

HTRI heat-exchanger (Xist) within ProSimPlus®

Use Case 4: Use of HTRI shell and tubes heat-exchanger (Xist) within ProSimPlus

Software & Services In Process Simulation

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ProSim

Introduction

ProSimPlus® is a process engineering software that performs rigorous mass and energy balance calculations for a wide range of industrial steady-state processes. It is used in design as well as in operation of existing plants for process optimization, units troubleshooting or debottlenecking, plants revamping or performing front-end engineering analysis.

This document gives an example of use of HTRI (Heat Transfer Research, Inc.) shell and tubes heat-exchangers (Xist) within ProSimPlus®.

Note: as a prerequisite for a better understanding of this document, the user should know the general use of ProSimPlus®.

STEP #1: Select your compounds

Select your compounds like for any usual case:

Thermodynamic calculator editor

This window helps you to define the context of your thermodynamic calculator

COMPOUNDS MODEL PARAMETERS

#	IUPAC Name	CAS Registry Number®
1	WATER	7732-18-5

COMMENTS :

CAS Registry Numbers® are the intellectual property of the American Chemical Society; and are used by ProSim SA with the express permission of ACS. CAS Registry Numbers® have not been verified by ACS and may be inaccurate.

Ok Cancel

STEP #2: Select your thermodynamic model

Select your thermodynamic model like for any usual case:

Thermodynamic calculator editor

This window helps you to define the context of your thermodynamic calculator

COMPOUNDS MODEL PARAMETERS

NAME
 Name: idéal

CATEGORY
 Category: All the profiles

PROFILE
 Profile:

APPROACH TYPE
 Approach type: From activity coefficients

EQUATION OF STATE
 Equation of state: Perfect gas

ALPHA FUNCTION
 Alpha function: Mathias-Copeman

MIXING RULES
 Mixing rules: Standard

ACTIVITY COEFFICIENT MODEL
 Activity coefficient model: Ideal

PURE LIQUID FUGACITY STANDARD STATE
 Pure liquid fugacity standard state: Vapor pressure

LIQUID MOLAR VOLUME
 Liquid molar volume: Ideal mixture

TRANSPORT PROPERTIES
 Transport properties: Classic methods

ENTHALPY CALCULATION
 Enthalpy calculation: $H^* = DH_0^f$, ideal gas, 25°C, 1 atm

USER-DEFINED THERMODYNAMIC MODEL
 User-defined thermodynamic model: None

Model index: 1

Comments:

THERMODYNAMIC MODEL CONFIGURATION

Parameters

Thermodynamic assistant

Thermodynamic help

Use a specific model for pure water

Advanced

Water-hydrocarbons model

Sol A: 6,25043

Sol B: 4015,3

The liquid phase splitting is taken into account

Predictive model parameters...

True species model

Reactive model parameters...

Ok Cancel

FILE
 Open...
 Save as...

PACKAGE
 Show the package manager...
 Import a package...
 Build a package...
 Select a CAPE-OPEN package

SERVICES
 Calculate
 Export as a PSF file
 Diagrams
 Residue...
 Export as a PVT file
 Stream...
 Sigma profiles

MODIFICATIONS

CONFIGURATION
 Name: Water Thermo Model
 Comments:
 Calculator type: Native
 Show the expert mode

STEP #3: Create your flowsheet

Like for any usual case, add the feeds and the product streams needed for your flowsheet, then edit the parameters (temperature, pressure, partial flowrates) for each feed:

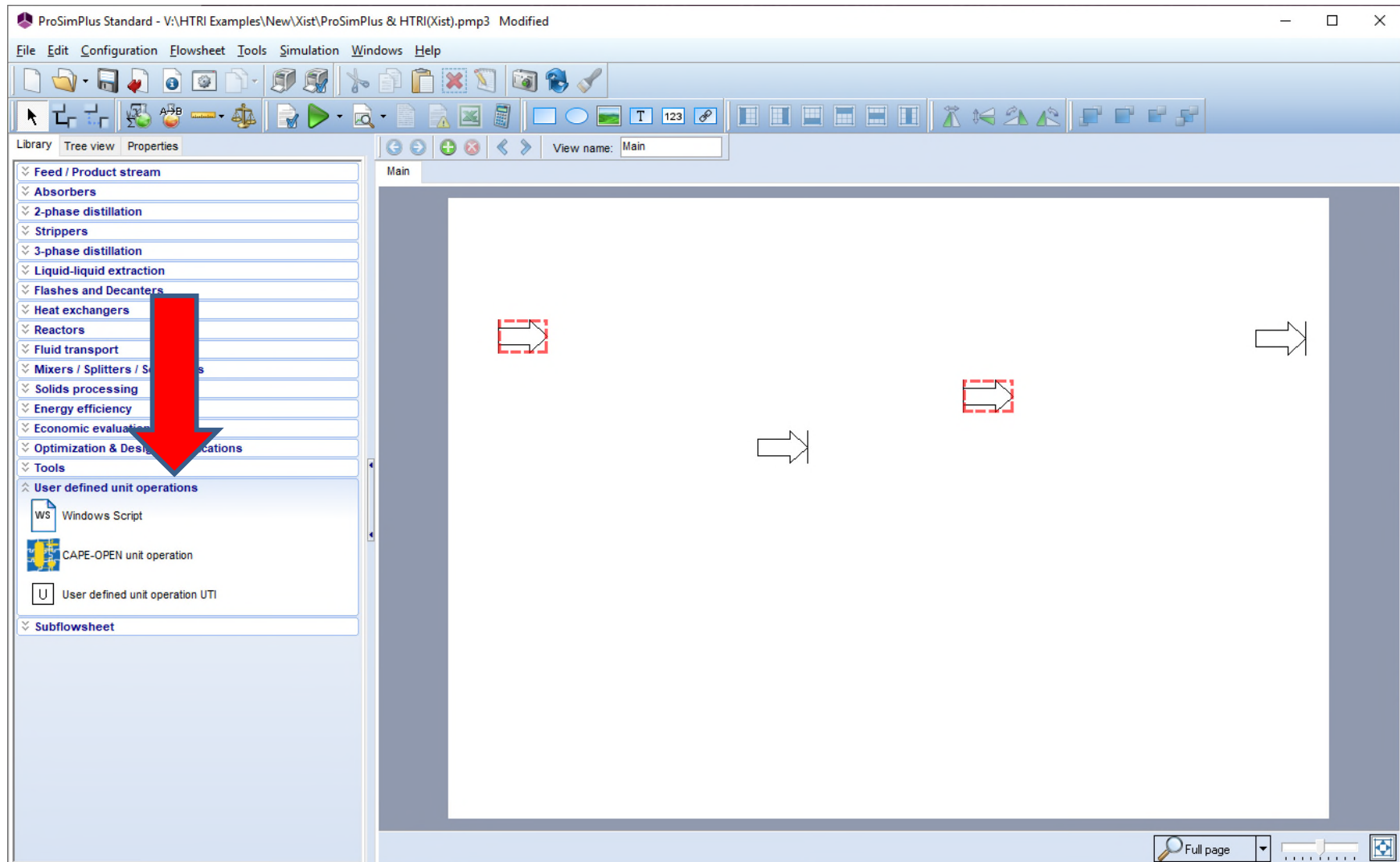
The screenshot displays the ProSimPlus Standard software interface. The main window shows a flowsheet with three streams: two feed streams on the left and one product stream on the right. The feed streams are highlighted with red dashed boxes, and blue callout boxes provide their parameters:

- Left Feed Stream:**
 - Temperature = 80 °C
 - Pressure = 450.00459 kPa
 - Partial mass flowrate (Water) = 50 kg/s
- Right Feed Stream:**
 - Temperature = 27 °C
 - Pressure = 450.00459 kPa
 - Partial mass flowrate (Water) = 30 kg/s

The product stream is shown as a white arrow pointing to the right. The software interface includes a menu bar (File, Edit, Configuration, Flowsheet, Tools, Simulation, Windows, Help), a toolbar, and a left sidebar with a tree view of process units. The status bar at the bottom indicates 'View name: Main' and 'Full page'.

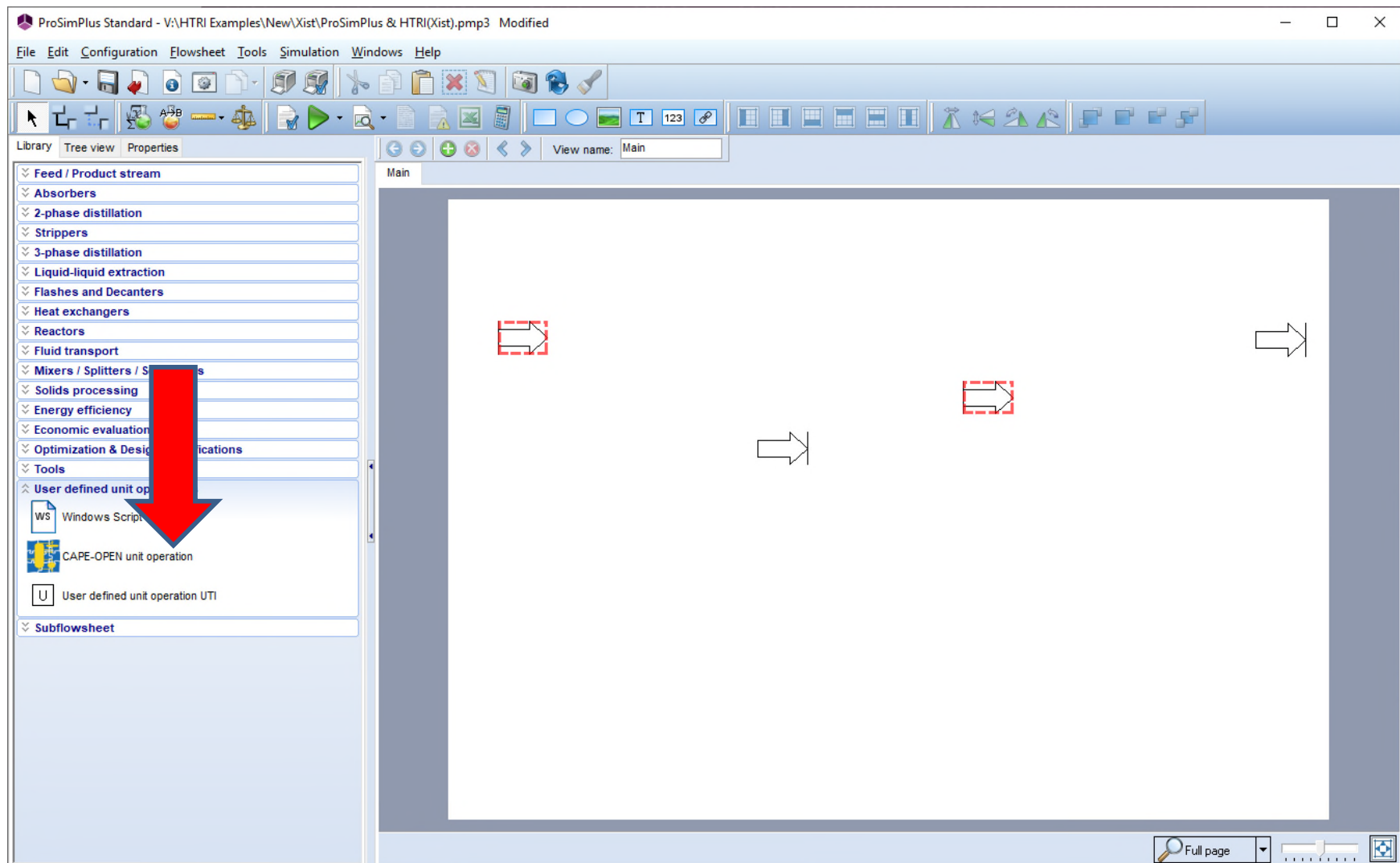
STEP #3: Create your flowsheet

To add a Xist heat-exchanger (shell and tubes module), click on the category “User defined operations” in the “Library” of unit operations:



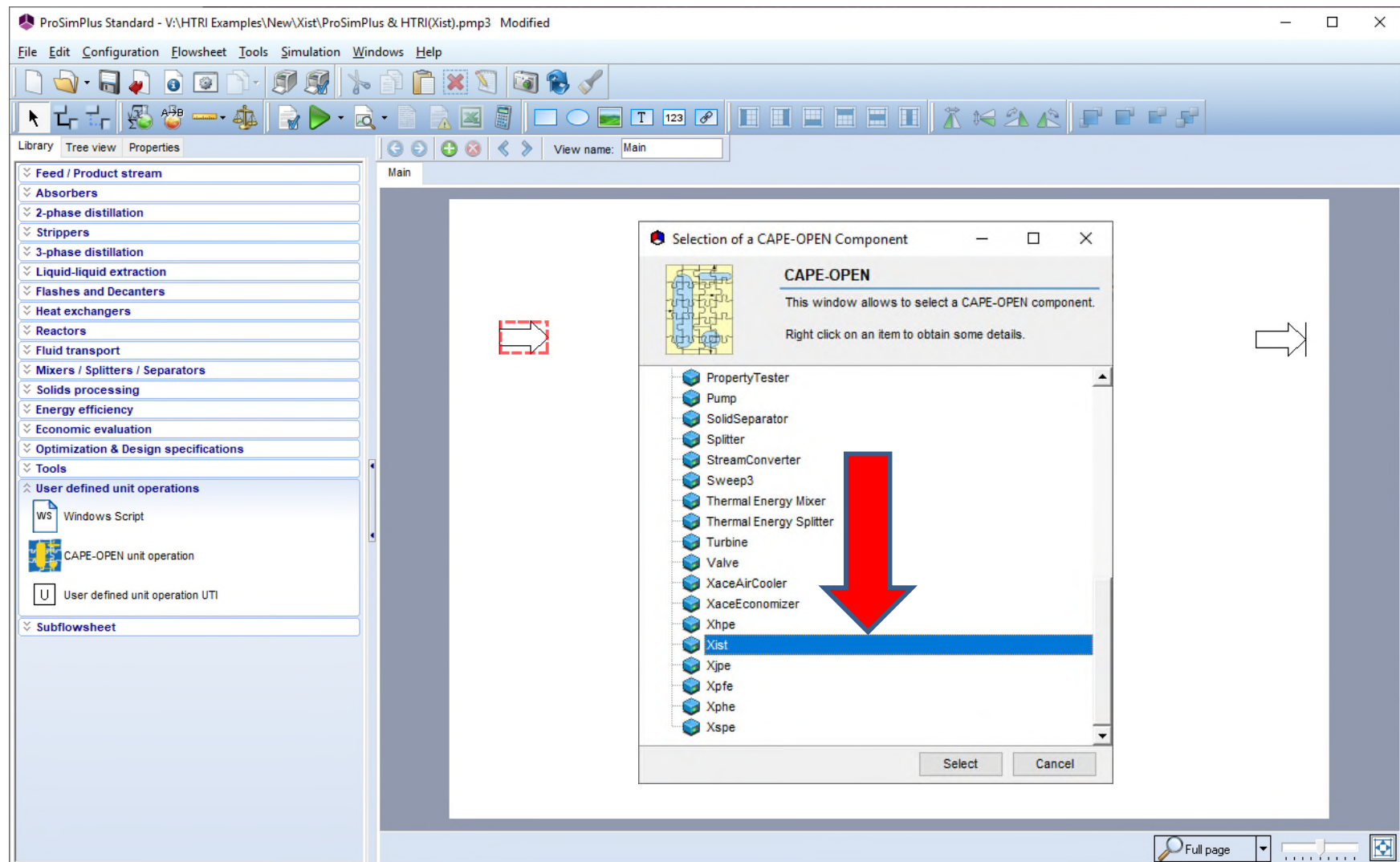
STEP #3: Create your flowsheet

Then click on “CAPE-OPEN unit operation”, then click on the flowsheet to add it:



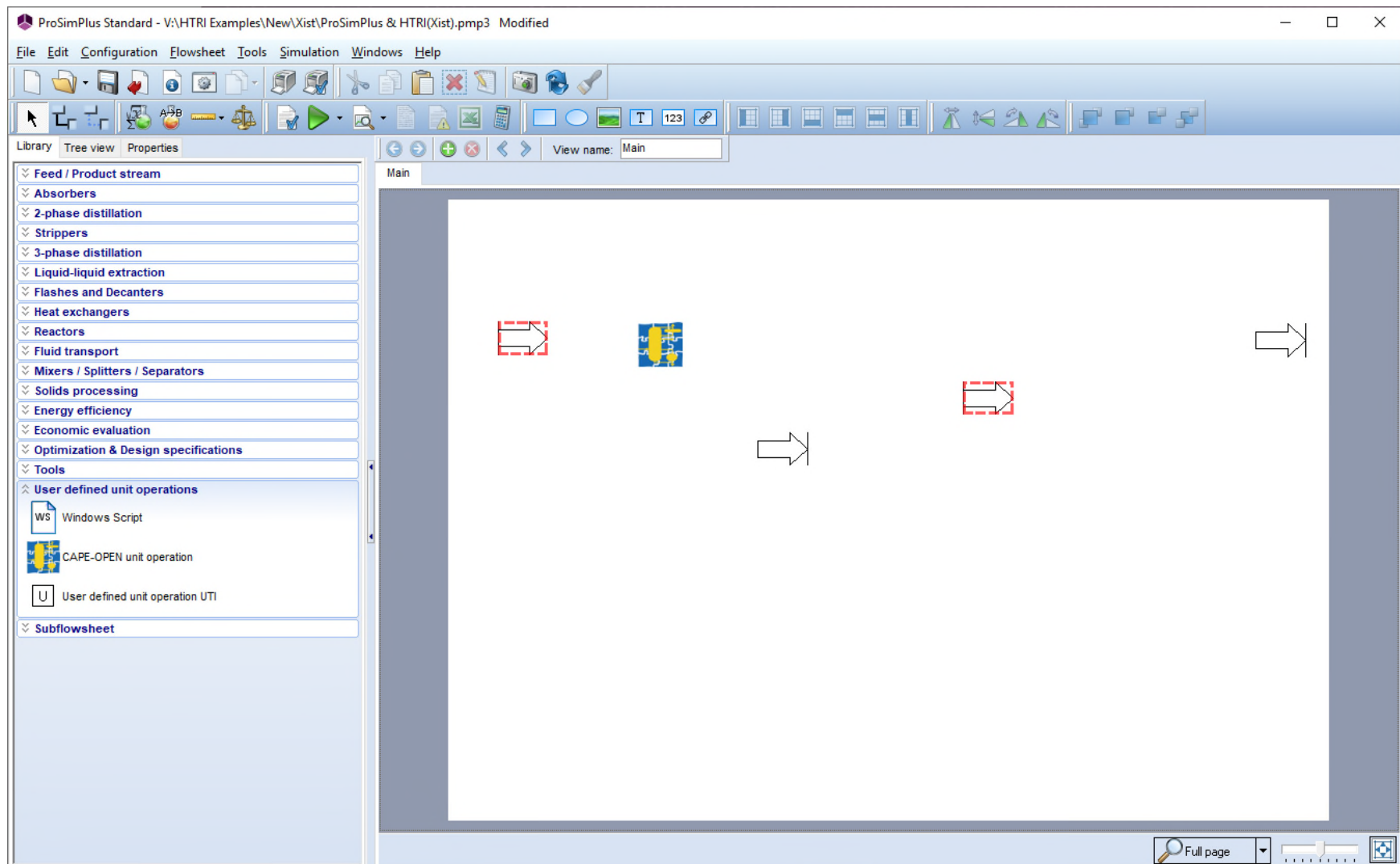
STEP #3: Create your flowsheet

The list of CAPE-OPEN unit operations available on your computer is displayed, select “Xist” and then click on the button “Select” to validate your choice:



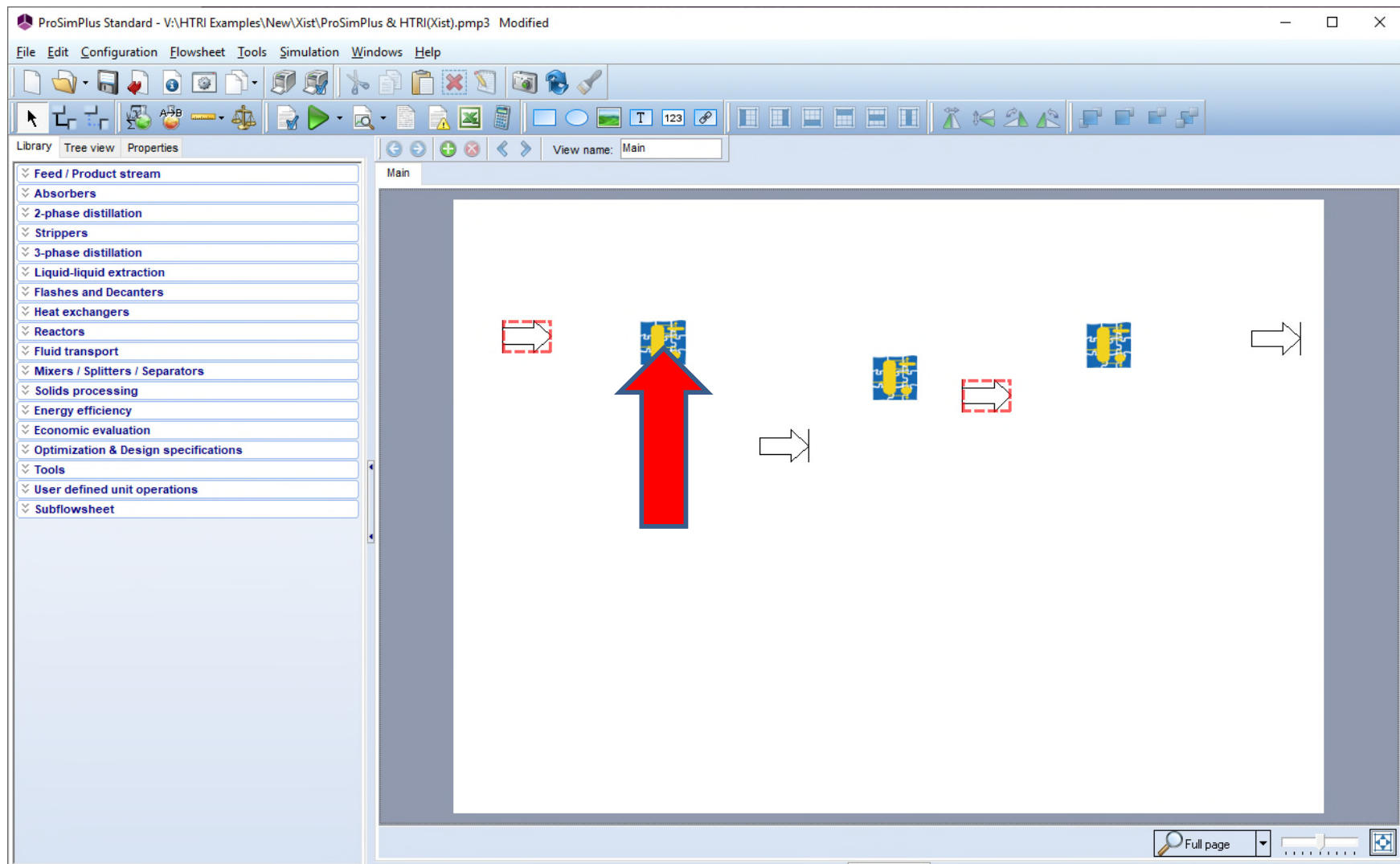
STEP #3: Create your flowsheet

The Xist heat-exchanger icon is added, then repeat if needed (in this example there are 3 Xist heat-exchangers):



STEP #3: Create your flowsheet

Edit the parameters with a double-click on the selected unit operation:



STEP #3: Create your flowsheet

Select the “Parameters” tab:

The screenshot displays the ProSimPlus Standard software interface. The main window shows a 'Main' view with a 'CAPE-OPEN operation (SXTMO)' dialog box open. The 'Parameters' tab is selected, and a red arrow points to the 'Name' field, which contains 'CAPE-OPEN operation'. Below the 'Name' field, there is a 'Desc' field. The 'Connections' section is visible, showing 'Inlet' and 'Outlet' material streams. The 'Inlet' section lists '1 Process feed' and '8 CAPE-OPEN Unit Operatic'. The 'Outlet' section lists '2 CAPE-OPEN Unit Operatic' and '5 Process outlet'. The 'OK' and 'Cancel' buttons are at the bottom right of the dialog box. A white arrow points to the right side of the dialog box.

STEP #3: Create your flowsheet

Then click on the “Edit...” button to open the specific dialog of a Xist heat-exchanger:

You can obtain some details about the unit operation

You can edit the public parameters of the unit operation

You can manually validate the unit operation

You can access to the standard textual reports

You can select a different thermodynamic model for each input material stream

You can select the version of the CAPE-OPEN Thermodynamic specifications: Select 1.0 for this case (BEFORE CONNECTING MATERIAL STREAMS)

The dialog shows the following 'Advanced parameters' tab content:

- Thermodynamics**
 - Thermo. version: 1.0
 - Output streams thermodynamics:
 - Use the same for all streams
 - Select for each stream
- Global model table:**

Stream	Model
No 4	Global model
No 2	Global model

The grayed buttons correspond to actions which are not available or which are not implemented by the unit operation.

STEP #3: Create your flowsheet

Then enter the parameters of the selected heat-exchanger (see HTRI user guides):

The screenshot displays the HTRI Xchanger Suite 8.1 software interface. The main window is titled "Xist - untitled1" and shows the "Input Summary" tab. The interface is divided into several sections:

- Input Summary:** A tree view on the left side of the window, showing the hierarchy of input parameters: Process Conditions, Hot Fluid Properties, Cold Fluid Properties, Geometry, Exchanger, Reboiler, Tubes, Baffles, Nozzles, Tube Layout, Design, Control, Name, and Input Notifications.
- PERFORMANCE OF ONE UNIT:** A table with columns for Shell Side and Tube Side. It includes fields for Fluid name, Fluid quantity (Total 1000-lb/hr), Temperature (In/Out) in degrees Fahrenheit, Vapor weight fraction (In/Out), Inlet pressure (psia), Pressure drop (allow. psi), Fouling resistance (min) in ft²-hr-F/Btu, and Exchanger duty in MM Btu/hr.
- CONSTRUCTION OF ONE SHELL:** A table with columns for Shell Side and Tube Side. It includes fields for Design/Test pressure (psig), Design temperature (F), Number passes per shell, Corrosion allowance (inch), Connection (In, Out, Intermediate) in inches, Tube No. (OD 1), Tube type (Plain), Shell (Carbon steel), Material (Carbon steel), ID, OD, Length (20 ft), Pitch, Tube pattern (30), Shell cover, Channel cover, Tubesheet-floating, Floating head cover, Baffles-cross (Type: Single segmental, Orientation: Program sets, %Cut, Spacing(c/c), Crosspasses), Baffles-long, Supports-tube (U-bend), Bypass seal (Program Set, pairs strips), Expansion joint (No), Gaskets-Shell side (Type: Tube side), Code requirements, and TEMA class (R).
- Sketch (Bundle/Nozzle Orientation):** A 3D schematic diagram of a shell and tube heat exchanger bundle, showing the shell, tubes, and various components like baffles and nozzles.

The software interface also includes a menu bar (Home, Graphs, Drawings, Design) and a toolbar with various icons for file operations, printing, and simulation. The bottom status bar shows "Xist 8.1".

STEP #3: Create your flowsheet

Or import data from an existing Xist case:

The screenshot displays the HTRI Xchanger Suite 8.1 interface. A red arrow points to the 'Import Data From Another File' button in the 'File' menu. The 'Import Case into Current Case' dialog box is open, showing a file explorer view of the 'Example' folder containing three HTRI Document files: Xist1.htri (109 Ko), Xist2.htri (113 Ko), and Xist3.htri (122 Ko). The 'Nom du fichier' field is set to 'Xist1.htri'. The main input form is visible in the background, showing various parameters for a heat exchanger design, including process conditions, geometry, and performance data.

PERFORMANCE OF ONE UNIT

	Shell Side	Tube Side
Fluid name		
Fluid quantity, Total	1000-lb/hr	
Temperature (In/Out)	F	
Vapor weight fraction (In/Out)		
Inlet pressure	psia	
Pressure drop, allow.	psi	
Fouling resistance (min)	ft ² -hr-F/Btu	
Exchanger duty	MM Btu/hr	

CONSTRUCTION OF ONE SHELL

	Shell Side	Tube Side
Design/Test pressure	psig	/
Design temperature	F	/
Number passes per shell		1
Corrosion allowance	inch	
Connection	In: 1 @	1 @
Size & Rating	Out: 1 @	1 @
Tube No.	OD 1	inch
Tube type	Plain	
Shell	Carbon steel	
Channel or bonnet	ID	inch
Shell cover		
Channel cover		
Tube-sheet-stationary		
Tube-sheet-floating		
Floating head cover		
Baffles-cross	Type: Single segmental	%Cut: Spacing(c/c) inlet: inch
Baffles-long	Orientation: Program sets	Crosspasses: Outlet: inch
Supports-tube	Seal type: U-bend	Type: Expanded (2 grooves)
Bypass seal	Program Set: pairs strips	Tube-tubesheet joint: Expanded (2 grooves)
Expansion joint	No	Type: Tube side
Gaskets-Shell side		
-Floating head		
Code requirements		TEMA class: R

Remarks: This line is reserved for program messages

Input Remarks

STEP #3: Create your flowsheet

Edit the parameters for each unit operation:

The screenshot displays the ProSimPlus Standard software interface. The window title is "ProSimPlus Standard - V:\HTRI Examples\New\Xist\ProSimPlus & HTRI(Xist).pmp3 Modified". The menu bar includes File, Edit, Configuration, Flowsheet, Tools, Simulation, Windows, and Help. The toolbar contains various icons for file operations, simulation, and editing. The left sidebar shows a library of unit operations, including Feed / Product stream, Absorbers, 2-phase distillation, Strippers, 3-phase distillation, Liquid-liquid extraction, Flashes and Decanters, Heat exchangers, Reactors, Fluid transport, Mixers / Splitters / Separators, Solids processing, Energy efficiency, Economic evaluation, Optimization & Design specifications, Tools, User defined unit operations, and Subflowsheet. The main workspace, titled "Main", shows a flowsheet diagram with three unit operations labeled 1, 2, and 3. Each unit operation is represented by a blue circle with a number and a yellow and blue icon. Arrows indicate the flow of material between the units. A red dashed box highlights the first unit operation. The bottom right corner of the interface has a "Full page" button and a zoom slider.

STEP #3: Create your flowsheet

Data for the heat-exchanger (summary) 1

The screenshot displays the HTRI Xchanger Suite 8.1 software interface. The main window shows the 'Input Summary' for a heat exchanger. The data is organized into several sections:

- General Information:** Case mode (Simulation), Service type (Generic shell and tube), Customer, Address, Location, Date, and Rev.
- PERFORMANCE OF ONE UNIT:**

	Shell Side	Tube Side
Fluid allocation	No 1 / No 4	No 12 / No 2
Fluid quantity, Total kg/s	50,000	30,000
Temperature (In/Out) C	80,00	68,63
Vapor weight fraction (In/Out)	0,00000	0,00000
Inlet pressure kPa	450,005	443,481
Pressure drop, allow. kPa		
Fouling resistance (min) m ² -K/W		
Estimated exchanger duty MegaWatts		
- CONSTRUCTION OF ONE SHELL:**

	Shell Side	Tube Side
Design/Test pressure kPaG	517,107	517,107
Design temperature C	110	98,89
Number passes per shell		2
Corrosion allowance mm	3,175	3,175
Connection In mm	1 @ 355	1 @ 254
Size & Rating Out mm	1 @ 355	1 @ 254
- Sketch (Bundle/Nozzle Orientation):** A schematic diagram of a shell and tube heat exchanger showing the bundle and nozzle orientations.
- Tube and Shell Details:**

Tube No.	OD	Thk(ave)	Length	Pitch
728	19,05 mm	2,108 mm	4,877 m	25,399 mm
- Materials and Components:** Tube type (Plain), Material (SA-214 Tube (W) K01807), Shell (SA-516 70 Pl. K02700), Channel or bonnet (SA-516 70 Pl. K02700), Tubesheet-stationary (SA-105 Forgings K03504), Floating head cover, Baffles-cross (Carbon steel), Baffles-long, Supports-tube, Bypass seal, Expansion joint, Gaskets-Shell side, Gaskets-Tube side, and Code requirements (TEMA class R).

The software interface also shows a left-hand navigation tree with categories like Process Conditions, Geometry, Exchanger, Reboiler, Tubes, Baffles, Nozzles, Tube Layout, Design, Control, and Name. The status bar at the bottom indicates 'Run Completed'.

STEP #3: Create your flowsheet

Data for the heat-exchanger (summary) 2

untitled1 - HTRI Xchanger Suite 8.1

Home Graphs Drawings Design

Update Import Print Input Copy SI Run All Costing Active Exchanger Optimizer Tools Help Context Windows

New Open Save As Export Duplicate File Print Preview Cut Paste Program Settings Edit Run Case Input Check Session Log Costing Help

Xist - untitled1

Input Summary

- Process Conditions
 - Hot Fluid Properties
 - Cold Fluid Properties
- Geometry
 - Exchanger
 - Reboiler
 - Tubes
 - Baffles
 - Nozzles
 - Tube Layout
- Design
 - Control
 - Name
- Input Notifications

HTRI

Case mode: Simulation Service type: Generic shell and tube

Customer: Job No. Address: Reference No. Location: Proposal No. Service of unit: Date Rev

Type: B E M Orientation: Horizontal Unit angle: Connected in 1 parallel 1 series

Hot fluid: Shellside

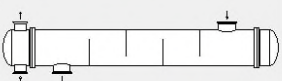
PERFORMANCE OF ONE UNIT

	Shell Side	Tube Side
Fluid allocation	No 4 / No 5	No 10 / No 12
Fluid name		
Fluid quantity, Total kg/s	50,0000	30,0000
Temperature (In/Out) C	75,25	53,74
Vapor weight fraction (In/Out)	0,00000	0,00000
Inlet pressure kPa	444,385	446,675
Pressure drop, allow. kPa		
Fouling resistance (min) m ² -K/W		
Estimated exchanger duty MegaWatts		

CONSTRUCTION OF ONE SHELL

	Shell Side	Tube Side
Design/Test pressure kPaG	517,107 /	517,107 /
Design temperature C	104,44	82,22
Number passes per shell		2
Corrosion allowance mm	3,175	3,175
Connection In mm	1 @ 355	1 @ 254
Size & Rating Out mm	1 @ 355	1 @ 254
Rating	Intermediate	@

Sketch (Bundle/Nozzle Orientation)



Tube No. 728 OD 19,05 mm Thk(avg) 2,108 mm Length 4,877 m Pitch 25,399 mm

Tube type Plain Material SA-214 Tube (W) K01807 Tube pattern 30

Shell SA-516 70 Pl. K02700 ID 780 OD 802,225 mm Shell cover Channel cover

Channel or bonnet SA-516 70 Pl. K02700 Tubesheet-stationary SA-105 Forgings K03504 Tubesheet-floating Imp. Prot. If required by TEMA Circular plate

Floating head cover Baffles-cross Carbon steel Type Single segmental %Cut 25 Spacing(c/c) 800 Inlet mm Outlet mm Orientation Perpendicular Crosspasses 5

Baffles-long Supports-tube Seal type U-bend Type Bypass seal None pairs strips Tube-tubesheet joint Expanded (2 grooves) Expansion joint No Type Gaskets-Shell side Mach. Mtl. (Kammprofile)\Flex. Face Tube side Mach. Mtl. (Kammprofile)\Flex. Face -Floating head Code requirements TEMA class R

Remarks: This line is reserved for program messages

Input Remarks

<< Previous Next >>

Input Reports Graphs Drawings Shells-in-Series Design

Run Completed

STEP #3: Create your flowsheet

Data for the heat-exchanger (summary) 3

The screenshot displays the HTRI Xchanger Suite 8.1 software interface. The main window shows the 'Input Summary' for a heat exchanger. The interface is divided into several sections:

- Case Information:** Case mode is set to 'Simulation'. Service type is 'Generic shell and tube'. Other fields include Customer, Address, Location, Service of unit, Type (B, E, M), Orientation (Horizontal), Unit angle, and Connected in (1 parallel, 1 series).
- PERFORMANCE OF ONE UNIT:** A table comparing Shell Side and Tube Side parameters.

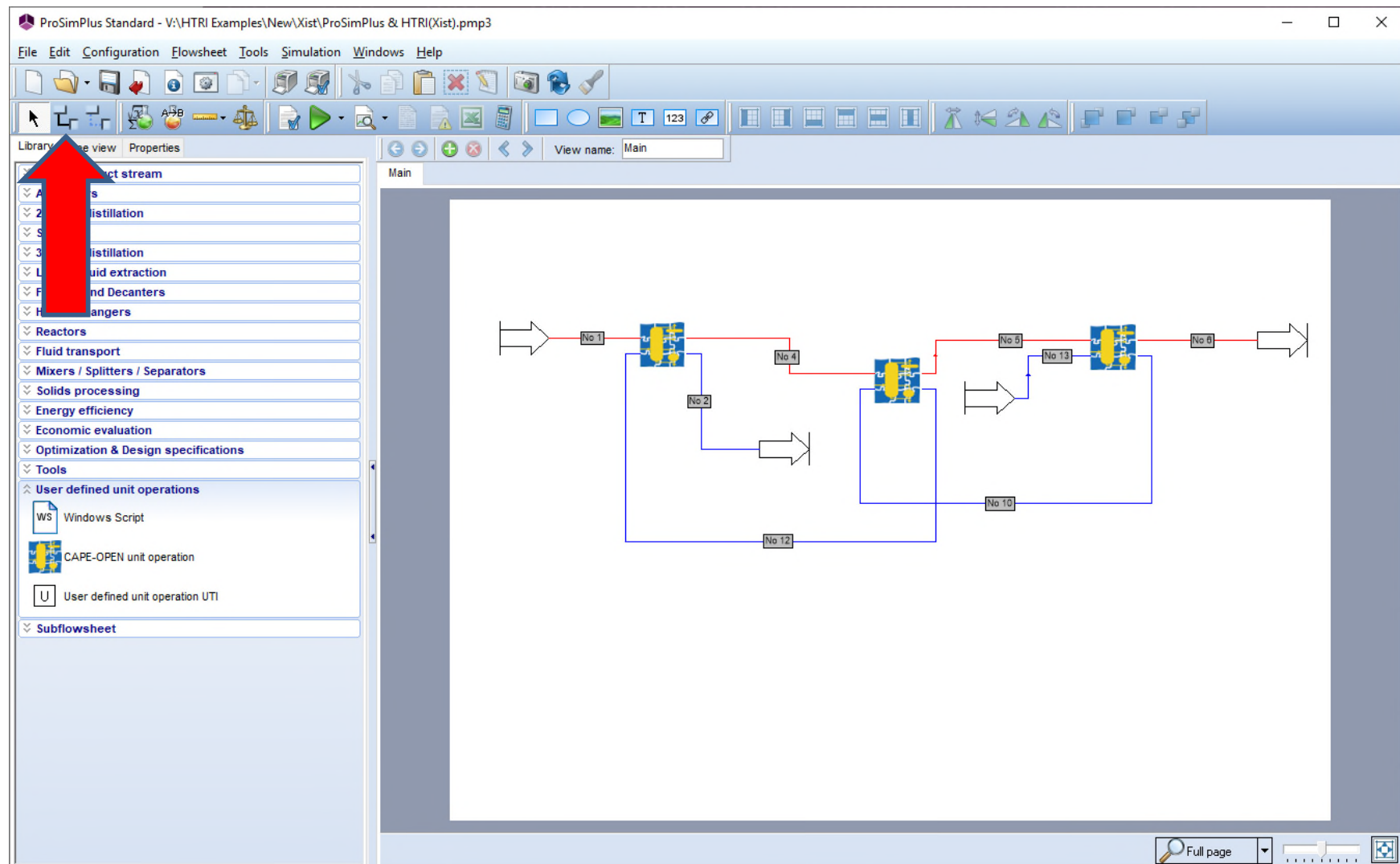
	Shell Side	Tube Side
Fluid allocation	No 5 / No 6	No 13 / No 10
Fluid quantity, Total (kg/s)	50,000	30,000
Temperature (In/Out) (C)	66,33	27,00
Vapor weight fraction (In/Out)	0,00000	0
Inlet pressure (kPa)	438,745	450,005
Pressure drop, allow. (kPa)		
Fouling resistance (min) (m ² -K/W)		
Estimated exchanger duty (MegaWatts)		
- CONSTRUCTION OF ONE SHELL:** A table comparing Shell Side and Tube Side construction parameters.

	Shell Side	Tube Side
Design/Test pressure (kPaG)	517,107	517,107
Design temperature (C)	98,89	60
Number passes per shell		2
Corrosion allowance (mm)	3,175	3,175
Connection (In mm)	1 @ 355	1 @ 254
Size & Rating (Out mm)	1 @ 355	1 @ 254
Rating	Intermediate	
- Sketch (Bundle/Nozzle Orientation):** A 3D schematic diagram of the heat exchanger bundle, showing the shell, tube bundle, and nozzle orientations.
- General Specifications:** Tube No. 728, OD 19,05 mm, Thk(avg) 2,108 mm, Length 4,877 m, Pitch 25,399 mm. Tube type is Plain, Material is SA-214 Tube (W) K01807. Shell is SA-516 70 PI, K02700, ID 780 mm, OD 802,225 mm. Shell cover is Channel cover, Tubesheet is floating, and Floating head cover is Imp. Prot. If required by TEMA, Circular plate.
- Baffles:** Baffles-cross is Carbon steel, Type is Single segmental, %Cut is 25, Spacing(c/c) is 800 mm. Orientation is Perpendicular, Crosspasses is 5.
- Supports and Seals:** Baffles-long is U-bend, Seal type is U-bend. Supports-tube is U-bend, Type is Expanded (2 grooves). Bypass seal is None, pairs strips is Tube-tubesheet joint.
- Expansion and Gaskets:** Expansion joint is No, Type is Type. Gaskets-Shell side is Mach. Mtl. (Kammprofile/Flex. Face), Tube side is Mach. Mtl. (Kammprofile/Flex. Face).
- Code requirements:** TEMA class is R.

The bottom of the window shows navigation buttons for 'Input', 'Reports', 'Graphs', 'Drawings', 'Shells-in-Series', and 'Design'. The status bar indicates 'Run Completed'.

STEP #3: Create your flowsheet

Like for any usual case, connect your material streams between the unit operations:



STEP #4: Run the simulation

When the input data is complete, click on the icon to run the simulation:

The screenshot displays the ProSimPlus Standard software interface. The main window shows a process flow diagram with several units and streams. A red arrow points to the 'Run' button (a green play icon) in the toolbar. The 'Simulation progress' window is open, showing the simulation status and a list of units. The status bar indicates 'Simulation in progress'.

Simulation progress window details:

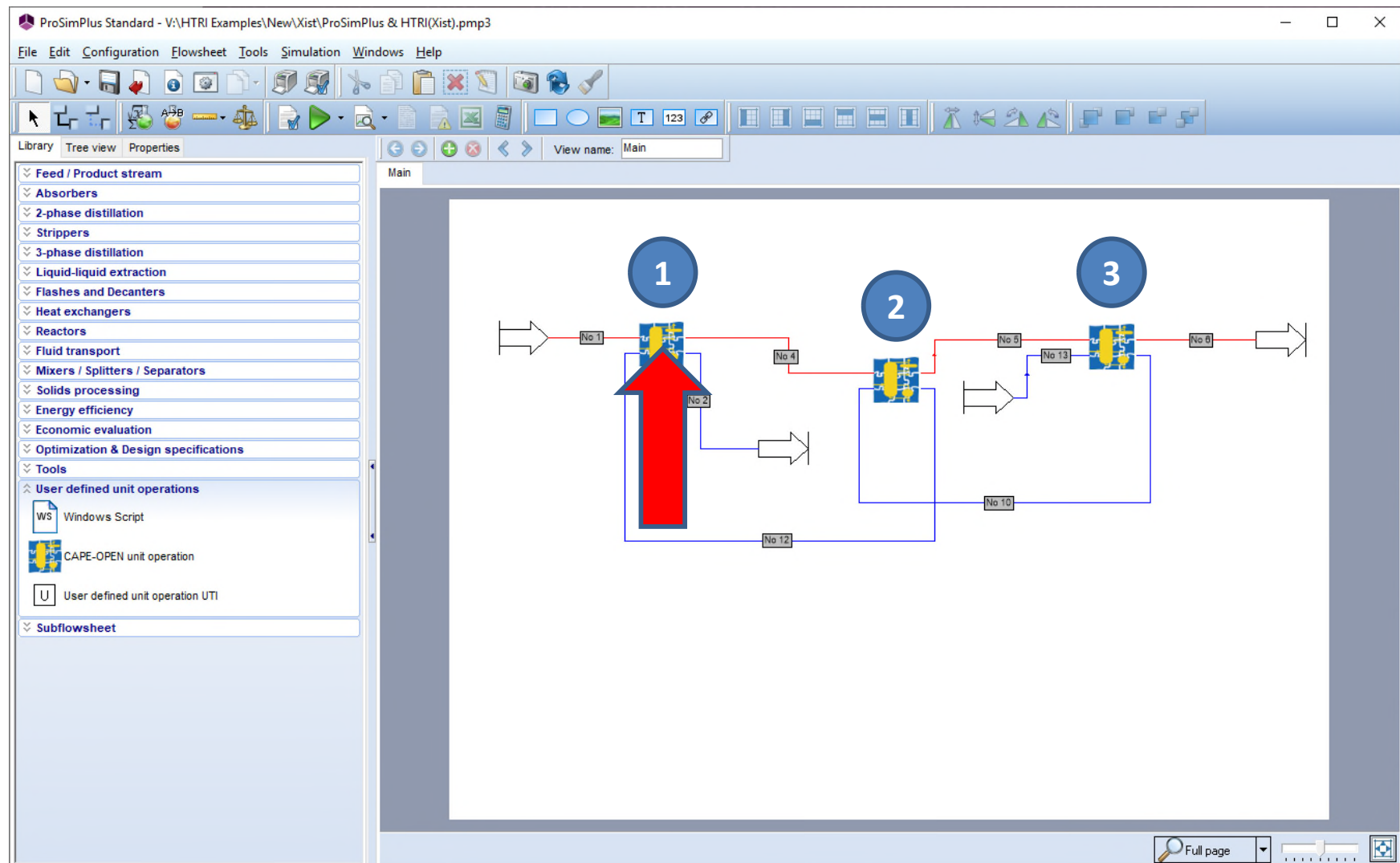
- Time: 00:00:13.407
- Visual update: Opacity: 0
- Complete simulation
- Hot feed:
- Cold feed:
- S_01:
- E101:
- E102:
- E103:

Main window details:

- File Edit Configuration Flowsheet Tools Simulation Windows Help
- Library Tree view Properties
- View name: Main
- Units: No 1, No 2, No 3, No 4, No 10, No 12

STEP #5: Analyze the results

When the simulation is complete, you can edit the reports for each Xist heat-exchanger with a double-click on the corresponding icon:



STEP #5: Analyze the results

Then click on the “Edit...” button to access to the various specific reports of the Xist heat-exchanger:

The screenshot displays the ProSimPlus Standard software interface. The main window shows a process flow diagram with a unit operation labeled 'E101'. A red arrow points to the 'Edit...' button in the 'Reports' tab of the unit operation's configuration window. The configuration window includes fields for Name (E101) and Desc, and tabs for Identification, Parameters, Reports, Scripts, Report, Streams, Notes, and Advanced parameters. The 'Reports' tab is active, showing options for Specifications management, Thermodynamics, and Output streams thermodynamics. A table lists the output streams and their models:

Stream	Model
No 4	Global model
No 2	Global model

The 'Edit...' button is highlighted with a red arrow, indicating the next step in the process.

STEP #5: Analyze the results

Analyze the reports of your heat-exchanger (see HTRI user guides):

Results (output summary) for the heat-exchanger

1

HTRI Output Summary Page 1
Released to the following HTRI Member Company:

Xist 8.1 CO v1.1.8.1 (x32) 17/12/2019 13:49 SN: 09528-441421916717 SI Units

E561 : E101
Simulation - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

No Data Check Messages.
[See Runtime Message Report for Warning Messages.](#)

Process Conditions		Hot Shellside		Cold Tubeside	
Fluid name		No 1 / No 4		No 12 / No 2	
Flow rate (kg/s)		50,000		30,000	
Inlet/Outlet Y (Wt. frac vap.)	0,0000	0,0000	0,0000	0,0000	
Inlet/Outlet T (Deg C)	80,00	75,21	68,51	76,50	
Inlet P/avg (kPa)	450,00	447,87	443,48	441,91	
dP/Allow. (kPa)	4,265	0,000	3,141	0,000	
Fouling (m2-KW)		0,000000		0,000000	

Exchanger Performance			
Shell h (W/m2-K)	5775,2	Actual U (W/m2-K)	1797,3
Tube h (W/m2-K)	3818,2	Required U (W/m2-K)	1759,9
Hot regime (-)	Sens. Liquid	Duty (MegaWatts)	1,0043
Cold regime (-)	Sens. Liquid	Eff. area (m2)	208,56
EMTD (Deg C)	2,7	Overdesign (%)	2,12

Shell Geometry		Baffle Geometry	
TEMA type (-)	BEM	Baffle type	Single-Seg.
Shell ID (mm)	780,00	Baffle cut (Pct Dia.)	25
Series (-)	1	Baffle orientation (-)	Perpend.
Parallel (-)	1	Central spacing (mm)	800,00
Orientation (deg)	0,00	Crosspasses (-)	5

Tube Geometry		Nozzles	
Tube type (-)	Plain	Shell inlet (mm)	355,00
Tube OD (mm)	19,050	Shell outlet (mm)	355,00
Length (m)	4,877	Inlet height (mm)	75,471
Pitch ratio (-)	1,3333	Outlet height (mm)	53,474
Layout (deg)	30	Tube inlet (mm)	254,00
Tube count (-)	728	Tube outlet (mm)	254,00
Tube Pass (-)	2		

Thermal Resistance; %		Velocities; m/s		Flow Fractions	
Shell	31,12	Min	Max	A	0,093
Tube	60,45	Tube side	0,49 0,49	B	0,774
Fouling	0,00	Crossflow	0,21 0,28	C	0,039
Metal	8,43	Longitudinal	0,44 0,54	E	0,094
				F	0,000

Run Completed

STEP #5: Analyze the results

Results (output summary) for the heat-exchanger

2

The screenshot displays the HTRI Xchanger Suite 8.1 interface. The main window shows the 'Output Summary' report for a simulation. The report includes process conditions, exchanger performance, shell and tube geometries, and thermal resistances.

HTRI Output Summary
Released to the following HTRI Member Company:
Xist 8.1 CO v1.1.8.1 (x32) 17/12/2019 13:49 SN: 09528-441421916717 SI Units

E561 : E102
Simulation - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

No Data Check Messages.
[See Runtime Message Report for Warning Messages.](#)

Process Conditions		Hot Shellside		Cold Tubeside	
Fluid name		No 4 / No 5		No 10 / No 12	
Flow rate (kg/s)		50,000		30,000	
Inlet/Outlet Y (Wt. frac vap.)	0,0000	0,0000	0,0000	0,0000	
Inlet/Outlet T (Deg C)	75,21	66,33	53,68	68,51	
Inlet P/Avg (kPa)	445,74	443,60	446,67	445,07	
dP/Allow. (kPa)	4,282	0,000	3,194	0,000	
Fouling (m2-KW)		0,000000		0,000000	

Exchanger Performance			
Shell h (W/m2-K)	5581,6	Actual U (W/m2-K)	1719,8
Tube h (W/m2-K)	3612,3	Required U (W/m2-K)	1739,2
Hot regime (-)	Sens. Liquid	Duty (MegaWatts)	1,8612
Cold regime (-)	Sens. Liquid	Eff. area (m2)	208,56
EMTD (Deg C)	5,1	Overdesign (%)	-1,12

Shell Geometry		Baffle Geometry	
TEMA type (-)	BEM	Baffle type	Single-Seg.
Shell ID (mm)	780,00	Baffle cut (Pct Dia.)	25
Series (-)	1	Baffle orientation (-)	Perpend.
Parallel (-)	1	Central spacing (mm)	800,00
Orientation (deg)	0,00	Crosspasses (-)	5

Tube Geometry		Nozzles	
Tube type (-)	Plain	Shell inlet (mm)	355,00
Tube OD (mm)	19,050	Shell outlet (mm)	355,00
Length (m)	4,877	Inlet height (mm)	75,471
Pitch ratio (-)	1,3333	Outlet height (mm)	53,474
Layout (deg)	30	Tube inlet (mm)	254,00
Tubecount (-)	728	Tube outlet (mm)	254,00
Tube Pass (-)	2		

Thermal Resistance; %		Velocities; m/s		Flow Fractions	
Shell	30,81	Min	Max	A	0,091
Tube	61,14	Tube side	0,48 0,49	B	0,775
Fouling	0,00	Crossflow	0,21 0,28	C	0,039
Metal	8,05	Longitudinal	0,44 0,54	E	0,095
				F	0,000

Run Completed

STEP #5: Analyze the results

Results (output summary) for the heat-exchanger

3

The screenshot displays the HTRI Xchanger Suite 8.1 interface. The main window shows the 'Output Summary' report for a simulation. The report includes the following sections and data:

Process Conditions

	Hot Shellside	Cold Tubeside
Fluid name	No 5 / No 6	No 13 / No 10
Flow rate (kg/s)	50,000	30,000
Inlet/Outlet Y (Wt. frac vap.)	0,0000	0,0000
Inlet/Outlet T (Deg C)	66,33	53,32
Inlet P/Avg (kPa)	441,46	450,00
dP/Allow. (kPa)	4,328	0,000
Fouling (m2-K/W)	0,000000	0,000000

Exchanger Performance

Shell h (W/m2-K)	5199,8	Actual U (W/m2-K)	1556,9
Tube h (W/m2-K)	3183,7	Required U (W/m2-K)	1579,8
Hot regime (-)	Sens. Liquid	Duty (MegaWatts)	3,3495
Cold regime (-)	Sens. Liquid	Eff. area (m2)	208,56
EMTD (Deg C)	10,2	Overdesign (%)	-1,45

Shell Geometry

TEMA type (-)	BEM
Shell ID (mm)	780,00
Series (-)	1
Parallel (-)	1
Orientation (deg)	0,00

Baffle Geometry

Baffle type	Single-Seg.
Baffle cut (Pct Dia.)	25
Baffle orientation (-)	Perpend.
Central spacing (mm)	800,00
Crosspasses (-)	5

Tube Geometry

Tube type (-)	Plain
Tube OD (mm)	19,050
Length (m)	4,877
Pitch ratio (-)	1,3333
Layout (deg)	30
Tubecount (-)	728
Tube Pass (-)	2

Nozzles

Shell inlet (mm)	355,00
Shell outlet (mm)	355,00
Inlet height (mm)	75,471
Outlet height (mm)	53,474
Tube inlet (mm)	254,00
Tube outlet (mm)	254,00

Thermal Resistance; %

Shell	29,94
Tube	62,80
Fouling	0,00
Metal	7,26

Velocities; m/s

	Min	Max
Shell		
Tube	0,48	0,48
Fouling	0,20	0,28
Metal	0,44	0,54

Flow Fractions

A	0,088
B	0,777
C	0,038
E	0,096
F	0,000

STEP #5: Analyze the results

Material streams

(SXTMO1) — □ ×

Name:

Desc:

Property	No 10	No 4	No 12	No 5	No 1	No 6	No 2	No 13
Temperature (°C)	53.7429	75.246	68.6301	66.3318	80	50.29	76.5623	27
Pressure (kPa)	446.675	444.385	443.482	438.745	450.005	433.05	440.34	450.005
Molar flowrate (kmol/h)	5994.91	9991.52	5994.91	9991.52	9991.52	9991.52	5994.91	5994.91
Mass flowrate (kg/s)	30	50	30	50	50	50	30	30
Volume flowrate (m3/h)	109.484	184.64	110.35	183.677	185.19	182.178	110.874	108.359
Enthalpy flux (MW)	-69.6623	-111.606	-67.7944	-113.472	-110.609	-116.826	-66.7979	-73.0168
Solid fraction (mol)	0	0	0	0	0	0	0	0
Liquid fraction (mol)	1	1	1	1	1	1	1	1
Vapor fraction (mol)	0	0	0	0	0	0	0	0
Partial molar flowrates (kmol/h)								
WATER	5994.91	9991.52	5994.91	9991.52	9991.52	9991.52	5994.91	5994.91
Partial mass flowrates (kg/s)								
WATER	30	50	30	50	50	50	30	30
Mole fractions								
WATER	1	1	1	1	1	1	1	1
Mass fractions								
WATER	1	1	1	1	1	1	1	1



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