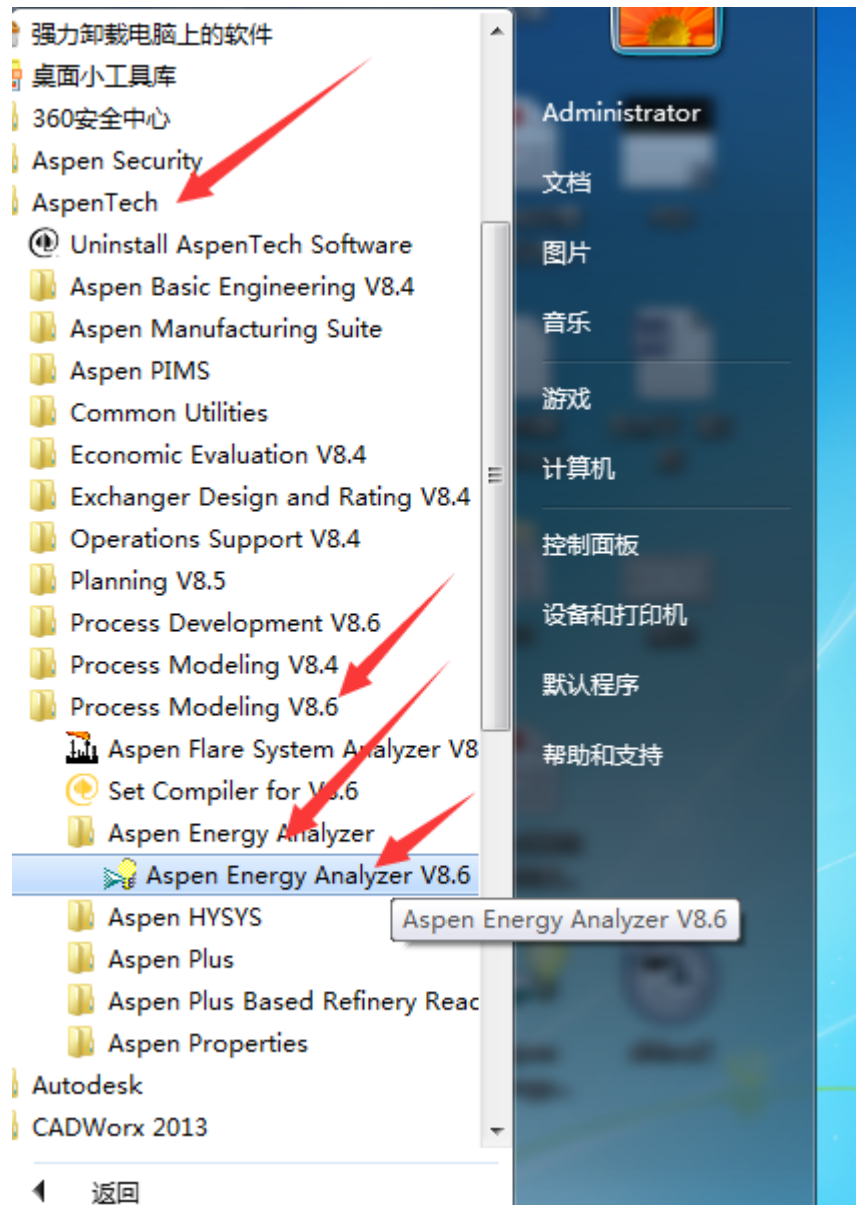


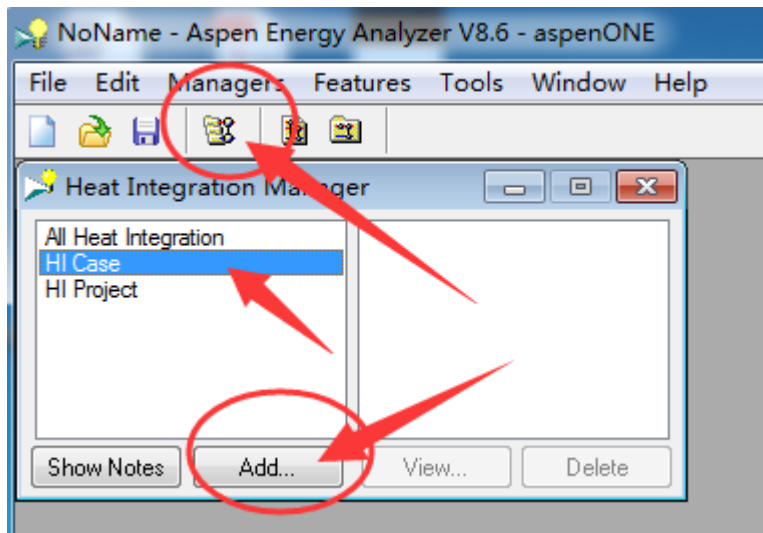
## 换热网络的设计

### ——第一部分:主要是 Aspen 导入与自动设计

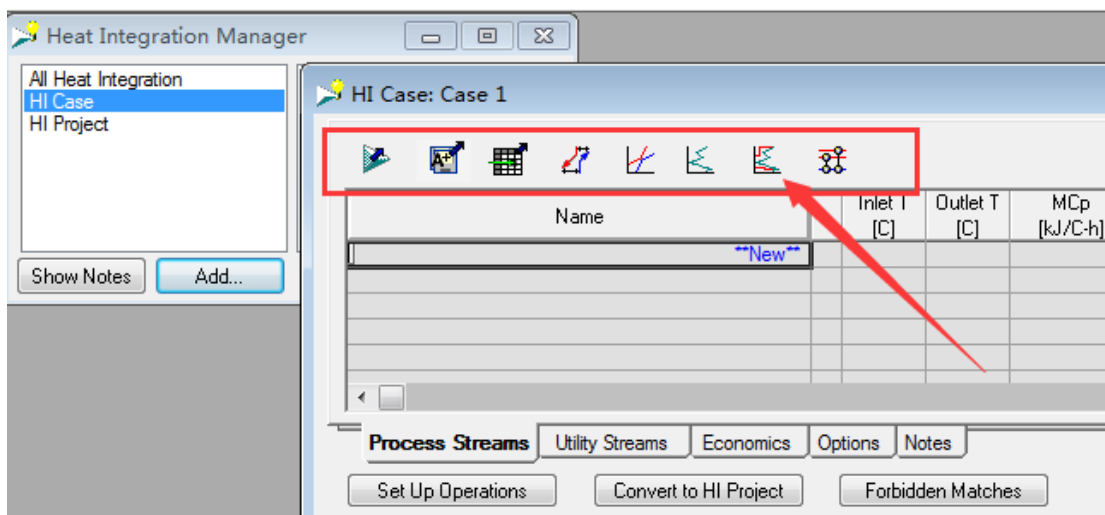
#### 1.启动 Aspen Energy Analyzer



#### 2.新建 HI Case/HI Project



### 3.工具介绍



从 Hvsvs 流程中导入数据



从 Aspen 流程中导入数据



从 Excel 中导入数据



打开目标查看窗口



打开复合曲线窗口



打开总复合曲线窗口

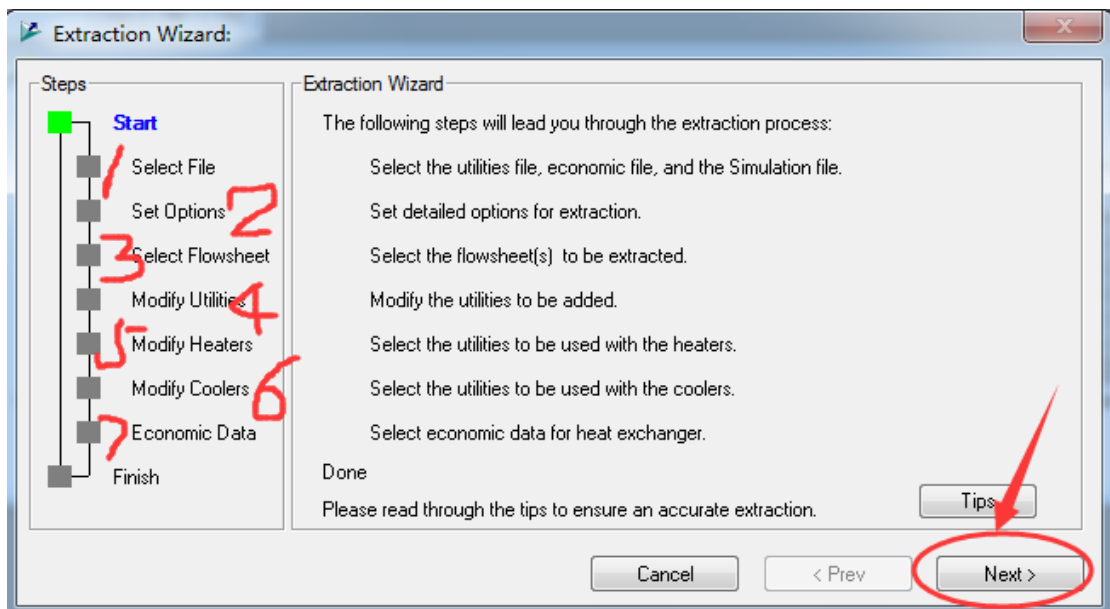
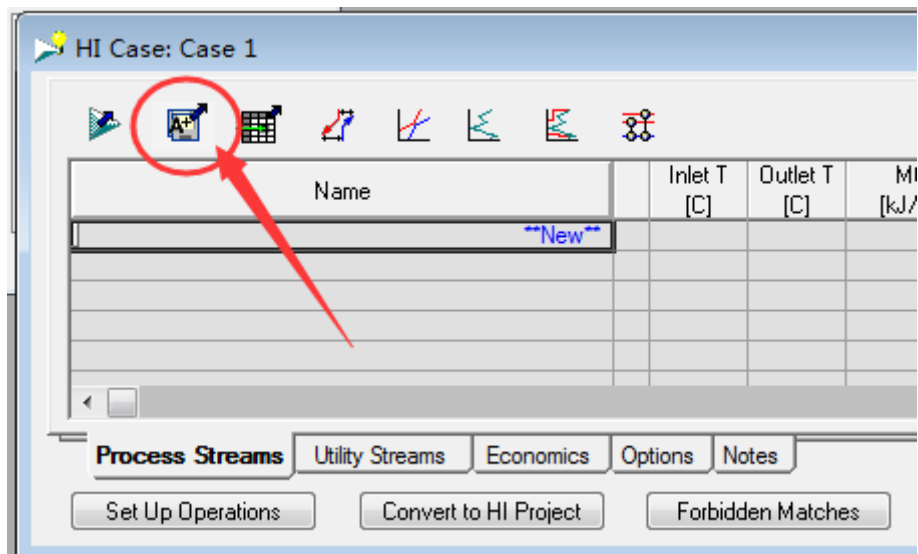


打开公用工程复合曲线窗口



打开换热网络网格图窗口

#### 4.从 Aspen 流程中导入数据（也可直接输入物流信息与公用工程）



第一行：选择文件类型，公用工程文件，模拟文件，经济文件

第二行：设定详细的选项

第三行：选择流程

第四行：改变公用工程或添加公用工程

第五行：选择加热器的公用工程

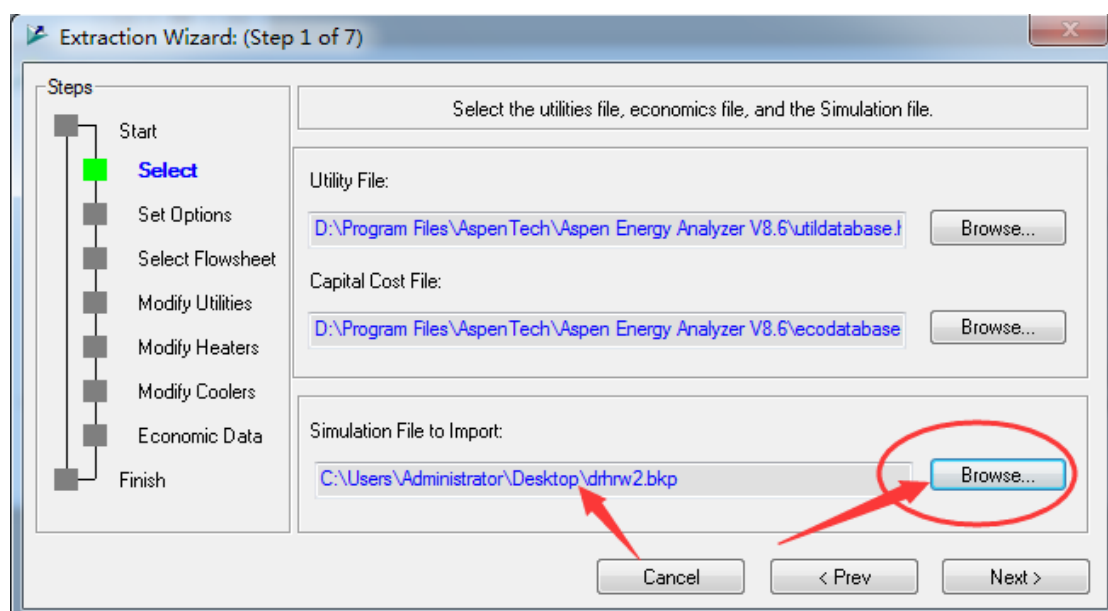
第六行：选择冷却器的公用工程

第七行：选择换热器的经济数据

右下角“Tips”有较详细介绍

在点击最右下角“Next”中之前，需要判断要导入的 Aspen Plus 流程模拟文件：模拟文件必须收敛，且没有错误；是否有不必要的物流和不必要的单元操作；是否有隐藏物流（在 Aspen Plus 流程里，右键——Reved Hidden objects，可将隐藏物流显示）；模拟文件在稳态模式；是否有内部物流，是否有多流股换热器，不支持内部物流和多流股换热器；是否有循环及循环精度是否合适。

检查完成可以点击“Next”



右下角“Browse”是要导入的文件路径，其左侧是要导入的文件名称  
点击“Next”



点击 “Next”

Extraction Wizard: drhrw2.bkp (Step 4 of 7)

The utilities listed will be used by default in the extraction. Modifications may be made.

Utility List

Name	Inlet T [C]	Outlet T [C]	Cost Index [Cost/kJ]	Segm.	Clean HTC [kJ/h-m <sup>2</sup> -C]
Cooling Water	20.00	25.00	2.125e-007		13500.00
Refrigerant 2	-40.00	-39.00	3.364e-006		4680.00
Air	30.00	35.00	1.000e-009		399.60
Very High Temperature	3000	2999	8.900e-006		399.60
LP Steam	125.0	124.0	1.900e-006		21600.00
HP Steam Generation	249.0	250.0	-2.490e-006		21600.00
Fired Heat (1000)	1000	400.0	4.249e-006		399.60
Refrigerant 1	-25.00	-24.00	2.739e-006		4680.00
Refrigerant 4	-103.0	-102.0	8.531e-006		4680.00
<empty>					

Modify < Prev Next >

点击 “Next”

Extraction Wizard: drhrw2.bkp (Step 5 of 7)

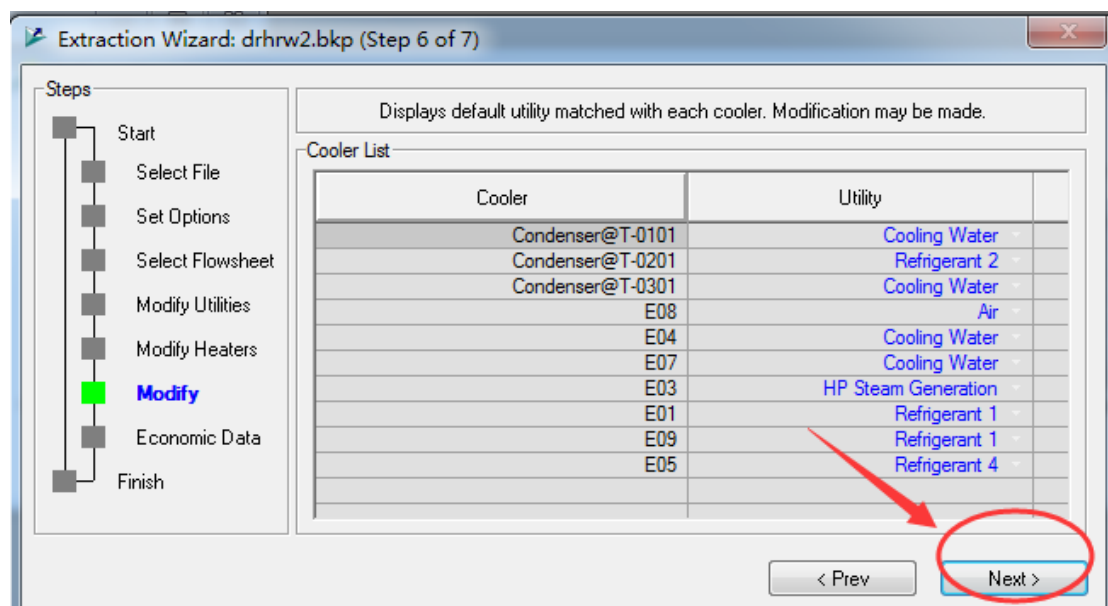
Displays default utility matched with each heater. Modifications may be made.

Heater List

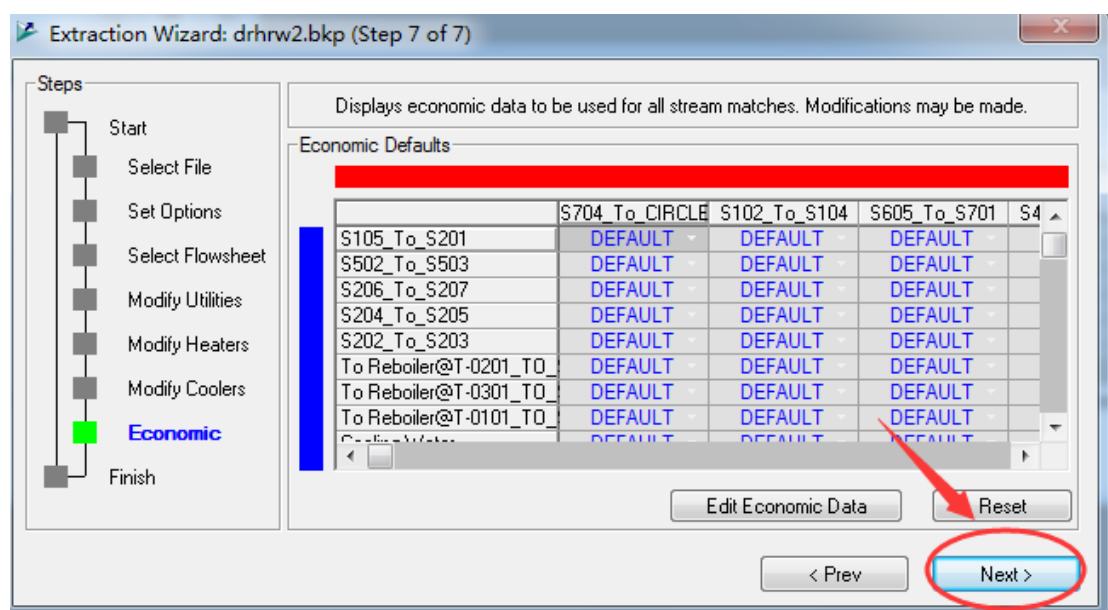
Heater	Utility
H4	Very High Temperature
Reboiler@T-0201	LP Steam
Reboiler@T-0301	LP Steam
H3	Very High Temperature
E02	Fired Heat (1000)
E06	LP Steam
H2	Very High Temperature
Reboiler@T-0101	LP Steam
H1	Fired Heat (1000)

< Prev Next >

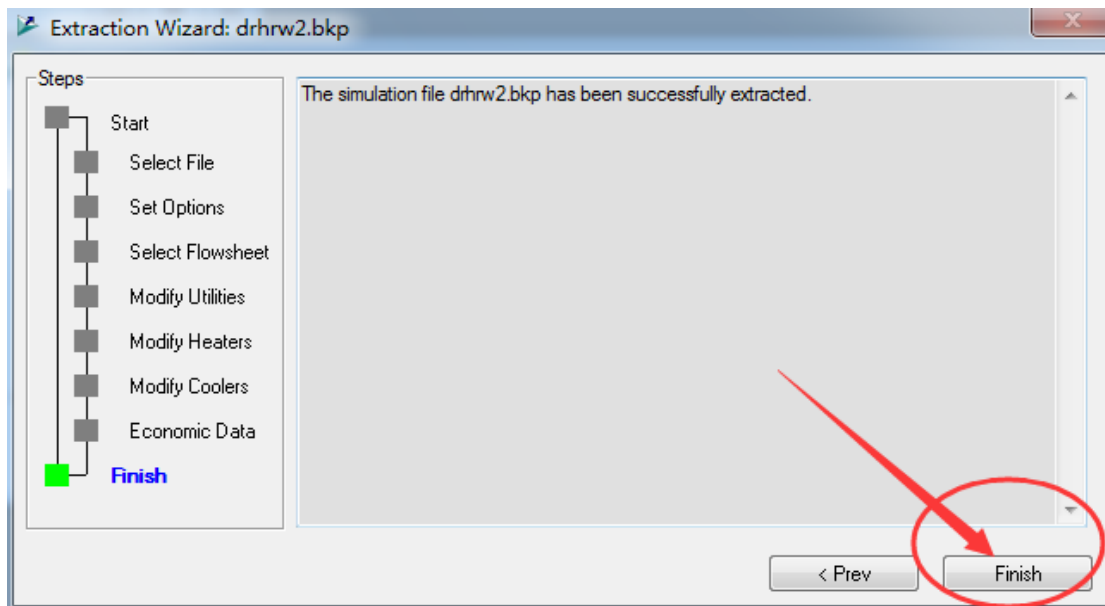
点击 “Next”



点击 “Next”



点击 “Next”



点击“finish”至此，数据已导入完成。保存文件。

## 5.目标查看窗口

Name	Inlet T [C]	Outlet T [C]	M [kg/h]	Enthalpy [kJ/h]	Segm	HT C [kJ/h-m2-C]	Flowrate [kg/h]	Effective Cp [kJ/kg-C]	DT Cont. [C]
S105_To_S201	22.9	600.0	7.827e+005	4.517e+008		134.2	2.390e+001	3.275	Global
S502_To_S503	-93.8	32.0	---	6.792e+007		---	2.229e+001	---	Global
S704_To_CIRCLE	54.3	25.0	---	4.470e+007		---	1.609e+001	---	Global
S102_To_S104	42.1	25.0	---	2.110e+007		---	6.833e+001	---	Global
S605_To_S701	54.5	53.6	7.819e+005	6.790e+005		3011.7	2.175e+001	3.595	Global
S206_To_S207	551.6	600.0	9.757e+005	4.724e+007		91.3	2.390e+001	4.082	Global
S204_To_S205	551.9	600.0	9.750e+005	4.691e+007		93.0	2.390e+001	4.079	Global
S202_To_S203	551.5	600.0	9.741e+005	4.727e+007		94.8	2.390e+001	4.075	Global
S401_To_S402	40.0	-95.0	---	1.710e+008		---	2.390e+001	---	Global
S208_To_S302	551.5	40.0	7.856e+005	4.018e+008		293.9	2.390e+001	3.287	Global
S504_To_S601	56.8	30.1	7.548e+005	2.014e+007		2837.5	2.390e+005	---	kg/h bal
To Reboiler@T-0201_To_S604	54.2	54.5	---	6.994e+007		---	5.270e+005	---	lb/hr bal
To Reboiler@T-0201_To_C703	54.0	54.3	---	4.402e+008		---	1.760e+001	---	Global

数字 1:物流名称，不需要的可以删除，比如流量太小或能量太少

数字 2:冷热物流符号，蓝色代表冷物流，红色代表热物流，箭头弯的代表有相变，点击弯箭头可显示该物流的区间能量变化数据



Process Stream: S401\_To\_S402

Flowrate [kg/h]	2.390e+008				
Total Heat Load [kJ/h]	1.710e+008				
Inlet T [C]	Outlet T [C]	Effective Cp [kJ/kg-C]	MCp [kJ/C-h]	Heat Load [kJ/h]	HTC [kJ/h-m <sup>2</sup> -C]
40.0	19.5	2.4038	5.746e+005	1.177e+007	606.7
19.5	-1.0	2.3322	5.575e+005	1.142e+007	604.8
-1.0	-9.5	1.6201e+01	3.873e+006	3.326e+007	3398
-9.5	-18.3	1.1802e+01	2.821e+006	2.471e+007	5064
-18.3	-33.6	8.1358	1.945e+006	2.970e+007	5766
-33.6	-48.3	5.6349	1.347e+006	1.988e+007	5931

Buttons: Insert Segment, Delete Segment, Delete All

Tabs: Segment Data, Physical Properties, Graphs

数字 3 和 4:代表进出口温度

数字 5:温度每度能量变化值

数字 6:该物流总的能量

数字 8:该物流质量流量

数字 9:该物流比热

HI Case: Case 1

HI Case: Case 1 Targets

Energy Targets

Heating [kJ/h]	7.506e+007
Cooling [kJ/h]	7.343e+008

Area Targets

Counter Current [m <sup>2</sup> ]	1.3430e+05
1-2 Shell & Tube [m <sup>2</sup> ]	1.5180e+05

Pinch Temperatures

Hot	Cold
3000.8 C	2987.3 C
994.3 C	980.8 C
551.5 C	538.0 C
67.5 C	54.0 C
43.2 C	29.7 C
9.8 C	-3.7 C

Number of Units Targets

Total Minimum	23
Minimum for MER	34
Shells	2/3

Cost Index Targets

Capital [Cost]	1.4376e+007
Operating [Cost/s]	0.7867
Total Annual [Cost/s]	1.234

Summary

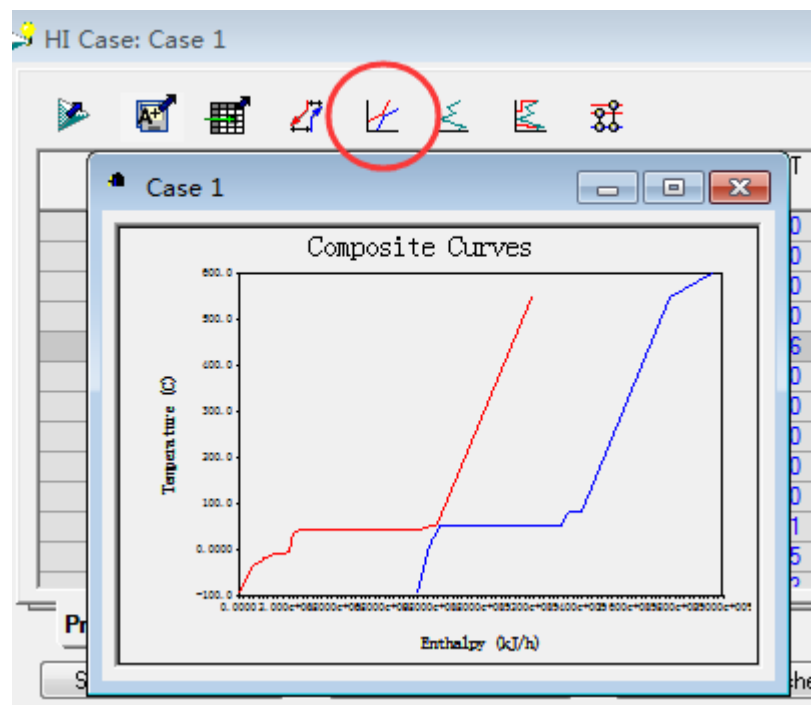
DTmin: 13.50 C

Heating: Sufficient

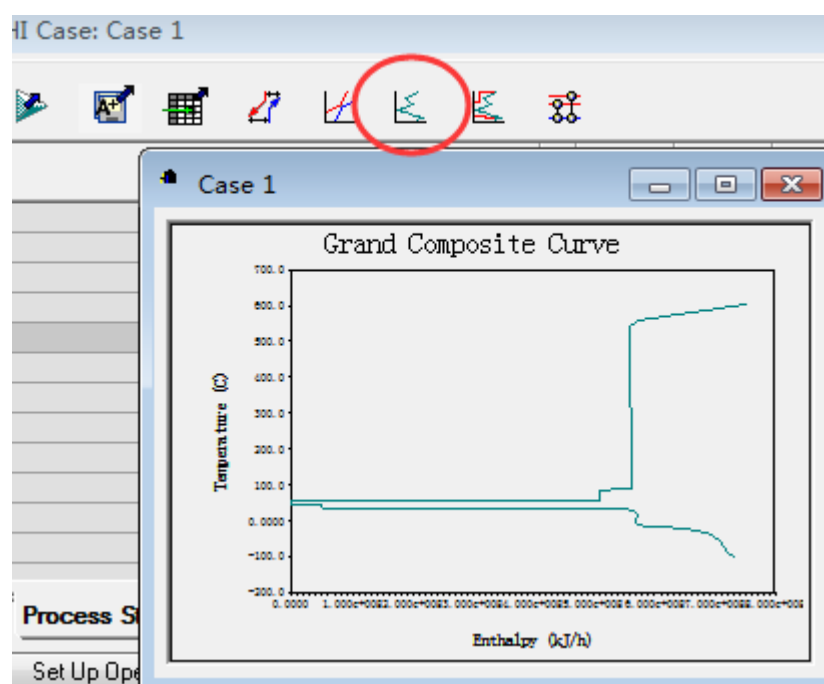
Cooling: Sufficient

Buttons: Set Up Operations, Convert to HI Project, Forbidden Matches

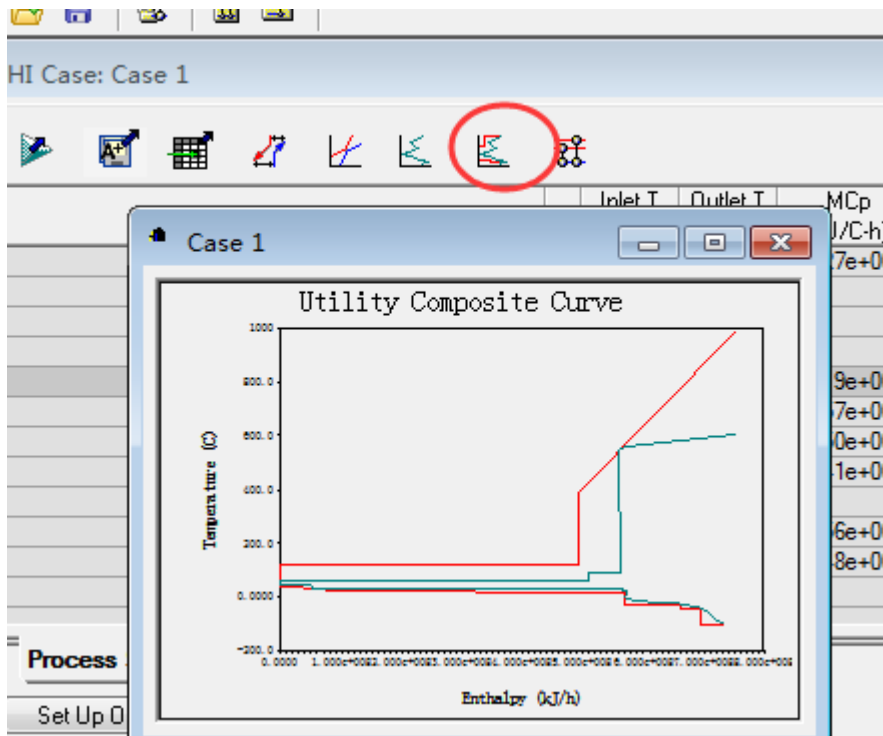
6.复合曲线窗口



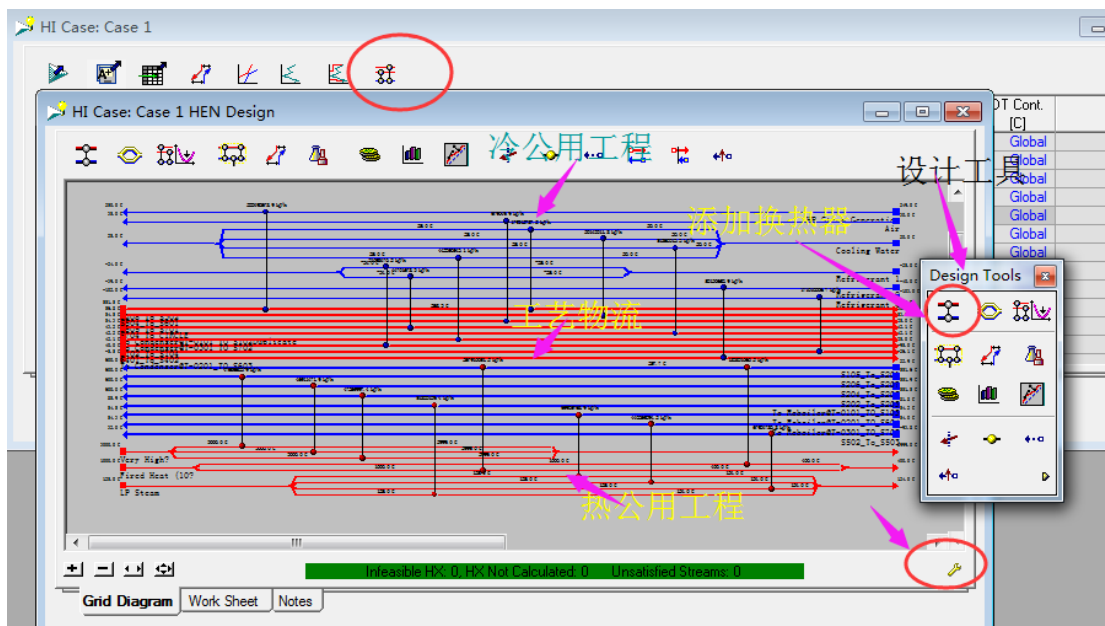
7.总复合曲线窗口



公用工程复合曲线

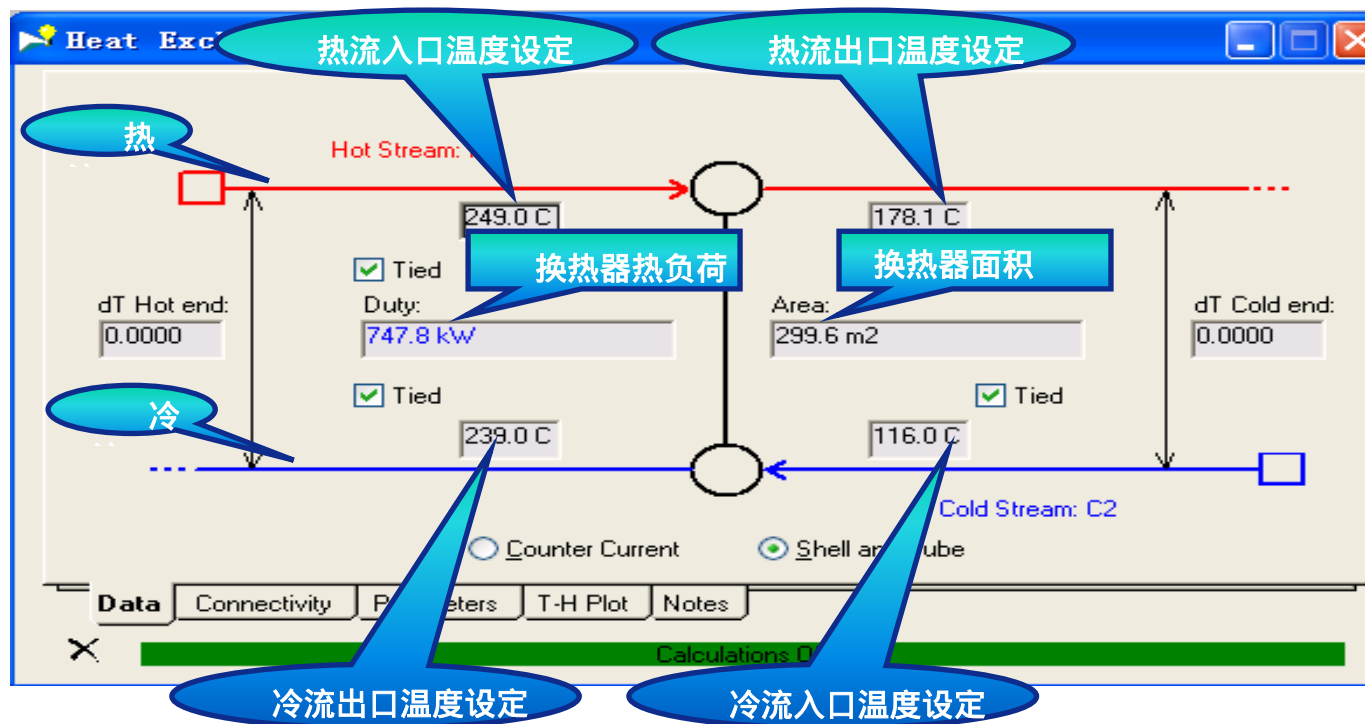


## 8.换热网络网格图窗口

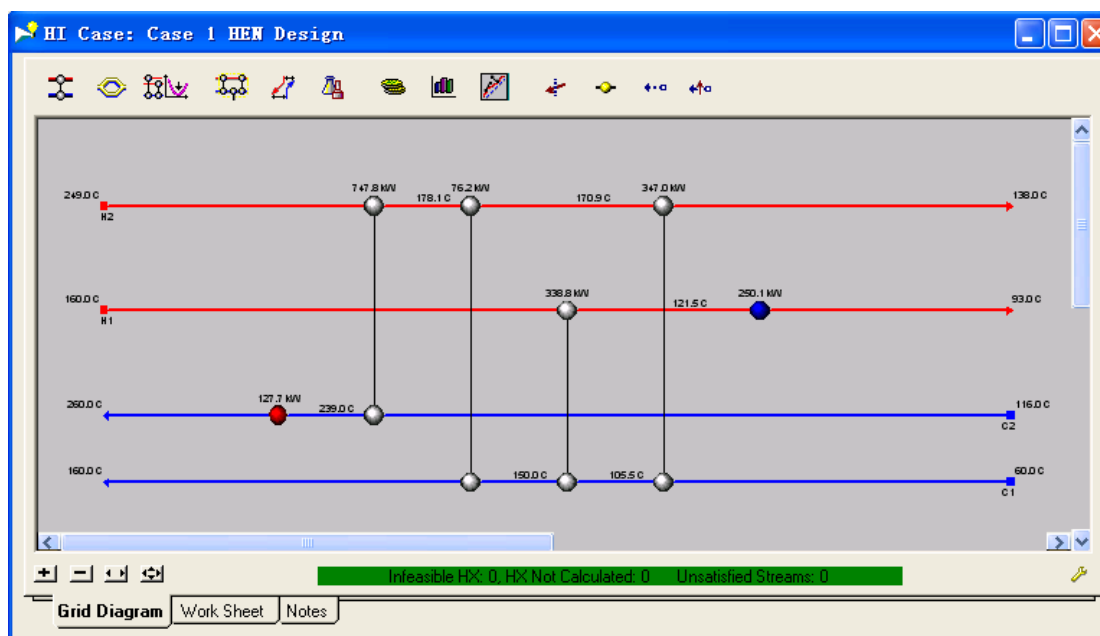


## 9.换热器参数设定窗口

点击换热网络网格图窗口里换热器图标可显示换热器参数设定窗口



## 10. 换热网络网格图



## 11. 自动设计换热网络

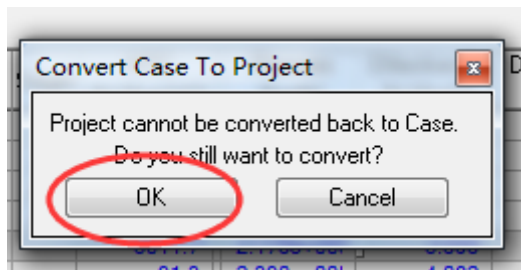
——首先将 Case 文件转换为 Project 文件

HI Case: Case 1

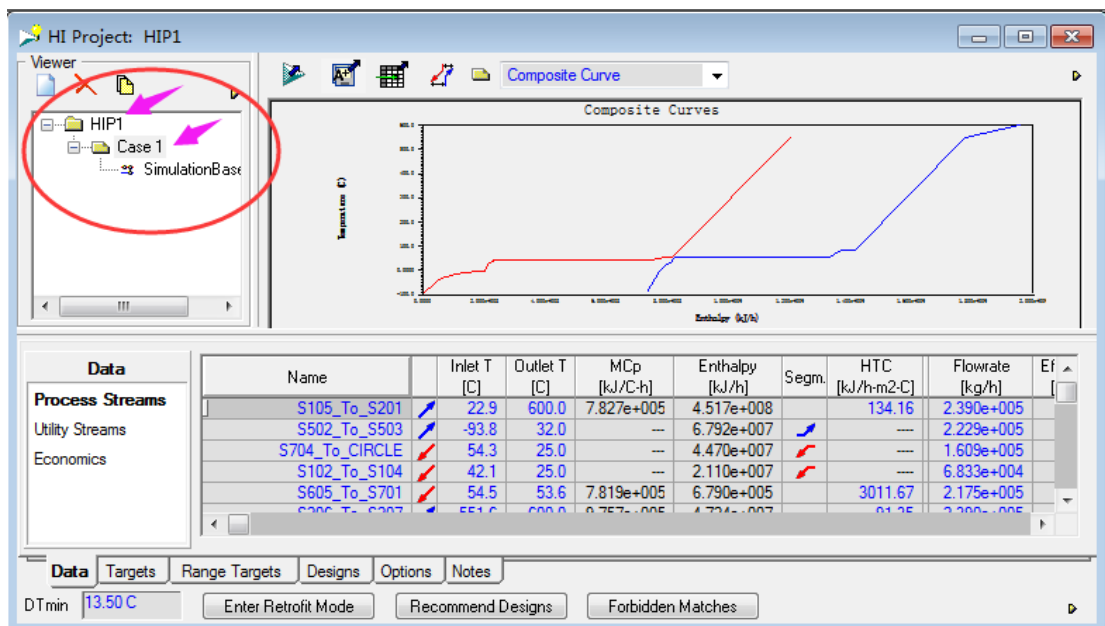
Name	Inlet T [C]	Outlet T [C]	MCp [kJ/C-h]	Enthalpy [kJ/h]	Segm.	HTC [kJ/h-m <sup>2</sup> -C]	Flowrate [kg/h]	Effective Cp [kJ/kg-C]	DT Cont. [C]
S105_To_S201	22.9	600.0	7.827e+005	4.517e+008		134.2	2.390e+001	3.275	Global
S502_To_S503	-93.8	32.0	---	6.792e+007		---	2.229e+001	---	Global
S704_To_CIRCLE	54.3	25.0	---	4.470e+007		---	1.609e+001	---	Global
S102_To_S104	42.1	25.0	---	2.110e+007		---	6.833e+001	---	Global
S605_To_S701	54.5	53.6	7.819e+005	6.790e+005		3011.7	2.175e+001	3.595	Global
S206_To_S207	551.6	600.0	9.757e+005	4.724e+007		91.3	2.390e+001	4.082	Global
S204_To_S205	551.9	600.0	9.750e+005	4.691e+007		93.0	2.390e+001	4.079	Global
S202_To_S203	551.5	600.0	9.741e+005	4.727e+007		94.8	2.390e+001	4.075	Global
S401_To_S402	40.0	-95.0	---	1.710e+008		---	2.390e+001	---	Global
S208_To_S302	551.5	40.0	7.856e+005	4.018e+008		293.9	2.390e+001	3.287	Global
S504_To_S601	56.8	30.1	7.548e+005	2.014e+007		2837.5	2.229e+001	3.386	Global
To Reboiler@T-0201_To_S604	54.2	54.5	---	6.994e+007		---	4.757e+001	---	Global
To Reboiler@T-0201_To_C703	54.0	54.3	---	4.402e+009		---	1.760e+001	---	Global

Process Streams Utility Streams Economics Options Notes

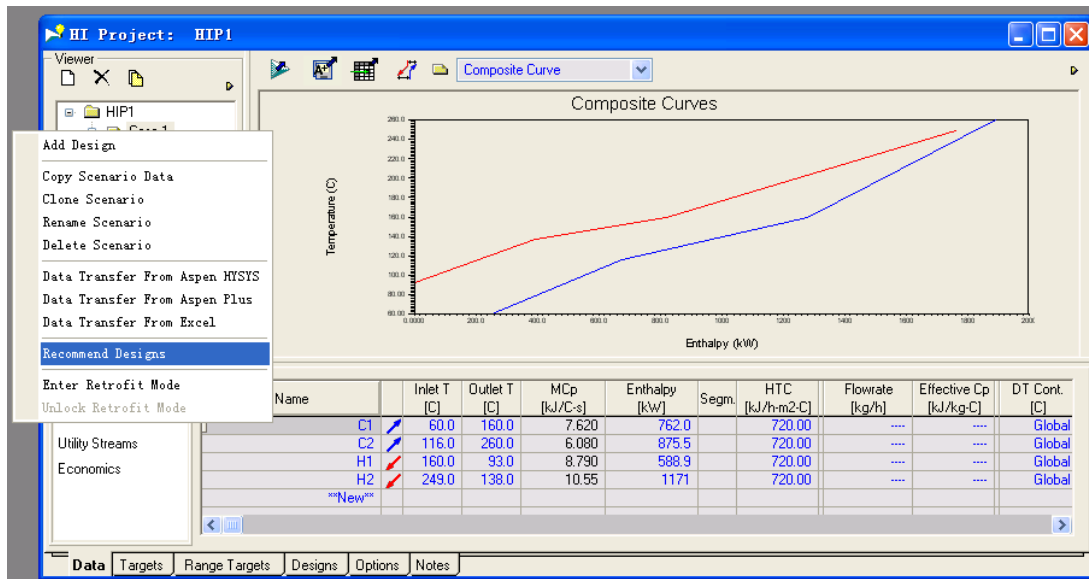
Set Up Operations **Convert to HI Project** Forbidden Matches



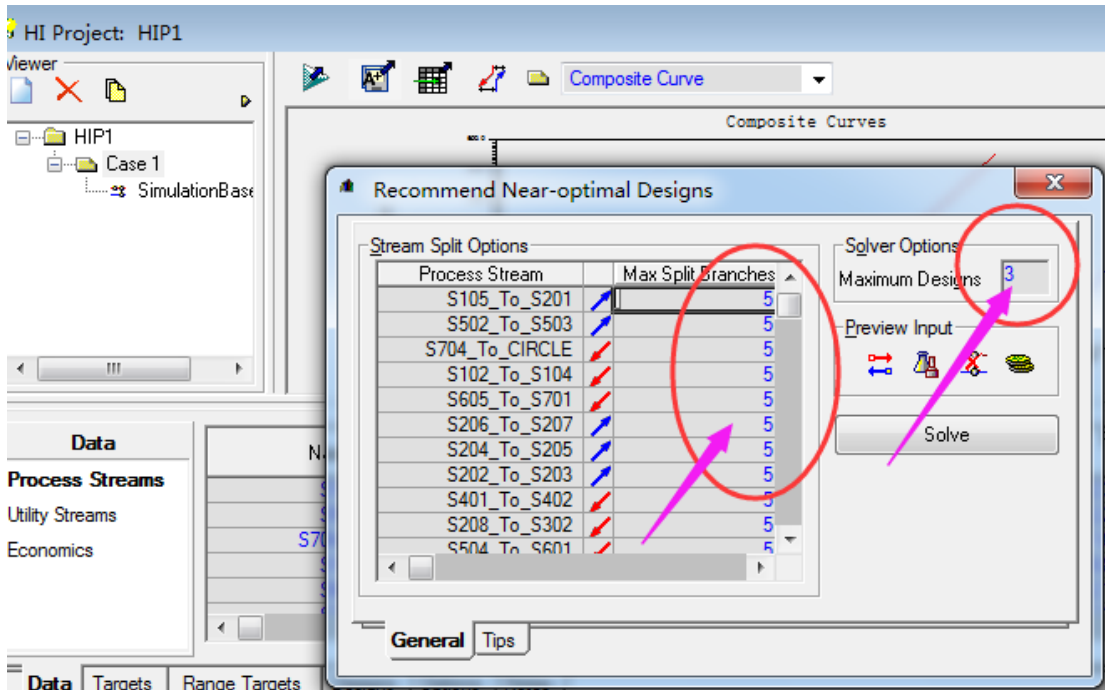
## 12.HI Project



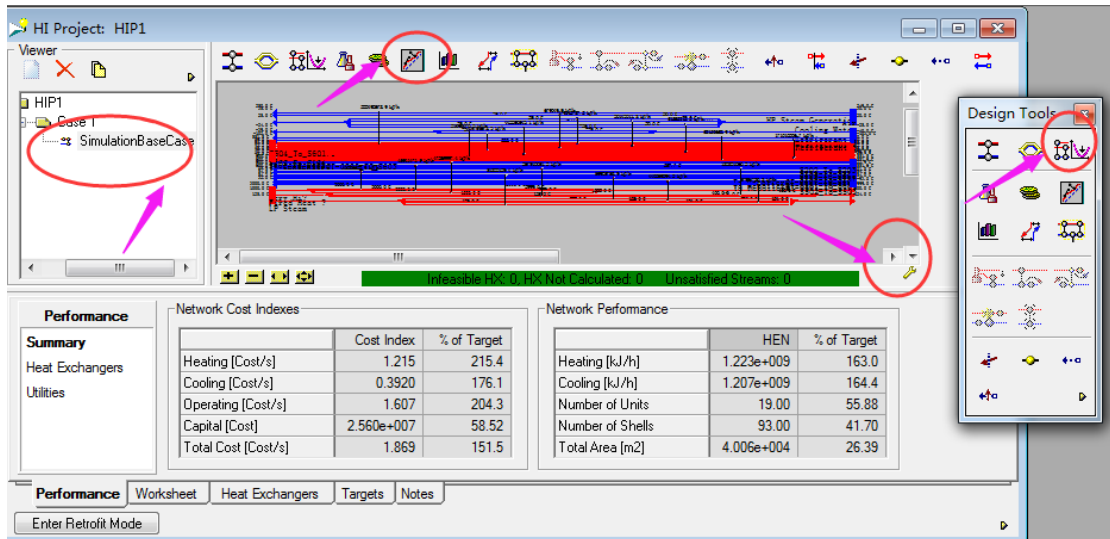
## 13.右击 Case1 选择 Recommended Designs



14.Recommend Designs 参数设置窗口

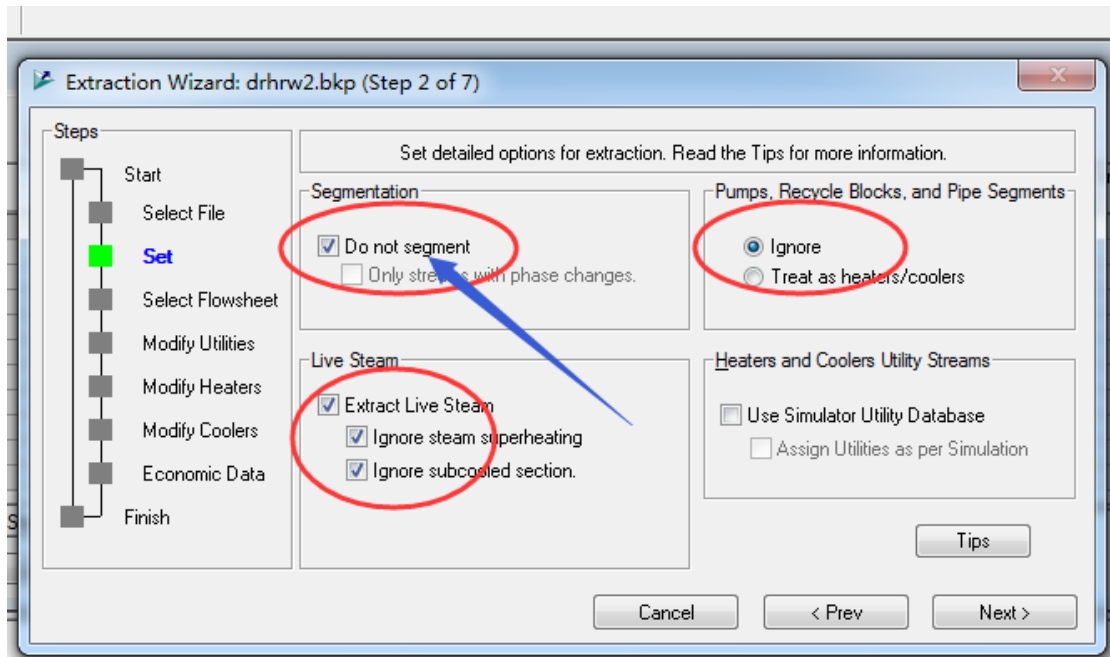


15.自动设计方案窗口



## 16.自动设计方案无法正常运行

在导入 Aspen plus 模拟流程时选择 Do not segment 如下图



导入以后点击 convert to H1project

HI Case: Case 1

Name	Inlet T [C]	Outlet T [C]	MCp [kJ/C-h]	Enthalpy [kJ/h]	Segm.	HTC [kJ/h-m <sup>2</sup> -C]	Flowrate [kg/h]	Effective Cp [kJ/kg-C]	DT Cont. [C]
S105_To_S201	22.9	600.0	7.827e+005	4.517e+008		134.2	2.390e+001	3.275	Global
S502_To_S503	-93.8	32.0	5.399e+005	6.792e+007		5268.7	2.229e+001	2.422	Global
S704_To_CIRCLE	54.3	25.0	-1.481e+001	4.340e+007		3378.2	1.609e+001	-9.203	Global
S102_To_S104	42.1	25.0	---	0.0000		720.0	6.833e+000	---	Global
S605_To_S701	54.5	53.6	7.819e+005	6.790e+005		3011.7	2.175e+001	3.595	Global
S206_To_S207	551.6	600.0	9.757e+005	4.724e+007		91.3	2.390e+001	4.082	Global
S204_To_S205	551.9	600.0	9.750e+005	4.691e+007		93.0	2.390e+001	4.079	Global
S202_To_S203	551.5	600.0	9.741e+005	4.727e+007		94.8	2.390e+001	4.075	Global
S401_To_S402	40.0	-95.0	1.267e+006	1.710e+008		4135.1	2.390e+001	5.259	Global
S208_To_S302	551.5	40.0	7.856e+005	4.018e+008		293.9	2.390e+001	3.287	Global
S504_To_S601	56.8	30.1	7.548e+005	2.014e+007		2837.5	2.229e+001	3.386	Global

Process Streams | Utility Streams | Economics | Options | Notes

Set Up Operations | **Convert to HI Project** | Forbidden Matches

Adding utility stream: Refrigerant 1  
Adding utility stream: Refrigerant 4  
Calculating Heat Exchanger Network:  
Performing range targeting:

S206_To_S207	551.6	600.0	9.757e+005	4.724e+007		91.3	2.390e+001
S204_To_S205	551.9	600.0	9.750e+005	4.691e+007		93.0	2.390e+001
S202_To_S203	551.5	600.0	9.741e+005	4.727e+007		94.8	2.390e+001
S401_To_S402	40.0	-95.0	1.267e+006	1.710e+008		4135.1	2.390e+001
S208_To_S302	551.5	40.0	7.856e+005	4.018e+008		293.9	2.390e+001
S504_To_S601	56.8	30.1	7.548e+005	2.014e+007		2837.5	2.229e+001

Utility Streams | Economics | Options | Notes

**Convert to HI Project** | Forbidden Matches

**Convert Case To Project**

Project cannot be converted back to Case.  
Do you still want to convert?

OK | Cancel

Refrigerant 1  
Refrigerant 4  
er Network:

HI Project: HIP1

Viewer

Composite Curve

Composite Curves

Data

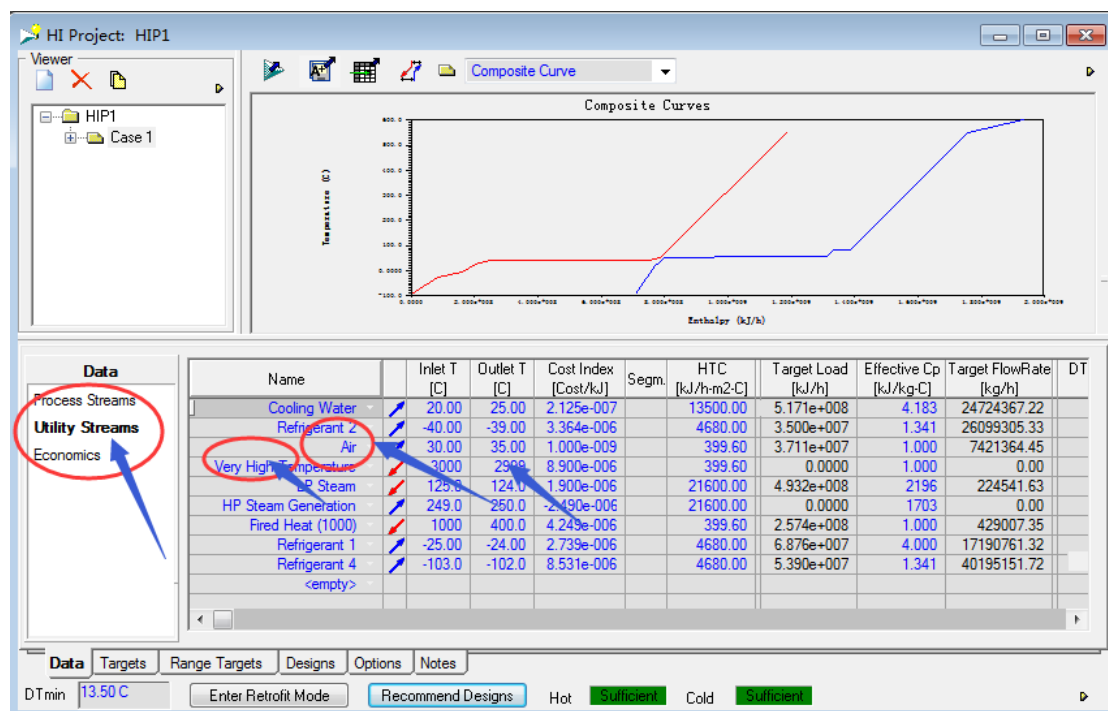
Name	Inlet T [C]	Outlet T [C]	MCp [kJ/C-h]	Enthalpy [kJ/h]	Segm.	HTC [kJ/h-m <sup>2</sup> -C]	Flowrate [kg/h]	Eff
S105_To_S201	22.9	600.0	7.827e+005	4.517e+008		134.16	2.390e+005	
S502_To_S503	-93.8	32.0	5.399e+005	6.792e+007		5268.66	2.229e+005	
S704_To_CIRCLE	54.3	25.0	-1.481e+001	4.340e+007		3378.17	1.609e+005	
S102_To_S104	42.1	25.0	---	0.0000		720.00	6.833e+004	
S605_To_S701	54.5	53.6	7.819e+005	6.790e+005		3011.67	2.175e+005	
S206_To_S207	551.6	600.0	9.757e+005	4.724e+007		91.35	2.390e+005	

Data | Targets | Range Targets | Designs | **Options** | Notes

DTmin 13.50 C | Enter Retrofit Mode | **Recommend Designs** | Forbidden Matches

可以先将公用工程不用的物流删除，如本设计不用空气



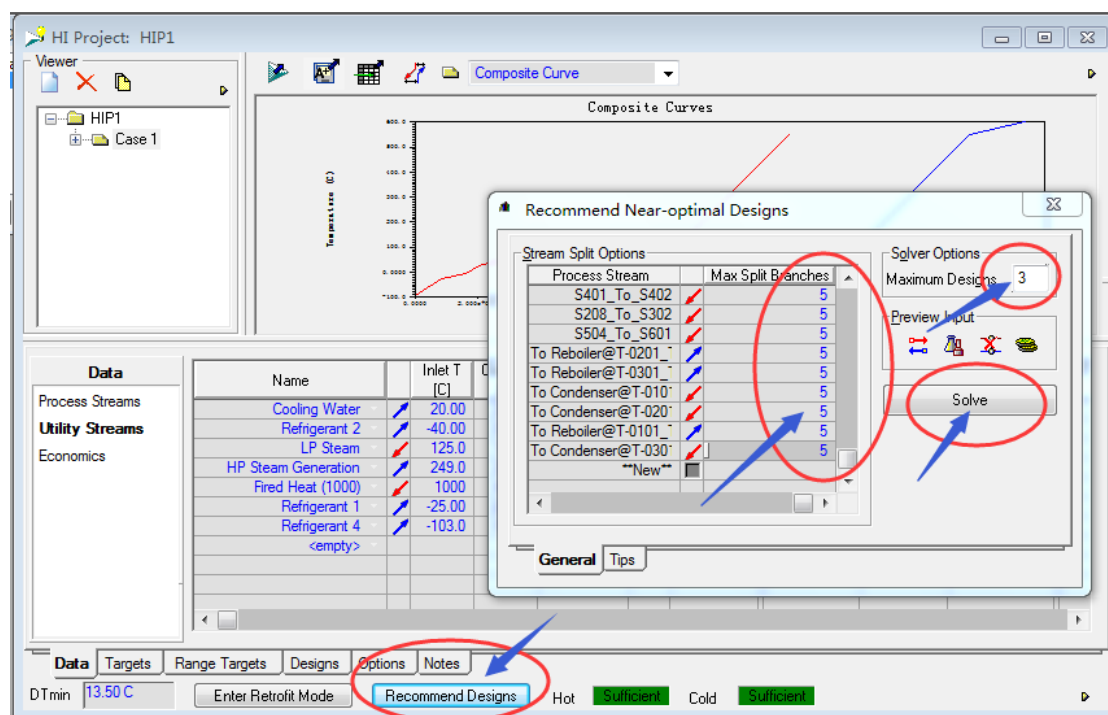
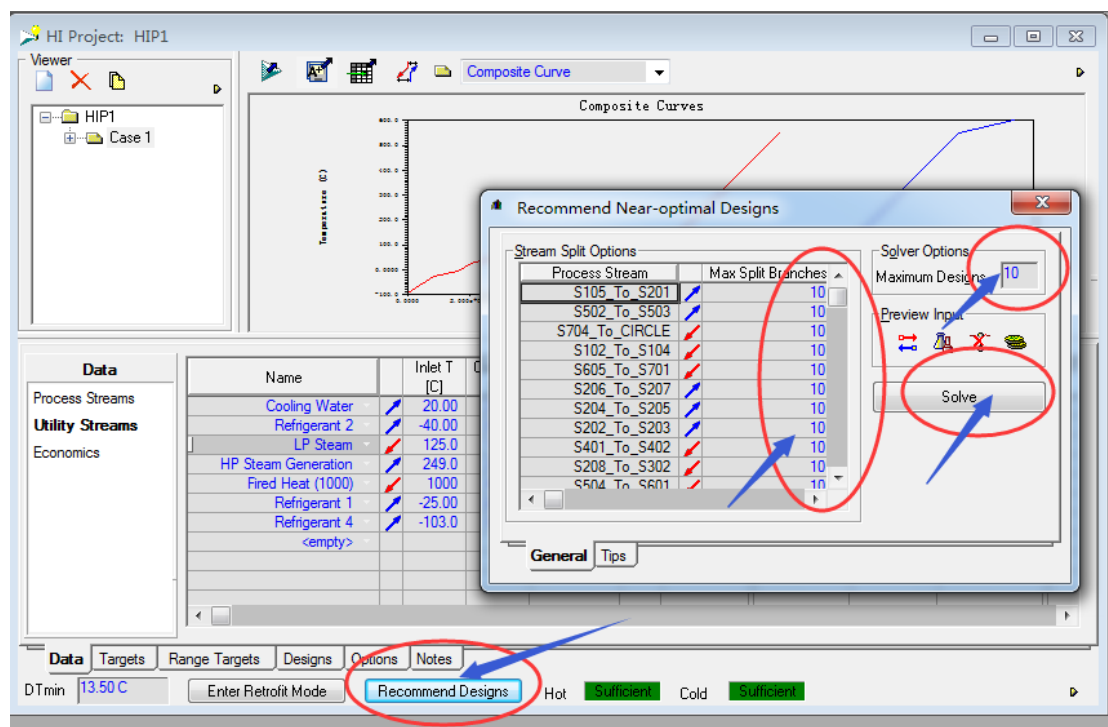


将工艺物流中能量太小或为 0 的物流删除

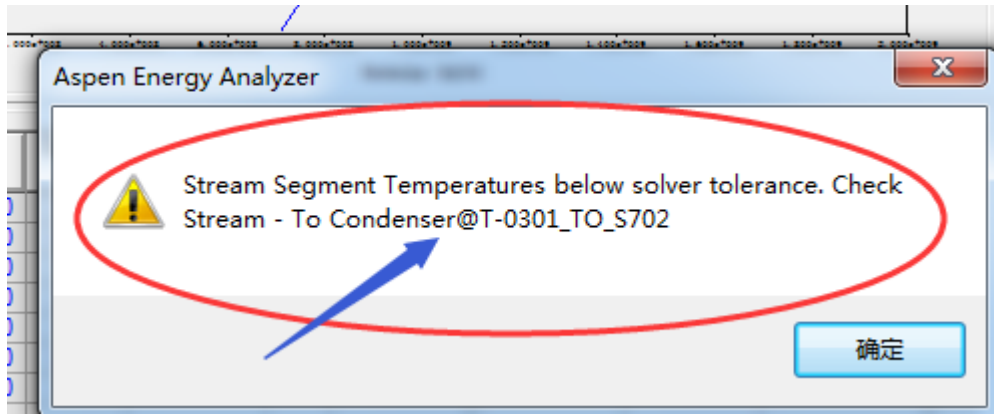
Name	Inlet T [C]	Outlet T [C]	MCp [kJ/C-h]	Enthalpy [kJ/h]	Segm	HTC [kJ/h-m2-C]	Flowrate [kg/h]	Effective Cp [kJ/kg-C]	DT Cont. [C]
S105_To_S201	22.9	600.0	7.827e+005	4.517e+008		134.16	2.390e+005	3.275	Global
S502_To_S688	-93.8	32.0	5.399e+005	6.792e+007		5268.66	2.229e+005	2.422	Global
S704_To_CIRCLE	54.3	25.0	-1.481e+001	4.340e+007		3378.17	1.609e+005	-9.203	Global
S102_To_S104	42.1	25.0	---	0.0000		720.00	6.833e+004	---	Global
S685_To_S701	54.5	53.6	7.819e+005	6.790e+005		3011.67	2.175e+005	3.595	Global
S206_To_S207	551.6	600.0	9.757e+005	4.724e+007		91.35	2.390e+005	4.082	Global
S204_To_S205	551.9	600.0	9.750e+005	4.691e+007		93.03	2.390e+005	4.079	Global
S202_To_S203	551.5	600.0	9.741e+005	4.727e+007		94.79	2.390e+005	4.075	Global
S401_To_S402	40.0	-95.0	1.267e+006	1.710e+008		4135.13	2.390e+005	5.299	Global
S208_To_S302	551.5	40.0	7.856e+005	4.018e+008		293.86	2.390e+005	3.287	Global
S504_To_S601	56.8	30.1	7.548e+005	2.014e+007		2837.55	2.229e+005	3.386	Global
To Reboiler@T-0201_TO_S	54.2	56.0	2.326e+008	4.187e+008		23654.30	4.757e+005	488.898	Global
To Reboiler@T-0301_TO_S	54.0	56.0	1.285e+009	2.632e+009		20895.45	1.760e+006	729.814	Global
To Condenser@T-0101_TO	43.2	41.0	4.474e+007	9.957e+007		11086.92	1.703e+005	262.726	Global

点击下方或在 Case 1 上右键点击 “Recommend Designs”

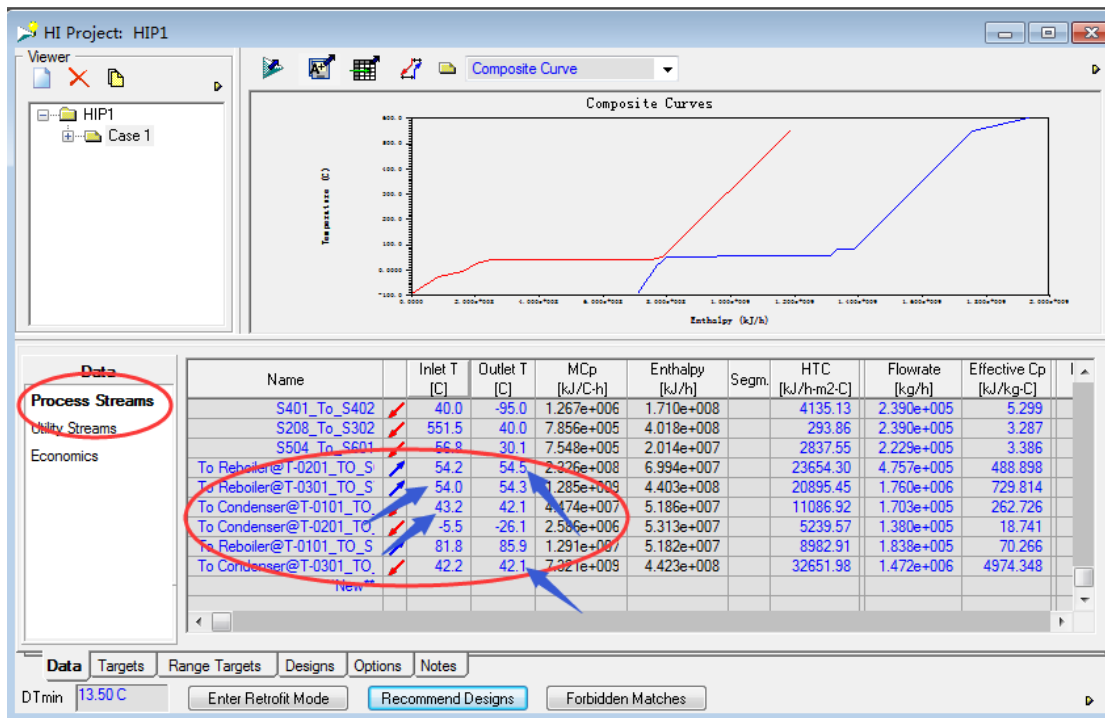
出现界面 Recommend Near-optimal Designs 界面将分离数改为 5，设计方案为 3 或更多

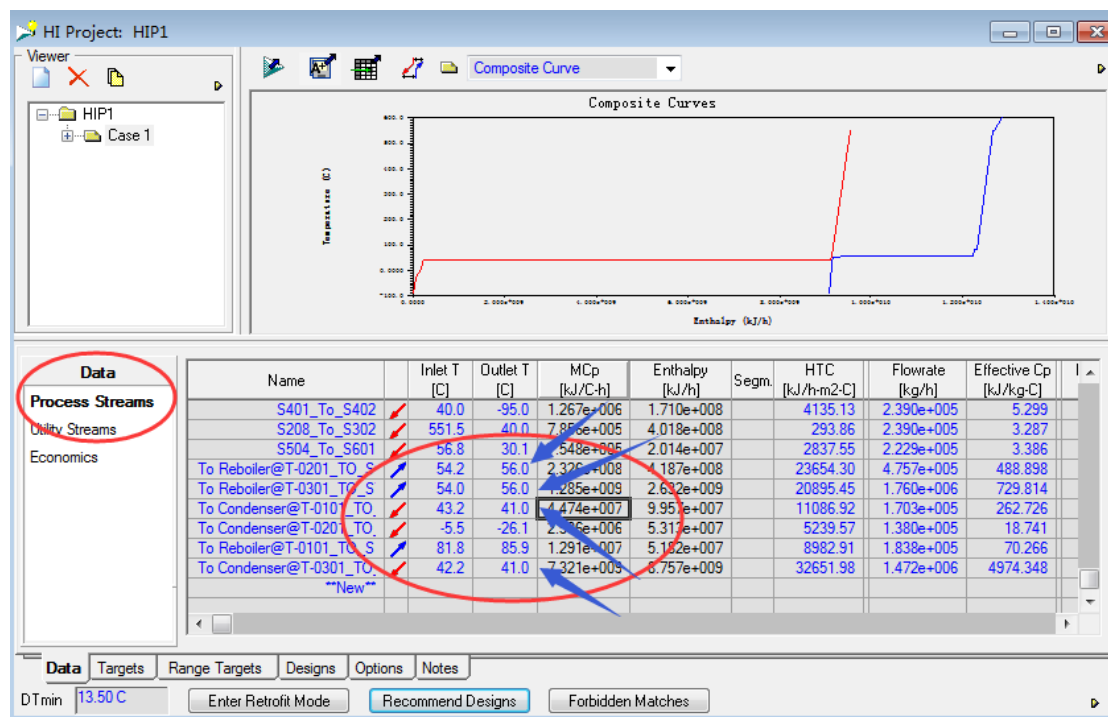


点击“Solve”出现警告如下

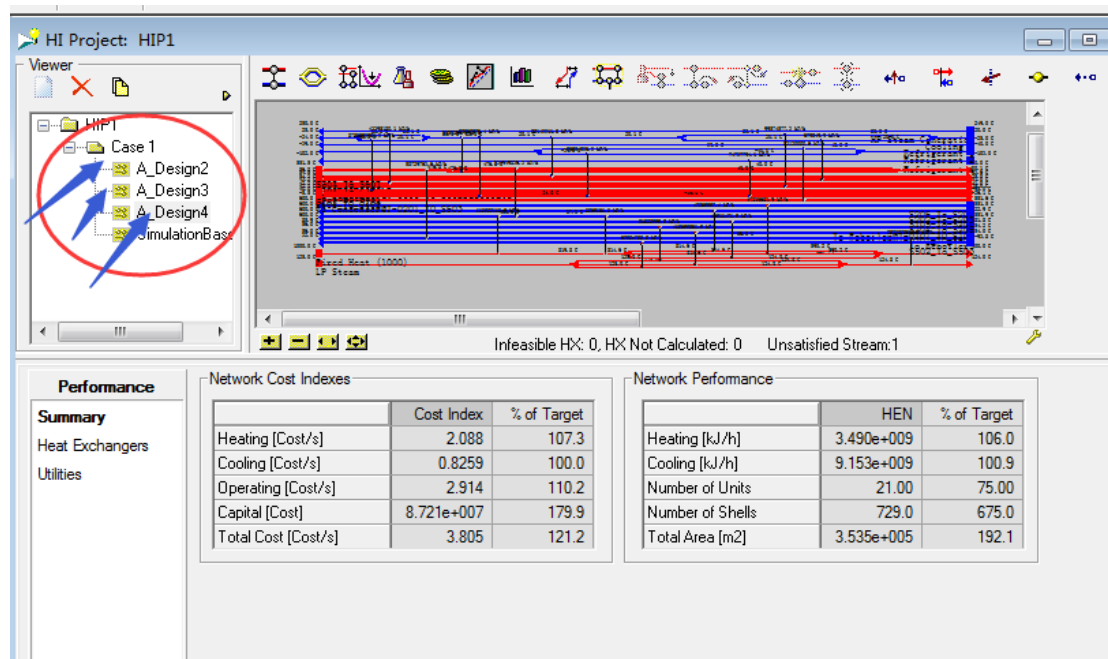


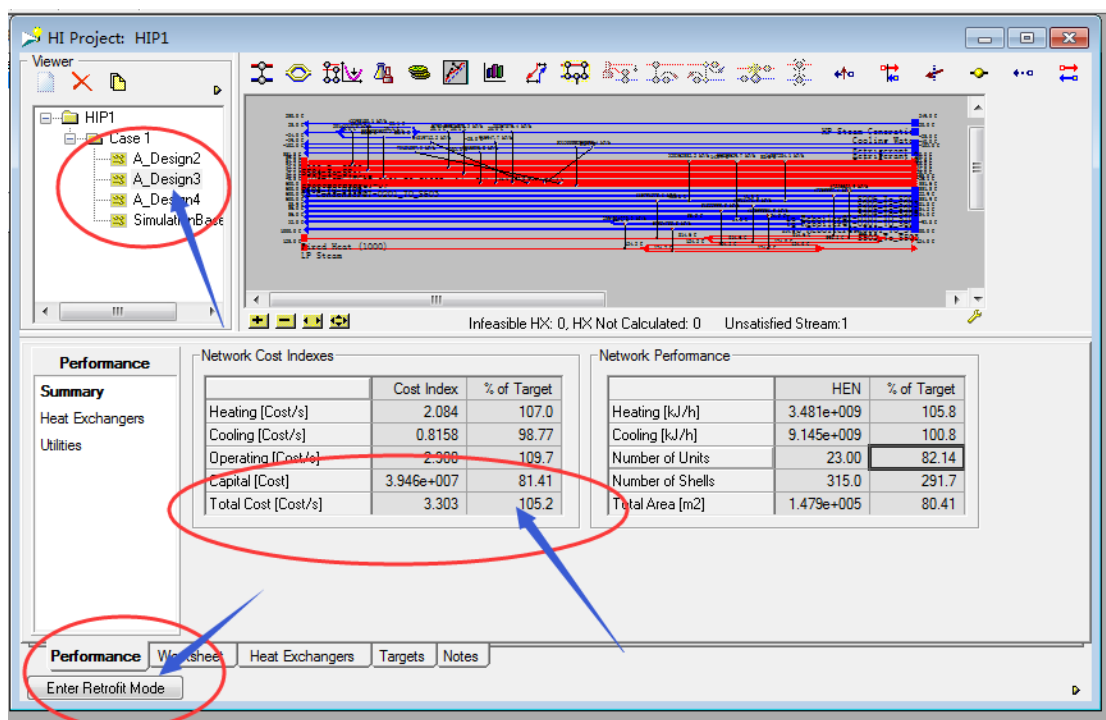
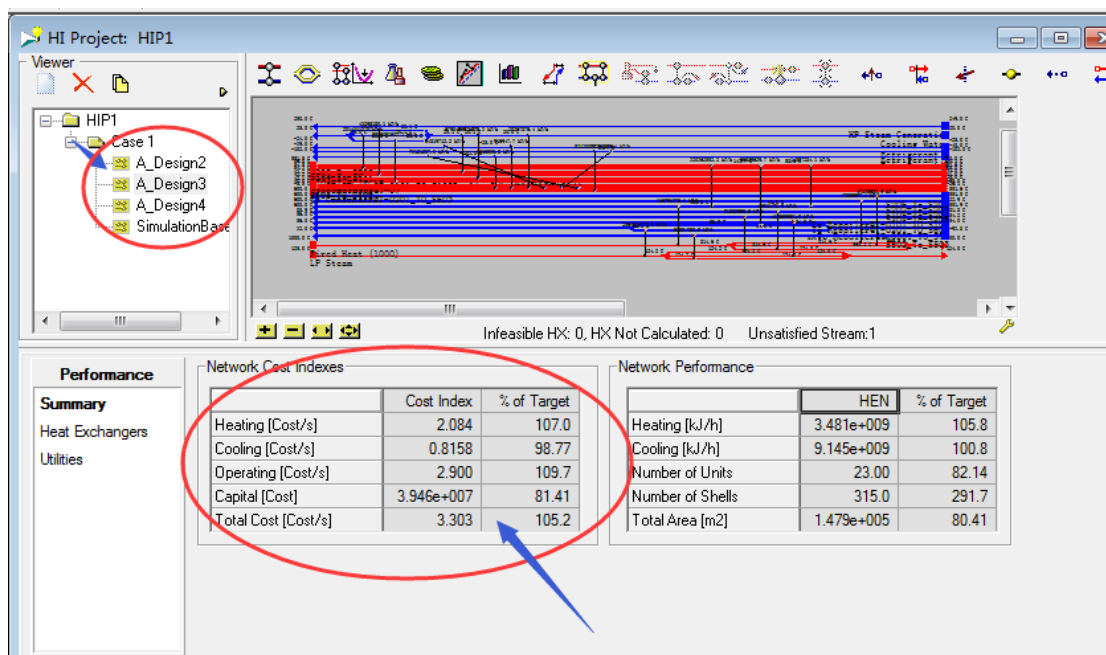
主要是塔设备塔顶冷凝器或再沸器温差太小, 适当加大温差, 本例加大  $2^{\circ}\text{C}$





再次点击“Recommend Designs”，可以显示自动设计的三个方案如上侧





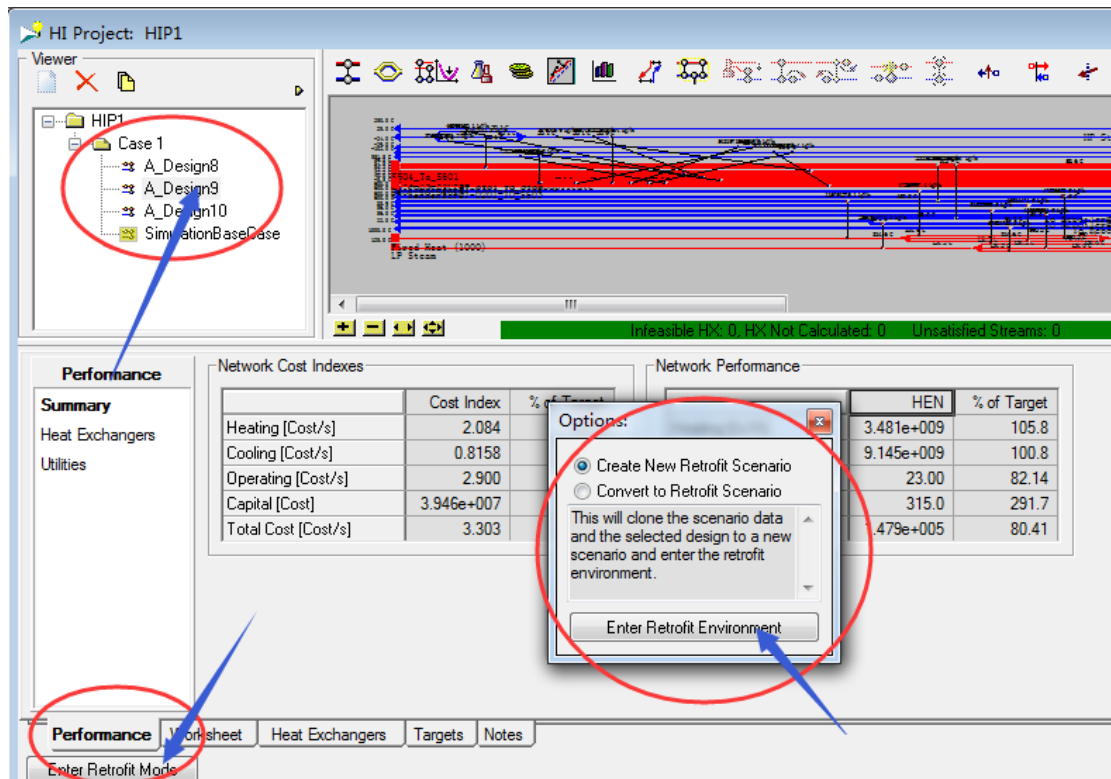
各方案比较：分析三个方案的数据

——可比较总费用、换热器面积、换热单元数、设备投资费用、冷热公用工程费用、操作费用，还可查看各参数目标值。

一般以年度总费用最小为目标，则选择方案。

点击下方或在该方案名称上右键“enter Retrofit mode”

出现“options”对话框，点击“Enter Retrofit Environment”



左上方显示该方案在新的 Case 目录内，可以对其编辑，进一步优化。

