Getting started with ProSec®

in ProSimPlus® environment

Use Case 2: Import/export parameters/results
Use case study capability
Define a specification

Software & Services In Process Simulation

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ProSim

Introduction

- This document presents how to modify a parameter to meet a specification in ProSec, ProSim's CAPE-OPEN compliant unit operation dedicated to the simulation of brazed plate-fin heat exchangers.
- The objective is to determine the splitting ratio of a side stream to obtain a specified heat duty.
- In this document, ProSec is used in ProSimPlus, ProSim's steady state simulation software.
- This step by step guide starts after the "Main features overview" getting started with ProSec in ProSimPlus environment document. It's advise to start by this first getting started before doing this one.

Methodology

- To exchange information between ProSec CAPE-OPEN unit operation and the simulation environment, inlet and outlet information ports have to be defined in ProSec.
  - Inlet port: Information port by which a parameter of the CAPE-OPEN unit operation is available for the simulation environment (e.g. to modify it during the simulation).
  - Outlet port: Information port by which a result of the CAPE-OPEN unit operation can be recovered in the simulation environment (e.g. to compare it to a set point).

The inlet and outlet parameters are expressed in ISO units.

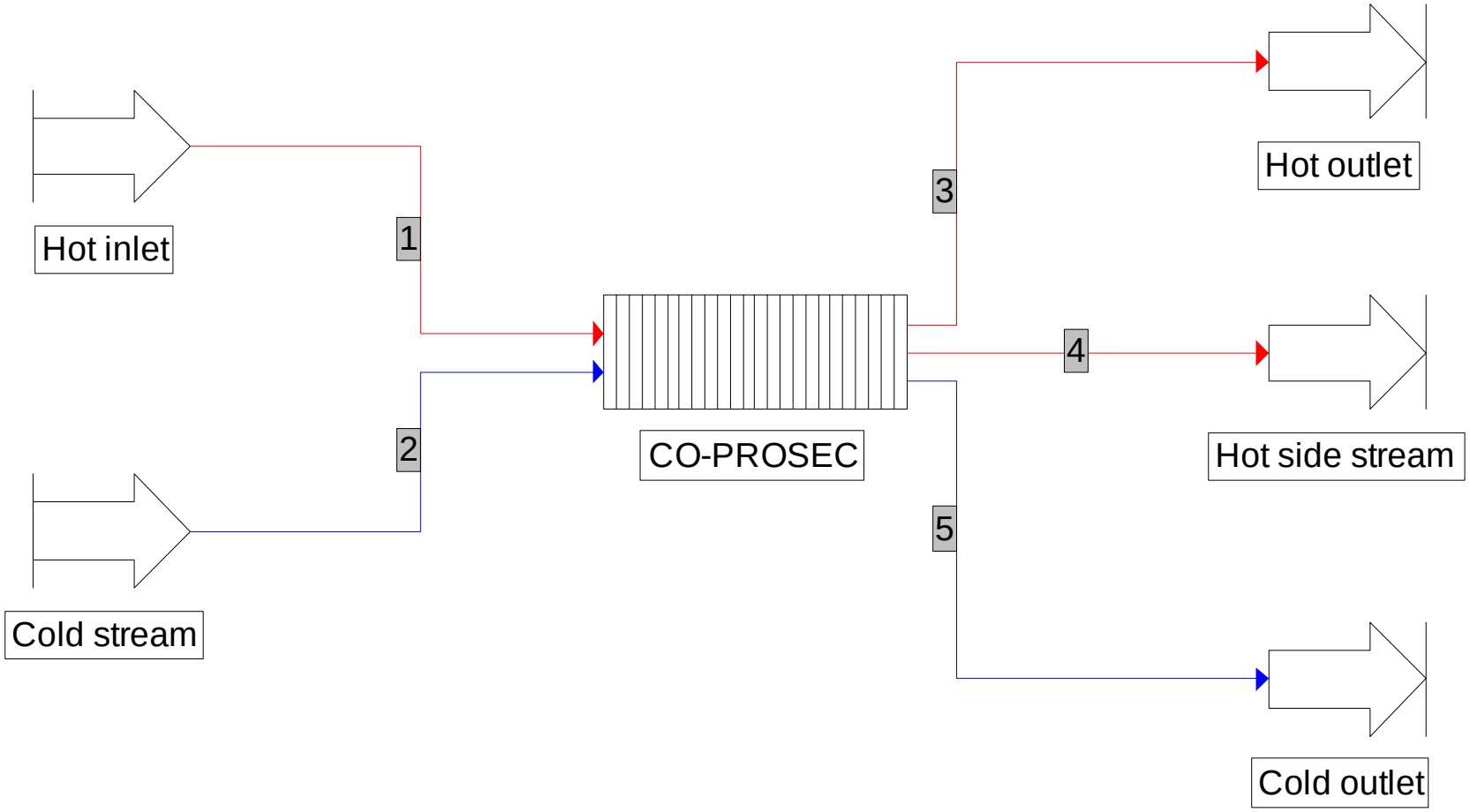
- In ProSimPlus simulation environment, the inlet and outlet information port have to be connected to windows script unit operations to be used during the simulation.

Methodology

- The methodology is:
  - Specify the inlet and outlet information ports in ProSec.
  - Create the windows script unit operations in ProSimPlus and connect them to ProSec.
  - Use the case study capability of ProSimPlus to check:
    - If the splitting ratio has an impact on the exchanger heat duty
    - If the specification can be reached
  - Set up the control in the simulation using a “Constraints & recycles management” module.

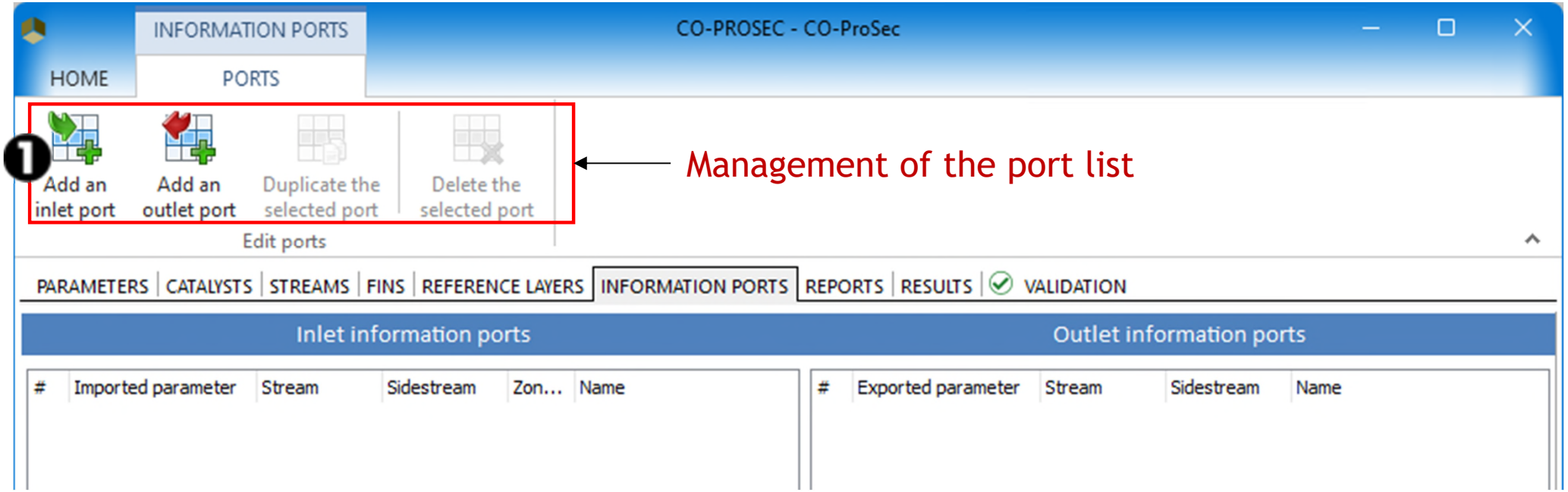
Starting point

- Simulation obtained at the end of the “Main features overview” getting started with ProSec in ProSimPlus environment document.



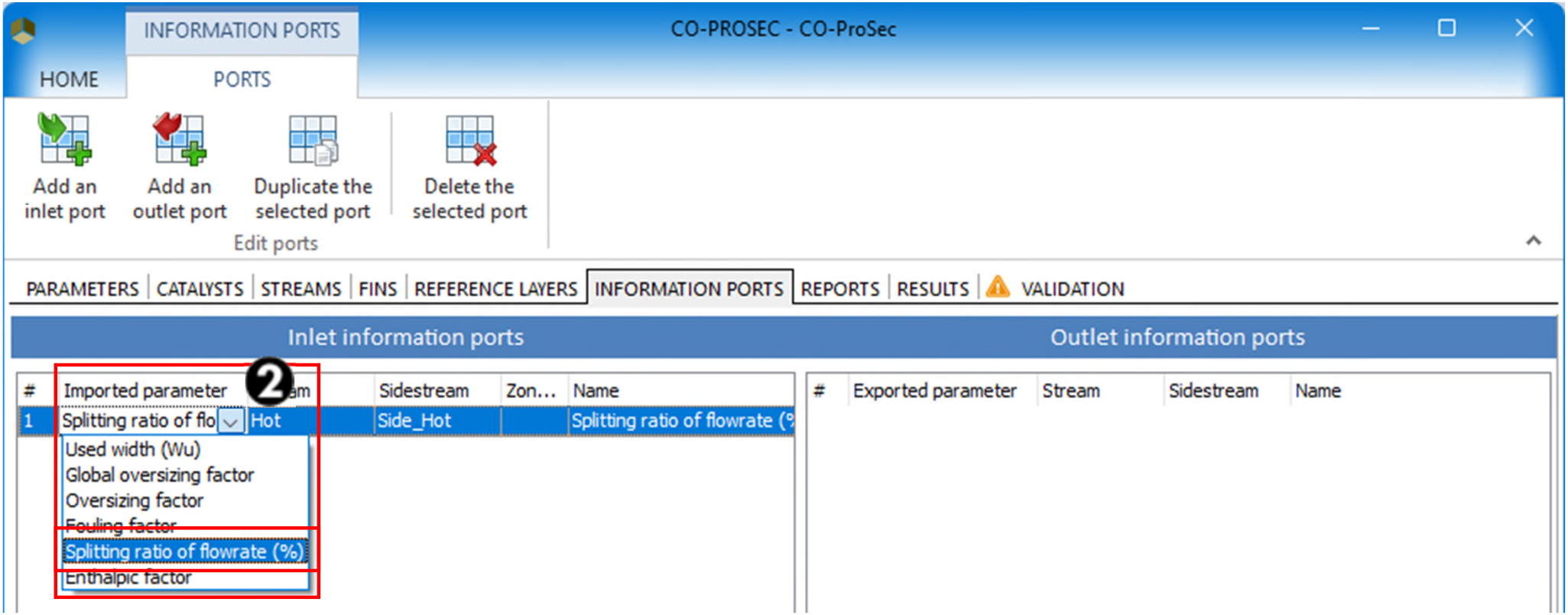
Step 1: Add information ports in ProSec

- Open (edit) ProSec unit operation.
- Go to “Information ports” tab
  1. Click on “Add an inlet port” to add the inlet information port



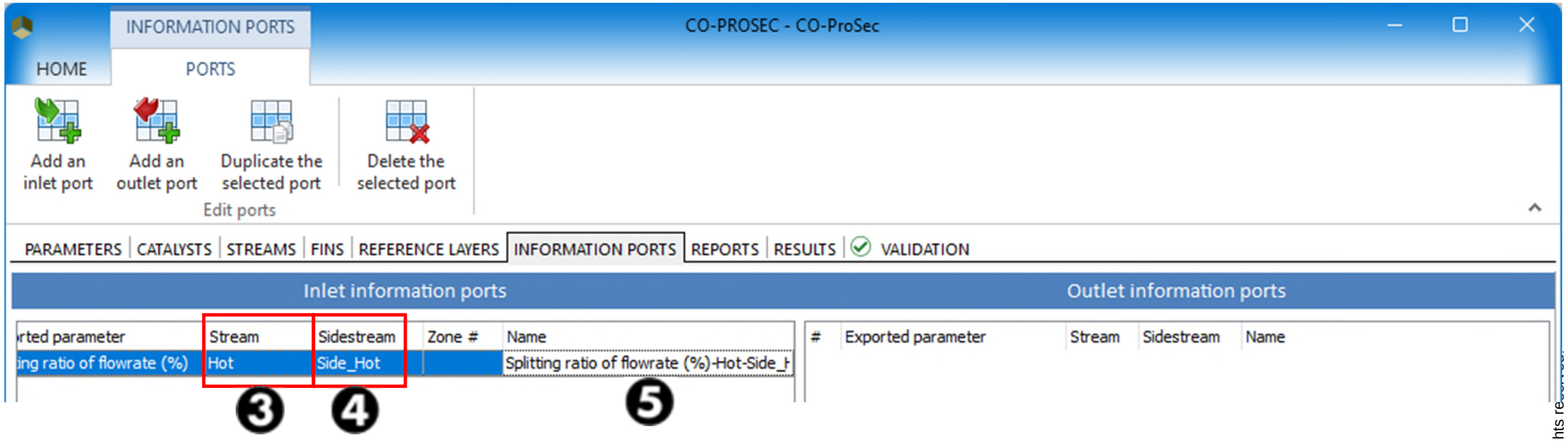
Step 1: Add information ports in ProSec

- "Information ports" tab
  2. In the "Imported parameter" menu, select "Splitting ratio of flowrate (%)"



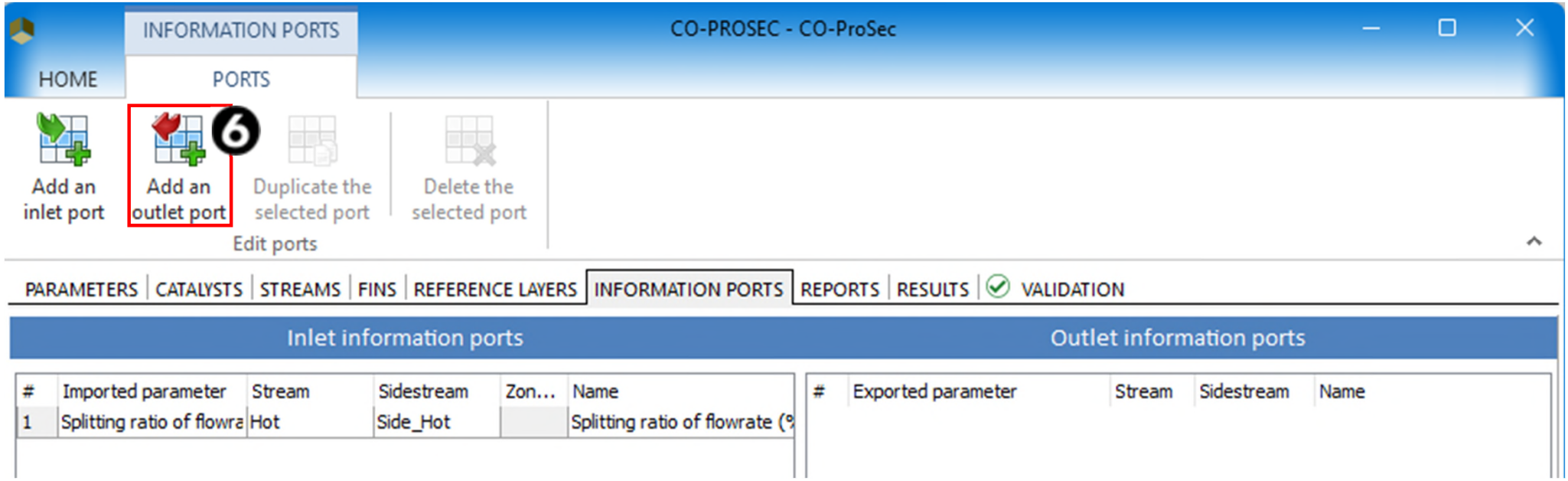
Step 1: Add information ports in ProSec

- "Information ports"
  3. In the "Stream" menu, select "Hot" (i.e. the name of the hot stream)
  4. In the "Sidestream" menu, select "Side_Hot" (i.e. the name of the side stream of the hot stream)
  5. Option: The name of the imported parameter can be changed



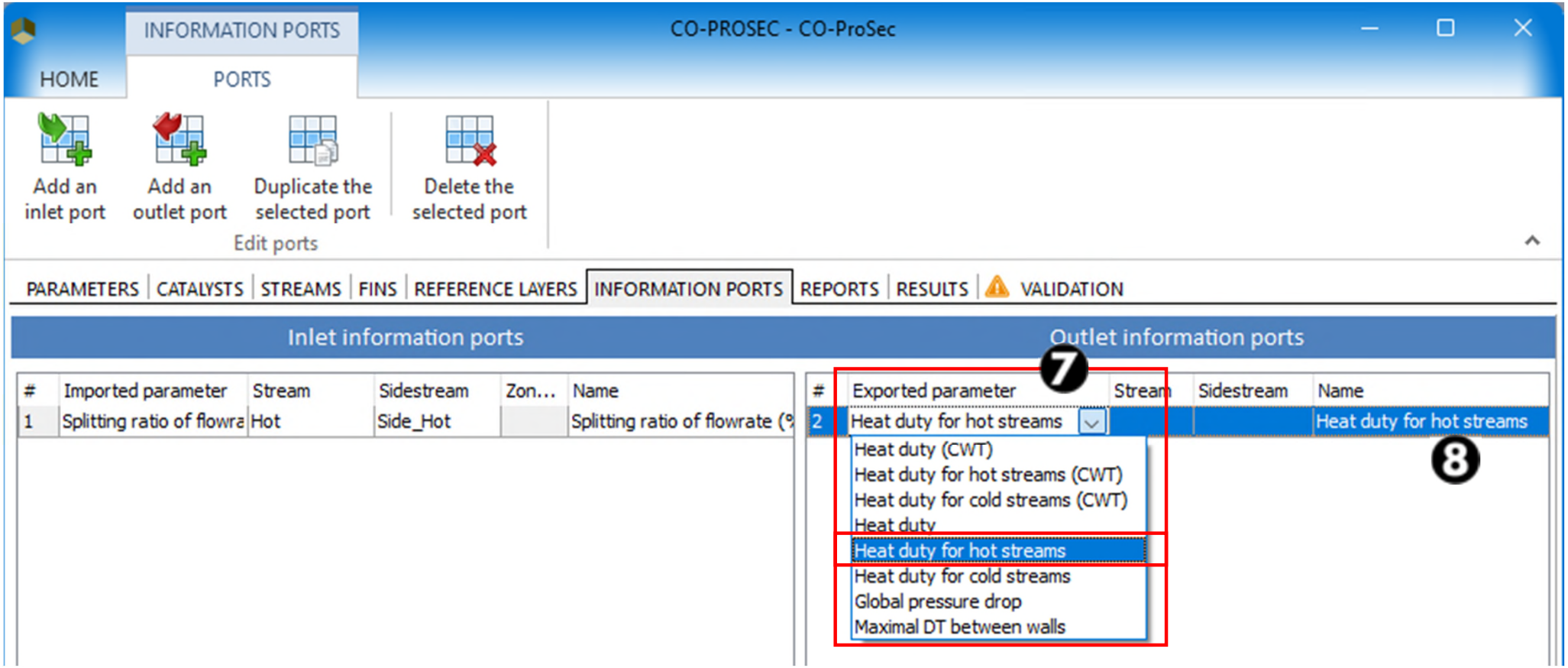
Step 1: Add information ports in ProSec

- “Information ports”
  6. Click on “Add an outlet port” to add the outlet information port



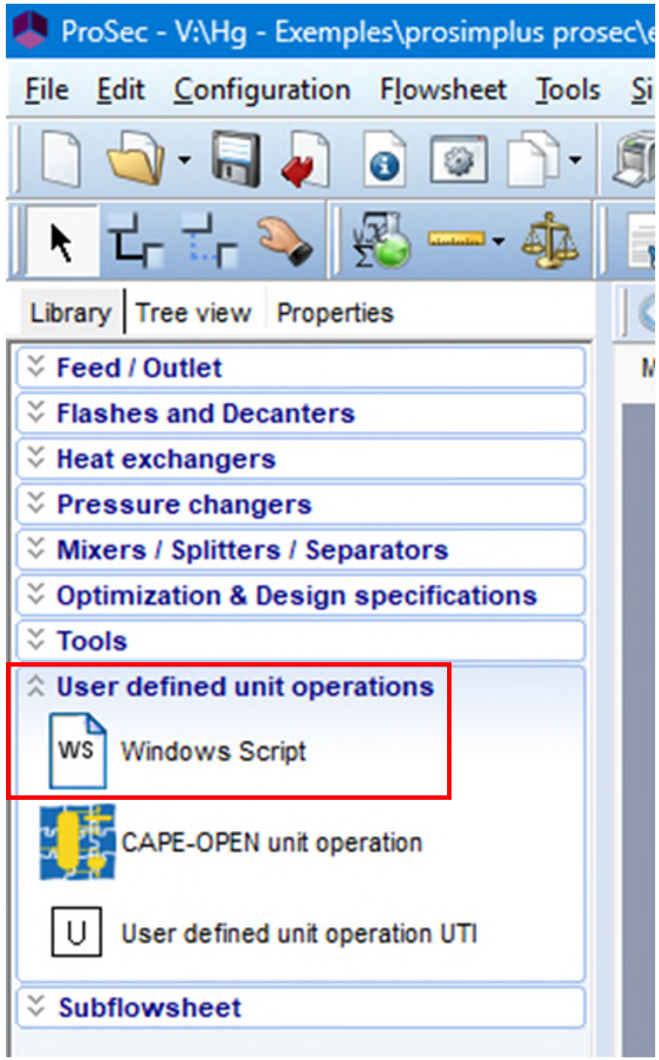
Step 1: Add information ports in ProSec

- "Information ports" tab
  7. In the "Exported parameter" menu, select "Heat duty for the hot streams"
  8. Option: The name of the exported parameter can be changed



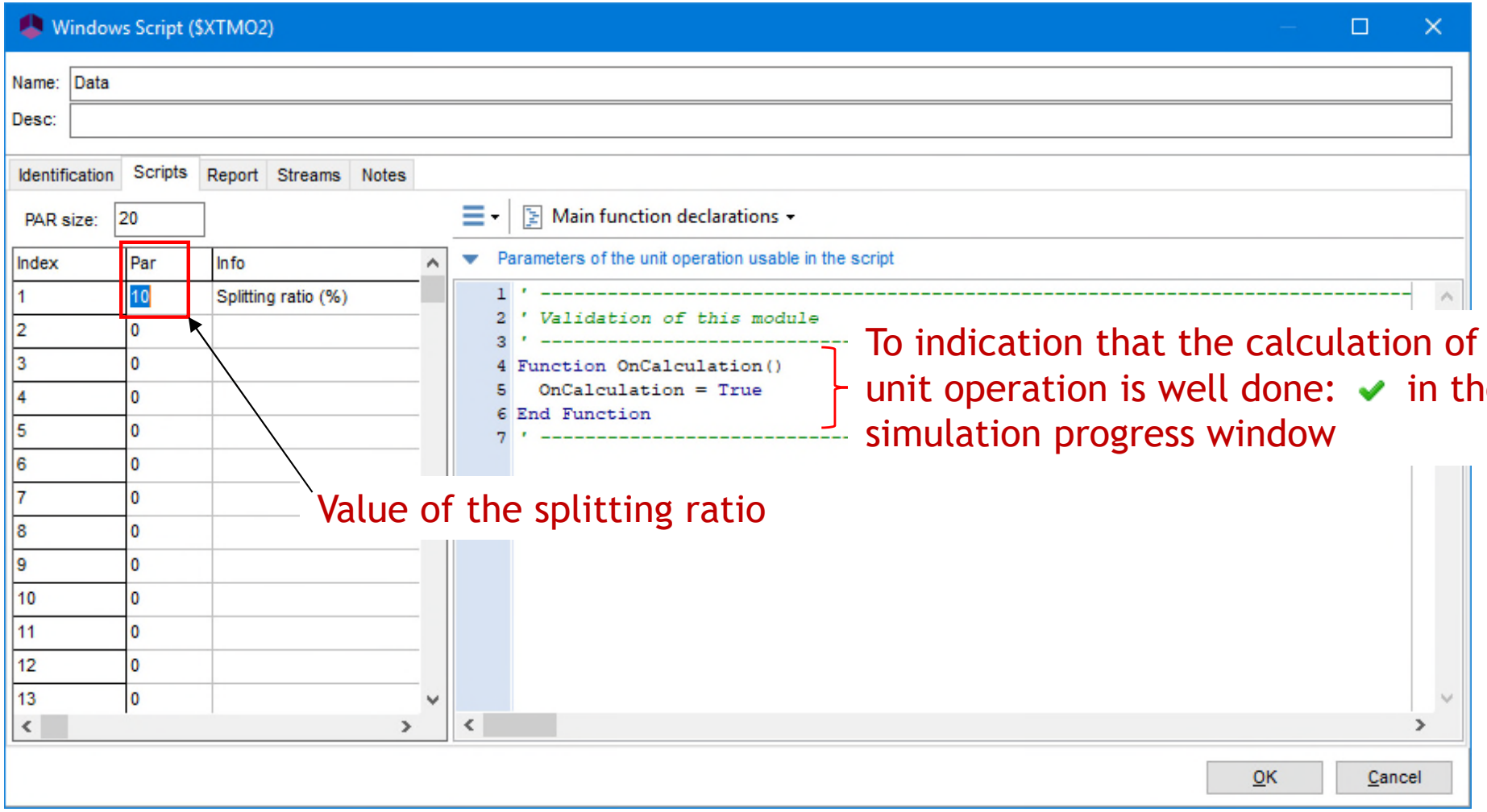
Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Add the first windows script module (named “Data”) to allow the modification of the splitting ratio in ProSec by ProSimPlus.



Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- The value of the splitting ratio is stored in the position #1.

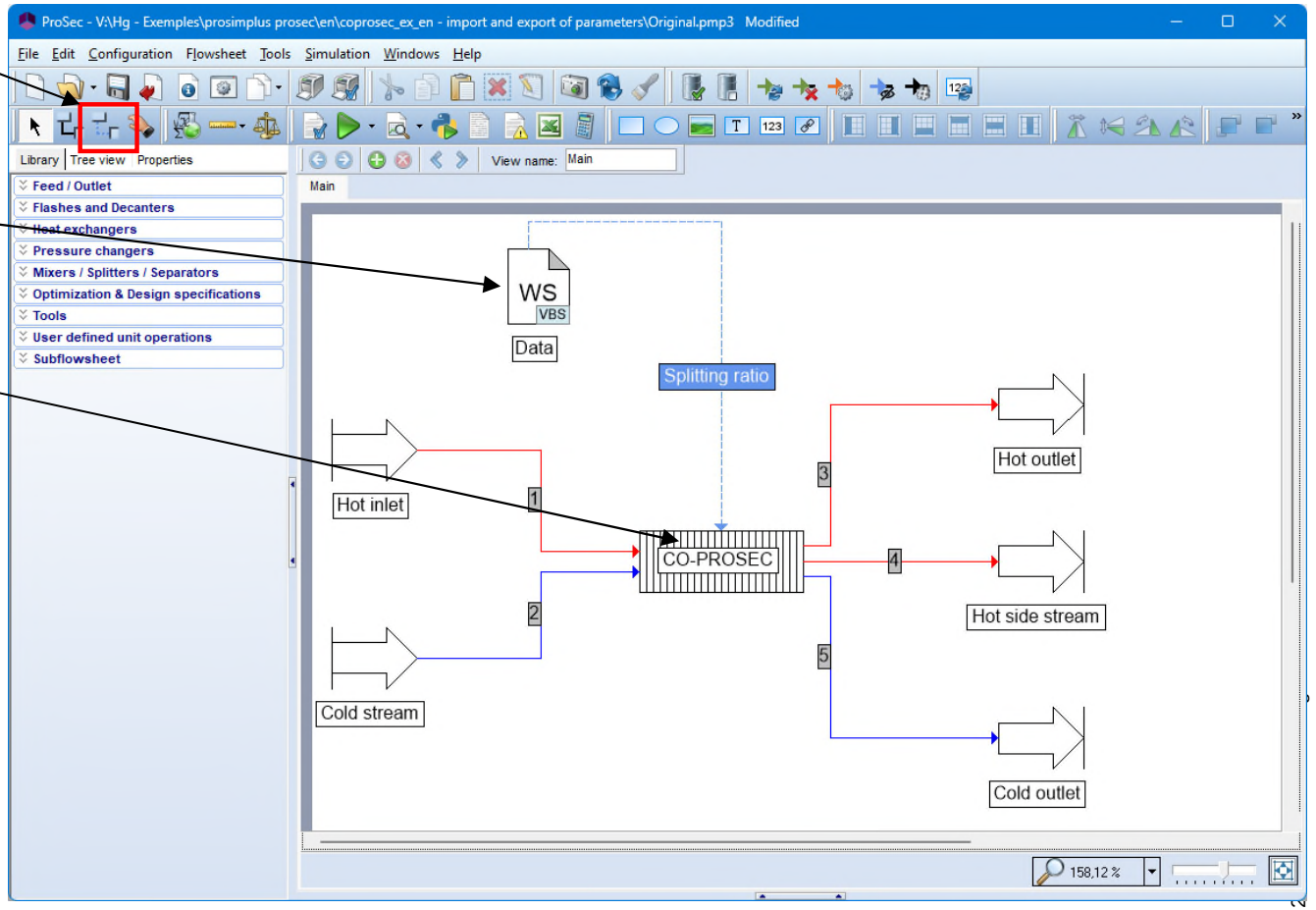


Use the “Info” cells to comment the parameters

Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Use an information stream to connect the “Data” windows script and the ProSec modules. By this way the splitting ratio value stored in “Data” will erase the one stored in ProSec.

1. Select the “Create an information stream” icon
2. Select the first unit operation (source) by clicking on it
3. Select the connected unit operation (target) by clicking on it as well

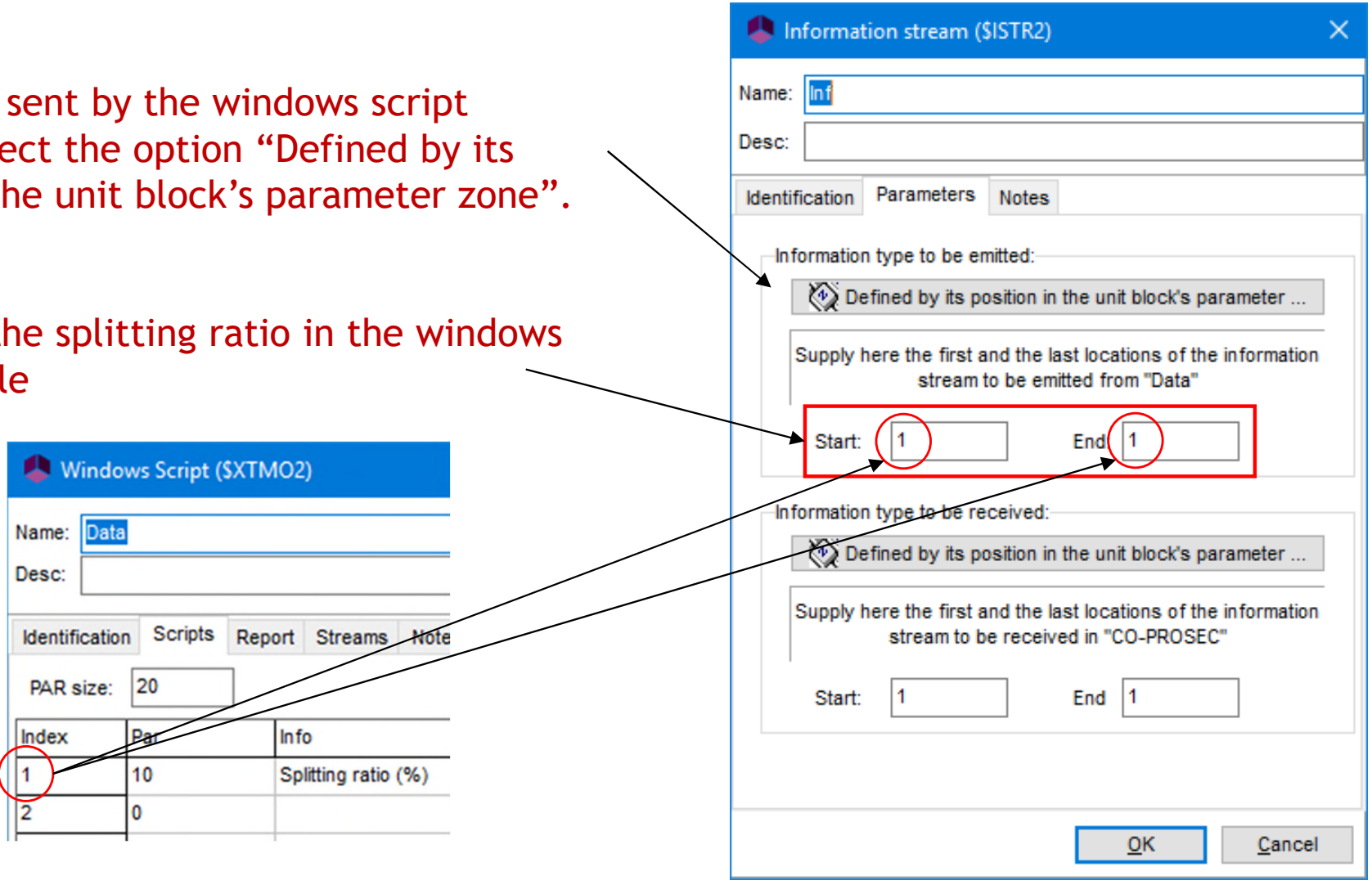


Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Enter the parameters in this information stream. Feel free to change the default name.

Information sent by the windows script module. Select the option “Defined by its position in the unit block’s parameter zone”.

Position of the splitting ratio in the windows script module

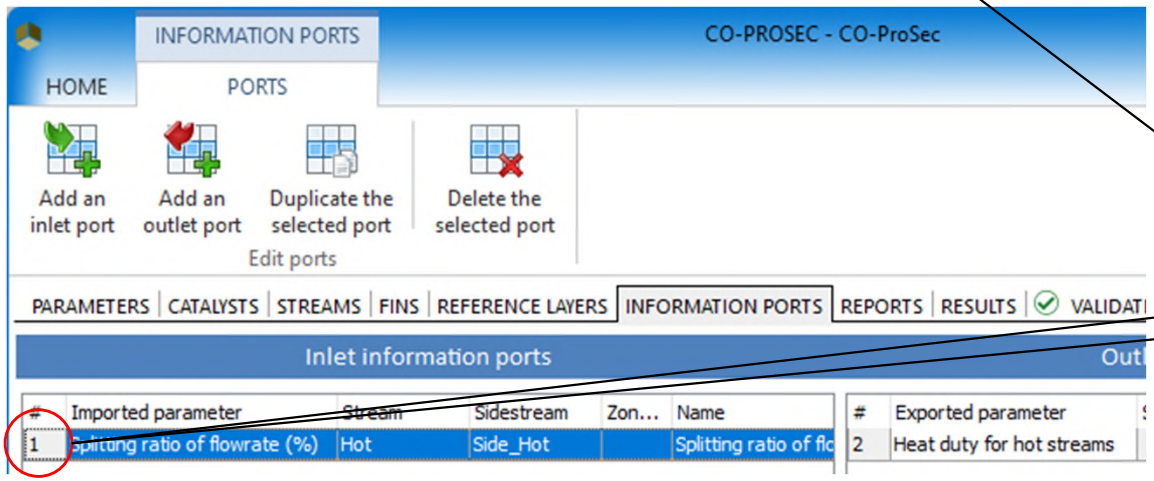


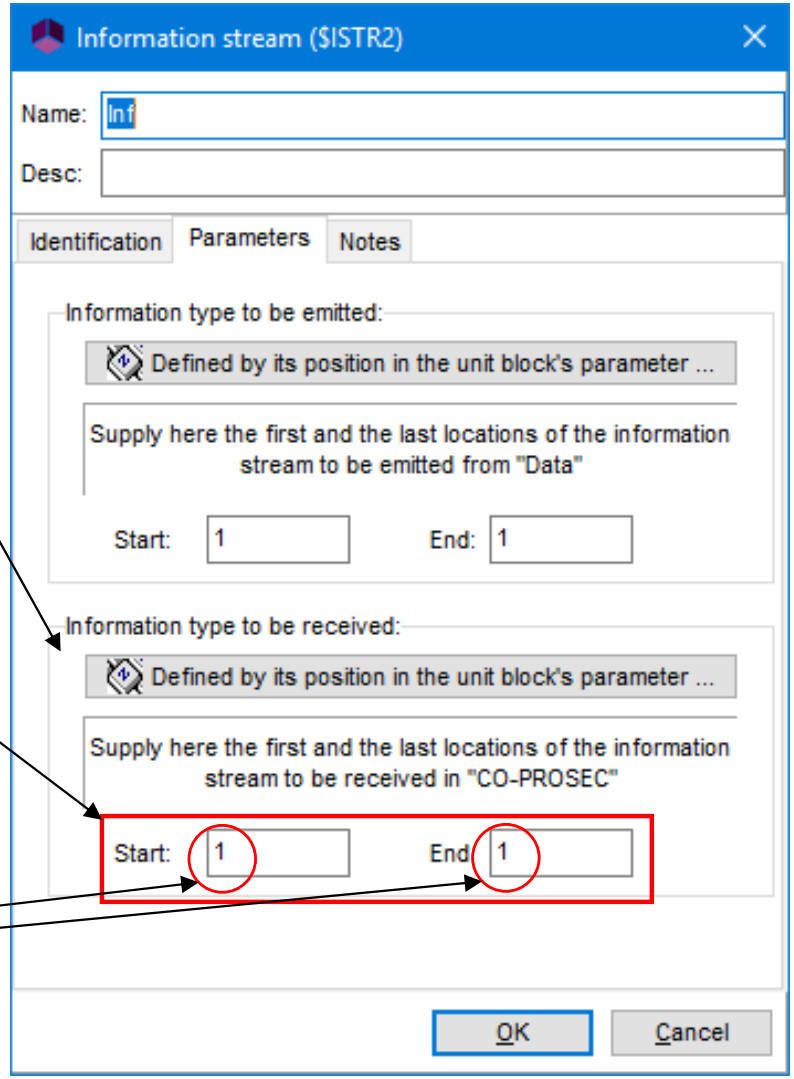
Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Enter the parameters in this information stream. Feel free to change the default name.

Information received by ProSec module. Select the option “Defined by its position in the unit block’s parameter zone”.

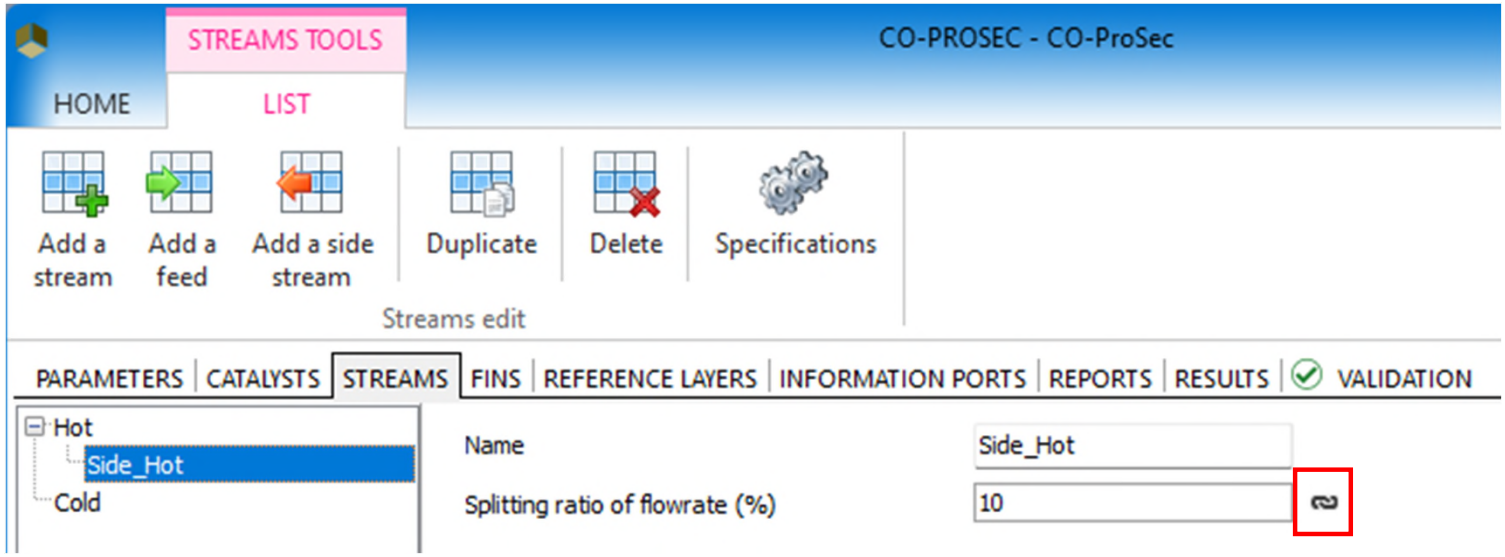
Position of the splitting ratio in the information port list of ProSec





Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- In ProSec interface, the 🔗 sign in front of a parameter indicates that it can be modified through an information stream (e.g. the splitting ratio in this getting started).



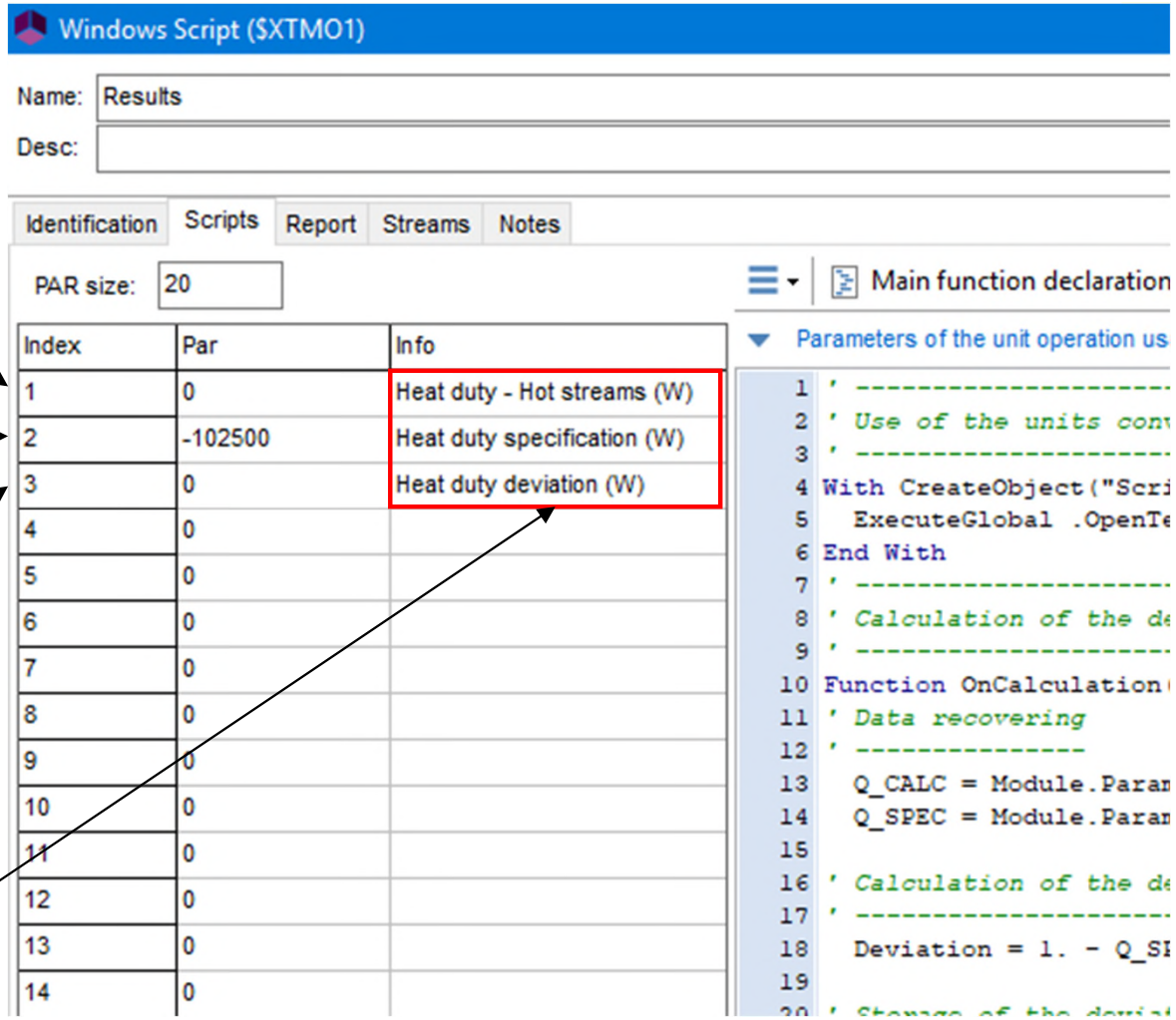
Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Add the second windows script module (named “Results”) to recover the exchanger heat duty and compare it to a set point.

Position 1:
Exchanger heat duty, value from ProSec by the information stream

Position 2:
Heat duty set point

Position 3:
Deviation between the heat duty calculated by ProSec and the heat duty set point



Give names to recover the parameters easily in the “Case study”.

Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Add the second windows script module (named “Results”) to recover the exchanger heat duty and compare it to a set point.

```
' ------------------------------------------------------------------------------
' Use of the units conversions pre-coded script
' ------------------------------------------------------------------------------
With CreateObject("Scripting.FileSystemObject")
  ExecuteGlobal .OpenTextFile(Project.ApplicationPath & "Scripts\UnitConversion.vbs", 1).ReadAll()
End With
' ------------------------------------------------------------------------------
' Calculation of the deviation
' ------------------------------------------------------------------------------
Function OnCalculation()
' Data recovering
' ---------------
  Q_CALC = Module.Parameter(1)
  Q_SPEC = Module.Parameter(2)

' Calculation of the deviation
' ----------------------------
  Deviation = 1. - Q_SPEC/Q_CALC

' Storage of the deviation
' ------------------------
  Module.Parameter(3) = Deviation

' Validation of this module
' -------------------------
  OnCalculation = True
End Function
' ------------------------------------------------------------------------------
' Impression des résultats
' ------------------------------------------------------------------------------
Sub OnPrintResults()
' Report unit selected by the user
' --------------------------------
  EnthalpicFlow_Unit   = ReportUnit("Enthalpic flow")

  Relative_Deviation = 100.*abs(Module.Parameter(2) - Module.Parameter(1))/abs(Module.Parameter(2))

' Printings
' ---------
  With Module
    .PrintReport("HEAT DUTIES")
    .PrintReport("----------------")
    .PrintReport("   - Hot streams : " & Convert("Enthalpic flow", .Parameter(1), "W", EnthalpicFlow_Unit) & " " & EnthalpicFlow_Unit)
    .PrintReport("")
    .PrintReport("   - Set point   : " & Convert("Enthalpic flow", .Parameter(3), "W", EnthalpicFlow_Unit) & " " & EnthalpicFlow_Unit)
    .PrintReport("   - Deviation   : " & Relative_Deviation & "%")
  End With
End Sub
```

To have access to units conversions tools for the results printing.

Calculation of the deviation between ProSec value and set point value.

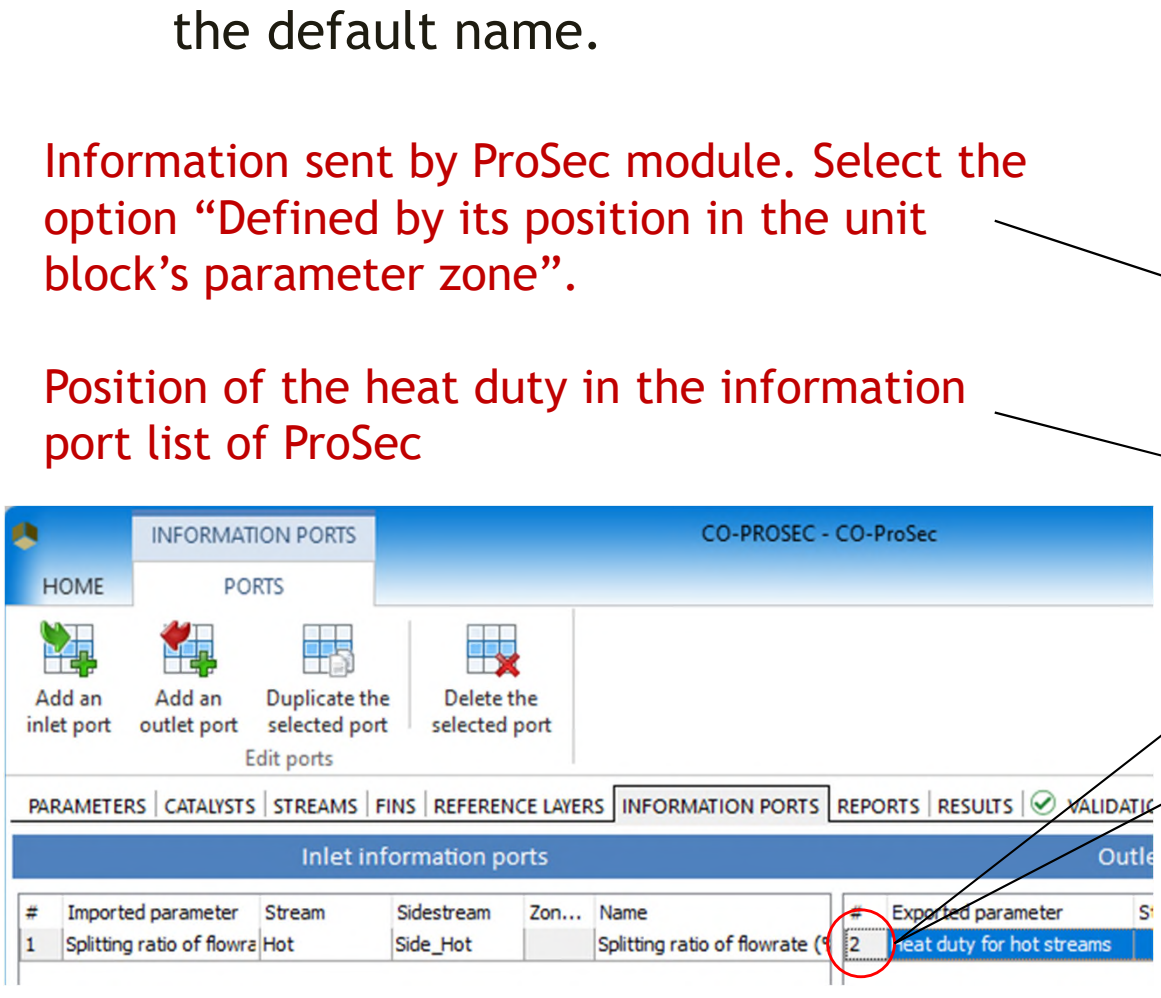
Printings of the results.

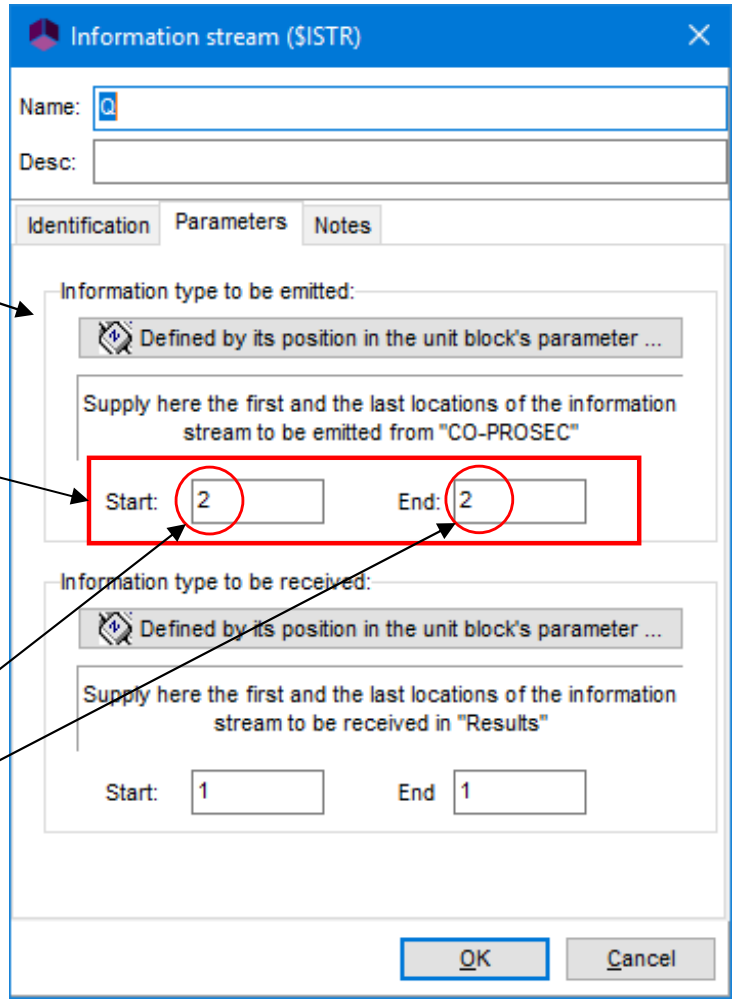
Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Use an information stream to connect the ProSec and the “Results” windows script modules. By this way the exchanger heat duty will be available in the “Results” module.
- Enter the parameters in this information stream. Feel free to change the default name.

Information sent by ProSec module. Select the option “Defined by its position in the unit block’s parameter zone”.

Position of the heat duty in the information port list of ProSec



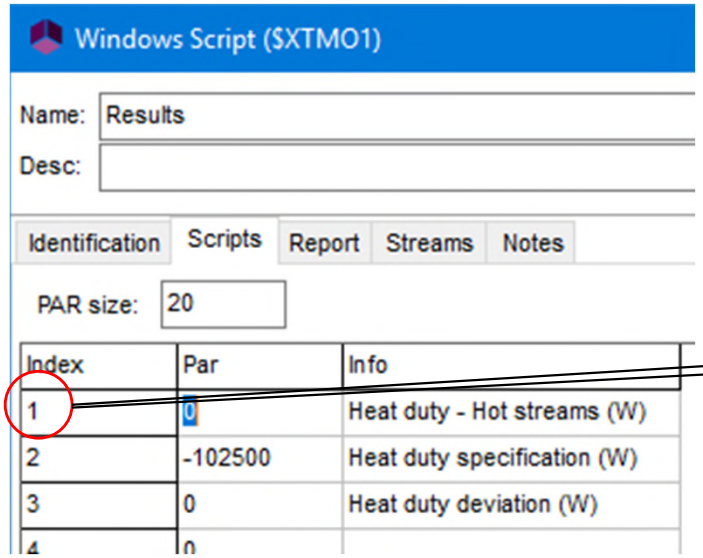


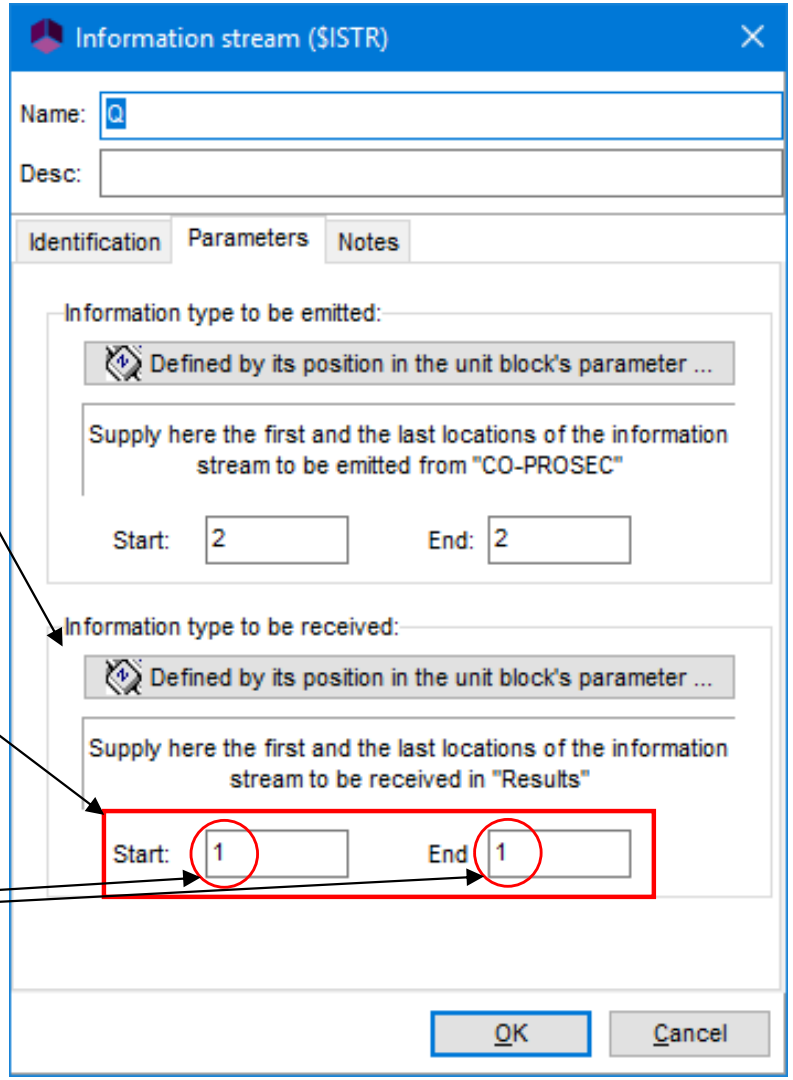
Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- Enter the parameters in this information stream. Feel free to change the default name.

Information received by the windows script module. Select the option “Defined by its position in the unit block’s parameter zone”.

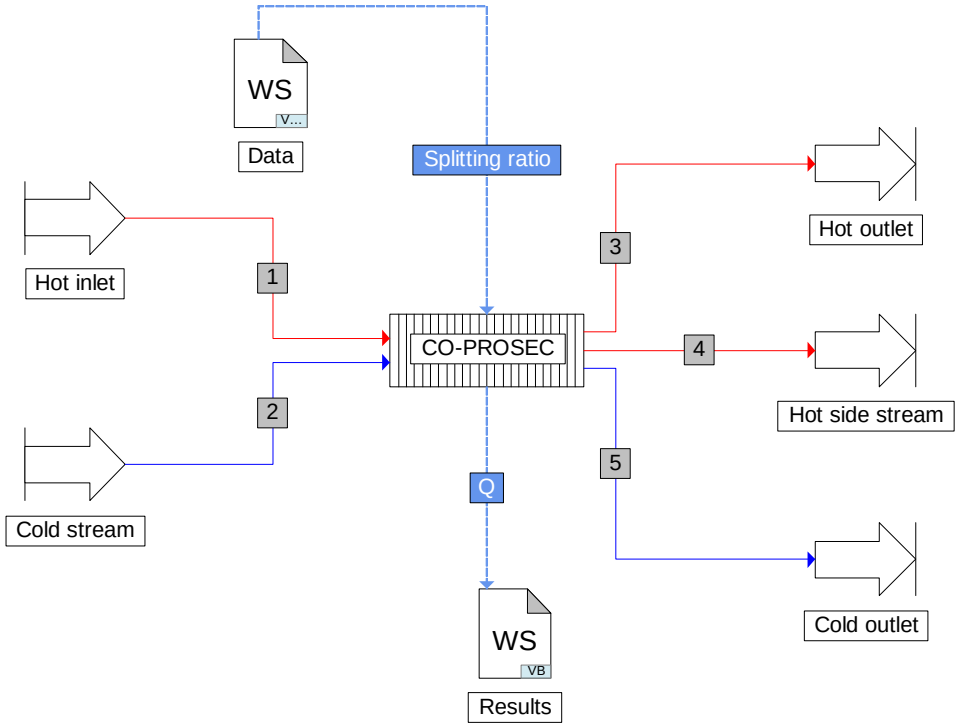
Position of the heat duty in the windows script module





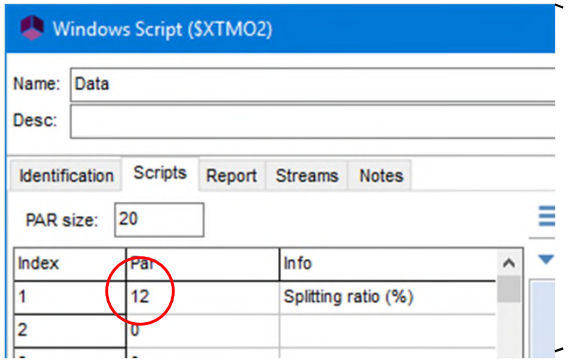
Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

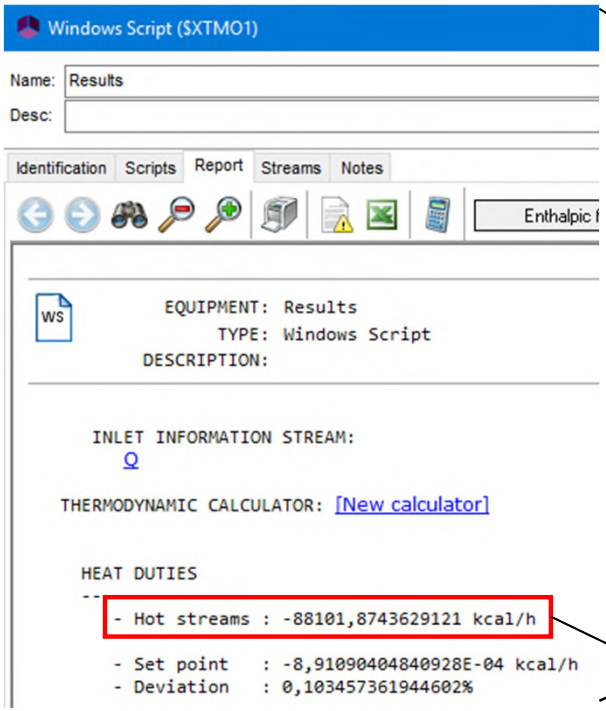
- Flowsheet at this step

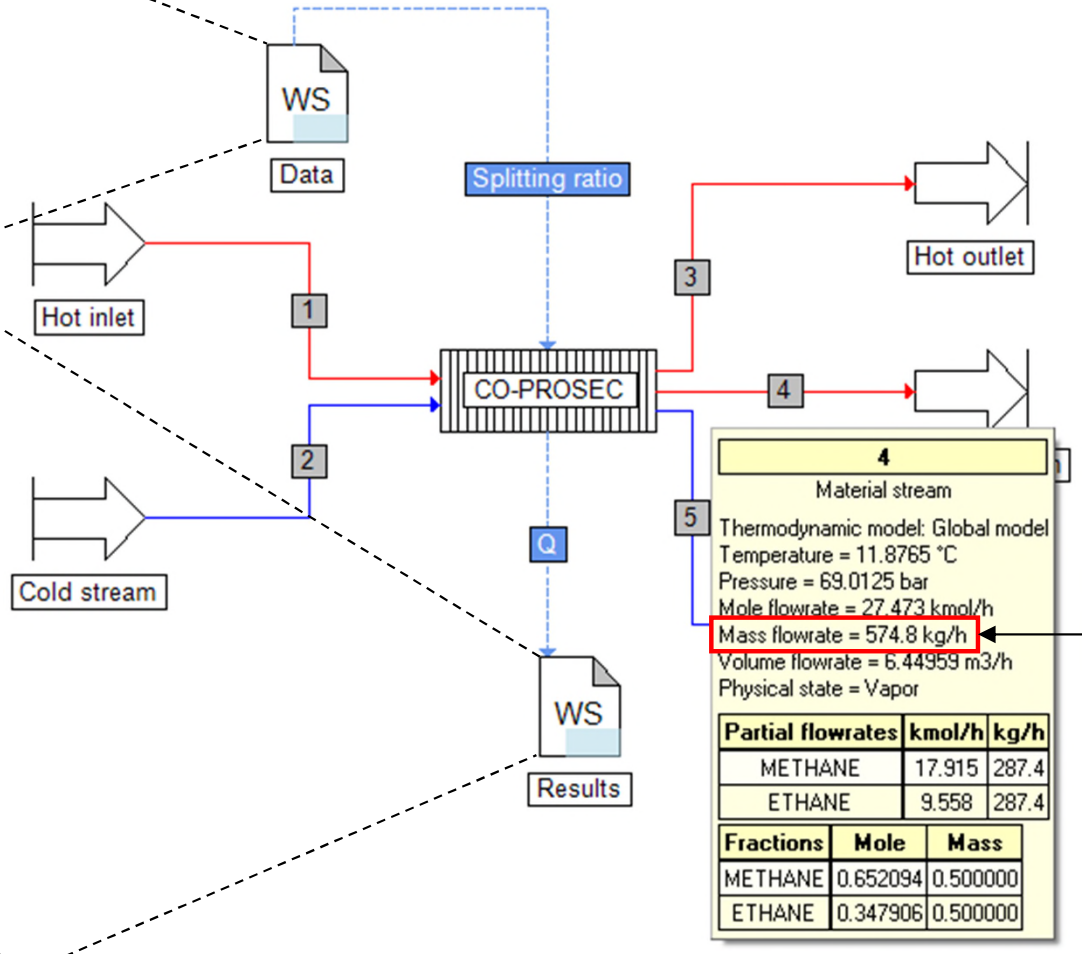


Step 2: Add windows script modules in ProSimPlus and connect them to ProSec

- E.g. specify a splitting ratio of 12% in the “Data” module and run the simulation







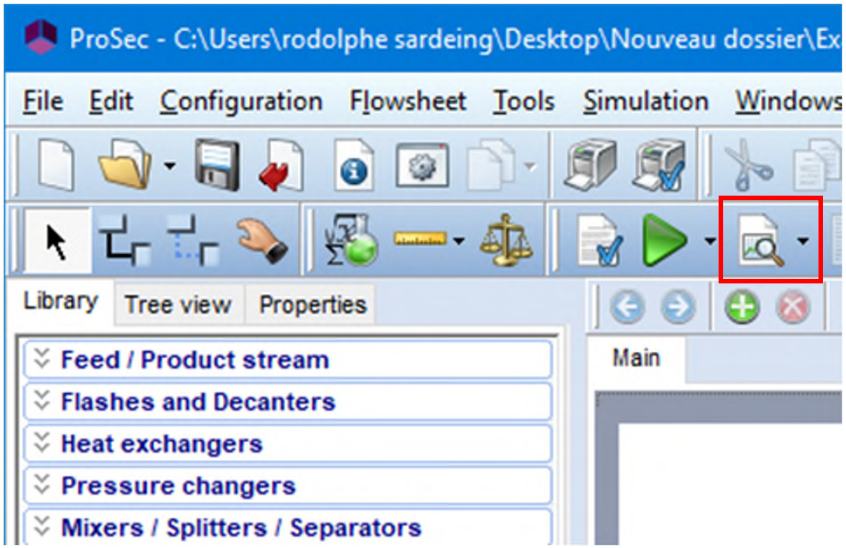
12% of stream “1” flow rate

Check that this value is the same as the one in ProSec results

Step 3: Case study

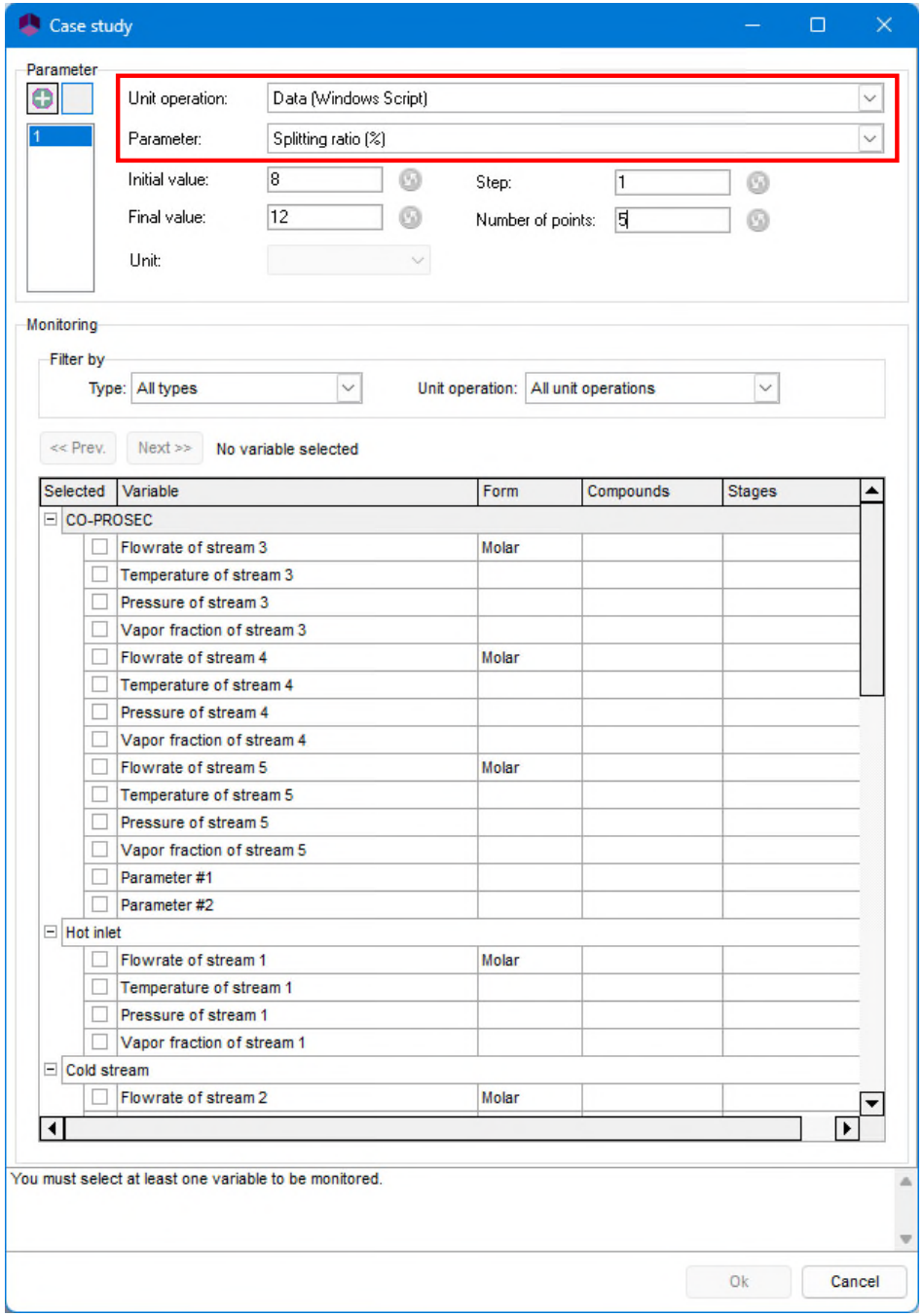
- Use the case study ProSimPlus' capability to analyze the influence of the slitting ratio of the side stream of the hot stream (stream "4") on the heat duty of the heat exchanger.

- From the "Case study" icon.



Step 3: Case study

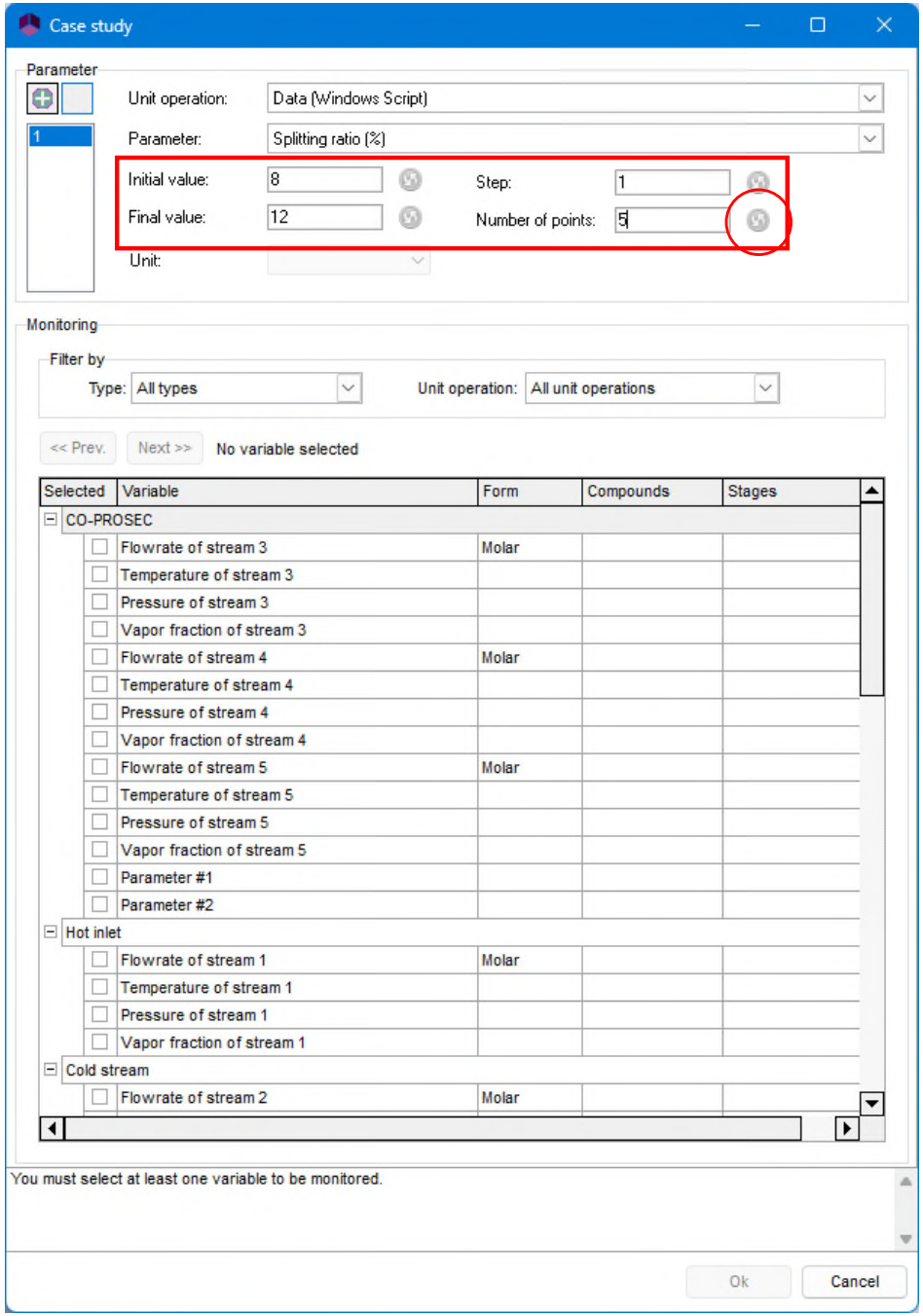
- Selection of the studied parameter
  - Select “Data” unit operation (windows script module containing the value of the splitting ratio).
  - Select the parameter “Splitting ratio(%)”.



Step 3: Case study

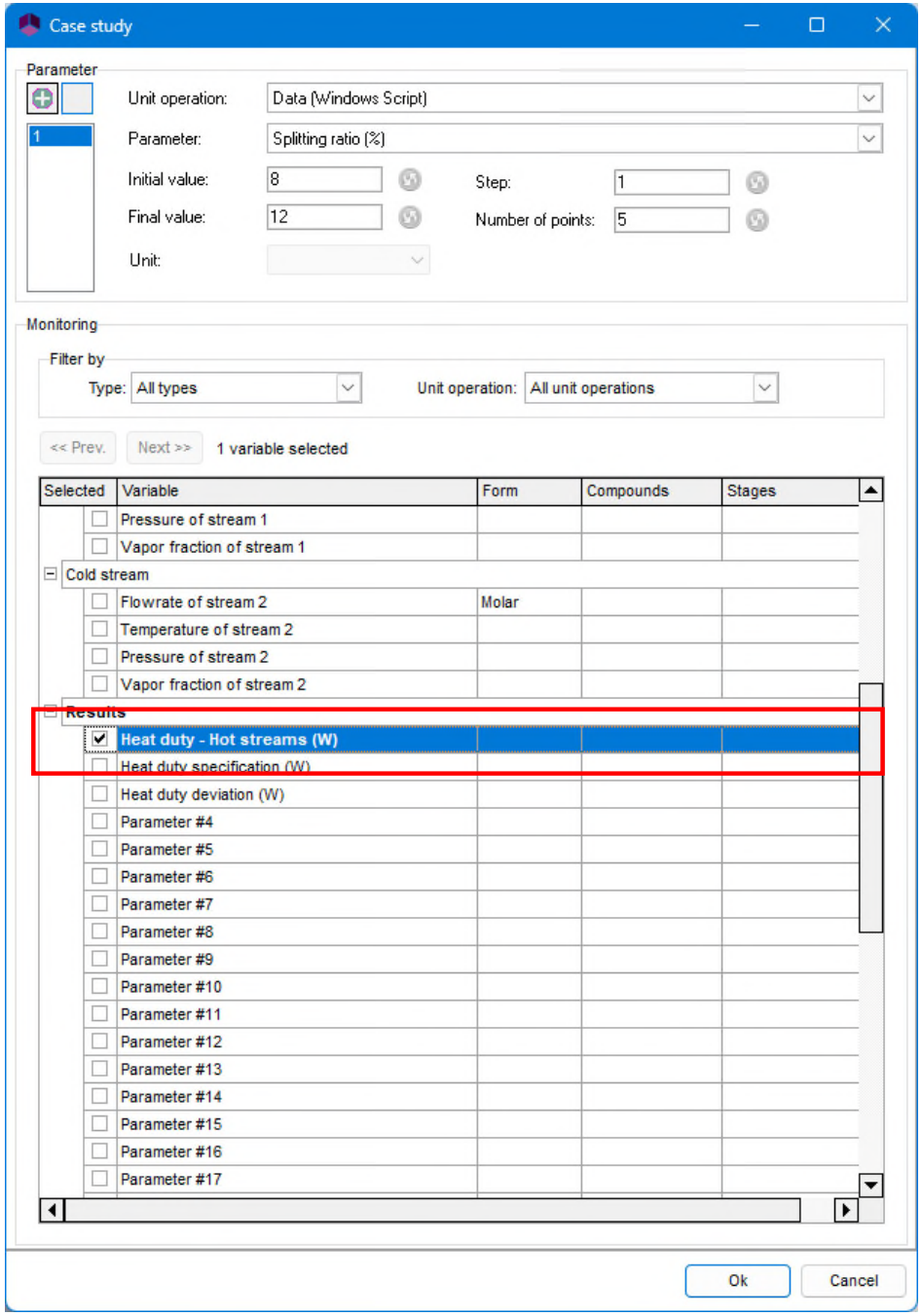
- Specification of the range of variation of the studied variable
  - Enter the initial value of the splitting ratio (e.g. 8), its final value (e.g. 12).
  - Enter the step (e.g. 1) and click on to update the number of points (the opposite can be done).

Select first the unit if necessary!



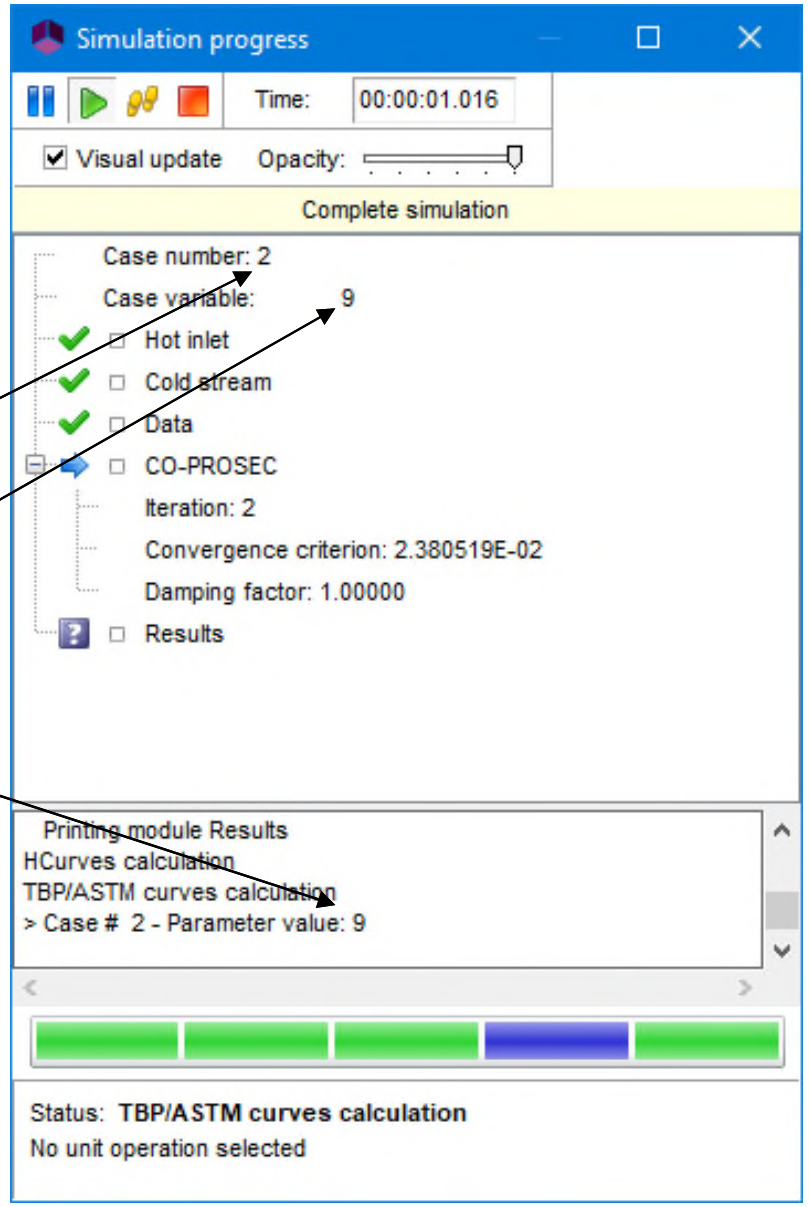
Step 3: Case study

- Select the monitored variables
  - Select “Results” unit operation (windows script module containing the exchanger heat duty).
  - Select the parameter “Heat duty – Hot streams (W)”.
- Click on “Ok” to start the case study



Step 3: Case study

- Simulation progress window

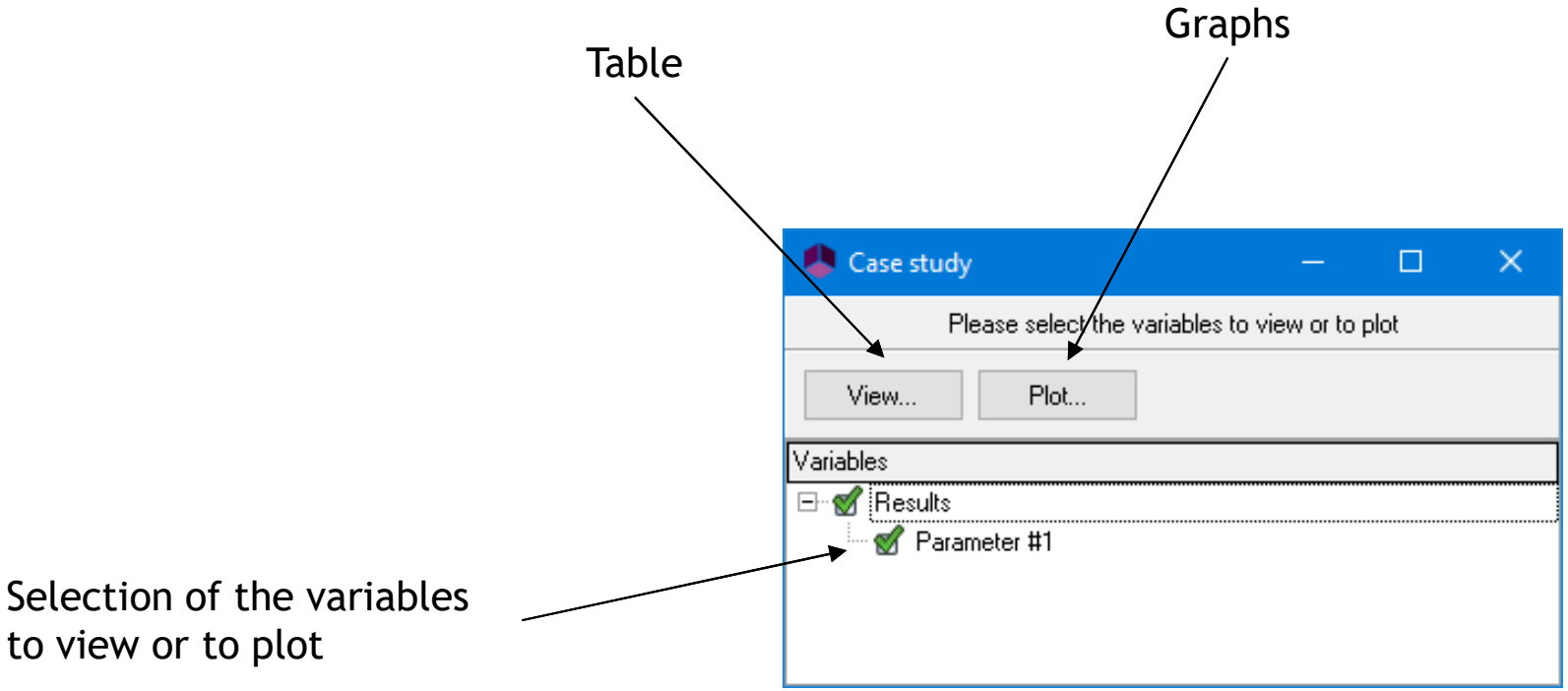


Number of the case in progress

Value of the studied parameter

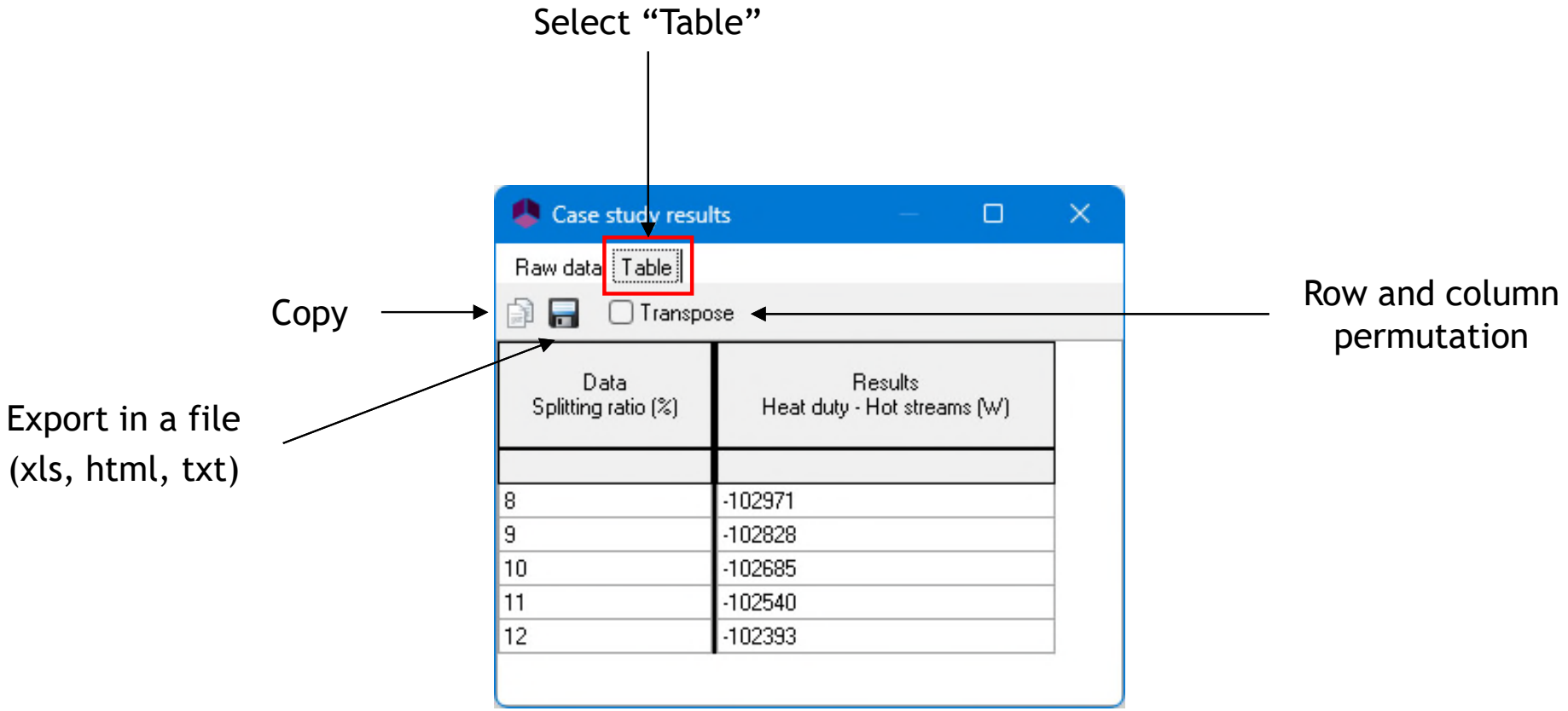
Step 3: Case study

- Visualization of the case study results (tables and graphs)



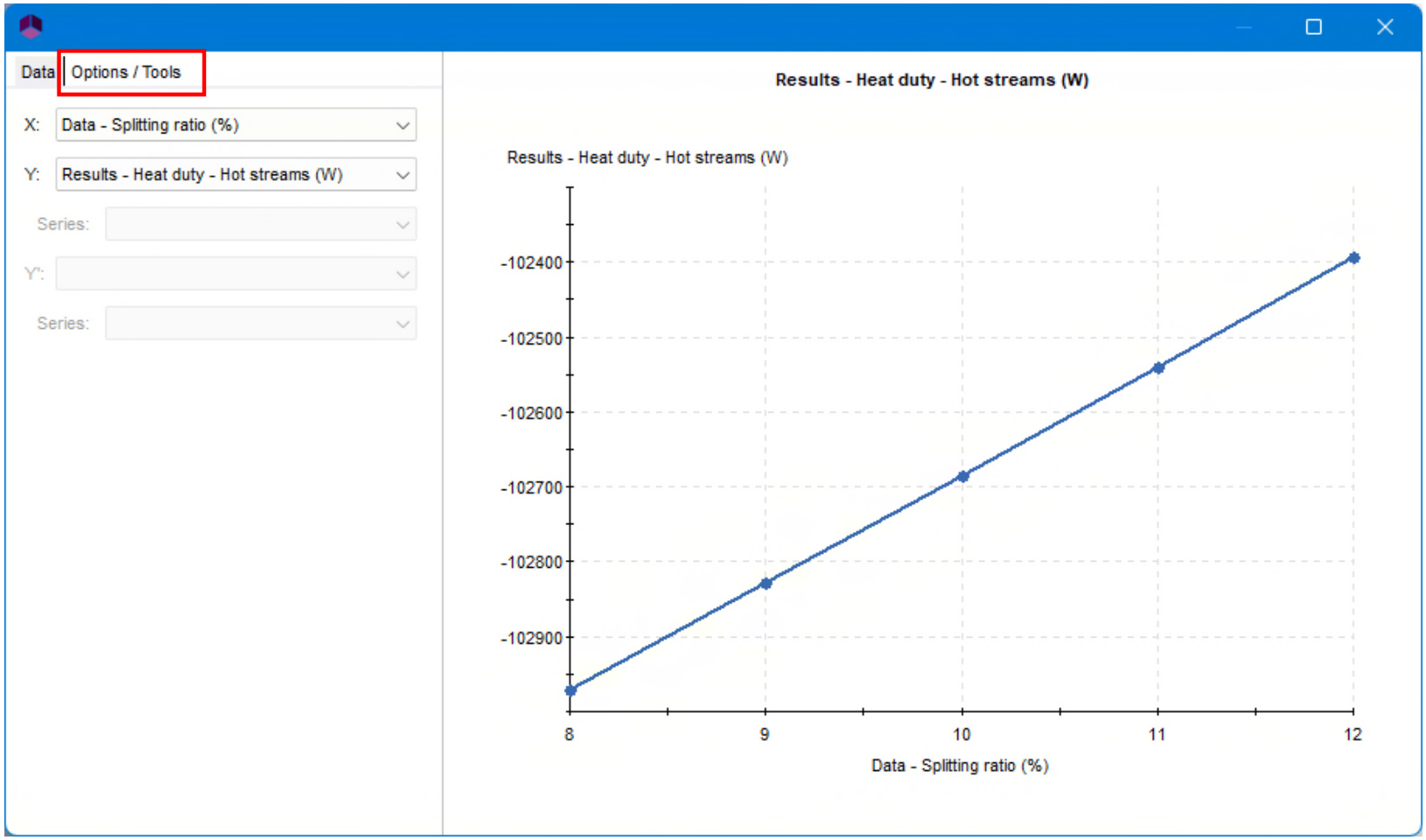
Step 3: Case study

- View: Table



Step 3: Case study

- Plot: Graphs (options: copy, print, graphical properties)

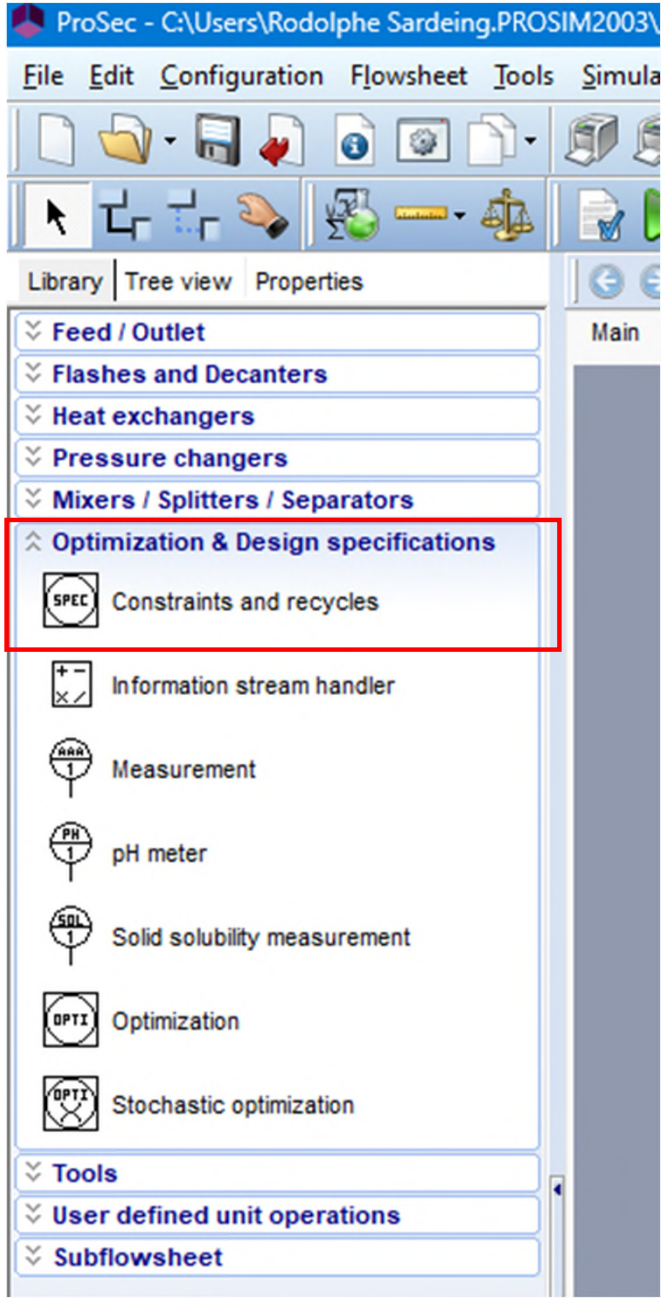


Step 3: Case study

- Conclusions
  - The splitting ratio has an effect on the exchanger heat duty
  - An heat duty of eg. -102500 W can be reached
- The control can now be set up

Step 4: Control

- Add a constraints and recycles module

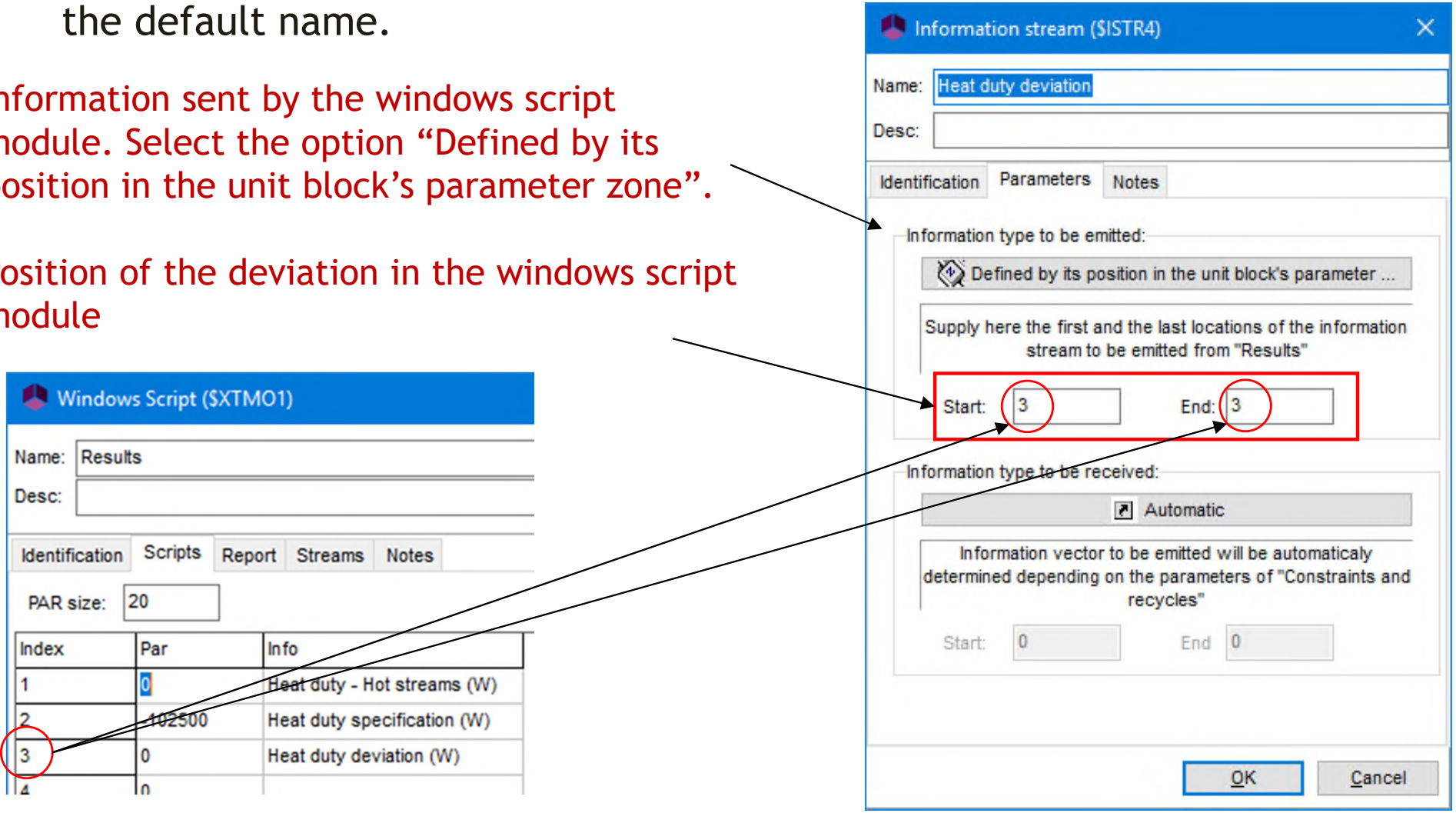


Step 4: Control

- Use an information stream to connect the “Results” windows script and the constraints & recycles unit operations.
- Enter the parameters in this information stream. Feel free to change the default name.

Information sent by the windows script module. Select the option “Defined by its position in the unit block’s parameter zone”.

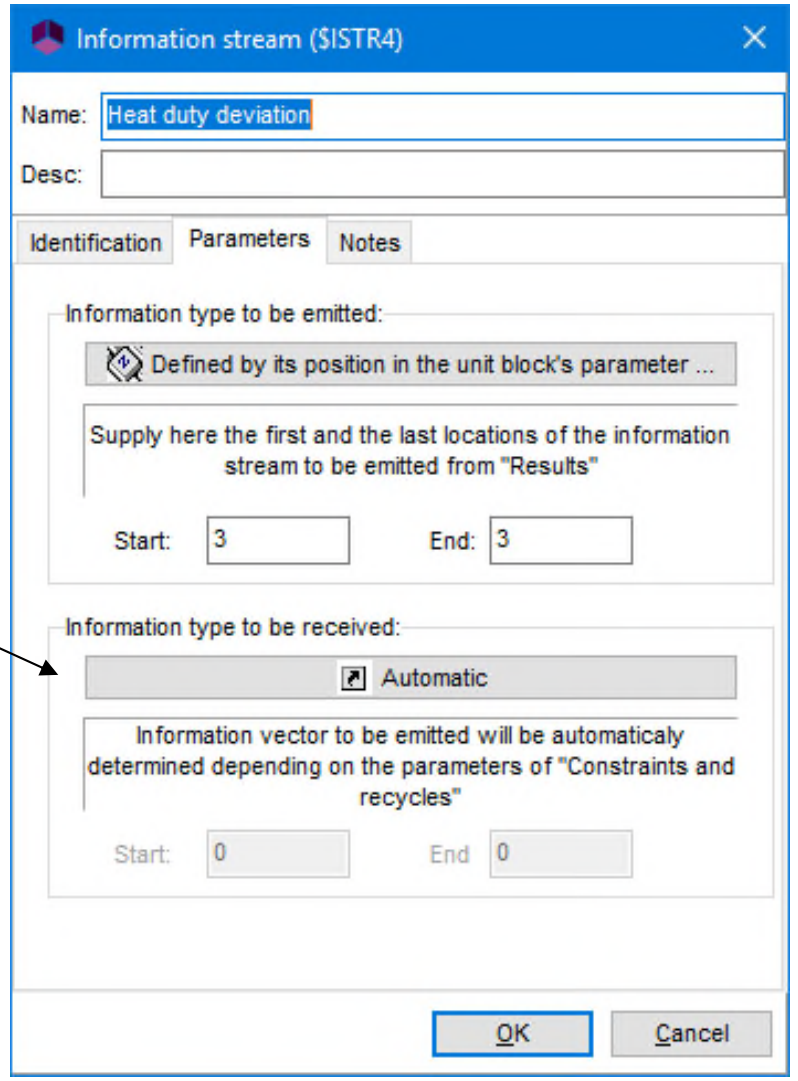
Position of the deviation in the windows script module



Step 4: Control

- Enter the parameters in this information stream. Feel free to change the default name.

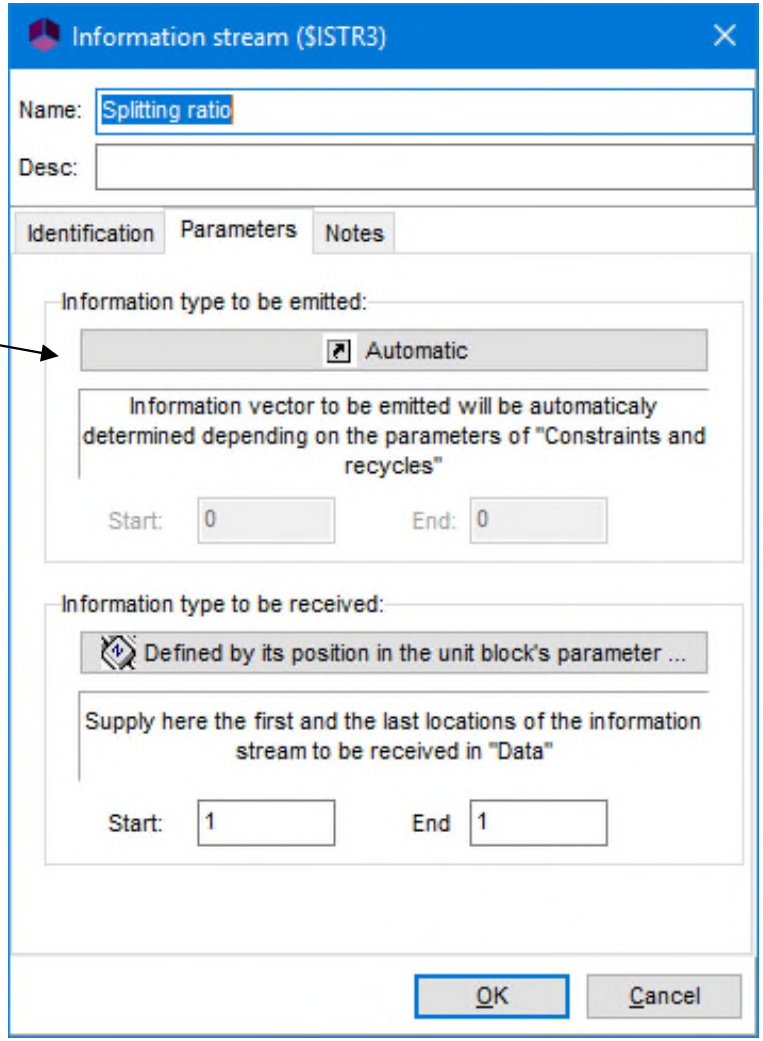
Information received by the constraints & recycles module, keep the default “Automatic” selection.



Step 4: Control

- Use an information stream to connect the constraints & recycles and the “Data” windows script unit operations.
- Enter the parameters in this information stream. Feel free to change the default name.

Information emitted by the constraints & recycles module, keep the default “Automatic” selection.

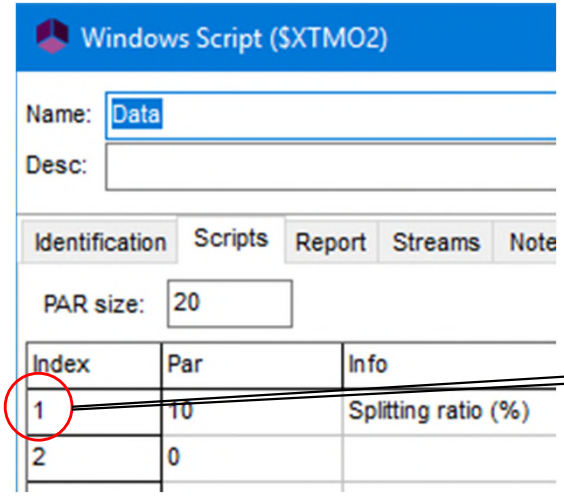


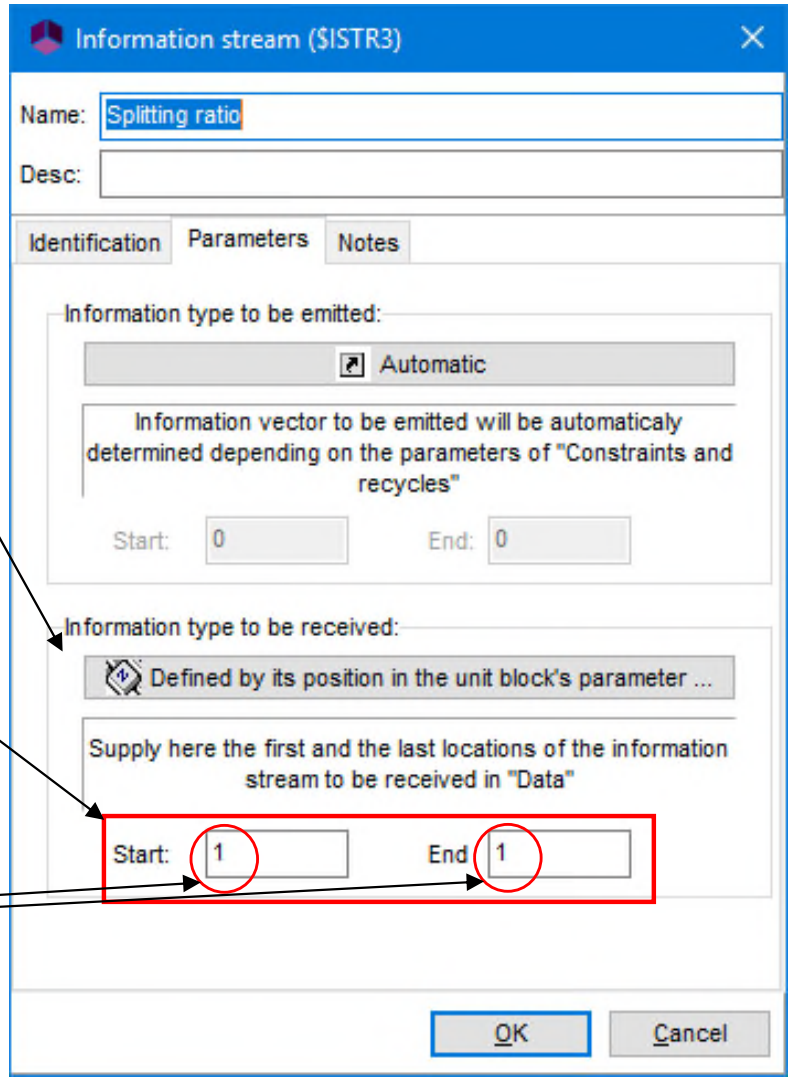
Step 4: Control

- Enter the parameters in this information stream. Feel free to change the default name.

Information received by the windows script module. Select the option “Defined by its position in the unit block’s parameter zone”.

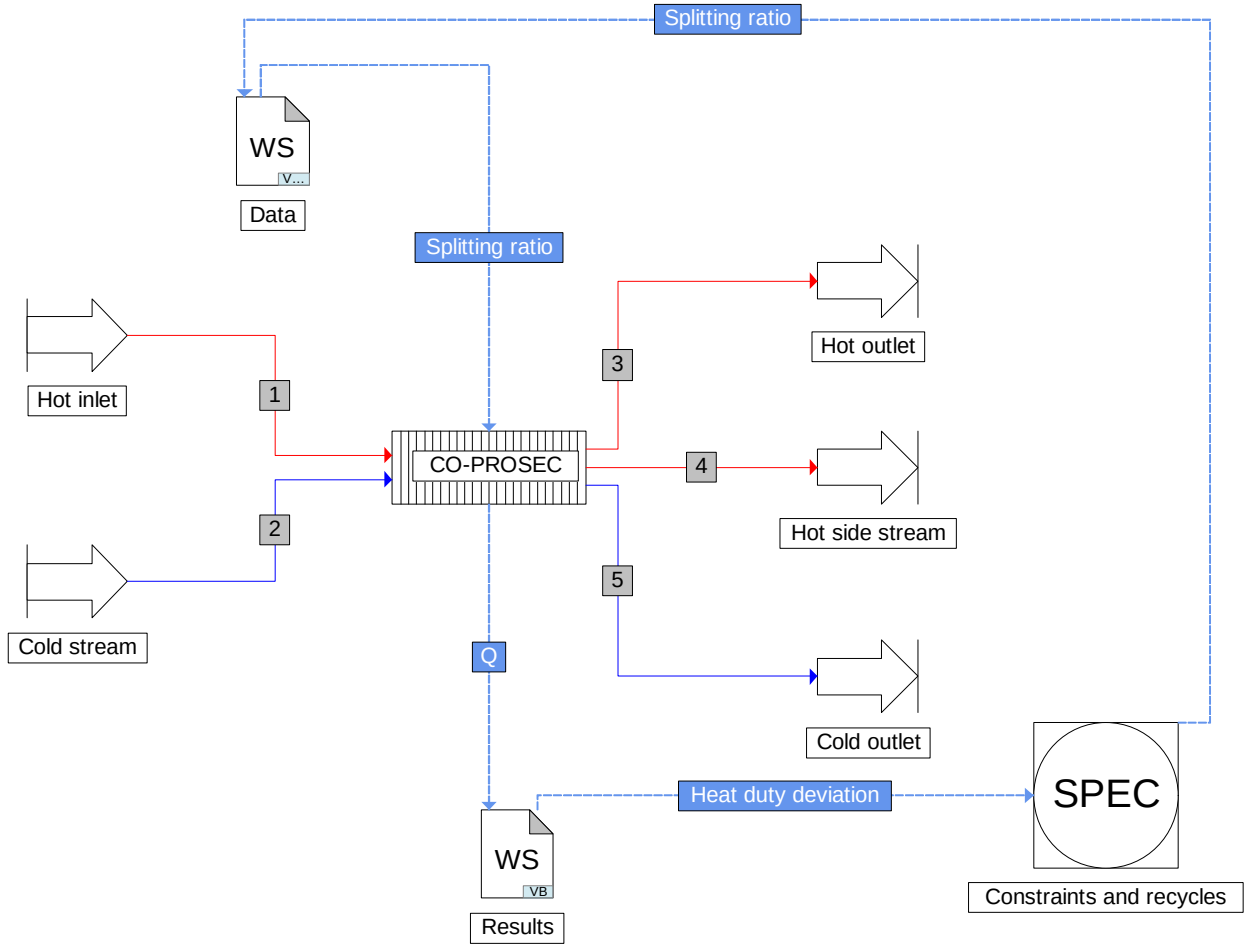
Position of the splitting ratio in the windows script module





Step 4: Control

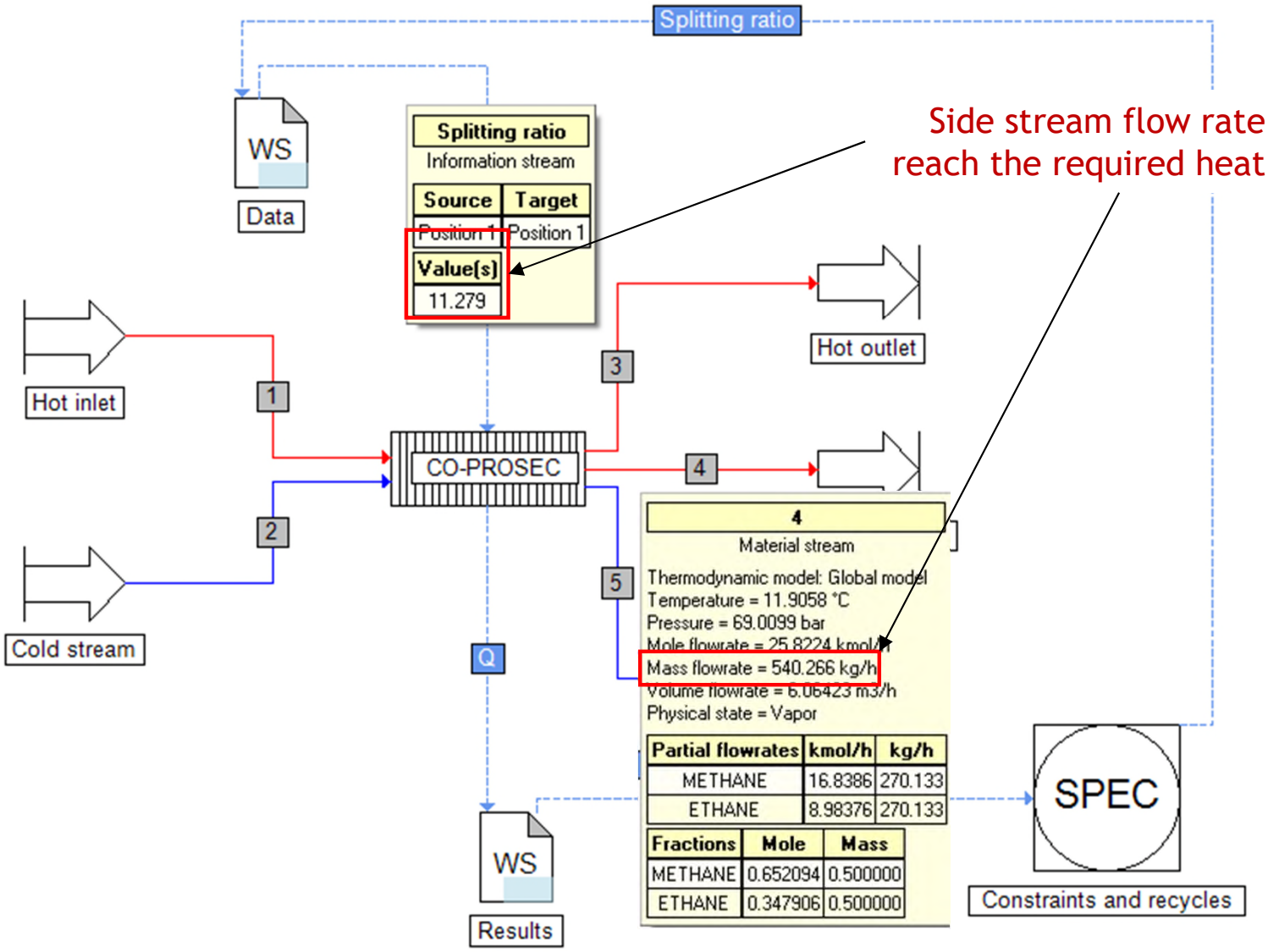
- Flowsheet at this step



- Run the simulation

Step 4: Control

- Results



ProSim

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