Getting started with ProSimPlus®

Case 9: Information stream

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Industry can do it

Context

There are two types of stream used in ProSimPlus: material streams and information streams. This Getting Started document introduces the use of **information stream**, which is a key functionality that enhances the robustness and flexibility of simulation models. Information streams have four essential purposes:

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1. **Transferring data** between unit operations
2. Defining process **specifications** through the constraints and recycles module (“SPEC”)
3. **Manipulate** data and results through arithmetic operations, using the information stream operator (“MANI”)
4. Imposing a specific **Calculation sequence** to control the order of the units calculation

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Summary of this Getting Started:

- Overview of the example
- Implementation of following applications:
  1. Configuration of the information stream for data transfer between two process units
  2. Configuration of process specifications (using the "SPEC" module)
  3. Setting up stream calculations (using the “MANI” module)
  4. Imposing a calculation sequence between two process units

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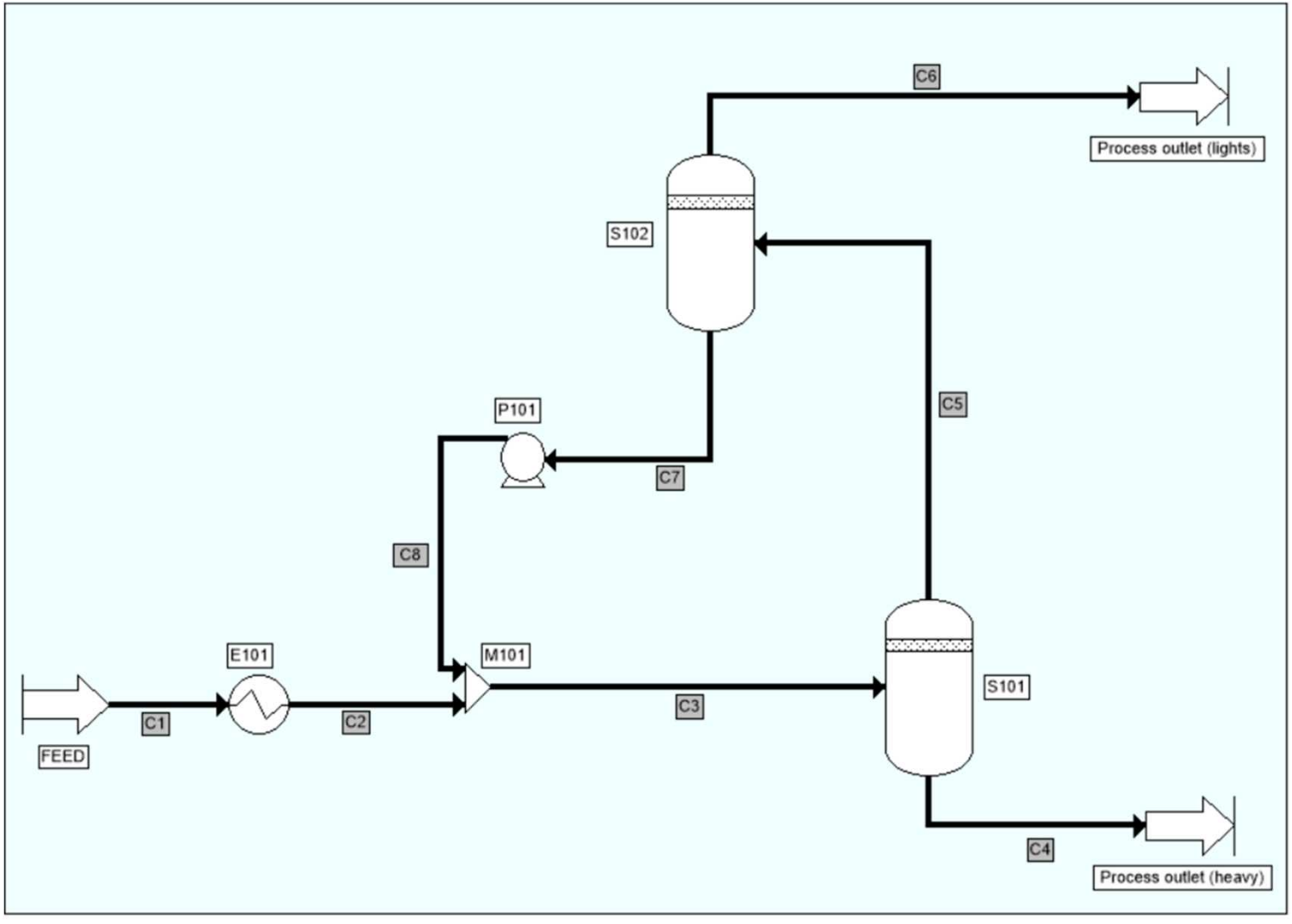
Presentation of Example

The example used in this Getting Started involves separating a hydrocarbon mixture into light and heavy components.

It is located in the ProSimPlus examples directory under the file name 'PSPS_EX_EN-Simple-Example'



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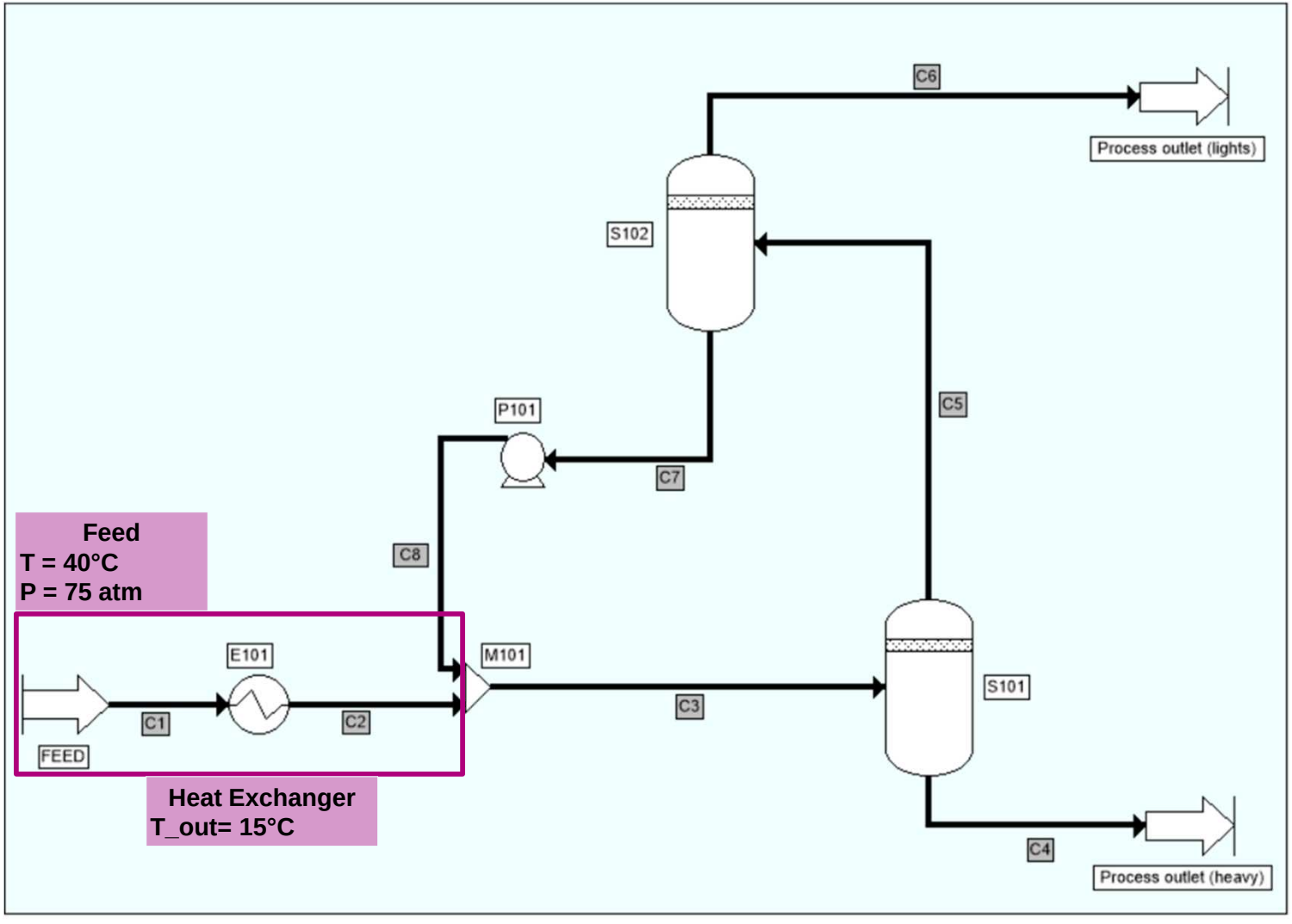
Initial feeding & cooling: Hydrocarbon mixture (C1) is cooled to 15°C (C2).



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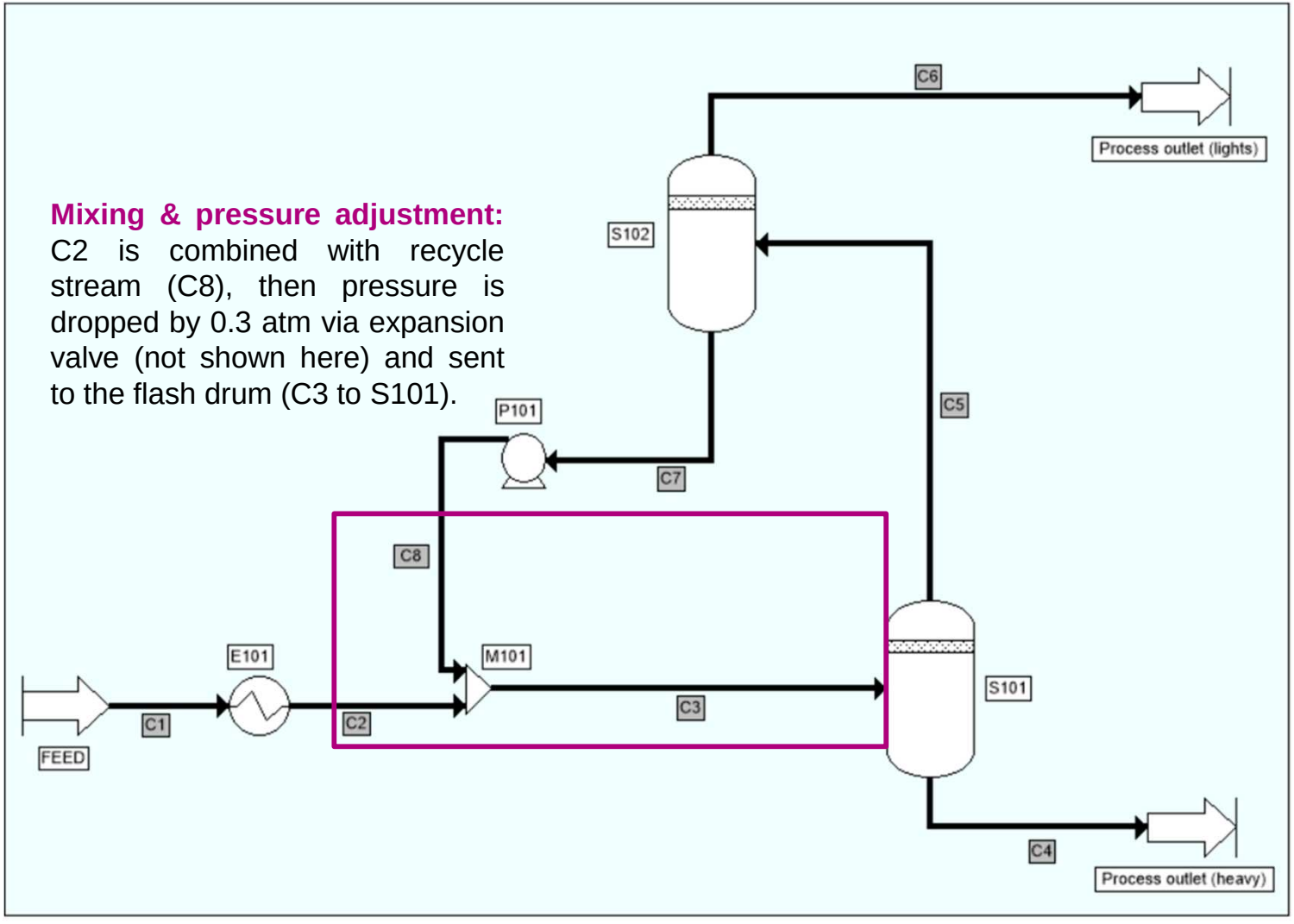
Mixing & pressure adjustment: C2 is combined with recycle stream (C8), then pressure is dropped by 0.3 atm via expansion valve (not shown here) and sent to the flash drum (C3 to S101).



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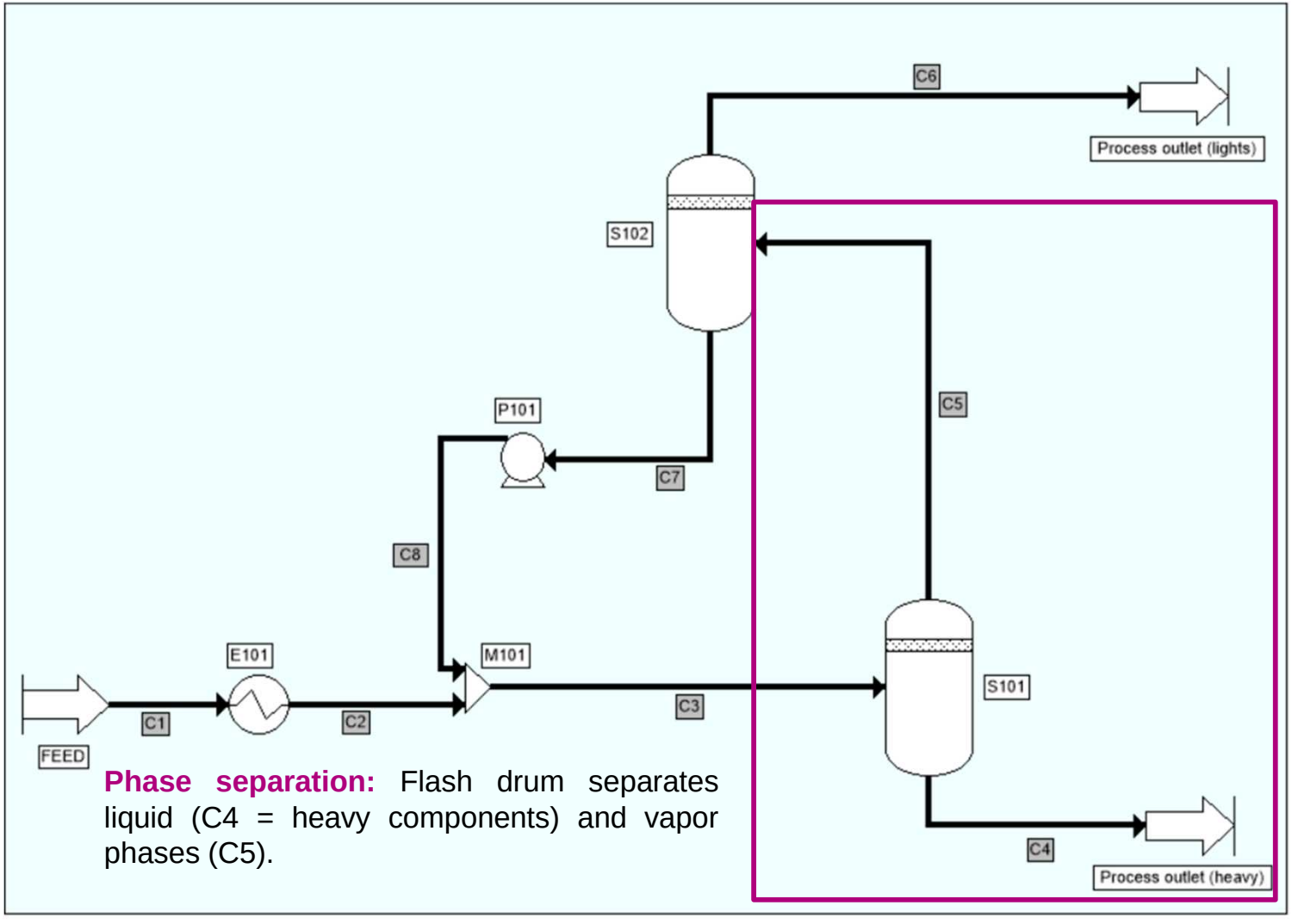

Phase separation: Flash drum separates liquid (C4 = heavy components) and vapor phases (C5).

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Presentation of Example

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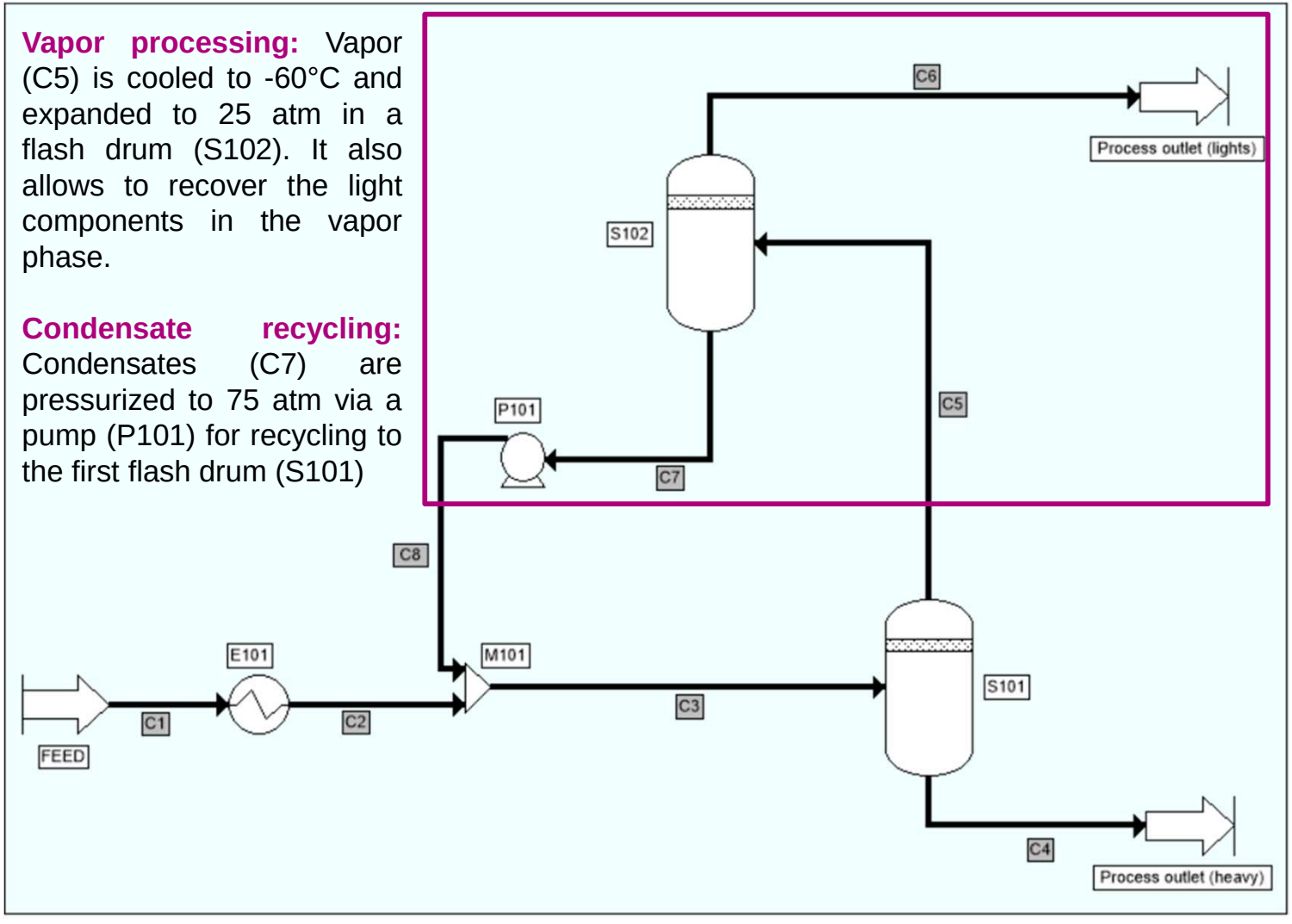
Vapor processing: Vapor (C5) is cooled to -60°C and expanded to 25 atm in a flash drum (S102). It also allows to recover the light components in the vapor phase.

Condensate recycling: Condensates (C7) are pressurized to 75 atm via a pump (P101) for recycling to the first flash drum (S101)



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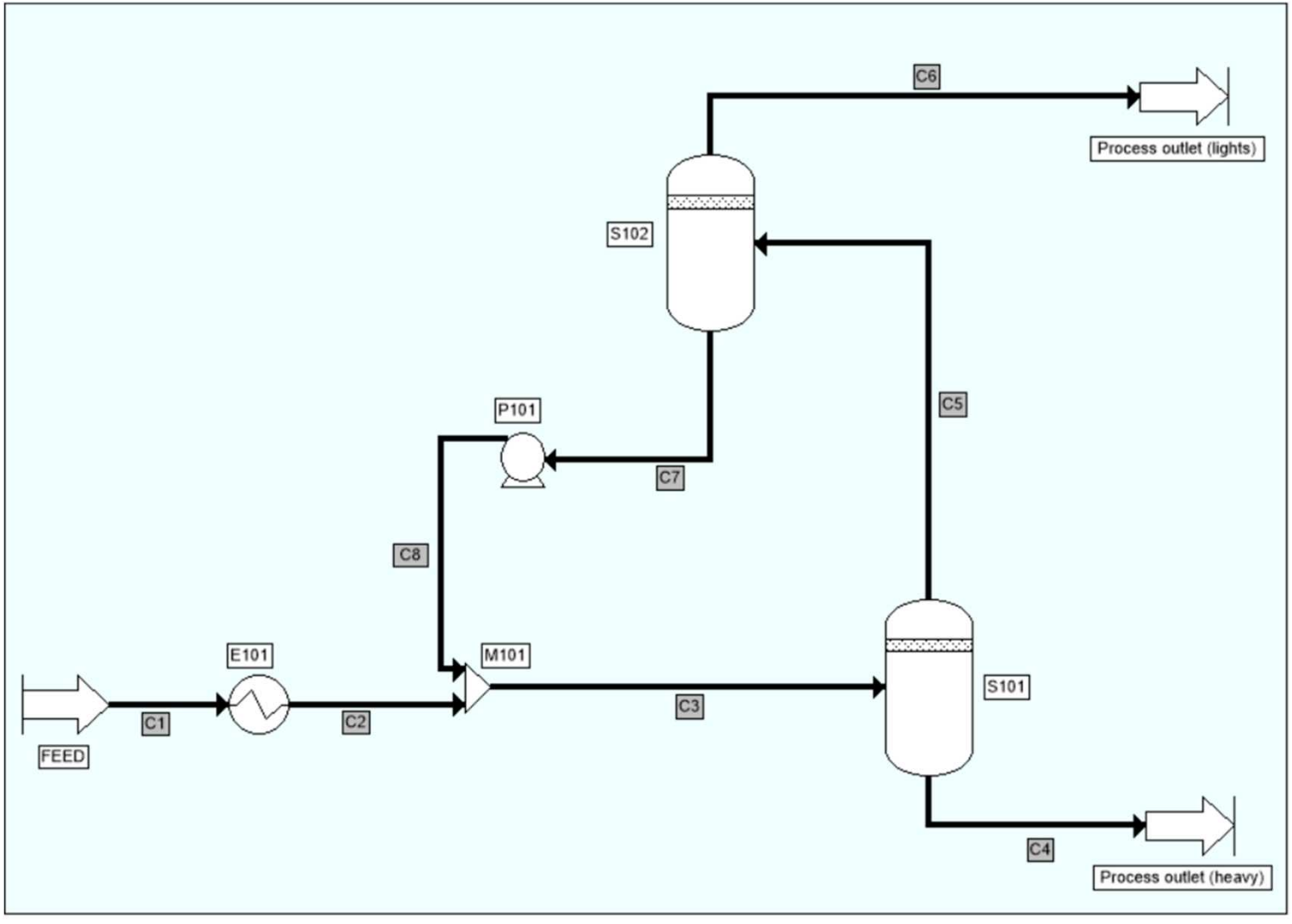
Presentation of Example

The example used in this Getting Started involves separating a hydrocarbon mixture into light and heavy components.

It is located in the ProSimPlus examples directory under the file name 'PSPS_EX_EN-Simple-Example'

All the details for the *Simple-Example* have been provided, so at this point no additional input is required from the user

Before making any modifications, the simulation can be run to analyze the results



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Presentation of Example

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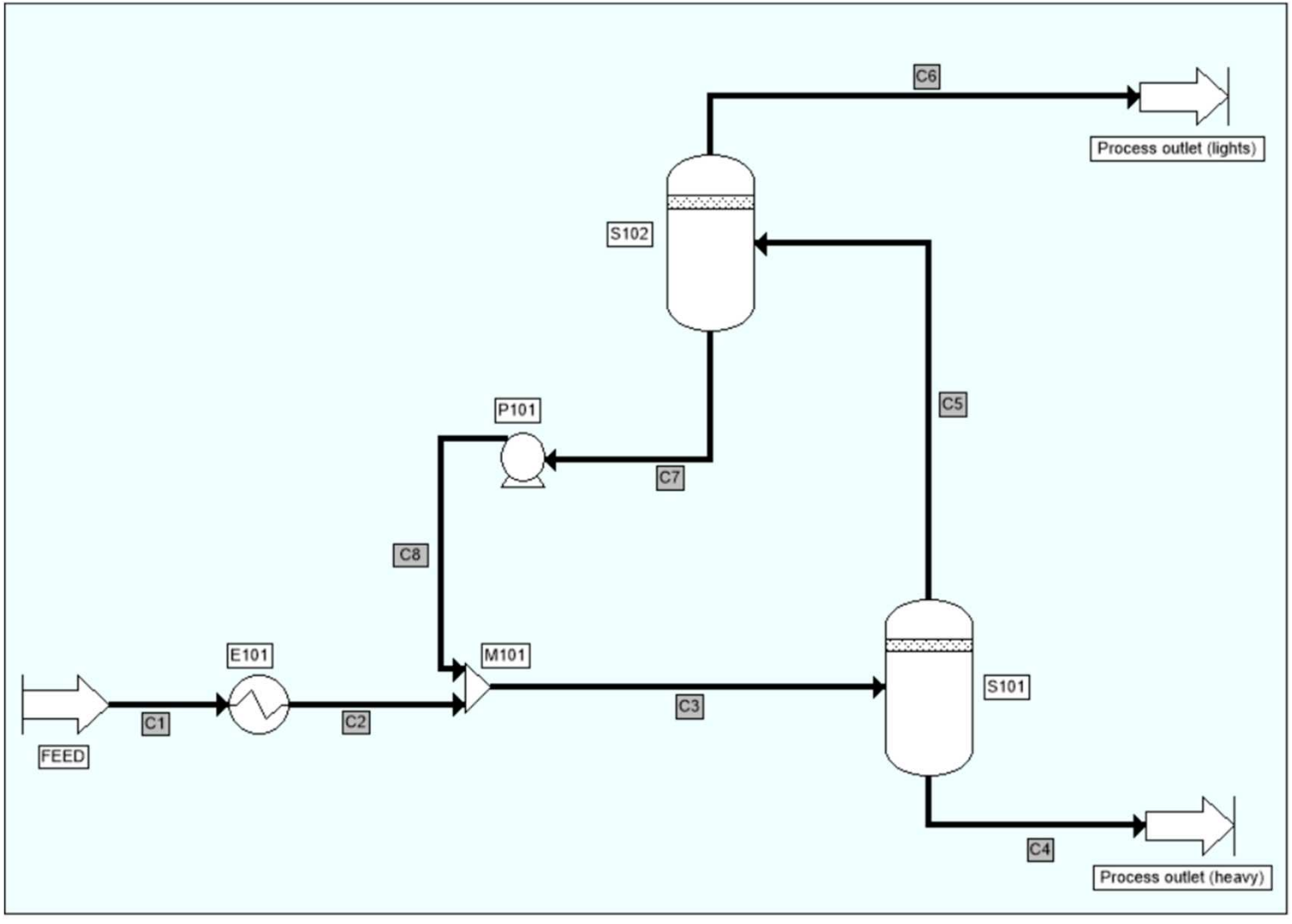
IMPORTANT

Streams notation

Information stream

Material stream



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Concept

Transferring data: Let's do it!

1. **Transferring data** between unit operations
2. Defining process **specifications** through the constraints and recycles module ("SPEC")
3. **Manipulate** data and results through arithmetic operations, using the information stream operator ("MANI")
4. Imposing a specific **Calculation sequence** to control the order of the units calculation

This feature allows to transfer data

(input data or results)

between unit operations

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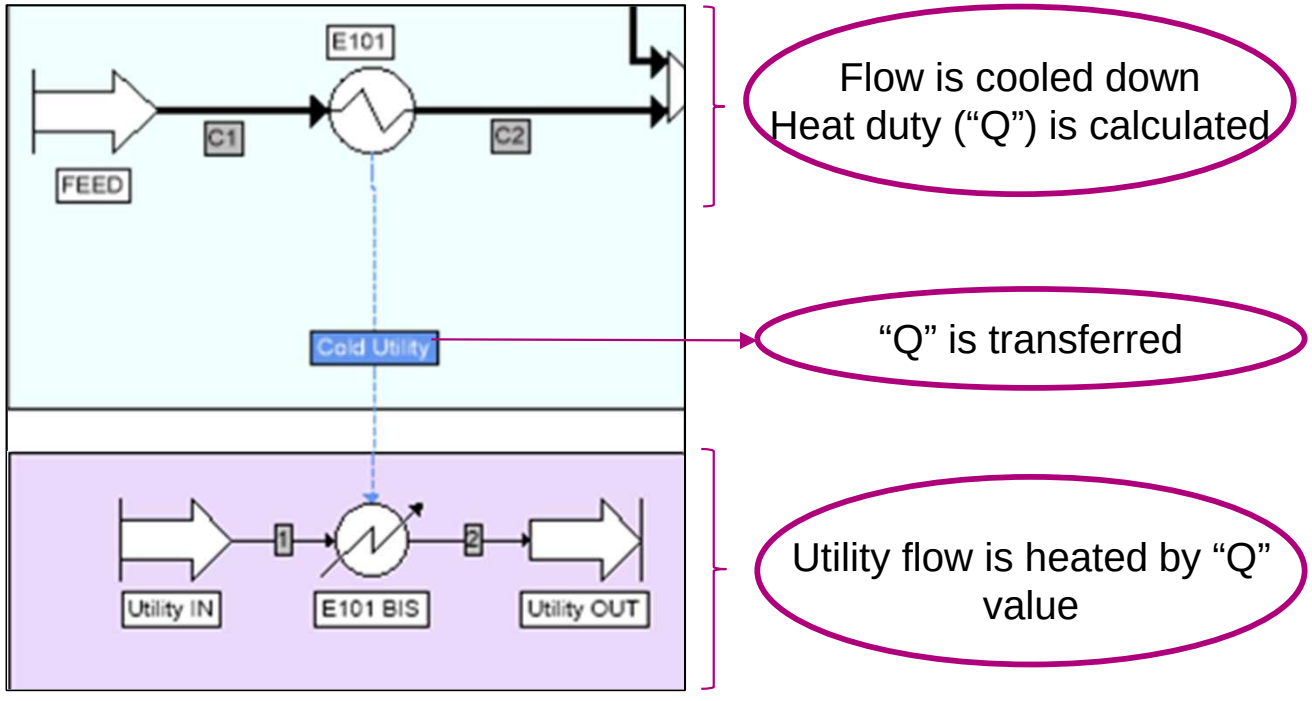
Concept

Objectives of the application example:

When simulating utilities, it is convenient to distinguish the process and utility sections. This approach allows to facilitate the understanding and convergence of the simulation model.

The information stream allows to transfer the heat duty value (Q), from the process section to the utility section.



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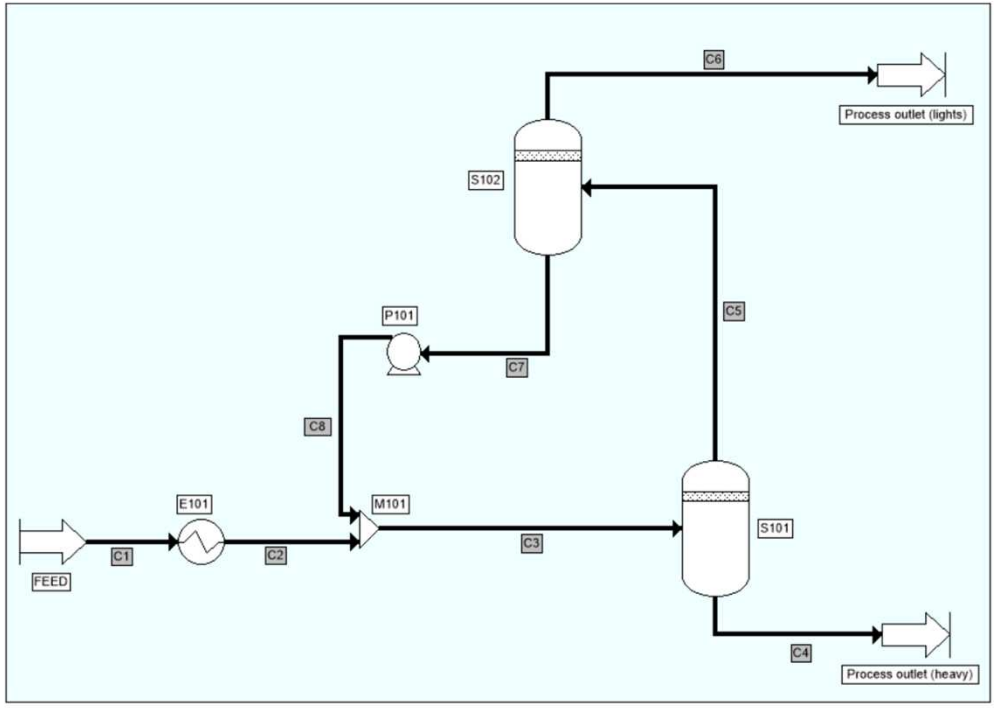
Practical Example

Let's apply this on our simple example!



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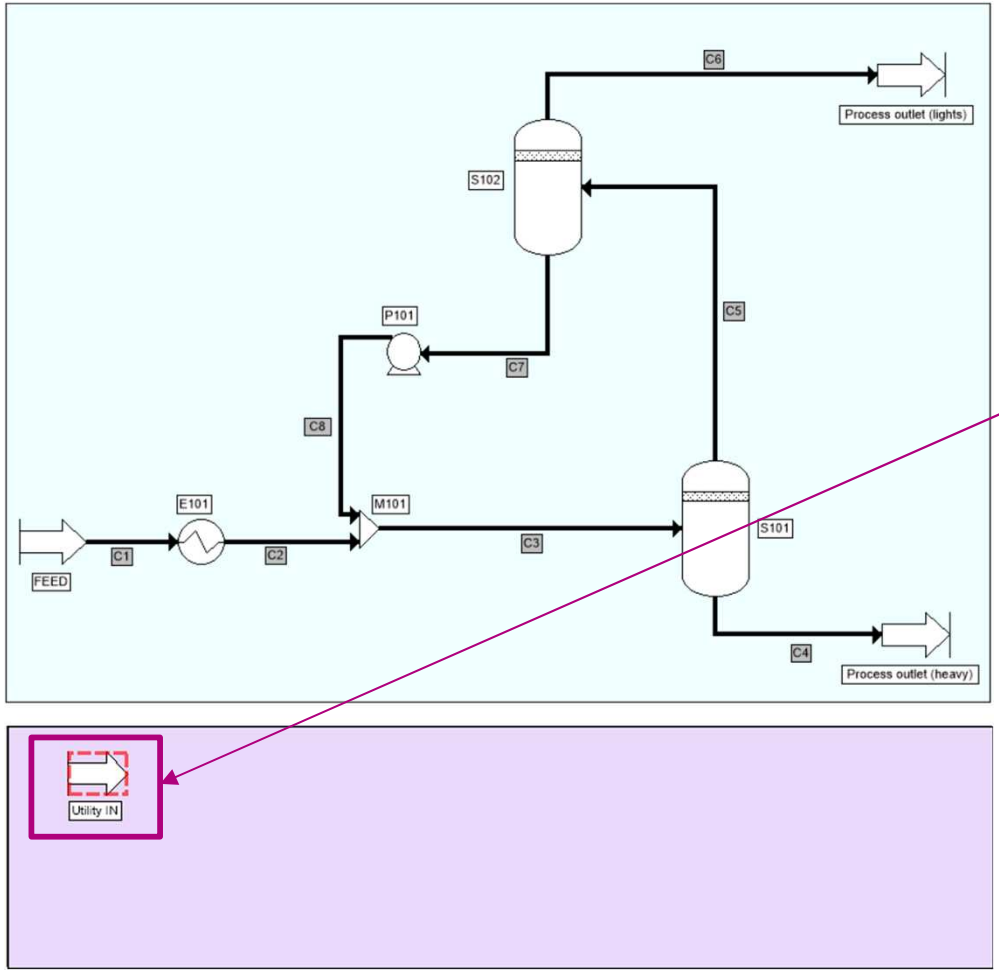
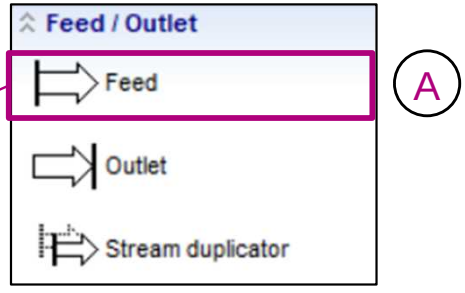
Practical Example

1 Insertion of feed (“Utility IN”), outlet (“Utility OUT”) and the Heat duty controller (“E101 BIS”) in the flowsheet





A

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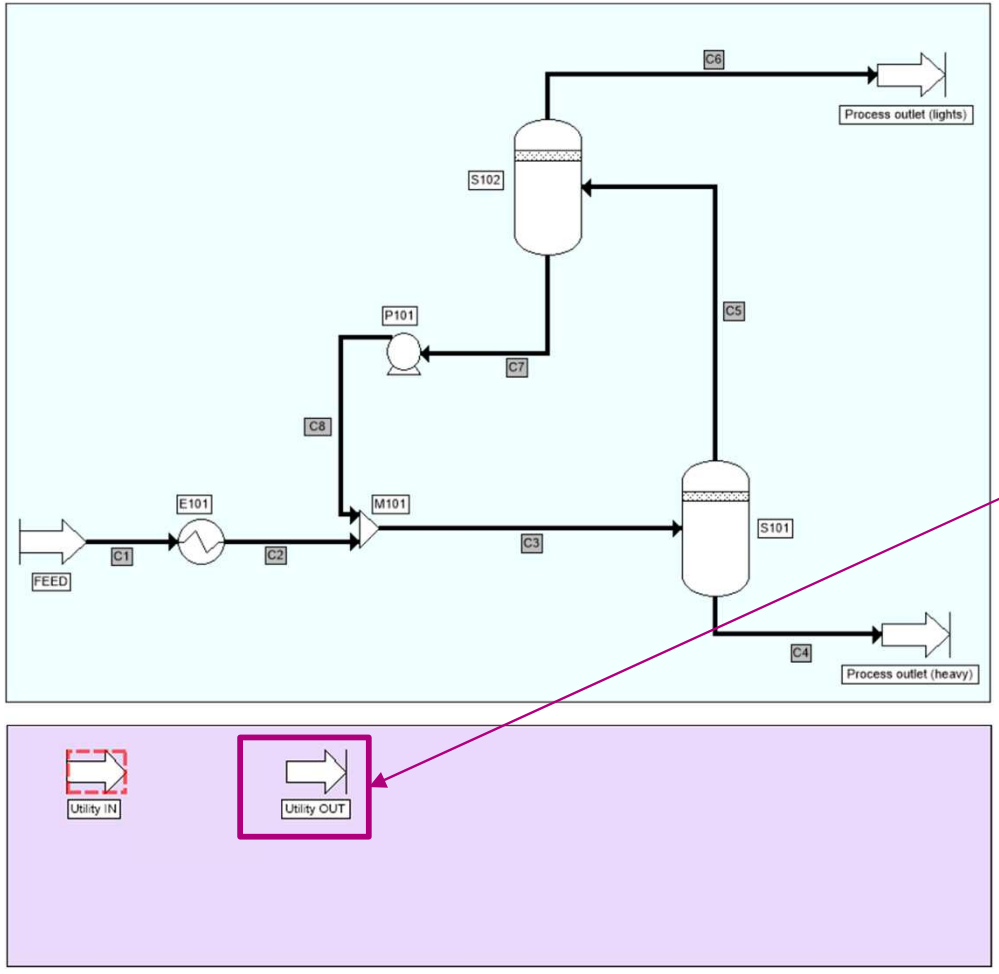
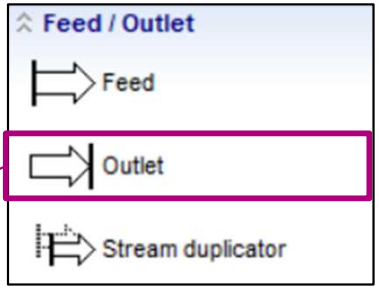
Practical Example

1 Insertion of feed (“Utility IN”), outlet (“Utility OUT”) and the Heat duty controller (“E101 BIS”) in the flowsheet





B

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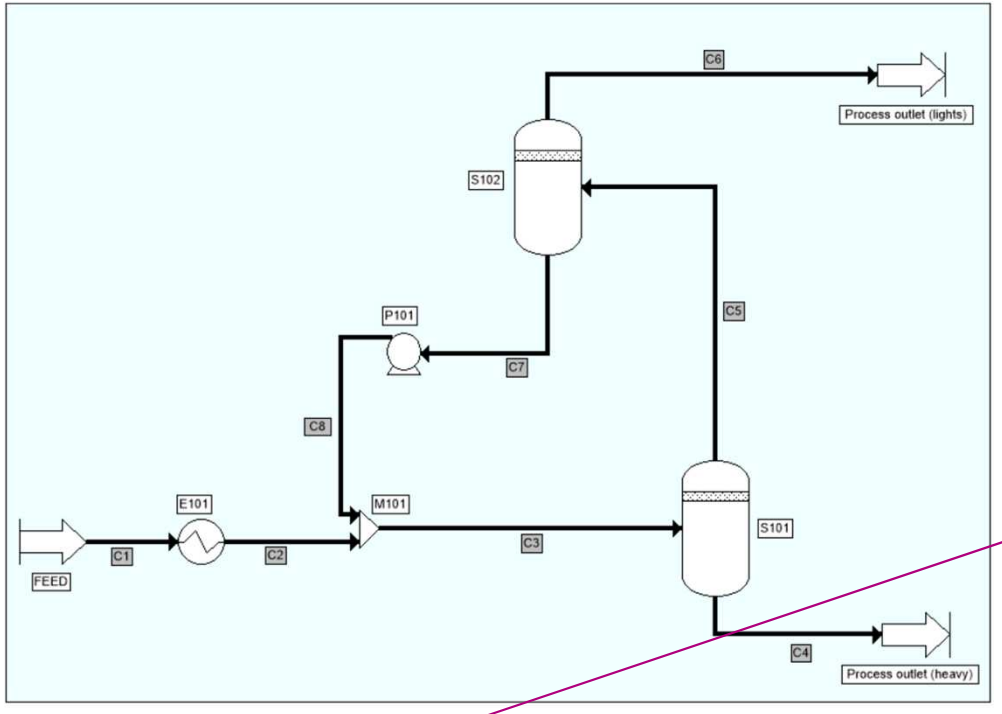
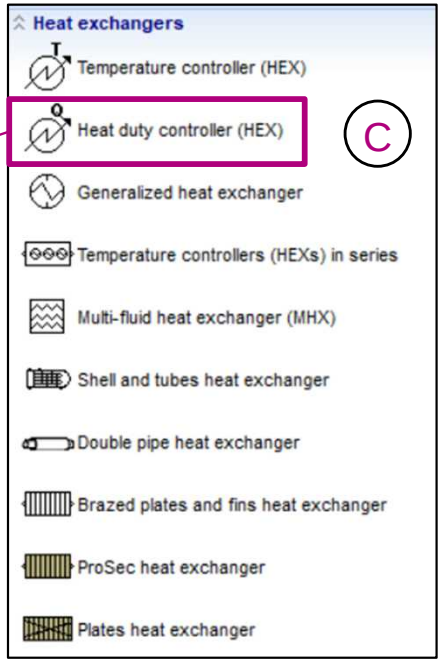
Practical Example

1 Insertion of feed (“Utility IN”), outlet (“Utility OUT”) and the Heat duty controller (“E101 BIS”) in the flowsheet





The visuals of the E101 and E101 bis heat exchangers have been modified via the “Visuals” functionality accessible with a right click on the unit operation

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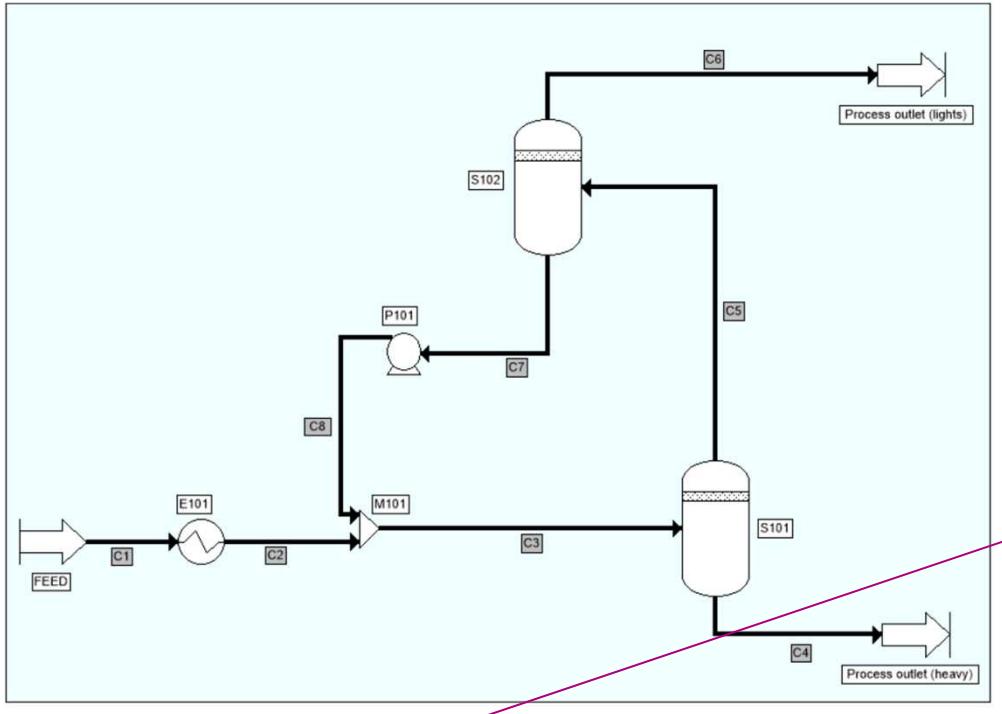
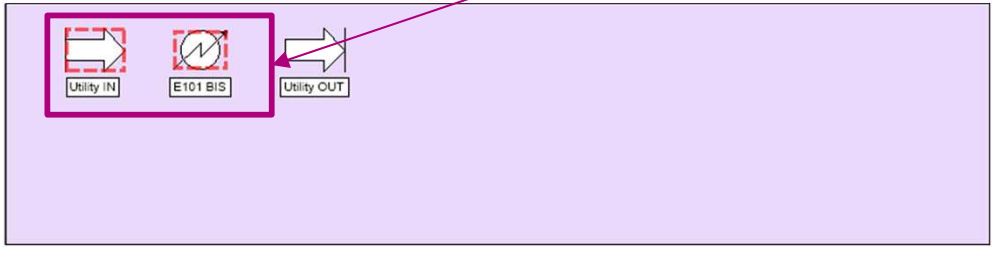
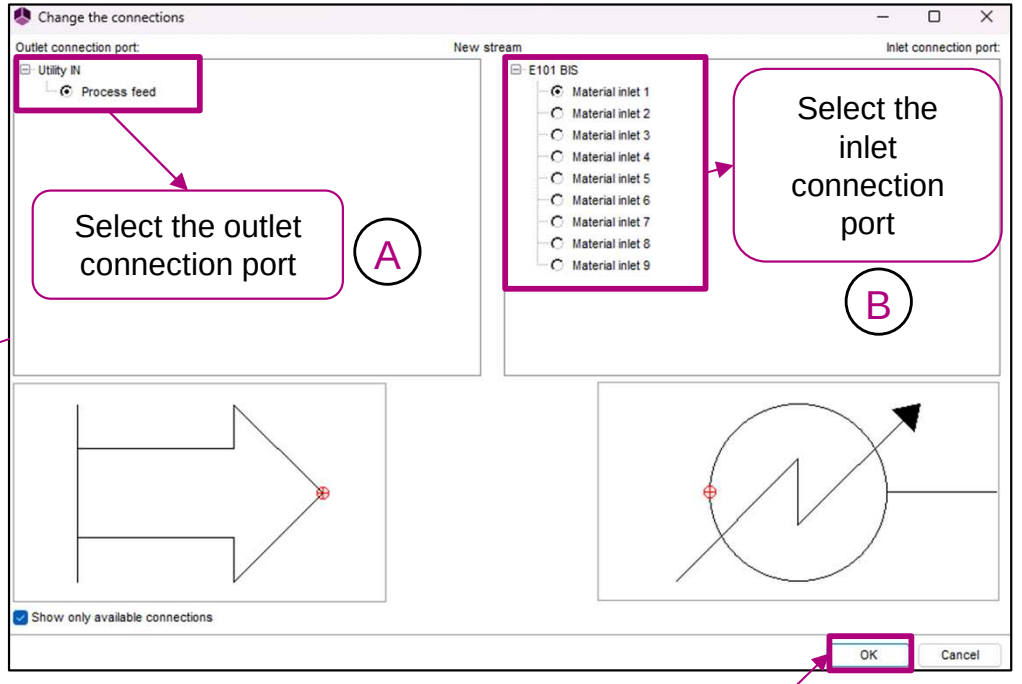
Practical Example

2 Connect the feed (“Utility IN”) to the Heat duty controller (“E101 BIS”)







Select the outlet connection port

A

Select the inlet connection port

B

C

Click on “OK” to save the data

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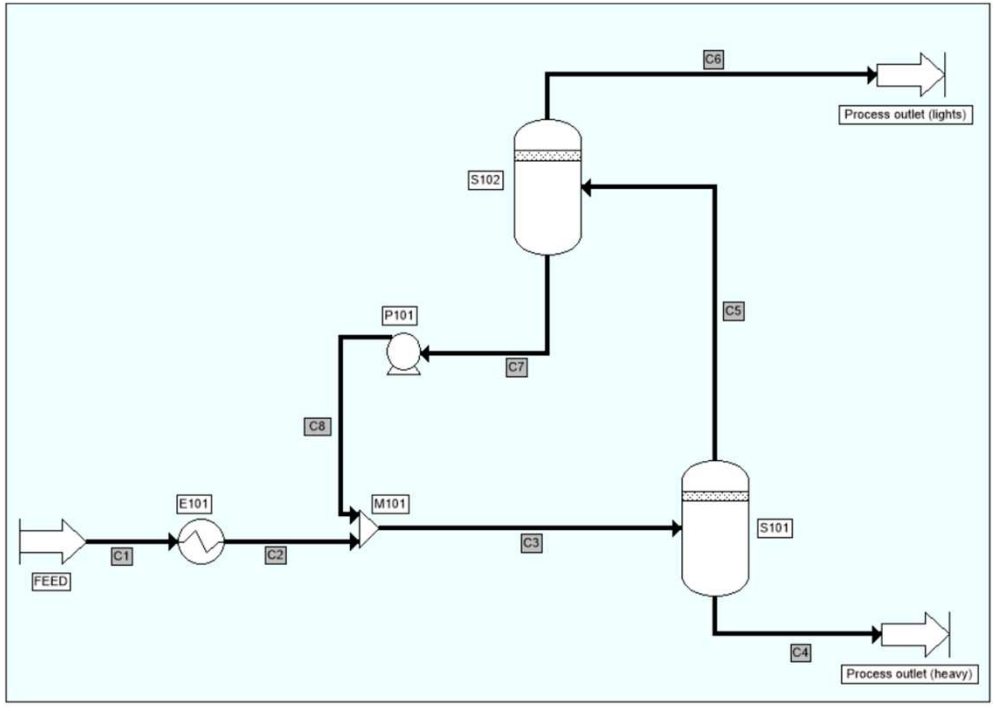
Practical Example

3 Connect the Heat duty controller (“E101 BIS”) to the outlet (“Utility OUT”)



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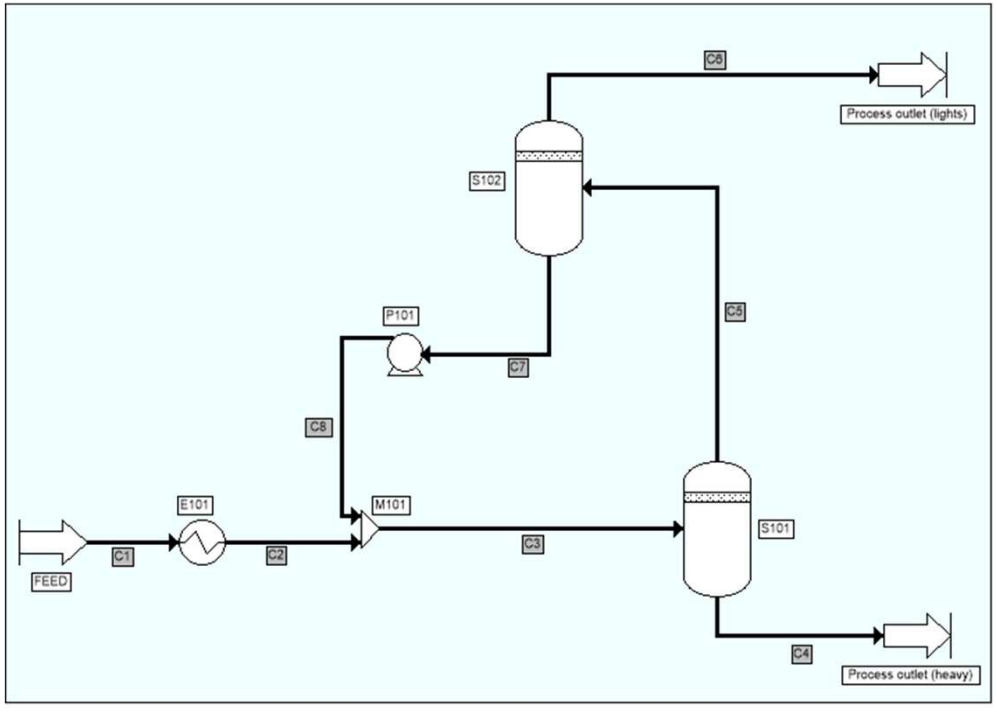
Practical Example

4 Specify feed (“Utility IN”) parameters



A

Create a new calculator dedicated to the utility fluid (water+ ethylene glycol)

For more detailed steps click here

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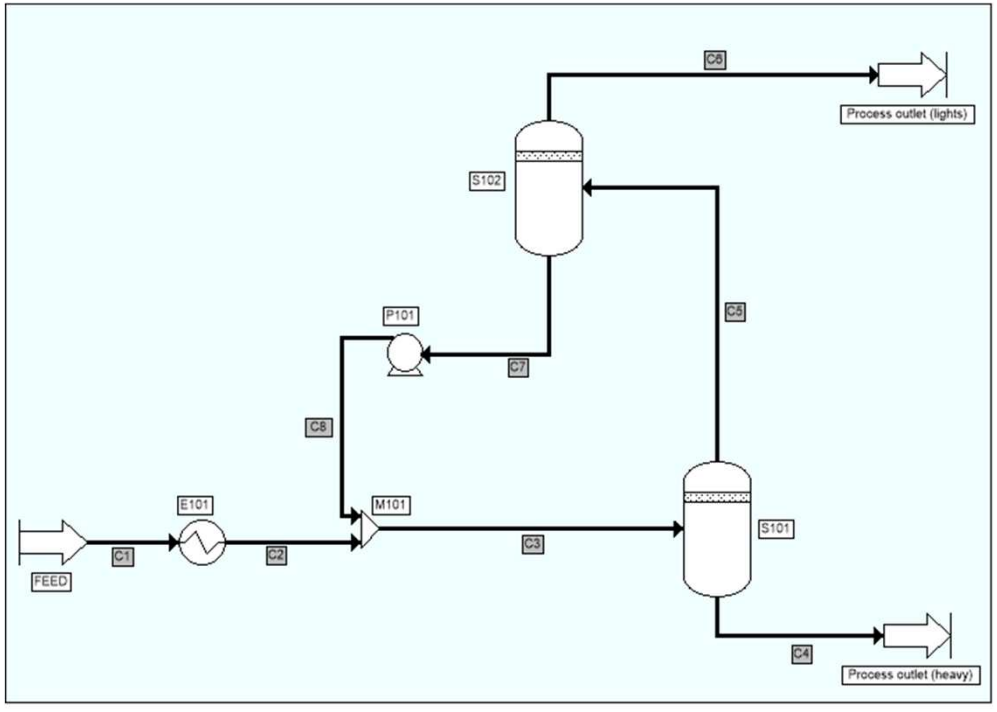
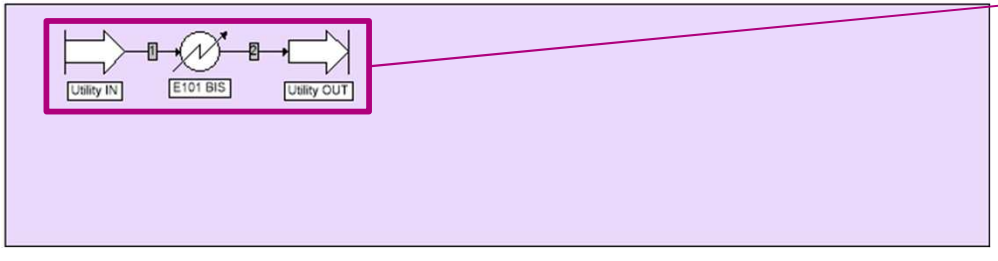
Practical Example

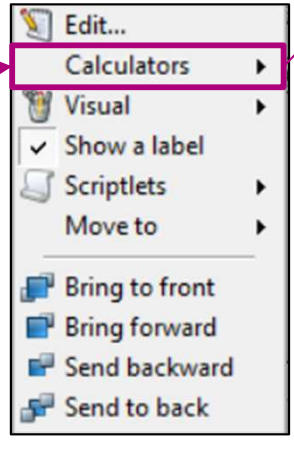
4 Specify feed (“Utility IN”) parameters

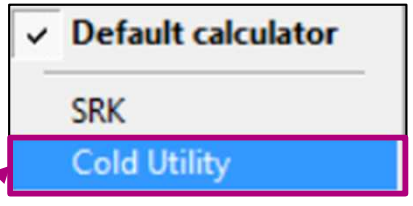




B

Select all the modules included in the utility section, right-click, and then select the “cold utility” calculator





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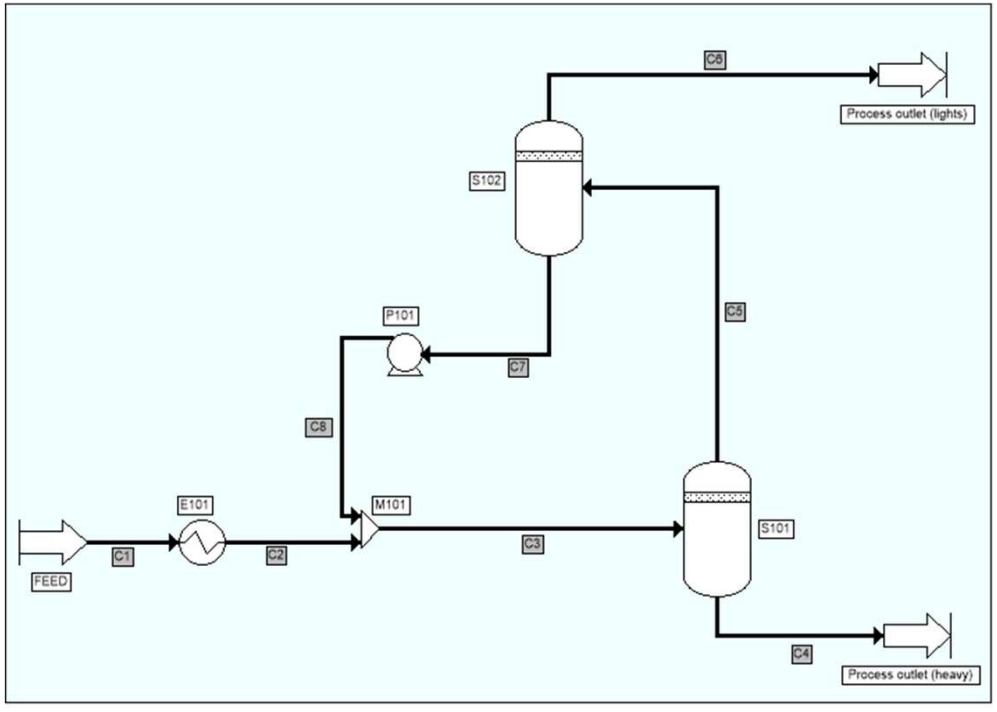
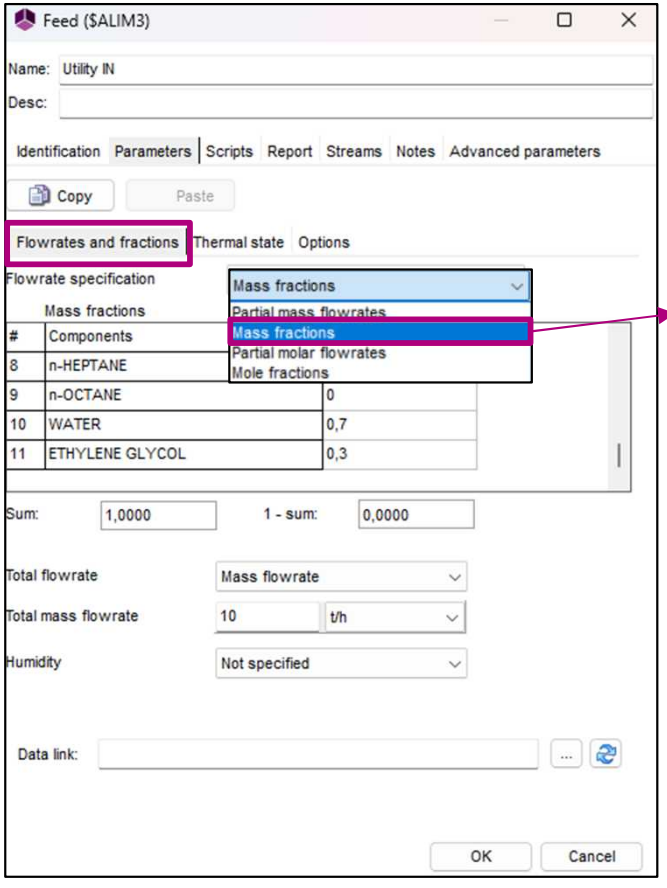
4 Specify feed (“Utility IN”) parameters





C

Double click on the feed (“Utility IN”)

D

Select mass fraction as the flowrate specification

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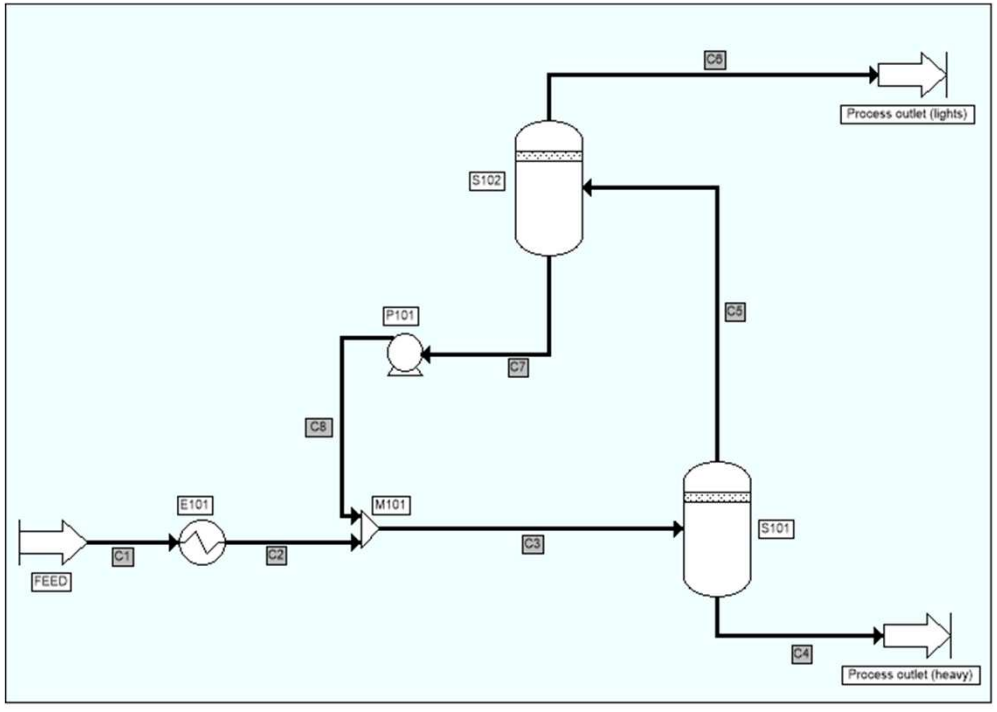
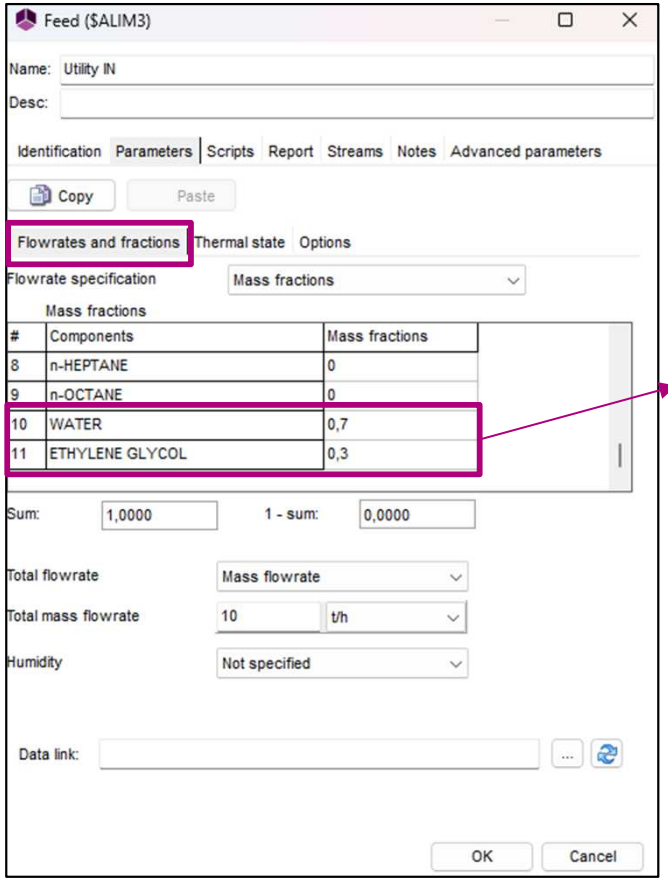
4 Specify feed (“Utility IN”) parameters





E

Provide the mass fraction:
- Water: 0.7
- Ethylene glycol: 0.3

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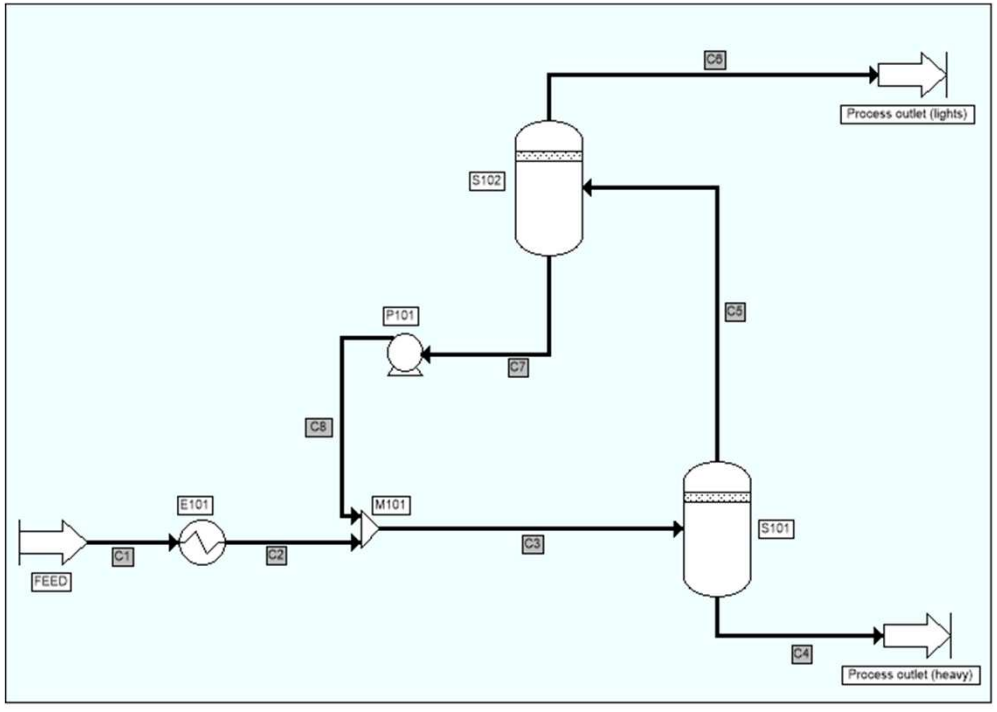
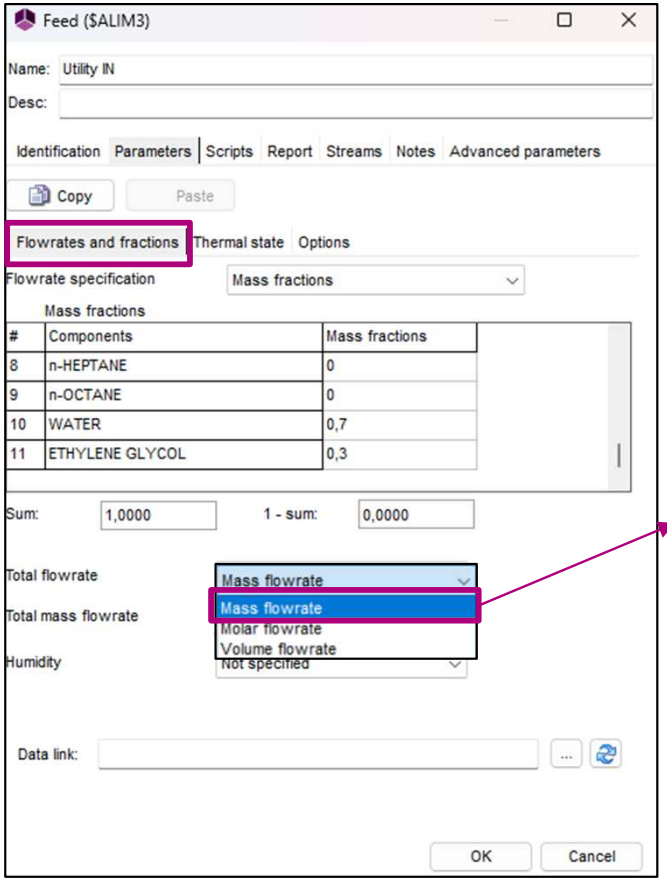
Practical Example

4 Specify feed (“Utility IN”) parameters





F

Select total flowrate as mass flowrate

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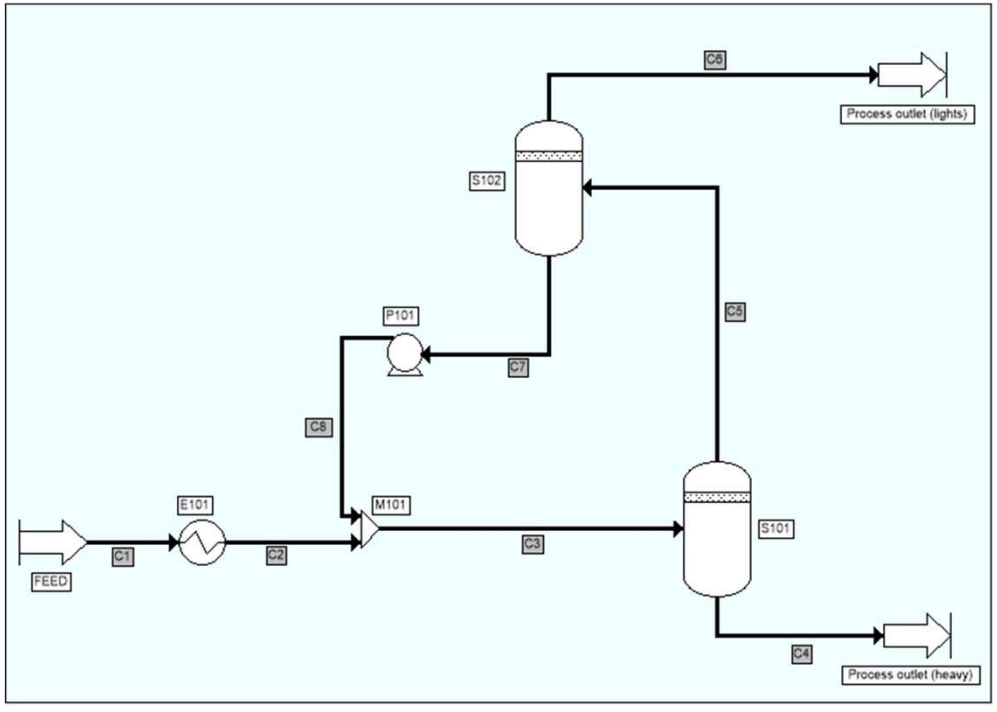
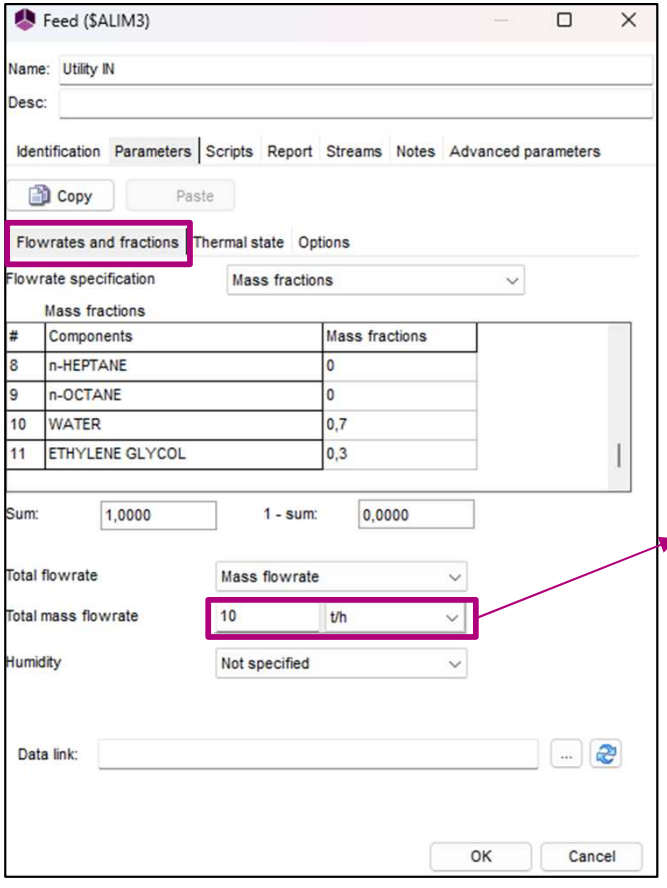
Practical Example

4 Specify feed (“Utility IN”) parameters





G

Specify the total mass flowrate: 10 t/h

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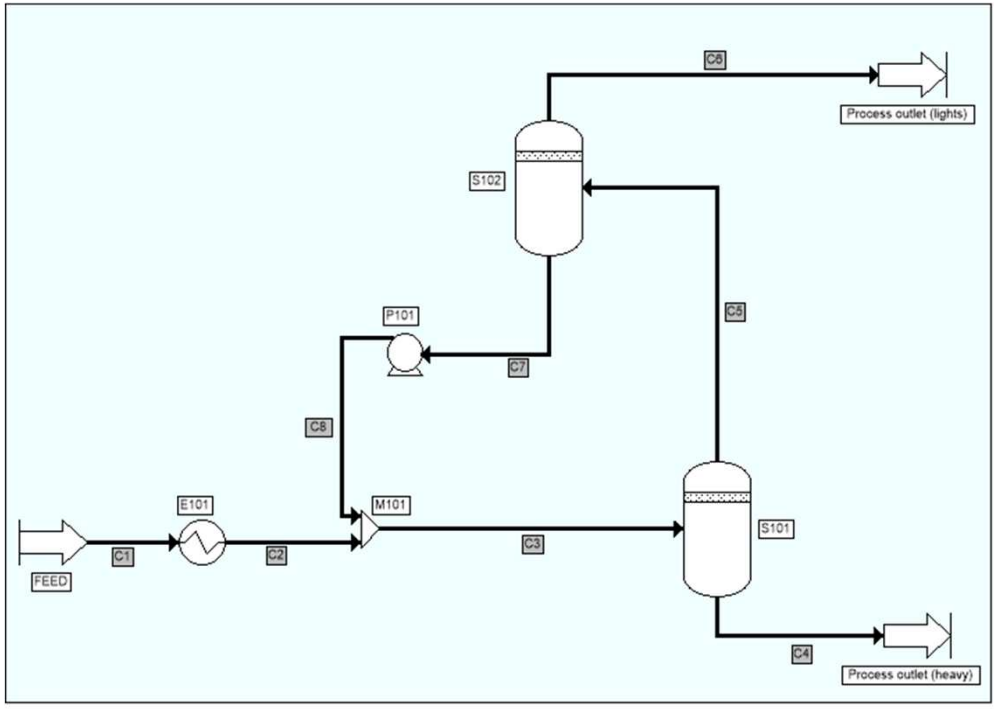
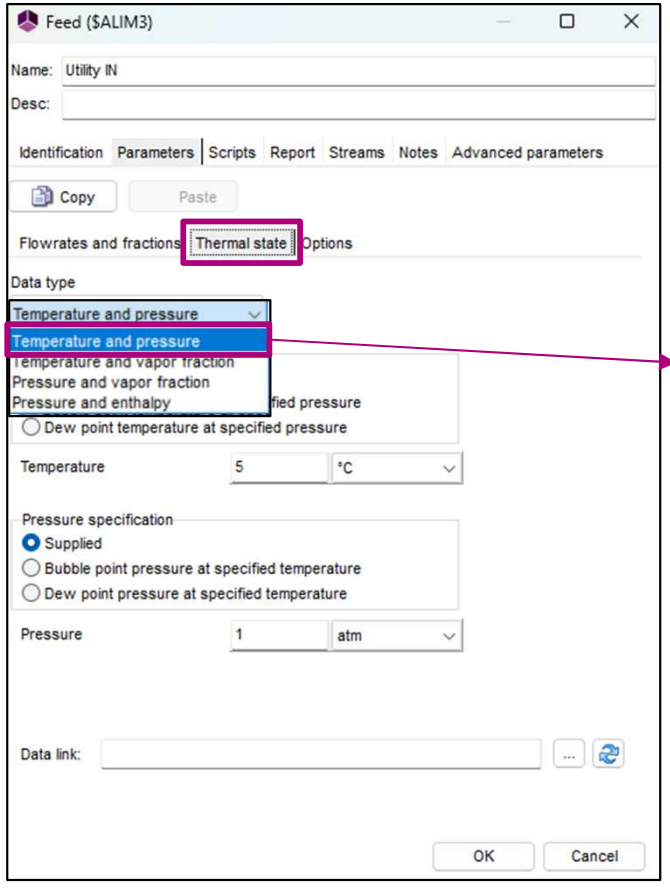
4 Specify feed (“Utility IN”) parameters





H

Select the data type: temperature and pressure

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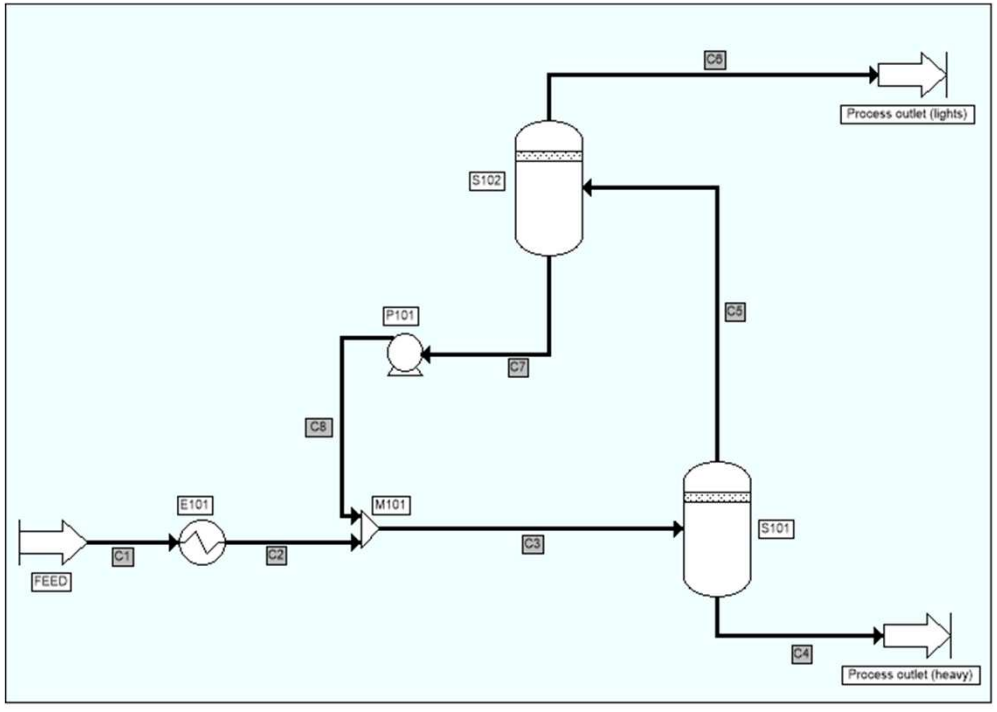
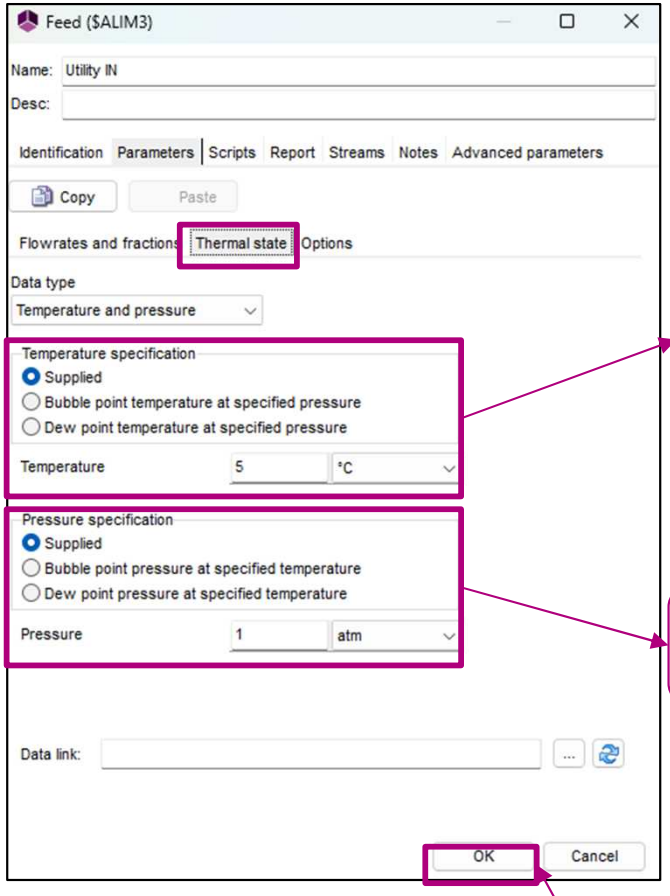
Practical Example

4 Specify feed (“Utility IN”) parameters





I

Supply the temperature: 5°C

J

Supply the pressure: 1 atm

K

Click on “OK” to save the information

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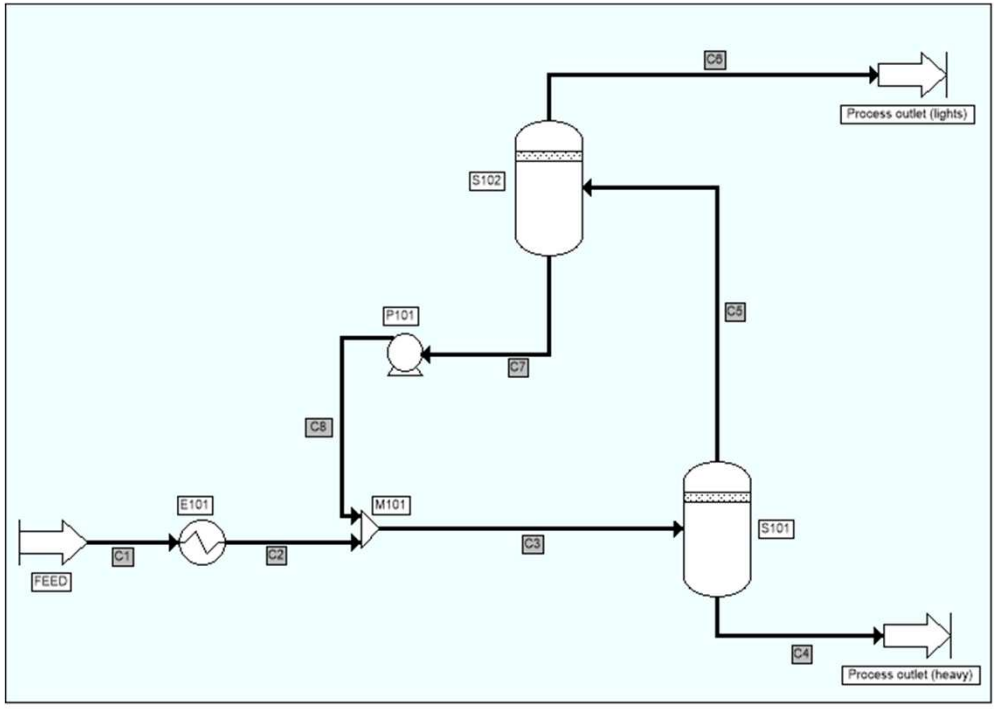
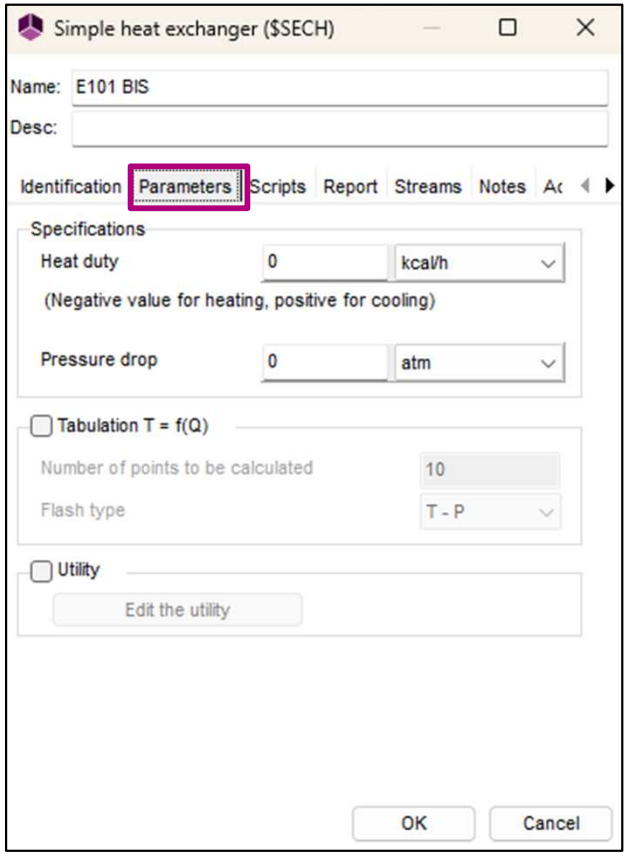
Practical Example

5 Specify Heat duty controller (“E101 BIS”) parameters





No input from the user is needed in this case, the **heat duty** will be provided by the **information stream.**

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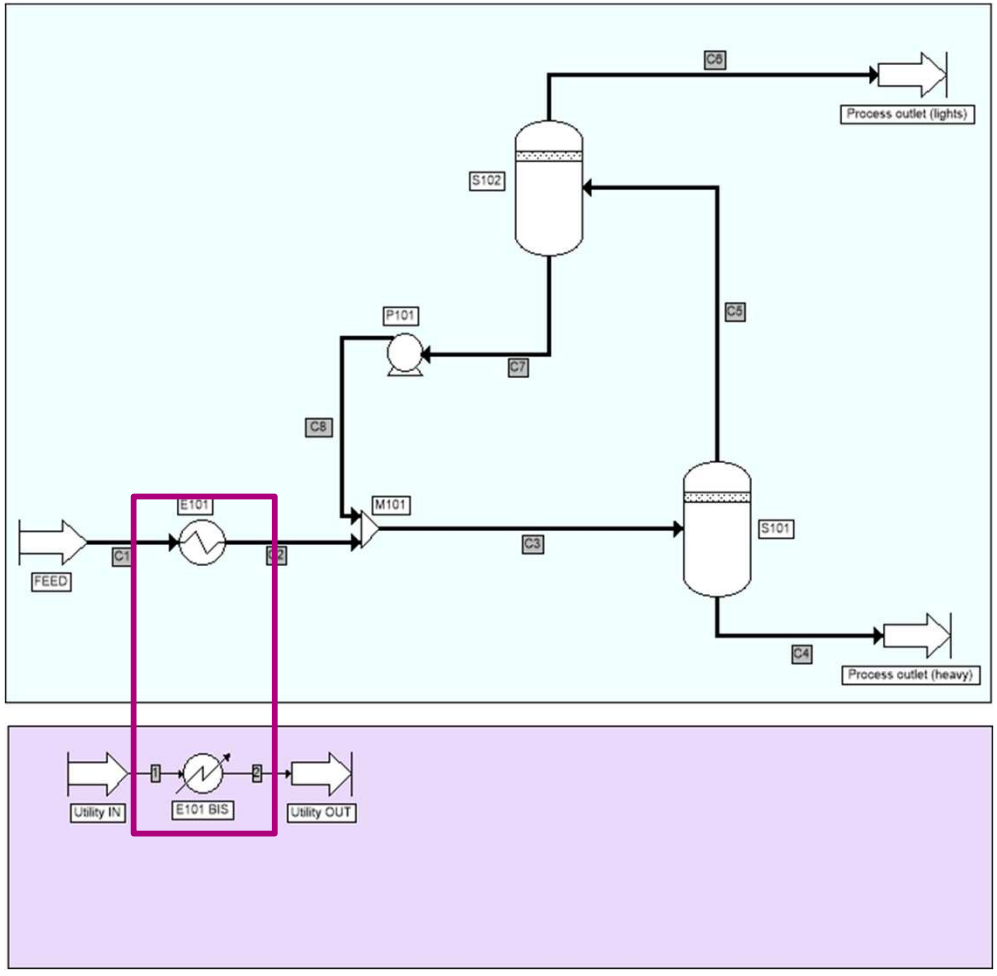
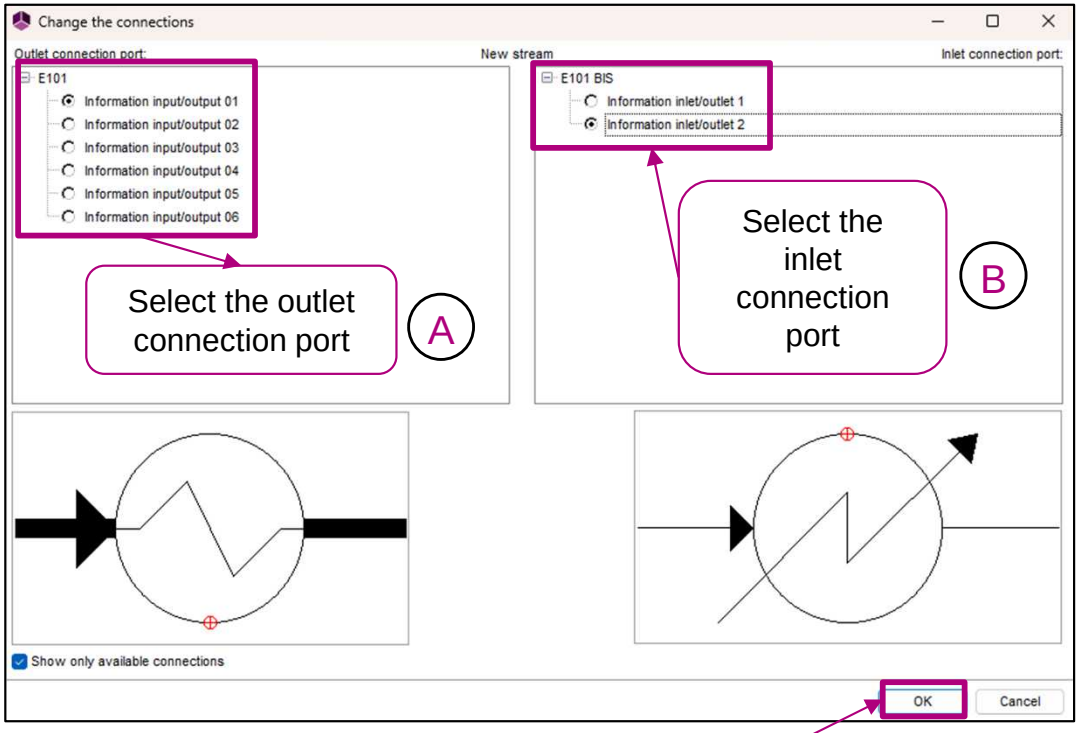
Practical Example

6 Insertion of the information stream (“Cold Utility”) from the temperature controller (“E101”) to the Heat duty controller (“E101 BIS”)



The order in which unit operations are connected determines the direction of the information stream. For example, if you click on unit operation A first and then unit operation B, the information will go from A to B.



C Click on “OK” to save the data

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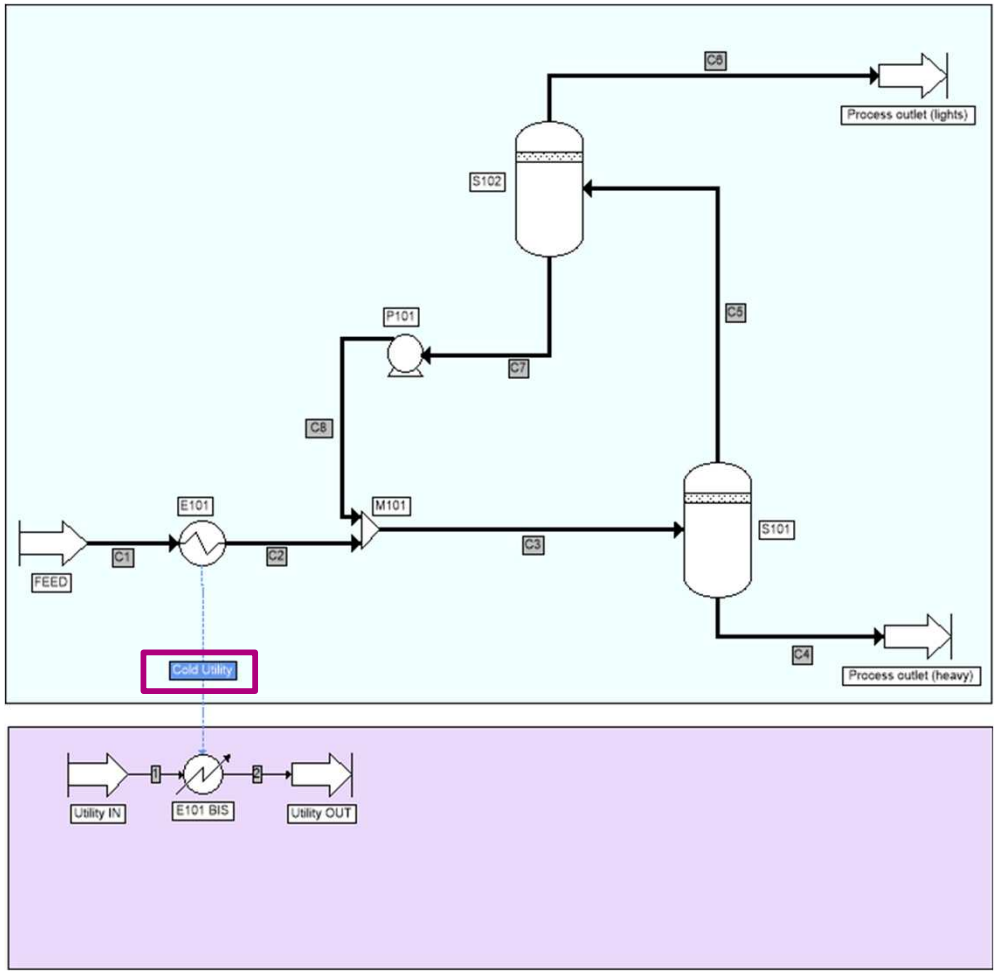
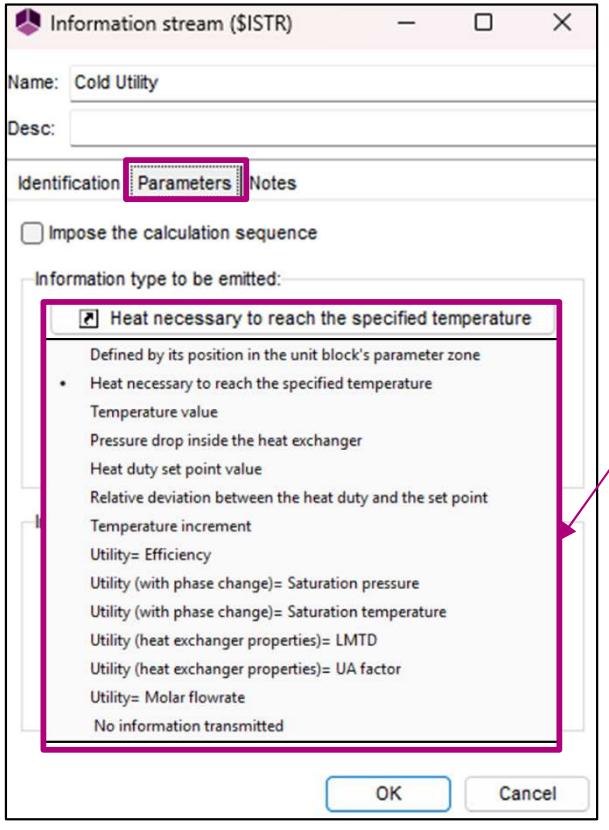
7 Specify the information stream (“Cold Utility”) information stream parameters





A

Select:

Heat necessary to reach the specified temperature

as the information to be emitted from

temperature controller (“E101”)

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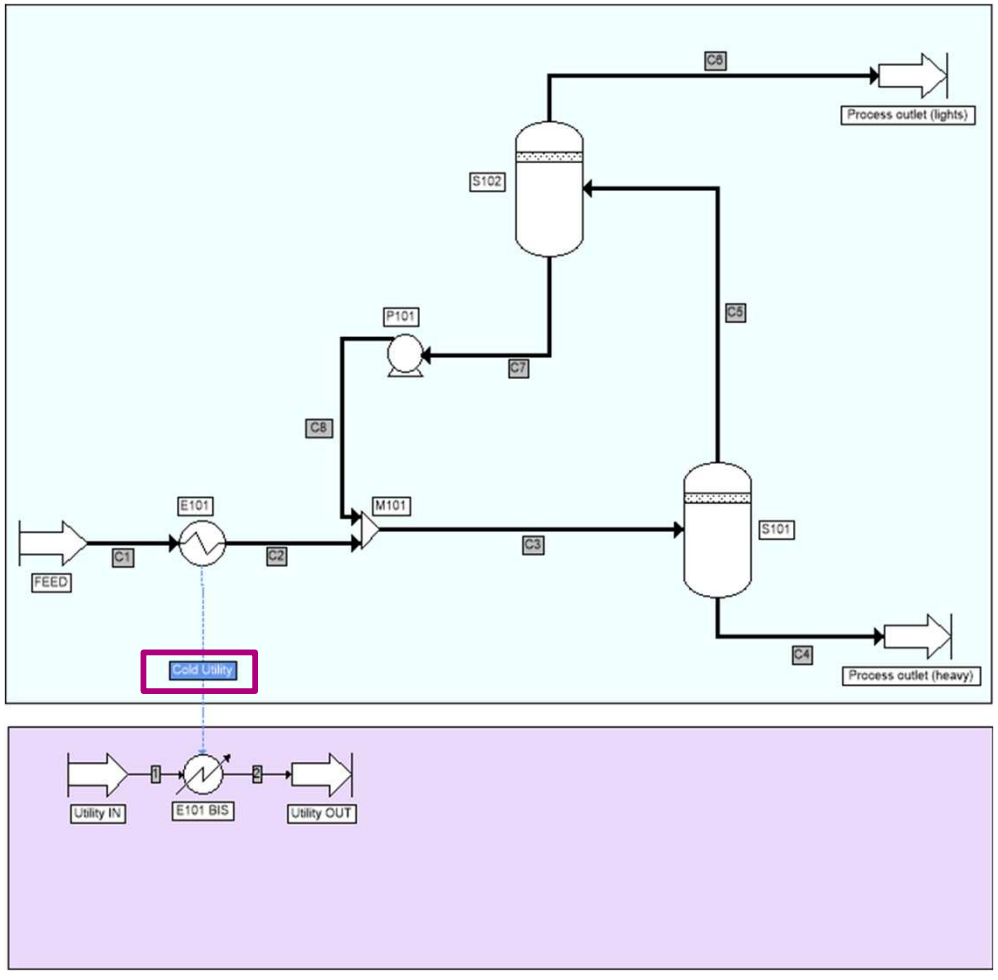
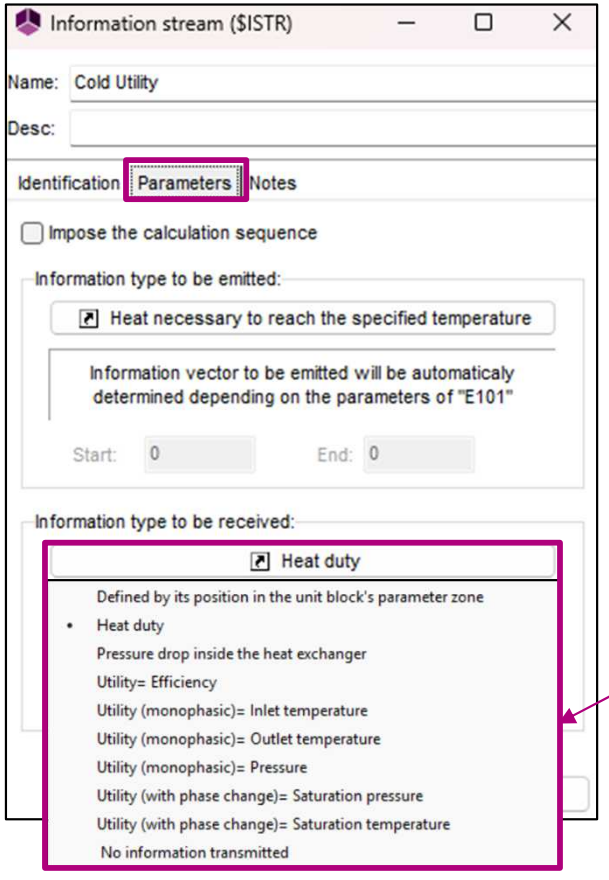
Practical Example

7 Specify the information stream (“Cold Utility”) information stream parameters





B

Select:
Heat duty
as the information to be received by the
Heat duty controller (“E101 BIS”)

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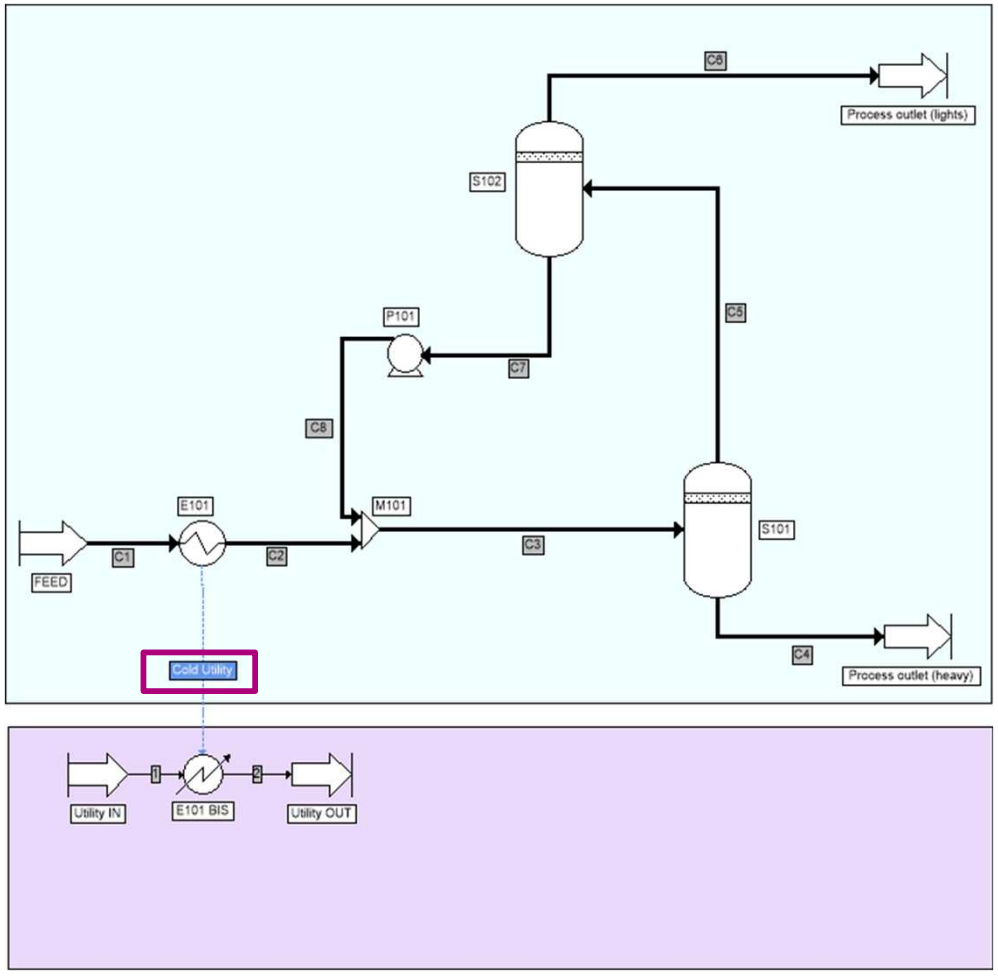
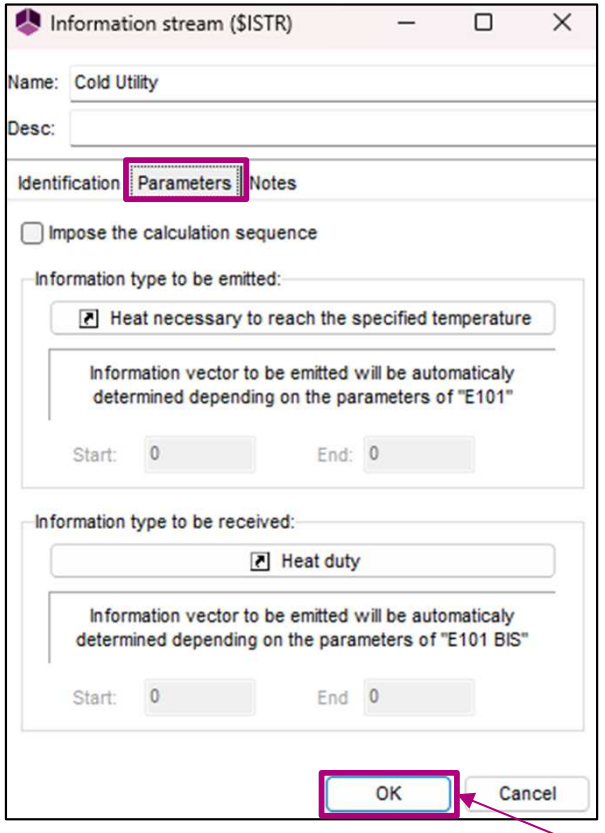
Practical Example

7 Specify the information stream (“Cold Utility”) information stream parameters





C

Click on “OK” to save the data

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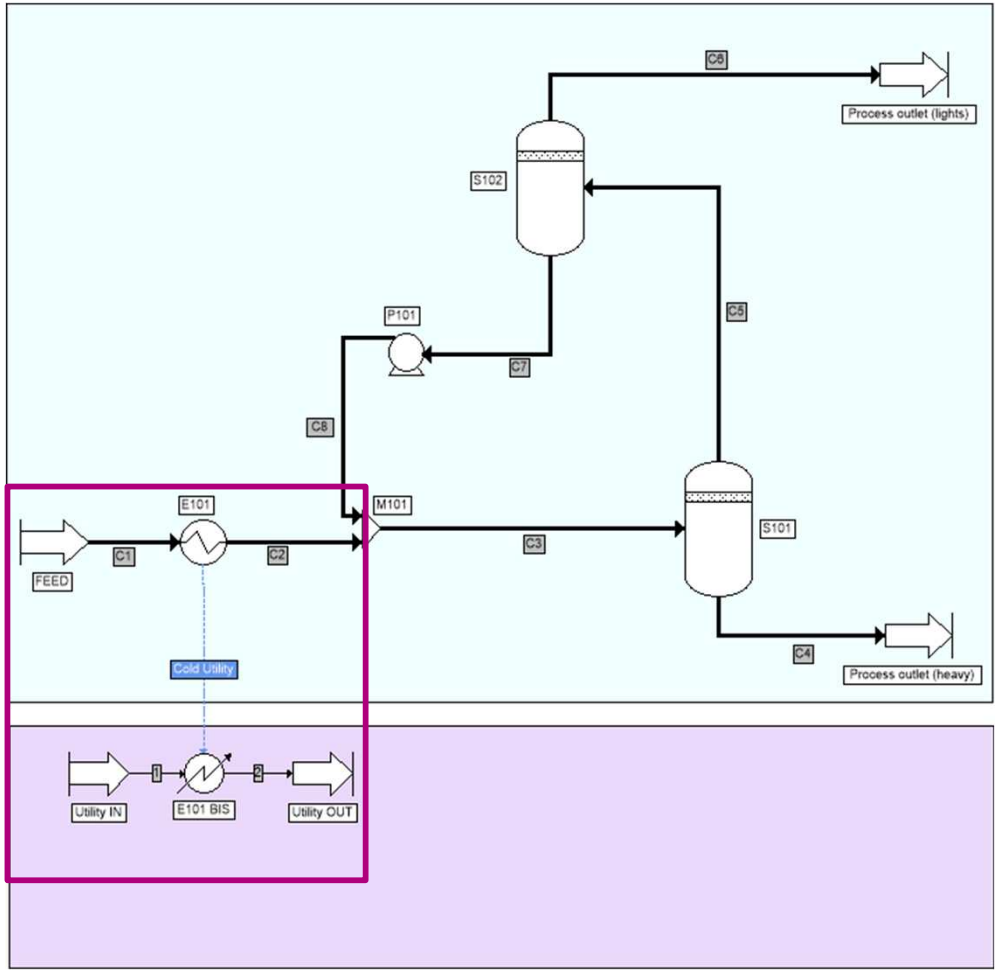
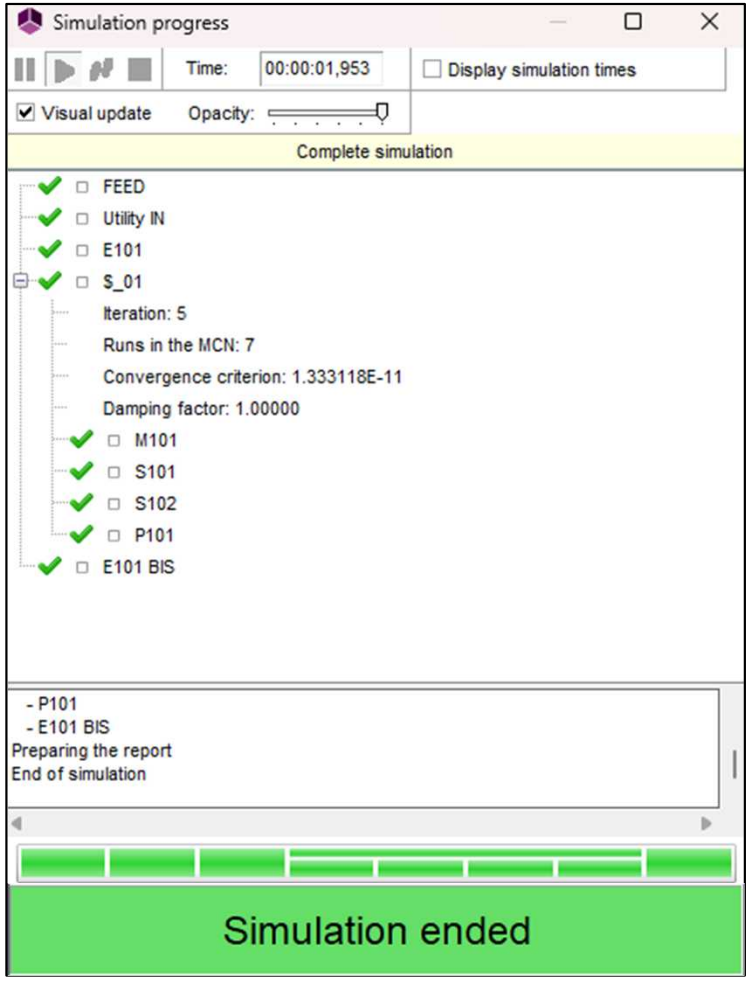
Practical Example

8 Run the simulation





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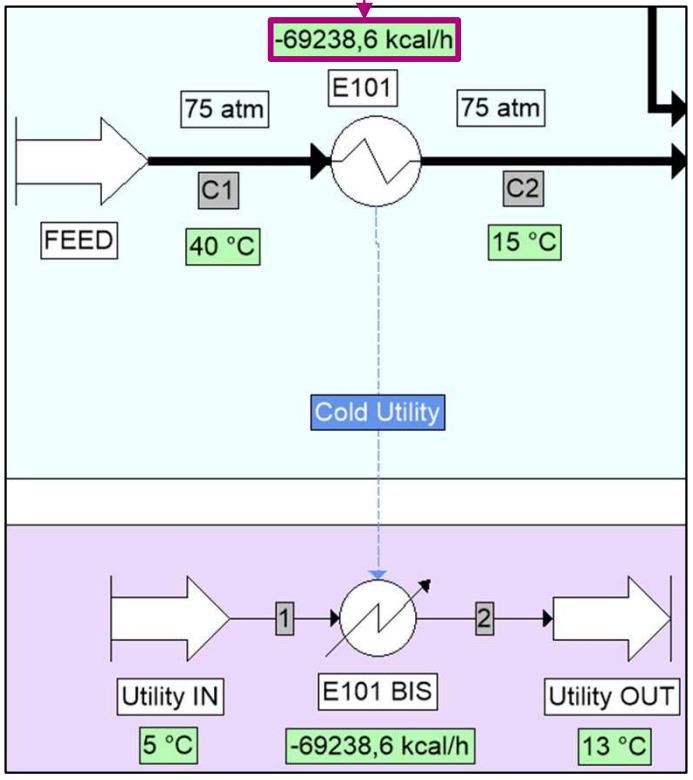
RESULTS

9 Results analysis

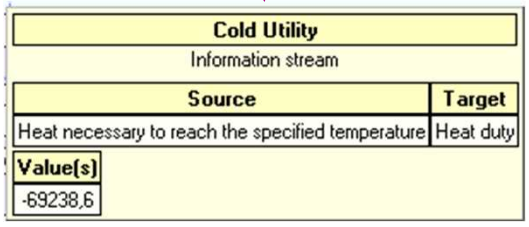


A — Add tags to display the key results (123)

In report unit system

B — Hover the mouse on the information stream to display the transferred value: heat duty (Q)

In ProSim unit system: kcal/h



The results show:

1. Temperature controller (“E101”):
    1. The process feed is cooled from 40°C to 15°C.
2. Heat duty controller (“E101 BIS”):
    1. The utility feed is heated from 5°C to 13°C.

→ It corresponds to heat duty value of 69239 kcal/h

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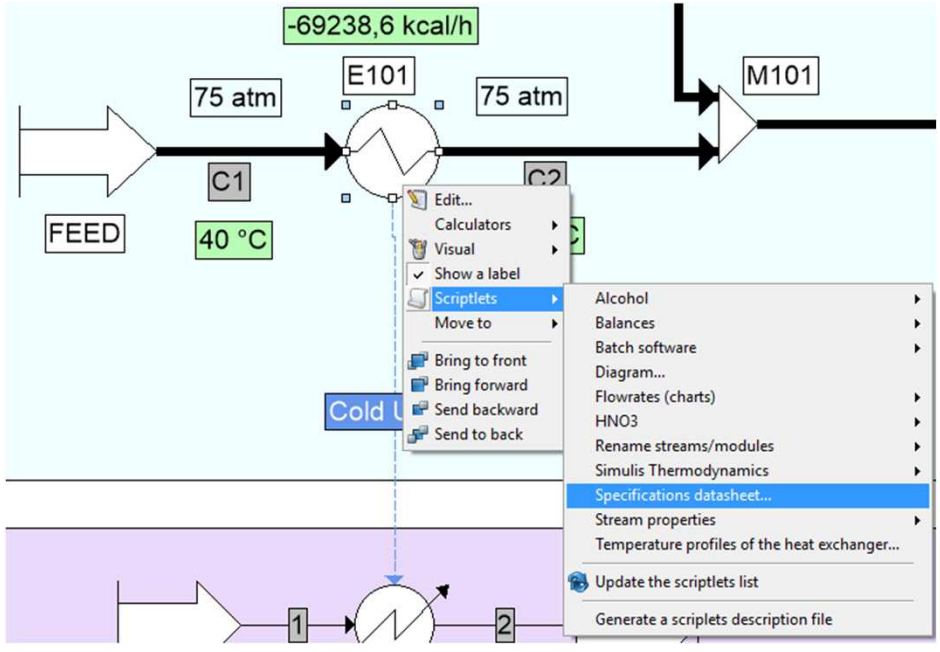
RESULTS

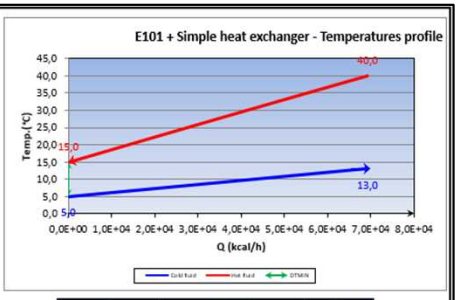
10 BONUS: you can generate the specifications datasheet for the corresponding heat exchanger



		Cold fluid	Hot fluid
Fluid name	-	1	C1
Input temperature	°C	5,0	40,0
Output temperature	°C	13,0	15,0
Mass flowrate	kg/h	10 000,0	4 332,2
Pressure	atm	1,0	75,0
Input physical state	-	Liquid	Vapor/Liquid
Phase change	-	NO	%VAP: 44 -> 38,4 (mol.)

HEAT EXCHANGER SPECIFICATIONS		
Simulation file		C:\Users\Carla Barcelo.PROSIM2003\Documents\6 Getting Started\GS_9_Info_
Equipment name		E101 + Simple heat exchanger

UNIT'S PERFORMANCES					
		Cold fluid		Hot fluid	
Fluid name	-	1		C1	
Total mass flowrate	kg/h	10 000		4 332	
Vapor mass flowrate (in/out)	kg/h	-	-	958	798
Liquid mass flowrate (in/out)	kg/h	10 000	10 000	3 374	3 534
Total volume flowrate (in/out)	m3/h	9,64	9,68	19,38	16,60
Temperature (in/out)	°C	5,0	13,0	40,0	15,0
Dew and bubble temperatures (in)	°C	-273,2	-273,2	-273,2	-273,2
Liquid	Density	1037,17	1033,11	543,71	560,78
	Dynamic viscosity	0,00216	0,00172	0,00017	0,00020
	Molar mass	22,89	22,89	60,25	57,33
	Specific heat	3642,371	3644,601	2475,228	2368,918
	Thermal conductivity	0,382	0,386	0,114	0,125
Vapor	Density	-	-	72,67	77,51
	Dynamic viscosity	-	-	0,000015	0,000014
	Molar mass	-	-	21,77	20,80
	Specific heat	-	-	2371,621	2420,475
	Thermal conductivity	-	-	0,041	0,039
Latent heat (in/out)	J/kg	2 071 712,7	2 056 804,6	-	-
Pressure (in/out)	atm	1,0	1,0	75,0	75,0
Pressure drop	atm	0,0		0,0	
LMTD	K	17,1			
UA factor	kcal/h/K	4 041,2			
Duty	kcal/h	69 239			



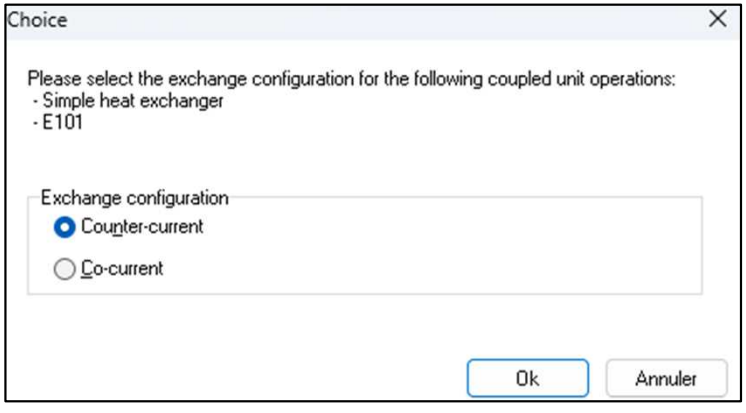
Q	Temp. (°C)		DT	
kcal/h	1	C1	K	
0	5,0	15,0	10,0	DTMIN
3 644	5,4	16,3	10,9	
7 288	5,8	17,7	11,8	
10 932	6,3	19,0	12,7	
14 577	6,7	20,3	13,7	
18 221	7,1	21,7	14,6	
21 865	7,5	23,0	15,5	
25 509	7,9	24,3	16,4	
29 153	8,3	25,6	17,3	
32 797	8,8	27,0	18,2	
36 441	9,2	28,3	19,1	
40 086	9,6	29,6	20,0	
43 730	10,0	30,9	20,9	
47 374	10,4	32,2	21,8	
51 018	10,9	33,5	22,7	
54 662	11,3	34,8	23,5	
58 306	11,7	36,1	24,4	
61 950	12,1	37,4	25,3	
65 594	12,5	38,7	26,2	
69 239	13,0	40,0	27,0	

A Right-click on one of the heat exchanger composing the utility section

B Select “**Scriptlets**”

C Select “**Specifications datasheet**”

D Select the **“exchange configuration”** type



Generation of an Excel spreadsheet

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Concept

Defining process specifications: Let's do it!

1. **Transferring data** between unit operations
2. Defining process **specifications** through the constraints and recycles module ("SPEC")
3. **Manipulate** data and results through arithmetic operations, using the information stream operator ("MANI")
4. Imposing a specific **Calculation sequence** to control the order of the units calculation

This feature allows to define **a set point** (such as temperature, composition, or flow rate) and automatically adjust **action variables** to meet the **specified objectives.**

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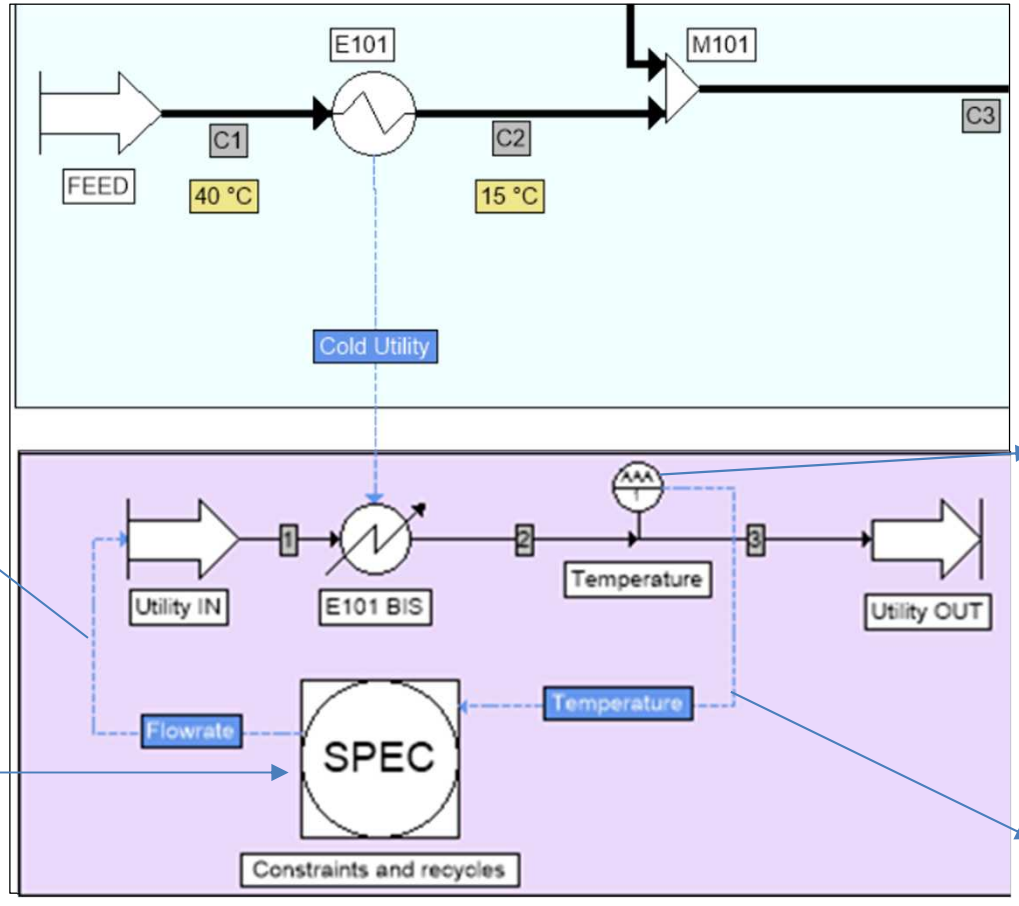
Concept

Objectives of the application example:
Adjustment of the feed “Utility IN” flowrate to meet the specification of the heat exchanger output temperature, by using the "SPEC“ module.



4
Adjusted flowrate value to meet “T” specification

3
SPEC module: adjust “Utility IN” flowrate to meet “T” target value

1
Measure the outlet temperature of the heat exchanger

2
The “Temperature” information stream sends the temperature difference between the measured value and the set point: **ΔT**

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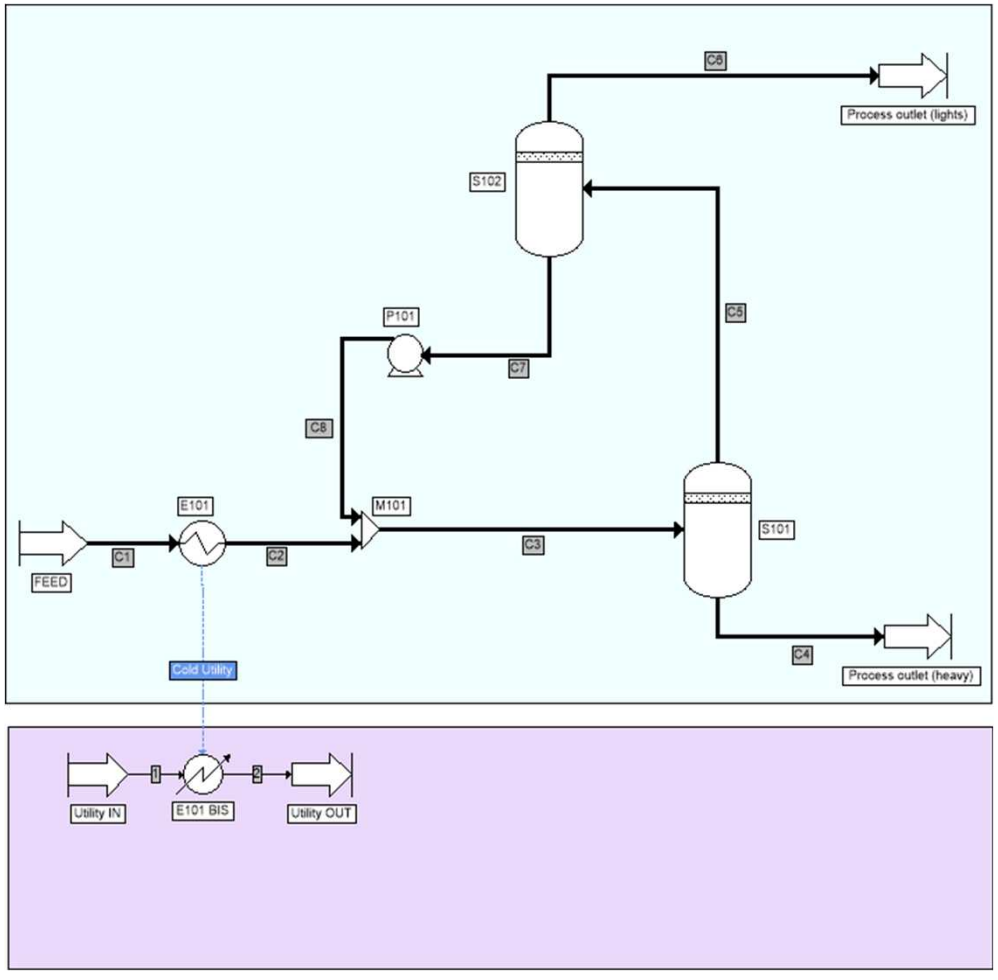
Concept

Let's apply this on our simple example!



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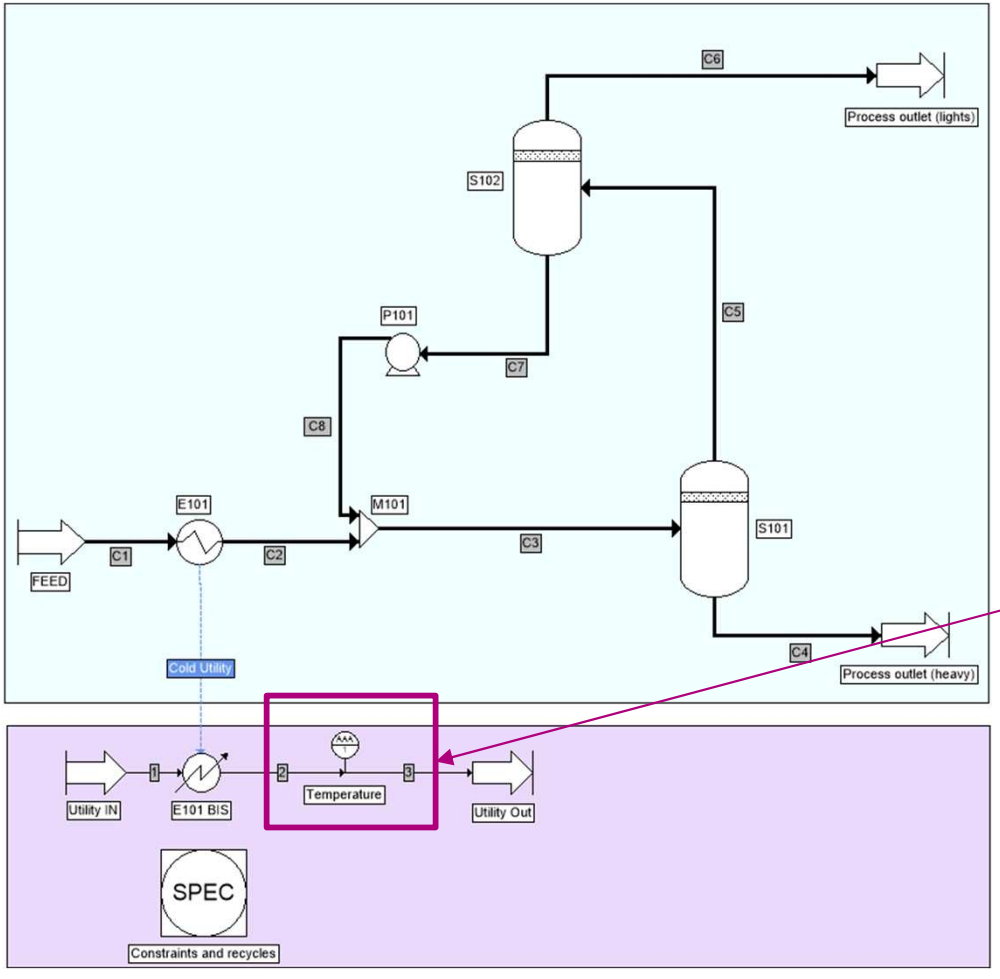
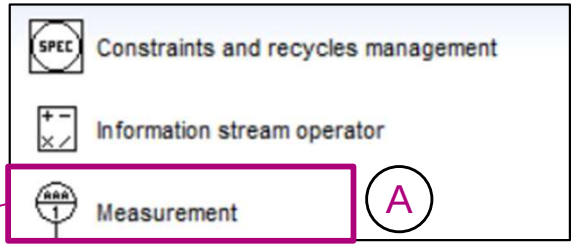
Practical Example

1 Set up of the measurement module ("Temperature") and "SPEC" module





For more information about the measurement and "SPEC" modules, please consult « Getting Started with ProSimPlus: use case 8 »

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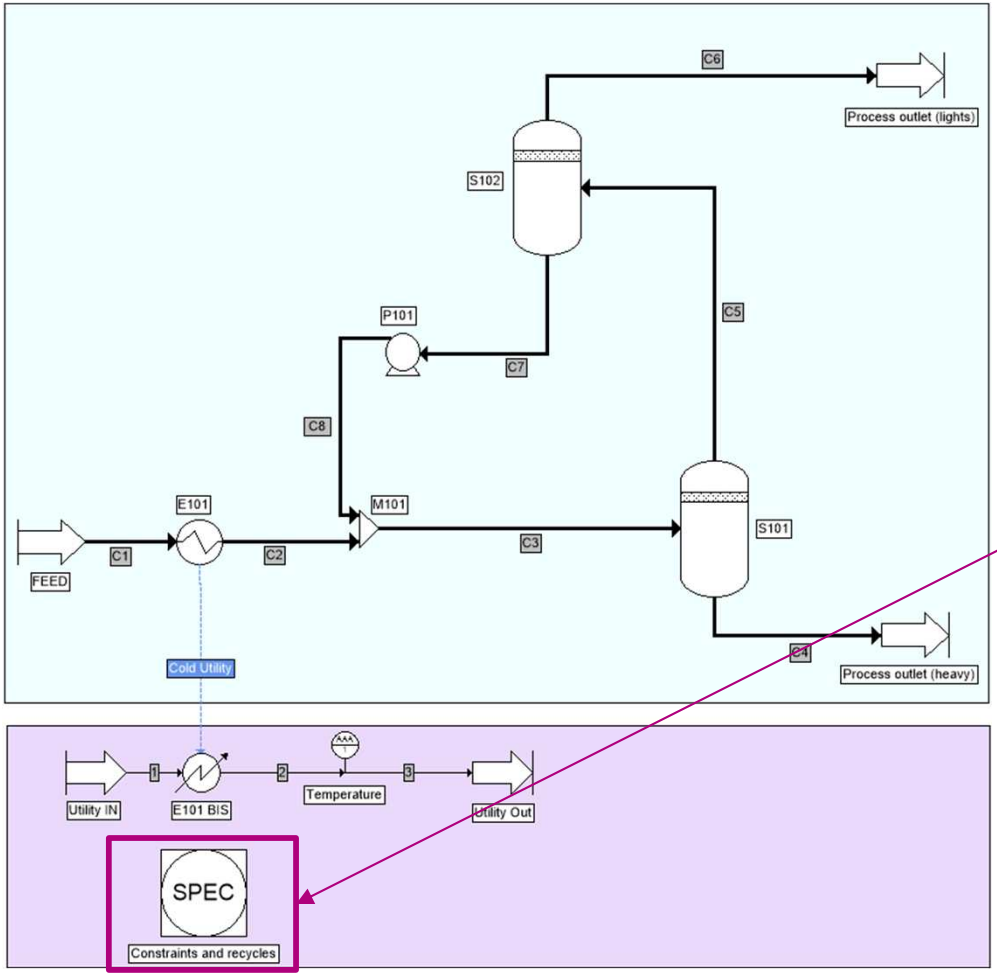
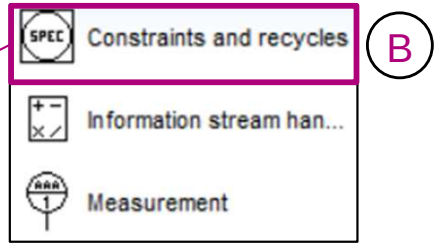
Practical Example

1 Set up of the measurement module (“Temperature”) and “SPEC” module





B

For more information about the "SPEC" and measurement module, please consult « Getting Started with ProSimPlus: use case 8 »

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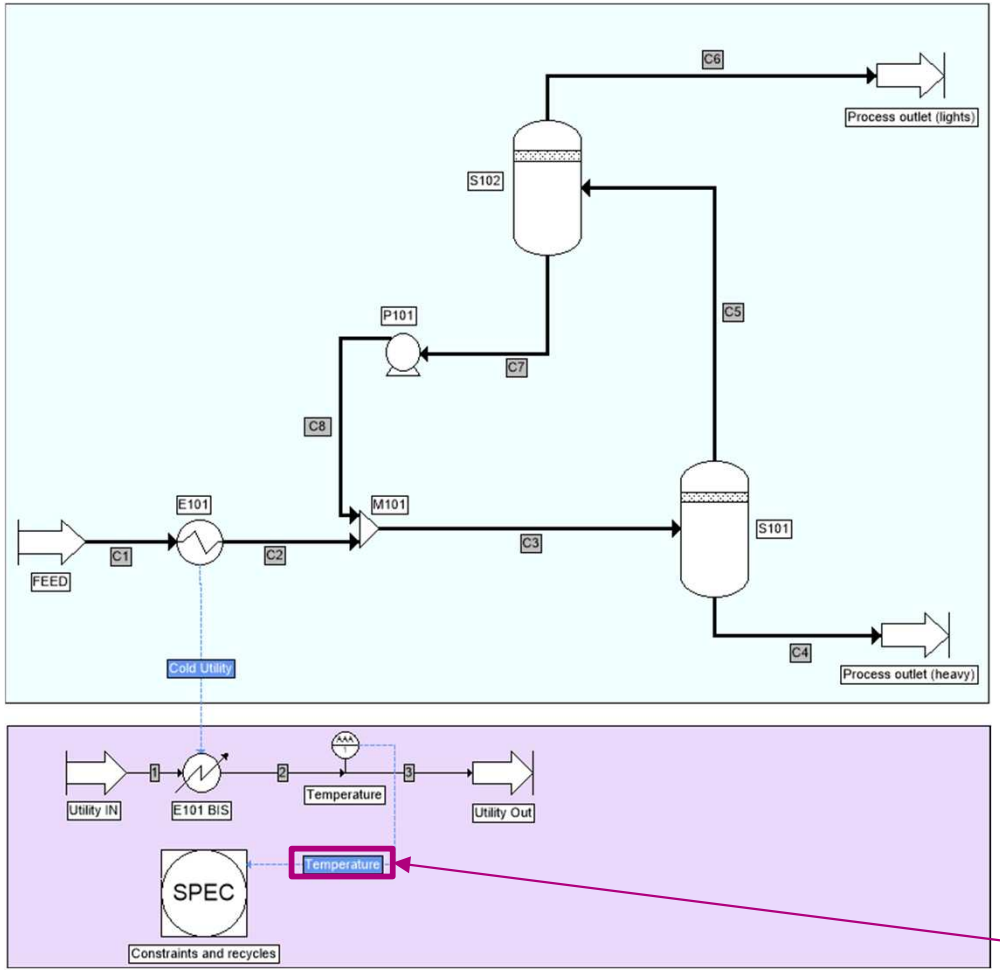
2 Insert the information streams



A

“Temperature” Information stream: connect the measurement module (“Temperature”) to the “SPEC” module

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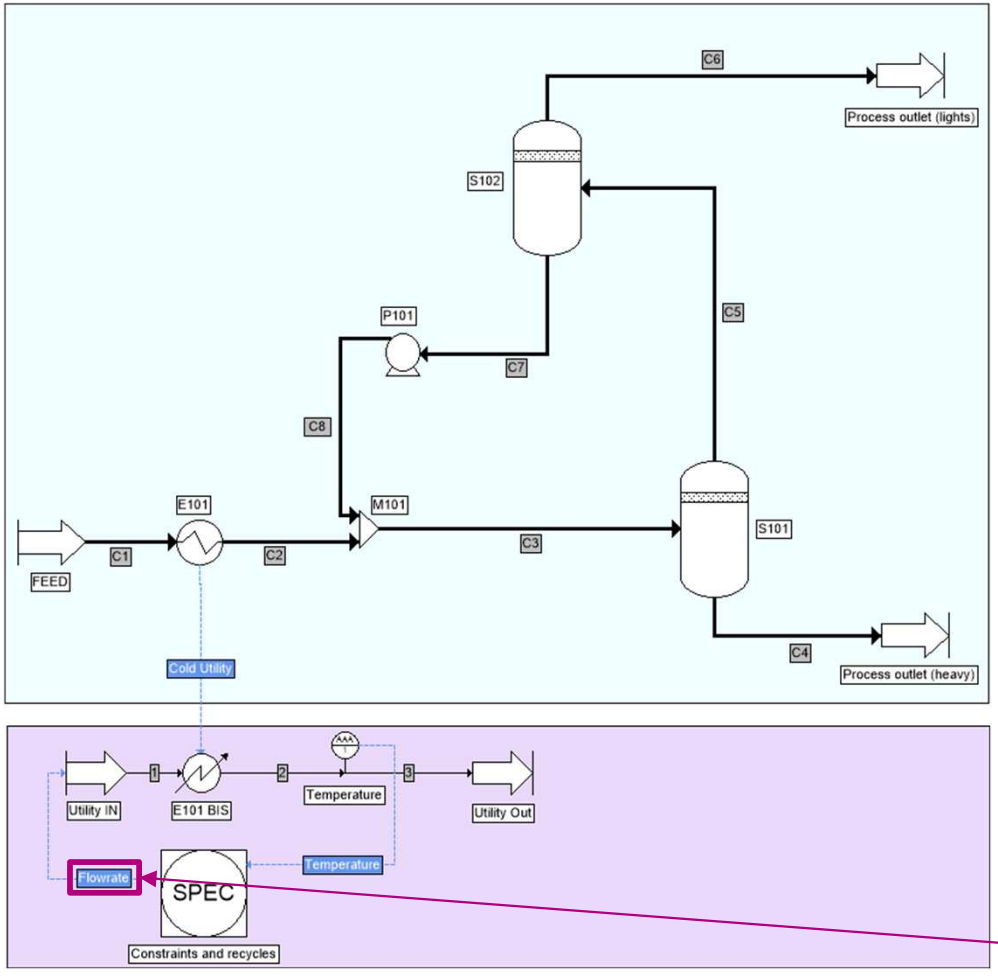
2 Insert the information streams



B

"Flowrate" Information stream: connect the "SPEC" module to the feed ("Utility IN")

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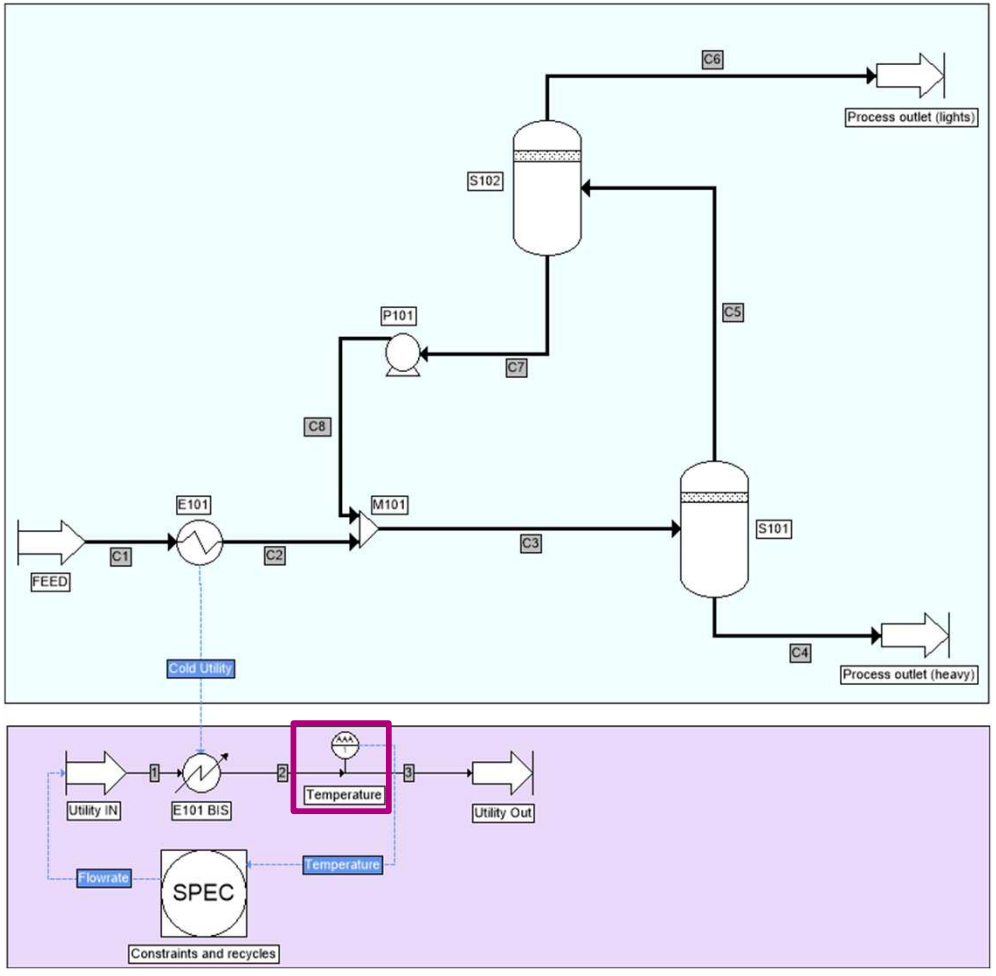
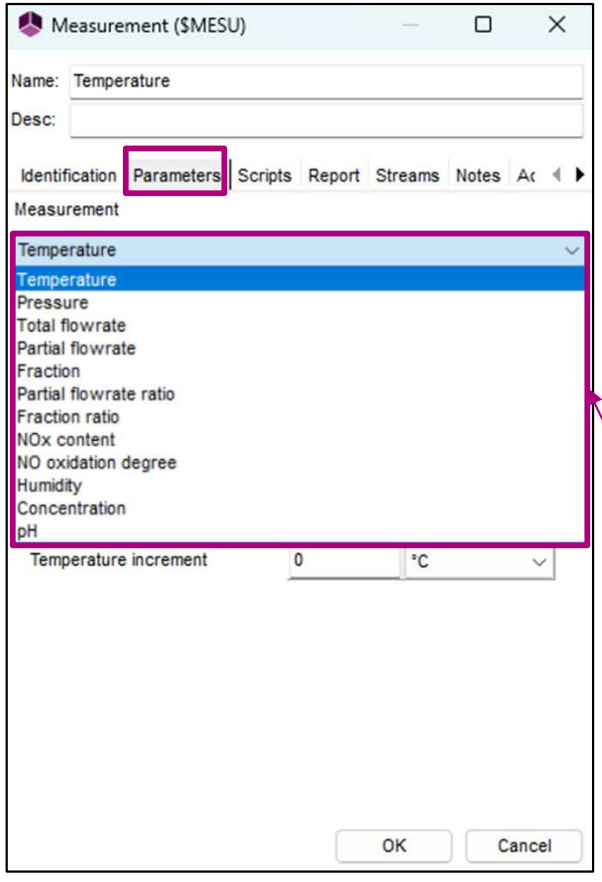
Practical Example

3 Specify the measurement module ("Temperature") parameters





A

Double click on the measurement module ("Temperature")

B

Select the parameter to measure: "Temperature"

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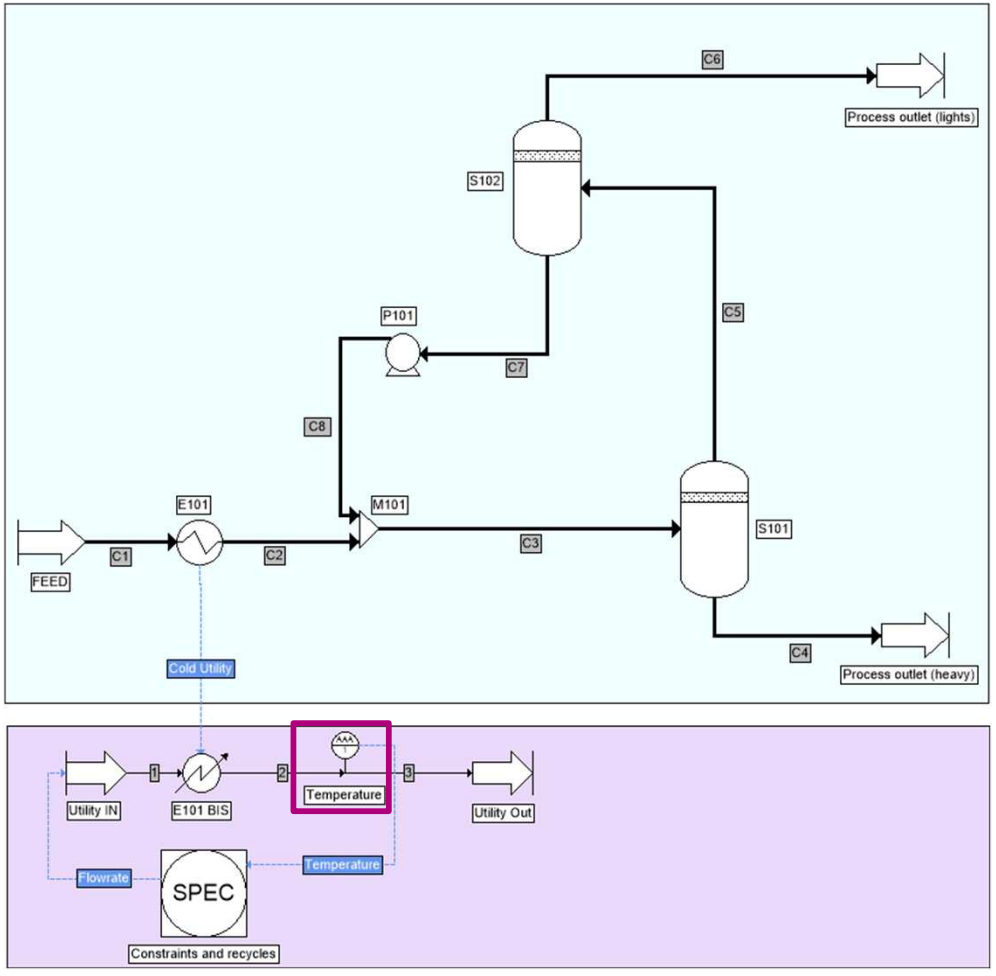
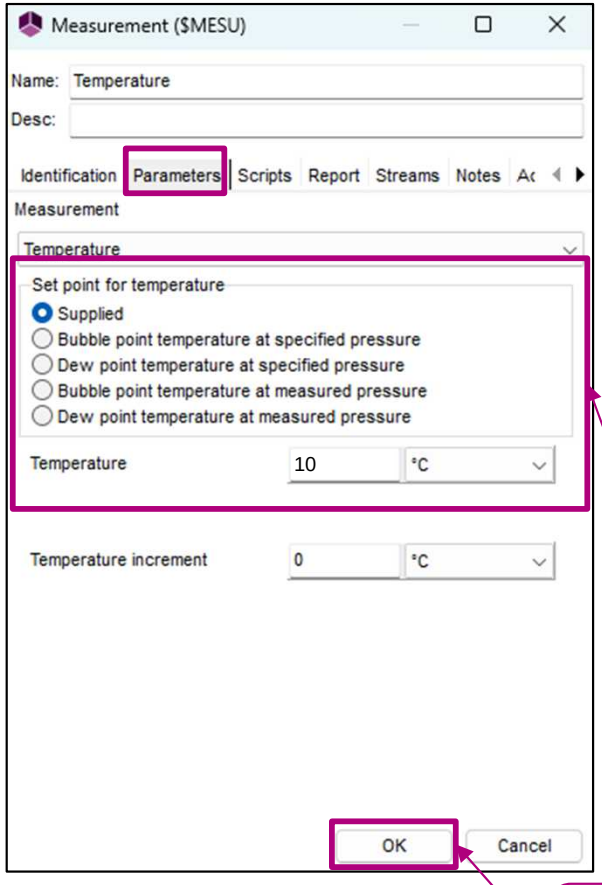
Practical Example

3 Specify the measurement module ("Temperature") parameters





C

Select the "supplied" option and give the temperature specification for the output of cold utility: 10°C

Click "OK" to save the data

D

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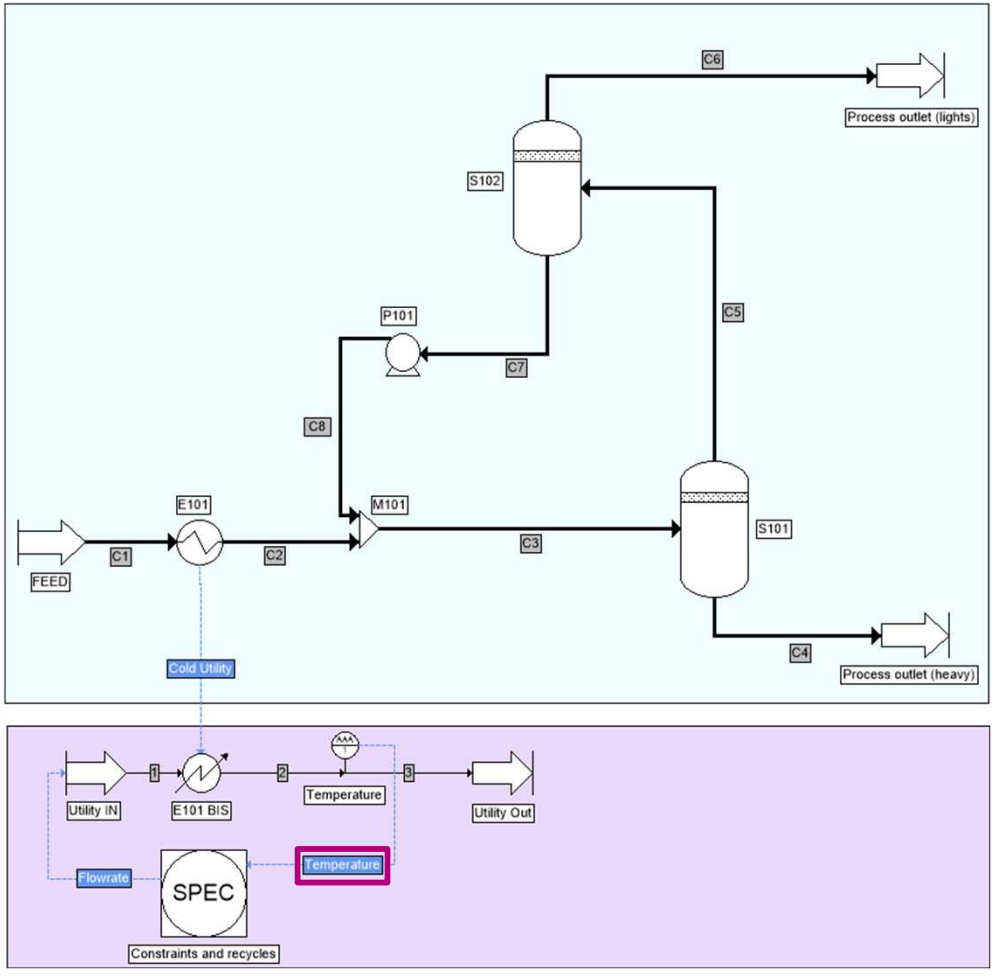
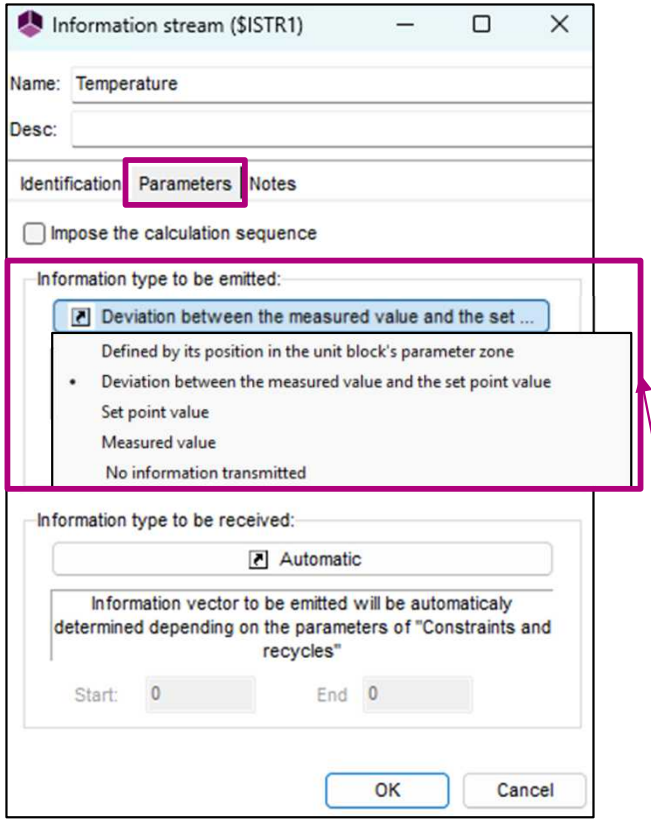
Practical Example

4 Specify the "Temperature" information stream parameters





A

Double click on the "Temperature" information stream

B

Select the data to be sent from the measurement module: "Deviation between the measured value and the set point value" **(ΔT)**

Selecting « Deviation between the measured value and the set point value » aims to satisfy the condition F(x) = 0

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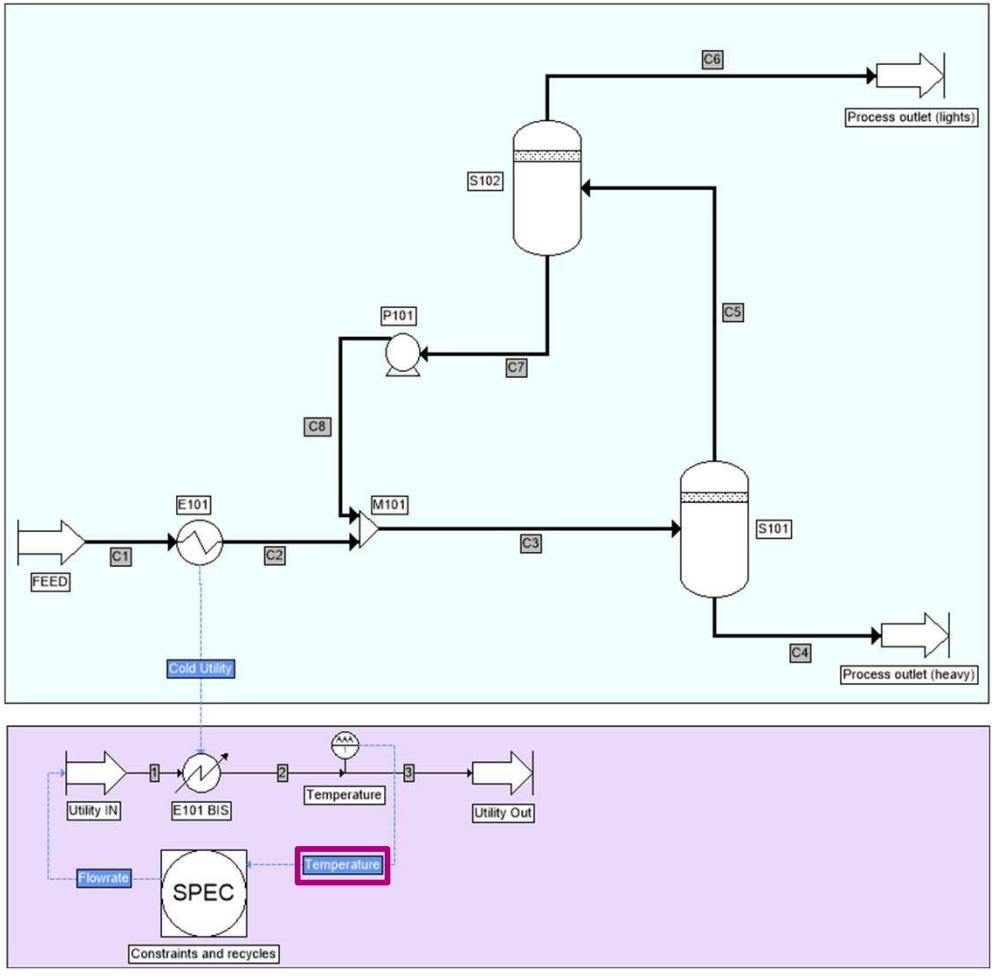
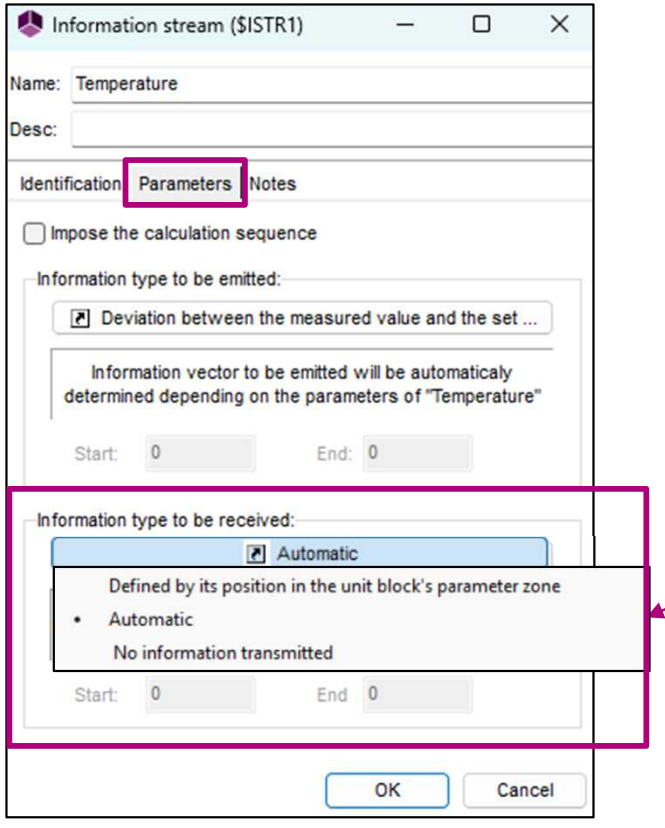
Practical Example

4 Specify the "Temperature" information stream parameters





C

Select the type of information to be received by the "SPEC" module

Always select **"Automatic"** for information received by the "SPEC" module

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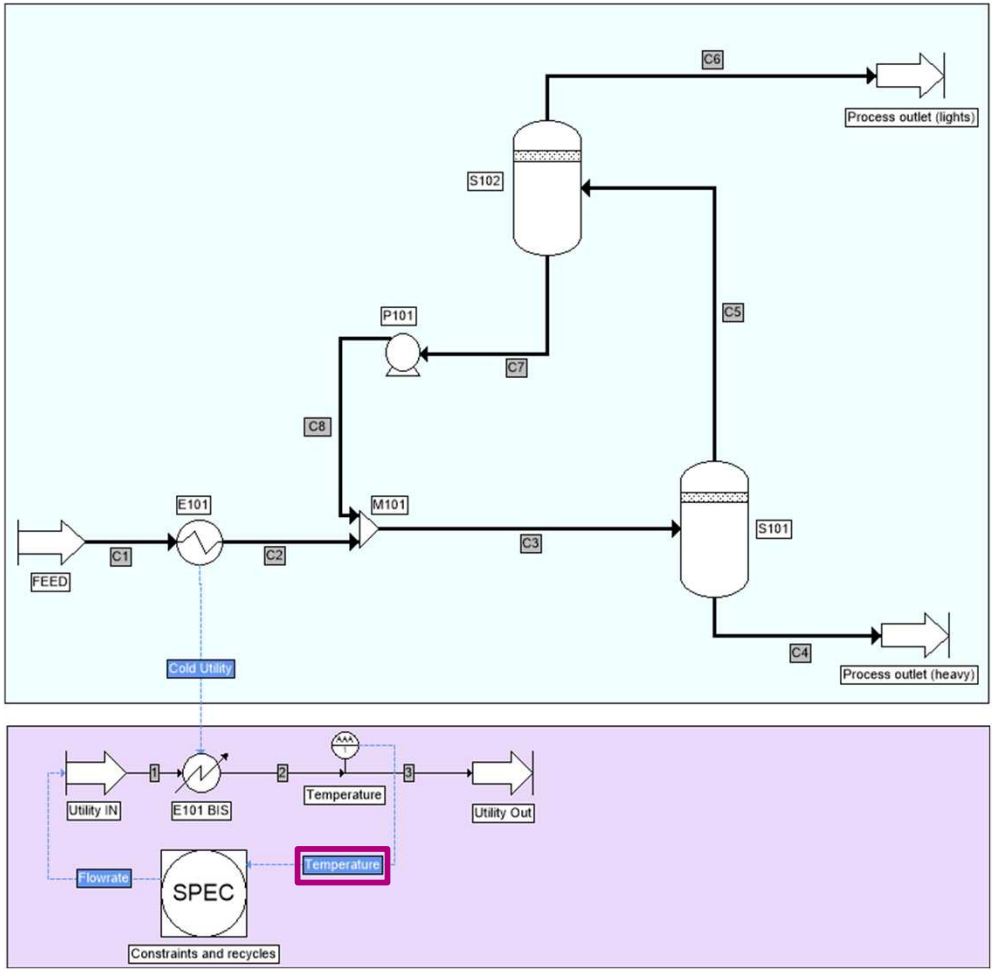
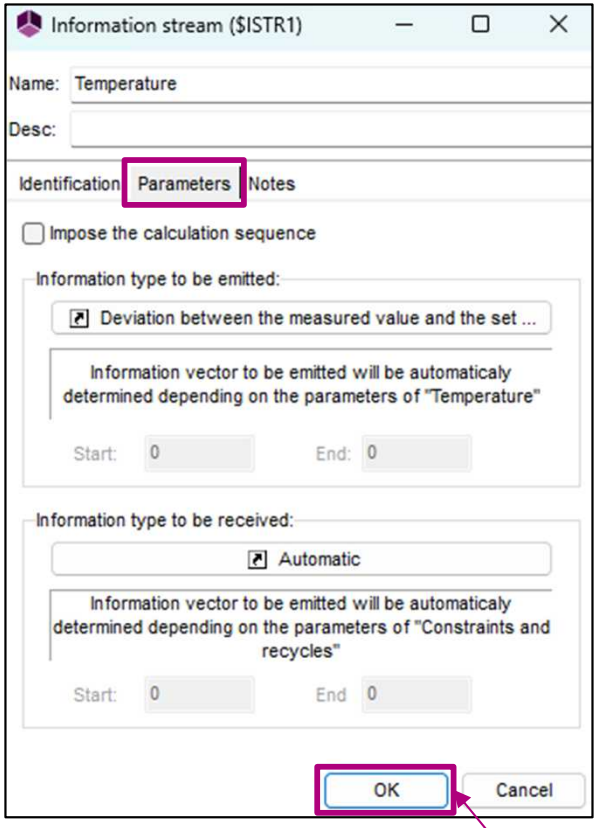
Practical Example

4 Specify the ”Temperature” information stream parameters





D

Click “OK” to save the data

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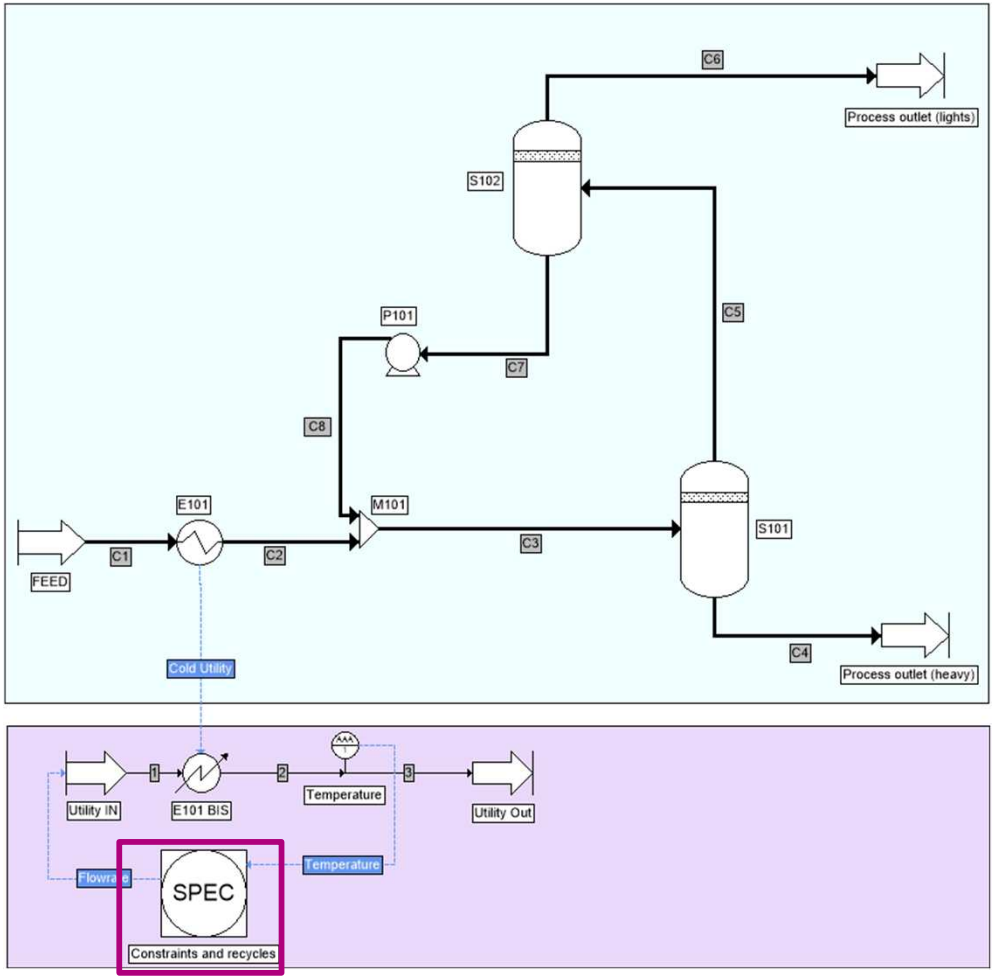
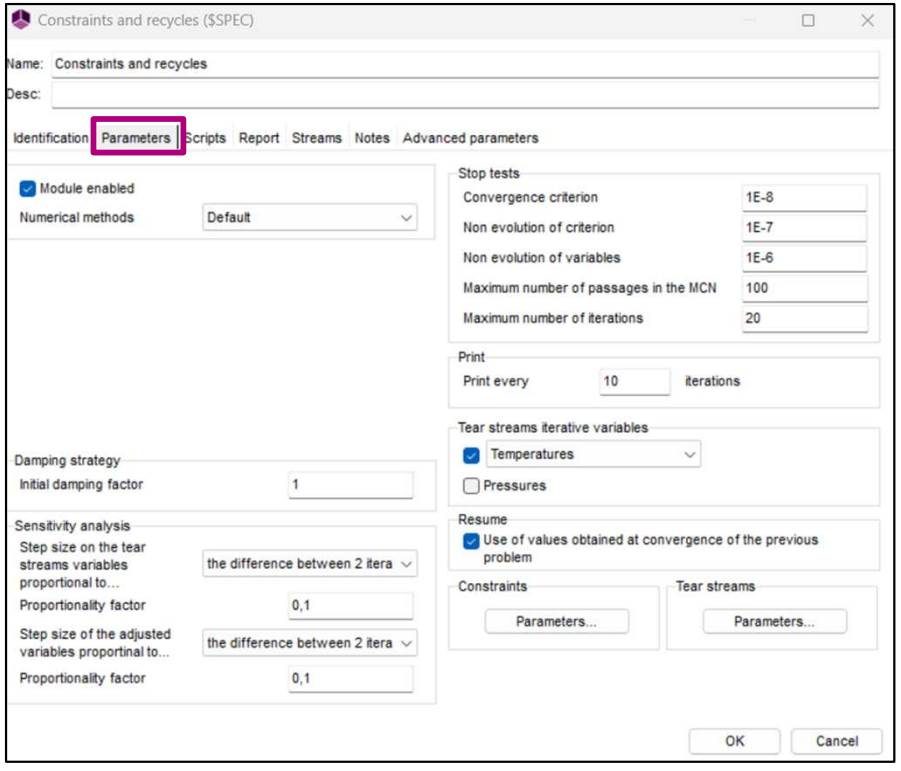
Practical Example

5 Specify the "SPEC" module parameters





A Double click on the "SPEC" module

The “SPEC” module parameters are set to default values and do not require modification, but users can adjust them if needed.
For more information about the "SPEC" module, please consult « Getting Started with ProSimPlus: use case 8 »

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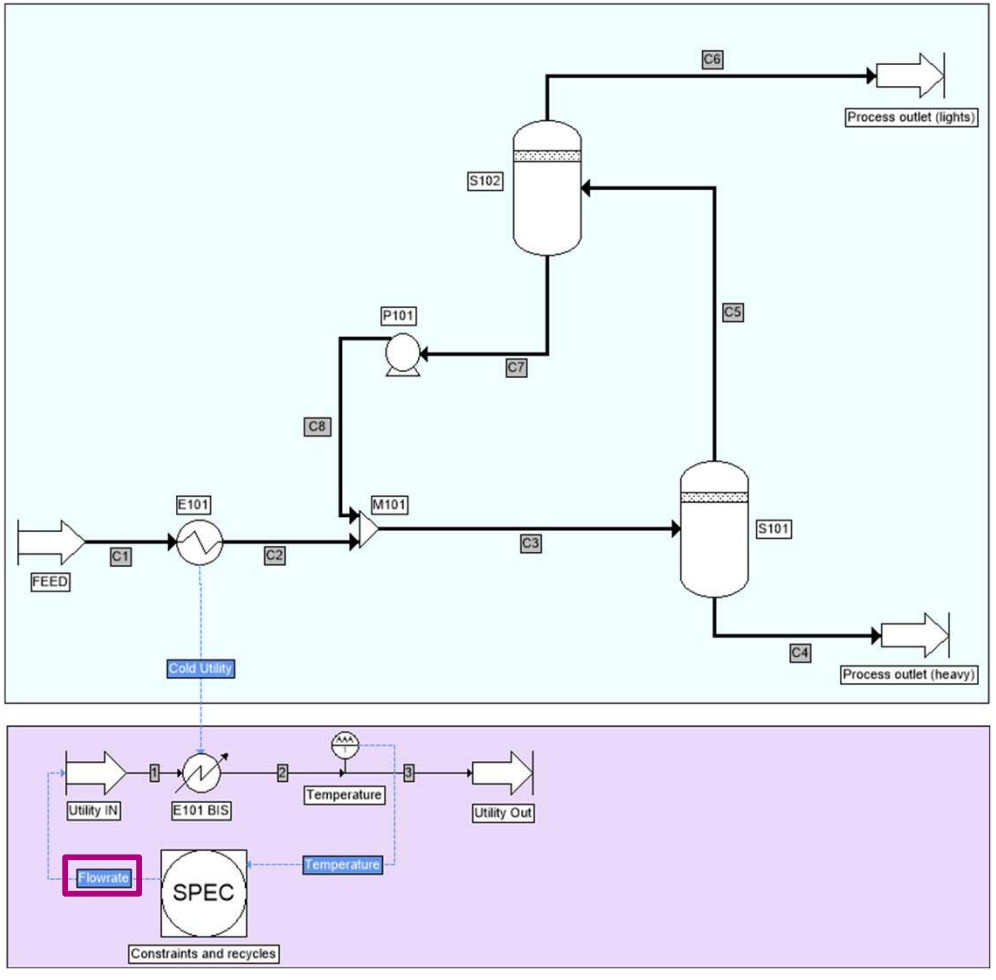
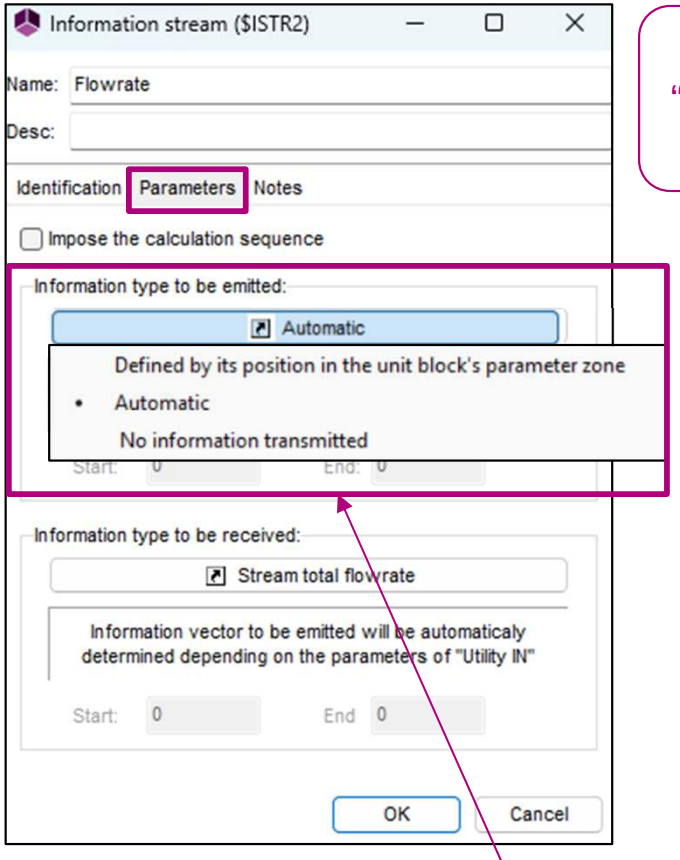
Practical Example

6 Specify the "Flowrate" information stream parameters



A

Double click on "Flowrate" information stream



B

Select the type of information to be sent by the "SPEC" module: "Automatic"

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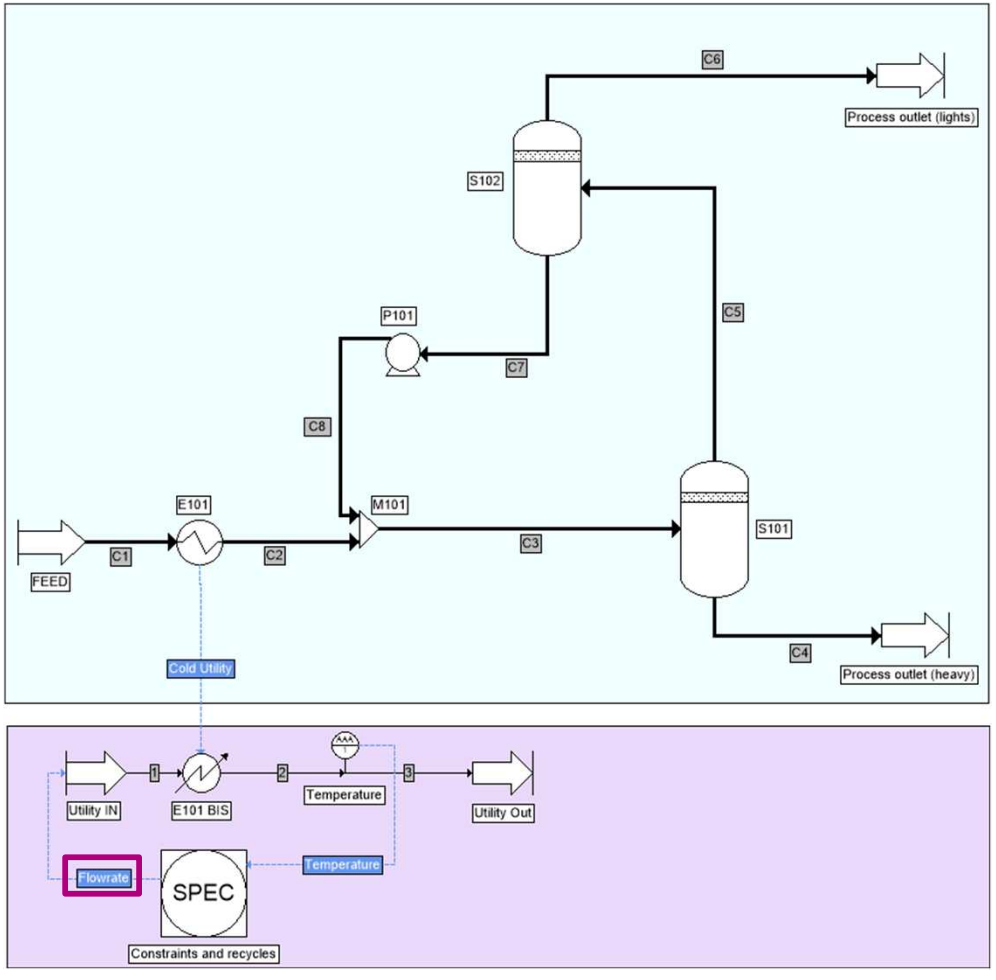
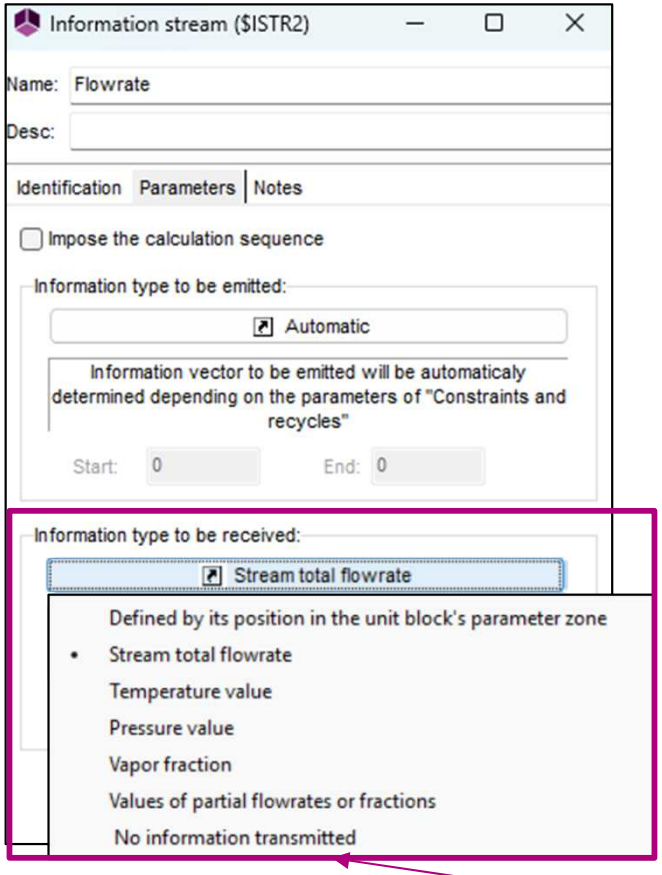
Practical Example

6 Specify the "Flowrate" information stream parameters





C

Select the input parameter stream total flowrate from the list of adjustable parameters to **satisfy the specification** defined in the **temperature measurement module**

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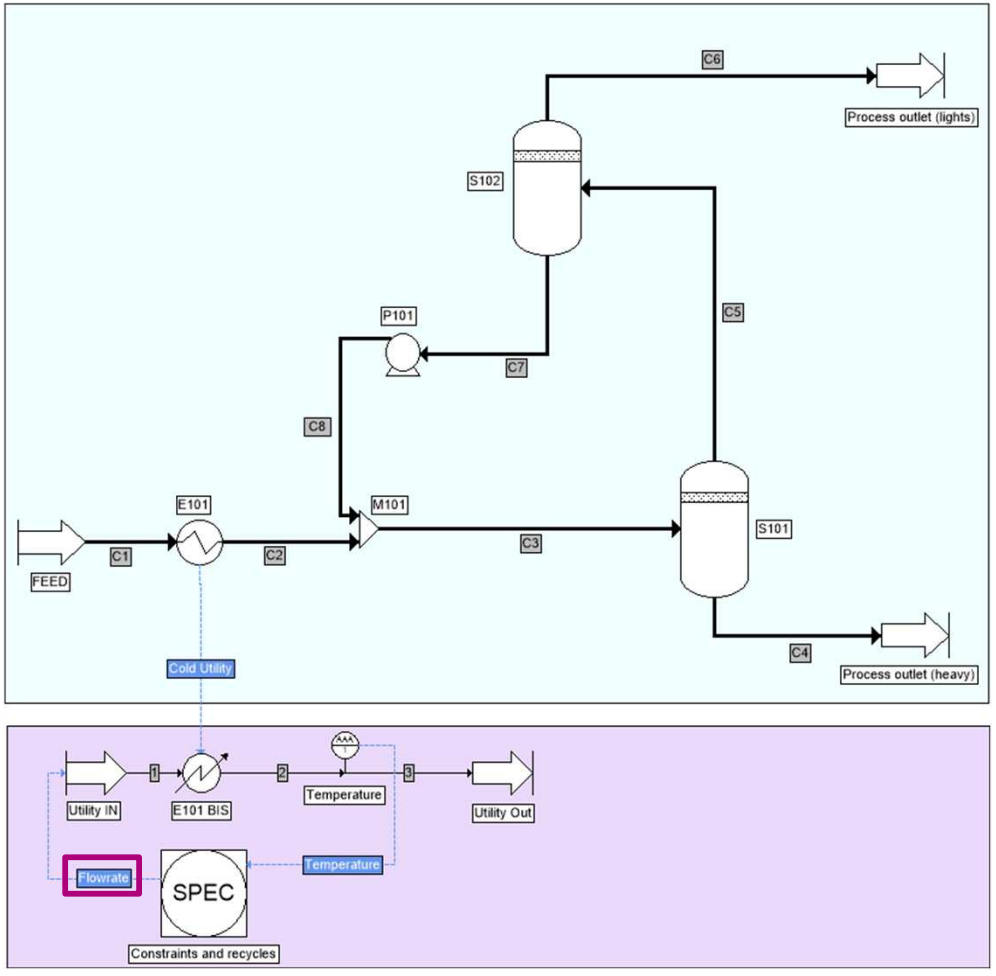
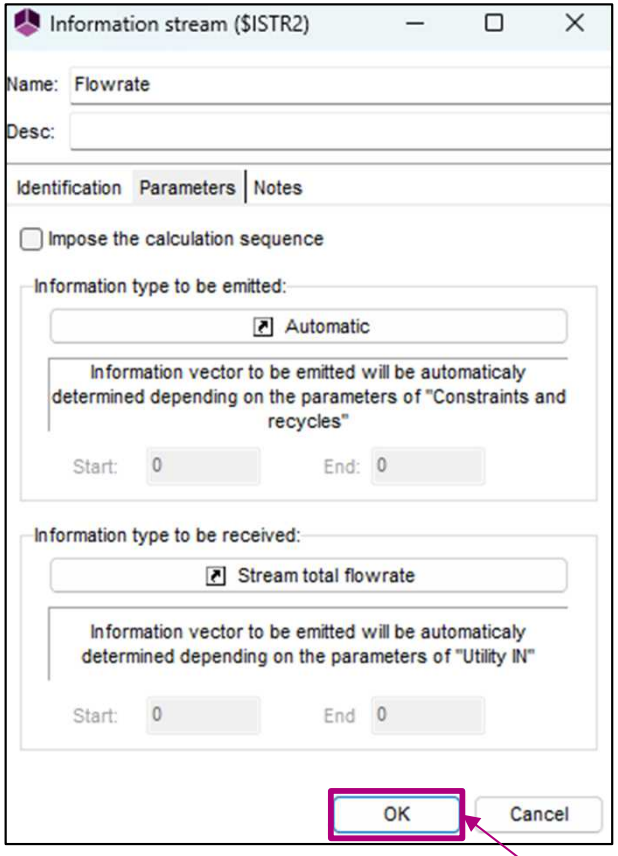
Practical Example

6 Specify the "Flowrate" information stream parameters





D

Click "OK" to save the data

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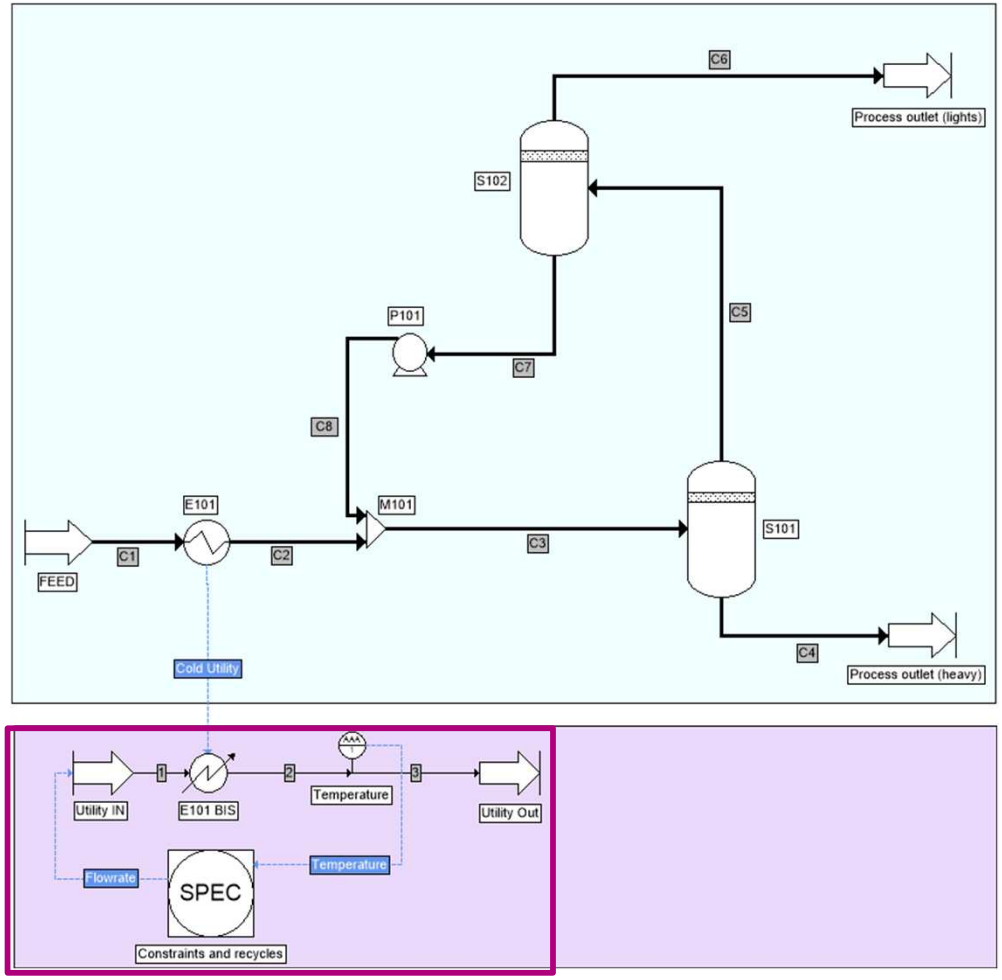
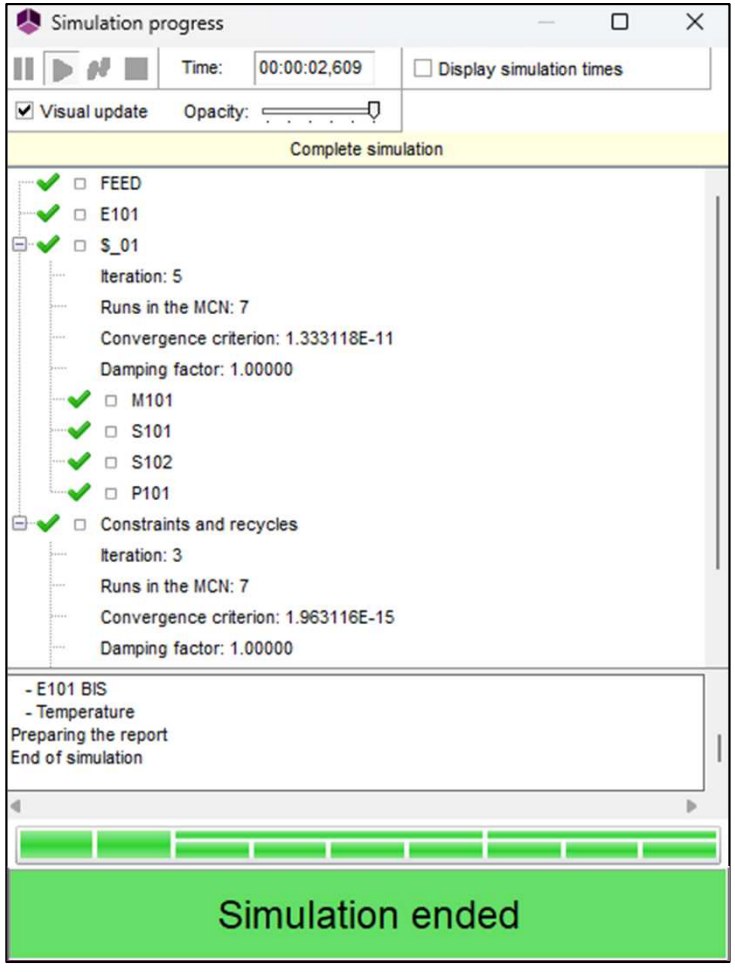
Practical Example

7 Run the simulation





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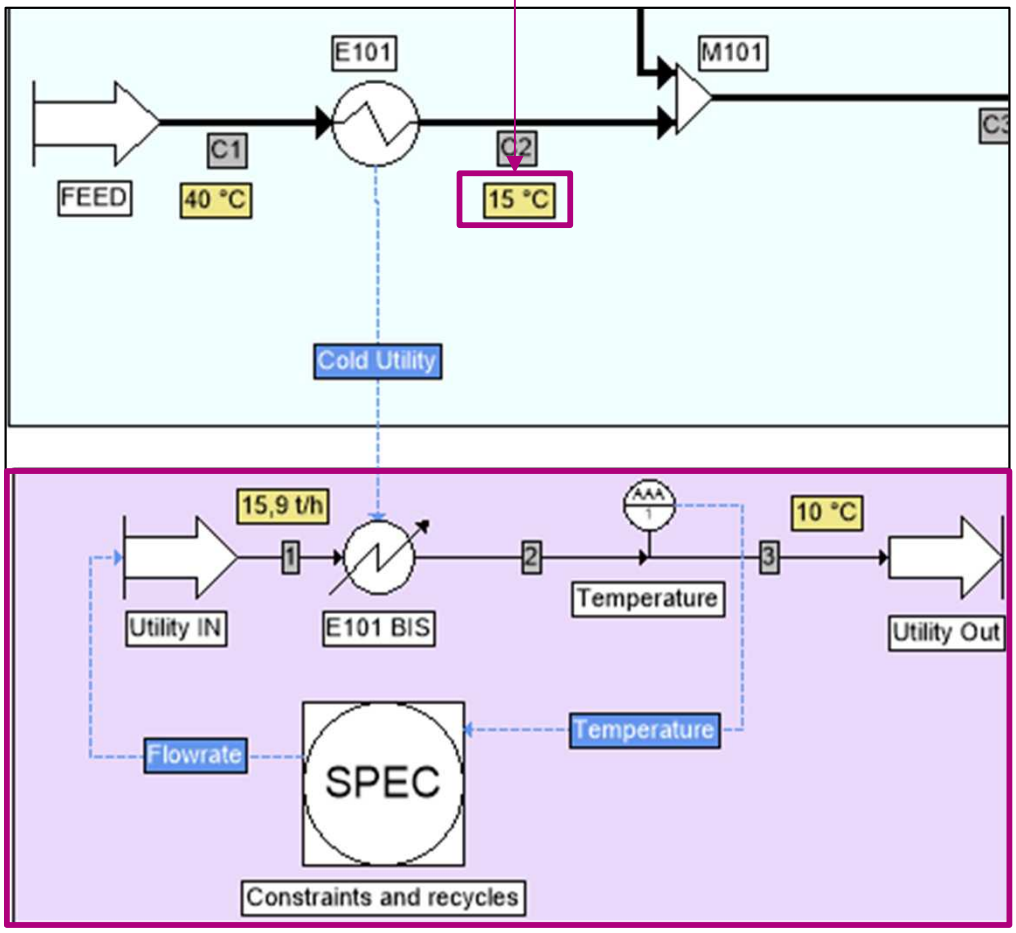
RESULTS



A — Add tags to display the key results (123) — *In report unit system*

B — Hover the mouse on the information stream to display the transferred value — *In ProSimPlus unit system*

The results show:

To achieve a **target outlet temperature** of 10 °C for the utility → a **flowrate** of 15.9 t/h is necessary

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Concept

Manipulation of data and results: Let's do it!

1. **Transferring data** between unit operations

2. Defining process **specifications** through the constraints and recycles module ("SPEC")

3. **Manipulate** data and results through arithmetic operations, using the information stream operator ("MANI")

4. Imposing a specific **Calculation sequence** to control the order of the units calculation

The **"MANI"** module allows to execute **arithmetic operations** on data and results that are transferred using **information streams**

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Concept

Equation used for **information streams** calculations

$$\boldsymbol{Out} = A(\boldsymbol{In})^P + B - C$$

Where:

Out = Output information stream *(the result)*

In = Input information stream (*mandatory value*)

A, B, C and P = values provided by the user or additional information streams

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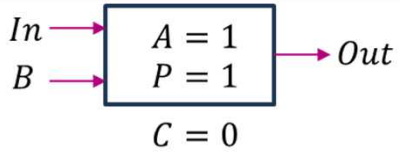
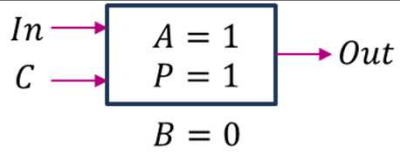
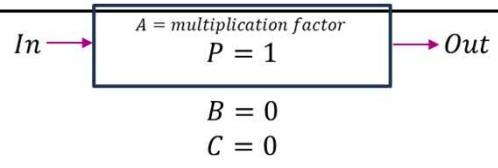
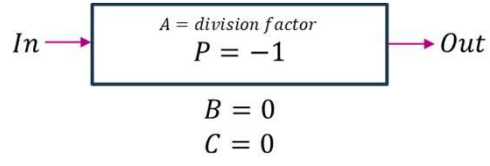
Possible configurations

Arithmetic operation	Parameters values	Final Equation
Addition		$\boldsymbol{Out} = (In) + B$
Substraction		$\boldsymbol{Out} = (In) - C$
Multiplication		$\boldsymbol{Out} = A(In)$
Division		$\boldsymbol{Out} = \frac{A}{(In)}$

Each parameter (A, B, C, or P) can be left blank to use the value of a selected information stream instead of entering a number manually, as shown in the following slides.

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Objectives

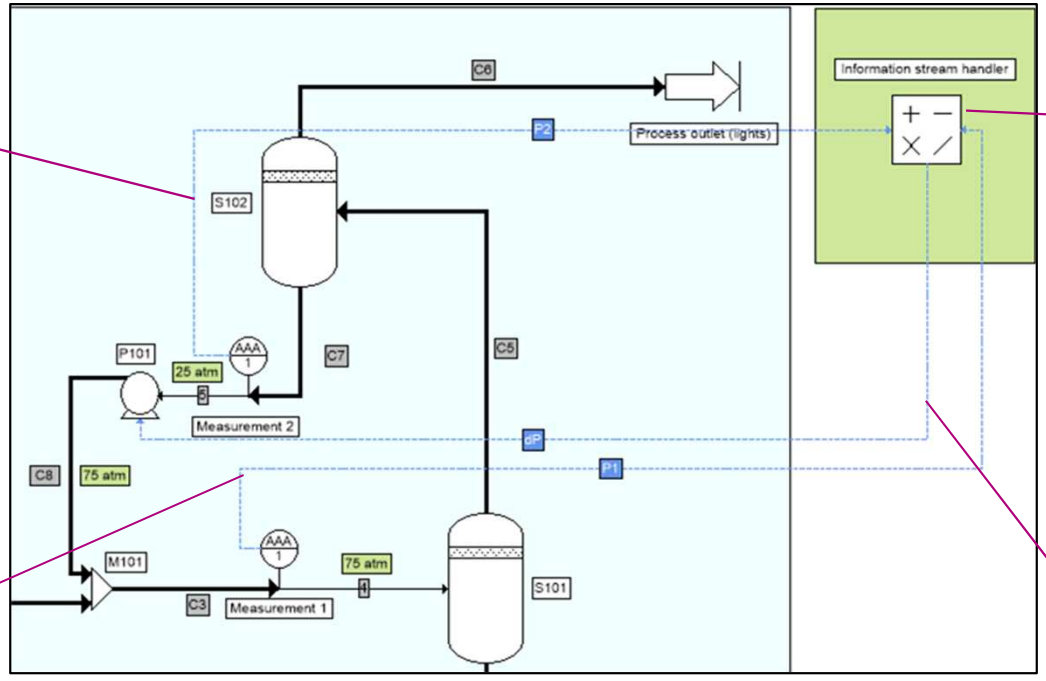
Objectives of the application example:
Calculate the pressure difference (ΔP = P1 (75 atm) − P2 (25 atm)) between the inlet and outlet streams of Flash S101 and Flash S102 respectively by performing an information stream subtraction. This ΔP (50 atm) is sent to Pump P101 as a pressure increase specification, serving as the starting point to reach the desired outlet pressure of 75 atm.

2

Transfer of measured pressure value : **“P2”**

1

Transfer of measured pressure value : **“P1”**



3

Pressure drop calculation:
ΔP = P1 (75 atm) − P2 (25 atm))

4

This **ΔP** (50 atm) is sent to Pump P101 as a pressure increase specification

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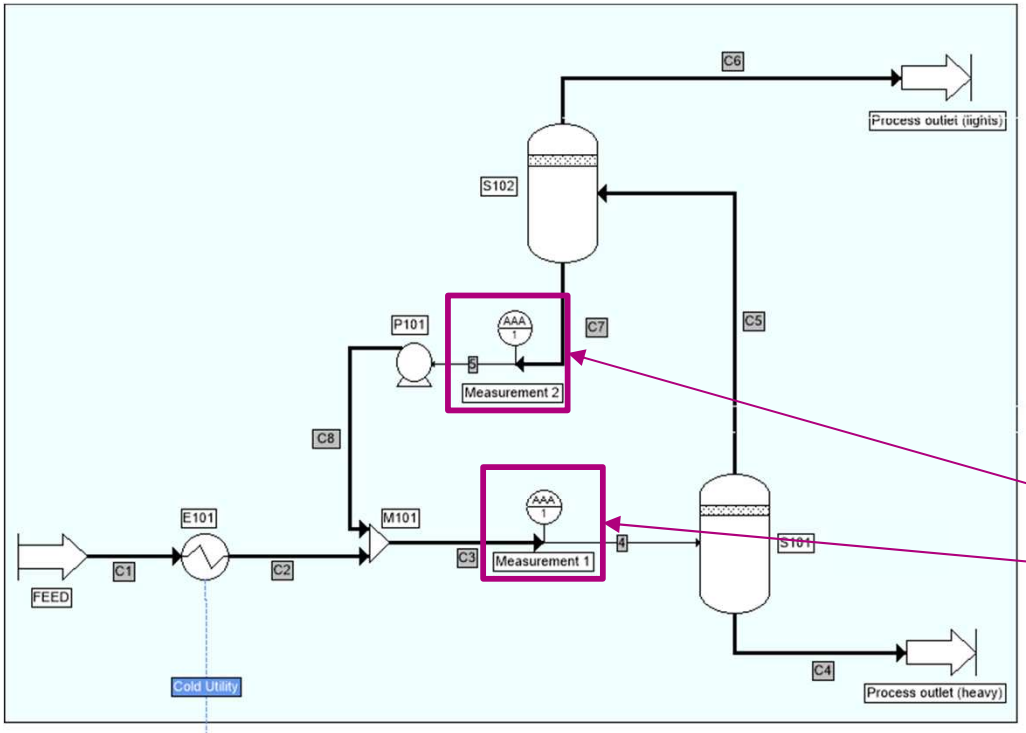
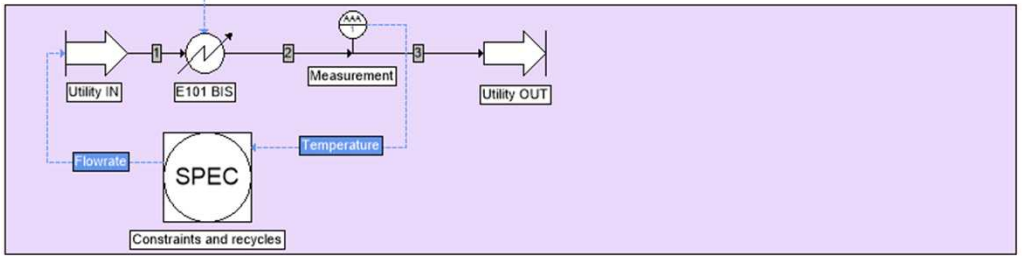
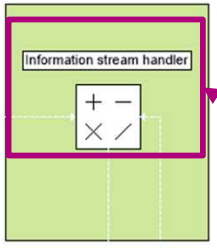
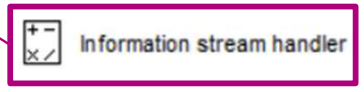
Practical Example

1 Set up the information stream operator module (“MANI”), and the measurement modules (1 & 2) on streams C3 and C7

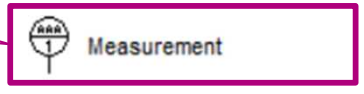








A



B

For more information about measurement modules, please consult « Getting Started with ProSimPlus: use case 8 »

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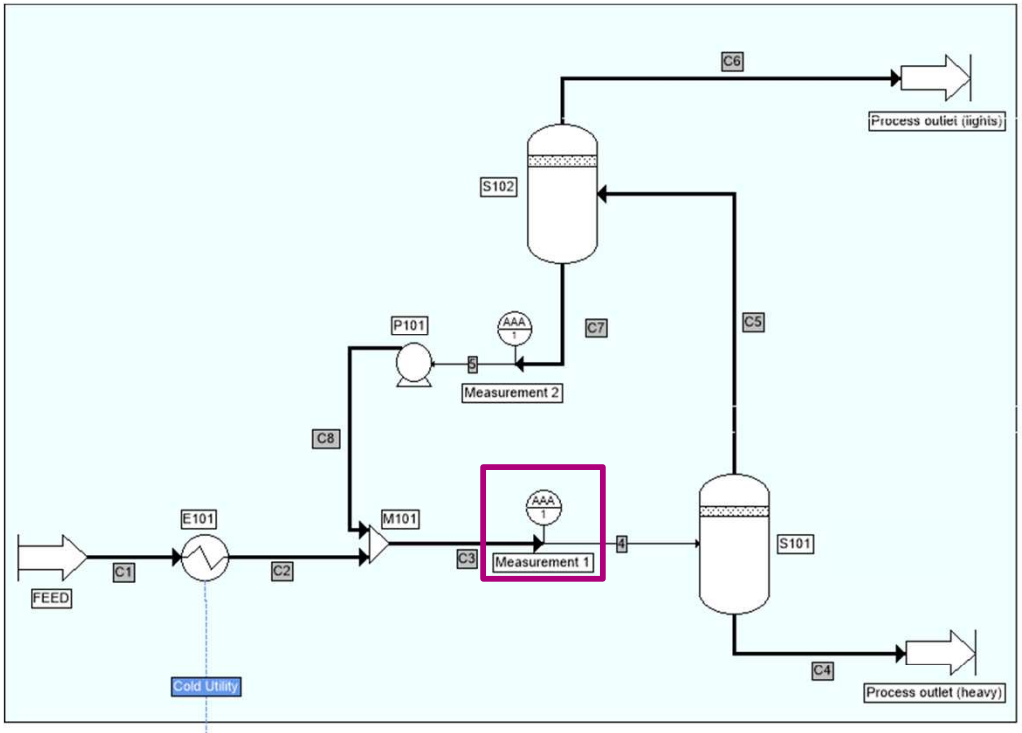
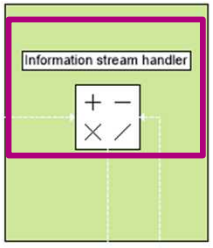
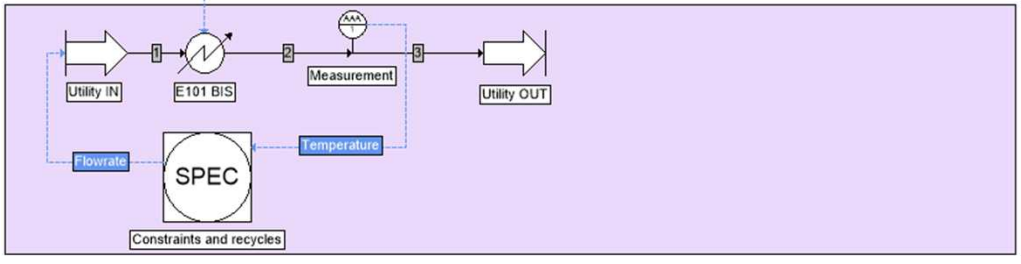
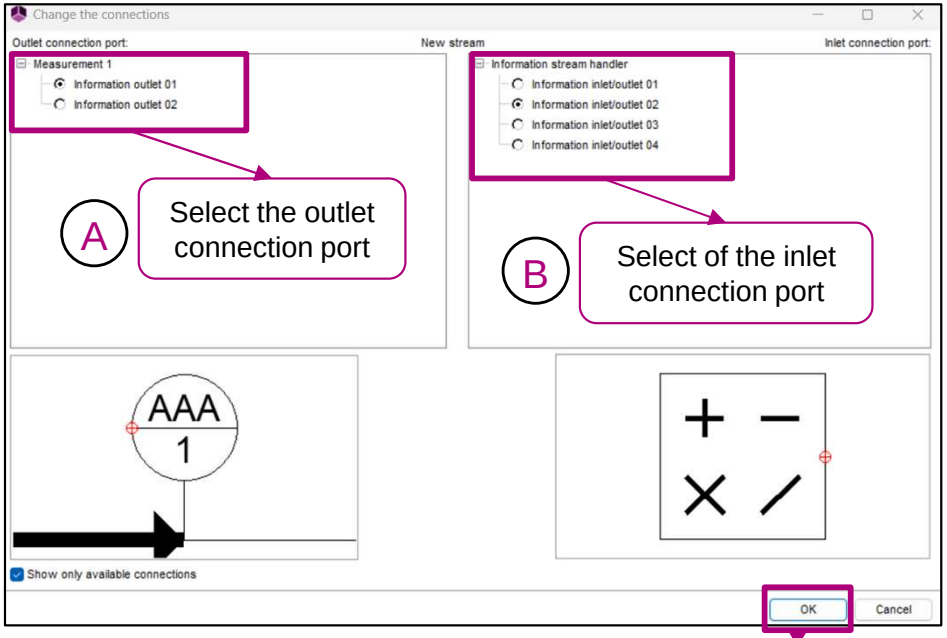
Practical Example

2 Insert the "P1" information stream linking measurement module 1 with the "MANI" module









C Click "OK" to save the data

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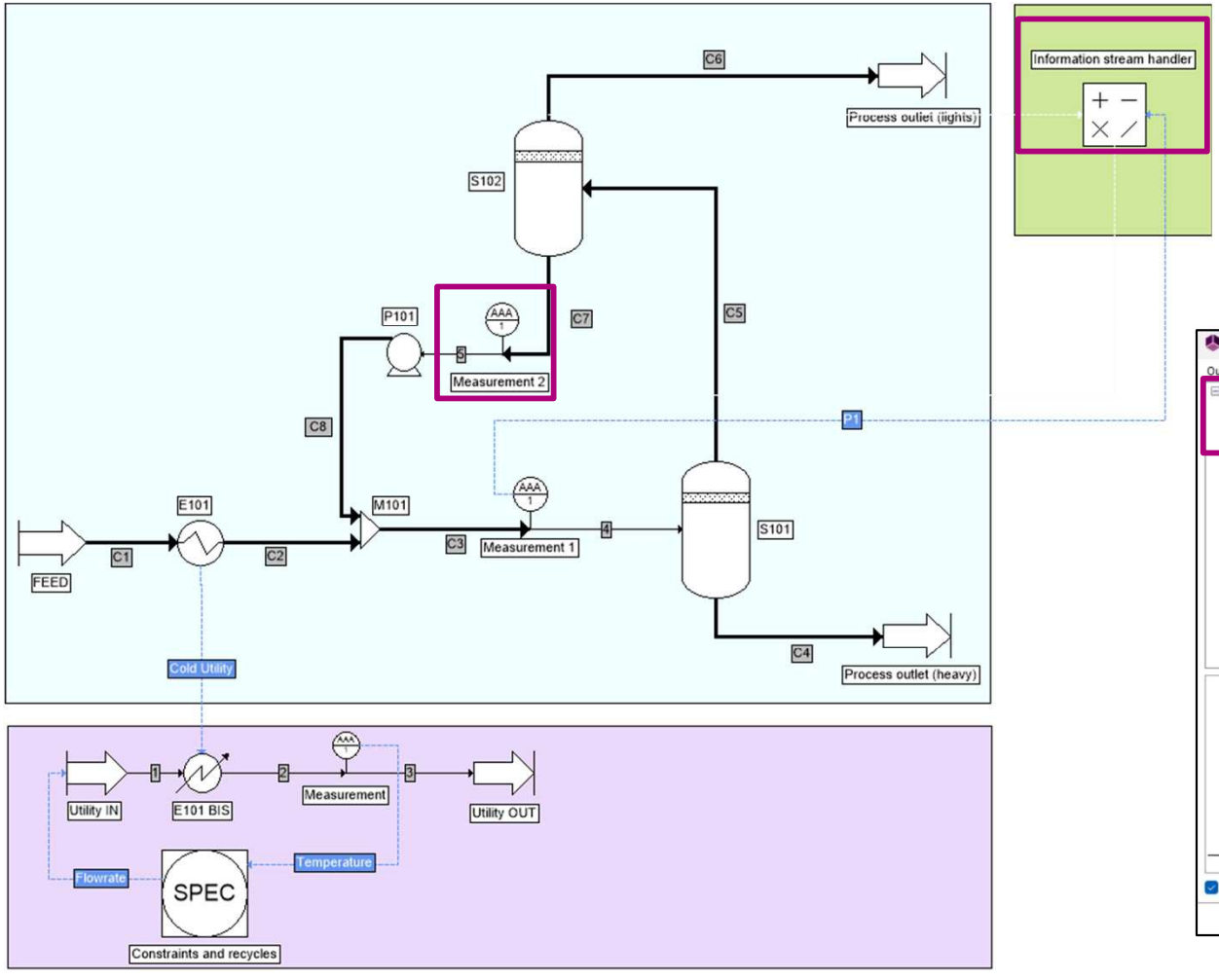
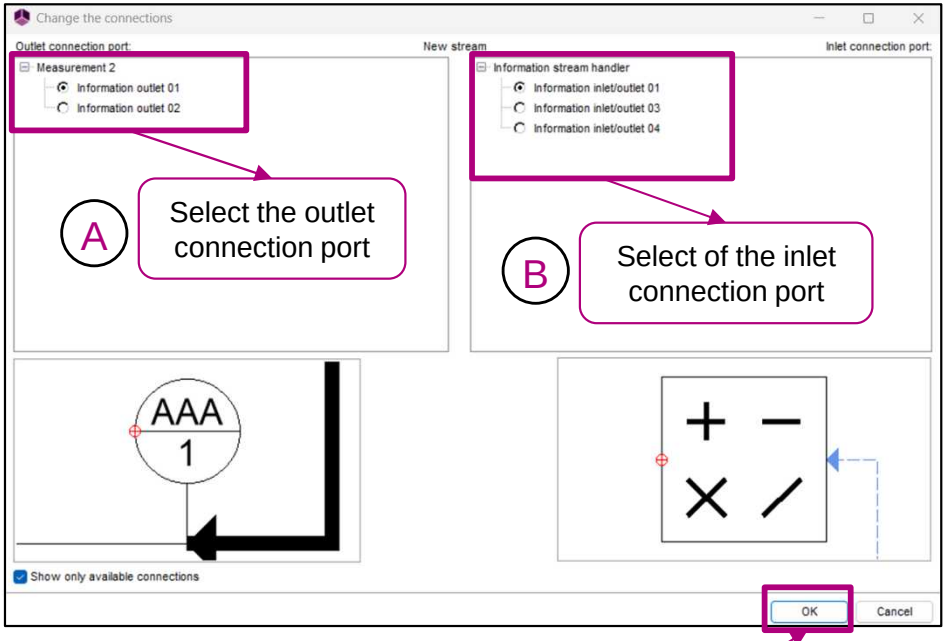
Practical Example

3 Insert the ”P2” information stream linking the measurement module 2 with the “MANI” module





A Select the outlet connection port

B Select of the inlet connection port

C Click “OK” to save the data

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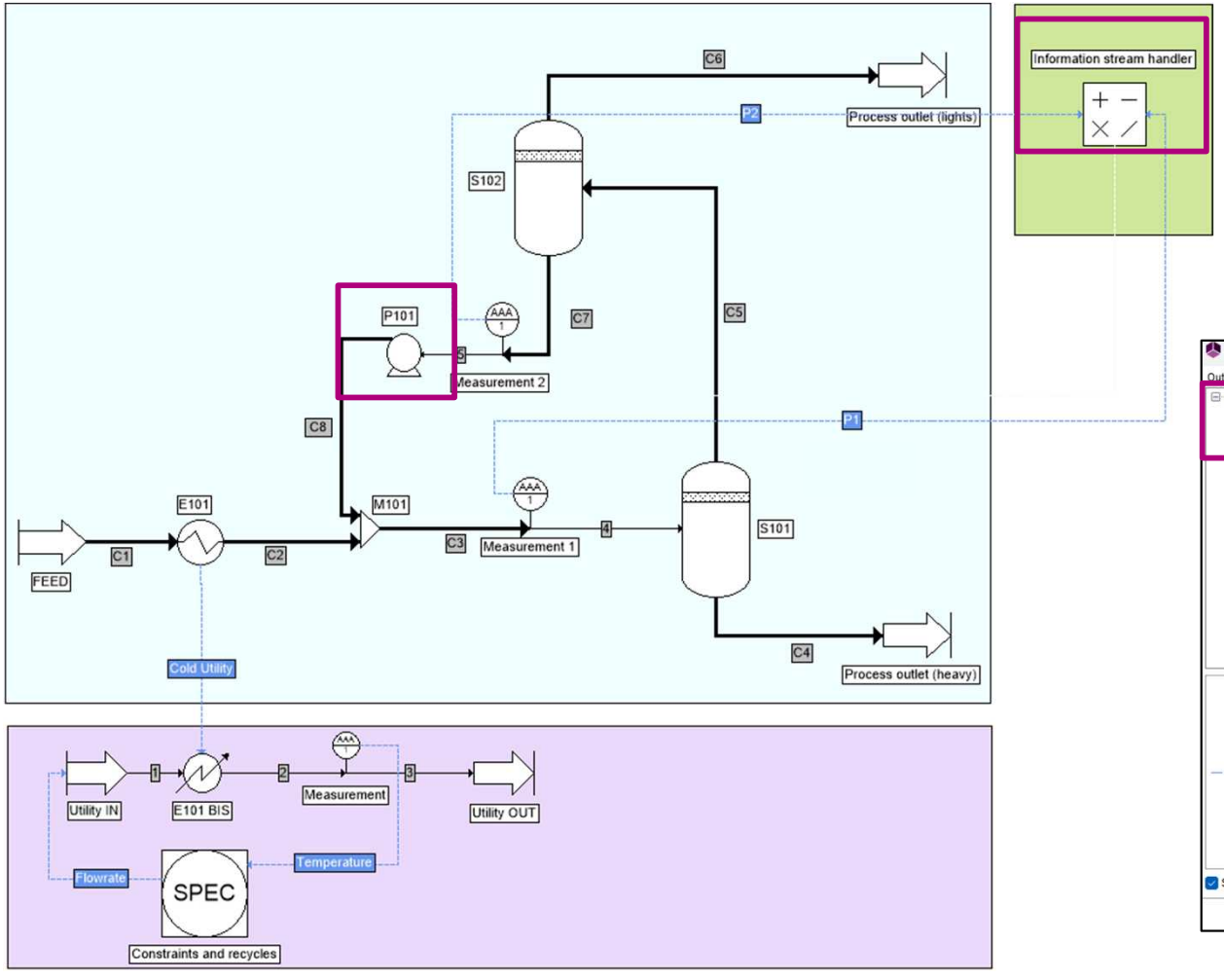
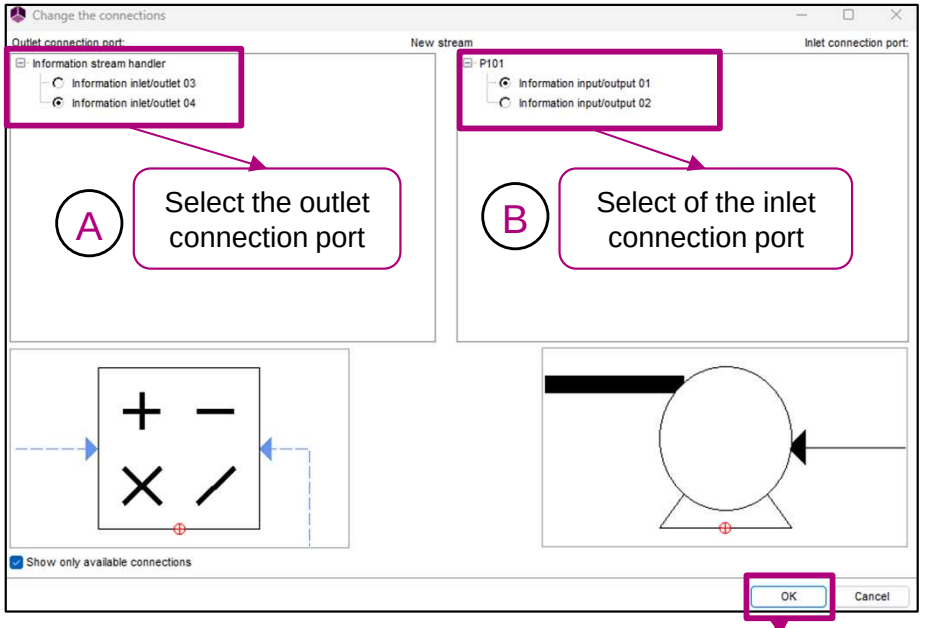
Practical Example

4 Insert the ”dP” information stream linking the “MANI” module with the “P101” Pump





A Select the outlet connection port

B Select of the inlet connection port

C Click “OK” to save the data

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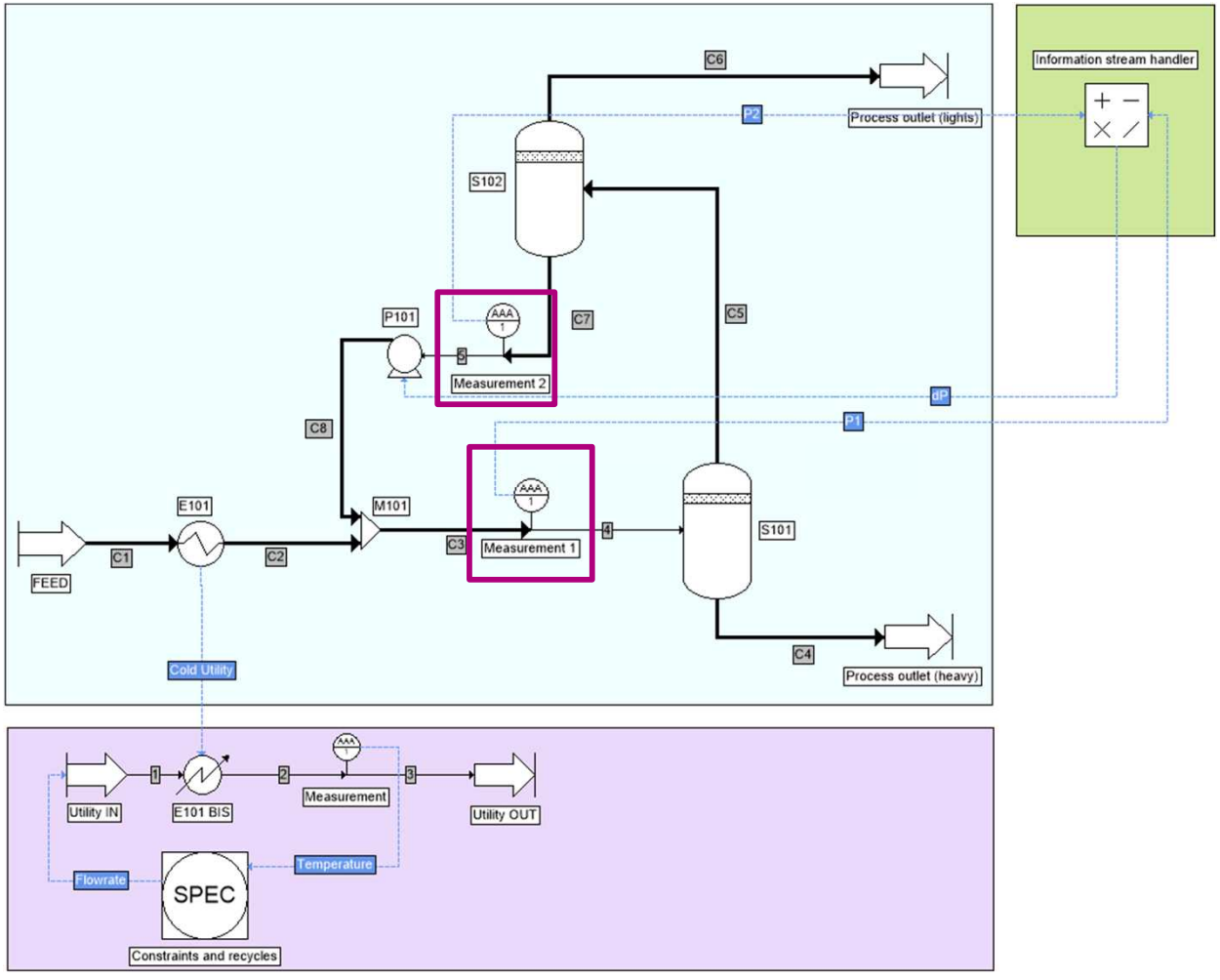
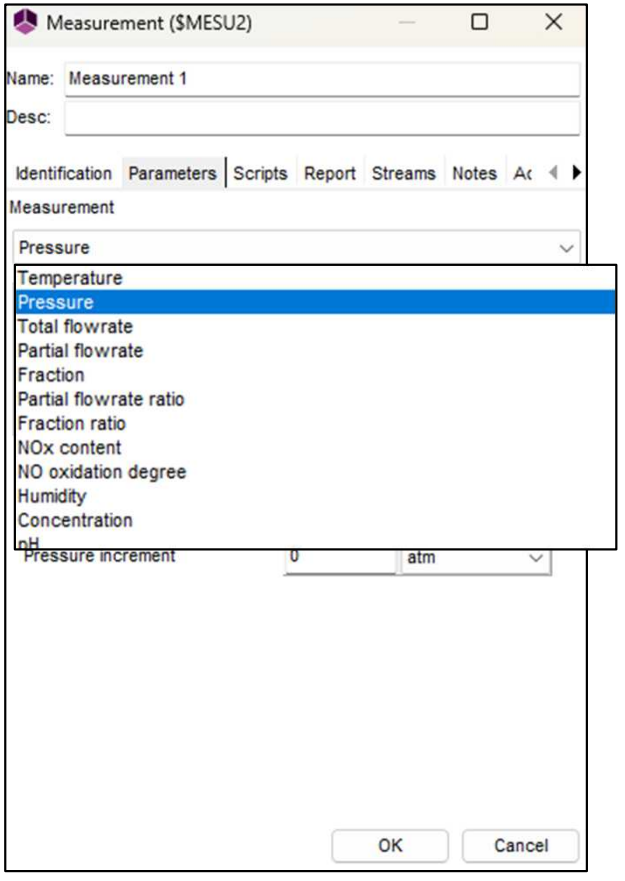
Practical Example

5 Set up the measurement modules 1 and 2



Double click on each of the Measurement modules (A)

Select on each the measurement parameter: Pressure (B)



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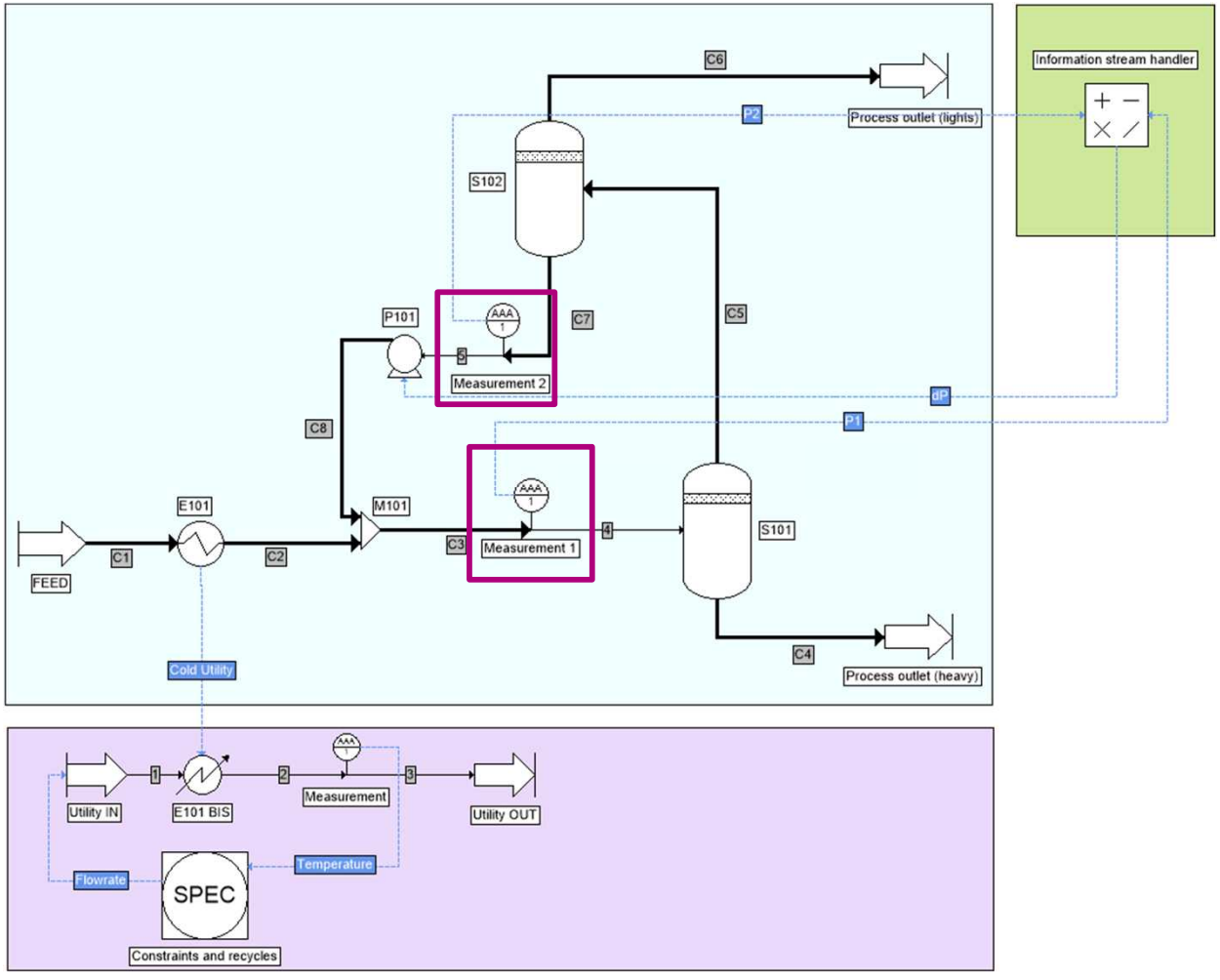
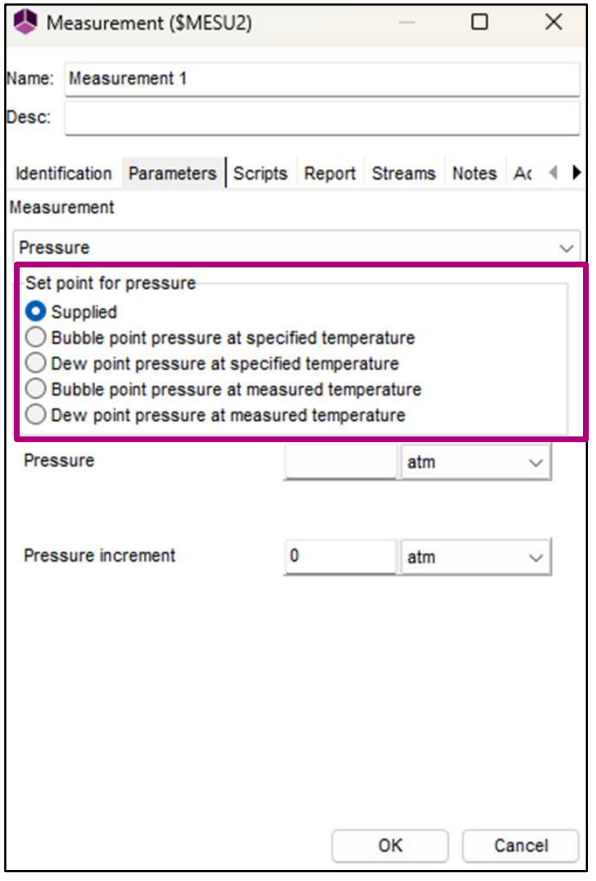
5 Set up the measurement modules 1 and 2



C

Select the set point for the pressure value as: supplied



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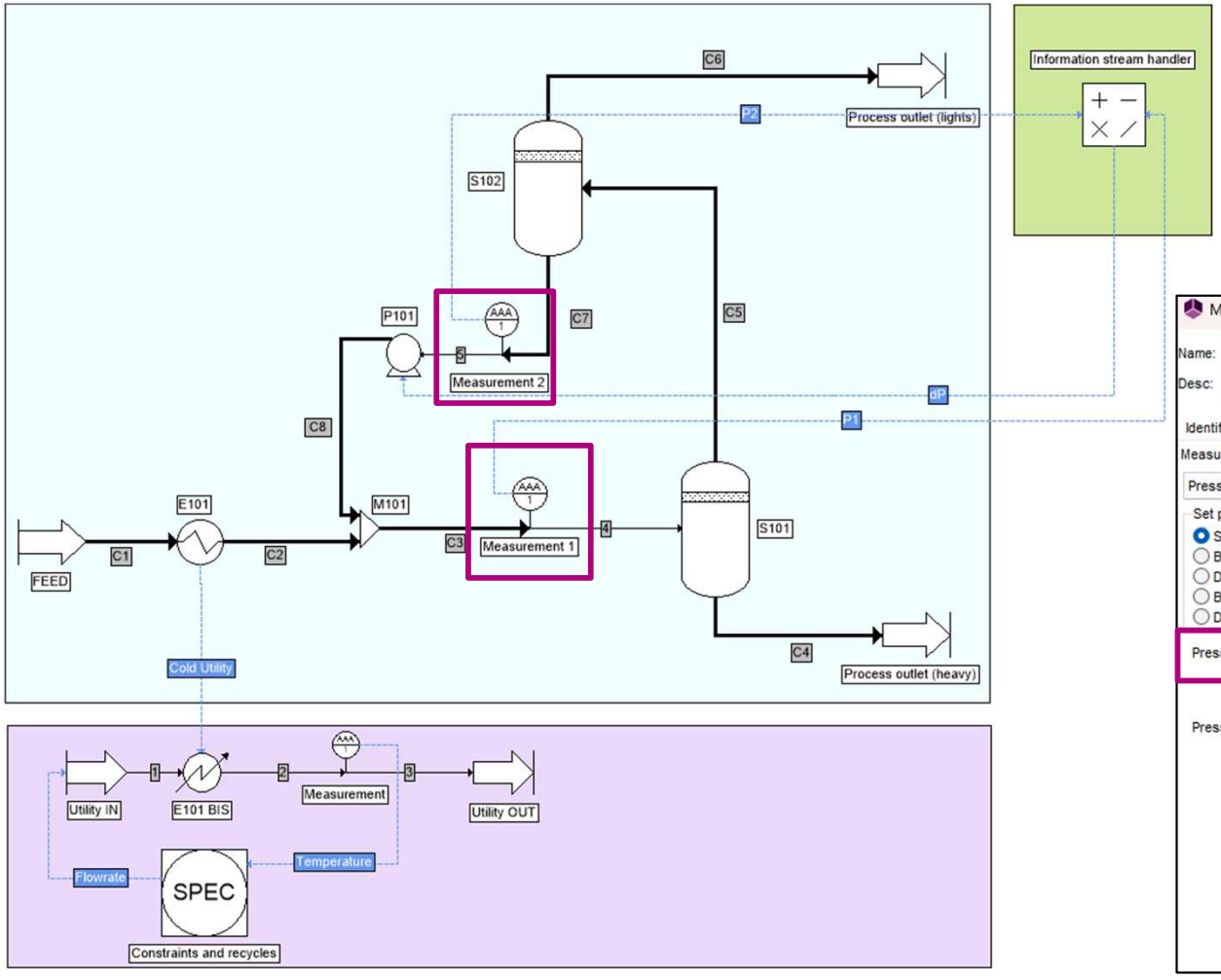
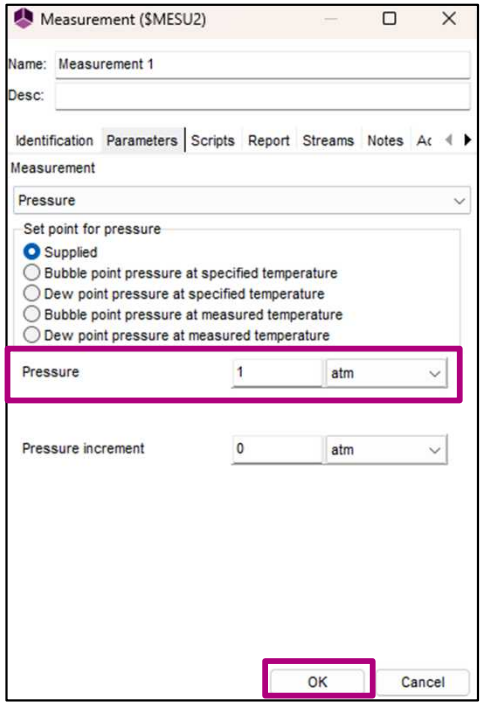
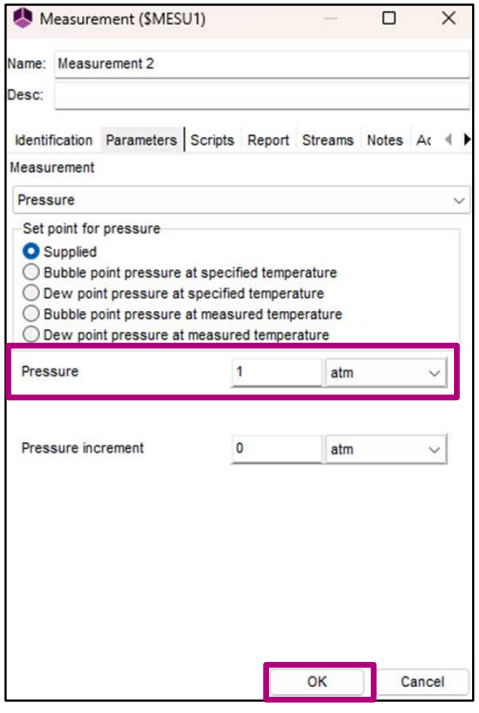
Practical Example

5 Set up the measurement modules 1 and 2



The supplied pressure must be a value higher than 0 (D)





(E) Click “OK” to save the data

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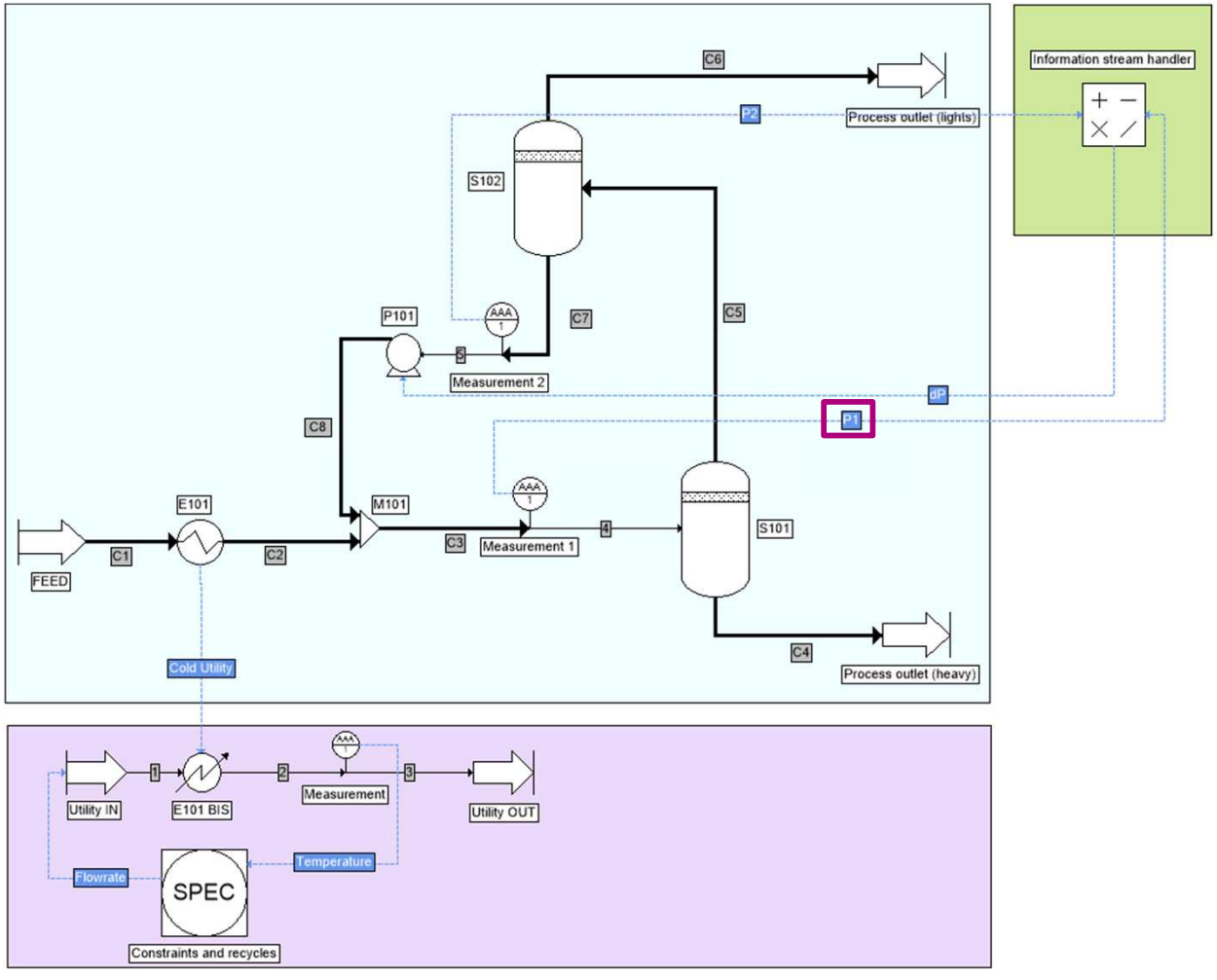
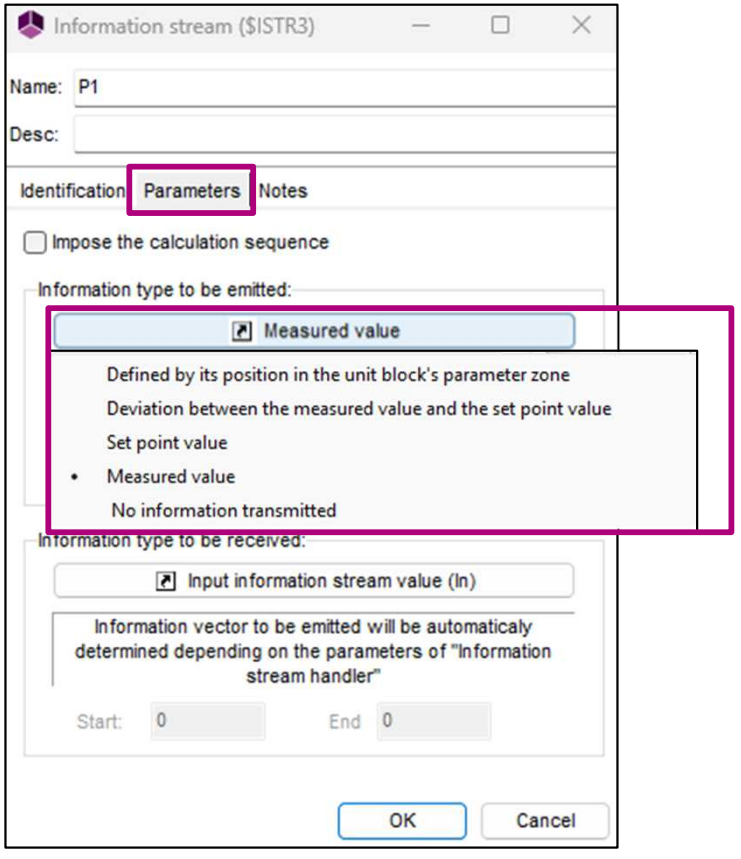
Practical Example

6 Specify "P1" information stream parameters



A Double click on the "P1" information stream

B Select "Measured value" as the data to be sent from the measurement module 1 to the "MANI" module



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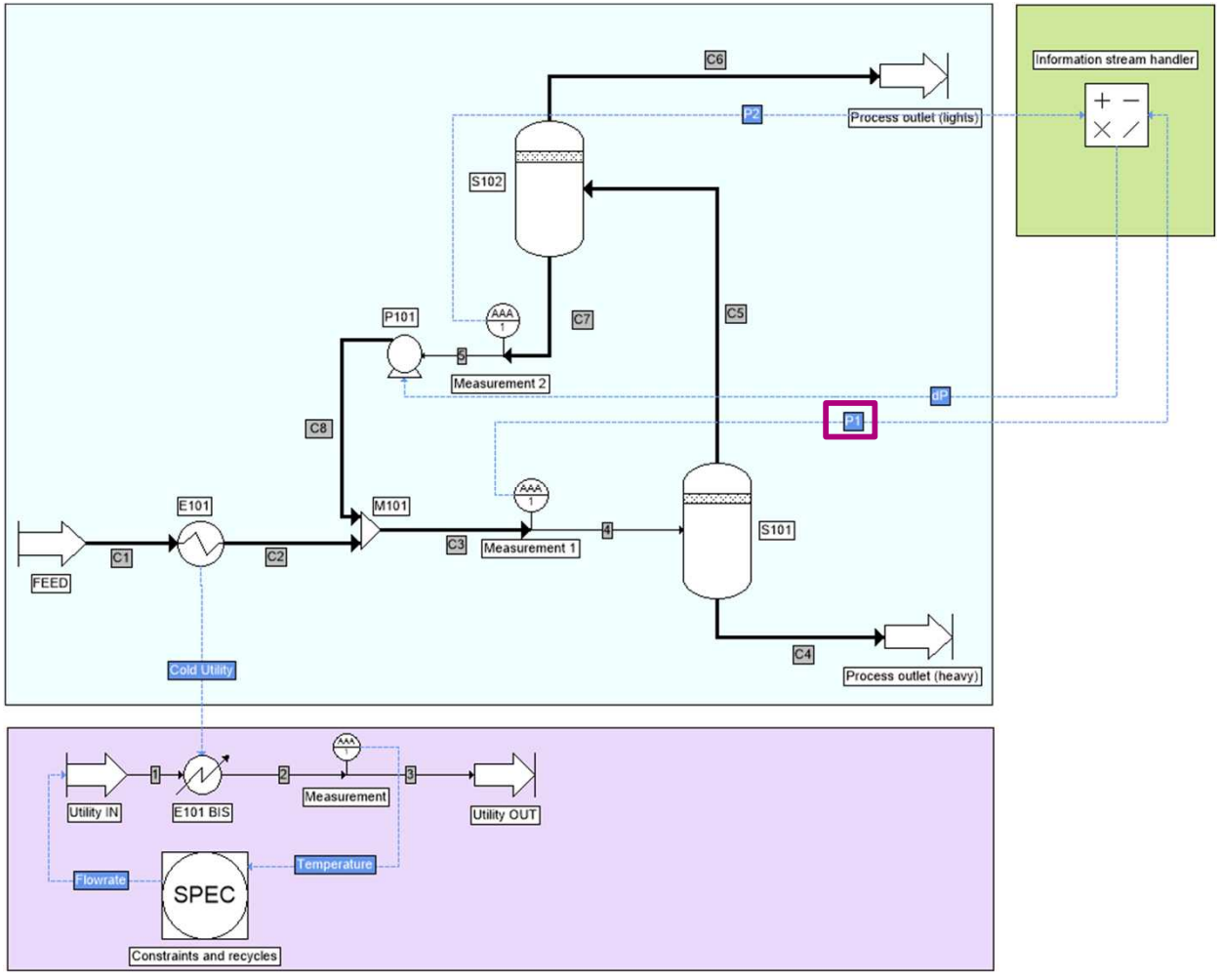
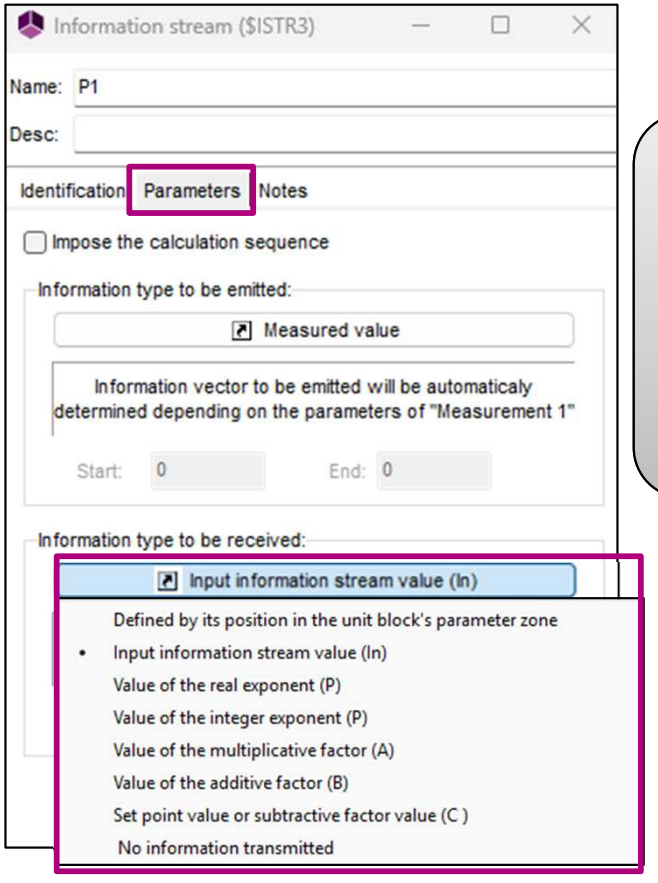
Practical Example

6 Specify "P1" information stream parameters



C

Select the parameter that the "P1" information stream will represent in the equation $Out = A * In^P + B - C$ within the "MANI" module, which will be the parameter "In"



Pressure from **measurement module 1** will be the parameter Specify value ("In")

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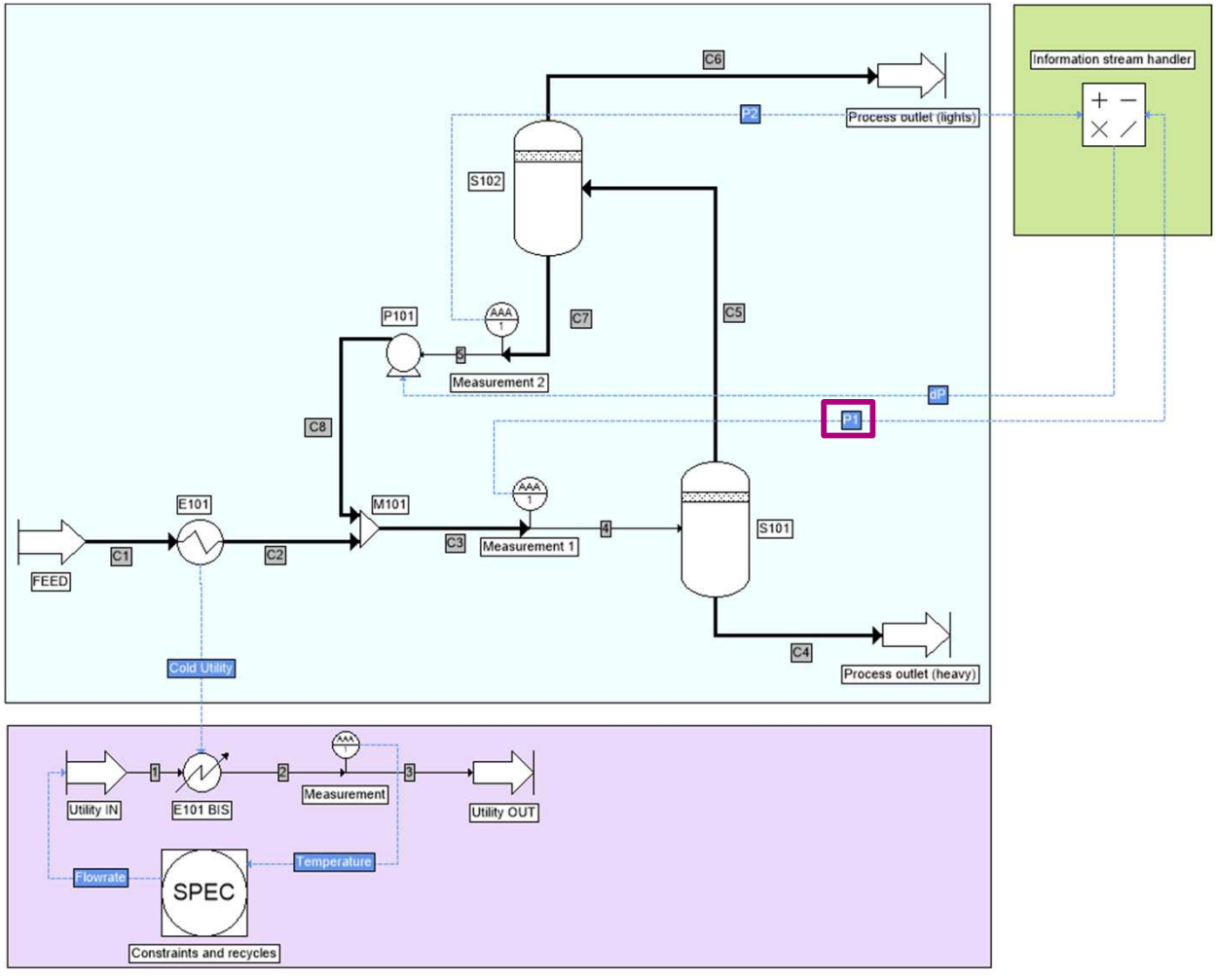
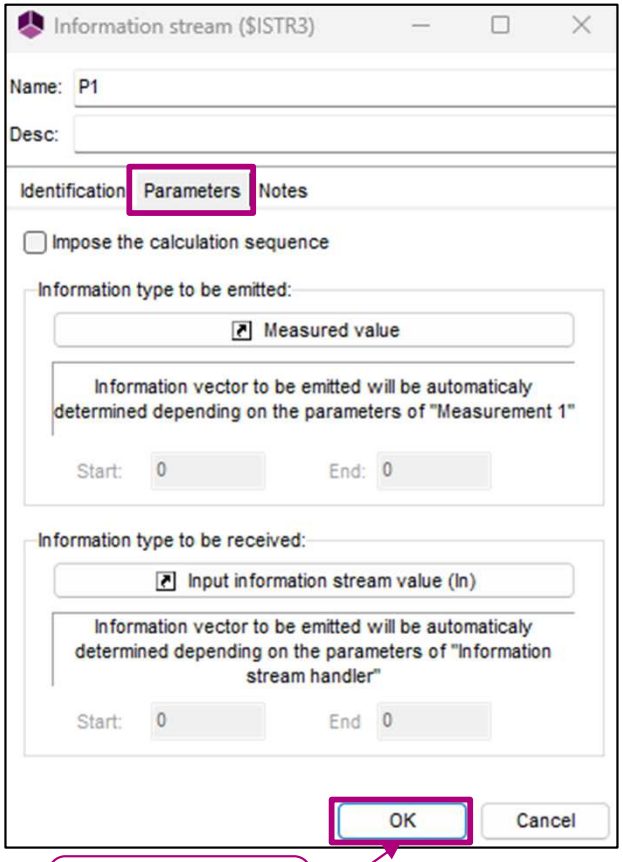
Practical Example

6 Specify “P1” information stream parameters





D Click “OK” to save the data

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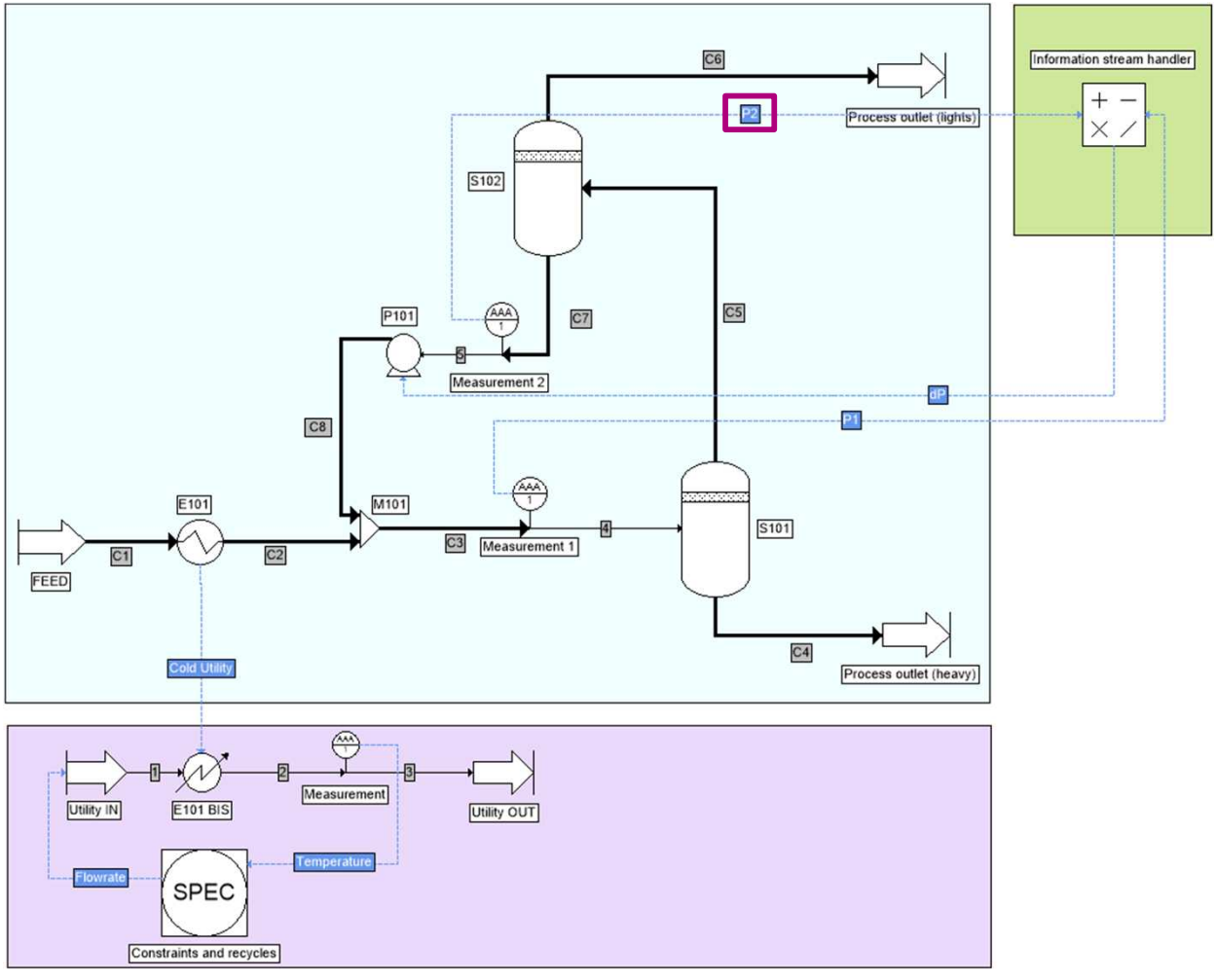
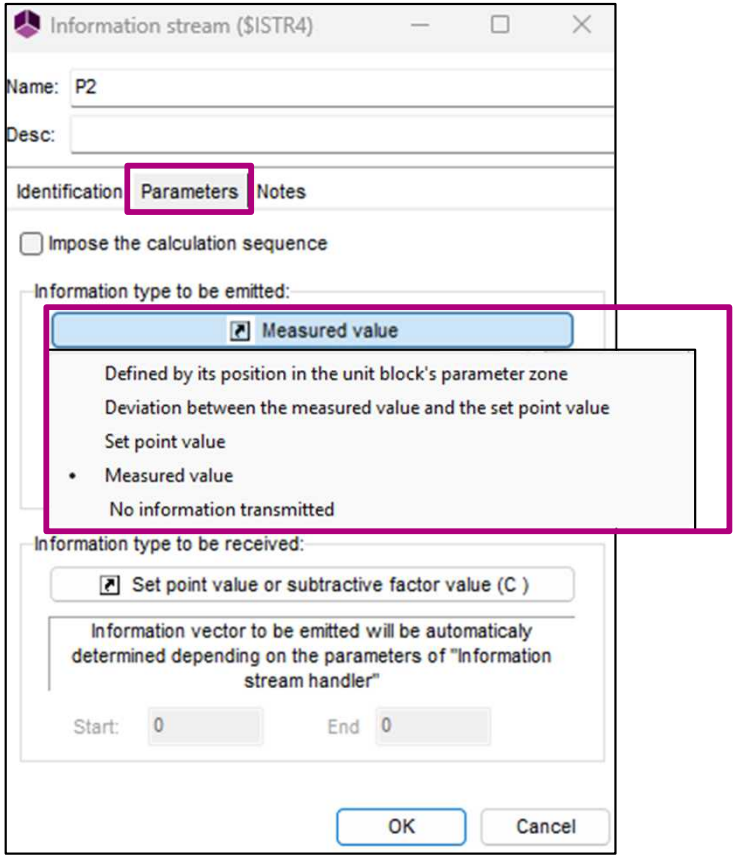
Practical Example

7 Specify "P2" information stream parameters

A — Double click on the "P2" information stream

B — Select "Measured value" as the data to be sent from the measurement module 2 to the "MANI" module





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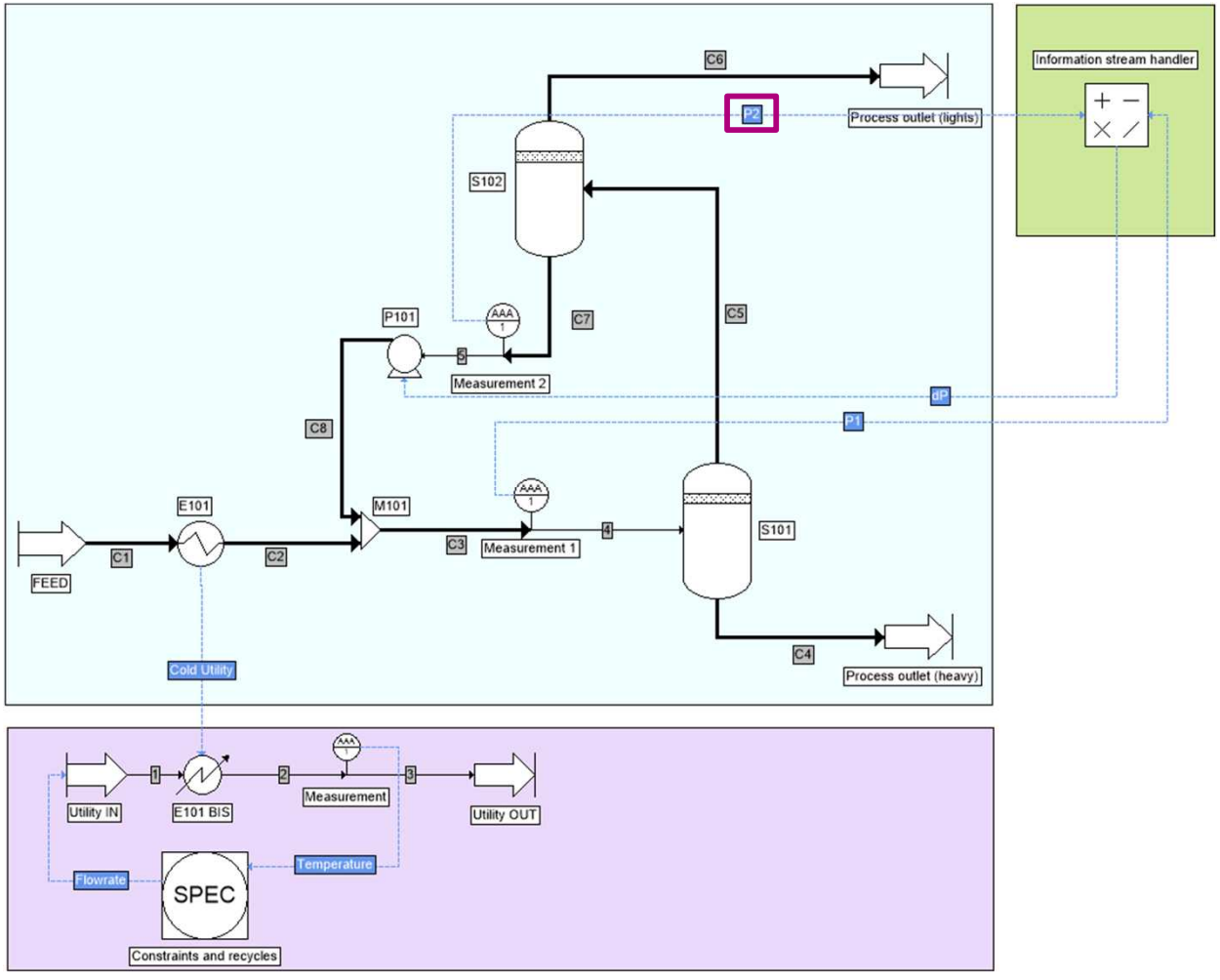
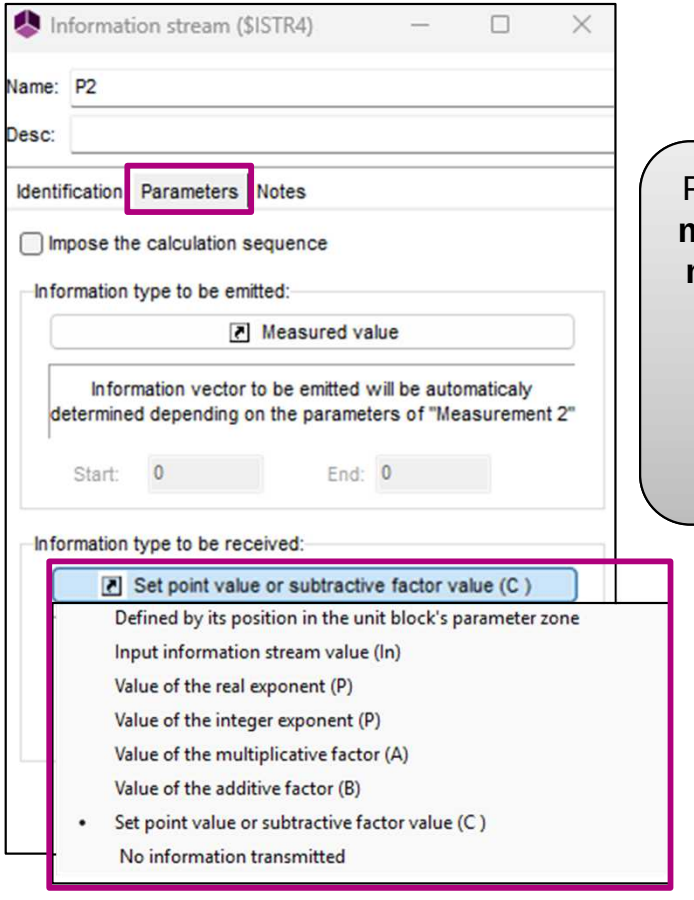
Practical Example

7 Specify "P2" information stream parameters



C

Select the parameter that the "P2" information stream will represent in the equation $Out = A * In^P + B - C$ within the "MANI" module, which will be the parameter *"C"*



Pressure from **measurement module 2** will be the subtractive factor value *"C"*

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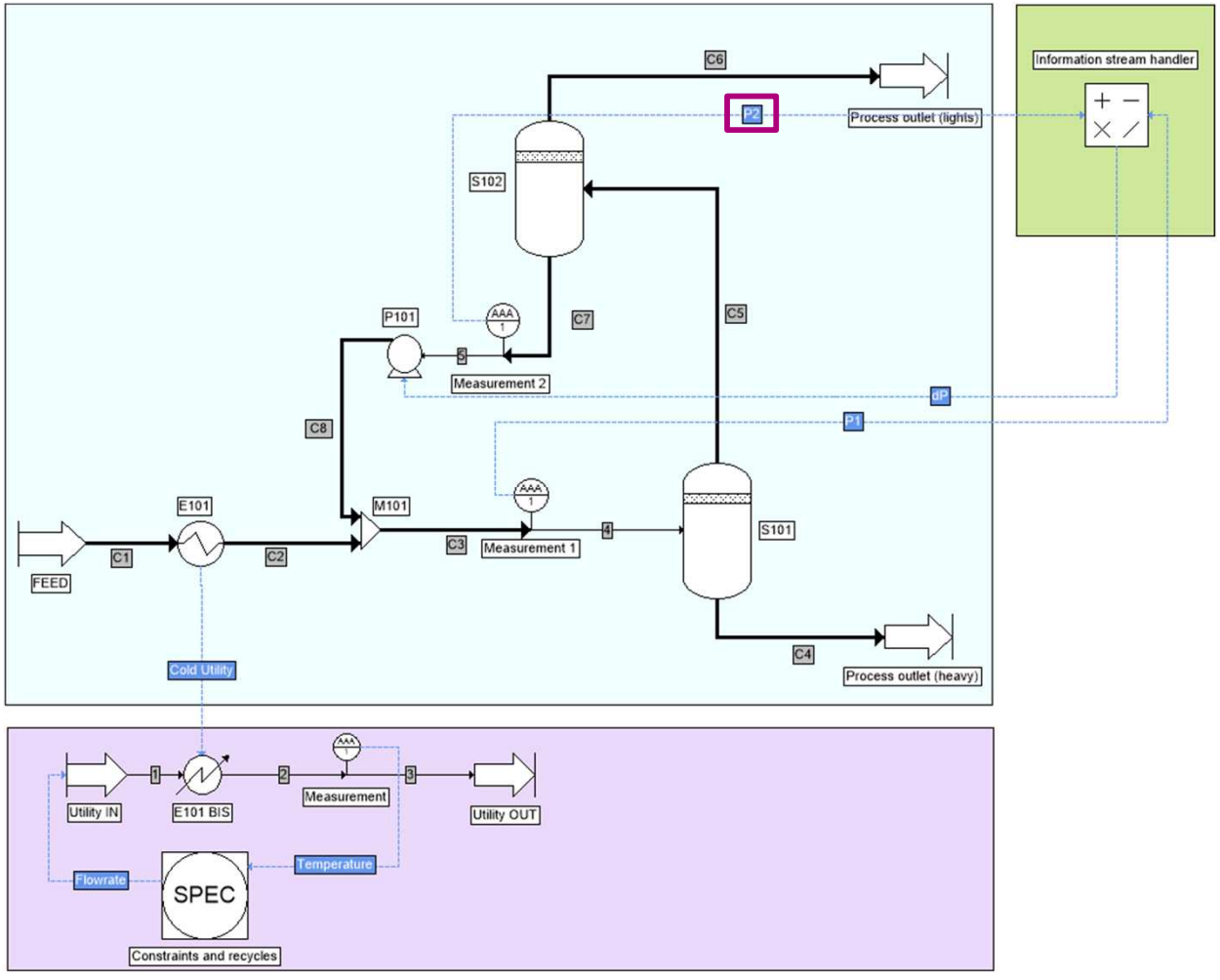
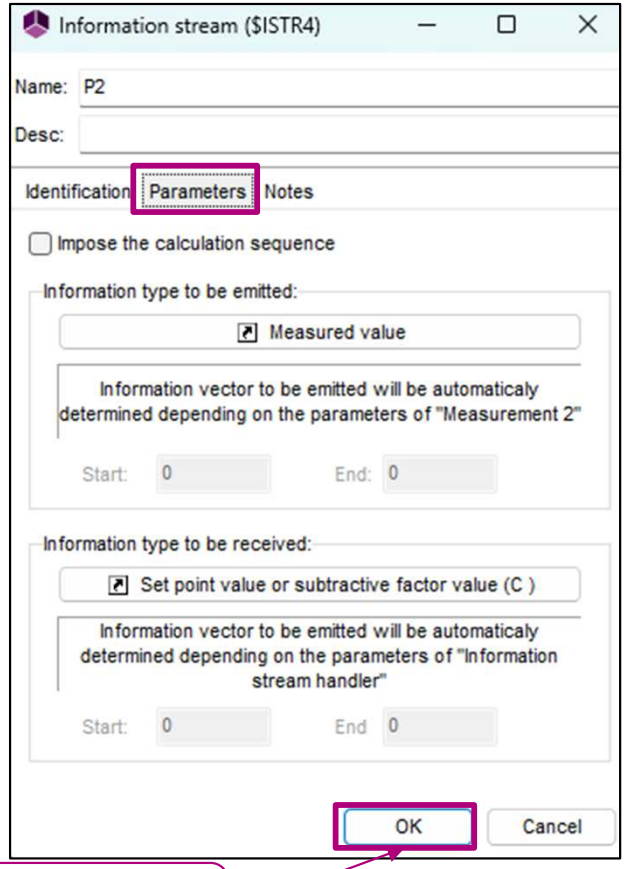
Practical Example

7 Specify "P2" information stream parameters





D Click "OK" to save the data

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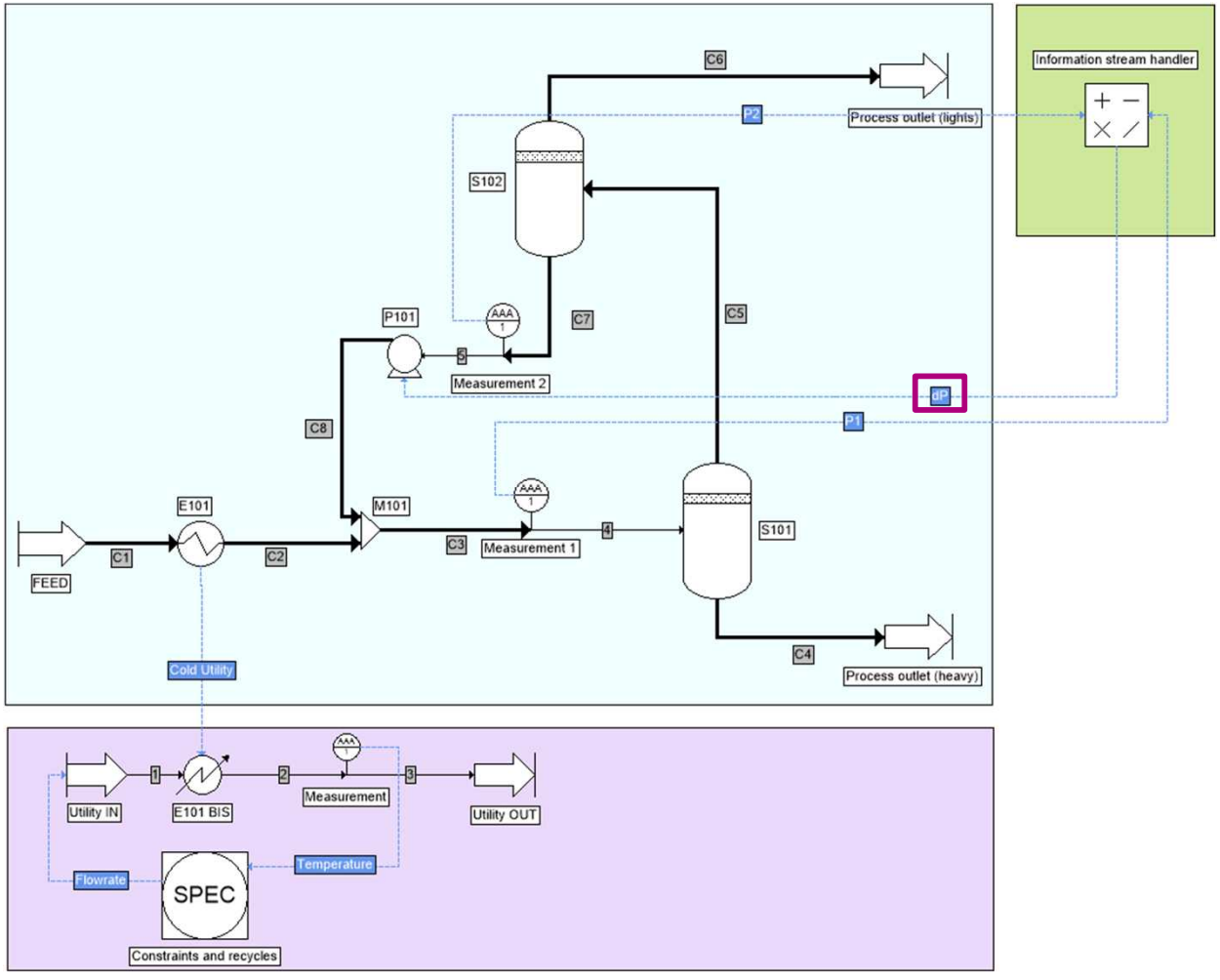
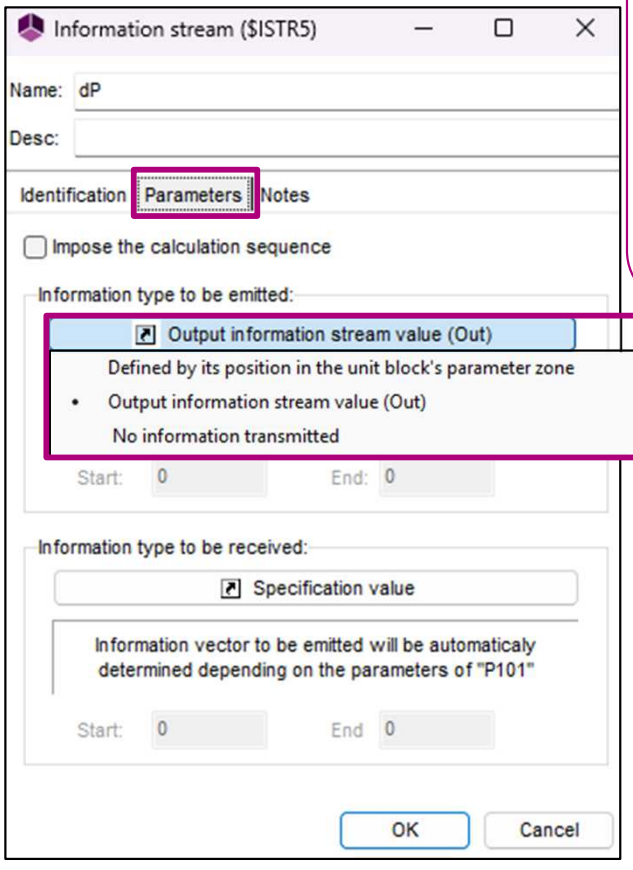
Practical Example

8 Specify "dP" information stream parameters



A

Double click on the "dP" information stream



B

Select the data to be sent from the "MANI" module: "**Output information stream value (Out)**"

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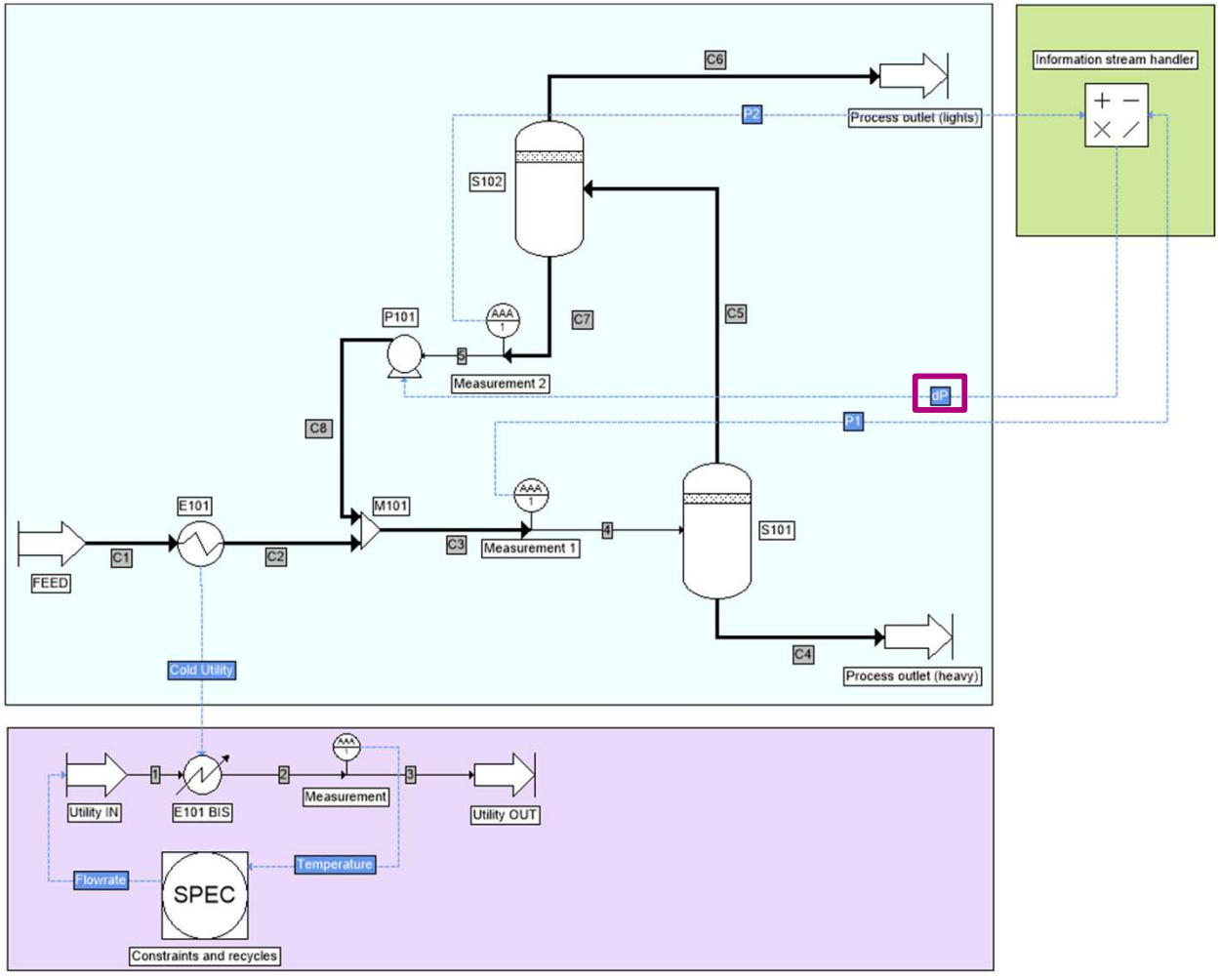
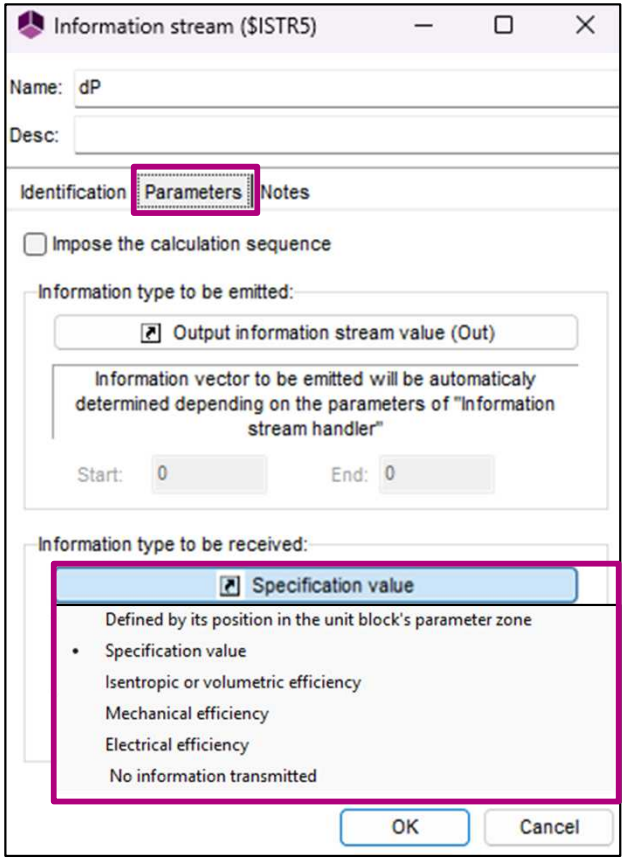
Practical Example

8 Specify “dP” information stream parameters





C

Select the parameter that "P101 Pump" will receive: **“Specification value”**

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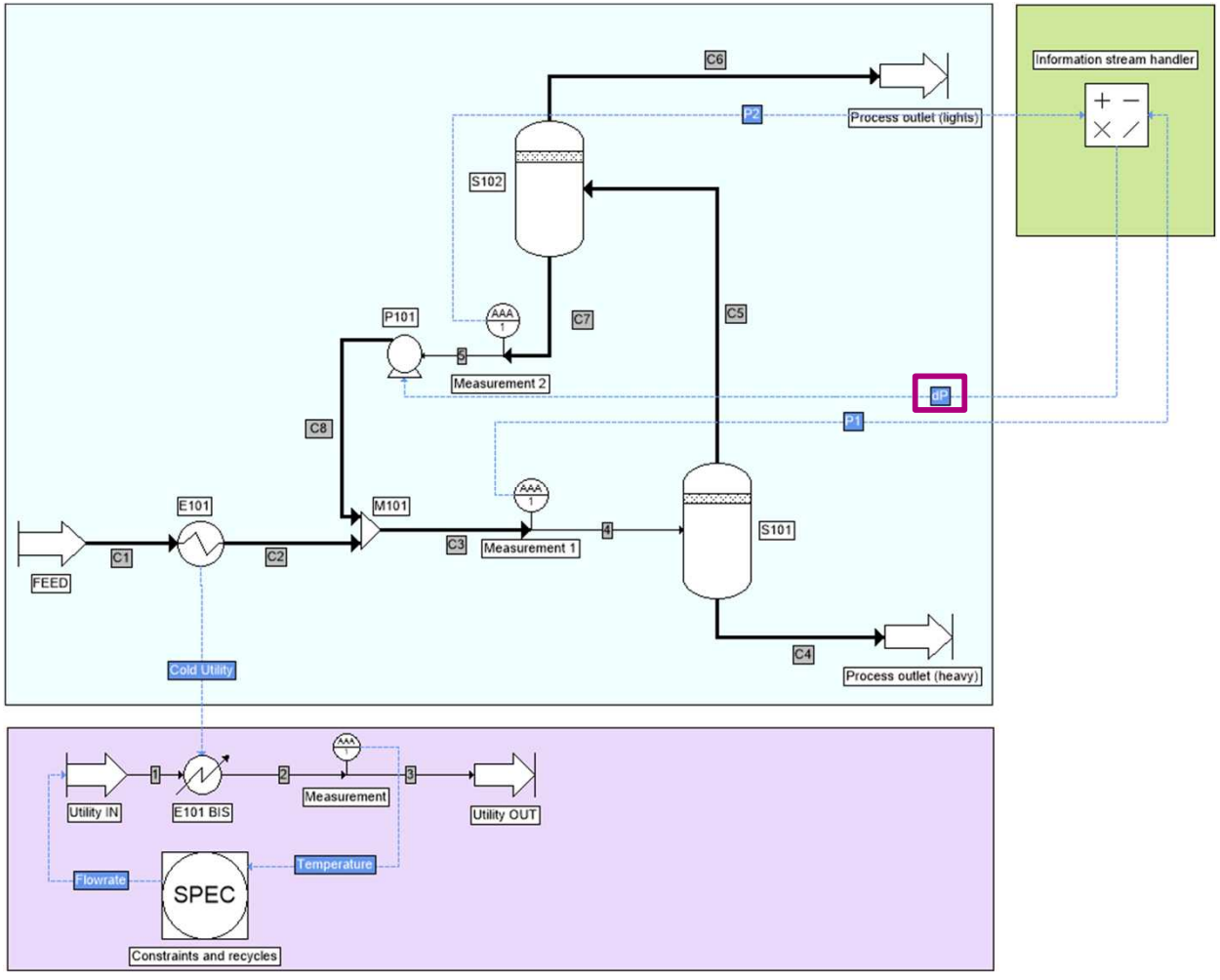
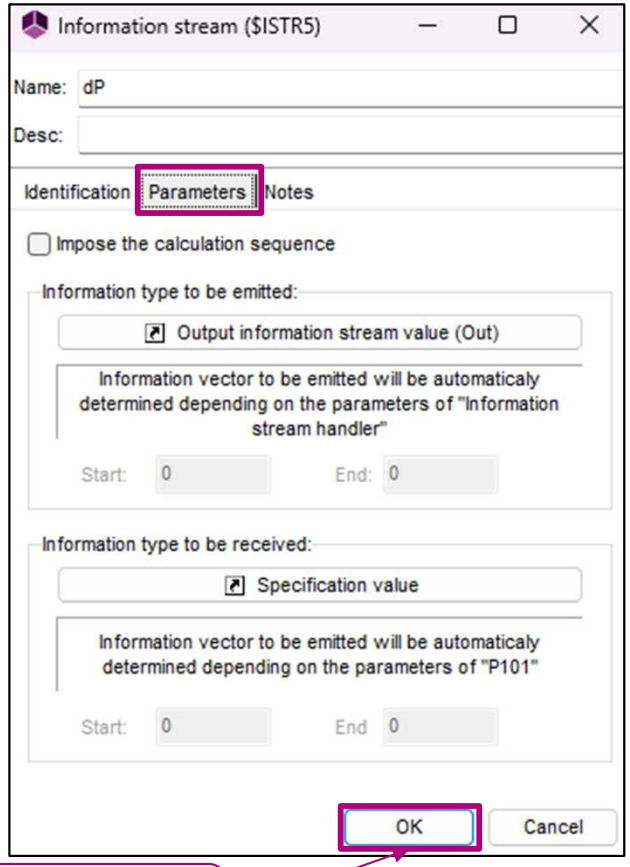
Practical Example

8 Specify “dP” information stream parameters





D Click “OK” to save the data

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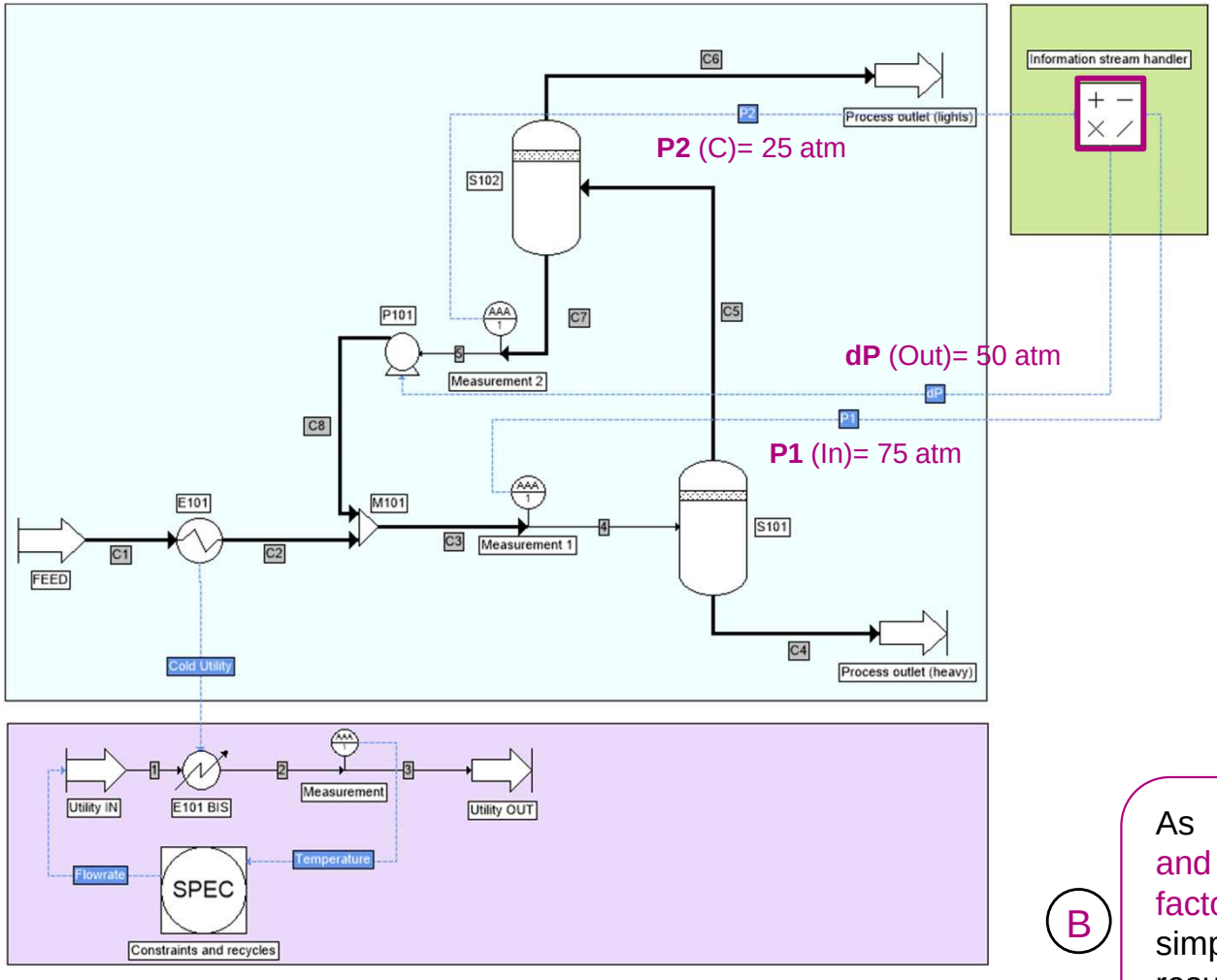
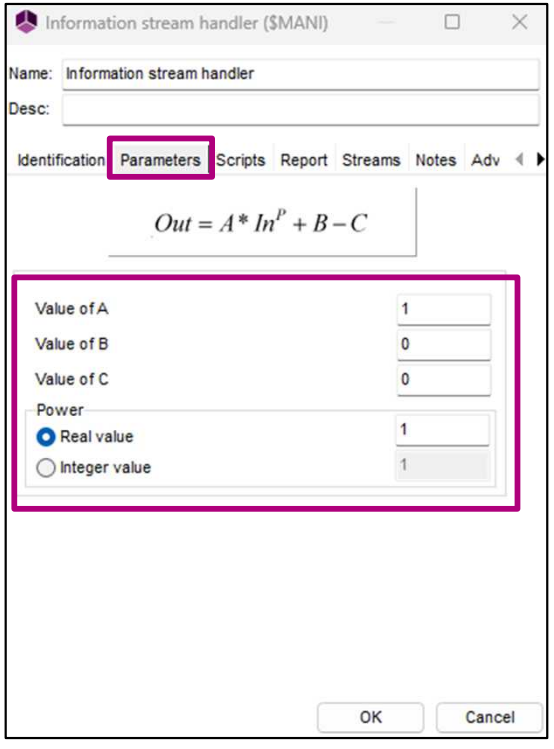
Practical Example

9 Specify "MANI" module equation parameters



A Double click on the "MANI" module



B As previously mentioned, information streams "P1" and "P2" correspond to input ("In") and subtractive factor value "C" parameters respectively. To perform a simple subtraction, set A=1, B=0 and P=1. The resulting equation becomes: $Out = In - C$, or equivalently, $Out = P_1 - P_2$

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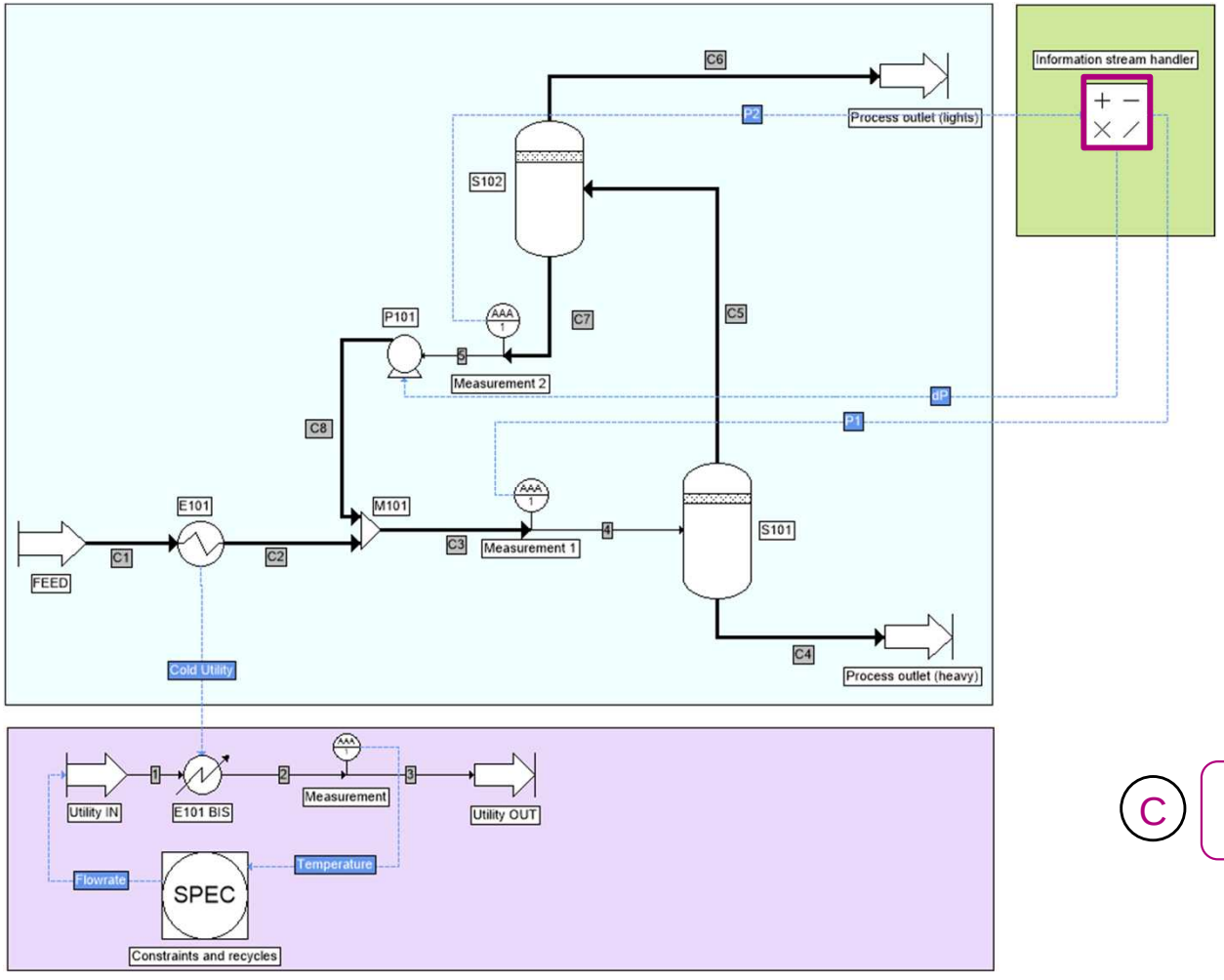
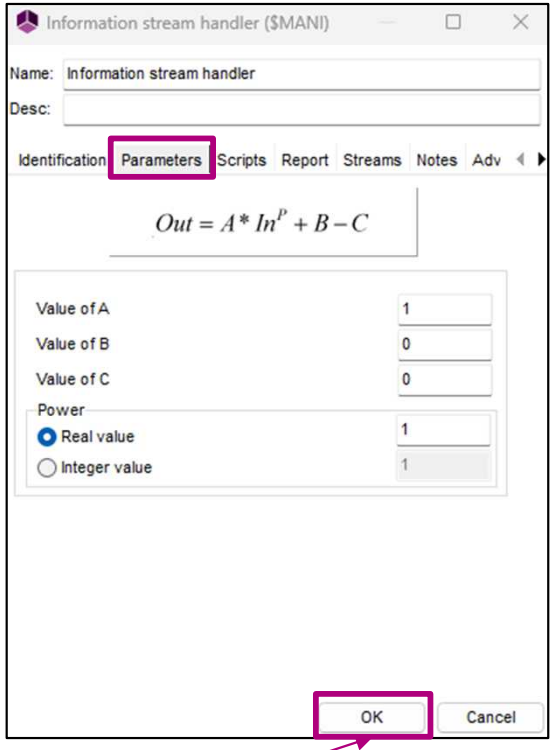
Practical Example

9 Specify “MANI” module equation parameters





C Click “OK” to save the data

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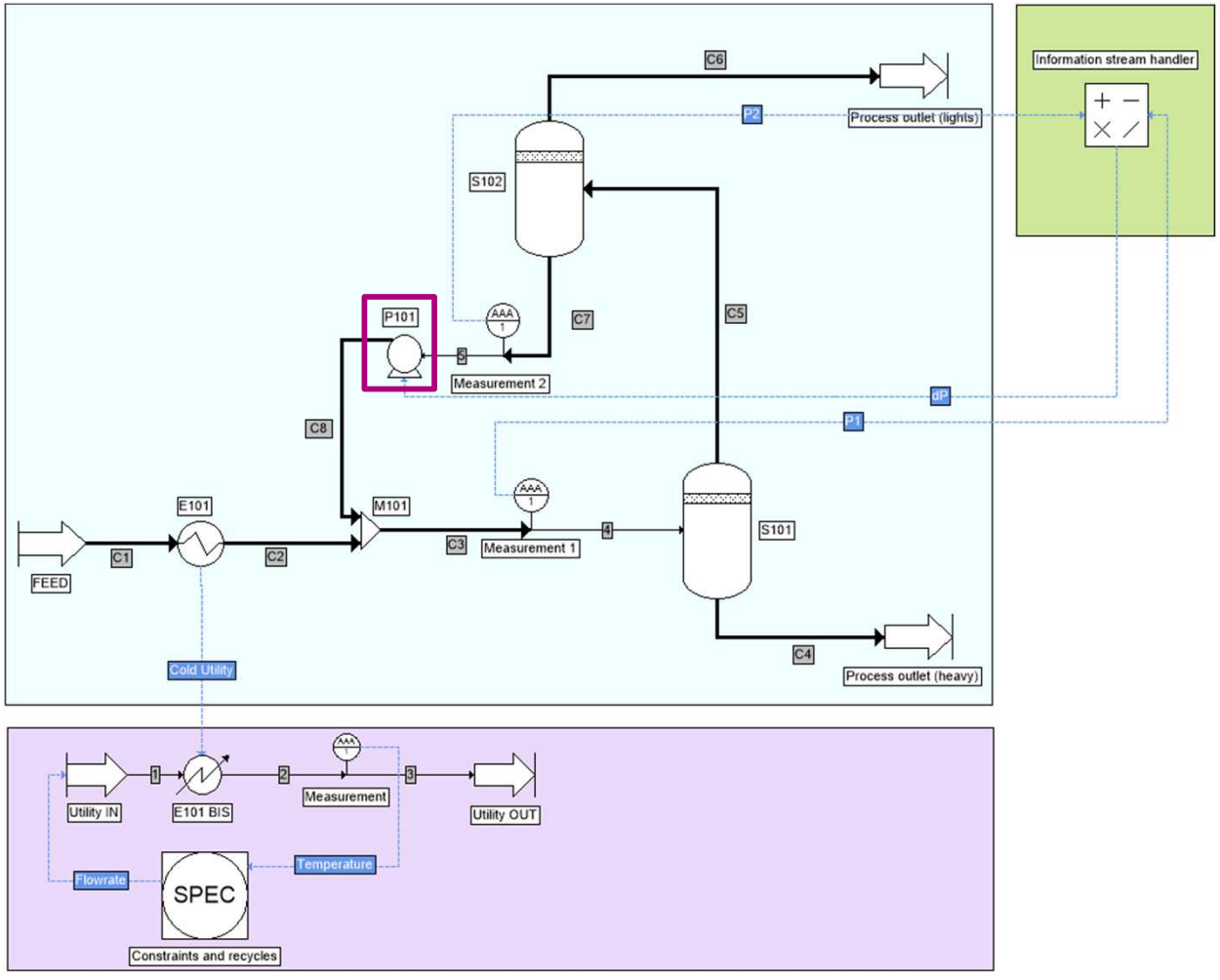
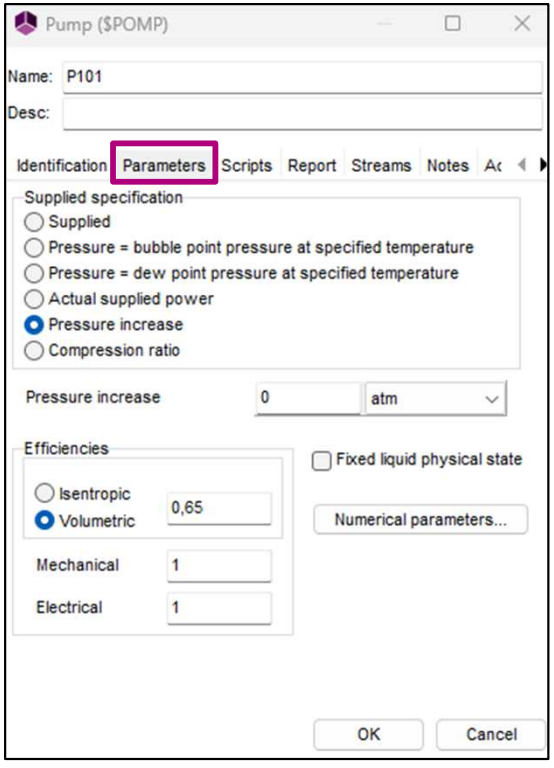
Practical Example

10 Specify Pump (“P101”) parameters

A Double click on the “P101” Pump





B

Select « Pressure increase » as the supplied specification

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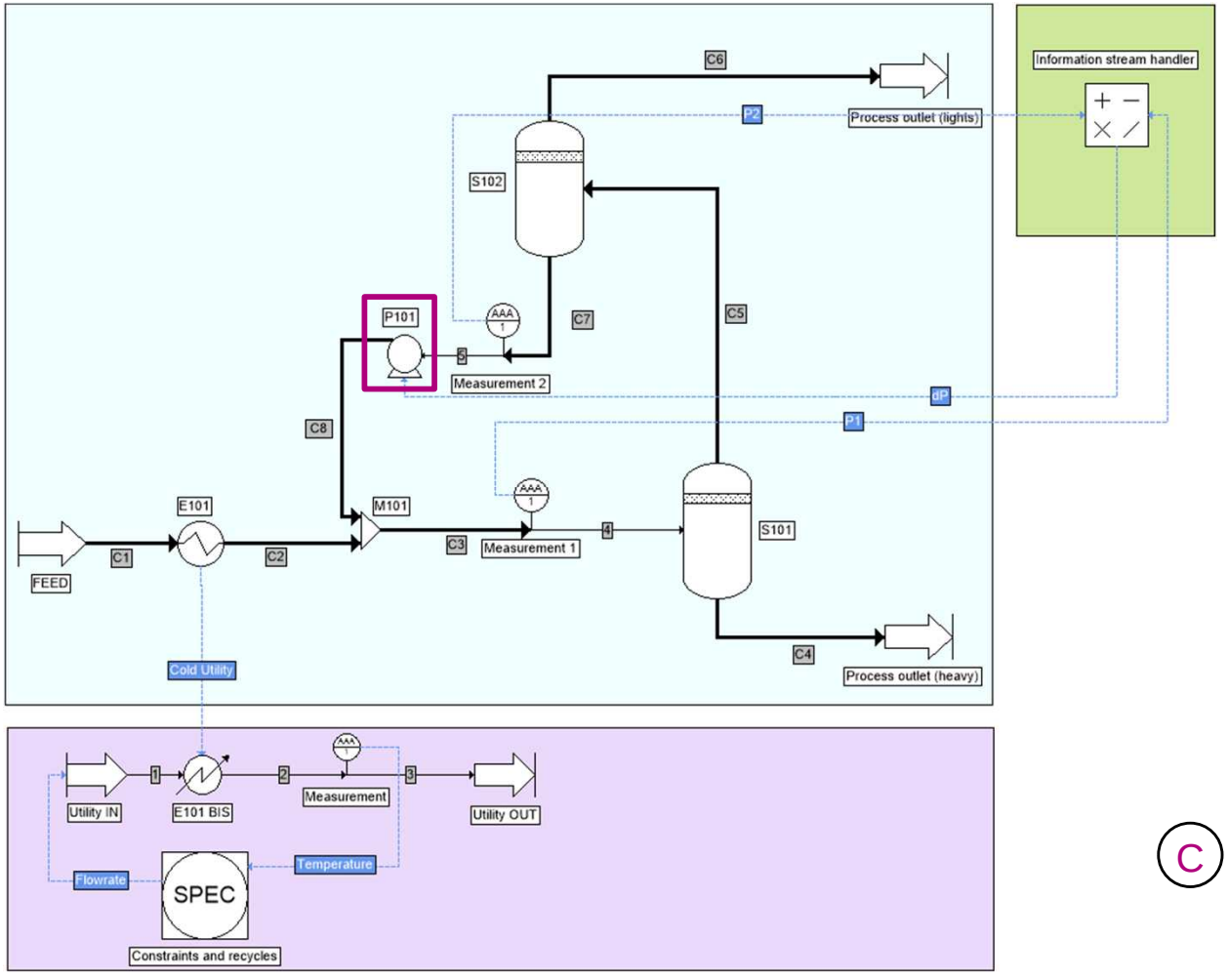
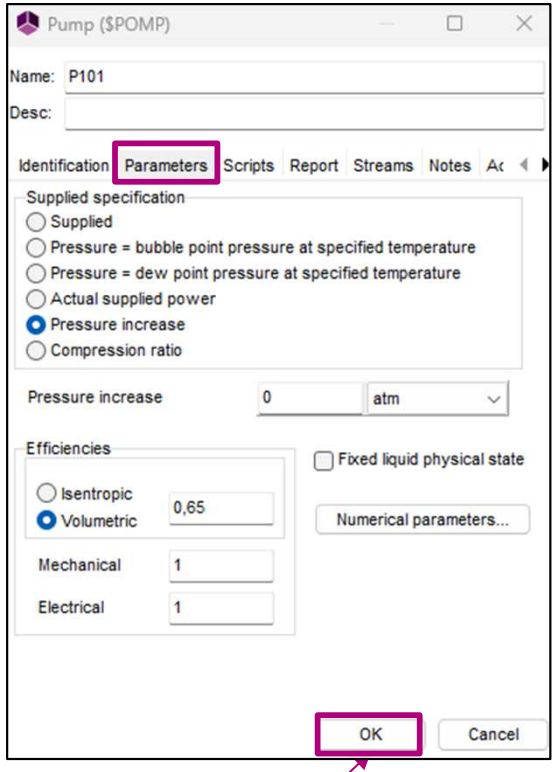
Practical Example

10 Specify Pump (“P101”) parameters





C Click “OK” to save the data

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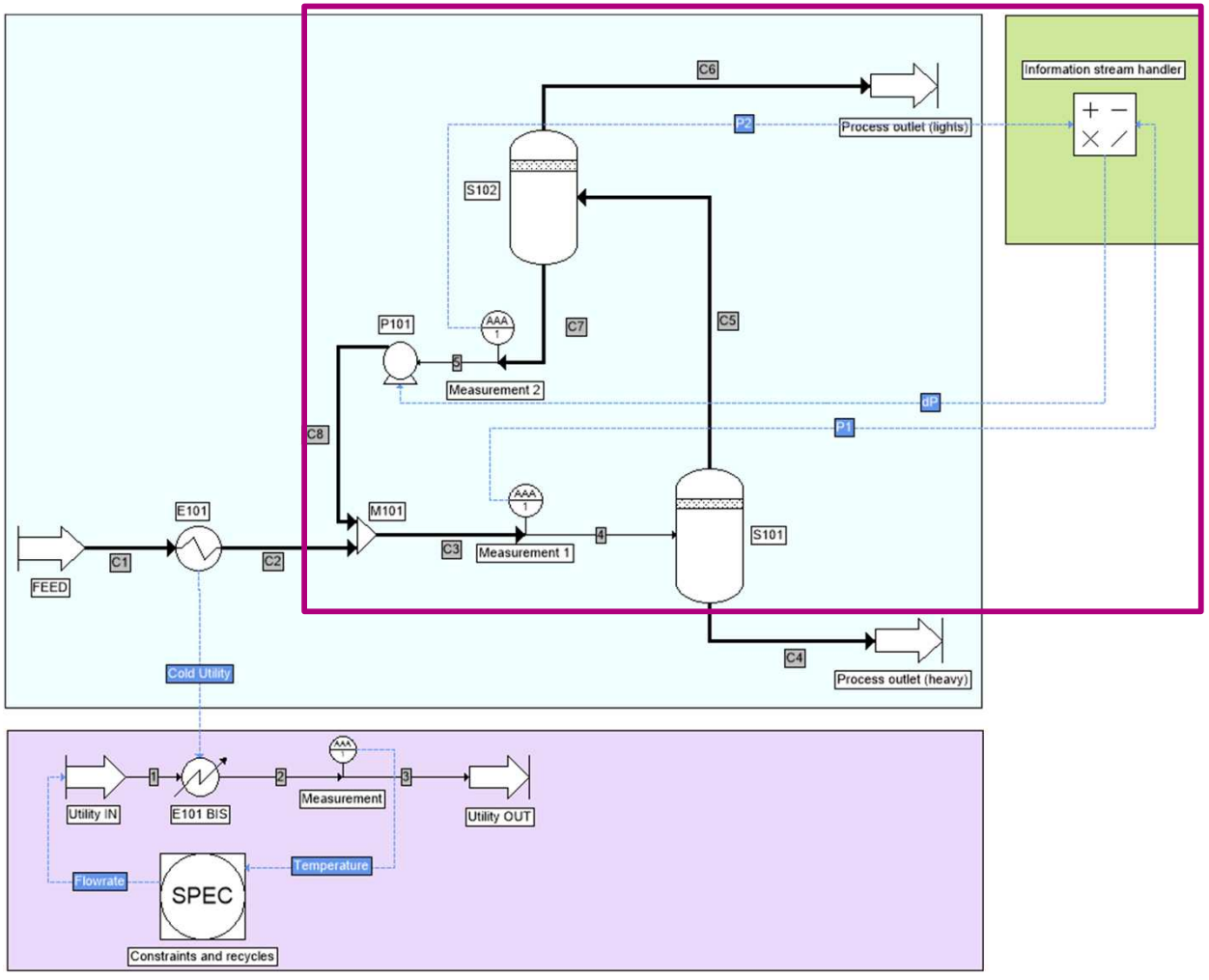
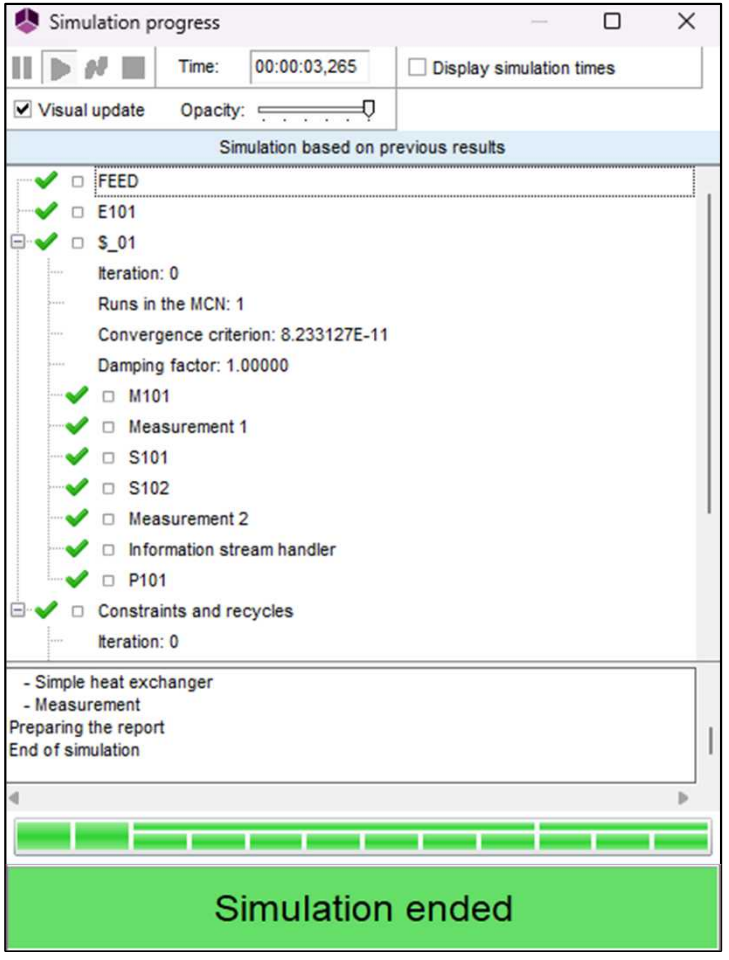
Practical Example

11 Run the simulation





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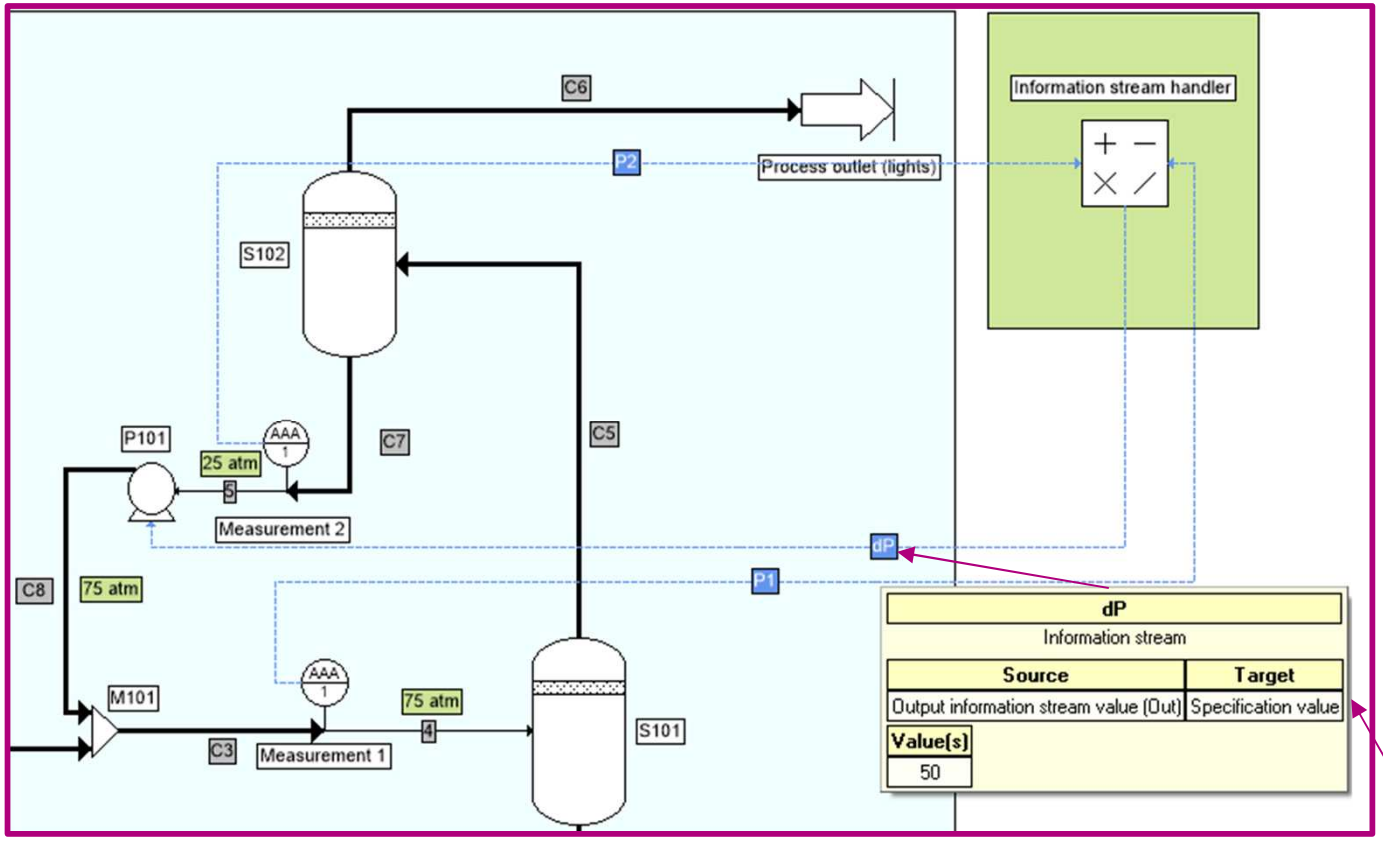
RESULTS



- The “MANI” module with the help of the information streams was able to calculate the ΔP (50 atm) between the flash units “S101” (75 atm) and “S102” (25 atm).

- This ΔP was then successfully used to adjust the “P101” Pump pressure to 75 atm, matching the process requirement.

Placing the pointer over a stream (material or information) displays the results conveyed by that stream, in ProSim unit system

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Concept

Defining a Calculation sequence: Let's do it!

1. **Transferring data** between unit operations
2. Defining process **specifications** through the constraints and recycles module ("SPEC")
3. **Manipulate** data and results through arithmetic operations, using the information stream operator ("MANI")
4. Imposing a specific **Calculation sequence** to control the order of the units calculation

Imposing a **Calculation sequence** ensures that unit operations are executed in the proper order when input variables depend on upstream results.

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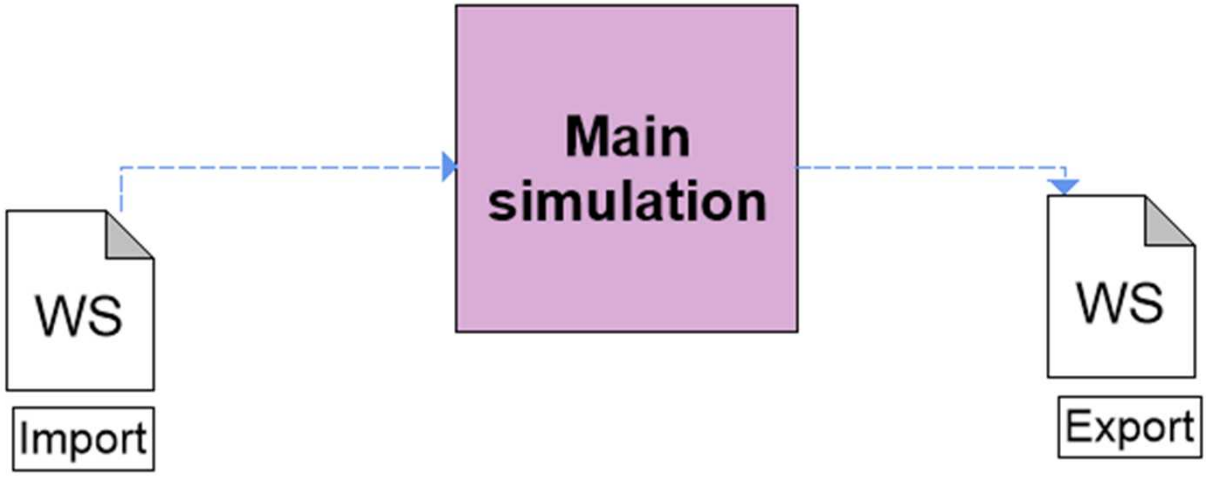
Concept

CONTEXT

In ProSimPlus, unit operations are consecutively calculated. The **Calculation sequence** is automatically determined by the program. However, in certain cases (particularly, when using a user-defined module), it may be necessary to manually impose the Calculation sequence. This can be achieved using **information streams**.



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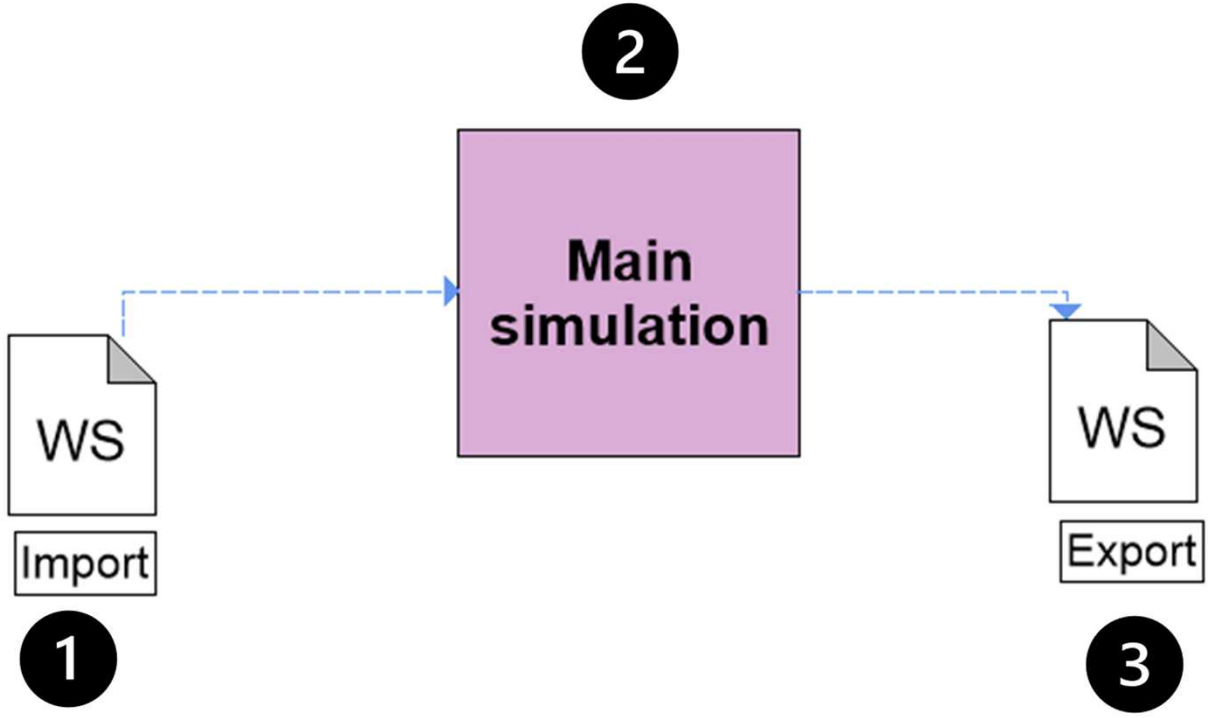
Concept

CONTEXT

In ProSimPlus, unit operations are consecutively calculated. The **Calculation sequence** is automatically determined by the program. However, in certain cases (particularly, when using a user-defined module), it may be necessary to manually impose the Calculation sequence. This can be achieved using **information streams**.



The objective of this script could be to retrieve input data from an external file, that will then be used in the main simulation

The objective of this script could be to export the results from the main simulation. These results would then be manipulated by the script (*e.g.*, additional custom calculations, custom reports...)

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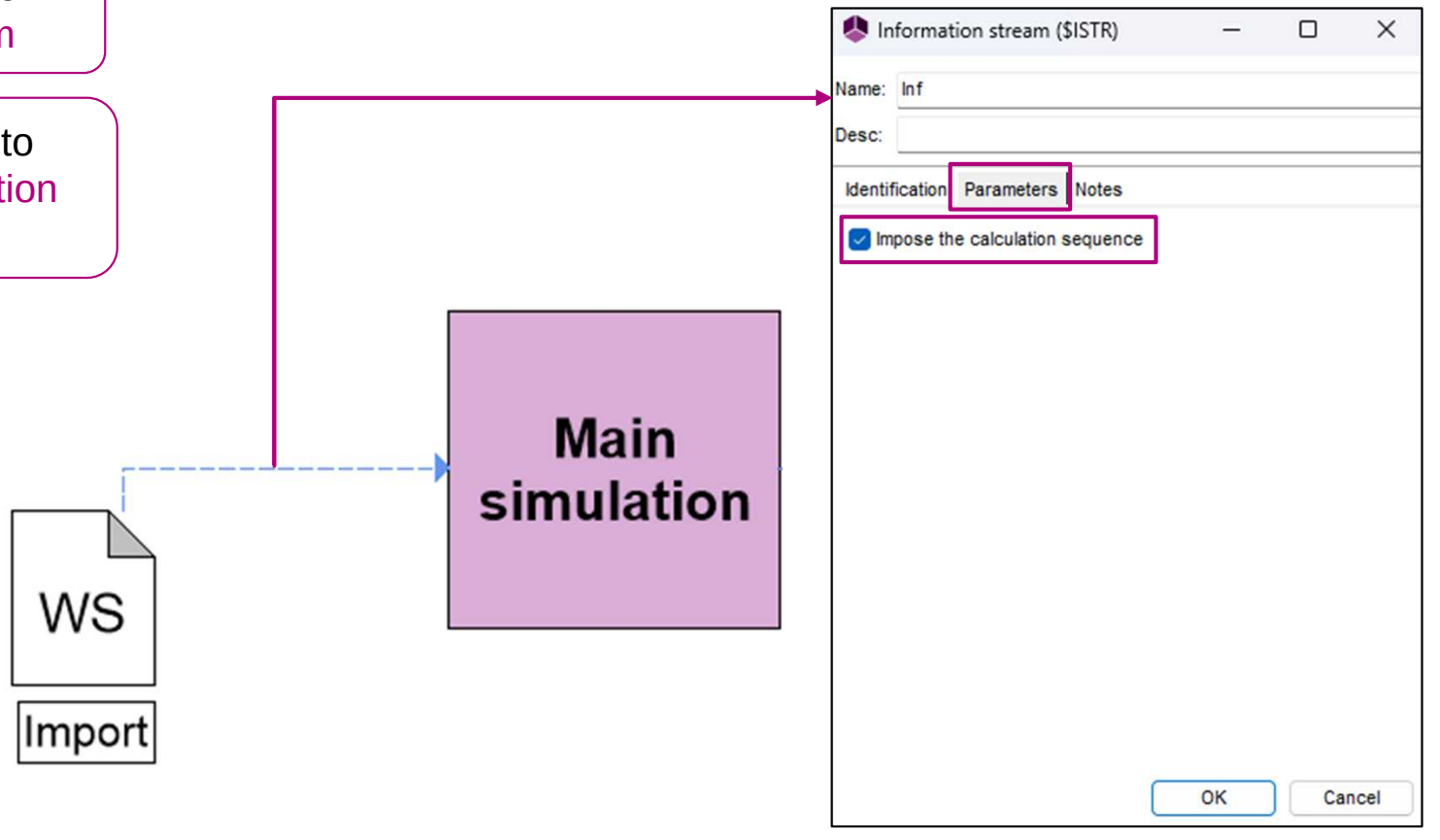
Concept

CONTEXT
In ProSimPlus, unit operations are consecutively calculated. The **Calculation sequence** is automatically determined by the program. However, in certain cases (particularly, when using a user-defined module), it may be necessary to manually impose the Calculation sequence. This can be achieved using **information streams**.

A Double click on the information stream

B Enable the option to impose the Calculation sequence



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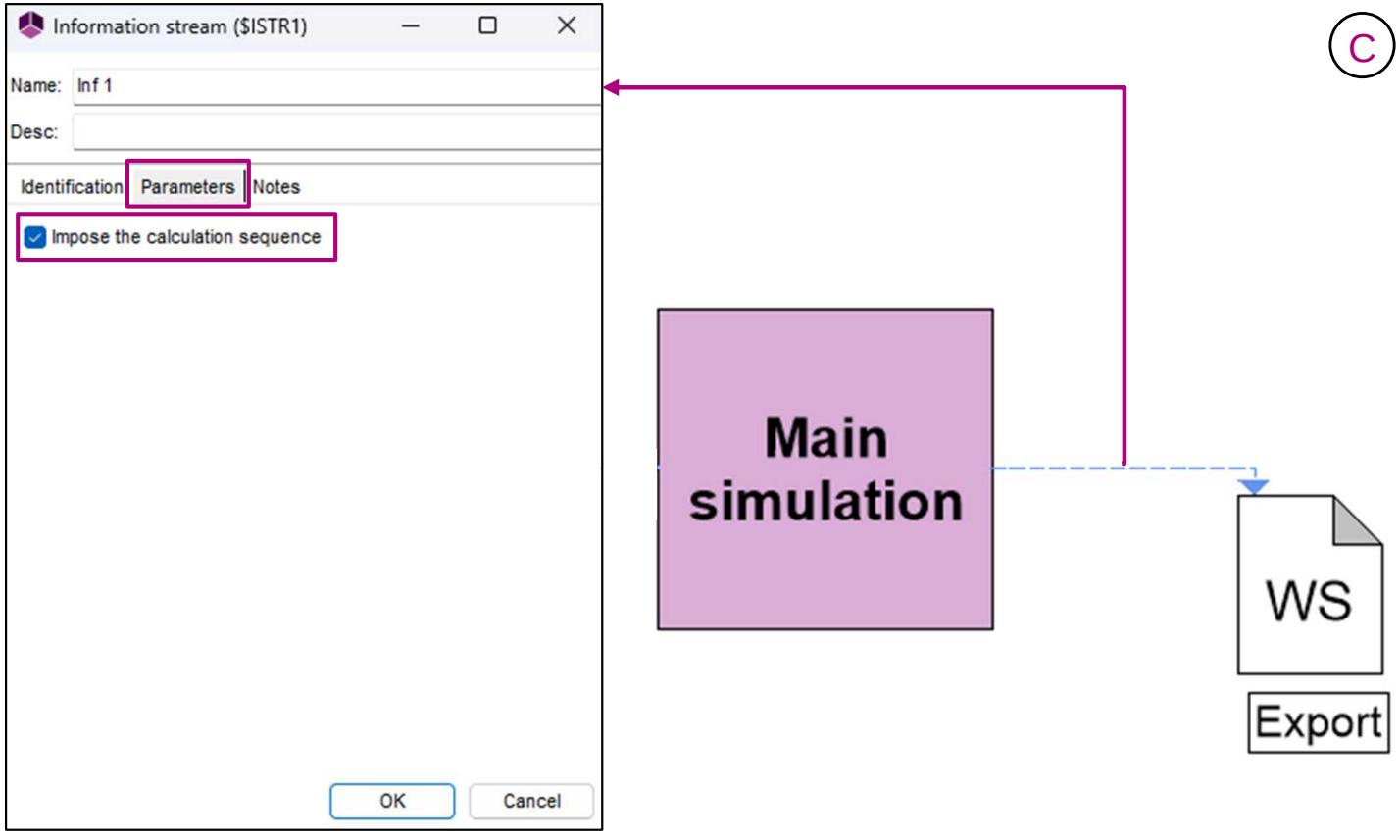
Concept

CONTEXT

In ProSimPlus, unit operations are consecutively calculated. The **Calculation sequence** is automatically determined by the program. However, in certain cases (particularly, when using a user-defined module), it may be necessary to manually impose the Calculation sequence. This can be achieved using **information streams**.



C Do the same for the other information stream

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CONCLUSION

This Getting Started shows how to fully leverage the capabilities of data manipulation in ProSimPlus through four key components:

1. **Data Transfer** - Easily share key values between unit operations.
2. **Specifications (“SPEC”)** - Set and control process targets.
3. **Information stream operator (“MANI”)** - Perform simple calculations on data and results.
4. **Calculation sequence** - Ensure scripts and modules run in the right order.

Together, these tools offer a flexible framework to enhance simulation logic and build smarter process models.

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Getting started with ProSimPlus®

Case 9: APPENDIX

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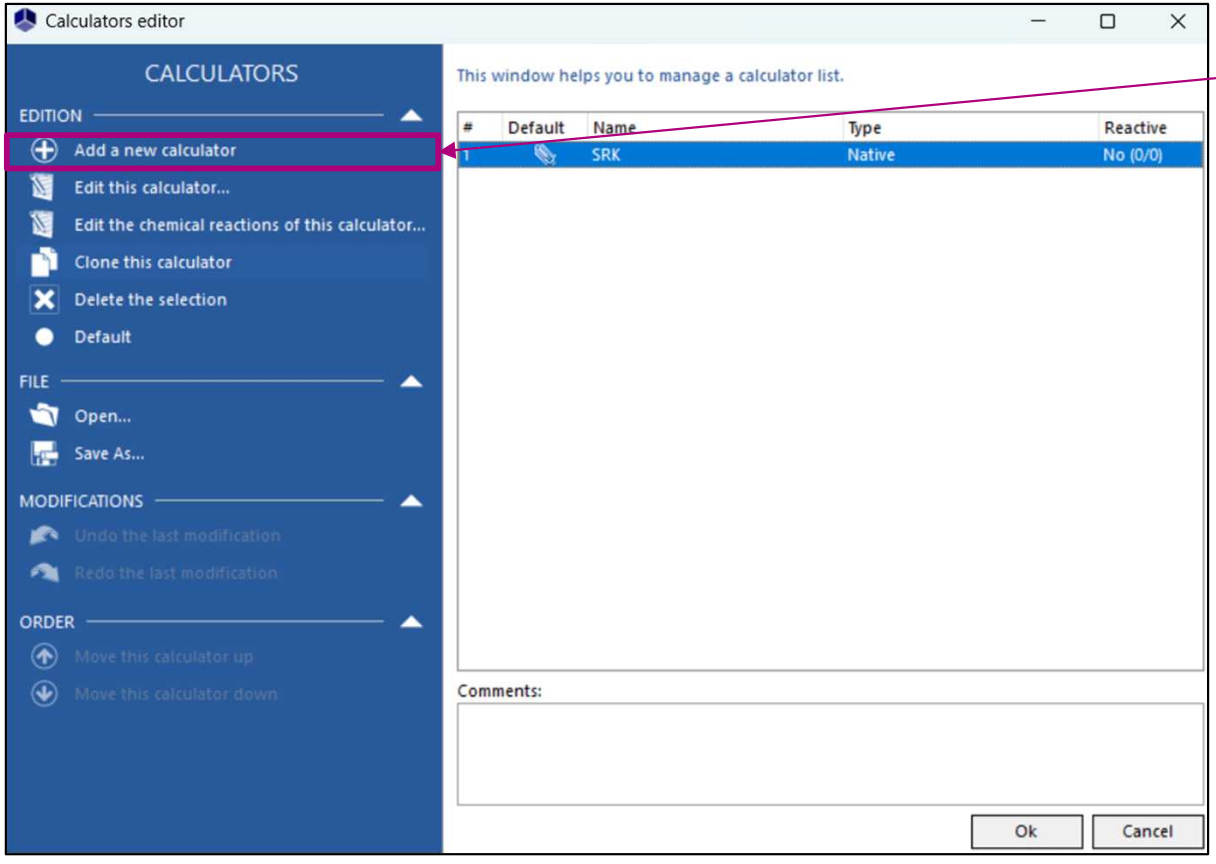
fives
Industry can do it

Creation of new calculator

Cold utility calculator: 1) Creation of new calculator



Click to add a new calculator

A

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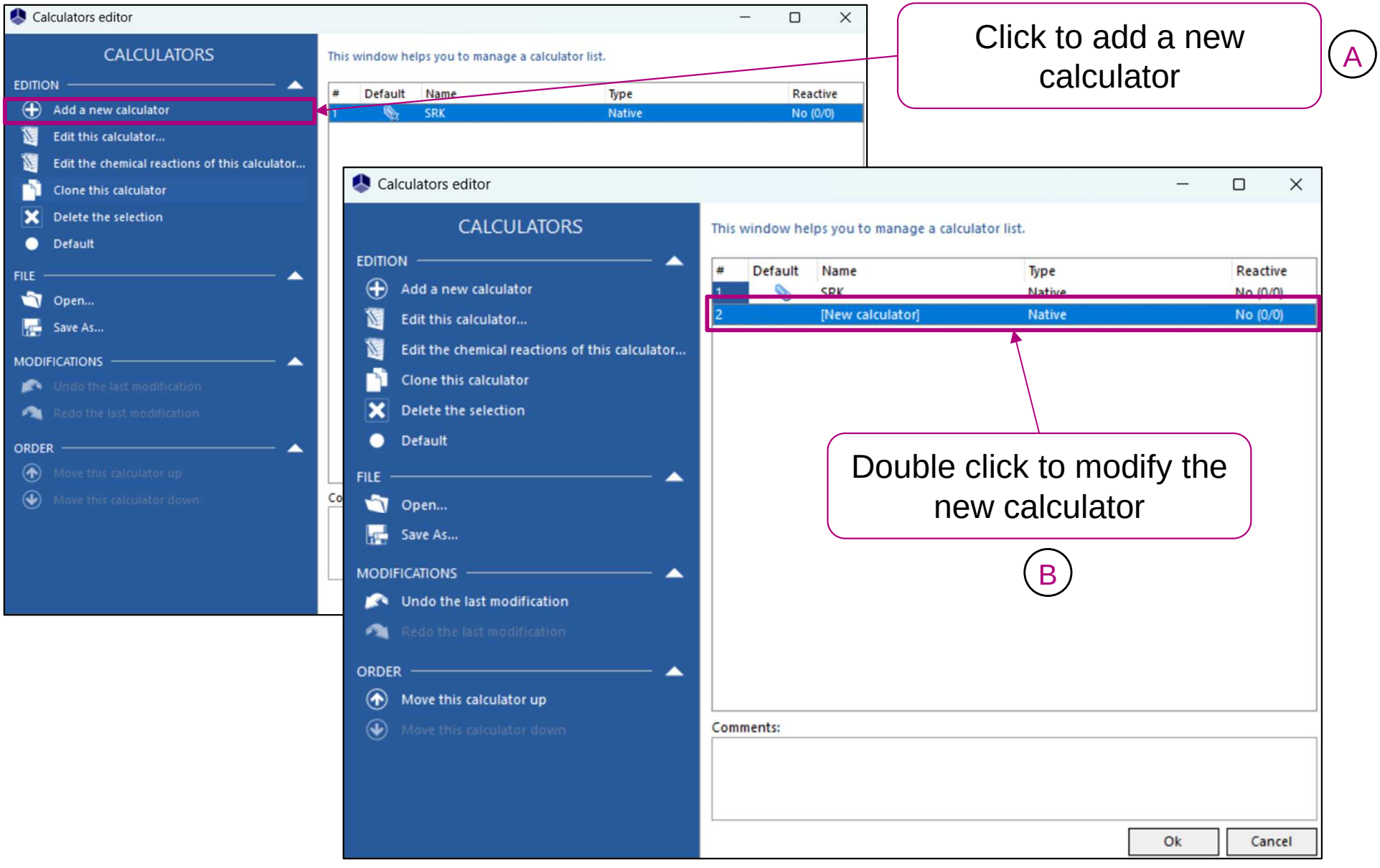
Creation of new calculator

Cold utility calculator: 1) Creation of new calculator



Click to add a new calculator

A

Double click to modify the new calculator

B

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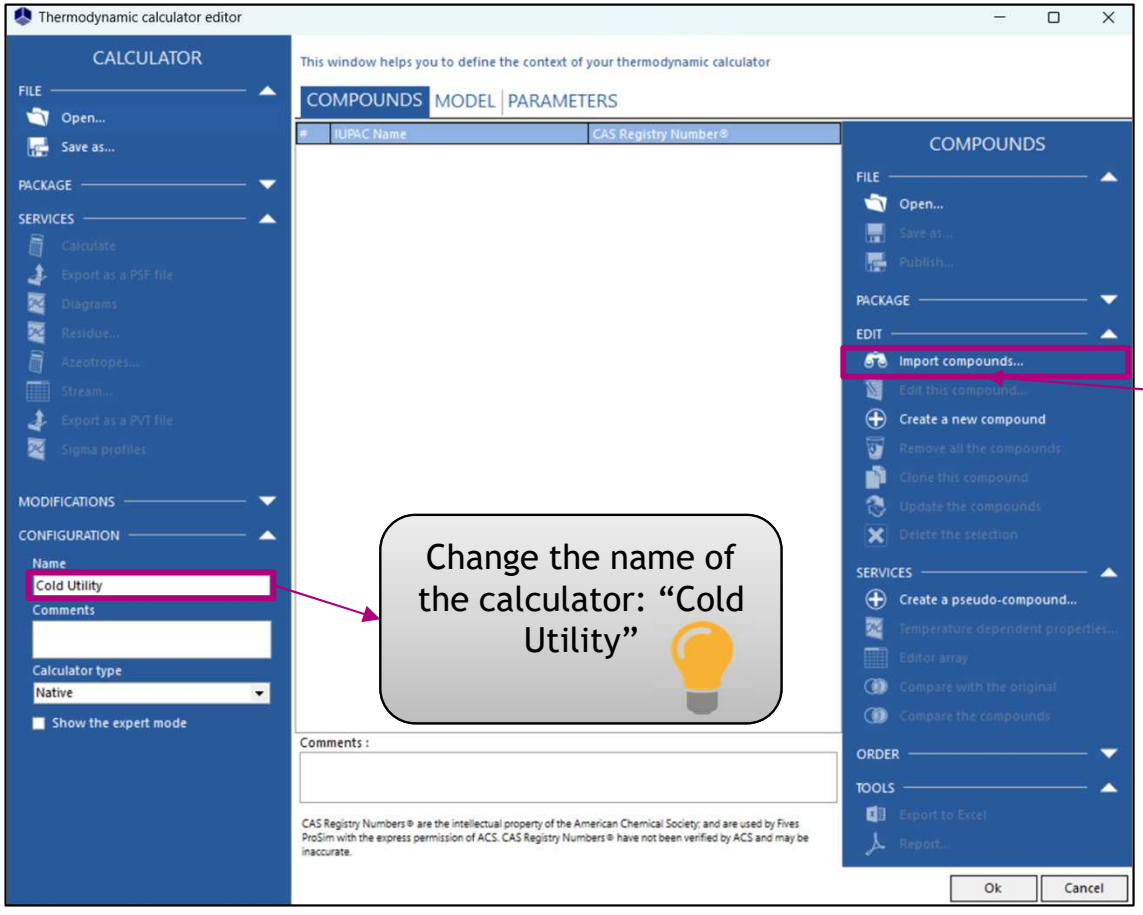
Creation of new calculator

Cold utility calculator: 2) Addition of components to the calculator



A

Click here to import the compounds

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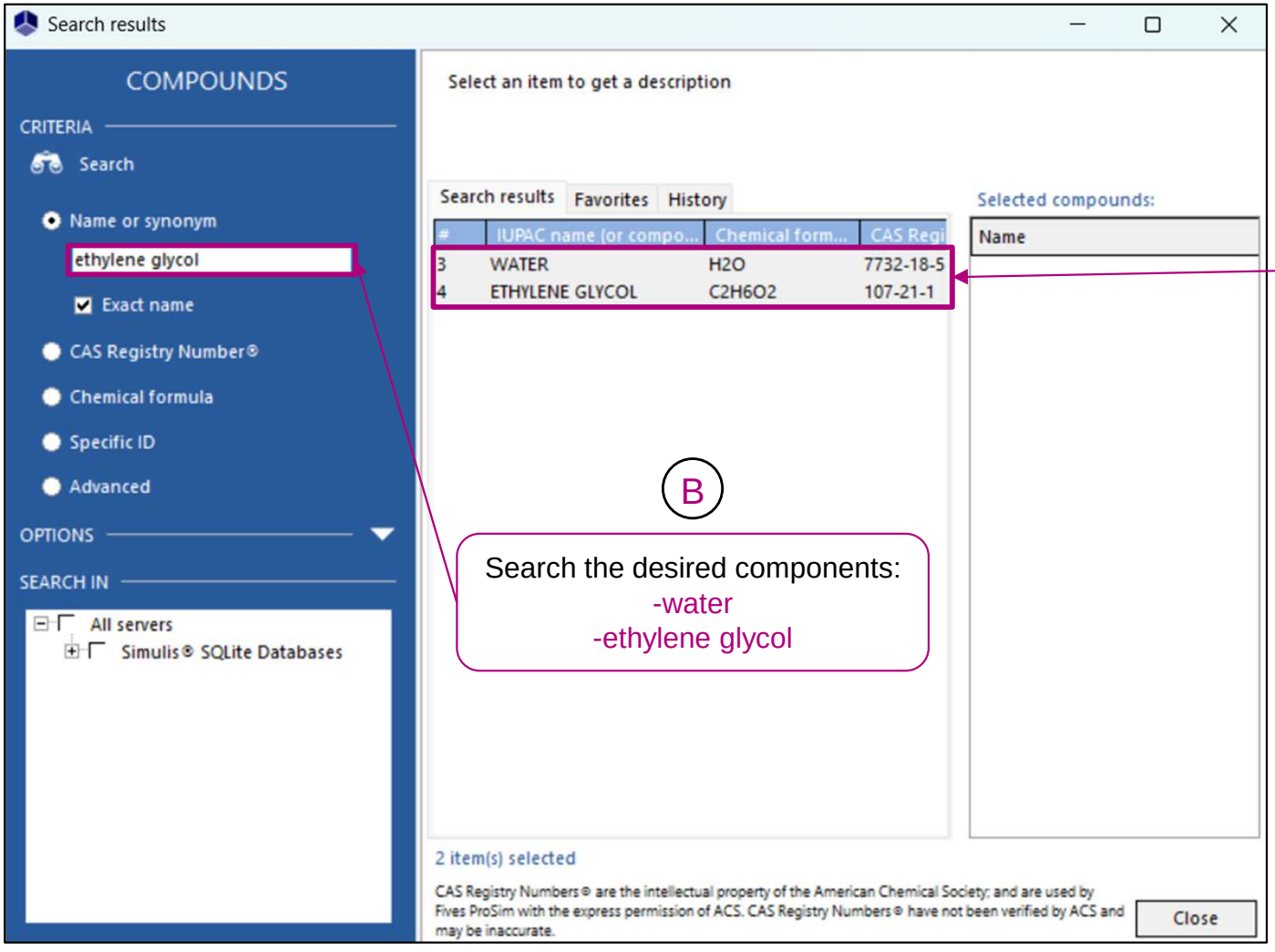
Creation of new calculator

Cold utility calculator: 2) Addition of components to the calculator



B

Search the desired components:
-water
-ethylene glycol

C

Double click on each of the selected components

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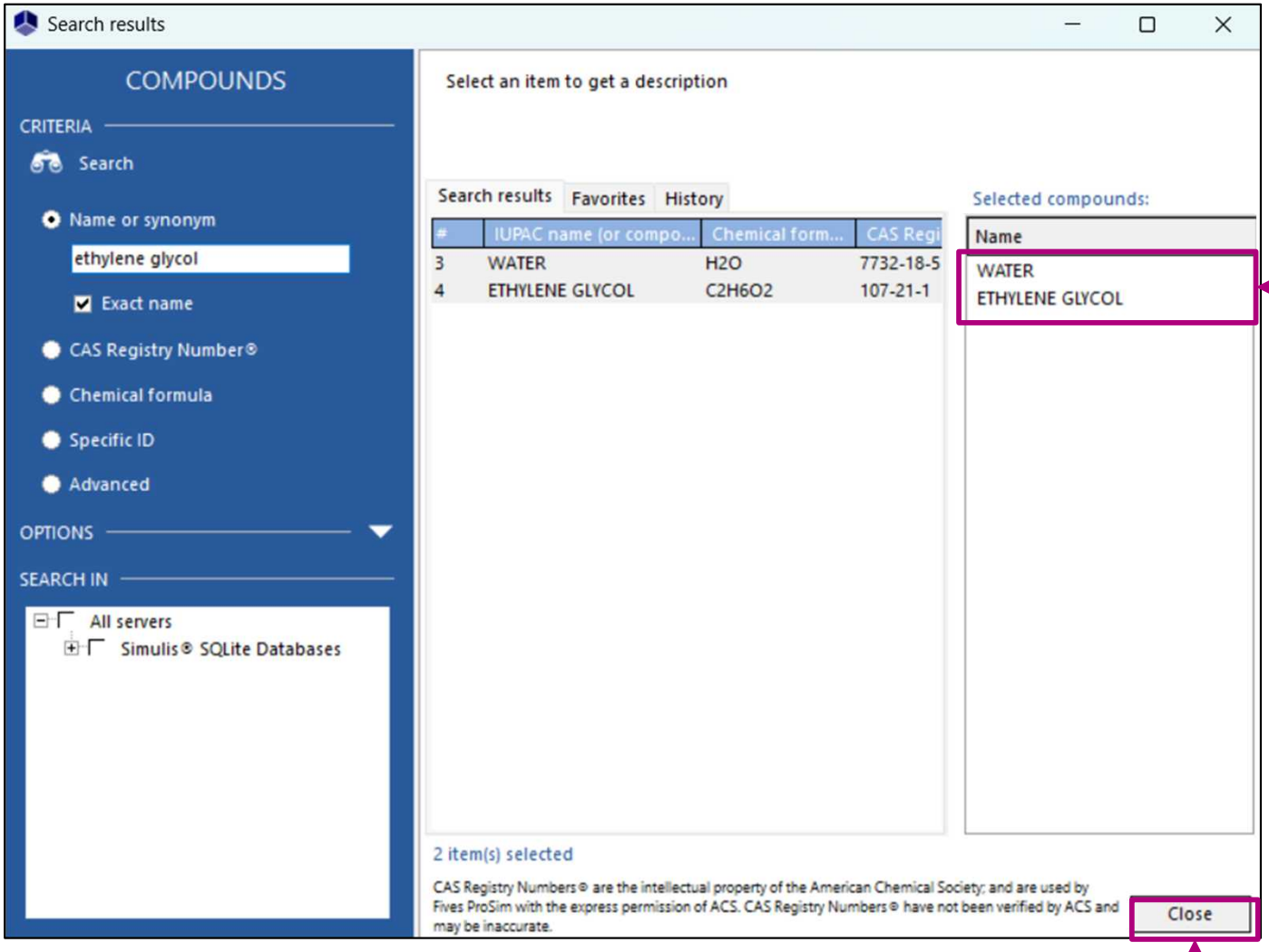
Creation of new calculator

Cold utility calculator: 2) Addition of components to the calculator



This will add them to the selected compounds list

D

Click on Close to save the information

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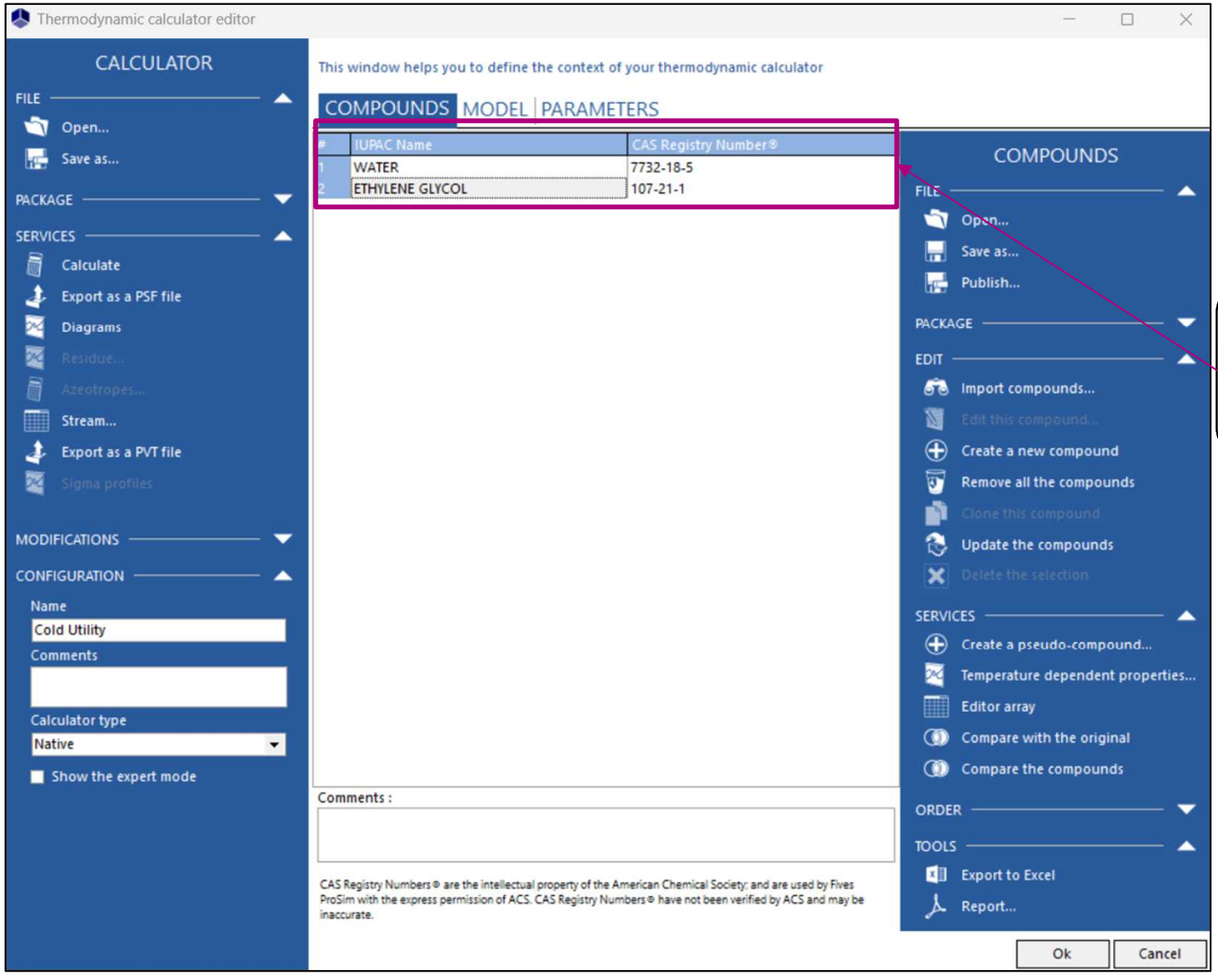
Creation of new calculator

Cold utility calculator: 2) Addition of components to the calculator



The desired compounds were added to the current calculator (Cold Utility)

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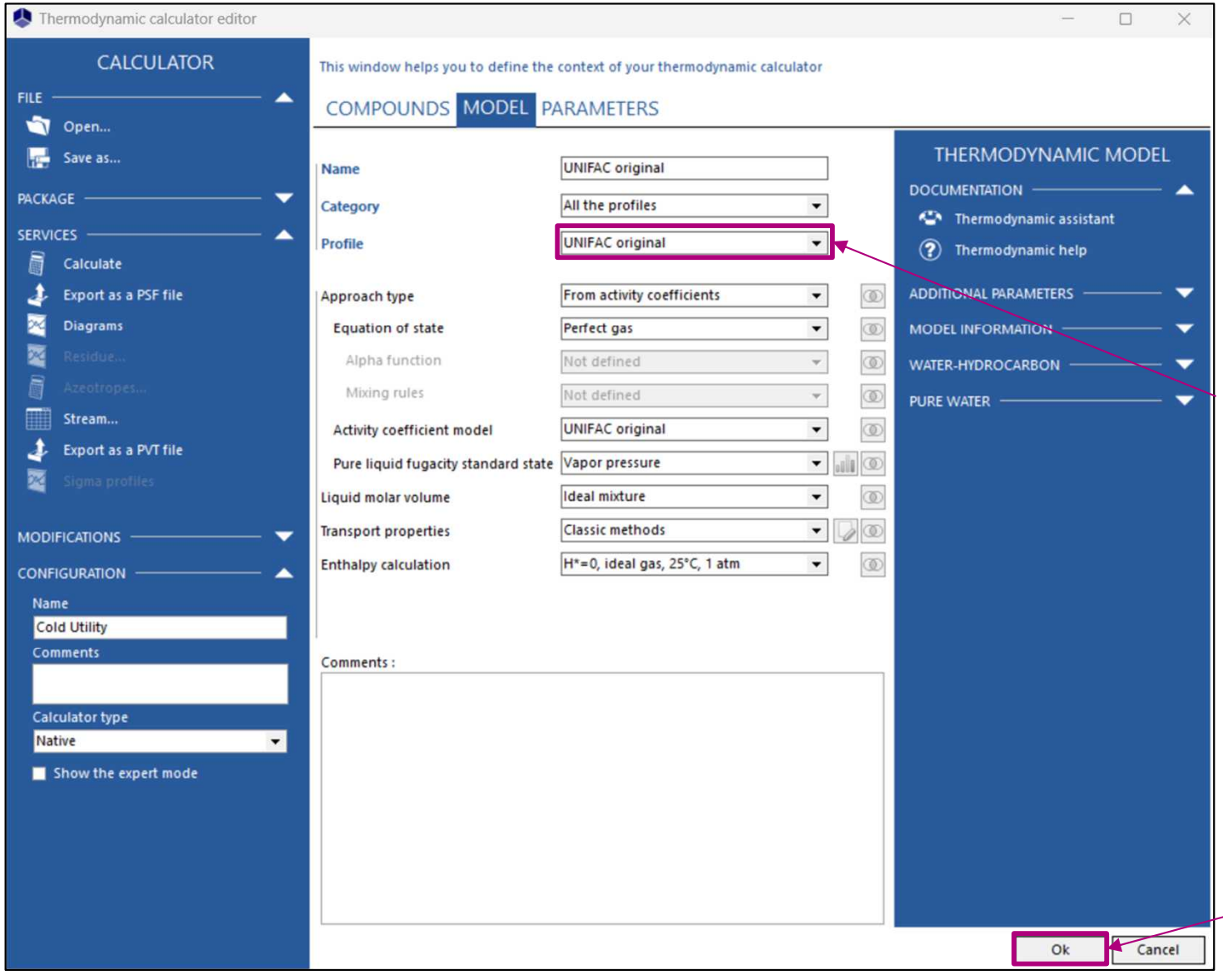
Creation of new calculator

Cold utility calculator: 3) Selection of thermodynamic model



A

Select UNIFAC original as the thermodynamic profile for this calculator

B

Click on “OK” to save the information

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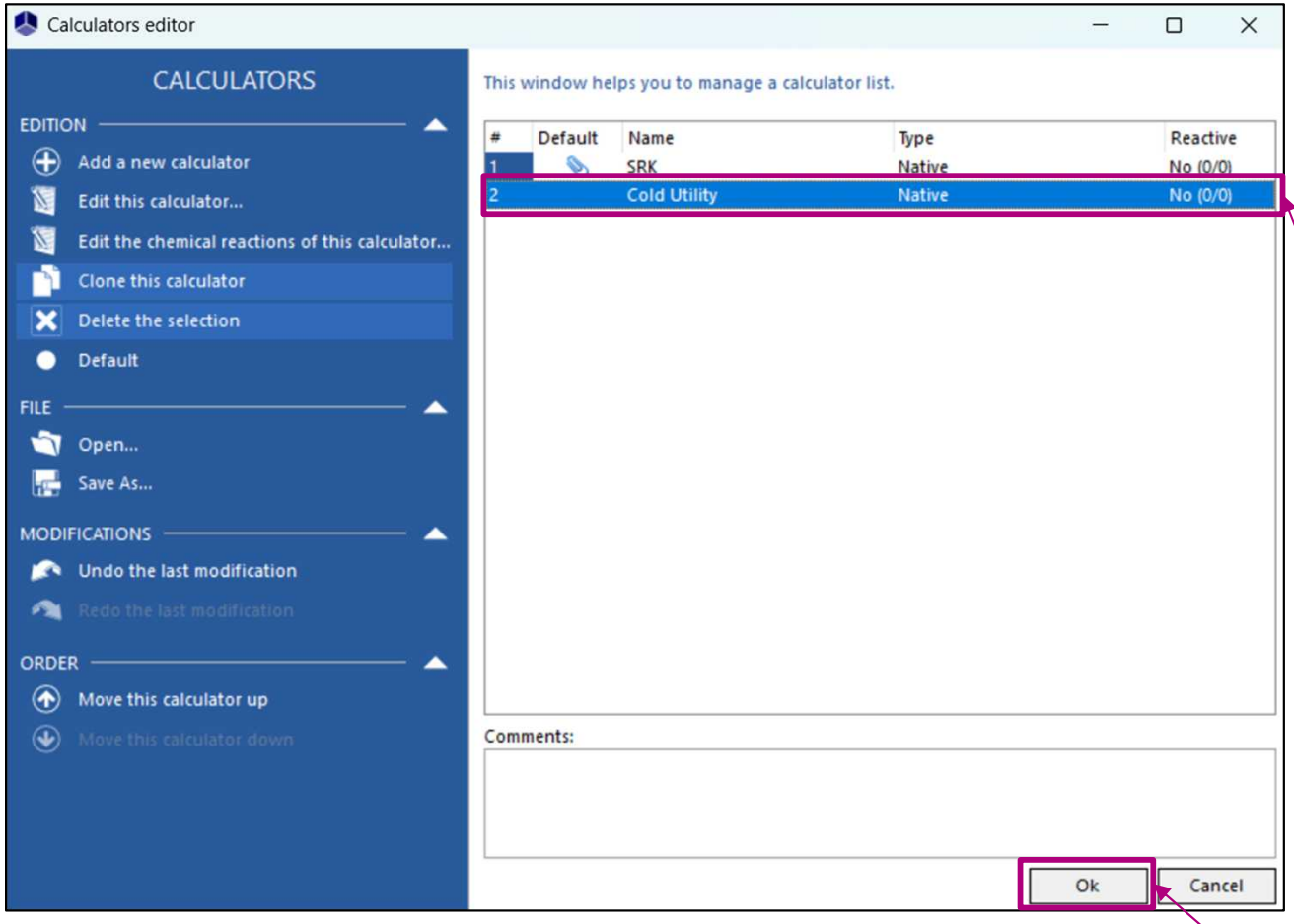
Creation of new calculator

Cold utility calculator: 4) Save the calculator



The new calculator (Cold Utility) is now ready to be used

A

Click on "OK" to save the information

Return

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