Improve Fidelity of your Process Models by Sizing Rigorous Heat Exchanger Models

Using Aspen HYSYS®

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Objective

This guide will demonstrate how you can increase the fidelity of your process model by sizing heat exchangers from Aspen HYSYS.

We will cover the following types of heat exchanger units:

- Shell & Tube heat exchanger
- Air Cooled heat exchanger

For this exercise we will use:

- EDR Template Files
- Aspen HYSYS model of the Crude Distillation Unit

To download the above files please visit Aspen Tech's customer support site.

(Refer to Knowledge Base Solution ID: 143028 at the following location http://support.aspentech.com/webteamasp/KB.asp?ID=143028)

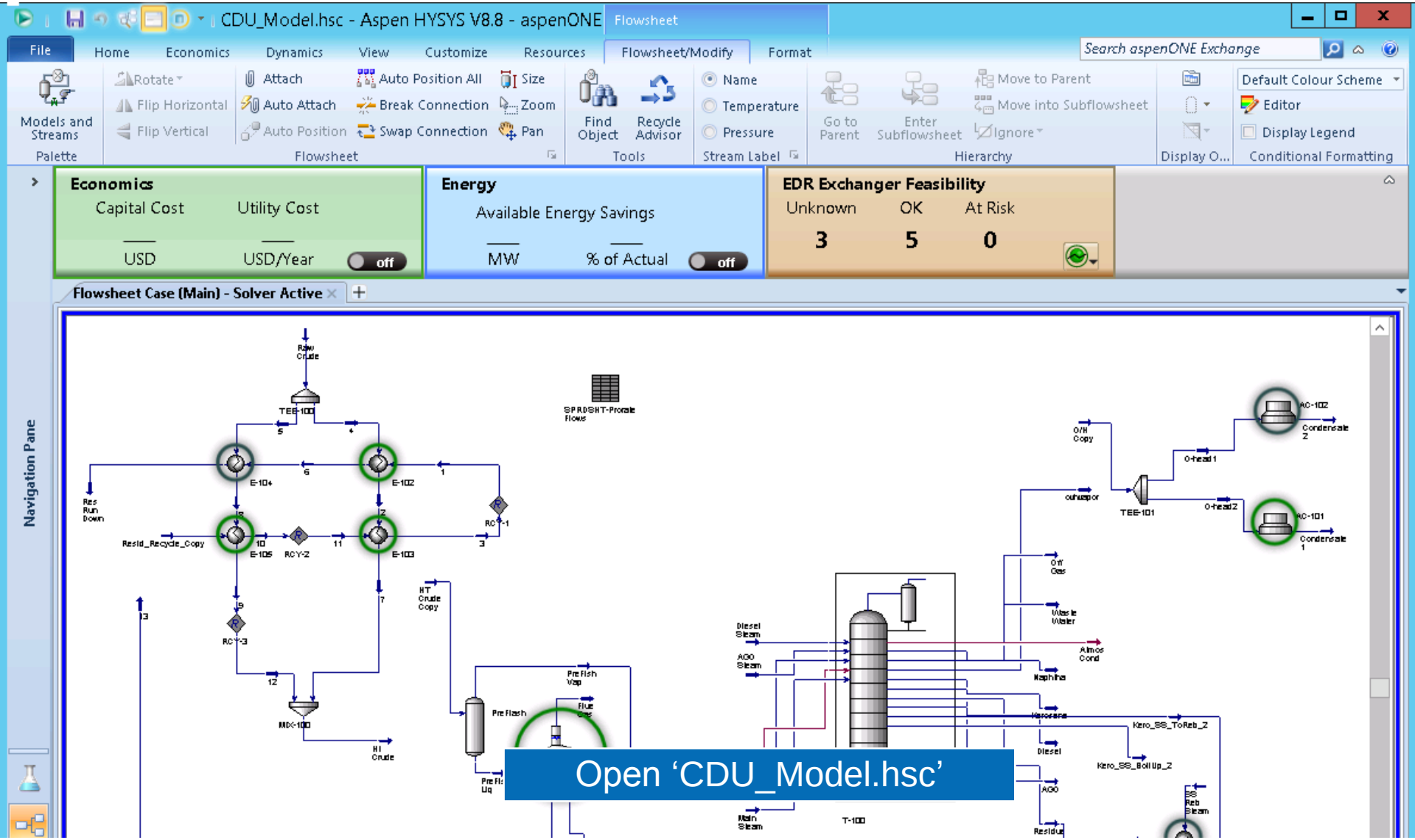
Shell & Tube Exchanger

Demonstration Workflow

Here is the order of tasks this guide will walk you through:

1. Identify the Simple Heat Exchanger Model
2. Convert the simple model to a rigorous model using an EDR Template
3. Learn how to read heat exchanger dimensions such as length, weights, etc.
4. Convert a rigorous model back to a simple model
5. Learn how to interactively size the heat exchanger using EDR and compare between different design options
6. Learn how to take offline one of the parallel shells in a shell & tube exchanger and analyze its implication

Open the Process Model



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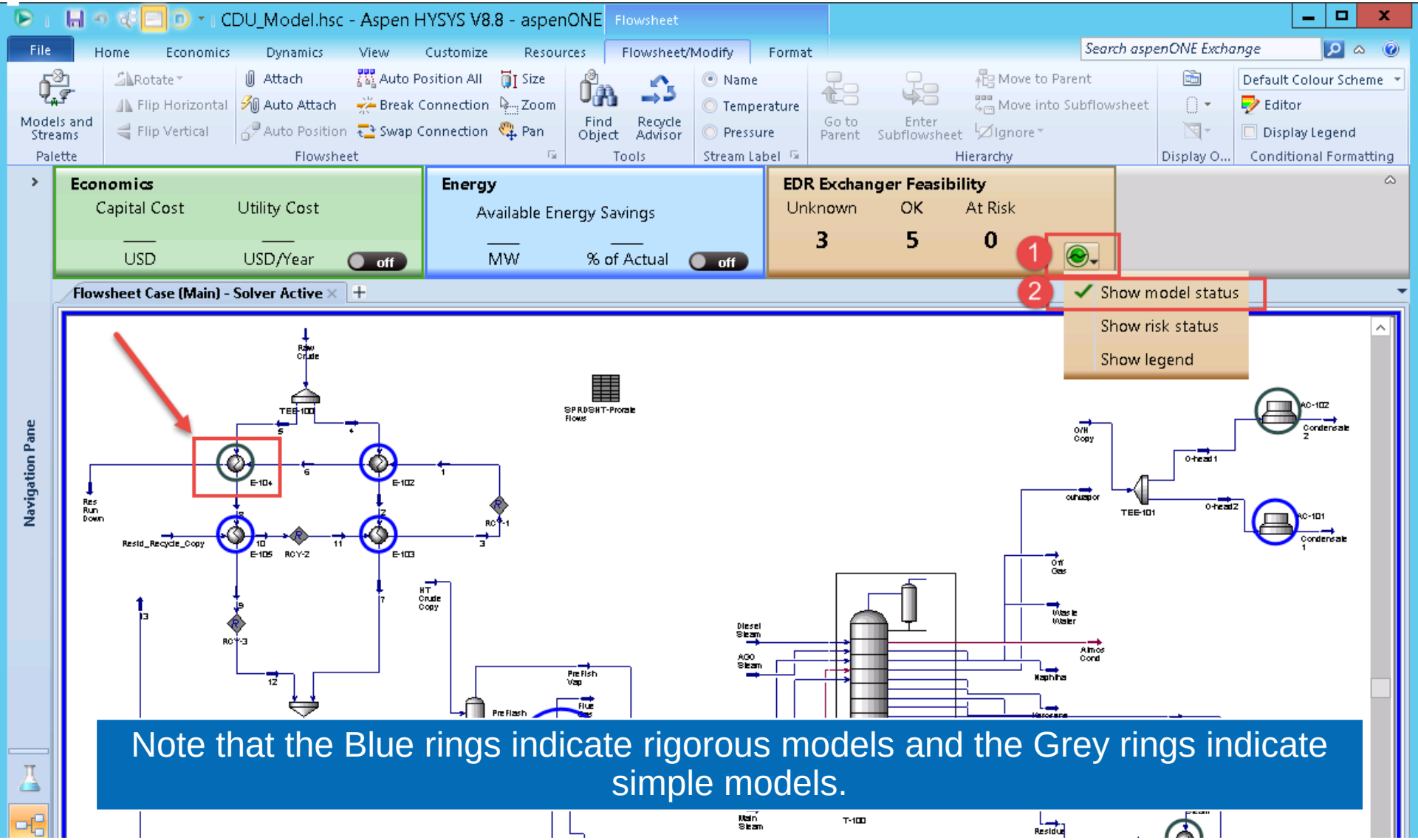
Locate the Heat Exchanger



Note that the Blue rings indicate rigorous models and the Grey rings indicate simple models.

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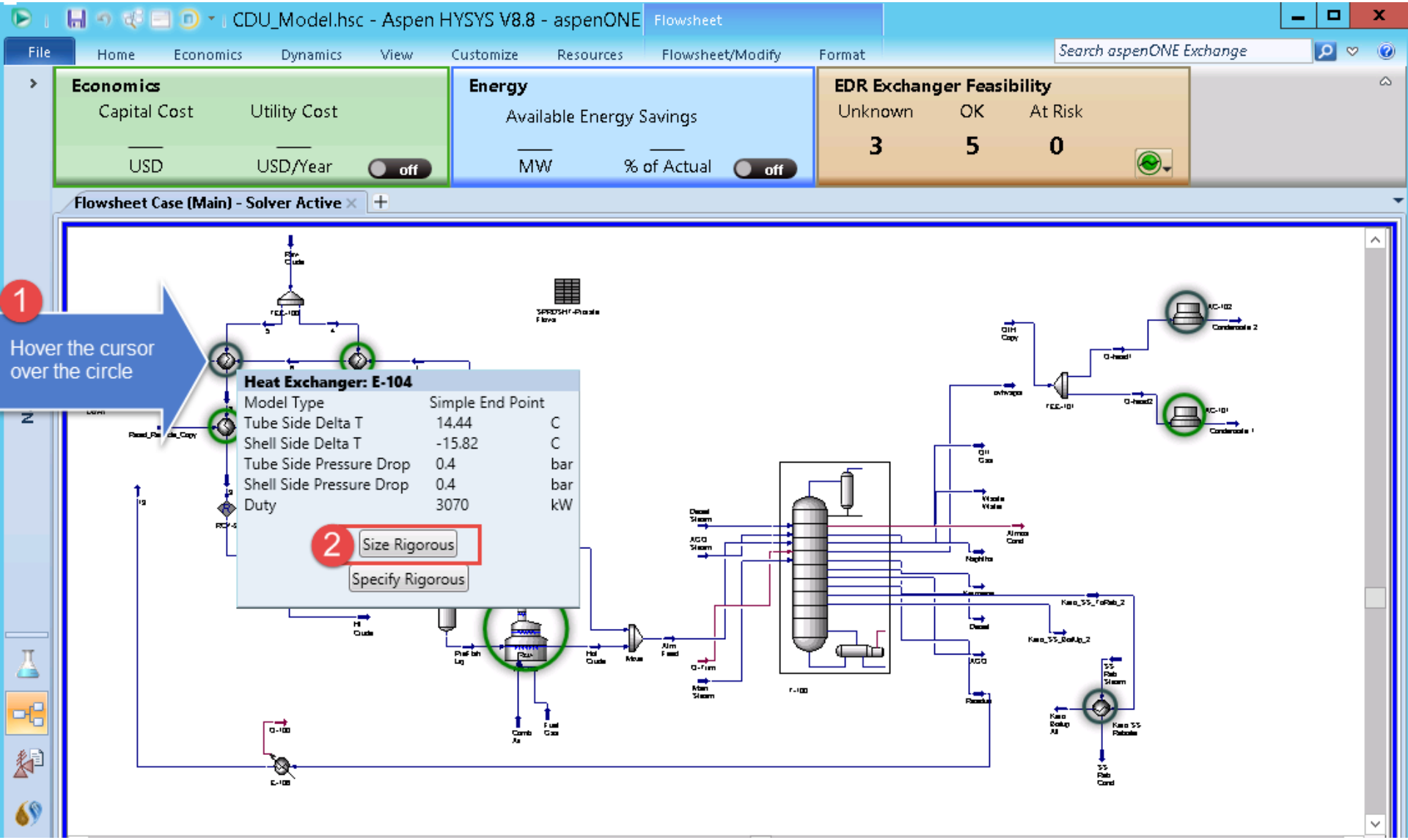
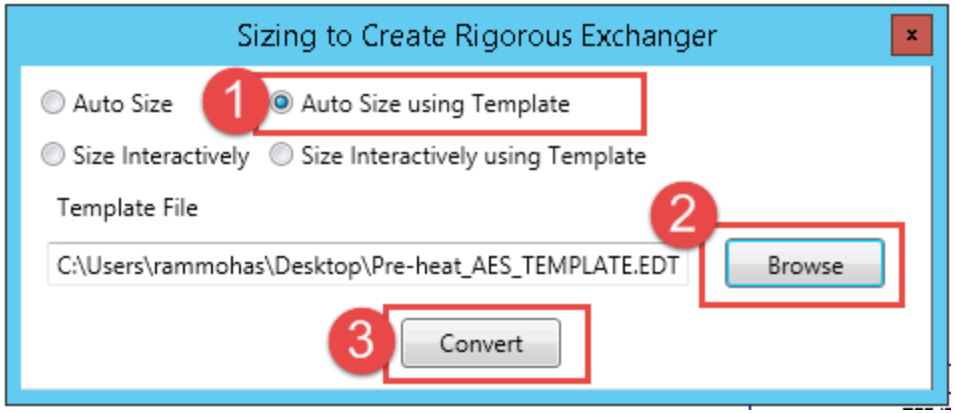
Convert to Rigorous Model

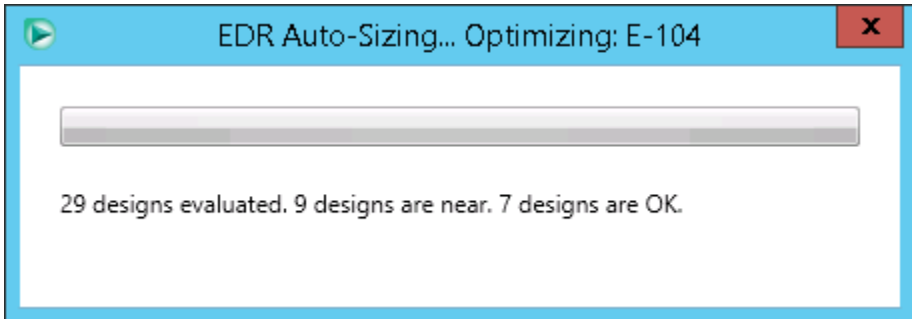


Select the EDR Template for Auto Sizing

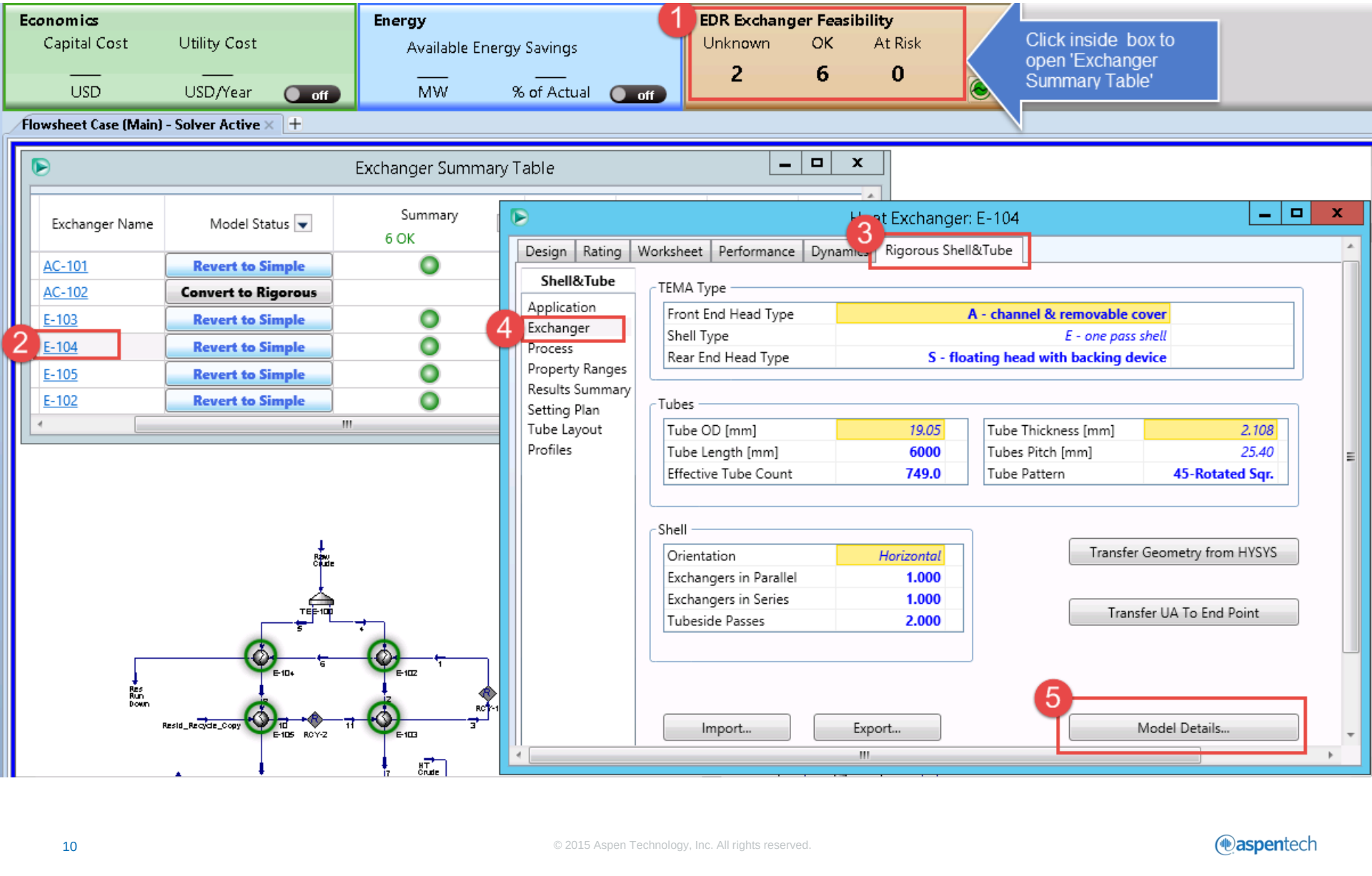


Choose the template: ‘Pre-heat_AES_TEMPLATE.EDT’ for sizing.

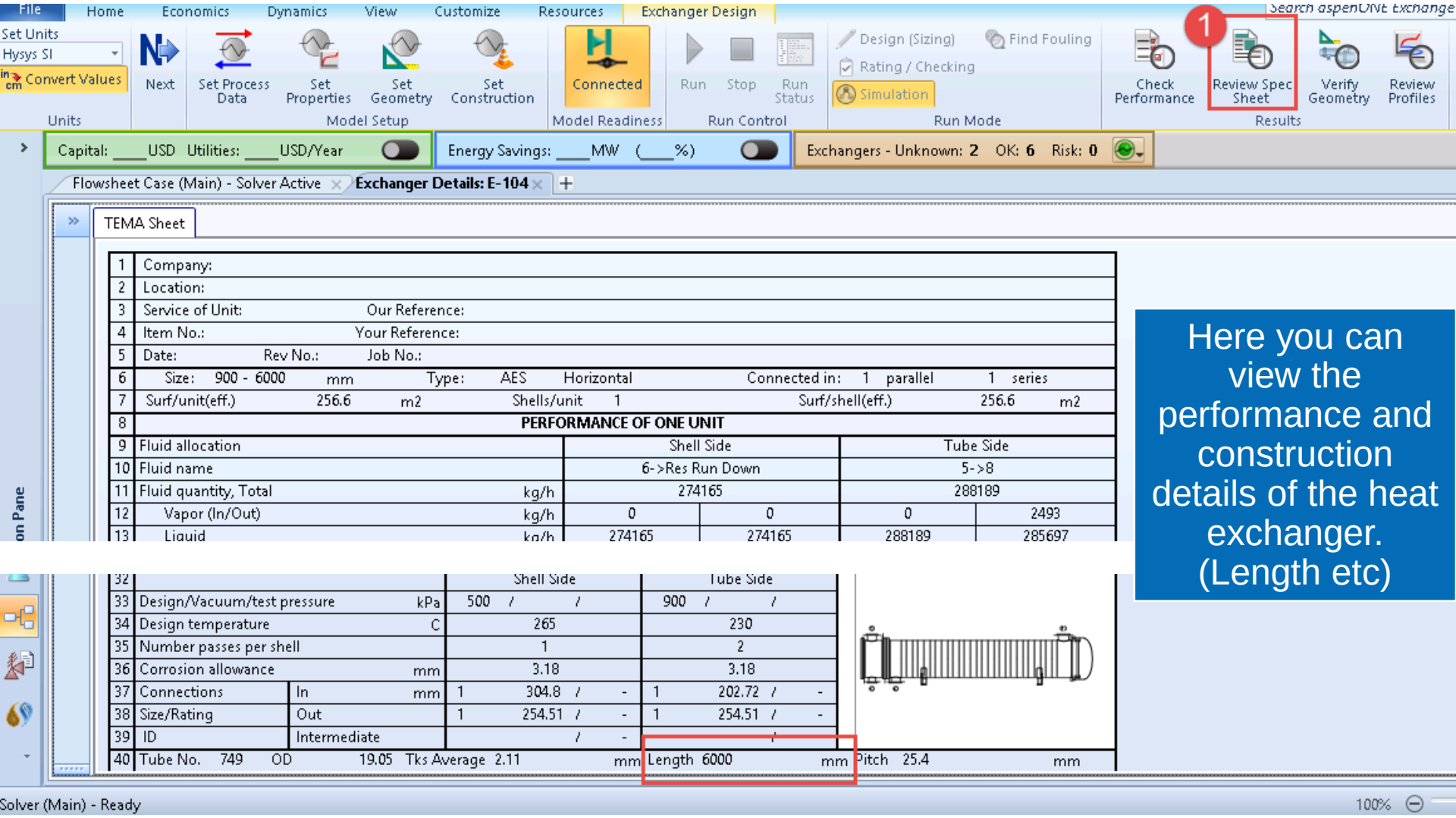
Auto-Sizing



View Model Details

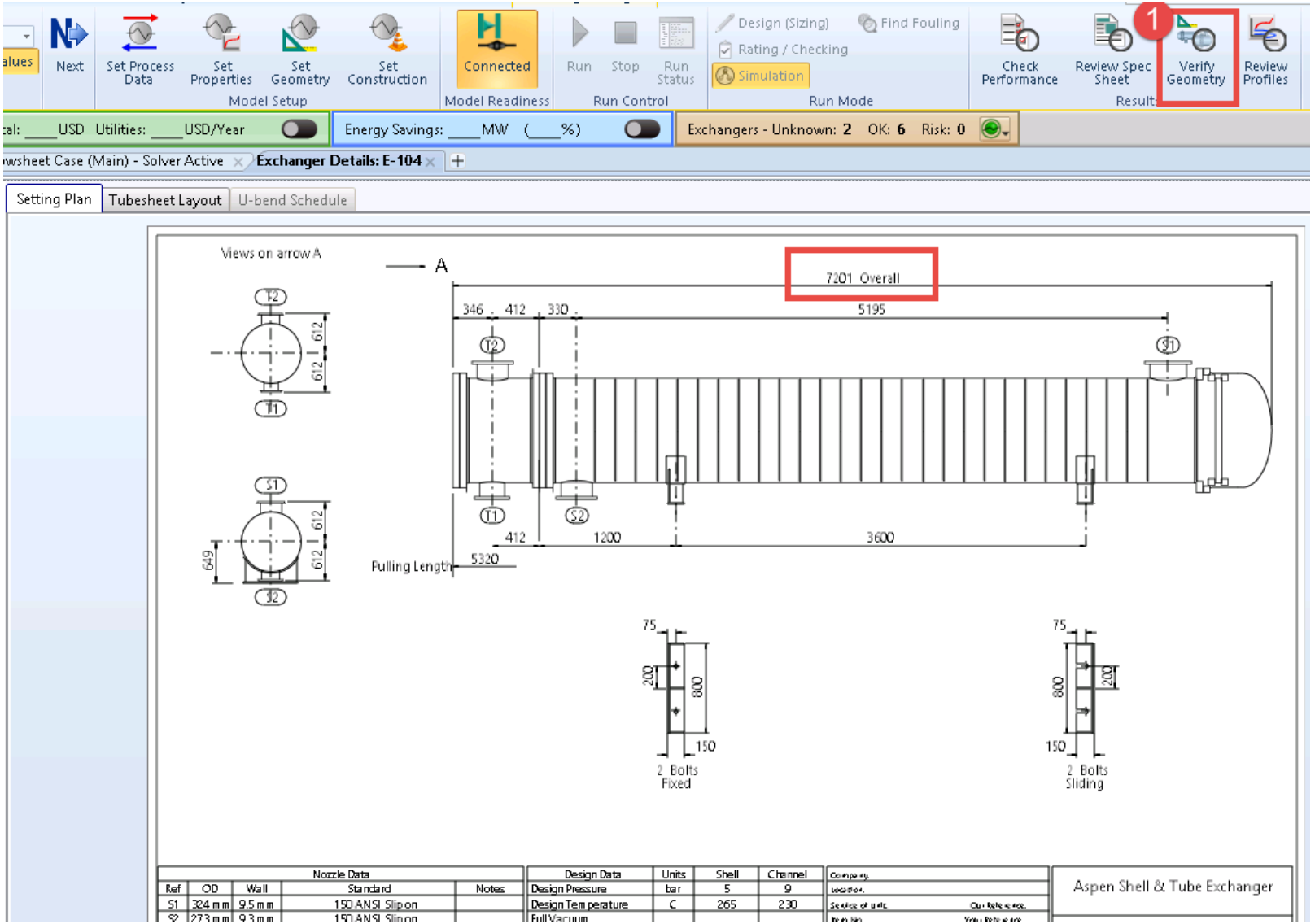


Review TEMA Sheet

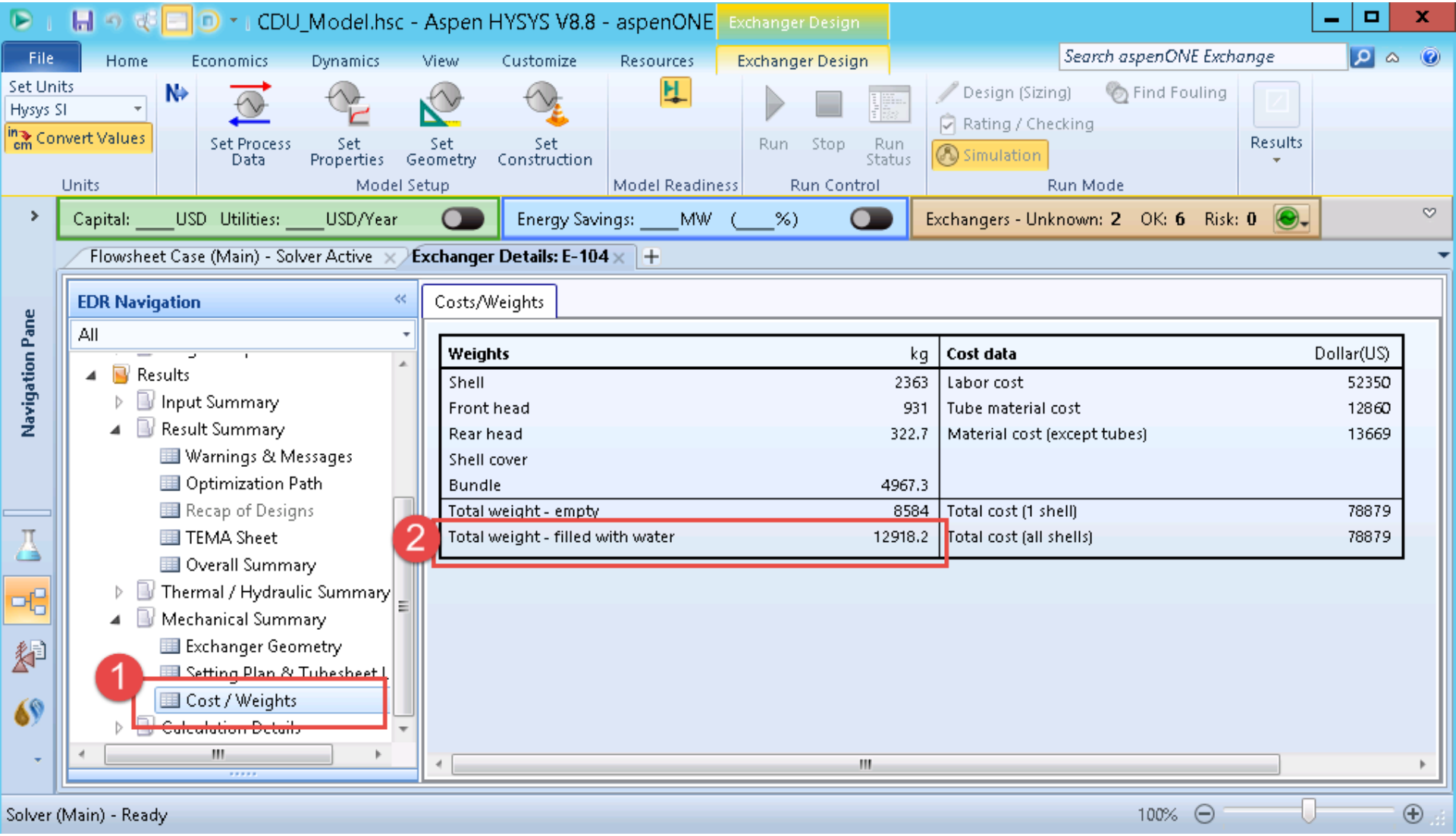


Here you can view the performance and construction details of the heat exchanger. (Length etc)

Verify Geometry



Verify Weights



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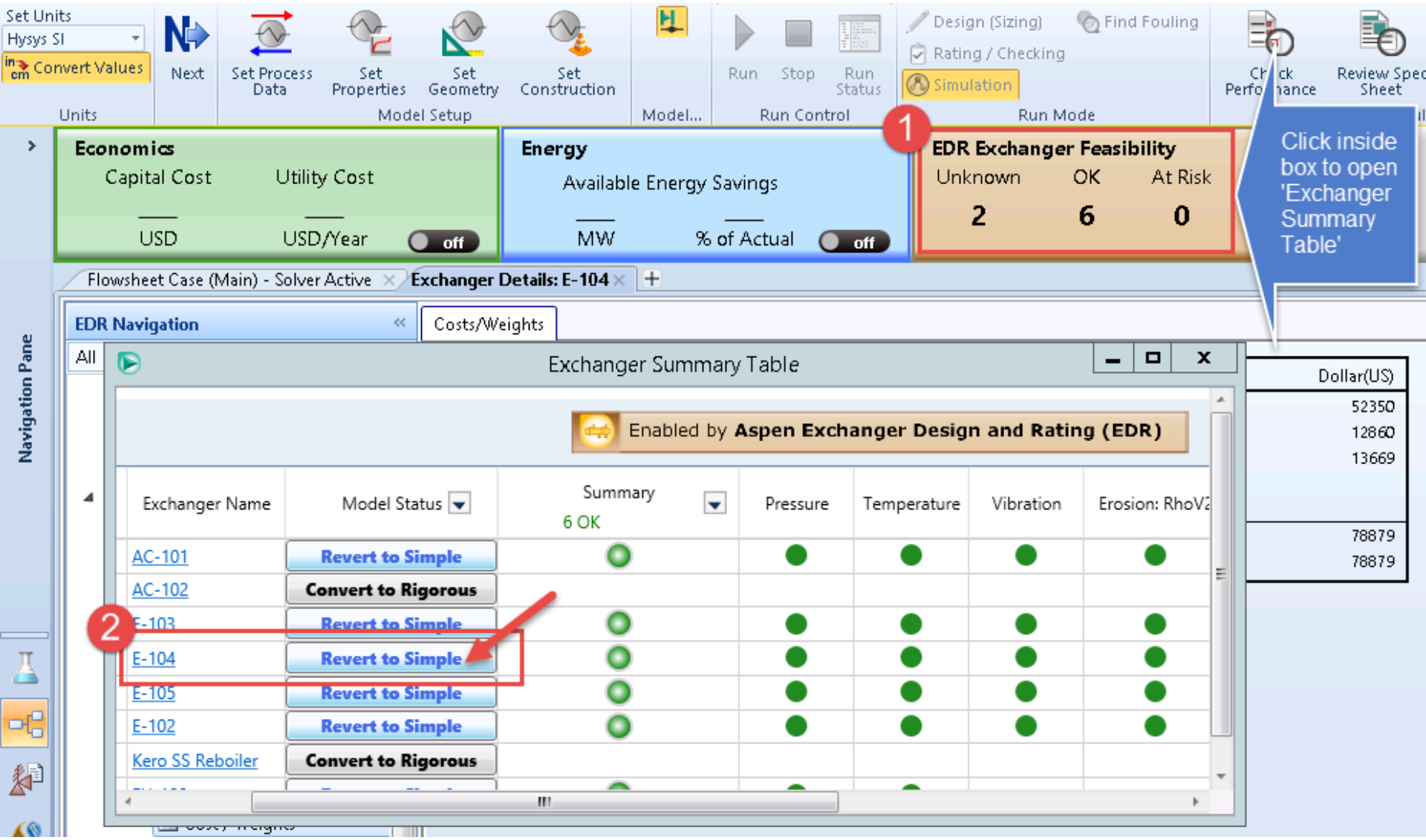
Convert Back to Simple Model



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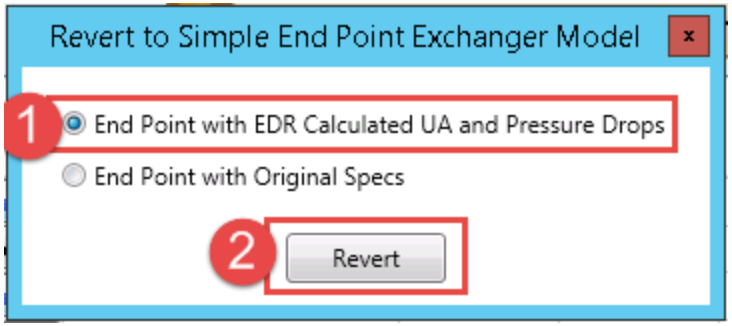
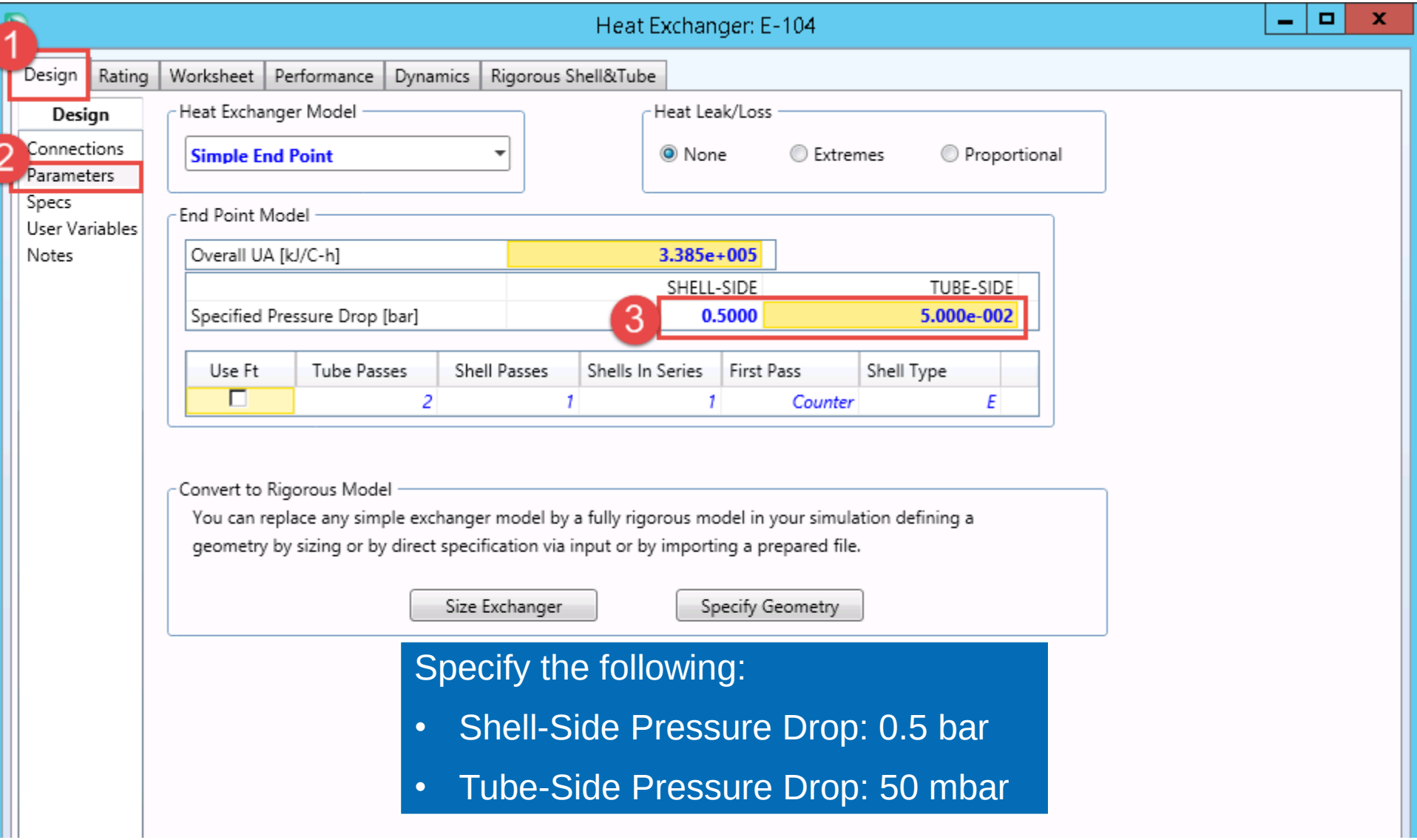
Revert to Simple End Point Model



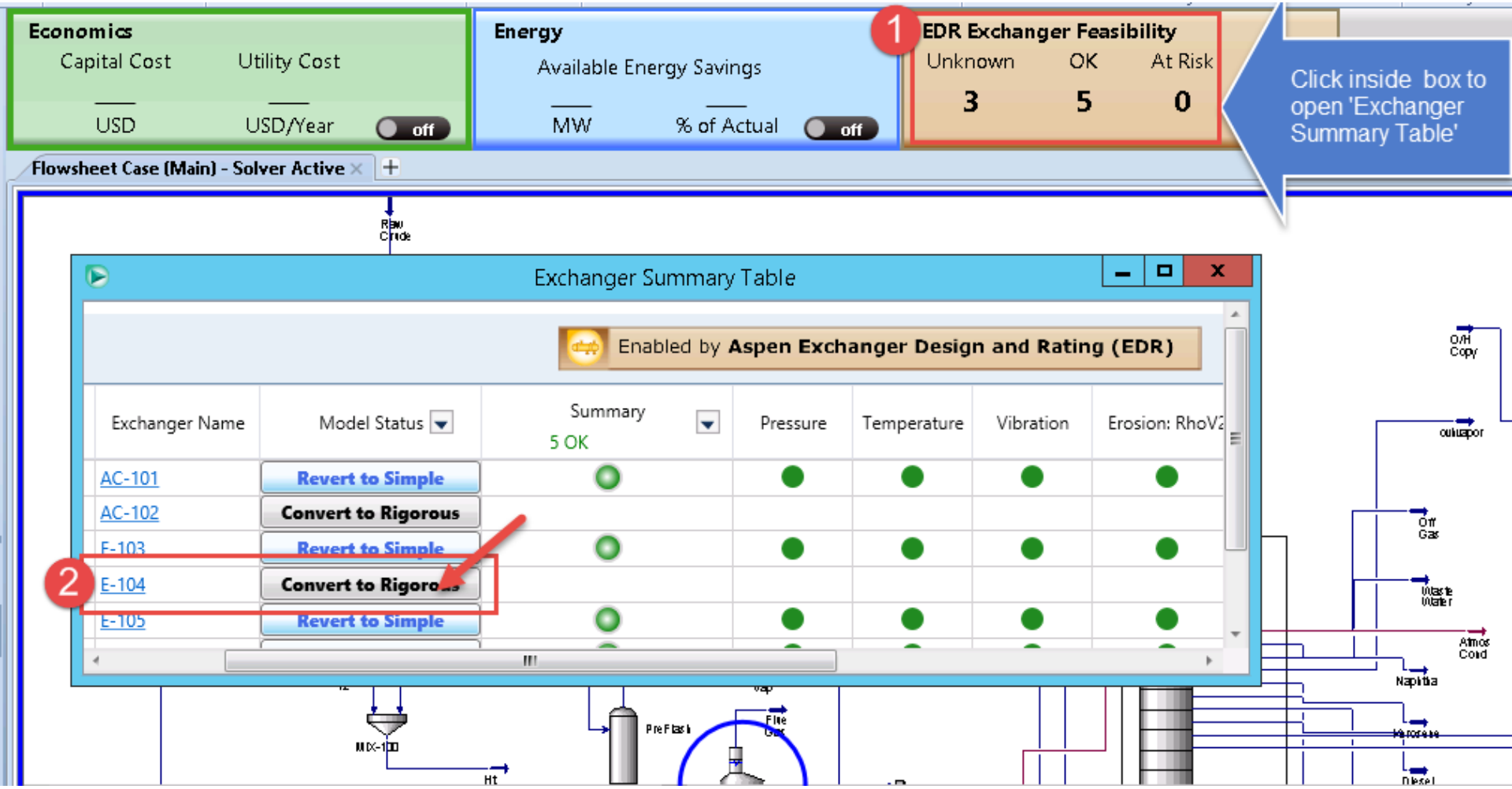
Edit Pressure Drops (Optional)



Specify the following:

- Shell-Side Pressure Drop: 0.5 bar
- Tube-Side Pressure Drop: 50 mbar

Convert Simple to Rigorous Model



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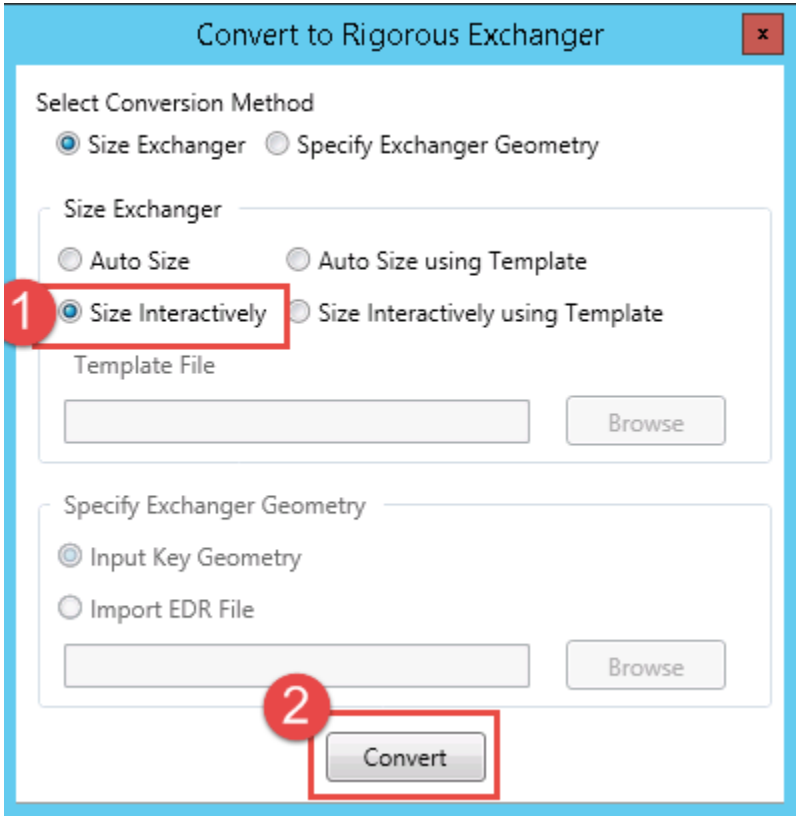
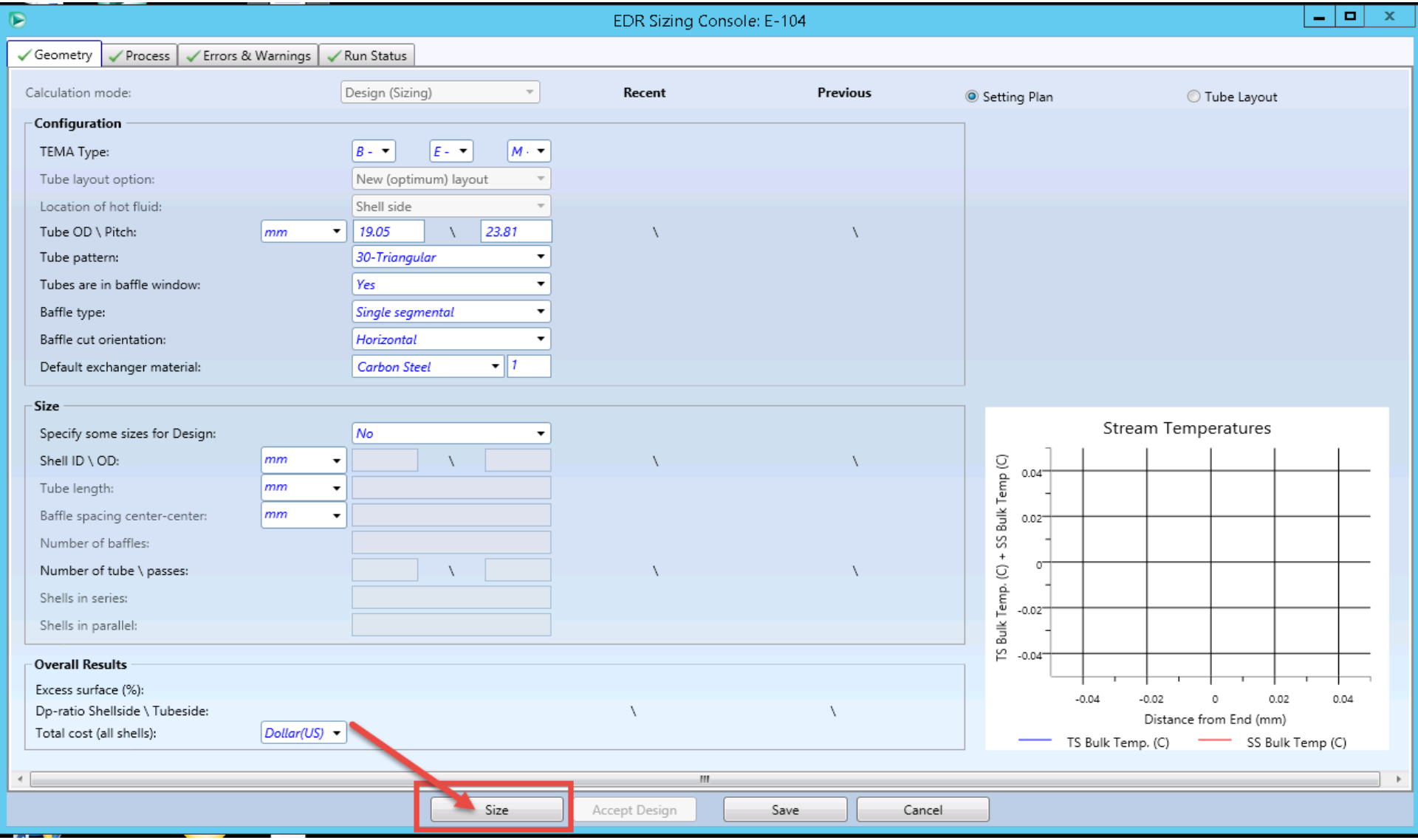
Size Interactively



Size Interactively



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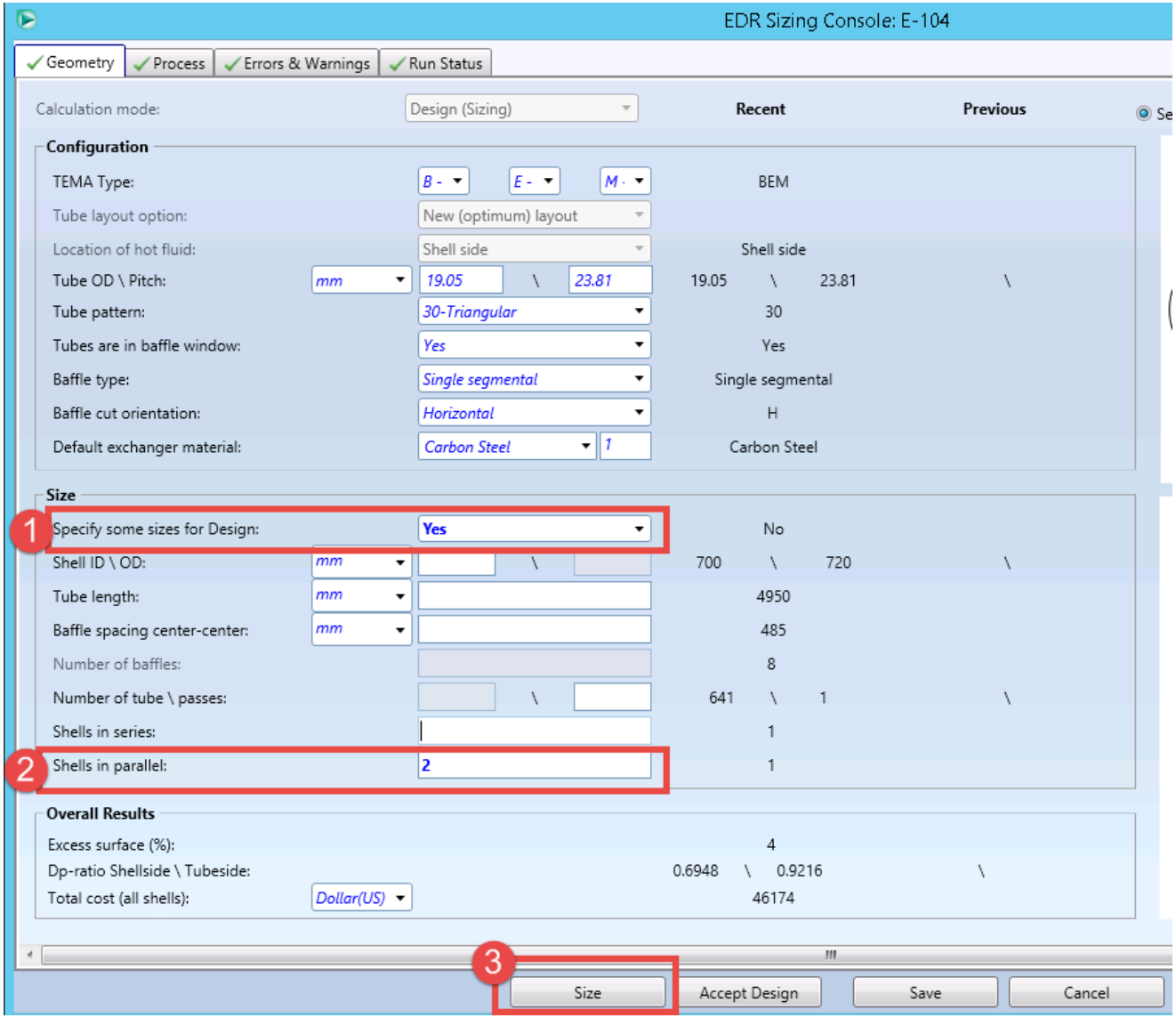
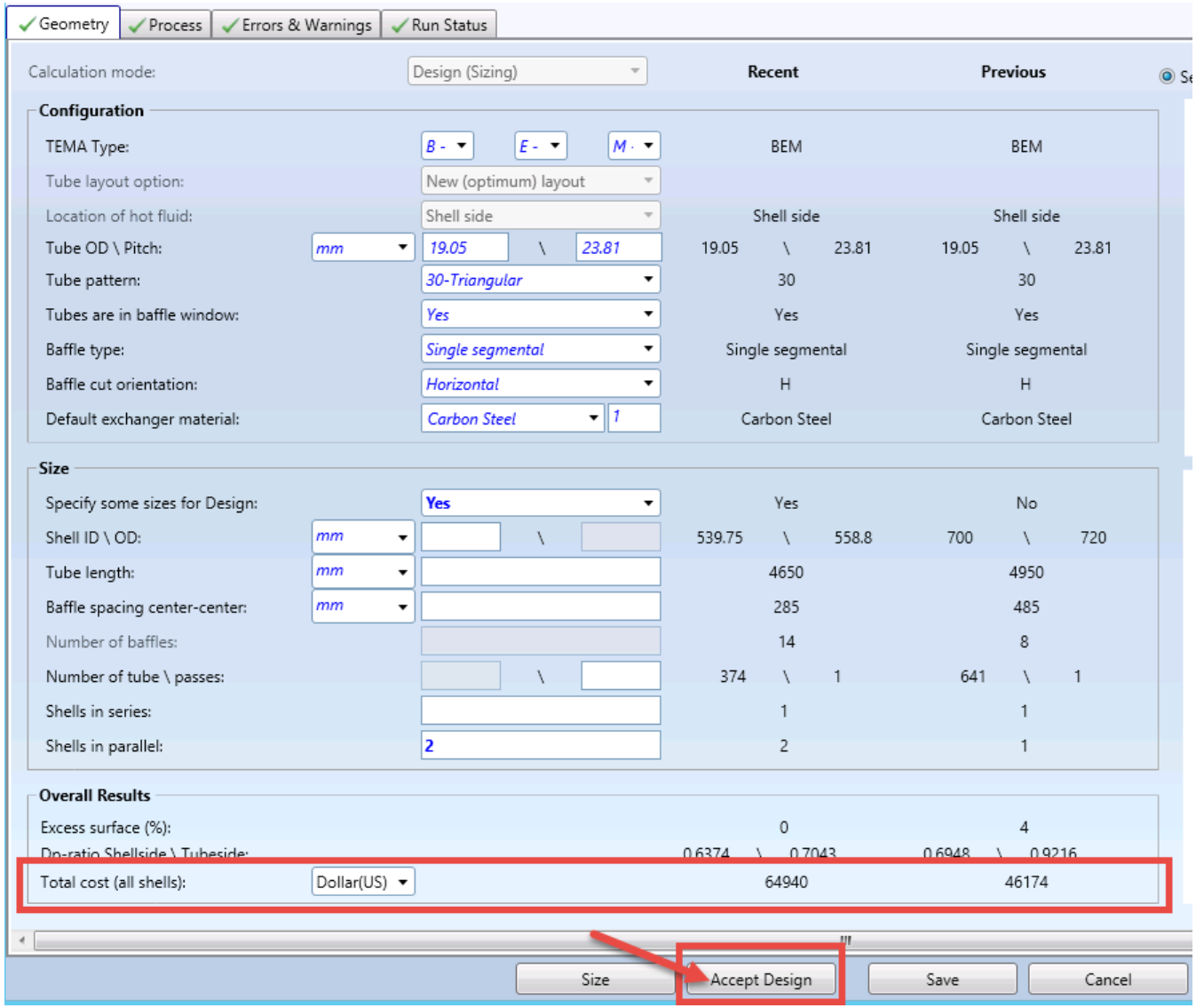
Design with Parallel Shells

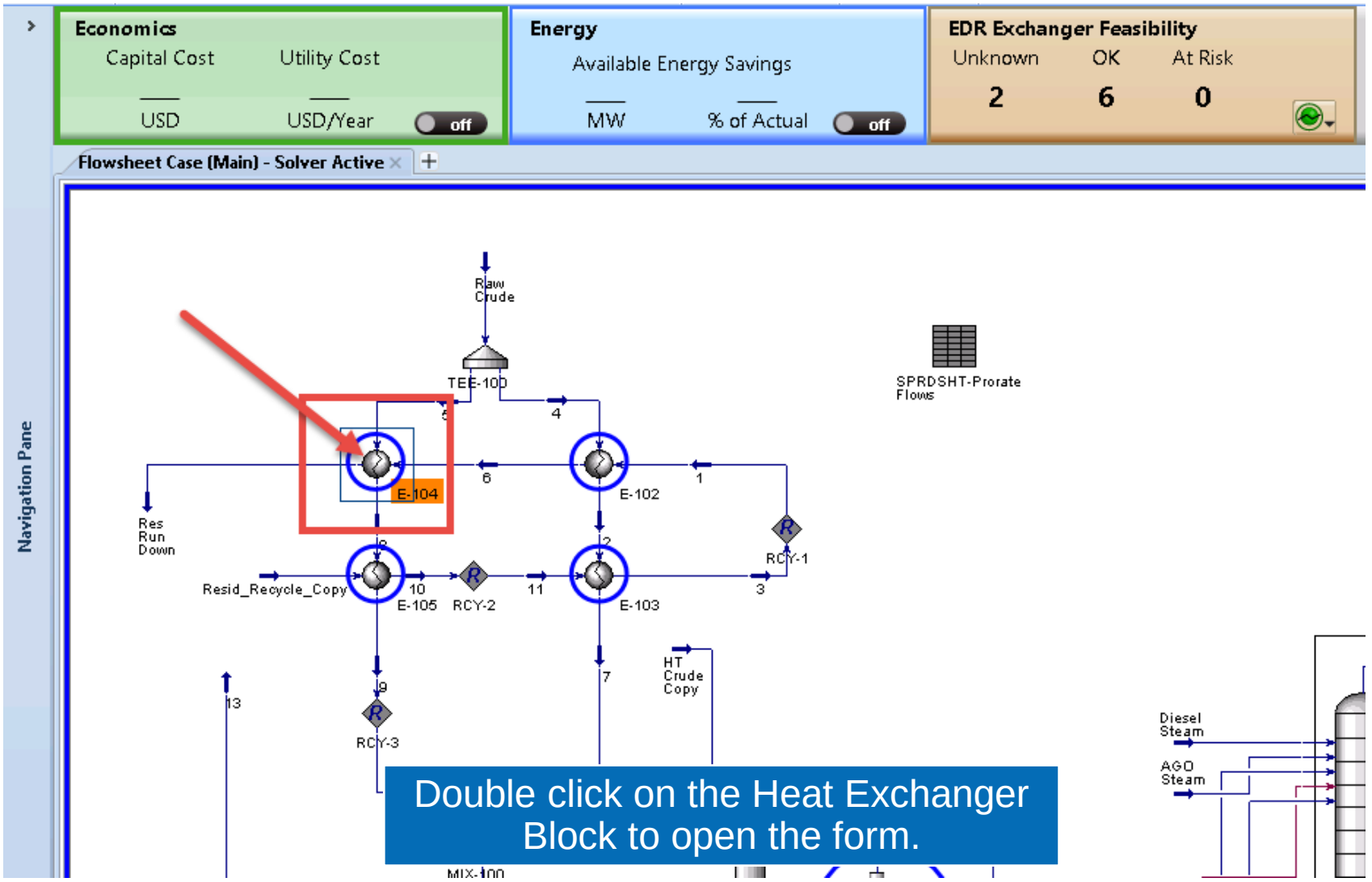


Design with Parallel Shells

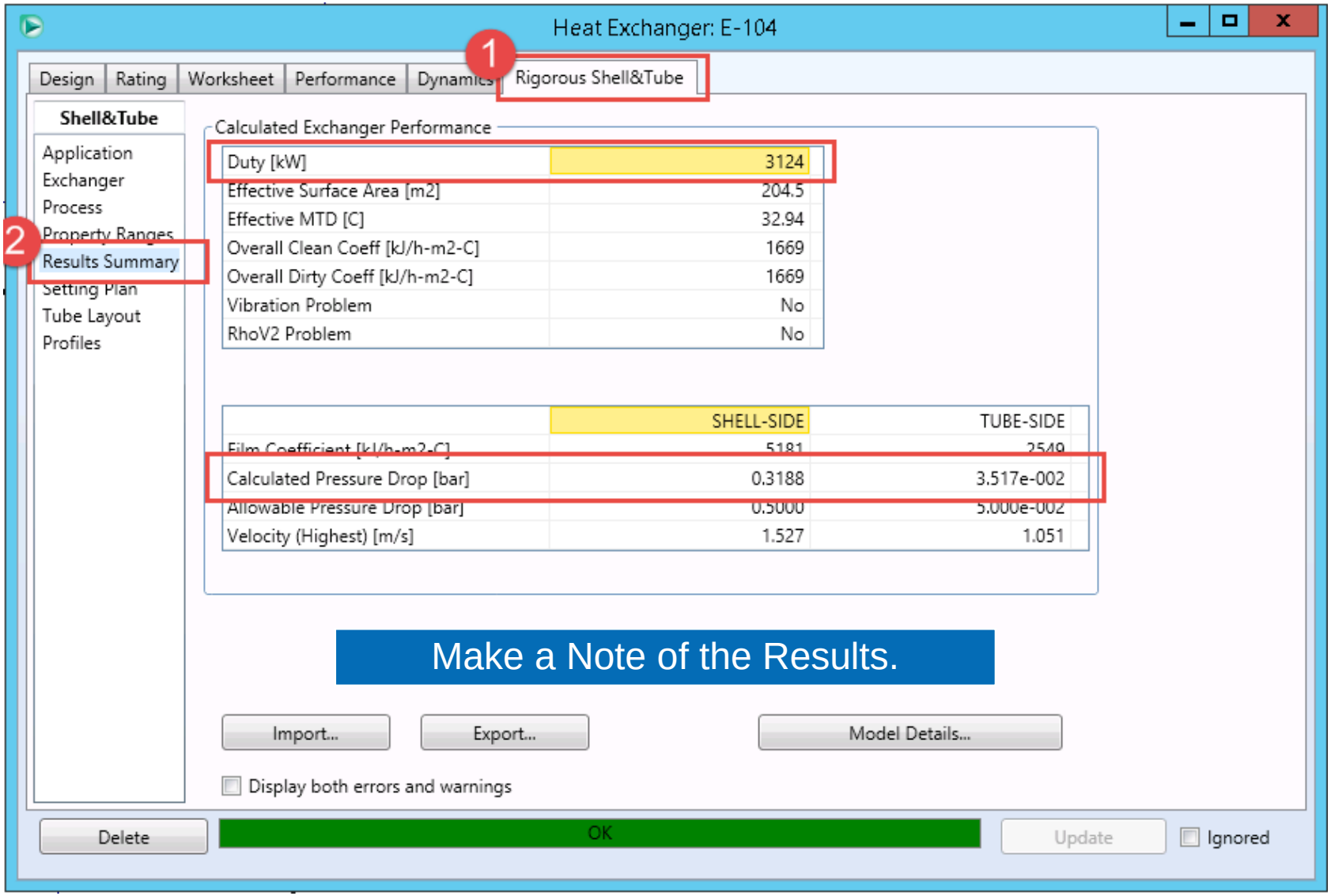


Here you can compare the two designs (total costs, etc.)

View Key Model Results



View Key Model Results



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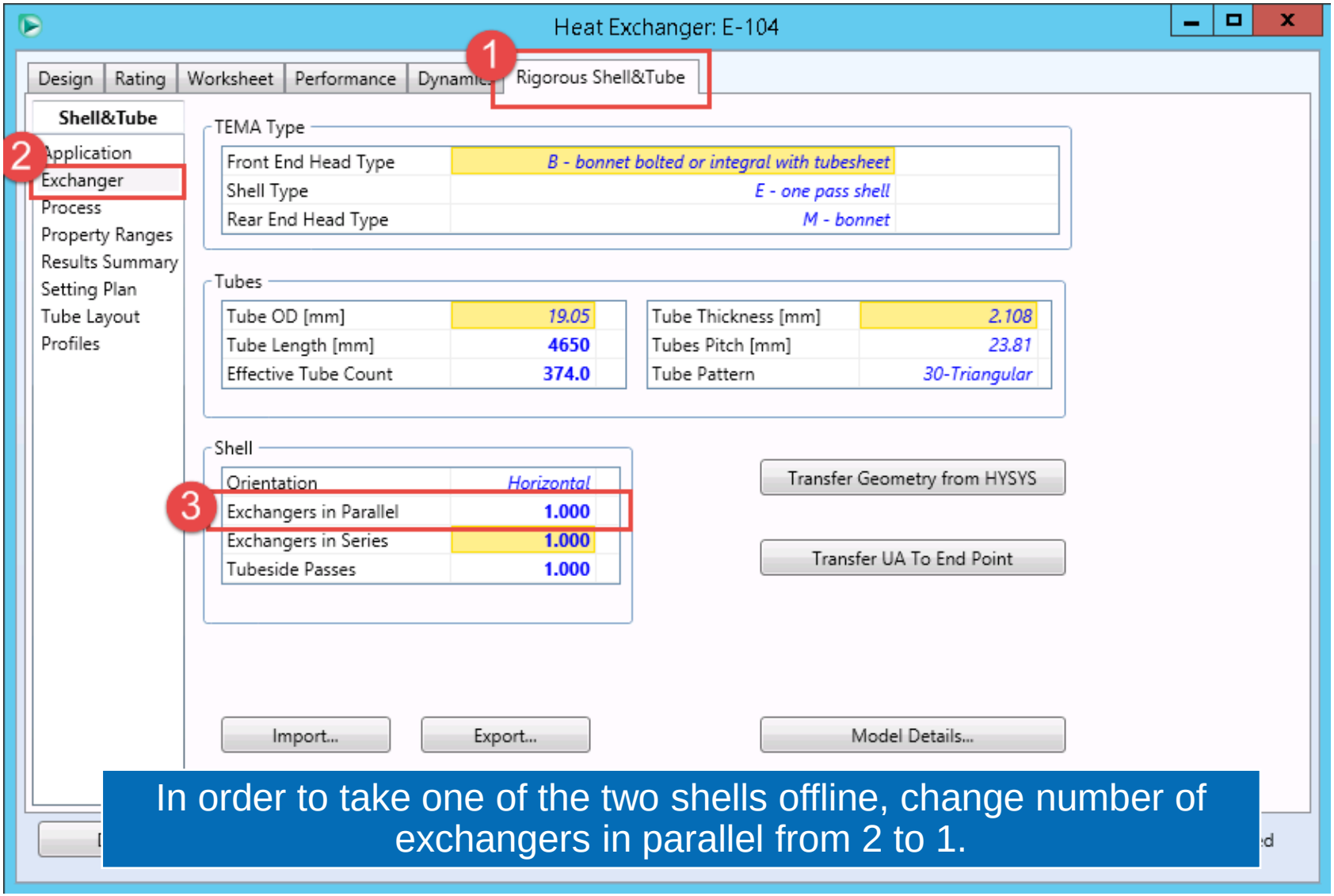
Take One Shell Offline



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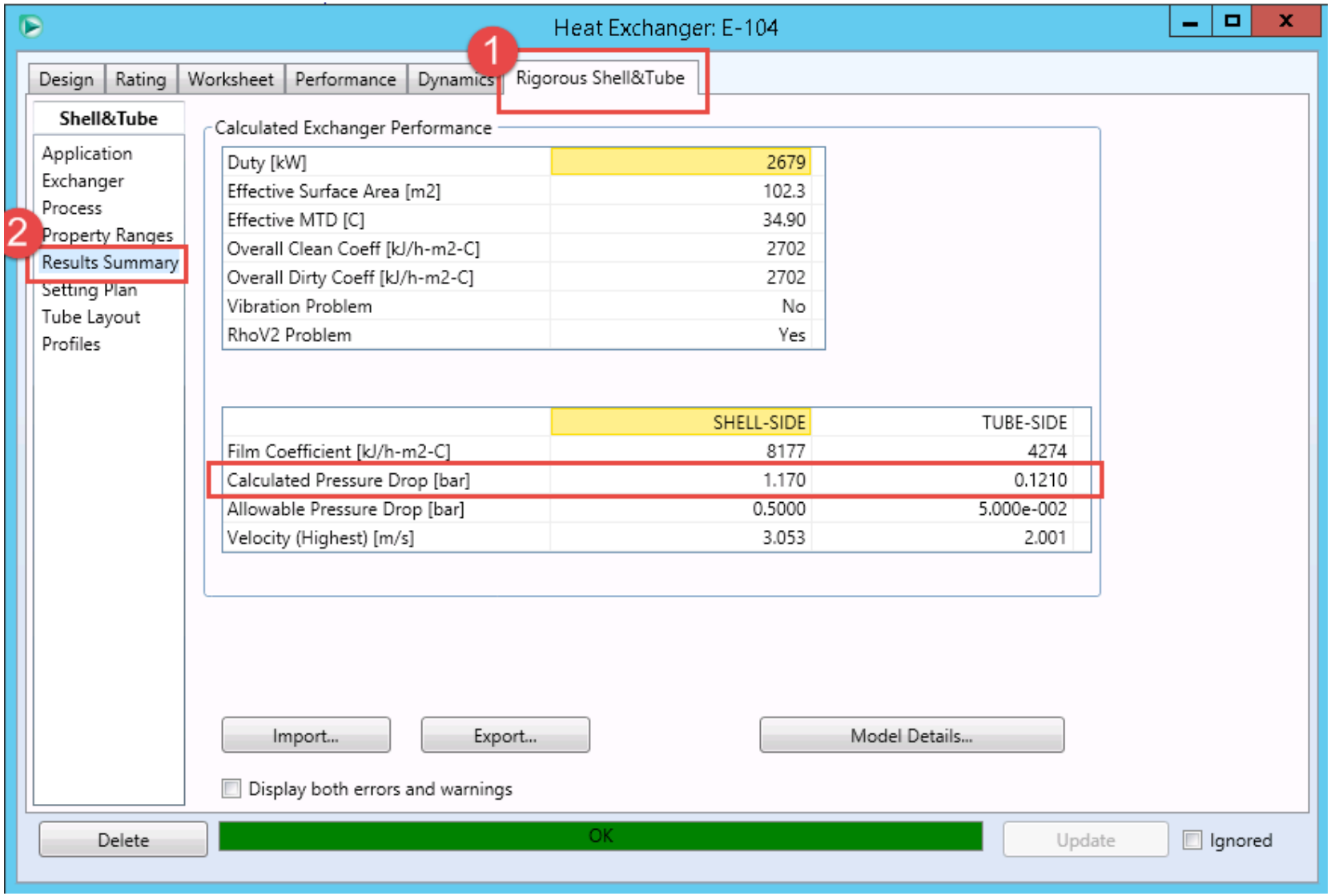
View Implications of the Change



Compare the Implications of the Change

Calculated Exchanger Performance

Duty [kW]	3124
Effective Surface Area [m2]	204.5
Effective MTD [C]	32.94
Overall Clean Coeff [kJ/h-m2-C]	1669
Overall Dirty Coeff [kJ/h-m2-C]	1669
Vibration Problem	No
RhoV2 Problem	No

	SHELL-SIDE	TUBE-SIDE
Film Coefficient [kJ/h-m2-C]	5181	2549
Calculated Pressure Drop [bar]	0.3188	3.517e-002
Allowable Pressure Drop [bar]	0.5000	5.000e-002
Velocity (Highest) [m/s]	1.527	1.051

Both Shells Online

Only ONE Shell Online

Calculated Exchanger Performance

Duty [kW]	2679
Effective Surface Area [m2]	102.3
Effective MTD [C]	34.90
Overall Clean Coeff [kJ/h-m2-C]	2702
Overall Dirty Coeff [kJ/h-m2-C]	2702
Vibration Problem	No
RhoV2 Problem	Yes

	SHELL-SIDE	TUBE-SIDE
Film Coefficient [kJ/h-m2-C]	8177	4274
Calculated Pressure Drop [bar]	1.170	0.1210
Allowable Pressure Drop [bar]	0.5000	5.000e-002
Velocity (Highest) [m/s]	3.053	2.001

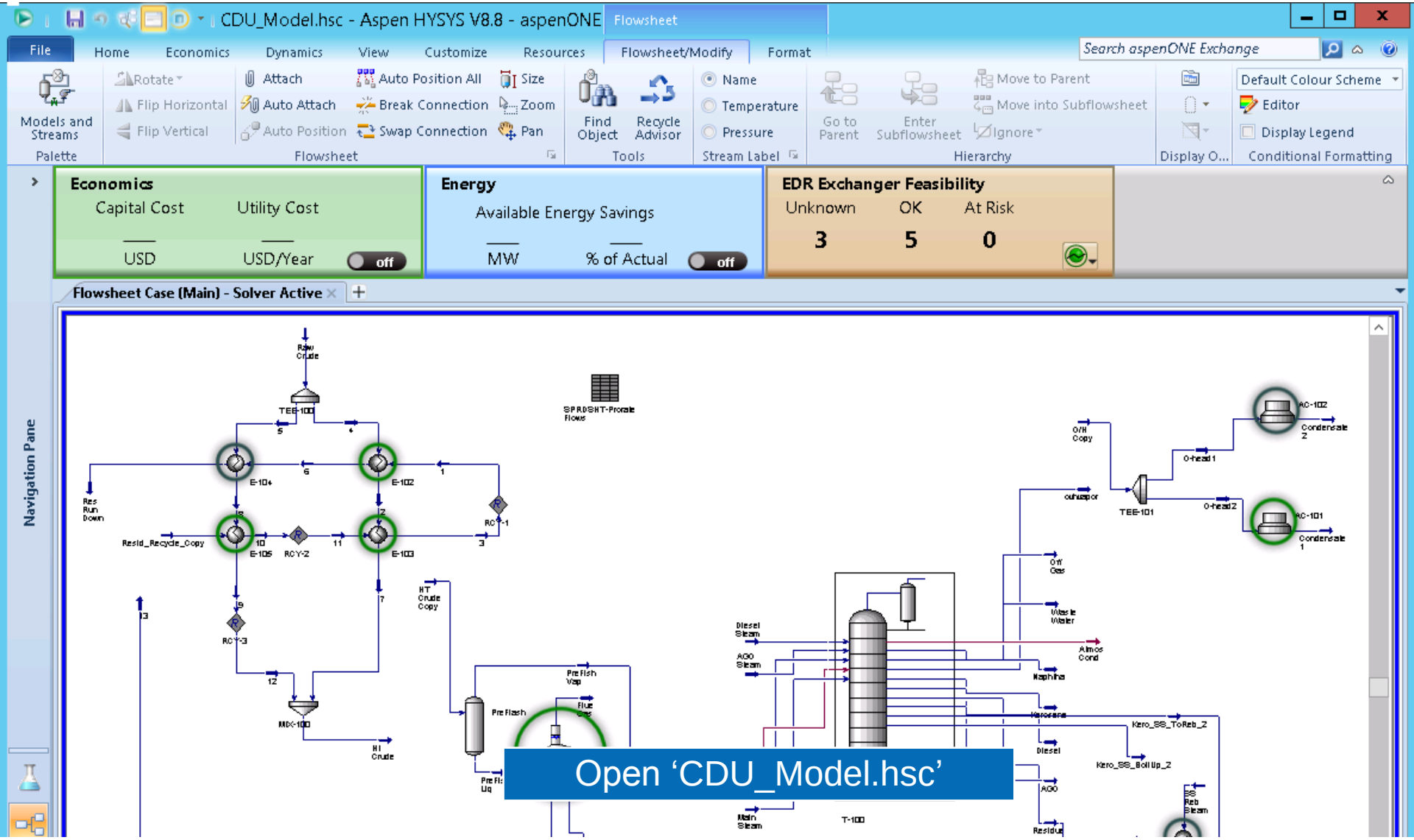
Air Cooled Heat Exchanger

Demonstration Workflow

Below is the order of tasks we will follow next:

1. Identify the Simple Heat Exchanger Model
2. Convert the simple model to a rigorous model
3. Compare the performance between the parallel Air Cooler models
4. Convert the rigorous model back to a simple model
5. Size the heat exchanger using EDR Template
6. Learn how to view key performance results
7. Change geometric configuration of the exchanger
8. Compare the implications of the change to the previous design

Open the Process Model



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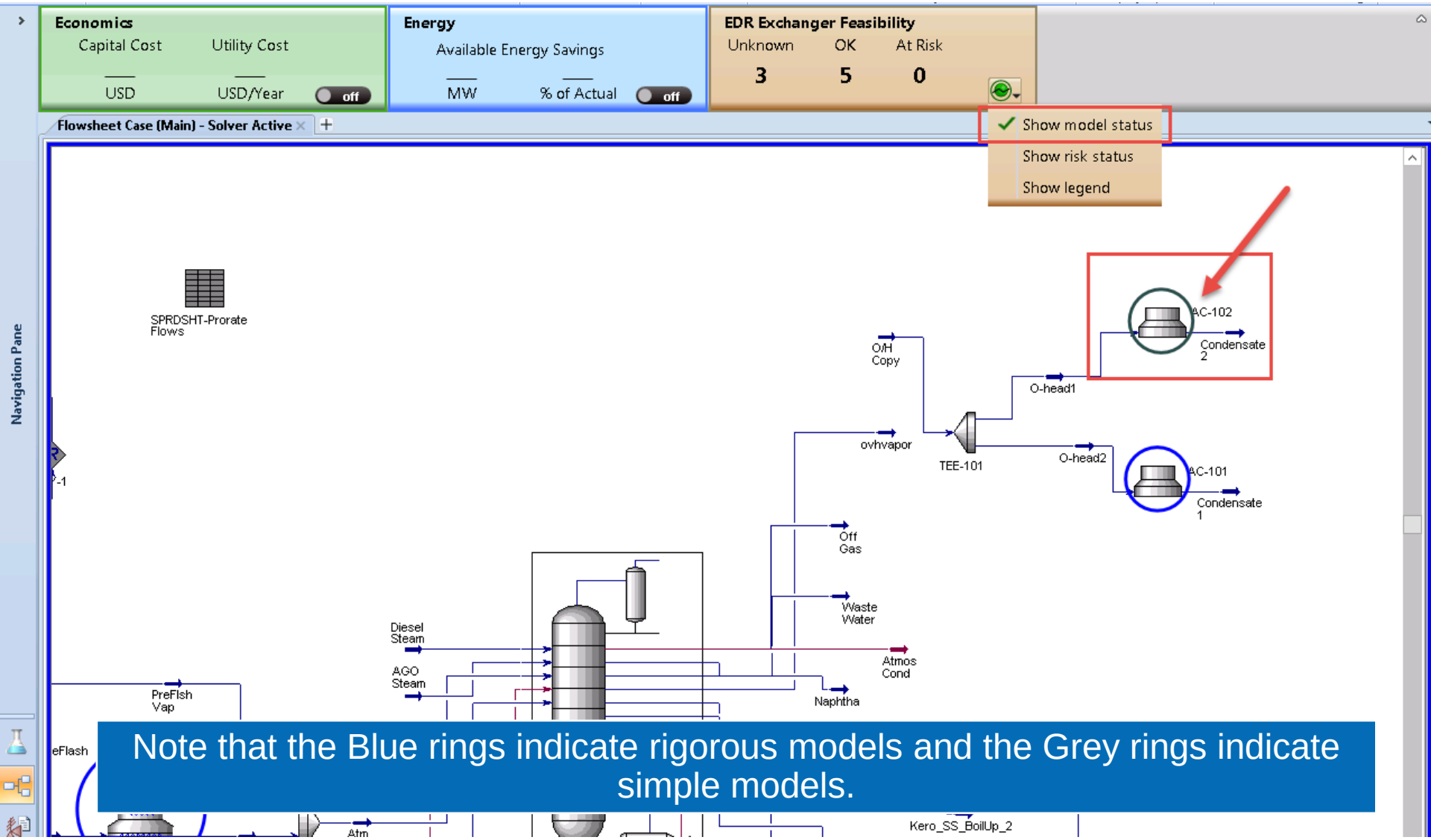
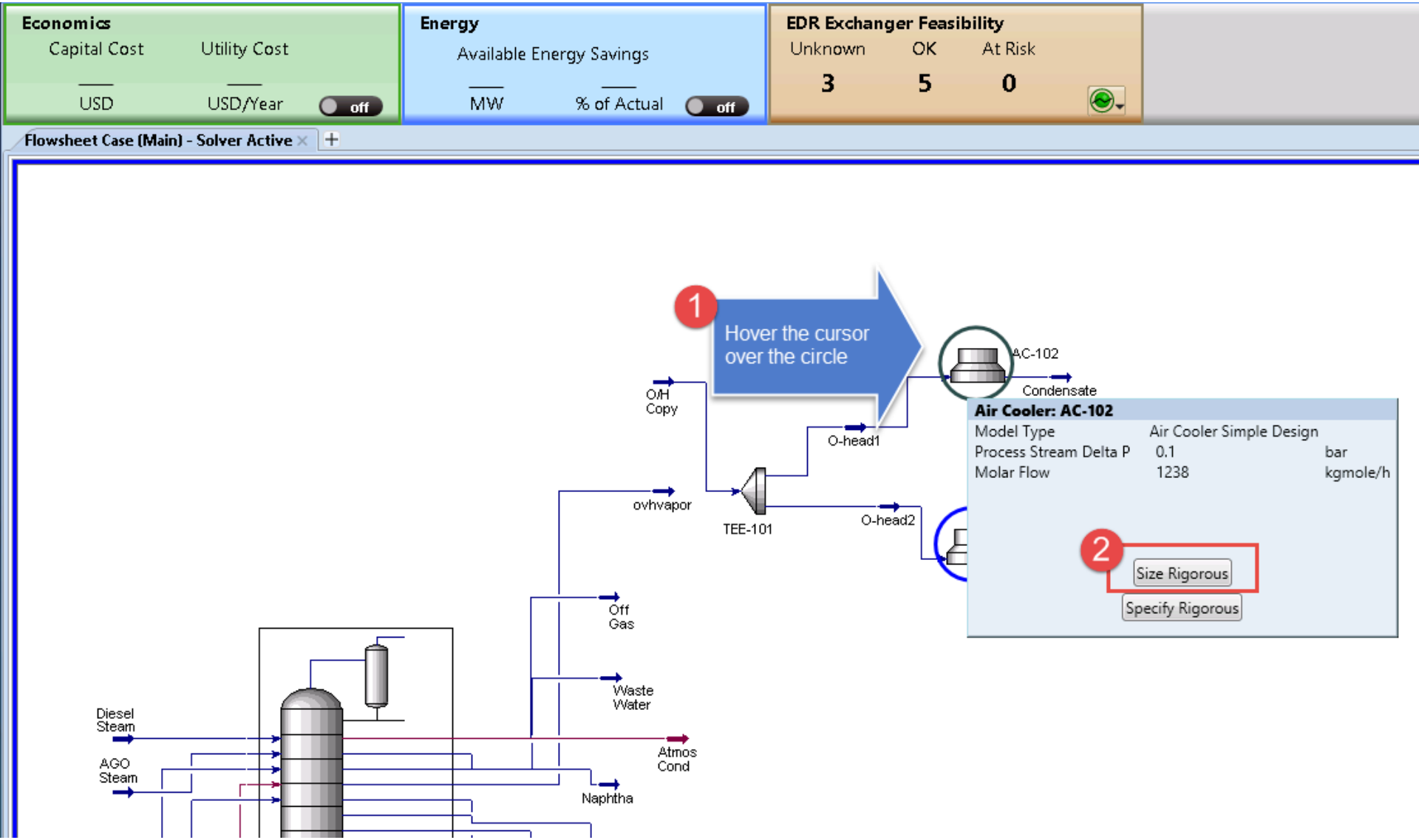
Locate the Heat Exchanger

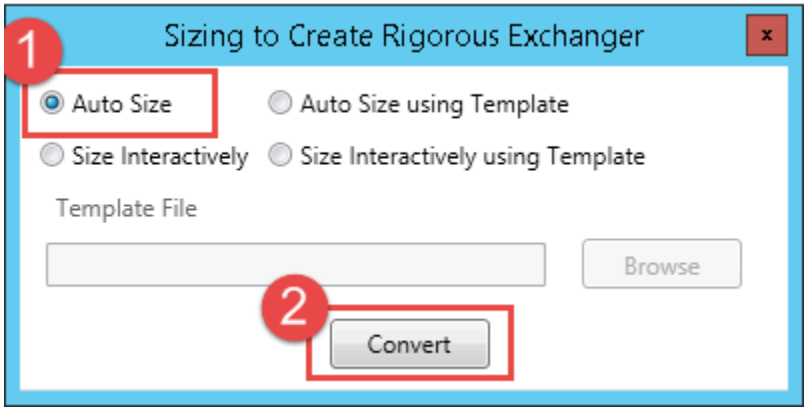


Note that the Blue rings indicate rigorous models and the Grey rings indicate simple models.

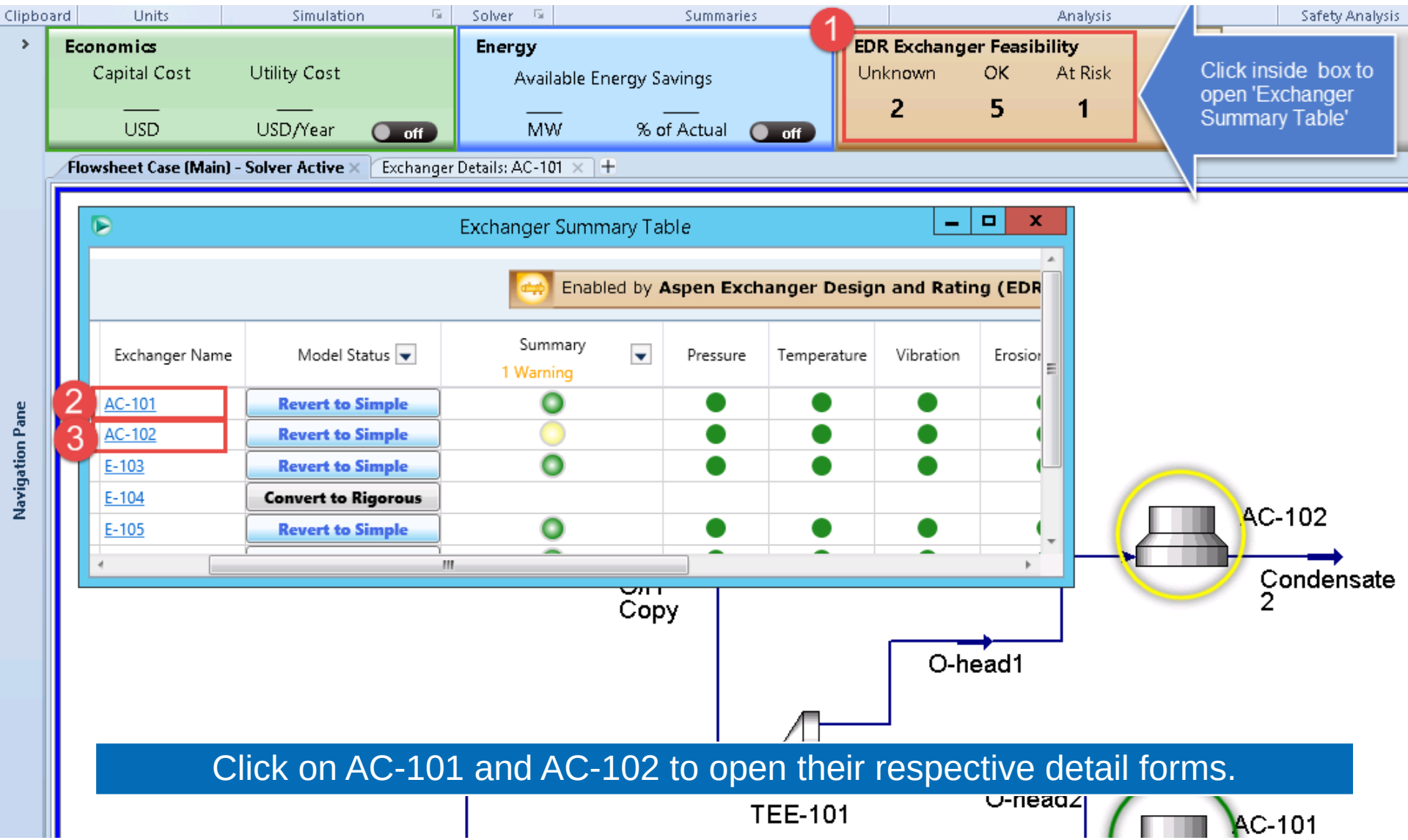
Convert to Rigorous Model



Auto Size to create a Rigorous Model

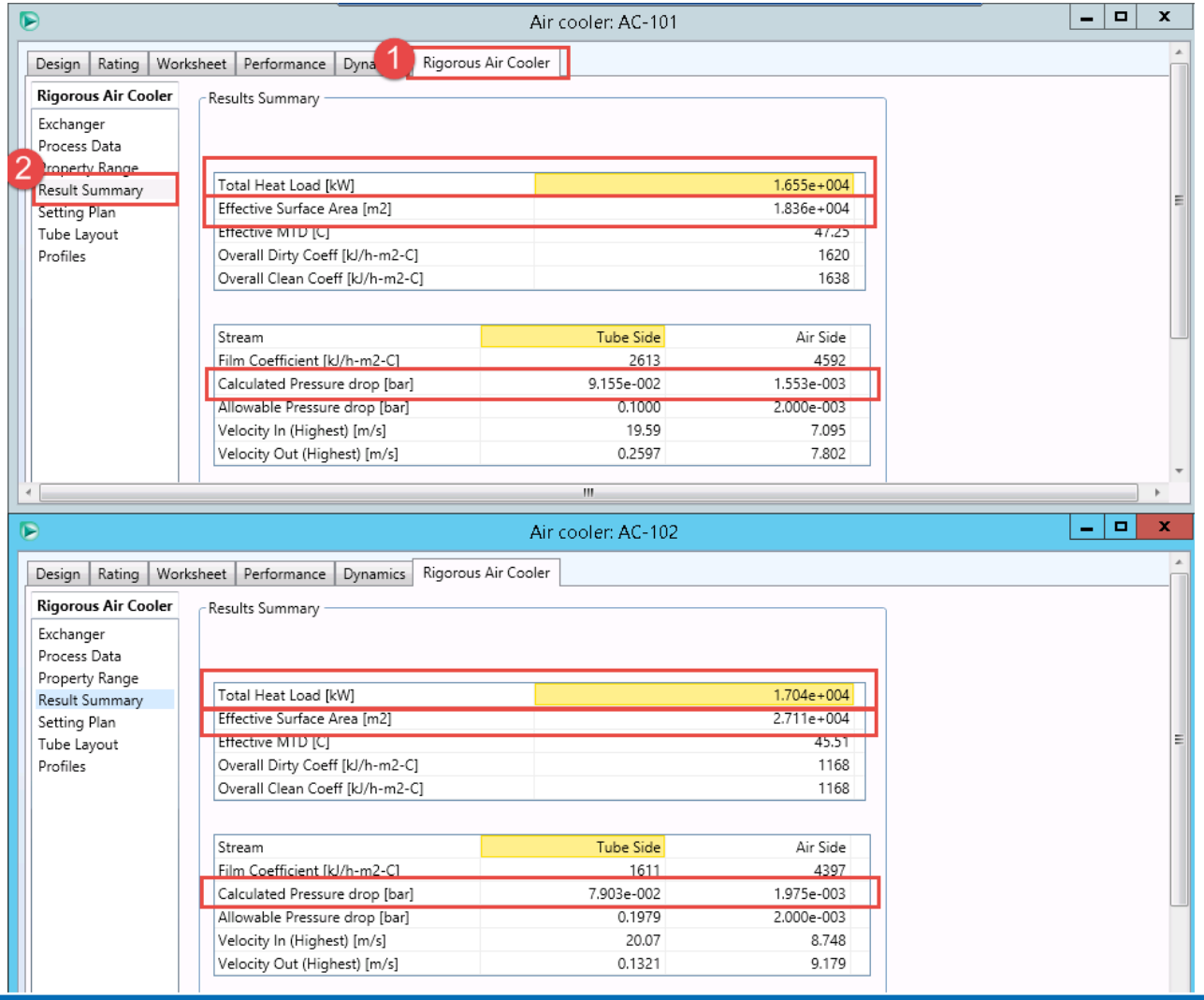


Compare Between the Parallel Air Coolers



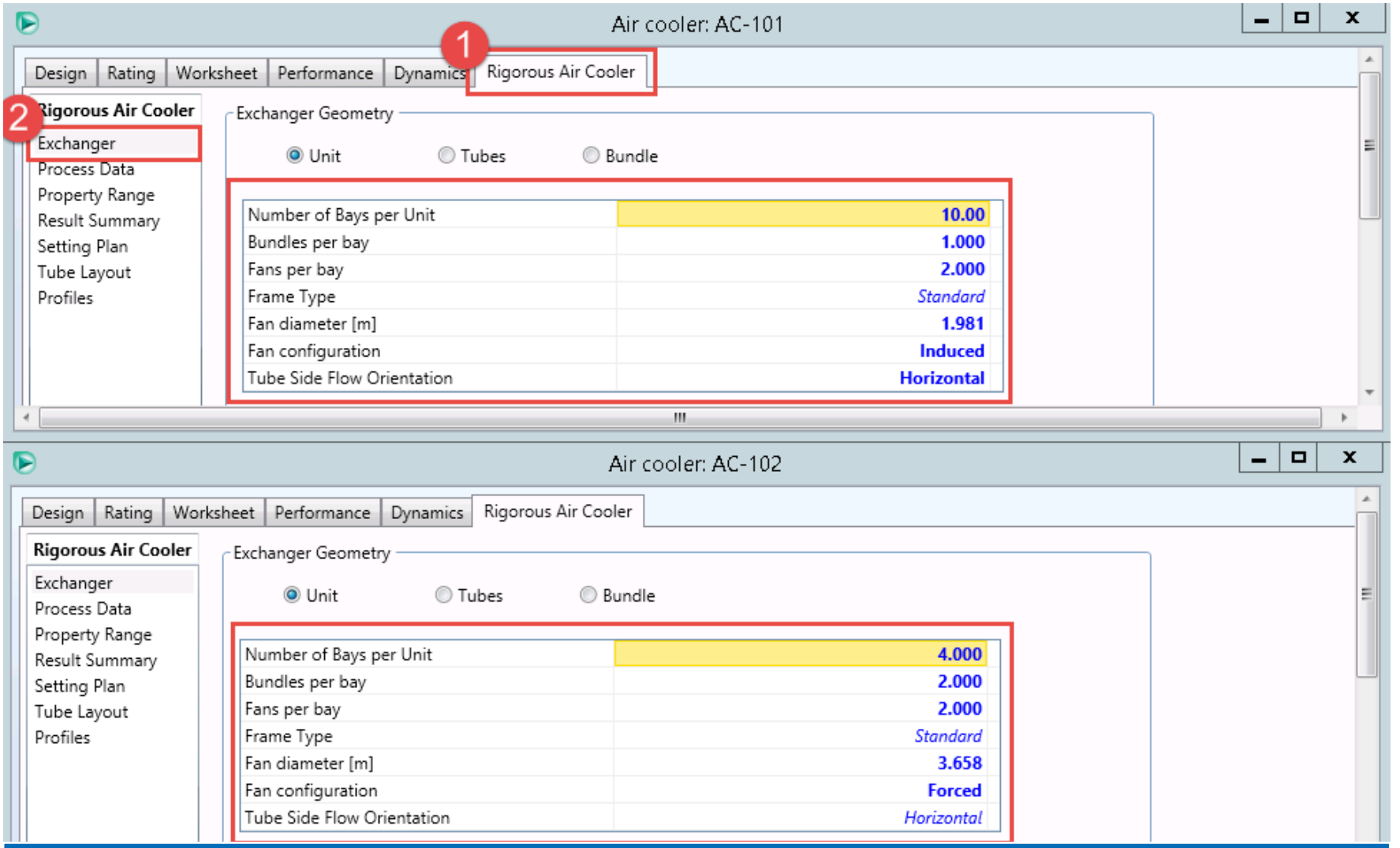
Click on AC-101 and AC-102 to open their respective detail forms.

Compare Between the Parallel Air Coolers



Note the difference in performance between the two parallel Air coolers.

Compare Between the Parallel Air Coolers



Note the difference in geometry between the two parallel Air coolers.

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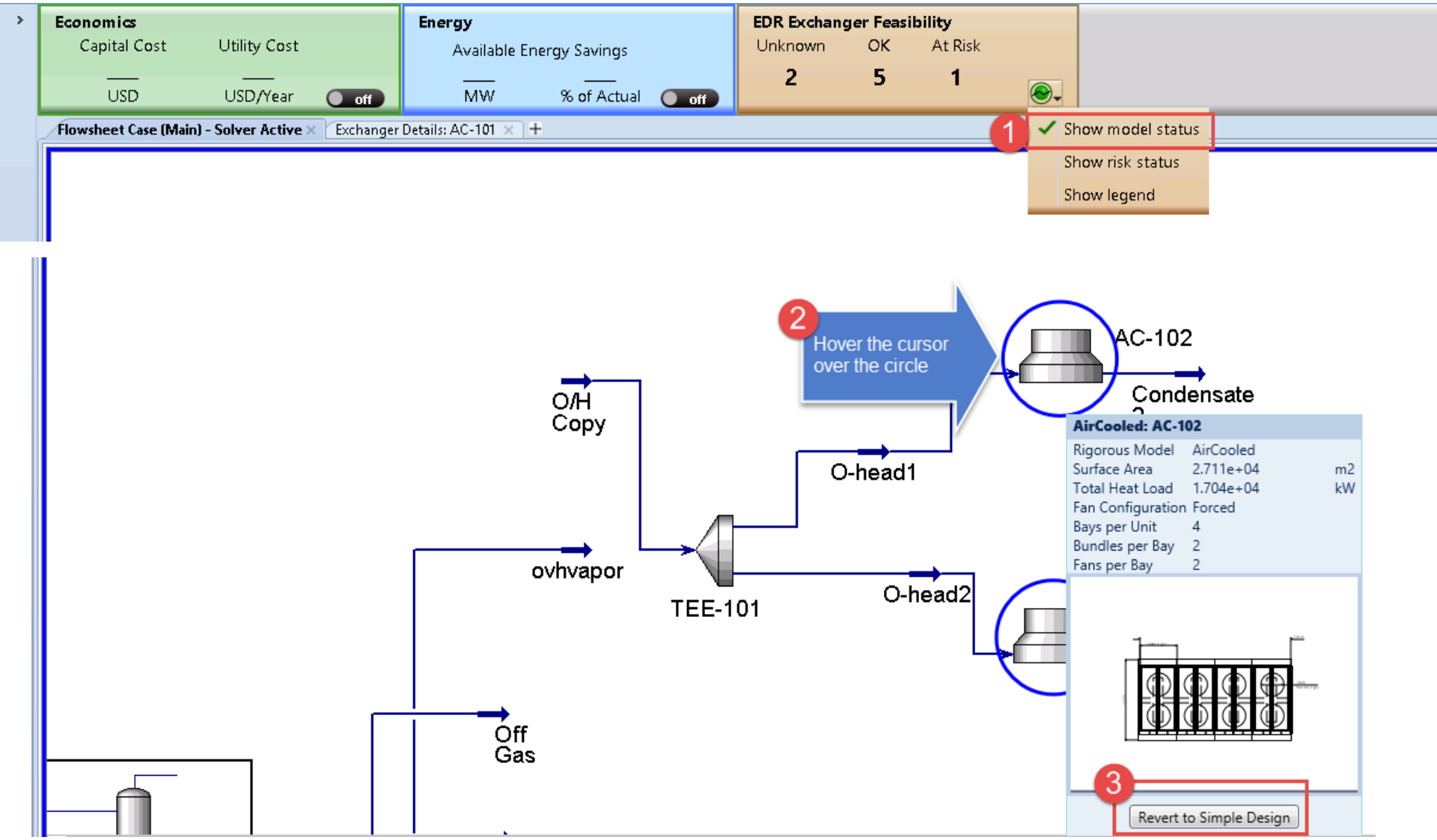
Convert Back to Simple Model



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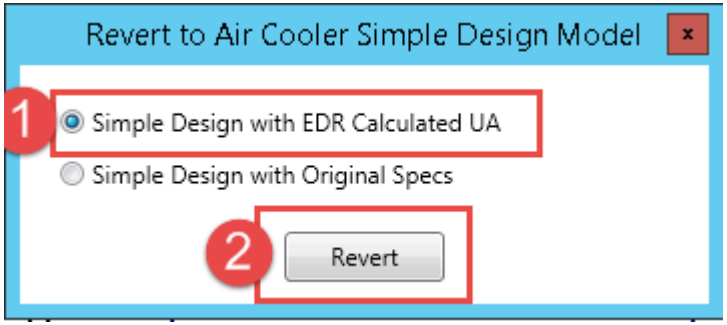
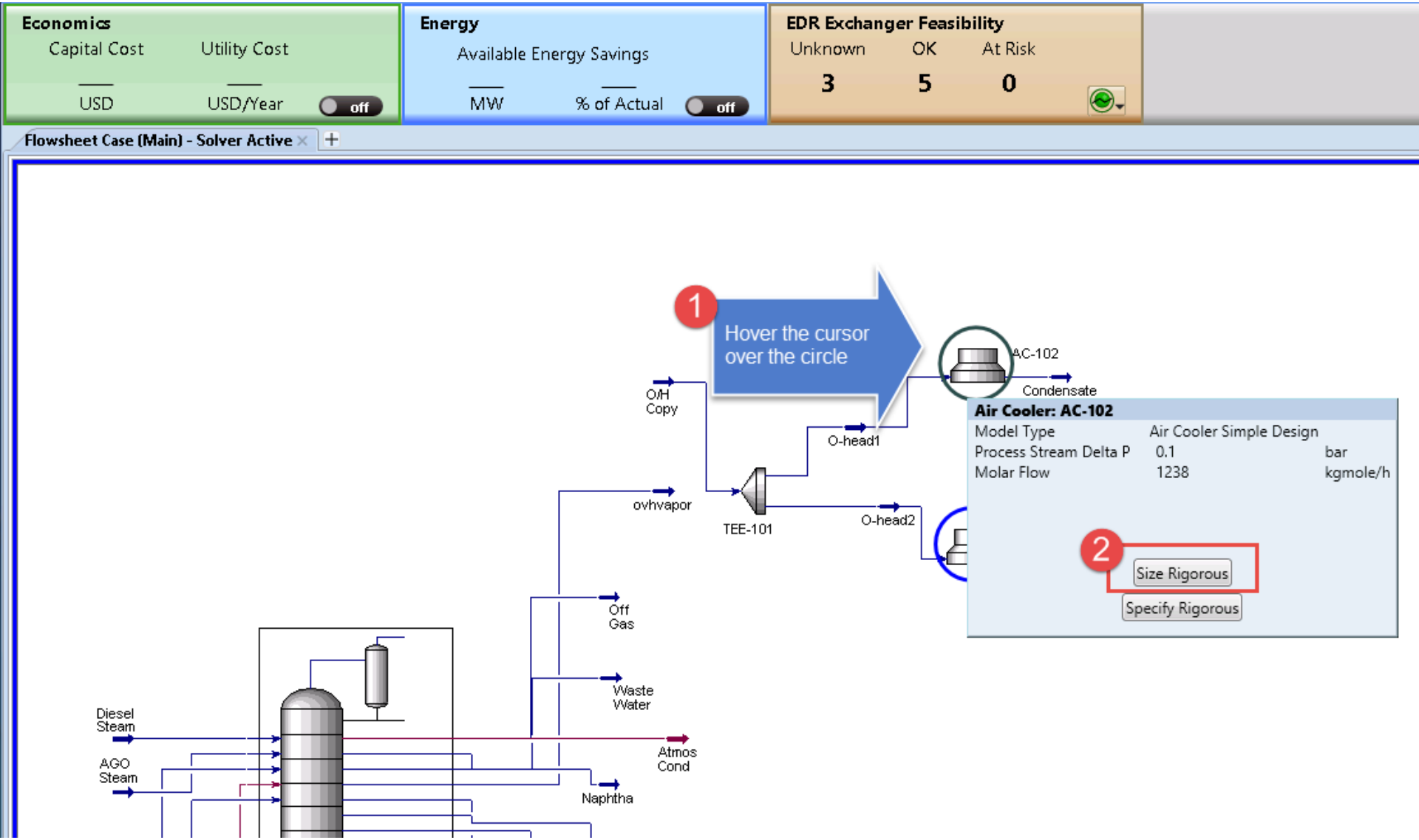
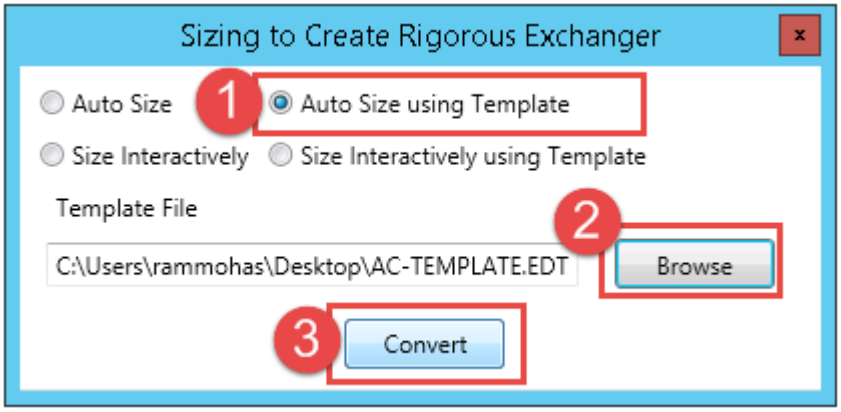
Convert Back to Simple Model



Convert Simple to Rigorous Model

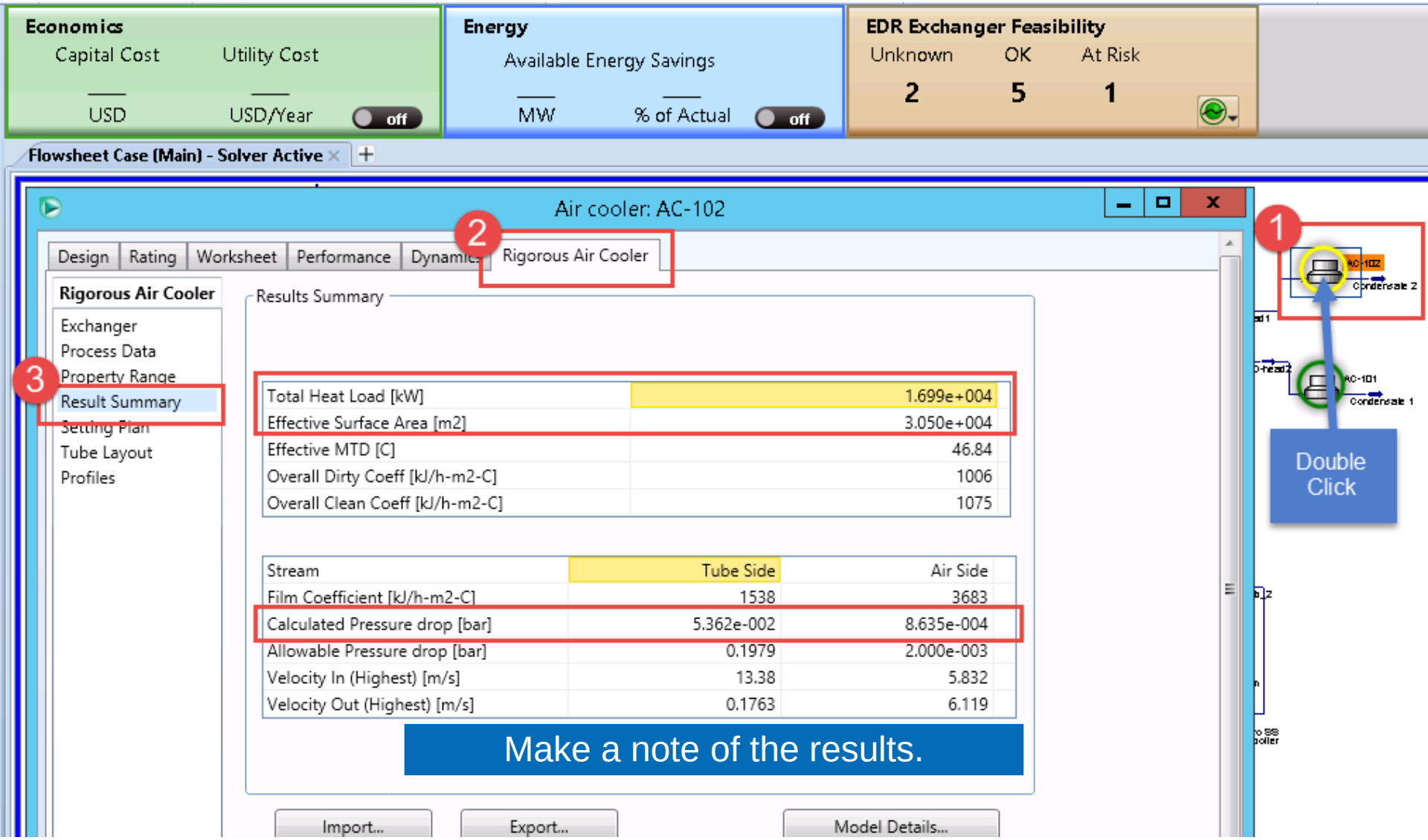


Auto Size using Template

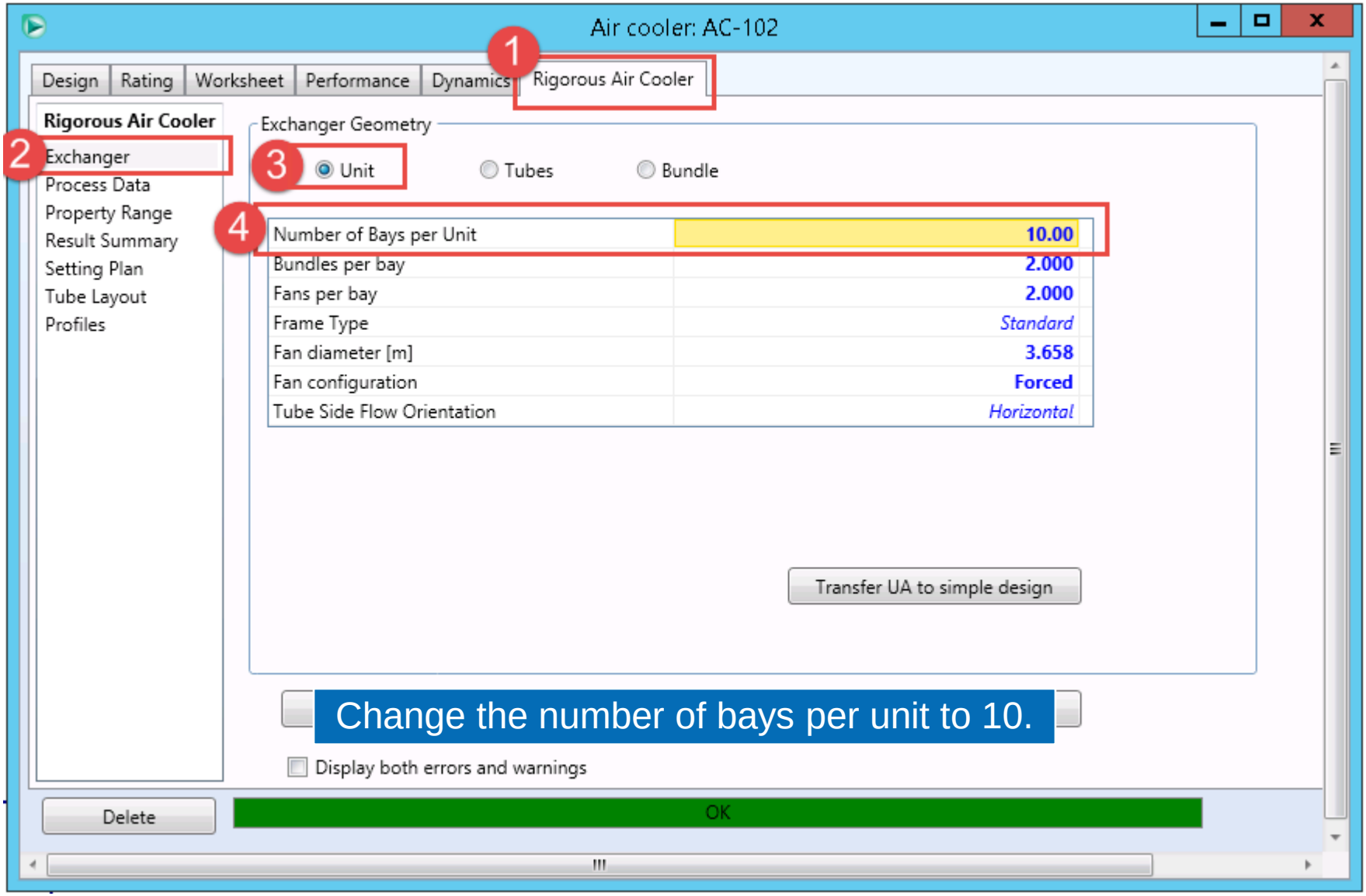


Choose the template: 'AC-TEMPLATE.EDT' for sizing.

View Key Model Results



Make Changes to Heat Exchanger Geometry



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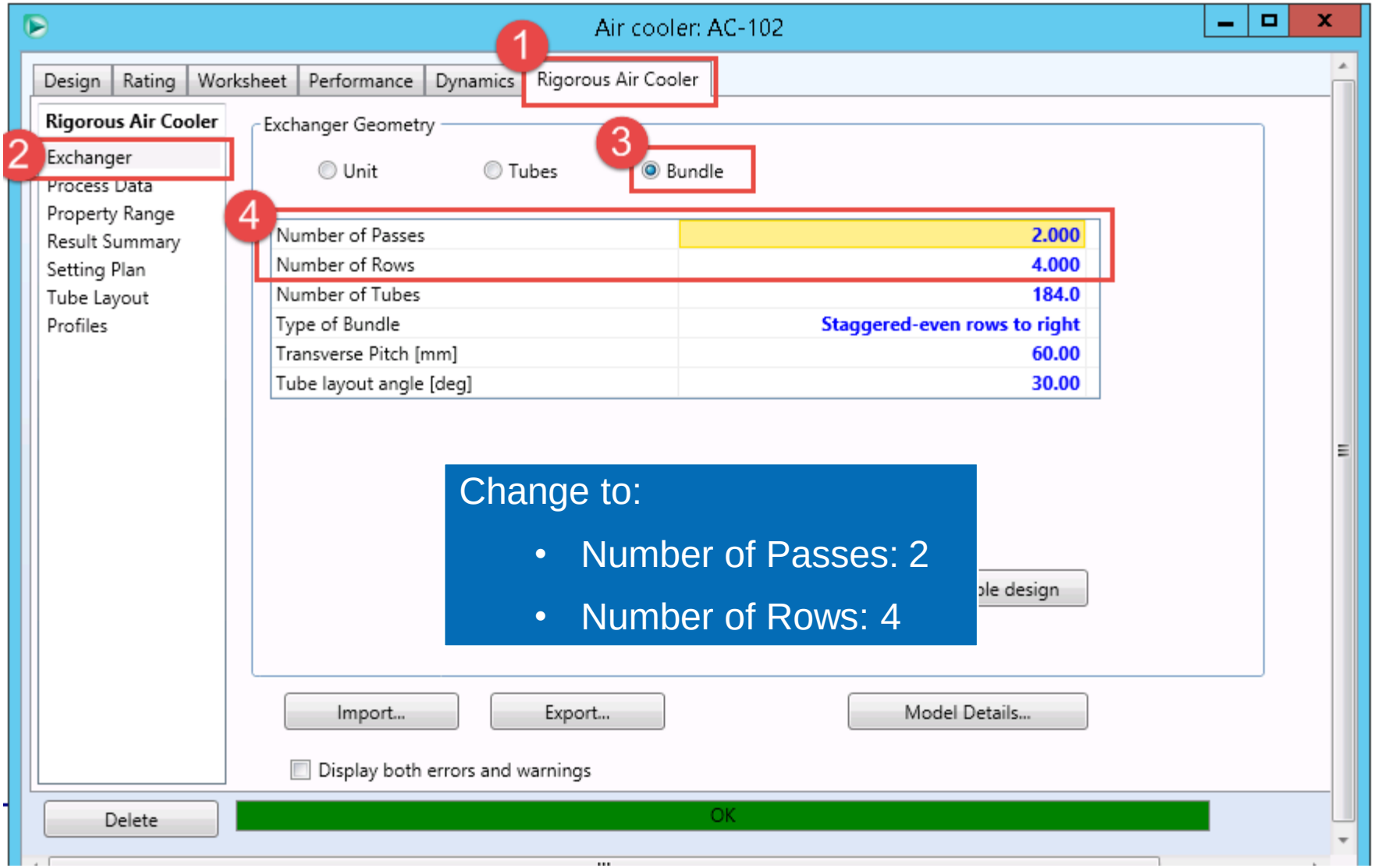
Make Changes to Heat Exchanger Geometry



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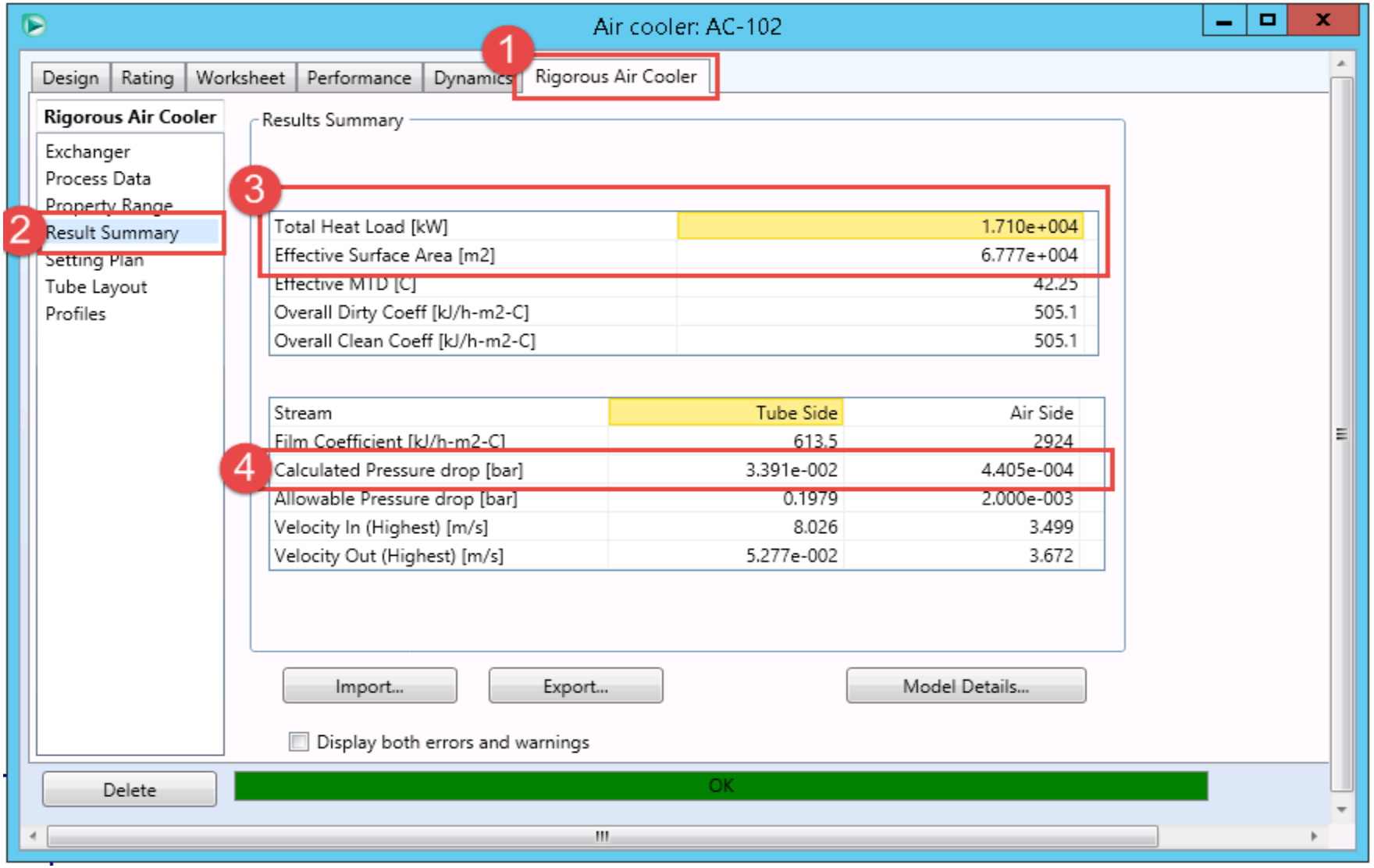
View Key Model Results



Compare the Performance Between Two Designs

Total Heat Load [kW]	1.699e+004
Effective Surface Area [m2]	3.050e+004
Effective MTD [C]	46.84
Overall Dirty Coeff [kJ/h-m2-C]	1006
Overall Clean Coeff [kJ/h-m2-C]	1075

Stream	Tube Side	Air Side
Film Coefficient [kJ/h-m2-C]	1538	3683
Calculated Pressure drop [bar]	5.362e-002	8.635e-004
Allowable Pressure drop [bar]	0.1979	2.000e-003
Velocity In (Highest) [m/s]	13.38	5.832
Velocity Out (Highest) [m/s]	0.1763	6.119

Design (Using EDR Template)

Design (Modified Geometry)

Total Heat Load [kW]	1.710e+004
Effective Surface Area [m2]	6.777e+004
Effective MTD [C]	42.25
Overall Dirty Coeff [kJ/h-m2-C]	505.1
Overall Clean Coeff [kJ/h-m2-C]	505.1

Stream	Tube Side	Air Side
Film Coefficient [kJ/h-m2-C]	613.5	2924
Calculated Pressure drop [bar]	3.391e-002	4.405e-004
Allowable Pressure drop [bar]	0.1979	2.000e-003
Velocity In (Highest) [m/s]	8.026	3.499
Velocity Out (Highest) [m/s]	5.277e-002	3.672

Additional Resources & Contacts

- AspenTech Support Website (http://support.aspentech.com)
- AspenTech Courseware Available in Classroom and Online Versions
- AspenTech Business Consultants

Contact Name	Contact Email
Sandeep Mohan	Sandeep.Mohan@aspentech.com