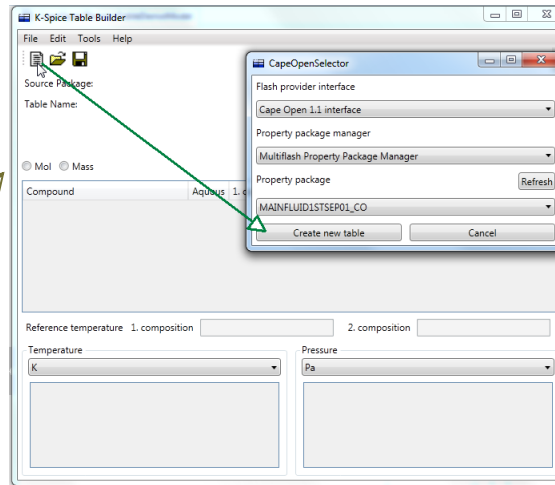
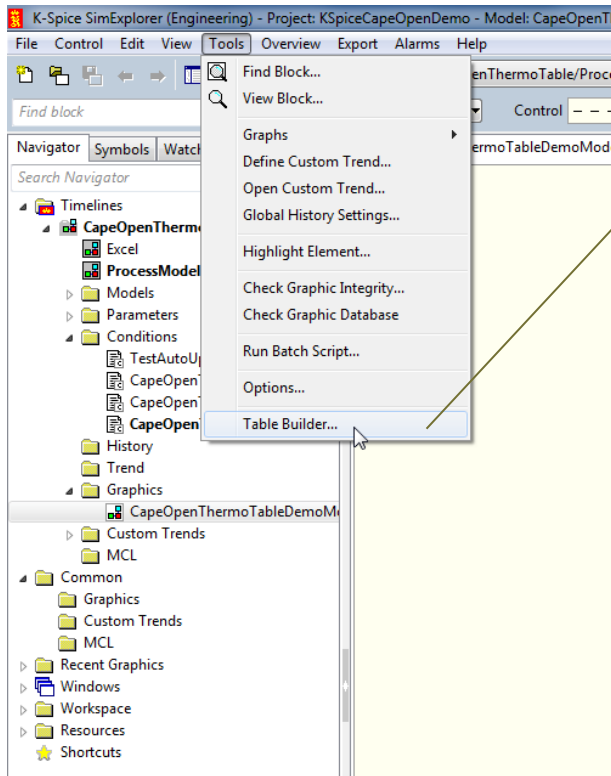


K-Spice thermodynamic table builder using CAPE-OPEN

- Demo

- Demo..
 - Create a thermodynamic look-up table based on a Multiflash CO Export file
 - Load the look-up table into a K-Spice process model

K-Spice thermodynamic table builder using CAPE-OPEN - Demo

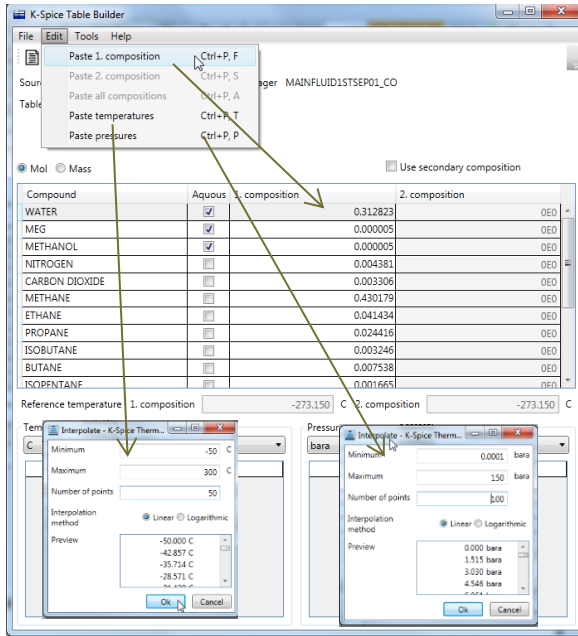


Select a CAPE-OPEN Property Package. In this case generated in Multiflash (mfl-file, MAINFLUID1STSEP01_CO.MFL)

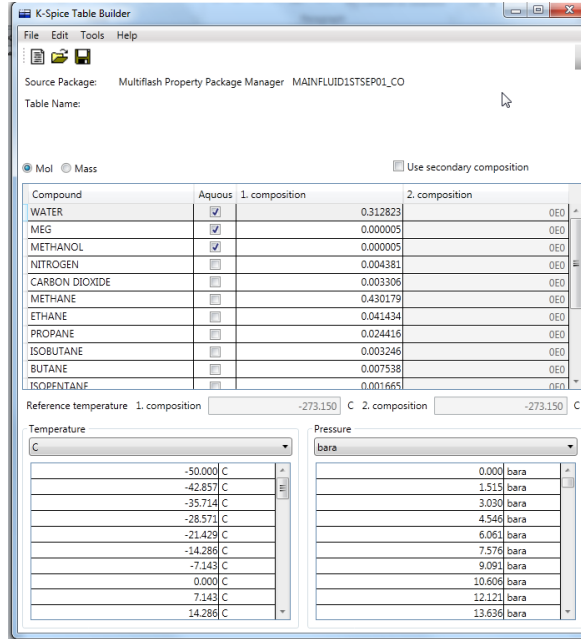
Open the Table Builder interface

K-Spice thermodynamic table builder using CAPE-OPEN

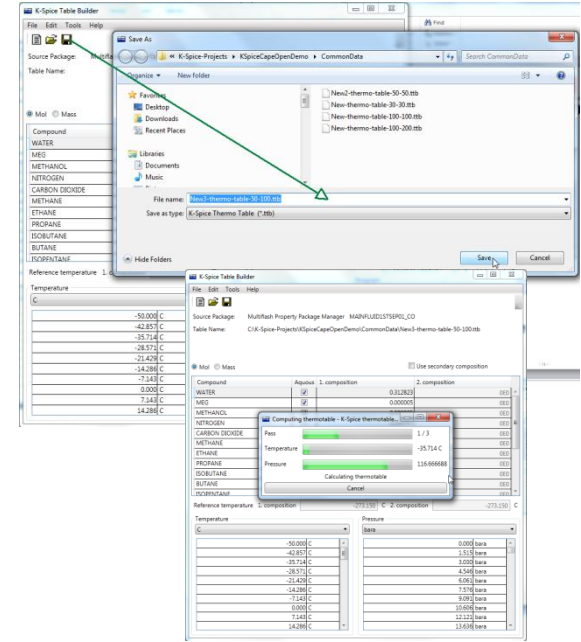
- Demo



Populate data; composition, temperature and pressure



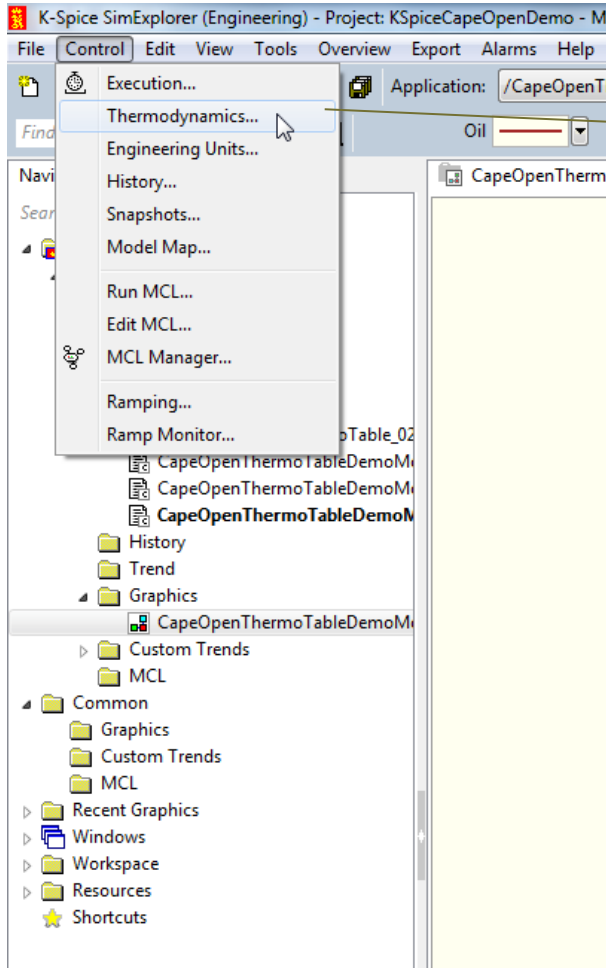
Ready to generate tables



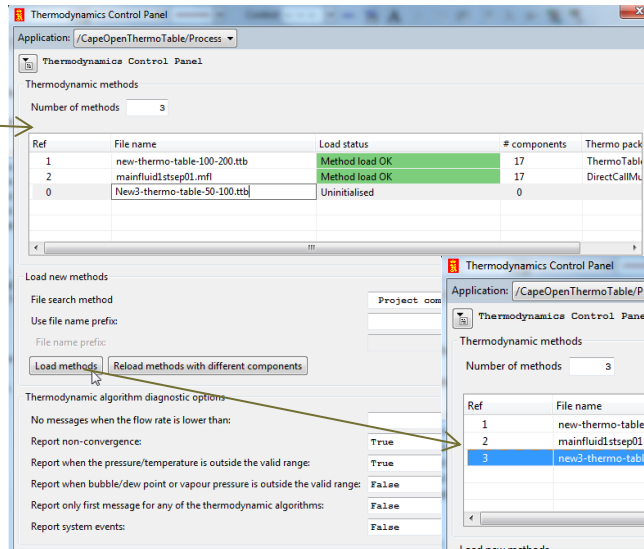
Save command will start generating tables in to ttb-file

K-Spice thermodynamic table builder using CAPE-OPEN

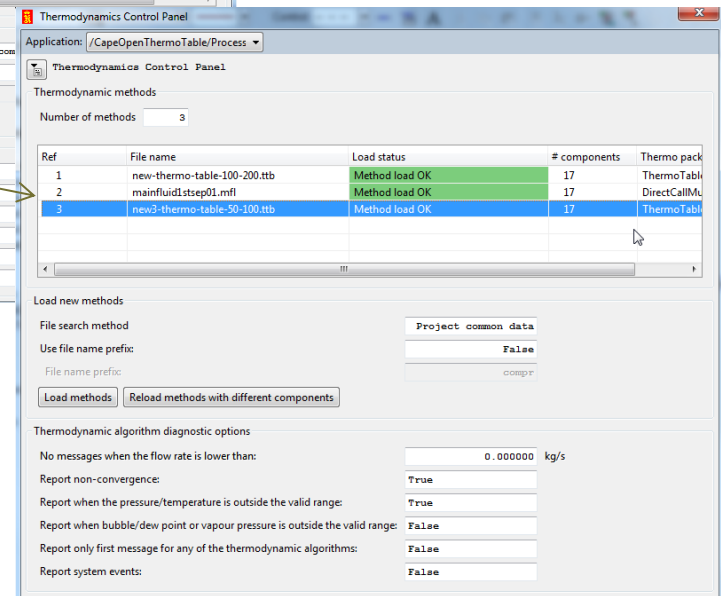
- Demo



Use the new thermo-table



Load the new thermo-table



Ready to use the new thermo-table

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